YAMAHA

Original instructions

YAMAHA 4-AXIS/2-AXIS ROBOT CONTROLLER

RCX3 Series

Programming Manual

RCX340/RCX320

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Introduction

Our sincere thanks for your purchase of this YAMAHA RCX 3 series robot controller.

This manual describes robot program commands and related information for using YAMAHA RCX 3 series robot controllers. Be sure to read this manual carefully as well as related manuals and comply with their instructions for using the YAMAHA robot controllers safely and correctly.
For details on how to operate YAMAHA robot controllers, refer to the separate controller user's manual that comes with the YAMAHA robot controller.

Applicable controllers: RCX340, RCX320

Safety precautions

Be sure to read before using

Before using the YAMAHA robot controller, be sure to read this manual and related manuals, and follow their instructions to use the robot controller safely and correctly.

Warning and caution items listed in this manual relate to YAMAHA robot controllers.

When this robot controller is used in a robot controller system, please take appropriate safety measures as required by the user's individual system.

This manual classifies safety caution items and operating points into the following levels, along with symbols for signal words "CAUTION" and "NOTE".

CAUTION

"CAUTION" indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the equipment or software.

NOTE

Primarily explains function differences, etc., between software versions.

MEMO

Explains robot operation procedures in a simple and clear manner.

Note that the items classified into "CAUTION" might result in serious injury depending on the situation or environmental conditions.

Keep this manual carefully so that the operator can refer to it when needed. Also make sure that this manual reaches the end user.

Chapter 1

Writing Programs

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1 The YAMAHA Robot Language

The YAMAHA robot language was developed by Yamaha Motor Co., Ltd. Robotics Company for simple and efficient programming to control YAMAHA industrial robots. The YAMAHA robot language is similar to BASIC (Beginner's All-purpose Symbolic Instruction Code) and makes even complex robot movements easy to program. This manual explains how to write robot control programs with the YAMAHA robot language, including actual examples on how its commands are used.

2 Characters

The characters and symbols used in the YAMAHA robot language are shown below.
Only 1-byte characters can be used.

- **Alphabetic characters**
  A to Z, a to z
- **Numbers**
  0 to 9
- **Symbols**
  ( ) [ ] + - * / ^ = < > & | ~ _ % ! # $: ; , . " ' { }@ ?
- **katakana (Japanese phonetic characters)**

MEMO

- Katakana (Japanese phonetic characters) cannot be entered from a programming box. Katakana can be used when communicating with a host computer (if it handles katakana).
- Spaces are also counted as characters (1 space = 1 character).

3 Program Basics

Programs are written in a "1 line = 1 command" format, and every line must contain a command. Blank lines (lines with no command) will cause an error when the program is executed. A line-feed on the program's final line creates a blank line, so be careful not to do so.

To increase the program's efficiency, processes which are repeated within the program should be written as subroutines or sub-procedures which can be called from the main routine. Moreover, same processing items which occurs in multiple programs should be written as common routines within a program named [COMMON], allowing those processing items to be called from multiple programs.

User functions can be defined for specific calculations. Defined user functions are easily called, allowing even complex calculations to be easily performed.

Multi-task programs can also be used to execute multiple command statements simultaneously in a parallel processing manner.

Using the above functions allows easy creation of programs which perform complex processing.

Reference

- For details regarding sub-procedure, refer to "11 CALL" and "127 SUB to END SUB" in Chapter 8.
- For details regarding user defined functions, refer to "24 DEF FN" in Chapter 8.

4 Program Names

Each program to be created in the robot controller must have its own name.
Programs can be named as desired provided that the following conditions are satisfied:

- Program names may contain no more than 32 characters, comprising a combination of alphanumeric characters and underscores (_).
- Each program must have a unique name (no duplications).

The 2 program names shown below are reserved for system operations, and programs with these names have a special meaning.

A) SEQUENCE
B) COMMON

The functions of these programs are explained below.

A) SEQUENCE

Functions Unlike standard robot programs, the RCX340/RCX320 Controller allow the execution of high-speed processing programs (sequence programs) in response to robot inputs and outputs (DI, DO, MO, LO, TO, SI, SO). Specify a program name of "SEQUENCE" to use this function, thus creating a pseudo PLC within the controller.

When the controller is in the AUTO or MANUAL mode, a SEQUENCE program can be executed in fixed cycles (regardless of the program execution status) in response to dedicated DI10 (sequence control input) input signals, with the cycle being determined by the program capacity. For details, refer to "4.6 Sequence program specifications" in Chapter 7.
This allows sensors, push-button switches, and solenoid valves, etc., to be monitored and operated by input/output signals.
Moreover, because the sequence programs are written in robot language, they can easily be created without having to use a new and unfamiliar language.

Sample

```
DO(20)=~DI(20)
DO(25)=DI(21) AND DI(22)
MO(26)=DO(26) OR DO(25)
      :
```

Reference For details, refer to "4.6 Sequence program specifications" in Chapter 7.

B) COMMON

Functions A separate "COMMON" program can be created to perform the same processing in multiple robot programs. The common processing routine which has been written in the COMMON program can be called and executed as required from multiple programs. This enables efficient use of the programming space.

The sample COMMON program shown below contains two processing items (obtaining the distance between 2 points (SUB *DISTANCE), and obtaining the area (*AREA)) which are written as common routines, and these are called from separate programs (SAMPLE 1 and SAMPLE 2).
When SAMPLE1 or SAMPLE2 is executed, the SUB *DISTANCE (A!,B!,C!) and the *AREA routine are executed.

Sample **Description**

Program Name: SAMPLE1

```
X!=2.5
Y!=1.2
CALL  *DISTANCE(X!,Y!,REF C!)
GOSUB *AREA
PRINT C!,Z!
HALT
```

Program Name: SAMPLE2

```
X!=5.5
Y!=0.2
CALL  *DISTANCE(X!,Y!,REF C!)
GOSUB *AREA
PRINT C!,Z!
HALT
```

Program Name: COMMON
Common Routine

```
SUB *DISTANCE(A!,B!,C!)
    C!=SQR(A!^2+B!^2)
END SUB
*AREA:
    Z!=X!*Y!
RETURN
```

Reference For details, refer to the command explanations given in this manual.

5 Identifiers

"Identifiers" are a combination of characters and numerals used for label names, variable names, and procedure names. Identifiers can be named as desired provided that the following conditions are satisfied:

- Identifiers must consist only of alphanumeric characters and underscores (_). Special symbols cannot be used, and the identifier must not begin with an underscore (_).
- The identifier length must not exceed 32 characters (all characters beyond the 32th character are ignored).
- The maximum number of usable identifiers varies depending on the length of the identifiers. When all identifier length is 32 characters, the number is at the maximum. Local variables can be used up to 128 (in one program task) and global variables can be used up to 512.
- Variable names must not be the same as a reserved word, or the same as a name defined as a system variable. Moreover, variable name character strings must begin with an alphabetic character. For label names, however, the "*" mark may be immediately followed by a numeric character.

Sample

```
LOOP, SUBROUTINE, GET_DATA
```

Reference

- Regarding reserved words, refer to Chapter 13 "1. Reserved word list",
- Regarding system variables, refer to Chapter 3 "9 System Variables".

6 LABEL Statement

Defines a *label* on a program line.

Format

```
*label:
```

A *label* must always begin with an asterisk (*), and it must be located at the beginning of the line.
Although a colon (:) is required at the end of the *label* when defining it, this mark is not required when writing a jump destination in a program.

- A *label* must begin with an alphabetic or numeric character.
- Alphanumeric and underscore (_) can be used as the remaining *label* characters. Special symbols cannot be used.
- The *label* must not exceed 32 characters (all characters beyond the 32th character are ignored).

Sample **Explanation**

```
*ST:         .................. Defines*ST.
 MOVE P,P0
 DO(20) = 1
 MOVE P,P1
 DO(20) = 0
GOTO *ST     .................. Jumps to *ST.
HALT
```

7 Comment

Characters which follow REM or an apostrophe (') are processed as a comment. Comment statements are not executed. Moreover, comments may begin at any point in the line.

Sample **Description**

```
REM *** MAIN PROGRAM ***
       (Main Program)
'*** SUBROUTINE ***
       (Subroutine)
HALT 'HALT COMMAND      ......... Comments may begin at any point in the line.
```

8 Command Statement Format

Format

```
label: statement operand
```

One robot language command must be written on a single line and arranged in the format shown below:

- The shaded section can be omitted.
- *The italic items* should be written in the specific format.
- Items surrounded by | | are selectable.
- The label can be omitted. When using a label, it must always be preceded by an asterisk (*), and it must end with a colon (:) (the colon is unnecessary when a label is written as a branching destination).

For details regarding labels, refer to "6 LABEL Statement" in this Chapter.

- Operands may be unnecessary for some commands.
- Programs are executed in order from top to bottom unless a branching instruction is given.
1 line may contain no more than 255 characters.

Chapter 2

Constants

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1 Outline

Constants can be divided into two main categories: "numeric types" and "character types". These categories are further divided as shown below.

Category	Type	Details/Range
Numeric type	Integer type	Decimal constants -2,147,483,648 to 2,147,483,647
		Binary constants &B0 to &B11111111
		Hexadecimal constants &H80000000 to &H7FFFFFFF
	Real type	Single-precision real numbers -999,999.9 to +999,999.9
		Exponential format single-precision real numbers -1.0×10^{38} to $+1.0\times10^{38}$
Character type	Character string	Alphabetic, numeric, special character, or katakana (Japanese) character string of 255 bytes or less.

2 Numeric constants

2.1 Integer constants

- **Decimal constants**
  Integers from -2,147,483,648 to 2,147,483,647 may be used.
- **Binary constants**
  Unsigned binary numbers of 8 bits or less may be used. The prefix "&B" is attached to the number to define it as a binary number.
  Range: &B0 (decimal: 0) to &B11111111 (decimal: 255)
- **Hexadecimal constants**
  Signed hexadecimal numbers of 32 bits or less may be used. The prefix "&H" is attached to the number to define it as a hexadecimal number.
  Range: &H80000000 (decimal: -2,147,483,648) to &H7FFFFFFF (decimal: 2,147,483,647)

2.2 Real constants

- **Single-precision real numbers**
  Real numbers from -999999.9 to +999999.9 may be used.
  7 digits including integers and decimals. (For example, ".0000001" may be used.)
- **Single-precision real numbers in exponent form**
  Numbers from -1.0×10^{38} to $+1.0\times10^{38}$ may be used.
  Mantissas should be 7 digits or less, including integers and decimals.

Sample

```
-1. 23456E-12
3. 14E0
1. E5
```

MEMO

An integer constant range of –1,073,741,824 to 1,073,741,823 is expressed in signed hexadecimal number as &H80000000 to &H7FFFFFFF.

3 Character constants

Character type constants are character string data enclosed in double quotation marks ("). The character string must not exceed 255 bytes in length, and it may contain upper-case alphabetic characters, numerals, special characters, or katakana (Japanese) characters.
To include a double quotation mark (") in a string, enter two double quotation marks in succession.

Sample	Description
"YAMAHA ROBOT"	
"EXAMPLE OF""A"""	………… Represents EXAMPLE OF "A".
PRINT "COMPLETED"	
"YAMAHA ROBOT"	

Chapter 3

Variables

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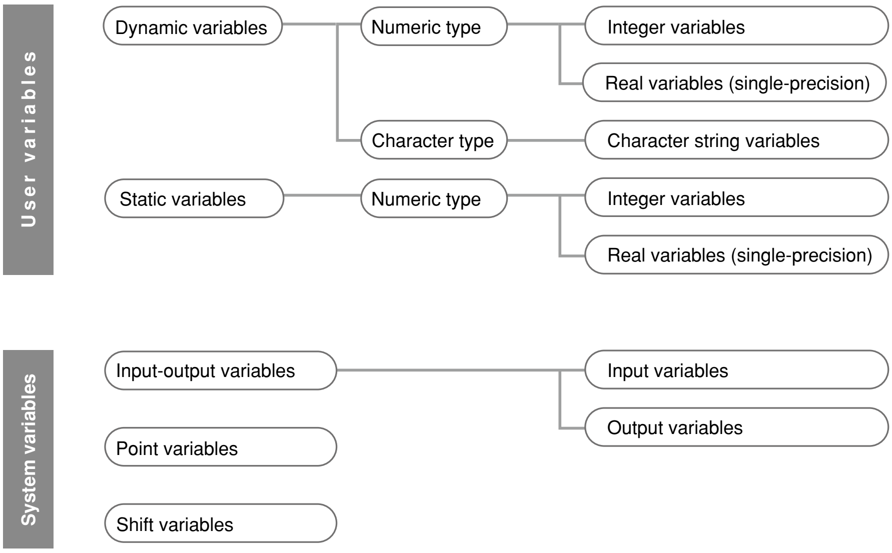
1 Outline

There are "user variables" which can be freely defined, and "system variables" which have pre-defined names and functions.

User variables consist of "dynamic variables" and "static variables". "Dynamic variables" are cleared at program editing, program resets, and program switching. "Static variables" are not cleared unless the memory is cleared. The names of dynamic variables can be freely defined, and array variables can also be used.

Variables can be used simply by specifying the variable name and type in the program.
A declaration is not necessarily required. However, array variables must be pre-defined by a DIM statement.

User variables & system variables


User variables
Dynamic variables
Numeric type
Integer variables
Real variables (single-precision)
Character type
Character string variables
Static variables
Numeric type
Integer variables
Real variables (single-precision)
System variables
Input-output variables
Input variables
Output variables
Point variables
Shift variables

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Reference For details regarding array variables, refer to "5 Array variables" in this Chapter.

2 User Variables & System Variables

2.1 User Variables

Numeric type variables consist of an "integer type" and a "real type", and these two types have different usable numeric value ranges. Moreover, each of these types has different usable variables (character string variables, array variables, etc.), and different data ranges, as shown below.

Category	Variable Type	Details/Range
Dynamic variables	Numeric type	Integer type variables -2,147,483,648 to 2,147,483,647 (Signed hexadecimal constants: &H80000000 to &H7FFFFFFF)
		Real variables (single-precision) -1.0×10^{38} to $+1.0\times10^{38}$
	Character type	Character string variables Alphabetic, numeric, special character, or katakana (Japanese) character string of 255 bytes or less.
Static variables	Numeric type	Integer type variables -2,147,483,648 to 2,147,483,647
		Real variables (single-precision) -1.0×10^{38} to $+1.0\times10^{38}$
Array variables	Numeric type	Integer array variables -2,147,483,648 to 2,147,483,647
		Real array variables (single-precision) -1.0×10^{38} to $+1.0\times10^{38}$
	Character type	Character string array variables Alphabetic, numeric, special character, or katakana (Japanese) character string of 255 bytes or less.

NOTE

Array variables are dynamic variables.

2.2 System Variables

As shown below, system variables have pre-defined names which cannot be changed.

Category	Type	Details	Specific Examples
Input/output variables	Input variables	External signal / status inputs	DI, SI, SIW, SID
	Output variables	External signal / status outputs	DO, SO, SOW, SOD
Point variables		Handles point data	Pnnnn
Shift variables		Specifies the shift coordinate No. as a numeric constant or expression	Sn

Reference For details, refer to "9 System Variables" in this Chapter.

3 Variable Names

3.1 Dynamic Variable Names

Dynamic variables can be named as desired, provided that the following conditions are satisfied:

- The name must consist only of alphanumeric characters and underscores (_). Special symbols cannot be used.
- The name must not exceed 32 characters (all characters beyond the 32th character are ignored).
- The name must begin with an alphabetic character.

Sample	Description
COUNT	✓ Use is permitted
COUNT123	✓ Use is permitted
2COUNT	– Use is NOT permitted

- Variable names must not be the same as a reserved word.
- Variable names must not begin with characters used for system variable names (pre-defined variables) and user-defined function. These characters include the following:
  FN, DIn, DOn, MOn, LOn, TOn, SIn, SOn, Pn, Sn, Hn ("n" denotes a numeric value)

Sample	Description
COUNT	✓ Use is permitted
ABS	– Use is NOT permitted (Reserved word)
FNAME	– Use is NOT permitted (FN: user-defined function)
S91	– Use is NOT permitted (Sn: pre-defined variable)

Reference For details regarding reserved words, refer to Chapter 13 "1 Reserved word list".

3.2 Static Variable Names

Static variable names are determined as shown below, and these names cannot be changed.

Variable Type	Variable Name
Integer variable	SGIn (n: 0 to 31)
Real variable	SGRn (n: 0 to 31)

Static variables are cleared only when initializing is executed by online command.

Reference For details regarding clearing of static variables, refer to "12 Clearing variables" in this Chapter.

4 Variable Types

The type of variable is specified by the type declaration character attached at the end of the variable name. However, because the names of static variables are determined based on their type, no type declaration statement is required.

Type Declaration Character	Variable Type	Specific Examples
$	Character variables	STR1$
%	Integer variables	CONT0%, ACT%(1)
!	Real variables	CNT1!, CNT1

MEMO

- If no type declaration character is attached, the variable is viewed as a real type.
- Variables using the same identifier are recognized to be different from each other by the type of each variable.
  - ASP_DEF% .... Integer variable
  - ASP_DEF .... Real variable

  → ASP_DEF% and ASP_DEF are different variables.
  - ASP_DEF! .... Real variable
  - ASP_DEF .... Real variable

  → ASP_DEF! and ASP_DEF are the same variables.

4.1 Numeric variables

Integer variables

Integer variables and integer array elements can handle an integer from -2,147,483,648 to 2,147,483,647 (in signed hexadecimal, this range is expressed as &H80000000 to &H7FFFFFFF).

Sample

```
R1% = 10
R2%(2) = R1% + 10000
```

NOTE

When a real number is assigned to an integer type variable, the decimal value is rounded off to the nearest whole number. For details, refer to Chapter 4 "1.5 Data format conversion".

Real variables

Real variables and real array elements can handle a real number from -1.0×10^{38} to 1.0×10^{38}.

Sample

```
R1!   = 10.31
R2!(2)= R1% + 1.98E3
```

NOTE

The "!" used in real variables may be omitted .

4.2 Character variables

Character variables and character array elements can handle a character string of up to 255 characters.
Character strings may include alphabetic characters, numbers, symbols and katakana (Japanese phonetic characters).

Sample	Description
`R1$ = "YAMAHA"` `R2$(2) = R1$ + "MOTOR"`	`Returns "YAMAHA MOTOR"`

5 Array variables

Both numeric and character type arrays can be used at dynamic variables.
Using an array allows multiple same-type continuous data to be handled together.
Each of the array elements is referenced in accordance with the parenthesized subscript which appears after each variable name. Subscripts may include integers or *expressions* in up to 3 dimensions.
In order to use an array, Array variables must be declared by DIM statement in advance, and the maximum number of elements which can be used is the declared subscripts + 1 (0 ~ number of declared subscripts).

MEMO

- All array variables are dynamic variables. (For details regarding dynamic variables, refer to "11 Valid range of variables" in this Chapter.)
- The length of an array variable that can be declared with the DIM statement depends on the program size.

Format

variable name	% ! $	(*expression*, *expression*, *expression*)

Sample	Description
`A%(1)`	Integer array variable
`DATA!(1,10,3)`	Single-precision real array variable (3-dimension array)
`STRING$(10)`	Character array variable

6 Value Assignments

An assignment statement (LET) can also be used to assign a value to a variable.

MEMO

"LET" directly specifies an assignment statement, and it can always be omitted.

Format

`LET` *variable = expression*

Write the value assignment target variable on the left side, and write the assignment value or the *expression* on the right side. The *expression* may be a constant, a variable, or an arithmetic expression, etc.

Reference For details, refer to Chapter 8 "54 LET (Assignment Statement)"

7 Type Conversions

When different-type values are assigned to variables, the data type is converted as described below.

- When a real number is assigned to an integer type:
  The decimal value is rounded off to the nearest whole number.
- When an integer is assigned to a real type:
  The integer is assigned as it is, and is handled as a real number.
- When a numeric value is assigned to a character string type:
  The numeric value is automatically converted to a character string.
- When a character string is assigned to numeric type:
  This assignment is not possible, and an error will occur at the program is execution. Use the "VAL" command to convert the character string to a numeric value, and that value is then assigned.

8 Value Pass-Along & Reference Pass-Along

A variable can be passed along when a sub-procedure is called by a CALL statement. This pass-along can occur in either of two ways: as a value pass-along, or as a reference pass-along.

Value pass-along

With this method, the variable's value is passed along to the sub-procedure. Even if this value is changed within the sub-procedure, **the content of the call source variable is not changed.**
A value pass-along occurs when the CALL statement's actual argument specifies a constant, an expression, a variable, or an array element (array name followed by (*subscript*)).

Reference pass-along

With this method, the variable's reference (address in memory) is passed along to the sub-procedure. If this value is changed within the sub-procedure, **the content of the call source variable is also changed.**
A reference pass-along occurs when the CALL statement's actual argument specifies an entire array (an array named followed by parenthetical content), or when the actual argument is preceded by "REF".

Value pass-along & reference pass-along

Value pass-along

```
X%=5
CALL *TEST( X% )
PRINT X%
HALT
’ SUB ROUTINE
SUB *TEST( A% )
  A%=A%*10
END SUB
```

Execution result: The X% value remains as "5".

Reference pass-along

```
X%=5
CALL *TEST( REF X% )
PRINT X%
HALT
’ SUB ROUTINE
SUB *TEST( A% )
  A%=A%*10
END SUB
```

Execution result: The X% value becomes "50".

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9 System Variables

The following system variables are pre-defined, and other variable names must not begin with the characters used for these system variable names.

Variable Type	Format	Meaning
Point variable	Pnnn / P [*expression*]	Specifies a point number
Shift variable	Sn / S [*expression*]	Specifies the shift number as a constant or as an expression
Parallel input variable	DI(mb), DIm(b)	Parallel input signal status
Parallel output variable	DO(mb), DOm(b)	Parallel output signal setting and status
Internal output variable	MO(mb), MOm(b)	Controller's internal output signal setting and status
Arm lock output variable	LO(mb), LOm(b)	Axis-specific movement prohibit
Timer output variable	TO(mb), TOm(b)	For sequence program's timer function
Serial input variable	SI(mb), SIm(b)	Serial input signal status
Serial output variable	SO(mb), SOm(b)	Serial output signal setting and status
Serial word input	SIW(m)	Serial input's word information status
Serial double-word input	SID(m)	Serial input's double-word information status
Serial word output	SOW(m)	Serial output's word information status
Serial double-word output	SOD(m)	Serial output's double-word information status

9.1 Point variable

This variable specifies a point data number with a numeric constant or expression.

Format

```
Pnnnnn or P[expression]
```

Notation	Value	Range
n	Point number	0 to 9

Functions A point data number is expressed with a "P" followed by a number of 5 digits or less, or an *expression* surrounded by brackets ([*expression*])
Point numbers from 0 to 29999 can be specified with point variables.

Sample

```
P0
P110
P[A]
P[START_POINT]
P[A(10)]
```

1
2
3
4
5
6

9.2 Shift variable

This variable specifies a shift coordinate number with a numeric constant or expression.

Format

```
Snn or S[expression]
```

Notation	Value	Range
n	Shift number	0 to 9

Functions A shift number is expressed with an "S" followed by a 2-digit number or an *expression* surrounded by brackets ([*expression*]). As a shift number, 0 to 39 can be specified.

Sample

```
S1
S[A]
S[BASE]
S[A(10)]
```

MEMO

The "shift coordinate range" for each shift number can be changed from the programming box.

9.3 Parallel input variable

This variable is used to indicate the status of parallel input signals.

Format 1

```
DIm(b, ..., b)
```

Format 2

```
DI(mb, ..., mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Sample	Description
`A%=DI1()`	Input status of ports DI(17) to DI(10) is assigned to variable A%. 0 to 255 integer can be assigned to A%.
`A%=DI5(7,4,0)`	Input status of DI(57), DI(54) and DI(50) is assigned to variable A%.(If all above signals are 1(ON), then A%=7.)
`A%=DI(27,15,10)`	Input status of DI(27), DI(15) and DI(10) is assigned to variable A%.(If all above signals except DI(10) are 1 (ON), then A%=6.)
`WAIT DI(21)=1`	Waits for DI(21) to change to 1(ON).

MEMO

- When specifying multiple bits, specify them from left to right in descending order (high to low).
- A "0" is input if an input port does not actually exist.

9.4 Parallel output variable

Specifies the parallel output signal or indicates the output status.

Format 1

```
DOm(b, ..., b)
```

Format 2

```
DO(mb, ..., mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Sample	Description
`A%=DO2()`	`Output status of DO(27) to DO(20) is assigned to variable A%.`
`A%=DO5(7,4,0)`	`Output status of DO(57), DO(54) and DO(50) is assigned to variable A%.` `(If all above signals are 1(ON), then A%=7.)`
`A%=DO(37,25,20)`	`Output status of DO(37), DO(25) and DO(20) is assigned to variable A%.` `(If all above signals except DO(20) are 1 (ON), then A%=6.)`

`DO3()=B%`	`Changes to a status in which the DO(37) to DO(30) output can be indicated by B%.`
	
	`Example) B% is "123":`
	`"123" is represented as "01111011" in binary number,`
	`DO(37) and DO(32) is "0", and the other bits is "1".`

`DO4(5,4,0)=&B101`	`DO(45) and DO(40) become "1", and DO(44) becomes "0".`

MEMO

- When specifying multiple bits, specify them from left to right in descending order (high to low).
- If an output port does not actually exist, the data is not output externally.

9.5 Internal output variable

Specifies the controller's internal output signals and indicates the signal status.

Format 1

```
MOm(b, ..., b)
```

Format 2

```
MO(mb, ..., mb)
```

Notation	Value	Range	Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27, 30 to 37	b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Functions Internal output variables which are used only in the controller, can set the status and refer.

These variables are used for signal communications, etc., with the sequence program.

Ports 30 to 37 are for dedicated internal output variables which can only be referenced (they cannot be changed).

1. Port 30 indicates the status of origin sensors for axes 1 to 8 (in order from bit 0). Port 1 indicates the status of origin sensors for axes 9 to 16 (in order from bit 0).

Each bit sets to "1" when the origin sensor turns ON, and to "0" when OFF.

2. Port 34 indicates the HOLD status of axes 1 to 8 (in order from bit 0). Port 35 indicates the HOLD status of axes 9 to 16 (in order from bit 0).

Each bit sets to "1" when the axis is in HOLD status, and to "0" when not.

Bit	7	6	5	4	3	2	1	0
Port 30	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Port 31	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9
	Origin sensor status 0: OFF / 1: ON (Axis 1 is not connected)							
Port 34	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Port 35	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9
	Hold status 0: RELEASE / 1: HOLD (Axis 1 is not connected)							

MEMO

- Axes where no origin sensor is connected are always ON.
- Being in HOLD status means that the axis movement is stopped and positioned within the target point tolerance while the servo is still turned ON.
- When the servo turns OFF, the HOLD status is released.
- Axes not being used are set to "1" (HOLD).
- The status of each axis in order from the smallest axis number used by robot 1 is maintained.
  Example) In the case of a configuration where robot 1 has 5 axes and robot 2 has 4 axes, bits 0 to 4 of port 30 indicate the status of axes 1 to 5 of robot 1, bits 5 to 7 of port 30 indicate the status of axes 1 to 3 of robot 2, and bit 0 of port 31 indicates the status of axis 4 of robot 2.

Sample	Description
`A%=MO2 ()`	`Internal output status of MO(27) to MO(20) is assigned to variable A%.`
`A%=MO5(7,4,0)`	`Internal output status of MO(57), MO(54) and MO(50) is assigned to variable A%. (If all above signals are 1 (ON), then A%=7.)`
`A%=MO(37,25,20)`	`Internal output status of MO(37), MO(25) and MO(20) is assigned to variable A%.(If all above signals except MO(25) are 1 (ON), then A%=5.)`

MEMO

When specifying multiple bits, specify them from left to right in descending order (high to low).

9.6 Arm lock output variable

Specifies axis-specific movement prohibit settings.

Format 1

```
LOm(b, ..., b)
```

Format 2

```
LO(mb, ..., mb)
```

Notation	Value	Range
m	port number	0, 1
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Functions The contents of this variable can be set the status and referred to as needed.
Of Port 0, bits 0 to 7 respectively correspond to axes 1 to 8, and of port 1, bits 0 to respectively correspond to axes 9 to 16.
When this bit is ON, movement on the corresponding axis is prohibited.

Sample	Description
A%=LO0()	Arm lock status of LO(07) to LO(00) is assigned to variable A%.
A%=LO0(7,4,0)	Arm lock status of LO(07), LO(04) and LO(00) is assigned to variable A%. (If all above signals are 1(ON), then A%=7.)
A%=LO(06,04,01)	Arm lock status of LO(06), LO(04) and LO(01) is assigned to variable A%. (If all above signals except LO(01) are 1(ON), then A%=6.)
LO1()=&B0010	LO(11) is set to 1(ON),then movement of axis 10 is prohibited.
LO1(2,0)=3	LO(12) and LO(10) are set to 1(ON), then movements of axes 11 and 9 are prohibited.

MEMO

- When specifying multiple bits, specify them from left to right in descending order (high to low).
- Servo OFF to ON switching is disabled if an arm lock is in effect at even 1 axis.
- When performing JOG movement in the MANUAL mode, axis movement is possible at axes where an arm lock status is not in effect, even if an arm lock status is in effect at another axis.
- When executing movement commands from the program, etc., the "12.401 Arm locked" error will occur if an arm lock status is in effect at the axis in question.
- Arm locks sequentially correspond to axes in order from the axis with the smallest axis number used by robot 1.
  Example) In the case of a configuration where robot 1 has 5 axes and robot 2 has 4 axes, the status of axes 1 to 5 of robot 1 is set by bits 0 to 4 of port 0, the status of axes 1 to 3 of robot 2 is set by bits 5 to 7 of port 0, and the prohibition of motion of axis 4 of robot 2 is set by bit 0 of port 1.

9.7 Timer output variable

This variable is used in the timer function of a sequence program.

Format 1

```
TOm(b, ..., b)
```

Format 2

```
TO(mb, ..., mb)
```

Notation	Value	Range
m	port number	0, 1
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Functions The contents of this variable can be changed and referred to as needed.
Timer function can be used only in the sequence program.
If this variable is output in a normal program, it is an internal output.

Reference For details regarding sequence program usage examples,
refer to the timer usage examples given in "4.2 Input/output variables" in Chapter 7.

Sample	Description
`A%=TO0()`	`Status of TO(07) to TO(00) is assigned to variable A%.`
`A%=TO0(7,4,0)`	`Status of TO(07), TO(04) and TO(00) is assigned to variable A%.` `(If all above signals are 1 (ON), then A%=7.)`
`A%=TO(06,04,01)`	`Status of TO(06), TO(04) and TO(01) is assigned to variable A%.` `(If all above signals except TO(01) are 1 (ON), then A%=6.)`

MEMO

When specifying multiple bits, specify them from left to right in descending order (high to low).

9.8 Serial input variable

This variable is used to indicate the status of serial input signals.

Format 1

```
SIm(b, ..., b)
```

Format 2

```
SI(mb, ..., mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Sample	Description
`A%=SI1()`	Input status of ports SI(17) to SI(10) is assigned to variable A%.
`A%=SI5(7,4,0)`	Input status of SI(57), SI(54) and SI(50) is assigned to variable A%. (If all above signals are 1(ON), then A%=7.)
`A%=SI(27,15,10)`	Input status of SI(27), SI(15) and SI(10) is assigned to variable A%. (If all above signals except SI(10) are 1 (ON), then A%=6.)
`WAIT SI(21)=1`	Waits until SI(21) sets to 1 (ON).

MEMO

- When specifying multiple bits, specify them from left to right in descending order (high to law).
- A "0" is input if a serial port does not actually exist.

9.9 Serial output variable

This variable is used to define the serial output signals and indicate the output status.

Format 1

```
SOm(b, ..., b)
```

Format 2

```
SO(mb, ..., mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

If the bit definition is omitted in Format 1, bits 0 to 7 are all selected.

Sample	Description
`A%=SO2()`	Output status of SO(27) to SO(20) is assigned to variable A%.
`A%=SO5(7,4,0)`	Output status of SO(57), SO(54) and SO(50) is assigned to variable A%. (If all above signals turn 1(ON), then A%=7.)
`A%=SO(37,25,20)`	Output status of SO(37), SO(25) and SO(20) is assigned to variable A%. (If all above signals except SO(25) turn 1(ON), then A%=5.)
`SO3()=B%`	Changes the output status of SO(37) to SO(30) to one indicated by B%. (If B% is 123, 123 is expressed B01111011 as a binary number, that means SO(37) and SO(32) turn 0(OFF), the other bits turn 1(ON).)
`SO4(5,4,0)=&B101`	DO(45) and DO(40) turn 1(ON), DO(44) turns 0(OFF).

MEMO

- When specifying multiple bits, specify them from left to right in descending order (high to law).
- If a serial port does not actually exist, the data is not output externally.

9.10 Serial word input

This variable indicates the status of the serial input word information.

Format

```
SIW(m)
```

Notation	Value	Range
m	port number	2 to 15*

The acquisition range is 0 (&H0000) to 65,535 (&HFFFF).
*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

Sample	Description
`A%=SIW(2)`	`The input status from SIW (2) is assigned to variable A%.`
`A%=SIW(15)`	`The input status from SIW (15) is assigned to variable A%.`

MEMO

- The information is handled as unsigned word data.
- "0" is input if a serial port does not actually exist.

9.11 Serial double word input

This variable indicates the state of the serial input word information as a double word.

Format

```
SID(m)
```

Notation	Value	Range
m	port number	2, 4, 6, 8, 10, 12, 14*

The acquisition range is -2,147,483,648(&H80000000) to 2,147,483,647(&H7FFFFFFF).
*When SIOW extension is enabled, the range of port number is extended to 2, 4, 6 -14, 24, 26, 28 -126.
For details, refer to RCX3 user's manual "Option board related parameters".

Sample	Description
`A%=SID(2)`	`The input status from SIW (2) , SIW (3) is assigned to variable A%.`
`A%=SID(14)`	`The input status from SIW (14), SIW (15) is assigned to variable A%.`

MEMO

- The information is handled as signed double word data.
- "0" is input if a serial port does not actually exist.
- The lower port number data is placed at the lower address.
  For example, if SIW(2) =&H2345, SIW(3) =&H0001, then SID(2) =&H00012345.

9.12 Serial word output

Outputs to the serial output word information or indicates the output status.

Format
`SOW(m)`

Notation	Value	Range
m	port number	2 to 15*

The output range is 0 (&H0000) to 65,535 (&HFFFF).
Note that if a negative value is output, the low-order word information will be output after being converted to hexadecimal.

*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

Sample	Description
`A%=SOW(2)`	The output status of SOW (2) is assigned to variable A%.
`SOW(15)=A%`	The contents of variable A% are assigned in SOW (15). If the variable A% value exceeds the output range, the low-order word information will be assigned.
`SOW(15)=-255`	The contents of -255 (&HFFFFFF01) are assigned to SOW (15). -255 is a negative value, so the low-order word information (&HFF01) will be assigned.

MEMO

- The information is handled as unsigned word data.
- If a serial port does not actually exist, the data is not output externally.
- If a value exceeding the output range is assigned, the low-order 2-byte information is output.

9.13 Serial double word output

Output the status of serial output word information in a double word, or indicates the output status.

Format
`SOD(m)`

Notation	Value	Range
m	port number	2, 4, 6, 8, 10, 12, 14*

The output range is -2,147,483,648(&H80000000) to 2,147,483,647(&H7FFFFFFF).

*When SIOW extension is enabled, the range of port number is extended to 2, 4, 6 -14, 24, 26, 28 -126.
For details, refer to RCX3 user's manual "Option board related parameters".

Sample	Description
`A%=SOD(2)`	The output status of SOD (2) is assigned to variable A%.
`SOD(14)=A%`	The contents of variable A% are assigned in SOD (14).

MEMO

- The information is handled as signed double word data.
- If a serial port does not actually exist, the data is not output externally.
- The lower port number data is placed at the lower address.
  For example, if SOW(2) =&H2345, SOW(3) =&H0001, then SOD(2) =&H00012345.

10 Bit Settings

Bits can be specified for input/output variables by any of the following methods.

1. Single bit

To specify only 1 of the bits, the target port number and bit number are specified in parentheses.
The port number may also be specified outside the parentheses.

Programming example: DOm(b)DOm(b)

Sample	Description
`DO(25)`	`Specifies bit 5 of port 2.`
`DO2(5)`	

2. Same-port multiple bits

To specify multiple bits at the same port, those bit numbers are specified in parentheses (separated by commas) following the port number.
The port number may also be specified in parentheses.

Programming example: DOm(b,b,…,b) DO(mb,mb,…,mb)

Sample	Description
`DO2(7,5,3)`	`Specifies DO(27), DO(25), DO(23)`
`DO(27,25,23)`	

3. Different-port multiple bits

To specify multiple bits at different ports, 2-digit consisting of the port number and the bit number must be specified in parentheses and must be separated by commas. Up to 8 bits can be written.

Programming example: DO(mb,mb,…,mb)

Sample	Description
`DO(37,25,20)`	`Specifies DO(37), DO(25), DO(20).`

4. All bits of 1 port

To specify all bits of a single port, use parentheses after the port number. Methods 2 and 3 shown above can also be used.

Programming example: DOm()

Sample	Description
`DO2()`	`Specifies all the DO(27) to DO(20) bits`
`DO(27,26,25,24,23,22,21,20)`	
`DO2(7,6,5,4,3,2,1,0)`	

11 Valid range of variables

11.1 Valid range of dynamic (array) variables

Dynamic (array) variables are divided into global variables and local variables, according to their declaration position in the program. Global and local variables have different valid ranges.

Variable Type	Explanation
Global variables	Variables are declared outside of sub-procedures (outside of program areas enclosed by a SUB statement and END SUB statement). These variables are valid throughout the entire program.
Local variables	Variables are declared within sub-procedures and are valid only in these sub-procedures.

MEMO

- For details regarding arrays, refer to Chapter 3 "5 Array variables".
- A variable declared at the program level can be referenced from a sub-procedure without being passed along as a dummy argument, by using the SHARED statement (for details, refer to Chapter 8 "111 SHARED").

11.2 Valid range of static variables

Static variable data is not cleared when a program reset occurs. Moreover, variable data can be changed and referenced from any program.

The variable names are determined as shown below (they cannot be named as desired).

Variable type	Variable name
Integer variable	SGIn (n: 0 to 31)
Real variable	SGRn (n: 0 to 31)

12 Clearing variables

12.1 Clearing dynamic variables

In the cases below, numeric variables are cleared to zero, and character variables are cleared to a null string. The array is cleared in the same manner.

- When a program reset occurs.
- When dedicated input signal DI15 (program reset input) was turned on while the program was stopped in AUTO mode.
- When either of the following is initialized by an initialization operation.
    1. Program memory
    2. Entire memory
- When any of the following online commands was executed.
  @RESET, @INIT PGM, @INIT MEM, @INIT ALL
- When the HALTALL statement was executed in the program (HALT statement does not clear dynamic variables).

12.2 Clearing static variables

In the cases below, integer variables and real variables are cleared to zero.

- When the following is initialized by an initialization operation.
  Entire memory
- When any of the following online commands was executed.
  @INIT MEM, @INIT ALL

Chapter 4

Expressions and Operations

1 Arithmetic operations 4-1
2 Character string operations 4-4
3 Point data format....................................... 4-5
4 DI/DO conditional expressions 4-6

1 Arithmetic operations

1.1 Arithmetic operators

Operators	Usage Example	Meaning
+	A+B	Adds A to B
-	A-B	Subtracts B from A
*	A*B	Multiplies A by B
/	A/B	Divides A by B
^	A^B	Obtains the B exponent of A (exponent operation)
-	-A	Reverses the sign of A
MOD	A MOD B	Obtains the remainder A divided by B

When a "remainder" (MOD) operation involves real numbers, **the decimal value is rounded off to the nearest whole number which is then converted to an integer** before the calculation is executed. The result represents the remainder of an integer division operation.

Sample	Results
`A=15 MOD 2`	`A=1(15/2=7....1)`
`A=17.34 MOD 5.98`	`A=2(17/5=3....2)`

1.2 Relational operators

Relational operators are used to compare 2 values. If the result is "true", a "-1" is obtained. If it is "false", a "0" is obtained.

Operators	Usage Example	Meaning
=	A=B	"-1" if A and B are equal, "0" if not.
<>, ><	A<>B	"-1" if A and B are unequal, "0" if not.
<	A<B	"-1" if A is smaller than B, "0" if not.
>	A>B	"-1" if A is larger than B, "0" if not.
<=, =<	A<=B	"-1" if A is equal to or smaller than B, "0" if not.
>=, =>	A>=B	"-1" if A is equal to or larger than B, "0" if not.

Sample	Results
`A=10>5`	`Since 10 > 5 is "true", A = -1.`

MEMO

When using equivalence relational operators with real variables and real arrays, the desired result may not be obtained due to the round-off error.

Sample	Description

`A=2`
`B=SQR(A!)`
`IF A!=B!*B! THEN...`
	`In this case, A! will be unequal to B!*B!.`

1.3 Logic operations

Logic operators are used to manipulate 1 or 2 values bit by bit. For example, the status of an I/O port can be manipulated.

- Depending on the logic operation performed, the results generated are either 0 or 1.
- Logic operations with real numbers convert the values into integers before they are executed.

Operators	Functions	Meaning
NOT, ~	Logical NOT	Reverses the bits.
AND, &	Logical AND	Becomes "1" when both bits are "1".
OR, |	Logical OR	Becomes "1" when either of the bits is "1".
XOR	Exclusive OR	Becomes "1" when both bits are different.
EQV	Logical equivalence operator	Becomes "1" when both bits are equal.
IMP	Logical implication operator	Becomes "0" when the first bit is "1" and the second bit is "0".

Examples: A%=NOT 13.05 → "-14" is assigned to A% (reversed after being rounded off to 13).

Bit	7	6	5	4	3	2	1	0
13	0	0	0	0	1	1	0	1
NOT 13=-14	1	1	1	1	0	0	1	0

Examples: A%=3 AND 10 → "2" is assigned to A%

Bit	7	6	5	4	3	2	1	0
3	0	0	0	0	0	0	**1**	1
10	0	0	0	0	1	0	**1**	0
3 AND 10 = 2	0	0	0	0	0	0	**1**	0

Examples: A%=3 OR 10 → "11" is assigned to A%

Bit	7	6	5	4	3	2	1	0
3	0	0	0	0	**0**	0	**1**	**1**
10	0	0	0	0	**1**	0	**1**	**0**
3 OR 10 = 11	0	0	0	0	**1**	0	**1**	**1**

Examples: A%=3 XOR 10 → "9" is assigned to A%

Bit	7	6	5	4	3	2	1	0
3	0	0	0	0	**0**	0	1	**1**
10	0	0	0	0	**1**	0	1	**0**
3 XOR 10 = 9	0	0	0	0	**1**	0	0	**1**

1.4 Priority of arithmetic operation

Operations are performed in the following order of priority. When two operations of equal priority appear in the same statement, the operations are executed in order from left to right.

Priority Rank	Arithmetic Operation
1	Expressions included in parentheses
2	Functions, variables
3	^ (exponents)
4	Independent "+" and "-" signs (Monomial operators)
5	* (Multiplication), / (Division)
6	MOD
7	+ (Addition), - (Subtraction)
8	Relational operators
9	NOT, ~ (Logical NOT)
10	AND, & (Logical AND)
11	OR, |, XOR (Logical OR, exclusive OR)
12	EQV (Logical equivalence)
13	IMP (Logical implication)

1.5 Data format conversion

Data format is converted in cases where two values of different formats are involved in the same operation.

When a real number is assigned to an integer, decimal places are rounded off.

Sample	Results
`A%=125.67`	`A%=126`

When integers and real numbers are involved in the same operation, the result becomes a real number.

Sample	Results
`A(0)=125 * 0.25`	`A(0)=31.25`

When an integer is divided by an integer, the result is an integer with the remainder discarded.

Sample	Results
`A(0)=100/3`	`A(0)=33`

2 Character string operations

2.1 Character string connection

Character strings may be combined by using the "+" sign.

Sample	Results

`A$="YAMAHA"`
`B$="ROBOT"`
`C$="LANGUAGE"`
`D$="MOUNTER"`
`E$=A$+" "+B$+" "+C$`
`F$=A$+" "+D$`
`PRINT E$`
`PRINT F$`
	`YAMAHA ROBOT LANGUAGE`
	`YAMAHA MOUNTER`

2.2 Character string comparison

Characters can be compared with the same relational operators as used for numeric values. Character string comparison can be used to find out the contents of character strings, or to sort character strings into alphabetical order.

- In the case of character strings, the comparison is performed from the beginning of each string, character by character.
- If all characters match in both strings, they are considered to be equal.
- Even if only one character in the string differs from its corresponding character in the other string, then the string with the larger (higher) character code is treated as the larger string.
- When the character string lengths differ, the longer of the character strings is judged to be the greater value string.

Sample	Results
`"AA"<"AB"`	`All examples are "true".`
`"X&">"X#"`	
`"DESK"<"DESKS"`	

3 Point data format

There are two types of point data formats: joint coordinate format and Cartesian coordinate format.
Point numbers are in the range of 0 to 29999.

Coordinate Format	Data Format	Explanation
Joint coordinate format	± nnnnnnn	This is a decimal integer constant of 8 digits or less with a plus or minus sign, and can be specified from –99999999 to 99999999. Unit: [pulses]
Cartesian coordinate format	± nnn.nn to ± nnnnnnn	This is a decimal fraction of a total of 7 digits including 3 or less decimal places. Unit: [mm] or [degrees]

NOTE

- The data format is common for axes 1 to 6 for both the joint coordinate format and the Cartesian coordinate format.
- Plus (+) signs can be omitted.
- The first arm and the second arm rotation information is not available on any robot model except the YK-TW series.

When setting an extended hand system flag for SCARA robots, set either "1" or "2" at the end of the data.
If a value other than "1" or "2" is set, or if no value is designated, "0" will be set to indicate that no hand system flag is set.

Hand System	Data Value
RIGHTY (right-handed system)	1
LEFTY (left-handed system)	2

On the YK-TW series robot, the first arm and the second arm movement range is extended beyond 360 degrees (The working envelope for both the first arm and second arm is -225° to +225°).
Therefore, attempts to convert Cartesian coordinate data ("mm" units) to joint coordinate data ("pulse" units) will result in multiple solutions, making the position impossible to determine.
In order to obtain the correct robot position and arm posture when converting to joint coordinates, the first arm and the second arm rotation information is added after the "mm" units point data's extended hand system flag.
The Cartesian coordinate data ("mm" units) is then converted to joint coordinate data ("pulse" units) according to the specified the first arm and the second arm rotation information.

To set extended the first arm and the second arm rotation information at the YK-TW series robot, a "-1", "0", or "1" value must be specified after the hand system flag. Any other value, or no value, will be processed as "0".

Arm rotation information	Data Value
"mm" → pulse converted angle data x (*1) range: -180° < x <= 180°	0
"mm" → pulse converted angle data x (*1) range: 180° < x <= 540°	1
"mm" → pulse converted angle data x (*1) range: -540° < x <= -180°	-1

*1: The joint-coordinates-converted pulse data represents each arm's distance (converted to angular data) from its mechanical origin point.

4 DI/DO conditional expressions

DI/DO conditional expressions may be used to set conditions for WAIT statements and STOPON options in MOVE statements.
Numeric constants, variables and arithmetic operators that may be used with DI/DO conditional expressions are shown below.

- Constant
  Decimal integer constant, binary integer constant, hexadecimal integer constant
- Variables
  Global integer type, global real type, input/output type
- Operators
  Relational operators, logic operators
- Operation priority
  1. Relational operators
  2. NOT, ~
  3. AND, &
  4. OR, |, XOR

Sample	Decsription
`WAIT DI(31)=1 OR DI(34)=1`	The program waits until either DI31 or DI34 turns ON.

Chapter 5

Multiple Robot Control

1 Overview 5-1
2 Command list with a robot setting.......... 5-2

1 Overview

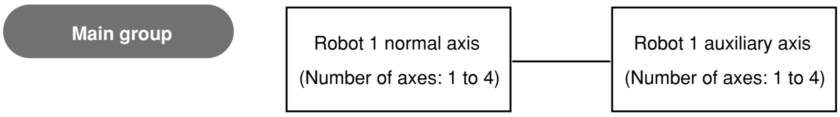
RCX340/RCX320 can be used to control multiple robots (up to 4).
The multi-task function also enables multiple robots to move asynchronously.
To use this function, settings for multiple robots or settings for auxiliary axes must be made in the system prior to shipment.
The following settings are possible to the axes of robots.

- Robot 1 (4 axes)
- Robot 1 (1 axis) + robot 2 (1 axis) + robot 3 (1 axis) + robot 4 (1 axis)
- Robot 1 (6 axes) + robot 2 (2 axes) (when using the YC-LINK/E option)
- Robot 1 (4 axes) + robot 2 (4 axes) (when using the YC-LINK/E option)
- Robot 1 (2 axes) + robot 2 (2 axes)
- Robot 1 (4 axes) + robot 2 (4 axes) + robot 3 (4 axes) + robot 4 (4 axes)
  (when a master controller is RCX340 and the YC-LINK/E option is used.)
- Robot 1 (2 axes) + robot 2 (4 axes) + robot 3 (4 axes) + robot 4 (4 axes)
  (when a master controller is RCX320 and the YC-LINK/E option is used.)

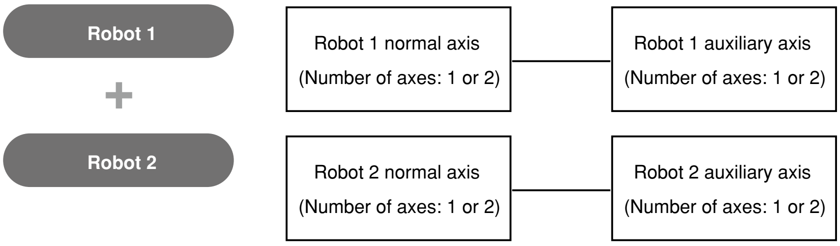
Each robot consists of normal axes and auxiliary axes.
When using one robot without auxiliary axes, the setting is made only to normal axes.

Axes configuration

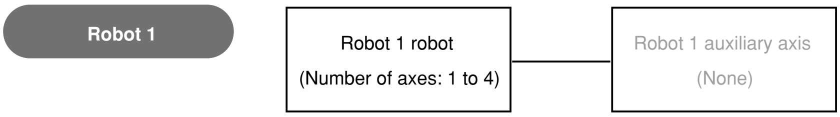
1. For robot 1


Main group
Robot 1 normal axis
(Number of axes: 1 to 4)
Robot 1 auxiliary axis
(Number of axes: 1 to 4)

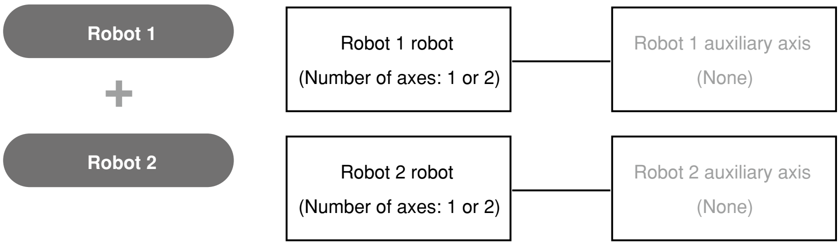
2. For robot 1 and robot 2


Robot 1
+
Robot 2
Robot 1 normal axis
(Number of axes: 1 or 2)
Robot 1 auxiliary axis
(Number of axes: 1 or 2)
Robot 2 normal axis
(Number of axes: 1 or 2)
Robot 2 auxiliary axis
(Number of axes: 1 or 2)

3. For 1 robot with no auxiliary axes used


Robot 1
Robot 1 robot
(Number of axes: 1 to 4)
Robot 1 auxiliary axis
(None)

4. When no auxiliary axes are set to two robots


Robot 1
+
Robot 2
Robot 1 robot
(Number of axes: 1 or 2)
Robot 1 auxiliary axis
(None)
Robot 2 robot
(Number of axes: 1 or 2)
Robot 2 auxiliary axis
(None)

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2 Command list with a robot setting

The special commands and functions for robot movements and coordinate control are common for all robots. A robot can be specified with an option of a command. Main commands are shown below.

Operator	Command name	
Robot movement	DRIVE	DRIVEI
	MOVE	MOVEI
	MOVET	PATH
	PMOVE	SERVO
	WAIT ARM	
Coordinate control	CHANGE	CHGWRK
	HAND	LEFTY
	PATH	RIGHTY
	SHIFT	WRKDEF
Status change	ACCEL	ARCHP1
	ARCHP2	ARMSEL
	ARMTYP	ASPEED
	AXWGHT	CONTPLS
	DECEL	INROFST
	MSPEED	ORGORD
	OUTPOS	SCRINR
	SPEED	TOLE
	WEIGHT	WEIGHTG
Point operation	CORRECTXY	JTOXY
	WHERE	WHRXY
	XYTOJ	
Parameter reference	ACCEL	ARCHP1
	ARCHP2	ARMTYP
	AXWGHT	CONTPLS
	DECEL	INROFST
	ORGORD	OUTPOS
	SCRINR	TOLE
	WEIGHT	WEIGHTG
Status reference	ABSRPOS	ARMCND
	ARMSEL	ARMTYP
	CORRECTXY	CURTQST
	CURTRQ	MCHREF
	WHERE	WHRXY
Torque control	CURTRQ	TORQUE
	TRQSTS	TRQTIME

- An axis specified as an auxiliary axis cannot be moved with the MOVE, MOVEI, MOVET and PMOVE commands. Use the DRIVE or DRIVEI command to move it.

Chapter 6

Multi-tasking

1 Outline 6-1
2 Task definition method............................. 6-1
3 Task status and transition 6-2
4 Multi-task program example 6-8
5 Sharing the data 6-9
6 Cautionary Items 6-9

1 Outline

The multi-task function performs multiple processing simultaneously in a parallel manner, and can be used to create programs of higher complexity. Before using the multi-task function, read this section thoroughly and make sure that you fully understand its contents.
Multi-tasking allows executing two or more tasks in parallel. However, this does not mean that multiple tasks are executed simultaneously because the controller has only one CPU to execute the tasks. In multi-tasking, the CPU time is shared among multiple tasks by assigning a priority to each task so that they can be executed efficiently.

- A maximum of 16 tasks (task 1 to task 16) can be executed in one program.
- Tasks can be prioritized and executed in their priority order (higher priority tasks are executed first).
- The priority level can be set to any level between 1 and 64.
- Smaller values have higher priority, and larger values have lower priority (High priority: 1 ⇔ 64: low priority).

2 Task definition method

A task is a set of instructions which are executed as a single sequence. As explained below, a task is defined by assigning a label to it.

- Create one program that describes a command which is to be defined as a task.
- In the START statement of the program that will be a main task, specify the program created at Step 1 above. Task numbers are then assigned, and the program starts.

Sample **Description**

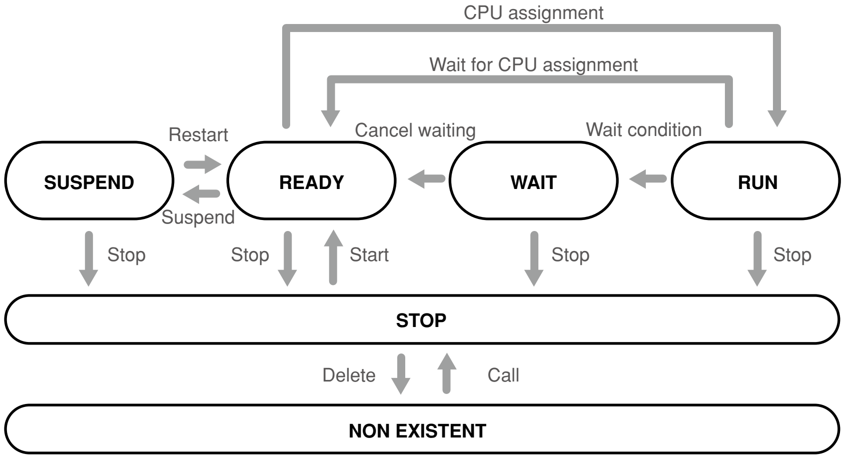
```
'MAIN TASK(TASK1)
START <SUB_PGM>,T2..........................    <SUB_PGM> is started as Task 2
*ST1:
MOVE P,P1,P0
    IF DO(20)= 1 THEN
       HALTALL
    ENDIF
GOTO *ST
HALTALL
                                                Program name:SUB_TSK2
'SUB TASK(TASK2)
*IOTASK:....................................    Task 2 begins here
    IF DI(21)=1 THEN
       DO(30)=1
    ELSE
       DO(30)=0
    ENDIF
GOTO *IOTASK ...............................    Task 2 processing ends here
EXIT TASK
```

3 Task status and transition

There are 6 types of task status.

• **STOP status**	A task is present but the task processing is stopped.
• **RUN status**	A task is present and the task processing is being executed by the CPU.
• **READY status**	A task is present and ready to be allocated to the CPU for task processing.
• **WAIT status**	A task is present and waiting for an event to begin the task processing.
• **SUSPEND status**	A task is present but suspended while waiting to begin the task processing.
• **NON EXISTENT status**	No tasks exist in the program. (The START command is used to perform a call.)

Task state transition



MEMO

Use REFTSK function to acquire the current task status.

Reference For details regarding REFTSK function, refer to Chapter 8 "101 REFTSK".

3.1 Starting tasks

When the START command is executed, a specified program is registered in the task and placed in RUN status. If the task number (1 to 16) is not specified by the START command, the task with the smallest number among the tasks yet to be started is automatically specified.

Reference For details regarding the START command, refer to "123 START" in Chapter 8.

MEMO

- When the LOAD command is executed, a specified program is registered in the task and placed in a STOP status. For details of the LOAD command, refer to "1. Register task" of "2.1 Program operations" in Chapter 12.
- If another program is already registered in the task number specified by the START command or the LOAD command, the "6.215: Task running" error will occur.
- When programs are registered in all task numbers and the START command or the LOAD command is executed without specifying the task number, the "6.263: Too many Tasks" error will occur.
- When the HALTALL command is executed, all tasks terminate and the task enters the NON EXISTENT (no task registration) status. When the main program is specified, the HALTALL command registers the main program in the task 1 and stops at the beginning line. When the main program is not specified, the HALTALL command registers the program that has been executed last (current program) in the task 1 and stops at the beginning line.

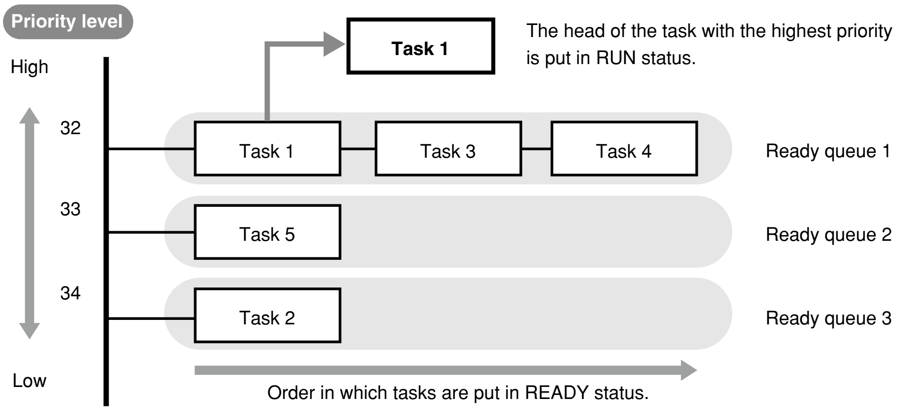
Reference For details regarding the main program, refer to "Setting the main program" of RCX3 user's manual.

3.2 Task scheduling

Task scheduling determines the priority to be used in allocating tasks in the READY (execution enabled) status to the CPU and executing them.
When there are two or more tasks which are put in the READY status, ready queues for CPU allocation are used to determine the priority for executing the tasks. One of these READY status tasks is then selected and executed (RUN status).

Only tasks with the same priority ranking are assigned to a given ready queue. Therefore, where several tasks with differing priority rankings exist, a corresponding number of ready queues are created. Tasks within a given ready queue are handled on a first come first serve (FCFS) basis. The task where a READY status is first established has priority. The smaller the number, the higher the task priority level.

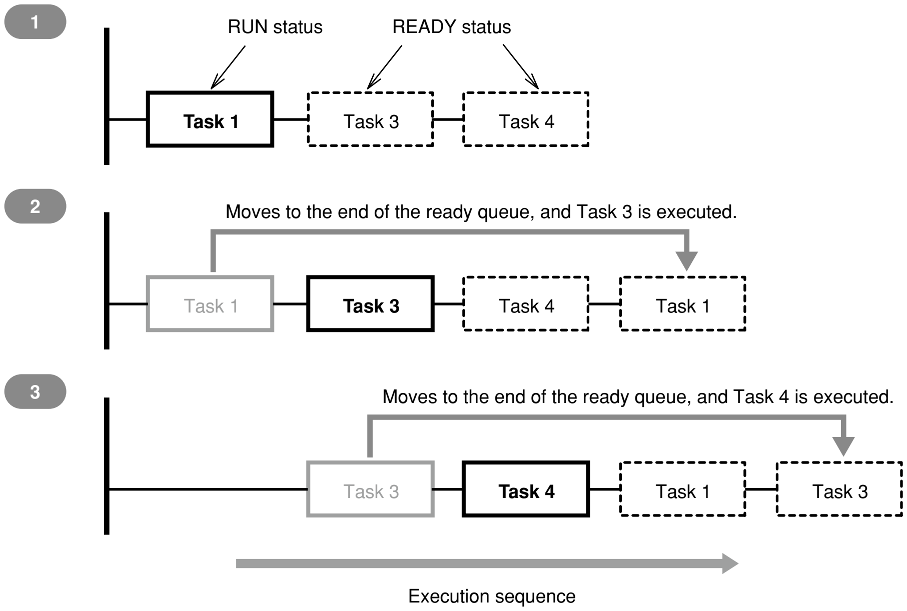
Task scheduling


Priority level
High
32
33
34
Low
Task 1
The head of the task with the highest priority is put in RUN status.
Task 1
Task 3
Task 4
Ready queue 1
Task 5
Ready queue 2
Task 2
Ready queue 3
Order in which tasks are put in READY status.

A RUN status task will be moved to the end of the ready queue if placed in a READY status by any of the following causes:

- A WAIT status command was executed.
- The CPU occupation time exceeds a specified time.
- A task with a higher priority level is put in READY status.

Ready queue


1
RUN status
READY status
Task 1
Task 3
Task 4
2
Moves to the end of the ready queue, and Task 3 is executed.
Task 1
Task 3
Task 4
Task 1
3
Moves to the end of the ready queue, and Task 4 is executed.
Task 3
Task 4
Task 1
Task 3
Execution sequence

NOTE

When the prescribed CPU occupation time elapses, the active command is ended, and processing moves to the next task.
However, if there are no other tasks of the same or higher priority (same or higher ready queue), the same task will be executed again.

3.3 Condition wait in task

A task is put in the WAIT status (waiting for an event) when a command causing WAIT status is executed for that task. At this time, the transition to READY status does not take place until the wait condition is canceled.

When a command causing WAIT status is executed, the following transition happens.

- Task for which a command causing WAIT status is executed → WAIT status
- Task at the head of the ready queue with higher priority → RUN status

MEMO

For example, when a MOVE statement (a command that establishes WAIT status) is executed,

the CPU sends a "MOVE" instruction to the driver, and then waits for a "MOVE COMPLETED" reply from the driver. This is "waiting for an event" status.

In this case, WAIT status is established at the task which executed the MOVE command, and that task is moved to the end of the ready queue. RUN status is then established at the next task.

When an event waited by the task in the WAIT status occurs, the following status transition takes place by task scheduling.

Task in the WAIT status for which the awaited event occurred → READY status

However, if the task put in the READY status was at the head of the ready queue with the highest priority, the following transition takes place.

- Task that is currently in RUN status → READY status
- Task at the head of the ready queue with higher priority → RUN status

MEMO

In the above MOVE statement example, the task is moved to the end of the ready queue.
Then, when a "MOVE COMPLETED" reply is received, this task is placed in READY status.

NOTE

If multiple tasks are in WAIT status awaiting the same condition event, or different condition events occur simultaneously, all tasks for which the waited events occur are put in READY status.

Tasks are put in WAIT status by the following commands.

Event		Command			
Wait for axis movement to complete	Axis movement command	MOVE DRIVEI SERVO	MOVEI PMOVE WAIT ARM	MOVET PATH	DRIVE MOTOR
	Parameter command	ACCEL AXWGHT ORGORD WEIGHT	ARCHP1 CONTPLS OUTPOS WEIGHTG	ARCHP2 DECEL SCRINR	ARMTYP INROFST TOLE
	Robot status change command	CHANGE MSPEED	SHIFT SPEED	LEFTY	ASPEED
Wait for time to elapse		DELAY, SET (Time should be specified.)			
Wait for condition to be met		WAIT			
Wait for data to send or to be received		SEND			
Wait for print buffer to become empty		PRINT			
Wait for key input		INPUT			

MEMO

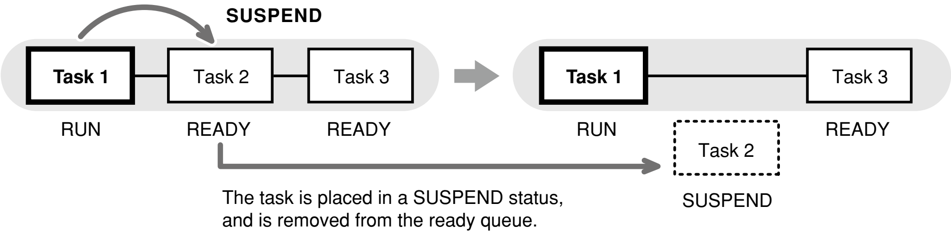
The tasks are not put in WAIT status if the event has been established before the above commands are executed.

3.4 Suspending tasks (SUSPEND)

The SUSPEND command temporarily stops tasks other than task 1 and places them in SUSPEND status. When the SUSPEND command is executed, the status transition takes place as follows.

- Task that executed the SUSPEND command → RUN status
- Specified task → SUSPEND status

Suspending tasks (SUSPEND)


SUSPEND
Task 1
Task 2
Task 3
RUN
READY
READY
Task 1
Task 3
RUN
Task 2
READY
SUSPEND

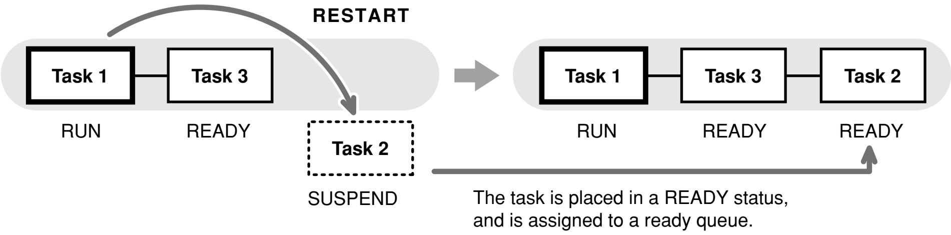
The task is placed in a SUSPEND status, and is removed from the ready queue.

3.5 Restarting tasks (RESTART)

Tasks in the SUSPEND status can be restarted with the RESTART command. When the RESTART command is executed, the status transition takes place as follows.

- Task for which the RESTART command was executed → RUN status
- Specified task → READY status

Restarting tasks (RESTART)


RESTART
Task 1
Task 3
RUN
READY
Task 2
SUSPEND
Task 1
Task 3
Task 2
RUN
READY
READY

The task is placed in a READY status, and is assigned to a ready queue.

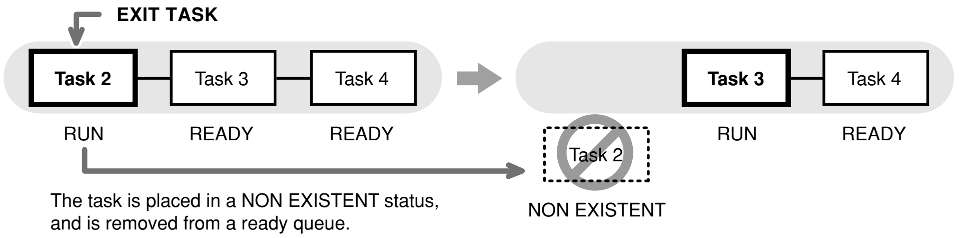
3.6 Deleting tasks

Task self-delete (EXIT TASK)

Tasks can delete themselves and set to the NON EXISTENT (no task registration) status by using the EXIT TASK command.
When the EXIT TASK command is executed, the status transition takes place as follows.

- Task that executed the EXIT TASK command → NON EXISTENT status
- Task at the head of the ready queue with higher priority → RUN status

Task self-delete (EXIT TASK)

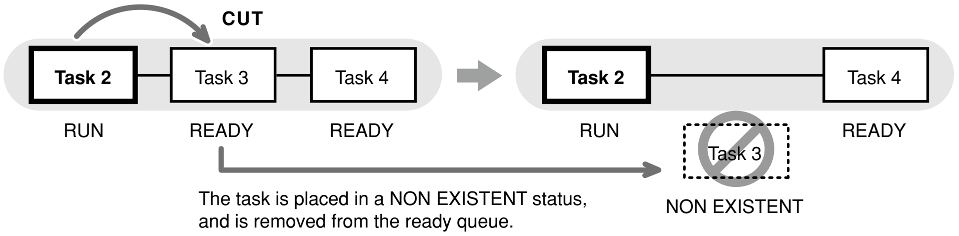

EXIT TASK
Task 2
Task 3
Task 4
RUN
READY
READY
Task 3
Task 4
RUN
READY
Task 2
NON EXISTENT
The task is placed in a NON EXISTENT status, and is removed from a ready queue.

Other-task delete (CUT)

Tasks can also delete the other tasks and put in the NON EXISTENT (no task registration) status by using the CUT command.
When the CUT command is executed, the status transition takes place as follows.

- Task that executed the CUT command → RUN
- Specified task → NON EXISTENT

Other-task delete (CUT)


CUT
Task 2
Task 3
Task 4
RUN
READY
READY
Task 2
Task 4
RUN
READY
Task 3
NON EXISTENT
The task is placed in a NON EXISTENT status, and is removed from the ready queue.

MEMO

If a SUSPEND command is executed for a WAIT-status task, the commands being executed by that task are ended.

3.7 Stopping tasks

All tasks stop if any of the following cases occurs.

HALTALL command is executed. (stop & reset)

All programs are reset and task is put in the NON EXISTENT status. When the main program is specified, the HALTALL command registers the main program in the task 1 and all tasks are put in the STOP status at the beginning line. When the main program is not specified, the HALTALL command registers the program that has been executed last (current program) in the task 1 and all tasks are put in the STOP status at the beginning line.

HOLDALL command is executed. (temporary stop)

All tasks are put in the STOP status. When the program is restarted, the tasks in the STOP status set to the READY or SUSPEND status.

STOP key on the programming box is pressed or the interlock signal is cut off.

Just as in the case where the HOLD command is executed, all tasks are put in the STOP status.
When the program is restarted, the tasks in the STOP status set to the READY status (or, the task is placed the SUSPEND status after being placed in the READY status).

When the emergency stop button on the programming box is pressed or the emergency stop signal is cut off.

All tasks are put in the STOP status. At this point, the power to the robot is shut off and the servo sets to the non-hold state.
After the canceling emergency stop, when the program is restarted, the tasks in the STOP status are set to the READY or SUSPEND status. However, a servo ON is required in order to restart the robot power supply.

MEMO

When the program is restarted without being reset after the tasks have been stopped by a cause other than 1., then each task is processed from the status in which the task stopped. This holds true when the power to the controller is turned off and then turned on.

4 Multi-task program example

Tasks are executed in their scheduled order. An example of a multi-task program is shown below.

```
Sample                                 Description

'TASK1                                 TASK1
START <SUB_TSK2>,T2
START <SUB_TSK3>,T3
*ST1:
       DO(20) = 1
       WAIT MO(20) = 1
       MOVE P,P1,P2,Z=0
       IF MO(21)=1 THEN *FIN
GOTO *ST1
*FIN:
CUT T2
HALTALL
```

```
                                       Program name:SUB_TSK2
'TASK2                                 Task 2 begins here.
*ST2:
       IF     DI(20) = 1
              MO(20) = 1
              DELAY 100
       ELSE
              MO(20) = 0
       ENDIF
GOTO *ST2
EXIT TASK                              Ends here.
```

```
                                       Program name:SUB_TSK3
'TASK3                                 Task 3 begins here.
*ST3:
       IF DI(21) = 0 THEN *ST3
       IF DI(30) = 0 THEN *ST3
       IF DI(33) = 0 THEN *ST3
       MO(21) = 1
EXIT TASK                              Ends here.
```

5 Sharing the data

All global variables, static variables, input/output variables, point data, shift coordinate definition data, hand definition data, work definition data, and pallet definition data are shared between all tasks.

Execution of each task can be controlled while using the same variables and data shared with the other tasks.

MEMO

In this case, however, use sufficient caution when rewriting the variable and data because improper changes may cause trouble in the task processing. Take great care when sharing the same variables and data.

6 Cautionary Items

A freeze may occur if subtasks are continuously started (START command) and ended (EXIT TASK command) by a main task in an alternating manner.

This occurs for the following reason: if the main task and subtask priority levels are the same, a task transition to the main task occurs during subtask END processing, and an illegal task status then occurs when the main task attempts to start a subtask.

Therefore, in order to properly execute the program, the subtask priority level must be set higher than that of the main task. This prevents a task transition condition from occurring during execution of the EXIT TASK command.

In the sample program shown below, the priority level of task 1 (main task) is set as 32, and the priority level of task 2 is set as 31 (the lower the value, the higher the priority).

Sample **Description**

```
FLAG1 = 0                                 MAIN_TASK
*MAIN_TASK:
    IF FLAG1=0 THEN
        FLAG1 = 1
        START <SUB_PGM>, T2, 31           <SUB_PGM> is started as task 2 with priority level
    ENDIF                                 31.
GOTO *MAIN_TASK
HALTALL

'=====================
'       TASK2                             SUB TASK (Program name:SUB_PGM)
'=====================
*TASK2:
    DRIVE(1,P1)
    WAIT ARM(1)
    DRIVE(1,P2)
    WAIT ARM(1)
    FLAG1 = 0
EXIT TASK
```

Chapter 7

Sequence function

1 Sequence function 7-1
2 Sequence program specifications 7-1
3 Creating a sequence program 7-2
4 Executing a sequence program 7-5
5 Programming a sequence program....... 7-6

1 Sequence function

Besides normal robot programs, the RCX340/RCX320 controller can execute high-speed processing programs (sequence programs) in response to the robot input/output (DI, DO, MO, LO, TO, SI, SO) signals.

- This function allows to monitor the input/output signals of sensors, push button switches, solenoid valves, etc. and move them. The sequence program starts running simultaneously the controller is turned on.
- The sequence program can be written in the same robot language used for robot programs. (The ladder logic are not necessary).
- Naming the program "SEQUENCE" makes the controller recognize as sequence program.
- For details regarding conditions to execute a sequence program, refer to "3 Executing a sequence program" in this Chapter.
- General-purpose outputs are not reset by the program reset while the sequence function is running.

NOTE

- While the "DI10" *: sequence control input" is ON, a sequence program runs according to its own cycle, regardless of robot program starts and stops. * "SI10" instead of "DI10" when an SIO board is inserted.
- The output while a sequence program is running is as follows.
  > When a dedicated PIO board is inserted: "DO12: Sequence program running" dedicated signal output
  > When an SIO board is inserted: "SO12: Sequence program running" dedicated signal output

MEMO

In the manners shown below, the reset of general-purpose output will be allowed while the sequence program is operating.

- Set a sequence flag value of the controller parameter at "3".
- Select "Output Reset Enable" on the sequence execution flag dialogue in the support software.

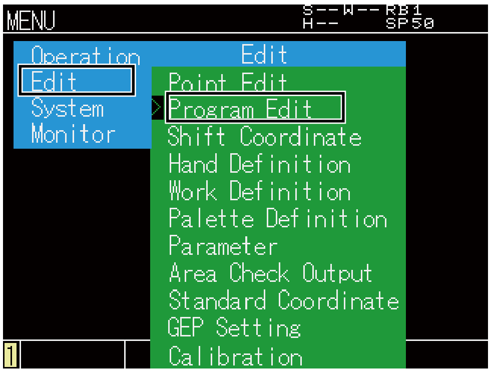
2 Sequence program specifications

Item	Specification
Commands	Logical NOT, AND, OR, XOR, EQV, IMP
I/O	Same as robot language
Program capacity	8,192 bytes (A maximum of 2,048 variables can be specified.)
Scan time	2 to 8 ms depending on the number of steps (this value changes automatically)

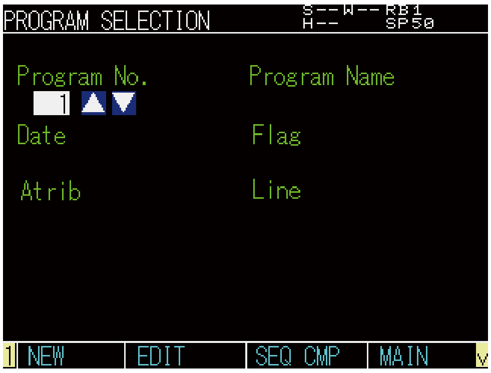
3 Creating a sequence program

3.1 Programming method

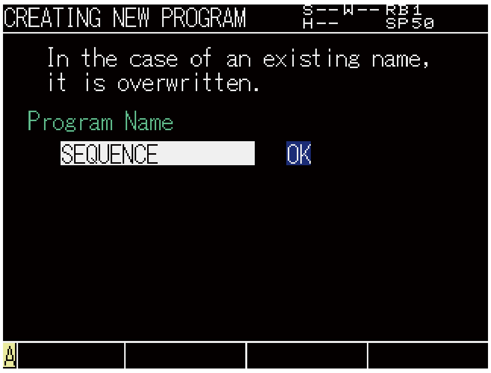
Step 1 Select (Program Edit) from (Edit) menus on the "MENU" screen of the programming box.


MENU
S--W-- RB1
H-- SP50
Operation
Edit
System
Monitor
Edit
Point Edit
Program Edit
Shift Coordinate
Hand Definition
Work Definition
Palette Definition
Parameter
Area Check Output
Standard Coordinate
GEP Setting
Calibration
1

Step 2 Press the F1 key (NEW) on the "PROGRAM SELECTION" screen.


PROGRAM SELECTION
S--W-- RB1
H-- SP50
Program No.
1 ▲ ▼
Program Name
Date
Flag
Atrib
Line
1 NEW
EDIT
SEQ CMP
MAIN
v

Step 3 Enter "SEQUENCE" on the program name entry screen, and press the (OK) button.

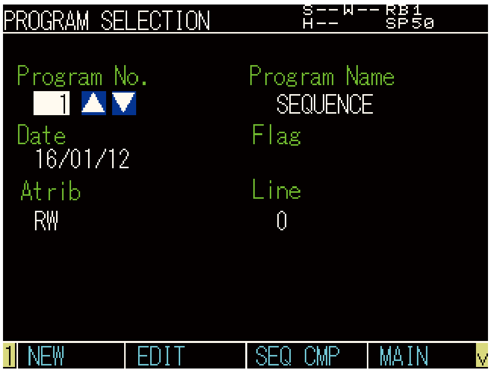

CREATING NEW PROGRAM
S--W-- RB1
H-- SP50

In the case of an existing name,
it is overwritten.

Program Name
SEQUENCE

OK
A

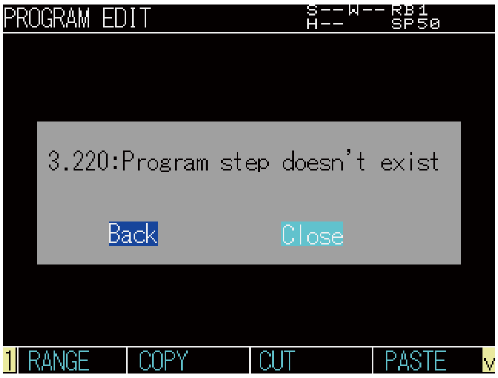
Step 4 Use the cursor keys (▲ / ▼) to select "SEQUENCE" on the "PROGRAM SELECTION" screen, and then press the F2 key (EDIT).


PROGRAM SELECTION
S--W-- RB1
H-- SP50

Program No. 1
Program Name SEQUENCE
Date 16/01/12
Flag
Atrib RW
Line 0

▲ ▼
1 NEW
EDIT
SEQ CMP
MAIN
v

Step 5 "3.220: Program step doesn't exist" message appears when creating a new program, and press (Close).


PROGRAM EDIT
S-- W-- RB1
H-- SP50
Back
Close
1
RANGE
COPY
CUT
PASTE
v

3.220:Program step doesn't exist

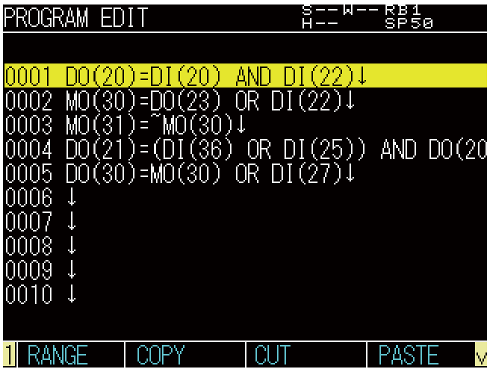
NOTE

When creating a new program, the alarm occurs since no program is written. This alarm does not occur when the robot language exists already in a program.

Step 6 Input a program on "PROGRAM SELECTION" screen.

Although usable commands are restricted, editing method is same as the standard robot program.

Commands which can be input are explained at "4 Programming a sequence program" in this Chapter.

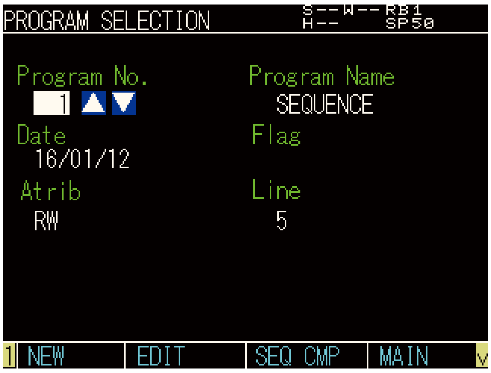

PROGRAM EDIT
S-- W-- RB1
H-- SP50
1
RANGE
COPY
CUT
PASTE
v

```
0001 DO(20)=DI(20) AND DI(22)↓
0002 MO(30)=DO(23) OR DI(22)↓
0003 MO(31)=~MO(30)↓
0004 DO(21)=(DI(36) OR DI(25)) AND DO(20
0005 DO(30)=MO(30) OR DI(27)↓
0006 ↓
0007 ↓
0008 ↓
0009 ↓
0010 ↓
```

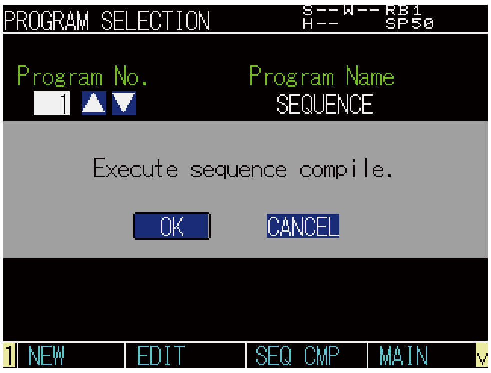
3.2 Compiling

Compile and create an executable sequence program.

Step 1 Press the F3 key (SEQ CMP) on the "PROGRAM SELECTION" screen.

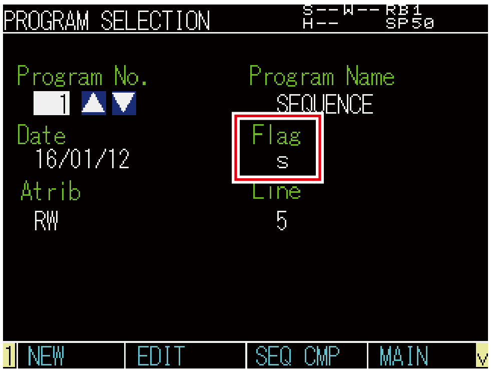

PROGRAM SELECTION
S-- W-- RB1
H-- SP50
Program No. 1
Program Name SEQUENCE
Date 16/01/12
Flag
Atrib RW
Line 5

Step 2 The confirmation message will appear whether you execute sequence compile.
Press (OK) to compile the program.


PROGRAM SELECTION
S-- W-- RB1
H-- SP50
Program No. 1
Program Name SEQUENCE
Execute sequence compile.

MEMO

If there is a syntax error in the program, an error message appears. When the compiling ends without any error, the display returns to the "PROGRAM SELECTION" screen and the letter "s" appears in "Flag". This means that the sequence program has been compiled successfully and is ready for use.


PROGRAM SELECTION
S-- W-- RB1
H-- SP50
Program No. 1
Program Name SEQUENCE
Date 16/01/12
Flag s
Atrib RW
Line 5

MEMO

The sequence execution program is erased and the Flag's letter "s" disappears in the following cases. In these cases the sequence function cannot be used.

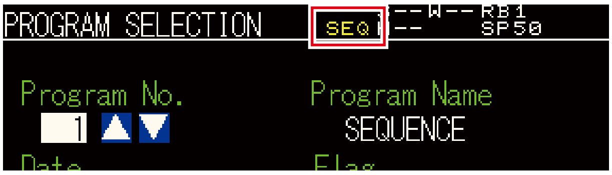
1. When the sequence program was erased.
2. When the sequence program was edited.
3. When the program data was initialized.
4. When the "9.729: Sequence object destroyed." alarm occurred.

4 Executing a sequence program

All the following conditions must be satisfied to execute a sequence program.

- The sequence program has been compiled.
- The sequence program execution flag is enabled.
  (For details regarding the sequence program execution flag, refer to the RCX3 user's manual.)
- The external sequence control input "DI10"* contact is ON. * "SI10" when an SIO board is inserted.

Sequence program execution in progress



Indicated during execution

PROGRAM SELECTION

SEQ

Program No.
1

Program Name
SEQUENCE

4.1 Sequence program STEP execution

The sequence program may be executed line by line while checking one command line at a time. This step execution can be executed in the same way as normal programs.
For details, refer to the RCX3 user's manual.
When the step is executed, satisfying the conditions described in the previous section is not required.

5 Programming a sequence program

When programming a sequence program, you may use only assignment statements comprised of input/output variables and logical operators.

5.1 Assignment statements

Format

```
output variable = expression
```

Notation	Description
expression	Any one of the following can be used. • Parallel input/output variables • Internal output variables • Arm lock output variables • Timer output variables • Serial input/output variable • The logic operation expression shown above

5.2 Input/output variables

Each variable must be specified in a 1-bit format

Sample	Description
`DO(35)`	Correct examples
`MO(24)`	
`DI(16)`	
`DO(37, 24)`	Incorrect examples
`DI3(4)`	
`MO3()`	

5.2.1 Input variables

Parallel input variables

Format

```
DI(mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

These variables show the status of the parallel input signal.

Serial input variables

Format

```
SI(mb)
```

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

Indicates a serial input signal status. Only referencing can occur. No controls are possible.

5.2.2 Output variables

Parallel output variables

Format

`DO(mb)`

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

A parallel output is specified, or the output status is referenced.
Ports 0 and 1 are for referencing only, and no outputs can occur there.

Internal output variables

Format

`MO(mb)`

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27, 30 to 37
b	bit definition	0 to 7

These variables are used within the controller.
Ports 30 to 37 are for referencing only and ON/OFF cannot be controlled.

Arm lock output variables

Format

`LO(mb)`

Notation	Value	Range
m	port number	0 , 1
b	bit definition	0 to 7

These variables are used to prohibit the arm (axis) movement. Movement is prohibited when ON.

- LO(00) to LO(07) corresponds to arm 1 to arm 8
- LO(10) to LO(17) corresponds to arm 9 to arm 16, respectively.

Timer output variables

Format

`TO(mb)`

Notation	Value	Range
m	port number	0 , 1
b	bit definition	0 to 7

There are a total of 16 timer output variables: TO(00) to TO(17).
The timer of each variable is defined by the timer definition statement TIM00 to 17.

Serial output variables

Format

`SO(mb)`

Notation	Value	Range
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

Control or reference serial output signal status. Port 0 is for referencing only, and no controls are possible.

5.3 Timer definition statement

Format

`TIMmb=`*`time`*

Notation	Value	Range
time		100 to 2,147,483,647 ms (0 second to 24 days)
m	port number	0 to 7, 10 to 17, 20 to 27
b	bit definition	0 to 7

These variables show the status of the parallel input signal.

Meaning The timer definition statement sets the timer value of the timer output variable.
This definition statement may be anywhere in the program.
When the timer definition statement is omitted, the timer setting value of the variable is 0.

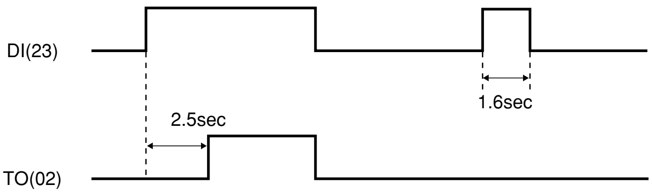
TIM00 to 17 correspond to the timer output variables TO(00) to (17).
Although this value can be set by 1 ms unit, it is effected by the scan cycle of sequence program (2 to 8 ms), the updated cycle of PIO board (2 to 4 ms), or the update cycle of SIO board (5 ms).

Timer usage example

Sample	Description
`TIM02=2500`	............`Timer 02 is set to 2.5 seconds.`
`TO(02)=DI(23)`	............`Timer starts when DI(23) switches ON.`

- When DI(23) is ON, after 2.5 seconds, TO(02) is set ON.
- When DI(23) is OFF, TO(02) is also OFF.
- When DI(23) isn’t ON after 2.5 second or more, TO(02) does not change to ON.

Timer usage example: Timing chart



5.4 Logical operators

Operators	Functions	Meaning
NOT, ~	Logical NOT	Reverses the bits.
AND, &	Logical AND	Becomes "1" when both bits are "1".
OR, |	Logical OR	Becomes "1" when either of the bits is "1".
XOR	Exclusive OR	Becomes "1" when both bits are different.
EQV	Logical equivalence operator	Becomes "1" when both bits are equal.
IMP	Logical implication operator	Becomes "0" when the first bit is "1" and the second bit is "0".

5.5 Priority of logic operations

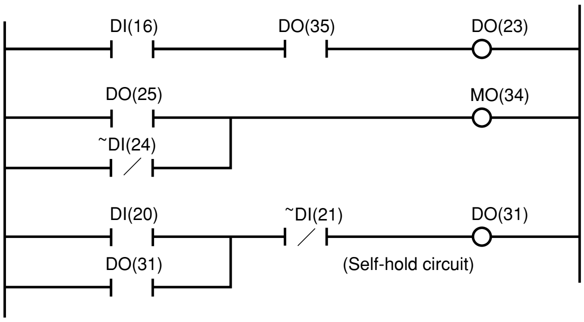
Priority Ranking	Operation Content
1	Expressions in parentheses
2	NOT, ~ (Logical NOT)
3	AND, & (Logical AND)
4	OR, | (Logical OR)
5	XOR (Exclusive OR)
6	EQV (Logical equivalence operator)
7	IMP (Logical implication operator)

Example with a ladder statement substitution

Sample

```
DO(23)=DI(16)&DO(35)
MO(34)=DO(25) | ~DI(24)
DO(31)=(DI(20) | DO(31))&~DI(21)
```

Ladder diagram



MEMO

- "NOT" cannot be used prior to the first parenthesis " (" or on the left of an expression. For example, the following commands cannot be used.
  - •DO(21)=~(DI(30) | DI(32))
  - •~DO(30)=DI(22)&DI(27)
- Numeric values cannot be assigned on the right of an expression.
  - •MO(35)=1
  - •DO(26)=0
- There is no need to define a "HALT" or "HOLD" statement at the end of the program.
- The variables used in sequence programs are shared with robot programs, so be careful not to make improper changes when using the same variables between them.

Chapter 8

Robot Language

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8 ASPEED 8-15
9 ATN / ATN2 8-16
10 AXWGHT 8-17
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13 CHGPRI 8-20
14 CHGWRK 8-21
15 CHR$ 8-22
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17 CONTPLS 8-24
18 CORRECTXY 8-25
19 COS 8-26

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22 CURTRQ 8-29
23 CUT 8-30
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40 EXIT SUB 8-55
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95 PSHMTD 8-149
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Robot language list

The key to reading the following robot language table is explained below.

Name (1)	Description (2)	Online (3)	Type (4)
DIM	Declares array variable	–	Command

(1) Name

Indicates each robot language (command) name.

(2) Description

Explains the function of the robot language.

(3) Online

If "✓" is indicated at this item, online commands can be used.

If "–" is indicated at this item, commands containing operands that cannot partially be executed by online command.

(4) Type

Indicates the robot language type as "Command" or "Function".

When a command is used as both a "Command" and "Function", this is expressed as follows: Command/Function

Name	Description	Online	Type
A			
ABS	Acquires the absolute value of a specified value.	✓	Function
ABSRPOS	Acquires the machine reference value for specified robot axes. (Valid only for axes whose return-to-origin method is set as "mark".)	✓	Function
ACCEL	Specifies/acquires the acceleration coefficient parameter of a specified robot.	✓	Command / Function
ARCHP1	Specifies/acquires the arch distance 1 parameter of a specified robot.	✓	Command / Function
ARCHP2	Specifies/acquires the arch distance 2 parameter of a specified robot.	✓	Command / Function
ARMCND	Acquires the current arm status of a specified robot.	✓	Function
ARMSEL	Specifies/acquires the current "hand system" setting of a specified robot.	✓	Command / Function
ARMTYP	Specifies/acquires the "hand system" setting of a specified robot.	✓	Command / Function
ASPEED	Specifies/acquires the AUTO movement speed of a specified robot.	✓	Command / Function
ATN	Acquires the arctangent of the specified value.	✓	Function
ATN2	Acquires the arctangent of the specified X-Y coordinates.	✓	Function
AXWGHT	Specifies/acquires the axis tip weight parameter of a specified robot.	✓	Command / Function
C			
CALL	Calls a sub-procedure.	–	Command
CHANGE	Switches the hand data of a specified robot.	✓	Command
CHGPRI	Changes the priority ranking of a specified task.	✓	Command
CHGWRK	Switches the work data of a specified robot.	✓	Command
CHR$	Acquires a character with the specified character code.	✓	Function

Name	Description	Online	Type
CLOSE	Close the specified General Ethernet Port.	✓	Command
CONTPLS	Specifies/acquires CONT pulse parameter of specified robot.	✓	Command / Function
CORRECTXY	Acquires the target position corrected for workpiece gripping position misalignment.	✓	Function
COS	Acquires the cosine value of a specified value.	✓	Function
CREWRK	Creates the work data from the offset; difference between 2 point data	✓	Function
CURTQST	Acquires the current torque value ratio of a specified axis to the rated torque.	✓	Function
CURTRQ	Acquires the current torque value of the specified axis of a specified robot.	✓	Function
CUT	Terminates another task currently being executed or temporarily stopped.	✓	Command
D			
DATE$	Acquires the date as a "yy/mm/dd" format character string.	✓	Function
DECEL	Specifies/acquires the deceleration rate parameter of a specified robot.	✓	Command / Function
DEF FN	Defines the functions that can be used by the user.	–	Command
DEGRAD	Converts a specified value to radians (↔RADDEG).	✓	Function
DELAY	Waits for the specified period (units: ms).	–	Command
DI	Acquires the specified DI status.	✓	Function
DIM	Declares the array variable name and the number of elements.	–	Command
DIST	Acquires the distance between 2 specified points.	✓	Function
DO	Outputs a specified value to the DO port or acquires the DO status.	✓	Command / Function
DRIVE	Moves a specified axis of a specified robot to an absolute position.	✓	Command
DRIVEI	Moves a specified axis of a specified robot to a relative position.	✓	Command
E			
END SELECT	Terminates the SELECT CASE statement.	–	Command
END SUB	Terminates the sub-procedure definition.	–	Command
ERR / ERL	Acquires the error code number of an error which has occurred / the line number where an error occurred.	✓	Function
ETHSTS	Acquires the Ethernet port status.	✓	Function
EXIT FOR	Terminates the FOR to NEXT statement loop.	–	Command
EXIT SUB	Terminates the sub-procedure defined by the SUB to END statement.	–	Command
EXIT TASK	Terminates its own task which is in progress.	–	Command
F			
FOR to NEXT	Executes the FOR to NEXT statement repeatedly until a specified value is exceeded.	–	Command
G			
GEPSTS	Acquires the General Ethernet Port status.	✓	Function
GOSUB to RETURN	Jumps to a subroutine with the label specified by GOSUB statement, and executes that subroutine.	–	Command
GOTO	Unconditionally jumps to the line specified by a label.	–	Command
H			
HALT	Stops the program and performs a reset.	–	Command
HALTALL	Stops and resets all programs.	–	Command
HAND	Defines the hand of a specified robot.	✓	Command

Name	Description	Online	Type
HOLD	Temporarily stops the program.	–	Command
HOLDALL	Temporarily stops all programs.	–	Command
I			
IF	Allows control flow to branch according to conditions.	–	Command
INPUT	Assigns a value to a variable specified from the programming box.	✓	Command
INROFST	Specifies/acquires R axis inertia offset for SCARA parameter.	✓	Command / Function
INT	Acquires an integer for a specified value by truncating all decimal fractions.	✓	Function
J			
JTOXY	Converts joint coordinate data to Cartesian coordinate data of a specified robot. (↔XYTOJ)	✓	Function
L			
LEFT$	Extracts a character string comprising a specified number of digits from the left end of a specified character string.	✓	Function
LEFTY	Sets the hand system of a specified robot to the left-handed system.	✓	Command
LEN	Acquires the length (byte count) of a specified character string.	✓	Function
LET	Executes a specified assignment statement.	✓	Command
LO	Outputs a specified value to the LO port to enable/disable axis movement or acquires the LO status.	✓	Command / Function
LOCx	Specifies/acquires point data for a specified axis or shift/work data for a specified element.	✓	Command / Function
LSHIFT	Shifts a value to the left by the specified bit count. (↔RSHIFT)	✓	Function
M			
MCHREF	Acquires the return-to-origin or absolute-search machine reference value for specified robot axes. (Valid only for axes whose return-to-origin method is set as "sensor" or "stroke-end".)	✓	Function
MID$	Extracts a character string of a desired length from a specified character string.	✓	Function
MO	Outputs a specified value to the MO port or acquires the MO status.	✓	Command / Function
MOTOR	Controls the motor power status.	✓	Command
MOVE	Performs absolute movement of all axes of a specified robot.	✓	Command
MOVEI	Performs relative movement of all axes of a specified robot.	✓	Command
MOVET	Performs relative movement of all axes of a specified robot when the tool coordinate is selected.	✓	Command
MTRDUTY	Acquires the motor load factor of the specified axis.	✓	Function
O			
OFFLINE	Sets a specified communication port to the "offline" mode.	✓	Command
ON ERROR GOTO	This command allows the program to jump to the error processing routine specified by the label without stopping the program, or it stops the program and displays the error message.	–	Command
ON to GOSUB	Jumps to a subroutine with labels specified by a GOSUB statement in accordance with the conditions, and executes that subroutine.	–	Command
ON to GOTO	Jumps to label-specified lines in accordance with the conditions.	–	Command
ONLINE	Sets the specified communication port to the "online" mode.	✓	Command
OPEN	Opens the specified General Ethernet Port.	✓	Command

Name	Description	Online	Type
ORD	Acquires the character code of the first character in a specified character string.	✓	Function
ORGORD	Specifies/acquires the axis sequence parameter for performing return-to-origin and an absolute search operation in a specified robot.	✓	Command / Function
ORIGIN	Performs return-to-origin.	✓	Command
OUT	Turns ON the bits of the specified output ports and terminates the command statement.	–	Command
OUTPOS	Specifies/acquires the "OUT position" parameter of a specified robot.	✓	Command / Function
P			
PATH	Specifies the PATH motion path.	–	Command
PATH END	Ends the path setting for PATH motion.	–	Command
PATH SET	Starts the path setting for PATH motion.	–	Command
PATH START	Starts the PATH motion.	–	Command
PDEF	Defines the pallet used to execute pallet movement commands.	✓	Command
PGMTSK	Acquires the task number in which a specified program is registered.	✓	Function
PGN	Acquires the program number from a specified program name.	✓	Function
PMOVE	Executes the pallet movement command of a specified robot.	✓	Command
Pn	Defines points within a program.	✓	Command
PPNT	Creates point data specified by a pallet definition number and pallet position number.	✓	Function
PRINT	Displays a character string at the programming box screen.	–	Command
PSHFRC	Specifies/acquires the "Push force" parameter.	✓	Command / Function
PSHJGSP	Specifies/acquires the push judge speed threshold parameter.	✓	Command / Function
PSHMTD	Specifies/acquires the push method parameter.	✓	Command / Function
PSHRSLT	Acquires the status at the end of the PUSH statement.	✓	Function
PSHSPD	Specifies/acquires the push speed parameter.	✓	Command / Function
PSHTIME	Specifies/acquires the push time parameter.	✓	Command / Function
PUSH	Executes a pushing operation in the axis unit.	✓	Command
R			
RADDEG	Converts a specified value to degrees. (↔DEGRAD)	✓	Function
REFTSK	Acquires the status of the task.	✓	Function
REM	Expresses a comment statement.	–	Command
RESET	Turns the bit of a specified output port OFF.	✓	Command
RESTART	Restarts another task during a temporary stop.	✓	Command
RESUME	Resumes program execution after error recovery processing.	–	Command
RETURN	Returns the processing branching with GOSUB to the next line of GOSUB.	–	Command
RIGHT$	Extracts a character string comprising a specified number of digits from the right end of a specified character string.	✓	Function
RIGHTY	Sets the hand system of a specified robot to the right-handed system.	✓	Command
RSHIFT	Shifts a value to the right by the specified bit count. (↔LSHIFT)	✓	Function

Name	Description	Online	Type
S			
SCRINR	Specifies/acquires R axis inertia for SCARA parameter.	✓	Command / Function
SELECT CASE to END SELECT	Allows control flow to branch according to conditions.	–	Command
SEND	Sends a file.	✓	Command
SERVO	Controls the servo ON/OFF of a specified axis or all axes of a specified robot.	✓	Command
SET	Turns the bit at the specified output port ON.	–	Command
SETGEP	Sets the General Ethernet Port.	✓	Command
SGI	Assigns the value to a specified integer type static variable / acquires the value of a specified integer type static variable.	✓	Command / Function
SGR	Assigns the value to a specified real type static variable / acquires the value of a specified real type static variable.	✓	Command / Function
SHARED	Enables reference with a sub-procedure without transferring a variable.	–	Command
SHIFT	Sets the shift coordinate for a specified robot by using the shift coordinate data specified by a shift variable.	✓	Command
SI	Acquires a specified SI status.	✓	Function
SID	Acquires a specified serial input's double-word information status.	✓	Function
SIN	Acquires the sine value for a specified value.	✓	Function
SIW	Acquires a specified serial input's word information status.	✓	Function
Sn	Defines the shift coordinates within the program.	✓	Command
SO	Outputs a specified value to the SO port or acquires the SO status.	✓	Command / Function
SOD	Outputs a specified serial output's double-word information or acquires the output status.	✓	Command / Function
SOW	Outputs a specified serial output's word information or acquires the output status.	✓	Command / Function
SPEED	Changes the program movement speed of a specified robot.	✓	Command
SQR	Acquires the square root of a specified value.	✓	Function
START	Specifies the task number and priority ranking of a specified program, and starts that program.	✓	Command
STR$	Converts a specified value to a character string (↔VAL).	✓	Function
SUB to END SUB	Defines a sub-procedure.	–	Command
SUSPEND	Temporarily stops another task which is being executed.	–	Command
SWI	Switches the program being executed, then begins execution from the first line.	–	Command
T			
TAN	Acquires the tangent value for a specified value.	✓	Function
TCOUNTER	Outputs count-up values at 1ms intervals starting from the point when the TCOUNTER variable is reset.	✓	Function
TIME$	Acquires the current time as an "hh:mm:ss" format character string.	✓	Function
TIMER	Acquires the current time in seconds, counting from midnight.	✓	Function
TO	Outputs a specified value to the TO port or acquires the TO status.	✓	Command / Function
TOLE	Specifies/acquires the tolerance parameter of a specified robot.	✓	Command / Function
TORQUE	Specifies/acquires the maximum torque command value which can be set for a specified axis of a specified robot.	✓	Command / Function
TSKPGM	Acquires the program number which is registered in a specified task.	✓	Function

Name	Description	Online	Type
V			
VAL	Converts the numeric value of a specified character string to an actual numeric value. (↔STR$)	✓	Function
W			
WAIT	Waits until the conditions of the DI/DO conditional expression are met (with time-out).	–	Command
WAIT ARM	Waits until the axis operation of a specified robot is completed.	–	Command
WEIGHT	Specifies/acquires the tip weight (kg) parameter of a specified robot.	✓	Command / Function
WEIGHTG	Specifies/acquires the tip weight (g) parameter of a specified robot.	✓	Command / Function
WEND	Terminates the command block of the WHILE statement.	–	Command
WHERE	Reads out the current position of the arm of a specified robot in joint coordinates (pulse).	✓	Function
WHILE to WEND	Controls repeated operations.	–	Command
WHRXY	Reads out the current position of the arm of a specified robot as Cartesian coordinates (mm, degrees).	✓	Function
WRKDEF	Defines the work data (Creates the work data of the specified number)	✓	Command
X			
XYTOJ	Converts the point variable Cartesian coordinate data to the joint coordinate data of a specified robot. (↔JTOXY).	✓	Function

1 ABS

Acquires absolute values

Format

```
ABS (expression)
```

Explanation Returns a value specified by an <*expression*> as an absolute value.

Sample	Description
`A=ABS(-362.54)`...........	`The absolute value of -362.54 (=362.54) is assigned to variable A.`

2 ABSRPOS

Acquires the machine reference value (axes: mark method)

Format

```
ABSRPOS [robot number](axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the machine reference value (units: %) of axes.

This function is valid only for axes whose return-to-origin method is set as "Mark", not for "Sensor" or "Stroke-end".

MEMO

At axes where return-to-origin method is set to "mark" method, absolute reset is possible when the machine reference value is in a 44 to 56% range.

Sample	Description
`A=ABSRPOS(4)`	...............The machine reference value for axis 4 of robot 1 is assigned to variable A.

3 ACCEL

Specifies/acquires the acceleration coefficient parameter

Format

```
1. ACCEL [robot number] expression
2. ACCEL [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	1 to 100 (units: %)

Explanation Changes the acceleration coefficient parameter to the <expression> value.
[Format 1] changes all axes of specified robot.
[Format 2] changes the only axis specified by <*axis number*>.

Functions

Format

```
ACCEL [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the acceleration coefficient parameter value of axis.

Sample **Description**

```
A=50
ACCEL A                .........The acceleration coefficient of all axes of robot 1 becomes
ACCEL(3)=100                    50%.
                       .........Only axis 3 of robot 1 becomes 100%.
'CYCLE WITH INCREASING ACCELERATION
FOR A=10 TO 100 STEP 10 .........The acceleration coefficient parameter is increased from 10%
                                 to 100% in 10% increments.
     ACCEL A
     MOVE P,P0
     MOVE P,P1
NEXT A
A=ACCEL(3)             .........The acceleration coefficient parameter of axis 3 of robot 1
HALT "END TEST"                 is assigned to variable A.
```

4 ARCHP1 / ARCHP2

Specifies/acquires the arch distance parameter

Format

```
1. ARCHP1[robot number] expression
2. ARCHP1[robot number] (axis number) = expression
```

Format

```
1. ARCHP2[robot number] expression
2. ARCHP2[robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	0 to 99999999 (Unit: pulse)

Explanation ARCHP1 corresponds to the arch distance 1 parameter; ARCHP2 corresponds to the arch distance 2 parameter, respectively.
Changes the parameter's arch distance to the value indicated in the <*expression*>.
[Format 1] changes all axes of specified robot.
[Format 2] changes the only axis specified by <*axis number*> to the value indicated in the <*expression*>.

Functions

Format

```
ARCHP1 [robot number] (axis number)
```

Format

```
ARCHP2 [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation ARCHP1 corresponds to the arch distance 1 parameter; ARCHP2 corresponds to the arch distance 2 parameter, respectively.
Acquires the arch distance parameter value of the axis specified at <*axis number*>.

ARCHP1 / ARCHP2

Sample	Description
ARCHP1(3)=10	………The arch distance 1 parameter value of the 3rd axis of robot 1 changes to 10 pulses.
ARCHP2(3)=20	………The arch distance 2 parameter value of the 3rd axis of robot 1 changes to 20 pulses
.	
.	
.	
FOR B=1 TO 4	
SAV(B-1)=ARCHP1(B)	
NEXT	………The arch distance parameters ARCHP1(1) to (4) are assigned to array variables SAV(0) to (3).

5 ARMCND

Acquires the current arm status

Format

```
ARMCND [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function acquires the current arm status of the SCARA robot.

The robot to acquire an arm status is specified by the <*robot number*>.

The arm status is "1" for a right-handed system and "2" for a left-handed system.

This function is enabled only when a SCARA robot is used.

Sample **Description**

```
A=ARMCND             .........The current arm status of robot 1 is assigned to variable A.
IF A=1 THEN          .........Right-handed system status.
 MOVE P, P100, Z=0
ELSE                 .........Left-handed system status.
 MOVE P, P200, Z=0
ENDIF
```

6 ARMSEL

Sets/acquires the current hand system selection

Format

`ARMSEL [robot number] expression`

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	1: right hand system, 2: left hand system

Explanation This function sets the current hand system selection of the SCARA robot. A robot to set a hand system is specified by the <*robot number*>.
This function is enabled only when a SCARA robot is used.

Sample **Description**

```
ARMSEL[2] 2     .........Sets the left-handed system for the hand system selection of
                         the robot 2.
```

Functions

Format

`ARMSEL [robot number]`

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function acquires the hand system currently selected for the SCARA robot. The robot to acquire a hand system is specified by the <*robot number*>.
The arm type is "1" for a right-handed system, and "2" for a left-handed system. This function is enabled only when a SCARA robot is used.

Sample **Description**

```
A=ARMSEL          .........The current hand system selection of robot 1 is assigned to the
                           variable A.
IF A=1 THEN       .........The hand system selection is a right-handed system.
 MOVE P,P100,Z=0
ELSE              .........The hand system selection is a left-handed system.
 MOVE P,P200,Z=0
ENDIF
```

7 ARMTYP

Sets/acquires the hand system selection during program reset

Format

```
ARMTYP [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	1: right hand system, 2: left hand system

Explanation This function sets the hand system at program reset of the SCARA robot.
A robot to set a hand system selection is specified by the <*robot number*>.
This function is enabled only when a SCARA robot is used.

Sample **Description**

```
ARMTYP[2] 2    .........Sets the left-handed system for the hand system of the robot 2.
```

Functions

Format

```
ARMTYP [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function provides the hand system at program reset of the SCARA robot.
The robot to acquire a hand system is specified by the <*robot number*>.
The arm type is "1" for a right-handed system, and "2" for a left-handed system. This function is enabled only when a SCARA robot is used.

Sample **Description**

```
A=ARMTYP          .........The arm type value of robot 1 is assigned to the variable A.
IF A=1 THEN       .........The arm type is a right-handed system.
 MOVE P,P100,Z=0
ELSE              .........The arm type is a left-handed system.
 MOVE P,P200,Z=0
ENDIF
HALTALL           .........Program reset
```

ASPEED

Sets/acquires the AUTO movement speed of robot

Format

```
ASPEED [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	1 to 100 (units: %)

Explanation Changes the automatic movement speed to the <expression> value.
This speed change applies to all axes.

The operation speed is determined by the product of the automatic movement speed (specified by programming box operation and by the ASPEED command), and the program movement speed (specified by SPEED command, etc.).

Operation speed = automatic movement speed x program movement speed.

Example:

Automatic movement speed: 80%
Program movement speed: 50%
Movement speed = 40% (80% × 50%)

NOTE

This command only defines the maximum speed, and does not guarantee the movement at the specified speed.

- Automatic movement speed: Specified by programming box operation or by the ASPEED command.
- Program movement speed: Specified by SPEED commands or MOVE, DRIVE speed settings.

Functions

Format

```
ASPEED [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the automatic movement speed value of robot.

Sample **Description**

```
SPEED 70
ASPEED 100
MOVE P,P0      .........Movement from the current position to P0 occurs
                        at 70% speed (= 100 * 70) of the robot 1.
ASPEED 50
MOVE P,P1      .........Movement from the current position to P1 occurs
                        at 35% speed (= 50 * 70) of the robot 1.
MOVE P,P2,S=10 .........Movement from the current position to P2 occurs
                        at 5% speed (= 50 * 10) of the robot 1.
HALT
```

Related commands	SPEED

9 ATN / ATN2

Acquires the arctangent of the specified value

Format

```
ATN (expression)
```

Format

```
ATN2 (expression 1, expression 2)
```

Explanation ATN: Acquires the arctangent values of the specified <*expression*> values. The acquired values are radians within the following range: - π / 2 to + π / 2

ATN2: Acquires the arctangent values of the specified <*expression 1*> and <*expression 2*> X-Y coordinates. The acquired values are radians within the following range: - π to + π

Sample	Description
`A(0)=A*ATN(Y/X)`	.........The product of the expression (Y / X) arctangent value and variable A is assigned to array A (0).
`A(0)=ATN(0.5)`	.........The 0.5 arctangent value is assigned to array A (0).
`A(0)=ATN2(B,C)-D`	.........The difference between the X-Y coordinates (B,C) arctangent value and variable D is assigned to array A (0).
`A(1)=RADDEG(ATN2(B,C))`	.........The X-Y coordinates (B,C) arctangent value is converted to degrees, and is then assigned to array A (1).

Related commands	COS, DEGRAD, RADDEG, SIN, TAN

10 AXWGHT

Sets/acquires the axis tip weight

Format

```
AXWGHT [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	Varies according to the specified robot.

Explanation Changes the axis tip weight parameter for the specified axis to the <*expression*> value.
This statement is valid in systems with "MULTI" axes and auxiliary axes (the robot type and auxiliary axes are factory set prior to shipment).

Functions

Format

```
AXWGHT [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the axis tip weight parameter value for the specified axis.
This statement is valid in systems with "MULTI" axes and auxiliary axes.

Sample **Description**

```
A=5
B=0
C=AXWGHT(1)  .........Axis tip weight value of the axis 1 of the robot 1 is acquired
                     (the current value is saved to variable C).

AXWGHT(1)=A
DRIVE(1,P0)
AXWGHT(1)=B
DRIVE(1,P1)
AXWGHT(1)=C  .........The axis tip weight value of the axis 1 of the robot 1 is set again.
HALT
```

Related commands	WEIGHT, WEIGHTG

11 CALL

Calls a sub-procedure

Format

CALL *label* *(actual argument , actual argument…)*

Explanation This statement calls up sub-procedures defined by the SUB to END SUB statements.

The <*label*> specifies the same name as that defined by the SUB statement.

1. When a constant or expression is specified as an actual argument, its value is passed on to the sub-procedure.
2. When a variable or array element is specified as an actual argument, its value is passed on to the sub-procedure. It will be passed on as a reference if "REF" is added at the head of the actual argument.
3. When an entire array (array name followed by parentheses) is specified as an actual argument, it is passed along as a reference.

NOTE

- When a value is passed on to a sub-procedure, the original value of the actual argument will not be changed even if it is changed in the sub-procedure.
- When a reference is passed on to a sub-procedure, the original value of the actual argument will also be changed if it is changed in the sub-procedure.
- For details , refer to Chapter 3 "8 Value Pass-Along & Reference Pass-Along".

MEMO

- CALL statements can be used up to 120 times in succession. Note that this number is reduced if commands which use stacks such as an FOR or GOSUB statement are used, or depending on the use status of identifiers.
- Always use the END SUB or EXT SUB statement to end a sub-procedure which has been called with the CALL statement. If another statement such as GOTO is used to jump out of the sub- routine, a "5.212: Stack overflow" error, etc., may occur.

Sample 1

```
X%=4
Y%=5
CALL *COMPARE ( REF X%, REF Y% )
HALT
'SUB ROUTINE:  COMPARE
SUB *COMPARE ( A%,  B% )
      IF A% < B% THEN
             TEMP%=A%
             A%=B%
             B%=TEMP%
      ENDIF
END SUB
```

Sample 2

```
I = 1
CALL  *TEST( I )
HALT
'SUB ROUTINE:  TEST
SUB *TEST
      X = X + 1
      IF X < 15 THEN
             CALL *TEST( X )
      ENDIF
END SUB
```

Reference For description of sample program, refer to "132 SUB to END SUB" in this Chapter.

Related commands	SUB, END SUB, EXIT SUB, SHARED

12 CHANGE

Switches the hand data

Format

```
CHANGE  [robot number]    Hn
                          OFF
```

Notation	Value	Range
	Robot Number	1 to 4 (If not input, robot 1 is specified.)
n	Hand Number	0 to 31

Explanation CHANGE is used to switch the robot hand data.
If OFF is specified, the hand setting is not enabled.

Before switching the hand data, the hands must be defined at the HAND statement, the programming box, or the support software.
If the hand data with another robot setting is specified, "6.258: Illegal robot no" error occurs.

Reference "HAND"

Sample **Description**

```
HAND H1=      0       150.000 0.000
HAND H2=      -5000   20.0000 0.000
P1=150.000 300.000 0.000 0.000 0.000 0.000
CHANGE H2     .........Changes the hand data of the robot 1 to hand 2.
MOVE P,P1     .........Moves the hand 2 tip of the robot 1 to P1 (1).
CHANGE H1     .........Changes to hand 1.
MOVE P,P1     .........Moves the hand 1 tip to P1 (2).
HALT
```

13 CHGPRI

Changes the priority ranking of task

Format

`CHGPRI`	`Tn`
	`<program name>`
	`PGm`
		`,p`

Notation	Value	Range
m	*Program Number*	0 to 100
n	Task Number	1 to 16
p	Task Priority Ranking	1 to 64

Explanation Changes the priority ranking of task "n" to "p".

The smaller the priority number, the higher the priority (high priority: 1 to low priority: 64).

When a READY status occurs at a task with higher priority, all tasks with lower priority also remain in READY status.

Sample **Description**

```
START <SUB_PGM>,T2,33                         .........Main Program
*ST:
       MOVE P,P0,P1
       IF DI(20) = 1 THEN                     .........When DI (20) is ON,
              CHGPRI T2,32                    .........The priority of Task 2 is No. 32
       ELSE                                   .........When DI (20) is OFF,
              CHGPRI T2,33                    .........The priority of Task 2 is No. 33
       ENDIF
GOTO *ST
HALTALL
                                              .........Program name: SUB_PGM (Sub task)
'SUBTASK ROUTINE                              .........From this line, Task 2
*SUBTASK:
       IF LOC3(WHERE) > 10000 THEN
              DO(20) = 1
              GOTO *SUBTASK
       ENDIF
       DO(20) = 0
GOTO *SUBTASK                                 .........Down to this line, Task 2 processing
EXIT TASK                                     .........Ends Task 2 (own task: SUB_PGM)
```

Related commands	CUT, EXIT TASK, RESTART, SUSPEND, START

14 CHGWRK

Switches the work data

Format

```
CHGWRK [robot number]    Wn
                         OFF
```

Notation	Value	Range
	Robot Number	1 to 4 (If not input, robot 1 is specified.)
n	Work Number	0 to 39

Explanation CHGWRK is used to switch the work data of robot.
If OFF is specified, the work setting is not enabled.

Before switching the work data, always define the work data using the WRKDEF statement, the programming box, or the support software.

Reference "WRKDEF", User's Manual "Work definitions"

Sample **Description**

```
CHANGE H1     .........Changes the hand data of the robot 1 to hand 1.
MOVE P,P1     .........Moves the hand 1 tip of the robot 1 to P1.
WRKDEF W1 = 115.000  -50.000  0.000  30.000
CHGWRK W1     .........Changes the work data of the robot 1 to work 1.
MOVE P,P2     .........Moves the work 1 tip of the robot 1 to P2.
HALT
```

Related commands	CREWRK, WRKDEF

15 CHR$

Acquires a character with the specified character code

Format

```
CHR$ expression
```

Value	Range
Expression	0 to 255

Explanation Acquires a character with the specified character code. An error occurs if the <*expression*> value is outside the 0 to 255 range.

Sample	Description
`A$=CHR$(65)`	`........."A" is assigned to A$.`

Related commands	ORD

16 CLOSE

Closes the specified General Ethernet Port

Format

```
CLOSE GPm
```

Notation	Value	Range
m	General Ethernet Port number	0 to 7

Explanation Closes the communication port of the specified General Ethernet Port.

Sample	Description
`OPEN GP1`	Opens the General Ethernet Port 1.
`SEND "123" TO GP1`	Sends the character strings "123" from the General Ethernet Port 1.
`SEND GP1 TO A$`	Receives the data from the General Ethernet Port 1 and Saves the received data in the variable A$.
`CLOSE GP1`	Closes the General Ethernet Port 1.

Related commands OPEN, SEND, SETGEP, GEPSTS

17 CONTPLS

Specifies/acquires CONT pulse parameter of specified robot.

Format

```
1.CONTPLS [robot number] expression
2.CONTPLS [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (If not input, all axes are specified.)
Expression	0 to 99999999 (unit: pulse)

Explanation Changes the CONT pulse parameter value of axis to the value indicated in the <*expression*>.

[Format 1] changes all axes of specified robot.

[Format 2] changes only the axis specified by <*axis number*>.

Reference "MOVE" CONT setting

Functions

Format

```
CONTPLS [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (If not input, all axes are specified.)

Explanation Acquires the CONT pulse parameter value of specified axis.

Sample 1	Description
`CONTPLS 20000`	......Changes the CONTPLS parameter for all axes of Robot 1 to 20000

Sample 2	Description
`CONTPLS (3) = 20000`	......Changes the CONTPLS parameter for 3rd axis of Robot 1 to 20000

Sample 3	Description
`A% = CONTPLS(3)`	......Acquires the value of the CONTPLS parameter for 3rd axis of robot 1, Assigns it to integer variable A%

18 CORRECTXY

Acquires the target position corrected for workpiece gripping position misalignment.

Format

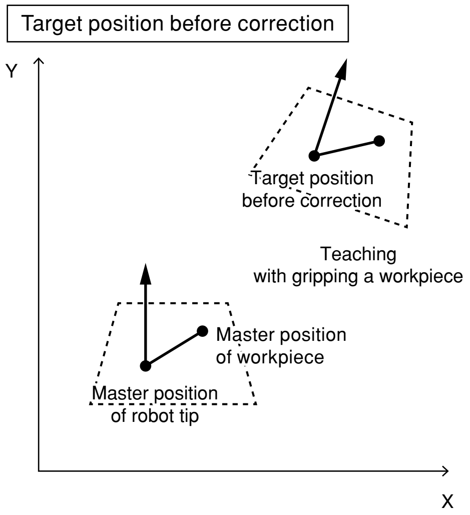
```
CORRECTXY [robot number] (master position of robot tip, master position
of workpiece, position of workpiece, target position before correction)
```

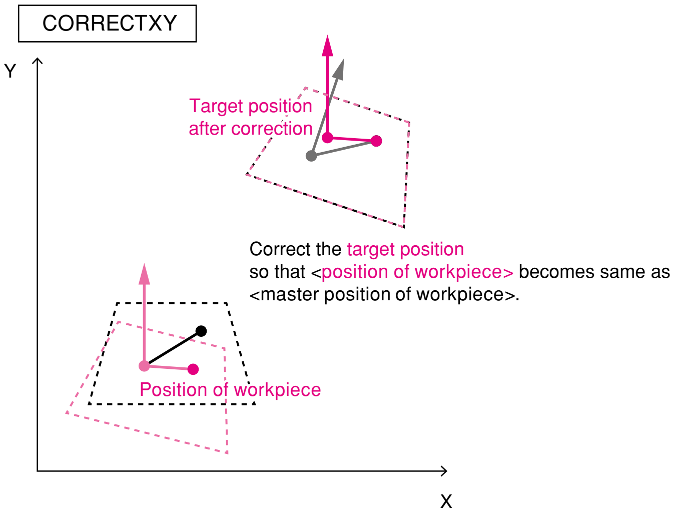
Value	Range/Contents
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Master position of robot tip	point data (unit: mm)
Master position of workpiece	point data (unit: mm)
Position of workpiece	point data when robot tip is at the master position of robot tip (unit: mm)
Target position before correction	point data (unit: mm)

Explanation Acquires the corrected target position of gripping position misalignment on XY coordinate plane.

=> For the target position, XYR-axes of <Target position before correction> are corrected and acquired. The axes position except XYR-axes remains the value of <Target position before correction>.

- Teach <Master position of robot tip>, <Master position of workpiece> and <Target position before correction> with gripping a workpiece beforehand.
- This command is available as online command.


Target position before correction
Y
Target position
before correction
Teaching
with gripping a workpiece
Master position
of workpiece
Master position
of robot tip
X


CORRECTXY
Y
Target position
after correction
Correct the target position
so that <position of workpiece> becomes same as
<master position of workpiece>.
Position of workpiece
X

CAUTION

- **All of usable point data are "mm" unit.**
- **This command is available only for the robot containing each XYR-axis. If this command is used for other robots, “2.354 Illegal coordinates for pos. correction" alarm will occur.**

Sample	Description

```
P1 = CORRECTXY[1](P2,P3,P4,P5)
                     ............The corrected target position is acquired and assigned to P1.
                                 Robot 1, Master position of robot tip P2, Master position of
                                 workpiece P3, Position of workpiece P4, Target position before
                                 correction P5.
```

19 COS

Acquires the cosine value of a specified value

Format

```
COS expression
```

Value	Contents
Expression	Angle (units: radians)

Explanation Acquires a cosine value for the <*expression*> value.

Sample	Description
`A(0)=B*COS(C)`	………The product of the C variable's cosine value and variable B is assigned to array A (0).
`A(1)=COS(DEGRAD(20))`	………The 20.0° cosine value is assigned to array A (1).

Related commands	ATN, DEGRAD, RADDEG, SIN, TAN

20 CREWRK

Creates the work data from the offset; difference between 2 point data

Format

```
CREWRK [robot number] (point of difference, standard point)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Point of Difference	point in Cartesian coordinate system
Standard Point	point in Cartesian coordinate system (If not input, the current position is specified.)

Explanation The work data is made of the offset data; the differential value in the coordinates between the standard point and one of difference.

The current position will be treated as the standard point when it is omitted.

An error occurs unless both the standard point and one of difference are Cartesian coordinate system.

Reference "WRKDEF", User's Manual "Work definitions"

MEMO

If "pulse" is specified as the unit for the point of difference / standard, "6.205: Coordinate type error" may occur.

Sample	Description
`CHANGE H1`	.........Changes the hand data of the robot 1 to hand 1.
`MOVE P,P1`	.........Moves the hand 1 tip of the robot 1 to P1.
`WRKDEF W1= CREWRK (P3)`	.........Defines work 1; the difference between the current position and P3 as the offset.
`CHGWRK W1`	.........Changes the work data of the robot 1 to work 1.
`MOVE P,P2`	.........Moves the work 1 tip of the robot 1 to P2.
`HALT`	

Related commands	CHGWRK, WRKDEF

21 CURTQST

Acquires the ratio of the current torque (current) value of axis against the rated torque (current) value

Format

```
CURTQST [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the percentage (-1000 to 1000 [%]) of the current torque value against the rated torque value of axis.

Plus/minus signs indicate the direction.

Sample	Description
`A = CURTQST(3)`	………The ratio of the current torque (current) value against the rated torque (current)value of the axis 3 of robot 1 is assigned to variable A.

22

CURTRQ

Acquires the ratio of the current torque (current) value of axis against the maximum torque (current) value

Format

```
CURTRQ [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the percentage (-100 to 100 [%]) of the current torque value against the maximum torque command value of axis .
Plus/minus signs indicate the direction.

Sample	Description
`A = CURTRQ(3)`	.........The ratio of the current torque (current) value against the maximum torque (current)value of the axis 3 of robot 1 is assigned to variable A.

23

CUT

Terminates another task which is currently being executed

Format

`CUT`	`Tn`
	`<program name>`
	`PGm`

Notation	Value	Range
m	Program Number	0 to 100
n	Task number	1 to 16

Explanation Terminates another task which is currently being executed or which is temporarily stopped.
A task can be specified by the name or the number of a program in execution.
This statement cannot terminate its own task.

MEMO

If a task (program) not active is specified for the execution, an error occurs.

Sample	Description

```
'TASK1 ROUTINE                           .........Task 1
*ST:
        MO(20) = 0
        START <SUB_PGM>,T2               .........Registers SUB_PGM program in Task No. 2
                                                  and starts it.
        MOVE P,P0
        MOVE P,P1
        WAIT MO(20) = 1
        CUT T2                           .........Forced termination of Task 2 in running.
GOTO *ST
HALTALL

'TASK2 ROUTINE                           .........Task 2(Program name: SUB_PGM)
*SUBTASK2:
        P100=JTOXY(WHERE)
        IF LOC3(P100) >= 100.0 THEN
                MO(20) = 1
        ELSE
                DELAY 100
        ENDIF
GOTO *SUBTASK2
EXIT TASK                                .........Ends Task 2 (own task: SUB_PGM)
```

Related commands	EXIT TASK, RESTART, START, SUSPEND

24

DATE$

Acquires the date

Format

```
DATE$
```

Explanation Acquires the date as a "yyyy/mm/dd" format character string.
"yyyy" indicates the year, "mm" indicates the month, and "dd" indicates the day.
Date setting is performed from an operation terminal such as a programming box.

Sample	Description
`A$=DATE$`	………Assigns the date into A as a string in yyyy / mm / dd format.
`PRINT DATE$`	………Displays dates in yyyy / mm / dd format.
`HALT`	

Related commands	TIME$

25 DECEL

Specifies/acquires the deceleration ratio parameter

Format

```
1. DECEL [robot number] expression
2. DECEL [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	1 to 100 (units: %)

Explanation Changes the deceleration ratio parameter of axis to the <*expression*> value.
In format 1, the change occurs at all axes of a specified robot.
In format 2, the change occurs at the axis specified in <*axis number*>.

MEMO

The acceleration parameter can be changed by using the ACCEL statement.

Functions

Format

```
DECEL [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the deceleration ratio parameter value of axis.

Sample **Description**

```
A =50
DECEL A          .........Specifies 50 in the deceleration rate parameter for all axes of
                          robot 1.
DECEL(3)=100     .........Specifies 100 as the deceleration rate parameter for the axis 3 of
                          robot 1.

'CYCLE WITH INCREASING DECELERATION
FOR A =10 TO 100 STEP 10
  DECEL A        .........Specifies the variable A value in the deceleration rate parameter
                          for all axes of robot 1.
  MOVE P ,P0
  MOVE P ,P1
NEXT A
A=DECEL(3)       .........The deceleration rate parameter for the axis 3 of robot 1 is
                          assigned to variable A.
HALT "END TEST"
```

26

DEF FN

Defines functions which can be used by the user

Format

```
DEF FN name (dummy argument, dummy argument…)=function definition expression
```

Value	Range / Meaning
name	Function name. Max. of 16 characters including "FN".
Dummy Argument	Numeric or character string variable

Explanation Defines the functions which can be used by the user. Defined functions are called in the FN <*name*> (variable) format.

MEMO

- The <*dummy argument*> names are the same as the variable names used in the <*function definition* <*expression*>. The names of these variables are valid only when the <*function definition expression*> is evaluated. There may be other variables with the same name in the program.
- When calling a function that uses a <*dummy argument*>, specify the constant, variable, or expression type which is the same as the <*dummy argument*> type. The <*dummy argument*> can be omitted. If <*dummy arguments*> are the same type, the difference of variable names does not affect.
- If a variable used in the <*function definition expression*> is not included in the <*dummy argument*> list, the current value of that particular variable is used for the calculation.
- A space must be entered between "DEF" and "FN". If no space is entered, DEFFN will be handled as a variable.
- The DEF FN statement cannot be used in sub-procedures.
- Definition by the DEF FN statement must be declared before statements which use functions.

Sample **Description**

```
DEF FNPAI=3.141592
DEF FNASIN(X)=ATN(X/SQR(-X^2+1))
      .            ………Both the <dummy argument> and <function definition expression>
      .               use "X".
      .
A=FNASIN(B)*10     ………"X" is not required for calling.
```

27 DEGRAD

Angle conversion (degree → radian)

Format

```
DEGRAD (expression)
```

Value	Contents
Expression	Angle (units: degrees)

Explanation The <*expression*> value is converted to radians.

MEMO

To convert radians to degrees, use RADDEG.

Sample	Description
`A=COS(DEGRAD(30))`	.........A cosine value which is converted 30° to radians is assigned to variable A.

Related commands ATN, COS, RADDEG, SIN, TAN

28

DELAY

Program execution waits for a specified period of time

Format

```
DELAY expression
```

Value	Range
Expression	0 to 3600000 (units: ms)

Explanation A "program wait" status is established for the period of time specified by the <*expression*>.
The minimum wait period is 1ms.

Sample	Description
`DELAY 3500`	………Waits 3,500 ms (3.5 seconds).

```
A-50
DELAY A*10            .........Waits 500 ms (0,5 seconds).
```

29 DI

Acquires the input status from the parallel port

Format

```
1. LET expression = DIm(b,...,b)
2. LET expression = DI(mb,...,mb)
3. LET expression = IO Name
```

Notation	Value	Range / Meaning
m	Port Number	0 to 7, 10 to 17, 20 to 27
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	IO Name	Users can name specific bits of DI and DO as they desire. Note that it can be added and edited on the support software only (not with a programming box)

Explanation Indicates the parallel input signal status.
"0" will be entered if no input port exists.

Sample	Description
`A%=DI2()`	........The input status from DI (27) to DI (20) is assigned to variable A%.
`A%=DI5(7,4,0)`	........The DI (57), DI (54), DI (50) input status is assigned to variable A% (when all the above signals are "1" (ON), A% = 7).
`A%=DI(37,25,20)`	........The DI (37), DI (25), DI (20) input status is assigned to variable A% (when all the above signals except DI (20) are "1" (ON), A% = 6).
`A%=END_SENSOR`	........The IO Name "END_SENSOR" input status is assigned to variable A% (when the "END_SENSOR" is "1" (ON), A% = 1).

Reference Chapter 3 "9.3 Parallel input variable"

30

DIM

Declares array variable

Format

```
DIM array definition , array definition,…
```

Format

```
name    %    (constant , constant, constant)
        !
        $
```

Notation	Value	Range
Constant	Array subscript	0 to 32,767 (positive integer)

Explanation Declares the name and length (number of elements) of an array variable. A maximum of 3 dimensions may be used for the array subscripts. Multiple arrays can be declared in a single line by using comma (,) breakpoints to separate the arrays.

MEMO

- The total number of array elements is <constant> + 1.
- A "9.300: Memory full" error may occur depending on the size of each dimension defined in an array.

Sample	Description
`DIM A%(10)`	………Defines a integer array variable A% (0) to A% (10). (Number of elements: 11).
`DIM B(2,3,4)`	………Defines a real array variable B (0, 0, 0) to B (2, 3, 4). (Number of elements: 60).
`DIM C%(2,2),D!(10)`	………Defines an integer array C% (0,0) to C% (2,2) and a real array D! (0) to D! (10).

31 DIST

Acquires the distance between 2 specified points

Format

```
DIST (point expression 1, point expression 2)
```

Value	Meaning
Point Expression 1	Cartesian coordinate system point
Point Expression 2	Cartesian coordinate system point

Explanation Acquires the distance (units: mm) between the 2 points (X,Y,Z) specified by <*point expression 1*> and <*point expression 2*>. An error occurs if the 2 points specified by each <point expression> do not have Cartesian coordinates.

Sample	Description
`A=DIST(P0,P1)`	.........The distance between P0 and P1 is assigned to variable A.

32 DO

Outputs to parallel port or acquires the output status

Format

```
1. LET DOm(b,...,b) = expression
2. LET DO(mb,...,mb) = expression
3. LET IO Name = expression
```

Notation	Value	Range / Meaning
m	Port Number	0 to 7, 10 to 17, 20 to 27
b	Bit Definition (*1)	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)
	IO Name	Users can name specific bits of DI and DO as they desire. Note that it can be added and edited on the support software only (not with a programming box)

Explanation Outputs the specified value to the DO port.
No output will occur if a nonexistent DO port is specified.

Reference (*1) Chapter 3 "10 Bit Settings"

CAUTION

Outputs to DO0() and DO1() are not possible. These ports are for reference only.

Sample	Description
`DO2() = &B10111000`	........DO (27, 25, 24, 23) are turned ON, and DO (26, 22, 21, 20) are turned OFF.
`DO2(6,5,1) = &B010`	........DO (25) are turned ON, and DO (26, 21) are turned OFF.
`DO3() = 15`	........DO (33, 32, 31, 30) are turned ON, and DO (37, 36, 35, 34) are turned OFF.
`DO(37,35,27,20) = A`	........The contents of the 4 lower bits acquired when variable A is converted to an integer are output to DO (37, 35, 27, 20) respectively.
`CHUCK = 1`	........IO name "CHUCK" is turned ON ("1" is output).

DO

Functions

Format

```
LET expression = DOm (b,...,b)
LET expression = DO (mb,...,mb)
LET expression = IO Name
```

Notation	Value	Range / Meaning
m	Port Number	0 to 7, 10 to 17, 20 to 27
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)
	IO Name	Users can name specific bits of DI and DO as they desire. Note that it can be added and edited on the support software only (not with a programming box)

Explanation References the parallel port signal status.

Sample	Description
`A% = DO2()`	………Output status of DO(27) to DO(20) is assigned to variable A%.
`A% = DO0(6, 5, 1)`	………Output status of DO(06), DO(05) and DO(01) is assigned to variable A%.(If all above signals are 1(ON), then A%=7.)
`A% = DO(37,35,27,10)`	………Output status of D0(37), DO(35) , DO(27) and D0(10) is assigned to variable A%. (If all above signals except D0(27) are 1 (ON), then A%=13.)
`A% = CHUCK`	………Output status of IO name "CHUCK" is assigned to variable A%. (When "CHUCK" is ON, then A% =1.)

Related commands	RESET, SET

33 DRIVE

Executes absolute movement of specified axes

Format

```
DRIVE [robot number](axis number, expression),(axis number, expression)...,
option, option ...
```

Value	Range / Meaning
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	Motor position (mm, degrees, pulses) or point expression

Explanation Executes absolute movement command for the specified axis
This command is also used in the same way for the auxiliary axes.

• Movement type	: PTP movement of specified axis.
• Point setting method	: Direct numeric value input, point definition.
• Options	: Relative Speed setting, absolute Speed setting, STOPON conditions setting, CONTON conditions setting, CONT setting, XY setting.

DRIVE

Movement type

● PTP (Point to Point) movement of specified axis:

PTP movement begins after positioning of all axes specified at <*axis number*> is complete (within the tolerance range), and the command terminates when the specified axes enter the OUT position range. When two or more axes are specified, they will reach their target positions simultaneously.

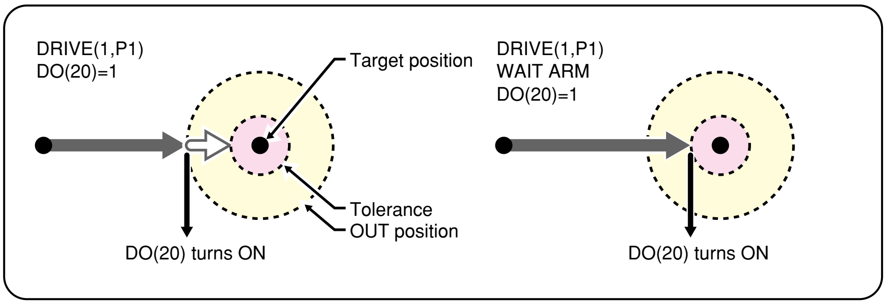
If the next command following the DRIVE command is an executable command such as a signal output command, that next command will start when the movement axis enters the OUT position range. In other words, that next command starts before the axis arrives within the target position tolerance range.

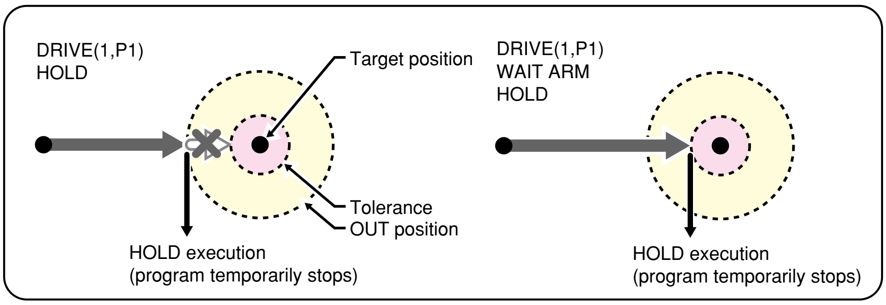
Example:

Signal output (DO, etc.)	Signal is output when axis enters within OUT position range.
DELAY	DELAY command is executed and standby starts, when axis enters the OUT position range.
HALT	Program stops and is reset when axis enters the OUT position range. Therefore, axis movement also stops.
HALTALL	All programs in execution stop when axis enters the OUT position range, task 1 is reset, and other tasks terminate. Therefore, the movement also stops.
HOLD	Program temporarily stops when axis enters the OUT position range. Therefore, axis movement also stops.
HOLDALL	All programs in execution temporarily stop when axis enters the OUT position range. Therefore, the movement also stops.
WAIT	WAIT command is executed when axis enters the OUT position range.

The WAIT ARM statement is used to execute the next command after the axis enters the tolerance range.

DRIVE command


DRIVE(1,P1)
DO(20)=1
Target position
Tolerance
OUT position
DO(20) turns ON
DRIVE(1,P1)
WAIT ARM
DO(20)=1
DO(20) turns ON


DRIVE(1,P1)
HOLD
Target position
Tolerance
OUT position
HOLD execution
(program temporarily stops)
DRIVE(1,P1)
WAIT ARM
HOLD
HOLD execution
(program temporarily stops)

Sample	Description
`DRIVE(1,P0)`	........Axis 1 of robot 1 moves from its current position to the position specified by P0.

DRIVE

Point data setting types

- **Direct numeric value input**

The target position is specified directly in <*expression*>.

If the numeric value is an integer, this is interpreted as "pulse" units. If the numeric value is a real number, this is interpreted as "mm/degrees" units, and each axis will move from the 0-pulse position to a pulse-converted position.

However, when using the optional XY setting, movement occurs from the Cartesian coordinate origin position.

Sample	Description
`DRIVE(1,10000)`	.........Axis 1 of robot 1 moves from its current position to the 10000 pulses position.
`DRIVE[2](2,90.00)`	.........Axis 2 of robot 2 moves from its current position to a position which is 90° in the plus-direction from the 0-pulse position.

- **Point definition**

Point data is specified in <*expressions*>. The axis data specified by the <*axis number*> is used. If the point expression is in "mm/degrees" units, movement for each axis occurs from the 0-pulse position to the pulse-converted position. However, when using the optional XY setting, movement occurs from the Cartesian coordinate origin position.

NOTE

If point data is specified with both integers and real numbers in the same statement, all values are handled in "mm/degrees" units.

Sample	Description
`DRIVE(1,P1)`	.........Axis 1 of robot 1 moves from its current position to the position specified by P1.
`DRIVE(4,P90)`	.........Axis 4 of robot 1 moves from its current position to the position specified by P90 (deg.) relative to the 0 pulse position. (When axis 4 is a rotating axis.)

DRIVE

Option types

- **Relative speed setting**
- **Absolute Speed setting**
- **STOPON conditions setting**
- **CONTON conditions setting**
- **CONT setting**

Reference "MOVE" statement

● XY setting

Format

```
XY
```

Explanation Moves multiple specified axes to a position specified by Cartesian coordinates.

All the specified axes arrive at the target position at the same time.

If all axes which can be moved by MOVE statement have been specified, operation is identical to that which occurs when using MOVE statement. The following restrictions apply to this command:

1. Axes specified by <*axis number*> must include the axis 1 and 2.
2. This command can be specified at SCARA robots and Cartesian robots with X and Y- axes.
3. Point settings must be in "mm" or "deg." units (real number setting).

Sample **Description**

```
DRIVE(1,P100),(2,P100),(4,P100),XY
                 .........The axis 1, 2 and 4 of robot 1 move from their current positions to
                     the Cartesian coordinates position specified by P100.
```

34

DRIVEI

Moves the specified robot axes in a relative manner

Format

```
DRIVEI [robot number](axis number, expression),
(axis number, expression)..., option, option
```

Value	Range / Meaning
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	Target position (mm, deg., pulses) or point expression

Explanation Executes relative movement, including the auxiliary axes.

• Movement type (*)	: PTP movement of a specified axis
• Point data setting (*)	: Direct coordinate data input, point definition
• Options (*)	: Relative Speed setting, absolute Speed setting, STOPON conditions setting, CONTON conditions setting, CONT setting,

Reference "DRIVE" "MOVE" statement

(To use Sample program, replace "DRIVE" or "MOVE" in Sample to "DRIVEI".

MEMO

When DRIVEI motion to the original target position is interrupted and then restarted, the target position for the resumed movement can be selected as the "MOVEI/DRIVEI start position" in the controller's parameters.

Reference RCX3 user's manual

1) KEEP (default)...Continues the previous (before interruption) movement. The original target position remains unchanged.
2) RESET...Relative movement begins anew from the current position. The target position before interruption is reset.

Movement type

● PTP (point-to-point) of specified axis

PTP movement begins after positioning of all axes specified at <*axis number*> is complete (within the tolerance range), and the command terminates when the specified axes enter the OUT position range. When two or more axes are specified, they will reach their target positions simultaneously.

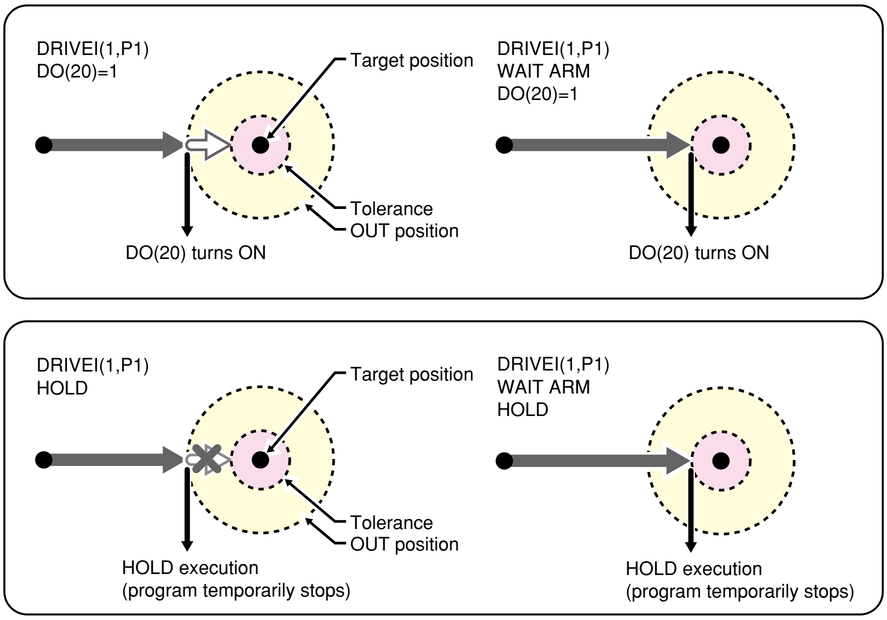
If the next command following the DRIVEI command is an executable command such as a signal output command, that next command will start when the movement axis enters the OUT position range. In other words, that next command starts before the axis arrives within the target position tolerance range.

Signal output (DO, etc.)	Signal is output when axis enters within OUT position range.
DELAY	DELAY command is executed and standby starts, when axis enters the OUT position range.
HALT	Program stops and is reset when axis enters the OUT position range. Therefore, axis movement also stops.
HALTALL	All programs in execution stop when axis enters the OUT position range, task 1 is reset, and other tasks terminate. Therefore, the movement also stops.
HOLD	Program temporarily stops when axis enters the OUT position range. Therefore, axis movement also stops.
HOLDALL	All programs in execution temporarily stop when axis enters the OUT position range. Therefore, the movement also stops.
WAIT	WAIT command is executed when axis enters the OUT position range.

The WAIT ARM statement are used to execute the next command after the axis enters the tolerance range.

DRIVEI command

WAIT ARM statement


DRIVEI(1,P1)
DO(20)=1
Target position
Tolerance
OUT position
DO(20) turns ON
DRIVEI(1,P1)
WAIT ARM
DO(20)=1
DO(20) turns ON
DRIVEI(1,P1)
HOLD
Target position
Tolerance
OUT position
HOLD execution
(program temporarily stops)
DRIVEI(1,P1)
WAIT ARM
HOLD
HOLD execution
(program temporarily stops)

DRIVEI

Point data setting types

● Direct numeric value input

The target position is specified in <*expression*>.

If the target position's numeric value is a real number, this is interpreted as a "mm/ deg." units, and each axis will move from its current position to a pulse-converted position.

Sample	Description
`DRIVEI(1,10000)`	.........`From its current position, the axis 1 of robot 1 moves a distance of "+10000 pulses".`
`DRIVEI(4,90.00)`	.........`From its current position, the axis 4 of robot 1 moves +90°(when axis 4 is a rotating axis).`

● Point definition

Point data is specified in <*expression*>. The axis data specified by the <*axis number*> is used.

From its current position, the axis moves the distance specified by the point in a relative manner.

If the point expression is in "mm/ degrees" units, movement for each axis occurs from the 0-pulse position to the pulse-converted position.

NOTE

If point data is specified with both integers and real numbers in the same statement, all values are handled in "mm/degrees" units.

Sample	Description
`DRIVEI(1,P1)`	.........`The axis 1 of robot 1 moves from its current position the distance specified by P1.`
`DRIVEI(4,P90)`	.........`The axis 4 of robot 1 moves from its current position the number of degrees specified by P90 (when axis 4 is a rotating axis).`

DRIVEI

Option types

● Speed setting

Format

```
1. SPEED = expression
2. S = expression
```

Value	Range
Expression	1 to 100 (units: %)

Explanation The program's movement speed is specified as an <expression>.
The actual speed is determined as shown below.

- Robot's max. speed (mm/sec., or deg./sec.) × automatic movement speed (%) × value of expression (%)

This option is enabled only for the specified DRIVE statement.

NOTE

This defines the maximum speed, and does not guarantee that all movement will occur at specified speed.

Sample	Description
`DRIVEI(1,10000),S=10`	.........The axis 1 of robot 1 moves from its current position to the +10000 pulses position at 10% of the program movement speed.

Format

```
1. DSPEED = expression
2. DS = expression
```

Value	Range
Expression	0.01 to 100.00 (units: %)

Explanation The axis movement speed is specified as an <*expression*>.
The actual speed is determined as shown below.

- Robot's max. speed (mm/sec., or deg./sec.) × axis movement speed (%)

This option is enabled only for the specified DRIVEI statement.
Movement always occurs at the DSPEED <*expression*> value (%) without being affected by the automatic movement speed value (%).

NOTE

SPEED option and DSPEED option cannot be used together.

Sample	Description
`DRIVEI(1,10000),DS=0.1`	.........The axis 1 of robot 1 moves from its current position to the +10000 pulses position at 0.1% of the maximum speed.

DRIVEI

● STOPON condition setting

Format

```
STOPON conditional expression
```

Explanation Stops movement when the conditions specified by the <conditional expression> are met.
Because this is a deceleration type stop, there will be some movement (during deceleration) after the conditions are satisfied.

- the <conditional expression> is specified with input/output signals or the variable.
- If the conditions are not satisfied, a robot moves to the target position.
- If the conditions are already satisfied before movement begins, the command is terminated without any movement.
- This option is enabled only by program execution.

Sample	Description
`DRIVEI(1,10000),STOPON DI(20)=1`	………Axis 1 of robot 1 moves from its current position toward the "+10000 pulses" position and stops at an intermediate point if the "DI (20) = 1" condition become satisfied. The next step is then executed.

MEMO

When the conditional expression used to designate the STOPON condition is a numeric expression, expression value other than "0" indicates a TRUE status, and "0" indicates a FALSE status.

35

END SELECT

Ends the SELECT CASE statement

Format

```
SELECT CASE expression

       CASE expression's list 1
              command block 1
       CASE expression's list 2
              command block 2
       :
       CASE ELSE
              command block n
END SELECT
```

Explanation Directly ends the SELECT CASE command block.
For details, refer to section "SELECT CASE to END SELECT".

Sample	Description
```
WHILE 1
   SELECT CASE DI3(7,6,5,4,3,2,1,0)          .........Executes each command block according to
      CASE &B00000001                             the input status of DI3(8 bits)
         MOVE P,P1                           .........Command block when DI3(0) is ON
      CASE &B00000010                        .........When DI3(1) is ON
         MOVE P,P2
      CASE &B00000011                        .........When DI3(0) and DI3(1) is ON
         MOVE P,P3
      CASE ELSE                              .........Case other than the above
         MOVE P,P0
   END SELECT                                .........Ends SELECT CASE statement
WEND
```

Related commands	SELECT CASE

A
B
C
D
E
F
G
H
I
J
K
L
M

36 END SUB

Ends the sub-procedure definition

Format

```
SUB label (dummy argument, dummy argument…)
        command block
END SUB
```

Explanation Ends the sub-procedure definition which begins at the SUB statement.
For details, refer to section "SUB to END SUB".

Sample **Description**

```
I=1
CALL  *TEST          .........Calls sub-procedure *TEST
PRINT I
HALT
'SUB ROUTINE: TEST   (Comment: Subprocedure name is "TEST")
SUB *TEST            .........Defines sub-procedure *TEST
  I=50
END SUB              .........Finishes defining sub procedures
```

Related commands	CALL, EXIT SUB, SUB to END SUB

37

ERR / ERL

Acquires the error code / error line number

Format

```
ERR(task number)
ERL(task number)
```

Value	Range
Task Number	1 to 16 (If not input, the task being executed is specified.)

Explanation Variables ERR and ERL are used in error processing routines specified by the ON ERROR GOTO statement.

ERR gives the error code of the error that has occurred and ERL gives the line number on which the error has occurred.

Sample **Description**

```
IF ERR(1) <> &H000600CC THEN HALT  .........If "Point doesn't exist" error has occured,
                                            This sample stops and resets the program.
IF ERL =20 THEN RESUME NEXT        .........If the line on which an error has occurred is 20,
                                            the program jumps to the next line of the error
                                            occurring line and continues the execution.
```

Related commands ON ERROR GOTO, RESUME

38

ETHSTS

Acquires the Ethernet port status

Format

```
ETHSTS
```

Explanation Acquires the Ethernet port status.

The values below are acquired depending on the status.

-2	Ethernet port is not opened yet.
-1	LAN cable is not connected.
0	The connection is not established.
1	The connection is established.
2	The connection is established / the data is stored in the reception buffer.

Sample	Description
`A=ETHSTS`	………Assigns the Ethernet port status to the variable A.

39

EXIT FOR

Terminates the FOR to NEXT statement loop

Format

```
EXIT FOR
```

Explanation Terminates the FOR to NEXT statement loop, then jumps to the command which follows the NEXT statement.

This statement is valid only between the FOR to NEXT statements.

MEMO

The FOR to NEXT statement loop will end when the FOR statement condition is satisfied or when the EXIT FOR statement is executed. A "5.212: Stack overflow" error, etc., will occur if another statement such as GOTO is used to jump out of the loop.

Sample **Description**

```
*ST:
WAIT DI(20)=1
FOR  A%=101 TO 109
       MOVE  P,P100,Z=0
       DO(20)=1
       MOVE P,P[A%],Z=0
       DO(20)=0
       IF DI(20)=0 THEN EXIT FOR  .........If DI(20) = 0 (false), exits between FOR and NEXT.
NEXT A%
GOTO  *ST
HALT
```

Related commands	FOR, NEXT

40 EXIT SUB

Terminates the sub-procedure defined by the SUB to END SUB statement

Format

```
EXIT SUB
```

Explanation The EXIT SUB statement terminates the sub-procedure defined by the SUB to END SUB statements, then jumps to the next command in the CALL statement that called up the sub-procedure.

This statement is valid only within the sub-procedure defined by the SUB to END SUB statements.

MEMO

To end the sub-procedure defined by the SUB to END SUB statements, use the END SUB statement or EXIT SUB statement. A "5.212: Stack overflow" error, etc., will occur if another statement such as GOTO is used to jump out of the loop.

Sample **Description**

```
'MAIN ROUTINE
CALL   *SORT2(REF X%,REF Y%)      .........Calls sub-procedure *SORT2
HALT

'SUB ROUTINE: SORT                .........Defines *SORT2 as a sub-procedure
SUB *SORT2(X%, Y%)
       IF X%>=Y% THEN EXIT SUB    .........If X is Y or more, exits between SUB and END SUB
       TMP%=Y%
       Y%=X%
       X%=TMP%
END SUB
```

Related commands	CALL, SUB to END SUB, END SUB

41

EXIT TASK

Terminates its own task which is in progress

Format

```
EXIT TASK
```

Explanation Terminates its own task which is currently being executed.

Sample | **Description**

```
'TASK1 ROUTINE
*ST:
        MO(20)=0
        START <SUB _ PGM>,T2          .........Registers SUB _ PGM program in Task No. 2 and
        MOVE P,P0,P1                           starts it.
        WAIT MO(20)=1
        GOTO *ST
HALTALL

Program name:SUB _ PGM
'TASK2 ROUTINE
*SUBTASK2:
        P100=JTOXY(WHERE)
        IF LOCZ(P100)>=100.000 THEN
        MO(20)=1
        EXIT TASK                     .........Ends Task 2 (own task: SUB _ PGM)
        ENDIF
        DELAY 100
GOTO *SUBPTASK2                       .........Jumps to *SUBTASK 2
EXIT TASK                             .........Ends Task 2 (own task: SUB _ PGM)
```

Related commands CUT, RESTART, START, SUSPEND, CHGPRI

42 FOR to NEXT

Performs loop processing until the variable exceeds the specified value

Format

```
FOR control variable = start value TO end value STEP step
        command block
NEXT control variable
```

Explanation These statements repeatedly execute commands between the FOR to NEXT statements for the <*start value*> to <*end value*> number of times, while changing the <*control variable*> value in steps specified by <*STEP*>.

- If <*STEP*> is omitted, its value becomes "1".
- The <*STEP*> value may be either positive or negative.
- The <*control variable*> must be a numeric <*simple variable*> or <*array variable*>.
- The FOR and NEXT statements are always used as a set.

Sample

```
'CYCLE WITH CYCLE NUMBER OUTPUT TO DISPLAY
FOR A=1 TO 10
        MOVE P,P0
        MOVE P,P1
        MOVE P,P2
        PRINT"CYCLE NUMBER=";A
NEXT A
HALT
```

FOR to NEXT is useful to make the program compact.

SAMPLE (Descriptions with FOR to NEXT)

```
FOR A=1 TO 5                .........Repeats 5 times between FOR and NEXT.
        MOVE P,P[A],A3=0.00     A number of destination point for MOVE changes depending
NEXT A                          on a value of a variable.
MOVE P,P10,A3=0.00
DO(20)=1
```

A example without FOR to NEXT;
though the description is simple, the number of programming line increases in accordance with one of the destination.

SAMPLE (Descriptions without FOR to NEXT)

```
MOVE P,P1,A3=0.00
MOVE P,P2,A3=0.00
MOVE P,P3,A3=0.00
MOVE P,P4,A3=0.00
MOVE P,P5,A3=0.00
MOVE P,P10,A3=0.00
DO(20)=1
```

MEMO

While FOR to NEXT is processed, leaving the loop is disabled by GOTO and so on.
In order to leave FOR to NEXT, use EXIT FOR.

Related commands	EXIT FOR

43 GEPSTS

Acquires the General Ethernet Port status

Format

`GEPSTS(General Ethernet Port number)`

Value	Range
General Ethernet Port number	1 to 4

Explanation Acquires the General Ethernet Port status.
The values below are acquired depending on the status.

-2	Specified General Ethernet Port is not opened yet.
-1	LAN cable is not connected.
0	The connection is not established. (Only server)
1	The connection is established.
2	The connection is established / the data is stored in the reception buffer.

Sample **Description**

```
OPEN GP1                          .........Opens the port which is specified at the General
                                           Ethernet port 1.
IF GEPSTS(1) > 0 THEN             .........Confirms if the connection is established.

       SEND "ABC" TO GP1          .........Sends the character string "ABC".
       IF GEPSTS(1)=2 THEN        .........Confirms if the data is stored in the reception
                                           buffer.
       SEND GP1 TO RET$           .........Receives the data and assigns the received to the
                                           variable RET$.
       ENDIF
ENDIF
CLOSE GP1                         .........Closes the port which is specified at the General
HALT                                       Ethernet port 1.
```

Related commands	OPEN, CLOSE, SEND, SETGEP

44

GOSUB to RETURN

Jumps to a subroutine

* GOSUB can also be expressed as "GO SUB".

Format

```
GOSUB label
   :
label:
   :
RETURN
```

Explanation Jumps to the <*label*> subroutine specified by the GOSUB statement.
A RETURN statement within the subroutine causes a jump to the next line of the GOSUB statement.

MEMO

- The GOSUB statement can be used up to 120 times in succession. Note that this number of times is reduced if commands containing a stack such as an FOR statement or CALL statement are used.
- When a jump to a subroutine was made with the GOSUB statement, always use the RETURN statement to end the subroutine. If another statement such as GOTO is used to jump out of the subroutine, an error such as "5.212: Stack overflow" may occur.

Sample **Description**

```
*MAIN:
MOVE P,P1,A3=0.00
GOSUB *SUB_DO          .........Jumps to the label "*SUB_DO"
MOVE P,P2,A3=0.00      .........Executes from this line after the subroutine *SUB_DO
HALT                            has reached RETURN

*SUB_DO:               .........Defines *SUB_DO as a subroutine label
DO(20)=1
DELAY 500
DO(20)=0
RETURN                 .........Executes from the next line of the GOSUB statement
```

Related commands RETURN

45 GOTO

Executes an unconditional jump to the specified line

Format

```
GOTO label  * GOTO can also be expressed as "GO TO".
```

Explanation Executes an unconditional jump to the line specified by the <label>.

MEMO

"Label" is the name which is put on a programming line.
For specifying the programming line, it is necessary to create a label on the line and specify it.

In order to create/define a label, always begin with * and end with : .
For details, refer to Chapter 1 "6. LABEL Statement".

Sample **Description**

```
*TOP:              .........Defines *TOP as a label
MOVE P,P1
DELAY 1000
MOVE P,P2
DELAY 1000         .........Jumps to the label *TOP
GOTO *TOP
```

46 HALT

Stops the program and performs a reset

Format

`HALT`	*expression* *character string*	

Explanation Stops the program and resets it. If restarted after a HALT, the program runs from its beginning. If an <expression> or a <character string> is written, the operation result of <expression> or the contents of <character string> are displayed on the programming box screen, respectively.

MEMO

- Variables are not reset by execution of HALT statement. HALTALL is available to reset variables.
- HALT is effective only in the executed task. The programs executed in other tasks continue execution.

Sample **Description**

```
'MAIN ROUTINE
*ST:
  MOVE P,P0,P1
  IF DI(20) = 1 THEN        .........If DI(20) is ON
    GOTO *FIN               .........Jumps to the label *FIN
  ENDIF
GOTO *ST
*FIN:                       .........Defines *FIN as a label
HALT "PROGRAM FIN"          .........Stops and resets the program (displayed as "PROGRAM FIN")
```

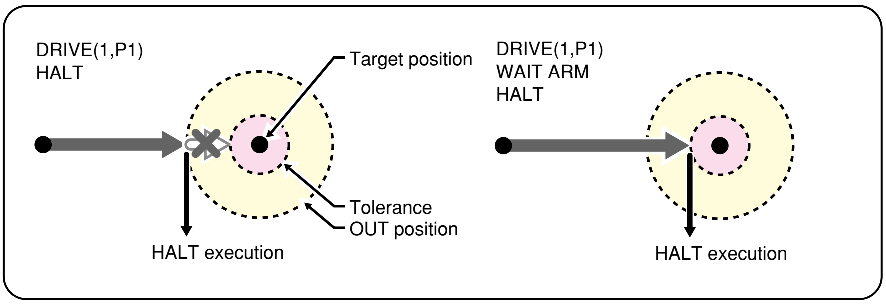
In PTP movement specified by movement commands such as MOVE and DRIVE, the next line's command is executed when the axis enters the OUT position range.

Therefore, if a HALT command exists immediately after a PTP movement command, that HALT command is executed before the axis arrives in the target position tolerance range.

Likewise, when specifying CONT options in interpolation movement during MOVE (L or C) command, the next command is executed immediately after movement starts. Therefore, if a HALT command exists immediately after the interpolation movement command during MOVE (L or C) command with CONT options, a HALT command is executed immediately after starting movement.

In either of the above cases, use the WAIT ARM command as shown below if desiring to execute the HALT command after the axis arrives within the target position tolerance range.

HALT command



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47 HALTALL

Stops all programs and performs reset

Format

HALTALL	*expression* *character string*

Explanation Stops and resets all programs. Dynamic variables, array variables, output variables are also rest. Output variables (DO/SO/MO/LO/TO/SOW) are reset under the condition as shown below.

- IO parameter "DO output at Program reset" is "IO_RESET".
- Sequence program is in execution and the sequence program execution flag is enabled.

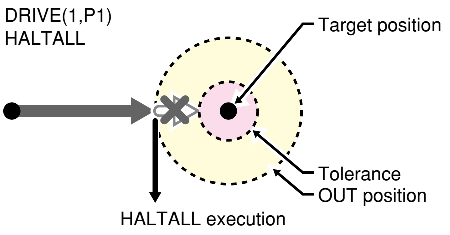
If a program is restarted after a HALTALL, the program runs from its beginning of the main program or of the last program executed at task 1.
If an <expression> or a <character string> is written, the calculation result of <expression> or the contents of <character string> are displayed on the programming box screen, respectively (if variable is written in an <expression>, the previous value before clearing is displayed).

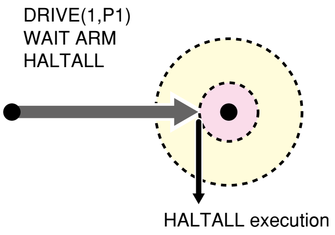
MEMO

- HALTALL stops all the programs which is run in multi tasking.
  After the reset, the main program or a current program is registered automatically at the task No.1 and the other tasks are cleared.
- Executing HALTALL resets all of general-purpose outputs and variables.
  Note that the reset of general-purpose output won't be executed if "DO output at program reset ‹RESCDO›" within I/O parameters is set to "1: IO_HOLD".

Sample	Description
`MOVE P,P1`	
`DELAY 1000`	
`HALTALL`	.........Reset is executed after the program.

In PTP movement specified by movement commands such as MOVE and DRIVE, the next line's command is executed when the axis enters the OUT position range.
Therefore, if a HALTALL command exists immediately after a PTP movement command, that HALTALL command is executed before the axis arrives in the target position tolerance range.
Likewise, when specifying CONT options in interpolation movement during MOVE (L or C) command, the next command is executed immediately after movement starts. Therefore, if a HALTALL command exists immediately after the interpolation movement command during MOVE (L or C) command with CONT options, a HALTALL command is executed immediately after starting movement.
In either of the above cases, use the WAIT ARM command as shown below if desiring to execute the HALTALL command after the axis arrives within the target position tolerance range.





48 HAND

Defines the hand

Format

```
Definition statement:
 HAND[robot number] Hn = 1st parameter 2nd parameter 3rd parameter  R

Selection statement:
 CHANGE[robot number] Hn
```

Notation	Value	Range
	Robot Number	1 to 4
n	Hand Number	0 to 31
R	Attaching Hand to R-axis	

Explanation The HAND statement only defines the hand.
To actually change the hands data, use the CHANGE statement.
For CHANGE statement details, refer to section "CHANGE".
If "R" is specified, the hand that are offset from the R-axis rotating center are selected.

MEMO

- If a power OFF occurs during execution of the hand definition statement, the "9.707 Hand data destroyed" error may occur.
- If specifying the hand data that was defined by specifying other robots in the CHANGE statement, "6.258: Illegal robot no" error may occur.

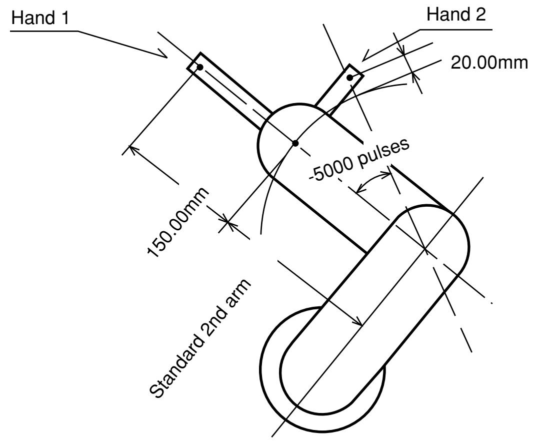
HAND

48.1 For SCARA Robots

48.1.1 *<4th parameter>* "R" is not specified.

Hands installed on the second arm tip are selected (see below).

1st parameter	Number of offset pulses between the standard second arm position and the virtual second arm position of hand "n". "+" indicates the counterclockwise direction [pulse].
2nd parameter	Difference between the hand "n" virtual second arm length and the standard second arm length [mm]
3rd parameter	Z-axis offset value for hand "n" [mm]


Hand 1
Hand 2
20.00mm
-5000 pulses
150.00mm
Standard 2nd arm

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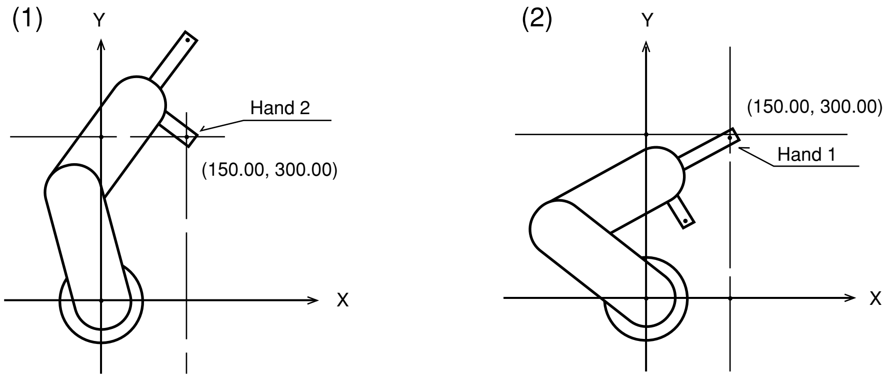
Sample **Description**

```
HAND H1=          0      150.000     0.0000
HAND H2=      -5000       20.000      0.000
P1=         150.000      300.000      0.000   0.000   0.000   0.000
CHANGE H2       .........Changes the hand data of robot 1 to hand 2.
MOVE P,P1       .........Tip of hand 2 of robot 1 moves to P1.(1)
CHANGE H1       .........Changes the hand data of robot 1 to hand 1.
MOVE P,P1       .........Tip of hand 1 of robot 1 moves to P1.(2)
HALT
```

SAMPLE:HAND


(1)
Y
Hand 2
(150.00, 300.00)
X
(2)
Y
(150.00, 300.00)
Hand 1
X

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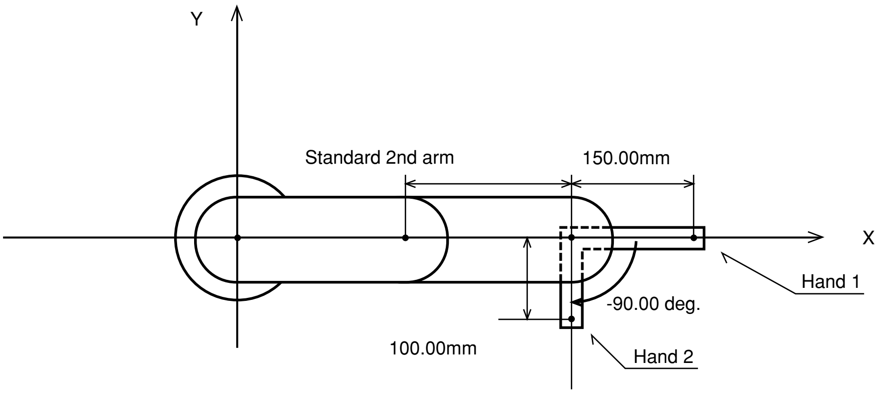
48.1.2 *<4th parameter>* "R" is specified.

The hands that are offset from the R-axis rotating center are selected (see below).

1st parameter	When the current position of R-axis is 0.00, this parameter shows the angle of hand "n" from the X-axis plus direction in a Cartesian coordinate system. ("+"indicates the counterclockwise direction.) [degree]
2nd parameter	Length of hand "n" [mm] (>0)
3rd parameter	Z-axis offset amount for hand "n" [mm]


Y
Standard 2nd arm
150.00mm
X
Hand 1
-90.00 deg.
100.00mm
Hand 2

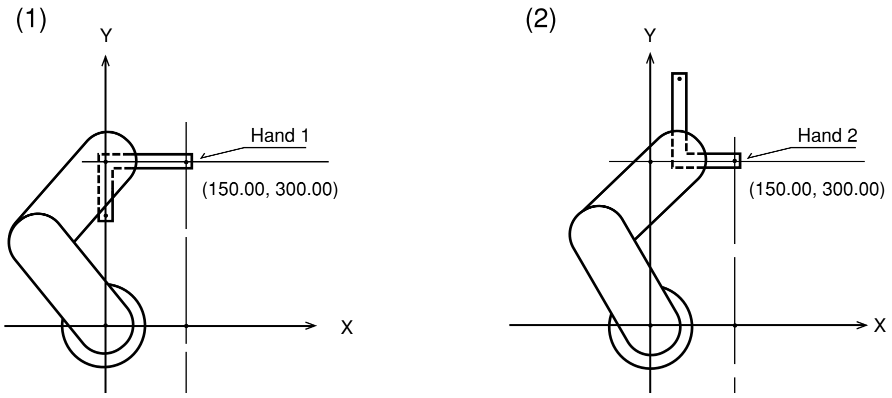
33804-R9-00

Sample **Description**

```
HAND H1=        0.00       150.0     0.0     R
HAND H2=      -90.00       100.00    0.0     R
P1=           150.00       300.00    0.00    0.00    0.00    0.00

CHANGE H1       .........Changes the hand data of robot 1 to hand 1.
MOVE P,P1       .........Tip of hand 1 of robot 1 moves to P1.(1)
CHANGE H2       .........Changes the hand data of robot 1 to hand 2.
MOVE P,P1       .........Tip of hand 2 of robot 1 moves to P1.(2)
HALT
```

SAMPLE:HAND


(1)
Y
Hand 1
(150.00, 300.00)
X
(2)
Y
Hand 2
(150.00, 300.00)
X

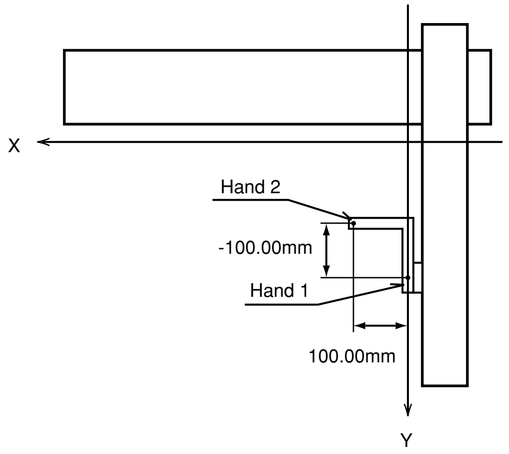
33804-R7-01

48.2 For Cartesian Robots

48.2.1 *<4th parameter>* "R" is not specified.

Hands installed on the second arm tip are selected (see below).

1st parameter	Hand "n" X-axis offset amount [mm]
2nd parameter	Hand "n" Y-axis offset amount [mm]
3rd parameter	Hand "n" Z-axis offset amount [mm]

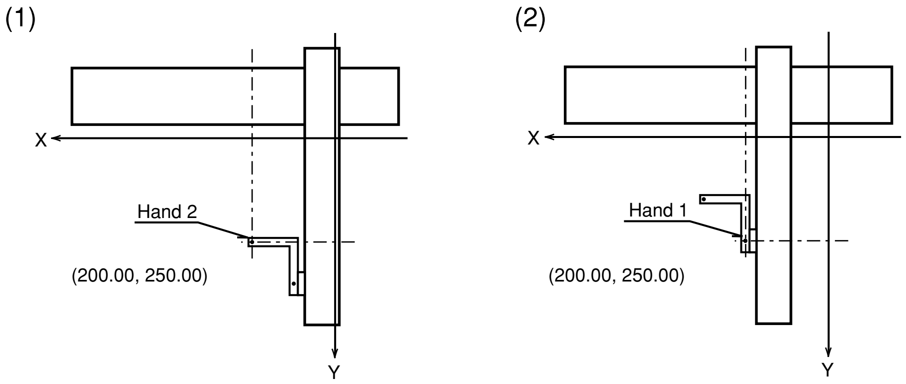

X
Hand 2
-100.00mm
Hand 1
100.00mm
Y

33805-R9-00

Sample **Description**

```
HAND H1=       0.000        0.000        0.000
HAND H2=     100.000     -100.000     -100.000
P1=          200.000      250.000        0.000    0.000    0.000    0.000
CHANGE H2      .........Changes the hand data of robot 1 to hand 2.
MOVE P,P1      .........Tip of hand 2 of robot 1 moves to P1.(1)
CHANGE H1      .........Changes the hand data of robot 1 to hand 1.
MOVE P,P1      .........Tip of hand 1 of robot 1 moves to P1.(2)
HALT
```

SAMPLE:HAND

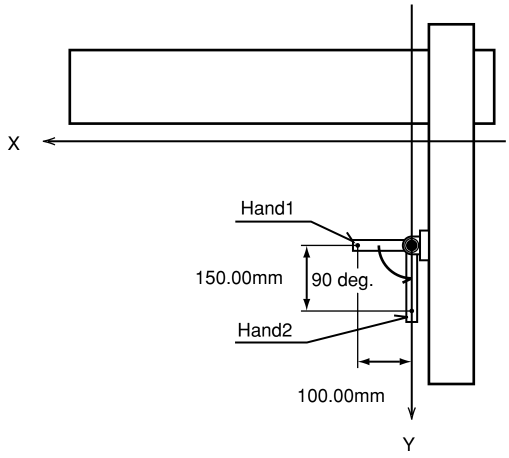

(1)
X
Hand 2
(200.00, 250.00)
Y
(2)
X
Hand 1
(200.00, 250.00)
Y

33806-R7-01

48.2.2 *<4th parameter>* "R" is specified.

The hands that are offset from the R-axis rotating center are selected (see below).

1st parameter	When the current position of R-axis is 0.00, this parameter shows the angle of hand "n" from the X-axis plus direction in a Cartesian coordinate system. ("+"indicates the counterclockwise direction.) [degree]
2nd parameter	Length of hand "n". [mm] (>0)
3rd parameter	Z-axis offset amount for hand "n". [mm]

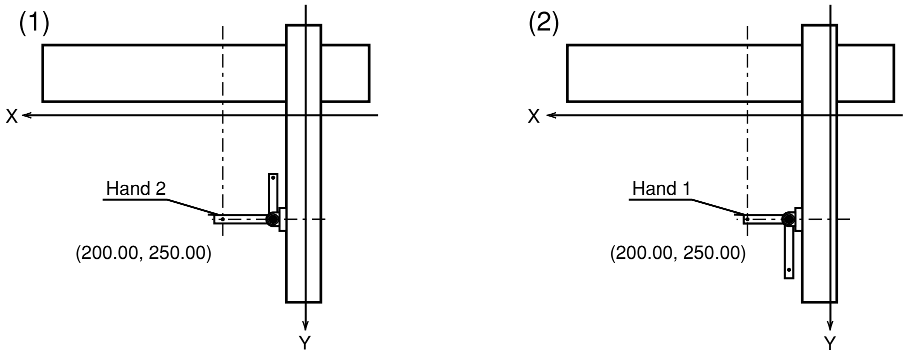


33806-R9-00

Sample **Description**

```
HAND H1=       0.000      100.000      0.000     R
HAND H2=      90.000      150.000      0.000     R
P1=          200.000      250.000      0.000   0.000      0.000   0.000
CHANGE H2     .........Changes the hand data of robot 1 to hand 2.
MOVE P,P1     .........Tip of hand 2 of robot 1 moves to P1.(1)
CHANGE H1     .........Changes the hand data of robot 1 to hand 1.
MOVE P,P1     .........Tip of hand 1 of robot 1 moves to P1.(2)
HALT
```

SAMPLE:HAND



33808-R7-01

49 HOLD

Temporarily stops the program

Format

HOLD	*expression* *character string*

Explanation Temporarily stops the program. When restarted, processing resumes from the next line after the HOLD statement. If an <*expression*> or <*character string*> is written in the statement, the contents of the <*expression*> or <*character string*> display on the programming box screen.

MEMO

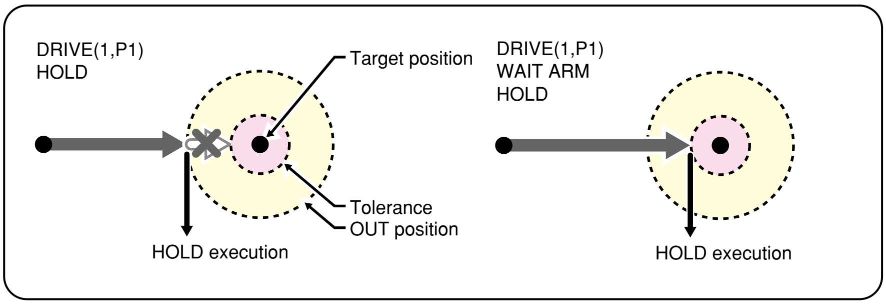
HOLD is effective only in the task executed. The programs executed in other tasks continue execution.

Sample **Description**

```
'MAIN ROUTINE
*ST:
     MOVE P,P0,P1
     IF DI(20)=1 THEN       .........If DI(20) is ON
       HOLD "PROGRAM STOP"  .........Suspends the running task program (displayed as
     ENDIF                           "PROGRAM STOP")
GOTO *ST
HALT                        .........Stops and resets the program
```

In PTP movement specified by movement commands such as MOVE and DRIVE, the next line's command is executed when the axis enters the effective OUT position range.
Therefore, if a HOLD command exists immediately after a PTP movement command, that HOLD command is executed before the axis arrives in the target position tolerance range.
Likewise, when specifying CONT options in interpolation movement during MOVE (L or C) command, the next command is executed immediately after movement starts. Therefore, if a HOLD command exists immediately after the interpolation movement command during MOVE (L or C) command with CONT options, a HOLD command is executed immediately after starting movement.
In either of the above cases, use the WAIT ARM command as shown below if desiring to execute the HOLD command after the axis arrives within the target position tolerance range.

HOLD command



50 HOLDALL

Temporality stops all programs

Format

HOLDALL	*expression* *character string*

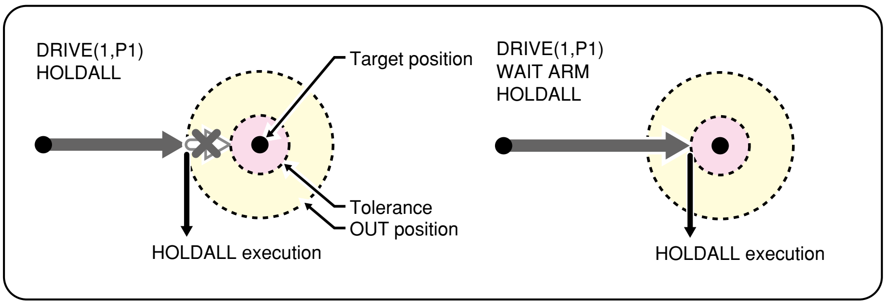
Explanation Temporality stops all programs. When restarted, the program that has executed HOLDALL is executed from the next line after the statement, and other programs are resumed from the line that has interrupted execution. If an <*expression*> or <*character sting*> is written in the statement, the contents of <*expression*> or <*character string*> displays on the programming box screen.

Sample **Description**

```
'MAIN ROUTINE
*ST:
     MOVE P,P0,P1
     IF DI(20)=1 THEN       .........If DI(20) is ON
       HOLD "PROGRAM STOP" .........Pauses all programs (displayed as "PROGRAM STOP")
     ENDIF
GOTO *ST
HALT                        .........Stops and resets the program
```

In PTP movement specified by movement commands such as MOVE and DRIVE, the next line's command is executed when the axis enters the effective OUT position range.
Therefore, if a HOLDALL command exists immediately after a PTP movement command, that HOLDALL command is executed before the axis arrives in the target position tolerance range.
Likewise, when specifying CONT options in interpolation movement during MOVE (L or C) command, the next command is executed immediately after movement starts. Therefore, if a HOLDALL command exists immediately after the interpolation movement command during MOVE (L or C) command with CONT options, a HOLDALL command is executed immediately after starting movement.
In either of the above cases, use the WAIT ARM command as shown below if desiring to execute the HOLDALL command after the axis arrives within the target position tolerance range.

HOLDALL command



33702-R9-00

51 IF

Evaluates a conditional expression value, and executes the command in accordance with the conditions

51.1 Simple IF statement

Format

`IF` *conditional expression* `THEN`	*label 1* *command 1*	`ELSE`	*label 2* *command 2*

Value	Range (Specifying format)
conditional expression	Input/Output signals or variables

Explanation This type of IF statement is available to write only when the conditional expression is "true" or when the number of <*command*> executed in the "false" condition is one.

If the condition specified by the <*conditional expression*> is met **true**;
processing jumps either to the <*label 1*> which follows THEN,
or
to the next line after <*command 1*> is executed.

If the condition specified by the <*conditional expression*> is not met **false**;

1. Processing either jumps to the <*label 2*> specified after the ELSE statement,
   or
   to the next line after <*command 2*> is executed.
2. If nothing is specified after the ELSE statement, no action is taken, and processing simply jumps to the next line.

MEMO

When the conditional expression used to designate the IF statement condition is a numeric expression, an expression value other than "0" indicates a TRUE status, and "0" indicates a FALSE status.

Sample

```
IF DI(20)=1 THEN *MAIN1 ELSE *MAIN2
  :
*MAIN1:
DO(20)=1
  :
*MAIN2:
DO(21)=1
  :
```

Description

```
........If DI(20) is ON "True",
        Jumps to label *MAIN1

        If DI(20) is OFF "false",
        Jumps to label *MAIN2
```

51.2 Block IF statement

Format

```
IF conditional expression 1 THEN
    command block 1
ELSEIF conditional expression 2 THEN
    command block 2
ELSE
    command block n
ENDIF
```

Value	Range (Specifying format)
conditional expression	Input/Output signals or variables

Explanation If the condition specified by <*conditional expression 1*> is met (true), this statement executes the instructions specified in <*command block 1*>, then jumps to the next line after ENDIF.

When an ELSEIF statement is present and the condition specified by <*conditional expression 2*> is met (true), the instructions specified in <*command block 2*> are executed.

If all the conditions specified by the conditional expression are not met (false), <*command block n*> is executed.

MEMO

When the conditional expression used to designate the IF statement condition is a numeric expression, an expression value other than "0" indicates a TRUE status, and "0" indicates a FALSE status.

Sample 1 (Block IF statement 1) **Description**

```
MOVE P,P1,A3=0.00
IF DI(20)=1 THEN              ......When DI(20) is ON, executes "true" command block.
     DO(20)=1                 ......From this line, "true" command block
     MOVE P,P10,A3=0.00
     DO(20)=0                 ......Down to this line, "true" command block
ELSE                          ......When DO(20) is OFF, executes "false" command block.
     DO(21)=1                 ......From this line, "false" command block
     MOVE P,P11,A3=0.00
     DO(21)=0                 ......Down to this line, "false" command block
ENDIF                         ......Definition end of IF statement
MOVE P,P20,A3=0.00            ......Jumps to this line after executing the IF statement
:
```

Sample 2 (Block IF statement 2) **Description**

```
MOVE P,P1,A3=0.00
IF DI(20)=1 THEN              ......When DI(20) is ON, executes "true" command block.
     DO(20)=1                 ......From this line, "true" command block
     MOVE P,P10,A3=0.00       ......Down to this line, "true" command block
ENDIF                         ......Definition end of IF statement
DO(20)=0                      ......Jumps to this line after executing the IF statement
:
```

52 INPUT

Assigns a value to a variable specified from the programming box

Format

```
INPUT prompt statement  ;  variable          ,  variable          ,...
                        ,  point variable       point variable
                           shift variable       shift variable
```

Explanation Assigns a value to the variable specified from the programming box.

The input definitions are as follows:

1. When two or more variables are specified by separating them with a comma (,), the specified input data items must also be separated with a comma (,).
2. At the <prompt statement>, enter a character string enclosed in double quotation marks (") that will appear as a message requiring data input. When a semicolon (;) is entered following the <prompt statement>, a question mark (?) and a space will appear at the end of the message.
   When a comma (,) is entered, nothing will be displayed following the message.
3. When the <prompt statement> is omitted, only a question mark (?) and a space will be displayed.
4. The input data type must match the type of the corresponding variables. When data is input to a point variable or shift variable, insufficient elements are set to "0".
5. If only the ENTER key is pressed without making any entry, the program interprets this as a "0" or "null string" input. However, if specifying two or more variables, a comma (,) must be used to separate them.
6. If the specified variable is a character type and a significant space is to be entered before and after a comma (,), double quotation mark (") or character string, the character string must be enclosed in double quotation marks ("). Note that in this case, you must enter two double quotation marks in succession so that they will be identified as a double quotation mark input.

Entry Example	Result ; Contents of A$
ABC	ABC
(space)ABC(space)	ABC: space is not entered before and after ABC
" ABC "	ABC : spaces are entered before and after ABC
ABC,XYZ	ABC is entered, and XYZ is entered when the next INPUT statement is executed.
"ABC,XYZ"	ABC,XYZ
"""ABC"""	"ABC"

7. Pressing the ESC key skips this command.

MEMO

- If the variable and the value to be assigned are different types, the specified message displays, and a "waiting for input" status is established.
- When assigning alphanumeric characters to a character variable, it is not necessary to enclose the character string in double quotation marks (").
- When using INPUT statement, the value is assigned to the variable from the channel specified in controller parameter "INPUT/PRINT using channel".

INPUT

Sample	Description
`INPUT A`	………Converts the entered character string to a real number and assigns to variable A!.
`INPUT "INPUT POINT NUMBER";A1`	………Displays INPUT POINT NUMBER on a prompt of programming box, etc. and converts the entered character string to a real number and assigns to variable A!.
`INPUT "INPUT STRING",B$(0),B$(1)`	………Displays INPUT STRING on a prompt of programming box, etc. If commas are contained in the entered character string, the first character string is assigned to 0 element of the array variable B$ and the second character string is assigned to its 1 element.
`INPUT P100`	………Assigns the entered character string to P100.
`HALT`	

53 INROFST

Specifies/acquires R axis inertia offset for SCARA parameter.

Format

```
INROFST [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	Value of R axis inertia offset for SCARA parameter 0 to 9999999 (units: 0.001mm)

Explanation Changes the value of "R axis inertia offset for SCARA" parameter of specified robot to the <expression> value.

Sample **Description**

```
INROFST 10      .........Sets "R axis inertia offset for SCARA" parameter of robot 1 to 10.
INROFST[2] 20   .........Sets "R axis inertia offset for SCARA" parameter of robot 2 to 20.
```

Functions

Format

```
INROFST [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function acquires the value of "R axis inertia offset for SCARA" parameter of specified robot.

Sample **Description**

```
A%=INROFST       .........The "R axis inertia offset for SCARA" parameter of robot 1 is
                          assigned to the variable A%.
A%=INROFST[2]    .........The "R axis inertia offset for SCARA" parameter of robot 2 is
                          assigned to the variable A%.
```

54

INT

Truncates decimal fractions

Format

```
INT (expression)
```

Explanation This function acquires an integer value with decimal fractions truncated.
The maximum integer value which does not exceed the <*expression*> value is acquired..

Sample	Description
`A=INT(A(0))`	………"-2" is assigned to B.
`B=INT(-1. 233)`	

55 JTOXY

Performs axis unit system conversions (pulse → mm)

Format

```
JTOXY [robot number](point expression)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.

Explanation Converts the joint coordinate data (unit: pulse) specified by the <*point expression*> into Cartesian coordinate data (unit: mm, degree) of the robot specified by the <*robot number*>.

Sample	Description
`P10=JTOXY(WHERE)`	………Current position data of robot 1 is converted to Cartesian coordinate data and assigned to P10.

Related commands	XYTOJ

56 LEFT$

Extracts character strings from the left end

Format

```
LEFT$ (character string expression, expression)
```

Value	Range
Expression	0 to 255

Explanation This function extracts a character string with the digits specified by the <*expression*> from the left end of the character string specified by <*character string expression*>.

- The <expression> value must be between 0 and 255; otherwise an error will occur.
- If the <expression> value is 0;
  extracted character string will be a null string (empty character string).
- If the <expression> value has more characters than the <character string expression>;
  extracted character string will become the same as the <character string expression>.

Sample	Description
`B$=LEFT$(A$,4)`	………4 characters from the left end of A$ are assigned to B$.

Related commands	MID$, RIGHT$

57 LEFTY

Sets the SCARA robot hand system as a left-handed system

Format

```
LEFTY [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.

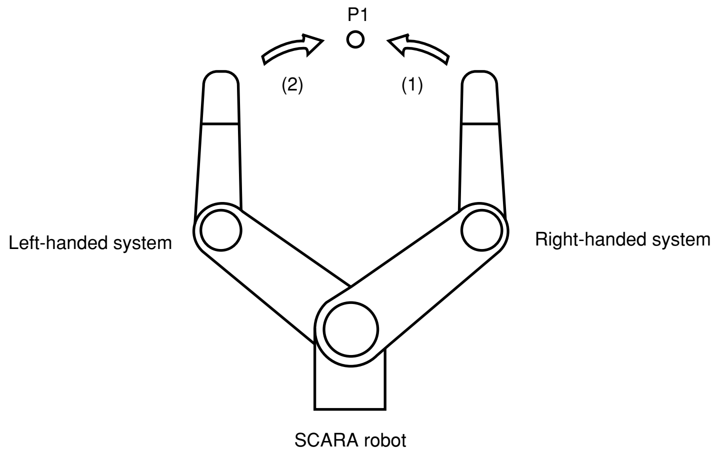
Explanation Specifies the robot as a left-handed system.
This command is only valid for SCARA robots.

This statement only specifies the hand system, and does not move the robot.
If executed while the robot arm is moving, execution waits until movement is complete (positioned within tolerance range).

Sample **Description**

```
RIGHTY      .........Specifies the hand system of robot 1 as a right-handed system.
MOVE P,P1   .........(1)
LEFTY       .........Specifies the hand system of robot 1 as a left-handed system.
MOVE P,P1   .........(2)
RIGHTY      .........Specifies the hand system of robot 1 as a right-handed system.
HALT
```

SAMPLE:LEFTY/RIGHTY



33809-R7-00

Related commands	RIGHTY

58 LEN

Acquires a character string length

Format

```
LEN(character string expression)
```

Explanation Returns the character string length of the <*character string expression*> as a number of bytes.

Sample	Description

```
A$="YAMAHA"
B$="YAMAHA MOTOR"
C$="YAMAHA CO., LTD."
PRINT LEN(A$)          .........Indicates "6".
PRINT LEN(B$)          .........Indicates "12".
PRINT LEN(C$)          .........Indicates "16".
```

59 LET

Assigns values to variables

Format

`LET`	*arithmetic assignment statement* *character string assignment statement* *point assignment statement* *shift assignment statement*	

Explanation Executes the specified assignment statement. The right-side value is assigned to the left side.
An assignment statement can also be directly written to the program without using a LET statement.

MEMO

If the controller power is turned off during execution of a <*point assignment statement*> or <*shift assignment statement*>, a memory-related error such as the "9.702: Point data destroyed" or the "9.706: Shift data destroyed" may occur

59.1 Arithmetic assignment statement

Format

`LET`	*integer variable* *real variable* *parallel output variable* *internal output variable* *arm lock output variable* *timer output variable* *serial output variable* *serial word output variable* *serial double-word output variable*	= *expression*

Value	Contents
Expression	Variables (except character string variables, point data variables, shift variables), Function, Numeric value

Explanation The expression value is assigned to the left-side variable

Sample

```
A!=B!+1
B%(1,2,3)=INT(10.88)
DO2()=&B00101101
MO(21,20)=2
LO(00)=1
TO(01)=0
SO12()=255
```

Reference For details of assignment statements and output variables,
refer to "5.1 Assignment statements" "5.2 Input/output variables" in Chapter 7.

59.2 Character string assignment statement

Format

```
LET character string variable = character string expression
```

Explanation The <*character string expression*> value is assigned to the character string variable.
Only the plus (+) arithmetic operator can be used in the <*character string expression*>.
Other arithmetic operators and parentheses cannot be used.

Sample

```
A$ ="YAMAHA"
B$ ="ROBOT"
D$ = A$ + "-" + B$

Execution result: YAMAHA-ROBOT
```

MEMO

The "+" arithmetic operator is used to link character strings..

59.3 Point assignment statement

Format

```
LET point variablee = point expression
```

Explanation Assigns <*point expression*> values to point variables.
Only 4 arithmetic operators (+, -, *, /) can be used in the <*point expression*>.
Multiplication and division are performed only for constant or variable arithmetic operations.

- Addition / Subtraction: Addition / subtraction is performed for each element of each axis.
- Multiplication / Division: Multiplication / division by a constant or variable is performed for each element of each axis.

Multiplication results vary according to the point data type.

- For "pulse" units: Assigned after being rounded to an integer.
- Assigned a real number after being rounded off to two decimal places.

Sample **Description**

```
P1  =P10        .........Point 10 is assigned to P1.
P20=P20+P5      .........Each element of point 20 and point 5 is summed and assigned to P20.
                .........Each element of point 3 is subtracted from point 30 and assigned to
P30=P30-P3           P30.
                .........Each element of point 70 is multiplied by 4 and assigned to P80.
P80=P70*4       .........Each element of point 5 is divided by 3 and assigned to P60.

P60=P5/3
```

MEMO

- Permissible examples: P15 * 5, P[E]/A, etc.
- Prohibited examples: P10 * P11, 3/P10, etc.

59.4 Shift assignment statement

Format

```
LET shift variable = shift expression
```

Explanation Assigns <shift expression> values to <shift variables>.

- Available elements in <shift expressions> are only shift elements.
- Available operators in <shift expressions> are only addition and subtraction arithmetic operators.
  *Addition/subtraction is performed for each element of each axis.
- Parentheses are not available.

Sample	Description
`S1=S0`	………"shift 0" is assigned to "shift 1".
`S2=S1+S0`	………Each element of "shift 1" and "shift 0" is summed and assigned to "shift 2".

MEMO

- Permissible examples: S1 + S2
- Prohibited examples: S1 + 3

60

LO

Arm lock output or acquires the output status

Format

```
1. LET LOm (b, ..., b) = expression
2. LET LO (mb, ..., mb) = expression
```

Notation	Value	Range
m	Port Number	0, 1
b	Bit Definition(*)	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

Explanation This statement outputs the specified value to the LO port to either prohibit or allow axis movement.

- LO(00) to LO(07) correspond to axes 1 to 8, LO(10) to LO(17) correspond to axes 9 to 16, respectively.
- An arm lock ON status occurs at axes where bits are set, and axis movement is prohibited.

Reference * Chapter 3 "10 Bit Settings"

MEMO

This statement is valid for axes whose movement is started.

Sample	Description
`LO0()=&B00001010`	.........Prohibits movement at axes 2 and 4.
`LO0(2,1)=&B10`	.........Prohibits movement at axis 3, permits movement at axis 2.

LO

Functions

Format

```
1. LET expression = LOm (b, ..., b)
2. LET expression = LO (mb, ..., mb)
```

Notation	Value	Range
m	Port Number	0, 1
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).

Explanation Acquires the output status of the specified LO port.

- LO(00) to LO(07) correspond to axes 1 to 8, LO(10) to LO(17) correspond to axes 9 to 16, respectively.
- An arm lock ON status occurs at axes where bits are set, and axis movement is prohibited.

Sample **Description**

```
A%= LO0()               .........Output status of ports DO(07) to LO(00) is assigned to
                                  variable A%.
A%= LO0(6, 5, 1)        .........Output status of LO(06), LO(05) and LO(01) is assigned to
                                  variable A%.
                                  (If all above signals are 1(ON), then A%=7.)
A%=LO(17,15,00)         .........Output status of L0(17), LO(15) and L0(00) is assigned to
                                  variable A%.
                                  (If all above signals except L0(15) are 1 (ON), then A%=5.)
```

Related commands	RESET, SET

61

LOCx

Specifies/acquires point data for a specified axis or shift coordinate data/work data for a specified element

Format

```
1. LOCx (point expression) = expression
2. LOCx (shift expression) = expression
3. LOCx (Wn) = expression
```

	Value	Range / Meaning
Format 1	x	1 to 6 (axis setting) F (hand system flag setting) F1 (first arm rotation information) F2 (second arm rotation information)
Format 2	x	1 to 4 (element setting)
Format 3	x	1 to 4 (element setting)
	n	0 to 39 (work number)
	Expression	• For Axis or element setting: coordinate value, variables • For Hand system flag setting: 0 (no setting), 1 (right-handed system), 2 (left-handed system) • For first / second arm rotation information(*1): 0, 1, -1
		*1: The first arm and the second arm rotation information is only for YK-TW. For details, refer to Chapter 4 "3. Point data format".

Explanation Format 1: Changes the value of the point data specified axis, the hand system flag, and the first arm and the second arm rotation information.

Format 2: Changes the value of a specified element from the shift coordinate data.

Format 3: Changes the value of a specified element from the work data.

NOTE

When changing the work data, execution will be in a waiting state until the operation of the target robot enters within the tolerance range.
(For LOCx during conveyor tracking, refer to the separate manual "Tracking System" CTMOVE.)

MEMO

Points where data is to be changed must be registered in advance. An error occurs when attempting to change an unregistered (no coordinate values / no element data) point, shift coordinate, or work data.

LOCx

Functions

Format

1. LOCx (*point expression*)
2. LOCx (*shift expression*)
3. LOCx (Wn)

	Value	Range
Format 1	x	1 to 6 (axis setting) F (hand system flag setting) F1 (first arm rotation information) F2 (second arm rotation information)
Format 2	x	1 to 4 (element setting)
Format 3	x	1 to 4 (element setting)
	n	0 to 39 (work number)
	Expression	For Axis or element setting: coordinate value, variables

Explanation Format 1: Acquires the value of the point data specified axis, the hand system flag, and the first arm and the second arm rotation information.

Format 2: Acquires a specified axis element from the shift coordinate data.

Format 3: Acquires a specified axis element from the work data.

Sample	Description
LOC1(P10)=A(1)	.........Axis 1 data of P10 is changed to the array A (1) value.
LOC2(S1)=B	.........2nd element (Y direction) of S1 is changed to the B value.
LOC3(W1)=C	.........3rd element (Z direction) of W1 is changed to the C value.
A(1)=LOC1(P10)	.........Axis 1 data of P10 is assigned to array A (1).
B(2)=LOC1(S1)	.........1st element (X direction) of S1 is assigned to array B (2).
C(3)=LOC1(W1)	.........1st element (X direction) of W1 is assigned to array C (3).

Related commands	Point variable, Shift variable, Work data

62 LSHIFT

Left-shifts a bit

Format

```
LSHIFT (expression 1, expression 2)
```

Explanation Shifts the <*expression 1*> bit value to the left by the amount of <*expression 2*>.
Spaces left blank by the shift are filled with zeros (0).

Sample	Description
`A=LSHIFT(&B10111011,2)`	........The 2-bit-left-shifted &B10111011 value (&B11101100) is assigned to A.

Related commands	RSHIFT

63 MCHREF

Acquires the machine reference value (axes: sensor method / stroke-end method)

Format

`MCHREF [robot number](axis number)`

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation This function returns the return-to-origin or absolute-search machine reference value (unit: %) of specified axes.

This function is valid only for axes whose return-to-origin method is set as "Sensor" or "Stroke-end".

Sample	Description
`A=MCHREF(1)`	.........The machine reference of axis 1 of robot 1 is assigned to variable A.

64 MID$

Acquires a character string from a specified position

Format

```
MID$ (character string expression, expression 1, expression 2)
```

Value	Range
Expression 1	1 to 255
Expression 2	0 to 255

Explanation This function extracts a character string of a desired length (number of characters) from the character string specified by <character string expression>. <expression 1> specifies the character where the extraction is to begin, and <expression 2> specifies the number of characters to be extracted.

- If the <expression 1> and <expression 2> values violate the permissible value ranges, An error will occur
- If <expression 2> is omitted, or if the number of characters to the right of the character of <expression 1> is less than the value of <expression 2>, then all characters to the right of the character specified by <expression 1> will be extracted.
- If <expression 1> is longer than the character string, the extracted value will be a null string (empty character string).

Sample	Description
`B$=MID$(A$,2,4)`	.........The 2nd to 4th characters (up to the 5th characters) of A$ are assigned to B$.

Related commands	LEFT$, RIGHT$

65 MO

Outputs a specified value to the MO port or acquires the output status

Format

```
1. LET MOm(b, ..., b) = expression
2. LET MO(mb, ..., mb) = expression
```

Notation	Value	Range / Meaning
m	Port Number	2 to 7, 10 to 17, 20 to 27, 30 to 37
b	Bit Definition(*)	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.

Explanation Outputs a specified value to the MO port.

In order to maintain the origin sensor status and axis HOLD status at each axis, ports "30" to "37" cannot be used as output ports (these ports are for referencing only). (Ports 32, 33, 36, and 37 are reserved by the system.)

Reference * Chapter 3 "10 Bit Settings"

Ports "30", "31", "34", and "35" outputs

Bit	7	6	5	4	3	2	1	0
Port 30	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Port 31	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9
	Origin sensor status 0: ON; 1: OFF (Axis 1 is not connected)							
Port 34	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Port 35	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9
	HOLD status 0: No HOLD / 1: HOLD (Axis 1 is not connected)							

MEMO

For details regarding MO ports "30" to "37", refer to Chapter 3 "9.5 Internal output variable".

Sample	Description
`MO2()=&B10111000`	..........`MO(27,25,24,23) are turned ON, and MO(26,22,21,20) are turned OFF.`
`MO2(6,5,1)=&B010`	..........`MO(25) are turned ON, and MO (26,21) are turned OFF.`
`MO3() = 15`	..........`MO(33,32,31,30) are turned ON, and MO(37,36,35,34) are turned OFF.`
`MO(37,35,27,20)=A`	..........`The contents of the 4 lower bits acquired when variable A is converted to an integer are output to MO(37,35,27,20), respectively.`

MO

Functions

Format

```
1. LET expression = MOm(b, ..., b)
2. LET expression = MO(mb, ..., mb)
```

Notation	Value	Range
m	Port Number	2 to 7, 10 to 17, 20 to 27, 30 to 37
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

Explanation Acquires the output status of the specified MO port.

Sample	Description
`A%= MO0()`	………Output status of ports MO(07) to MO(00) is assigned to variable A%.
`A%= MO0(6, 5, 1)`	………Output status of MO(06), MO(05) and MO(01) is assigned to variable A%. (If all above signals are 1(ON), then A%=7.)
`A%=MO(17,15,00)`	………Output status of M0(17), MO(15) and M0(00) is assigned to variable A%. (If all above signals except M0(15) are 1 (ON), then A%=5.)
`A%=MO(377,365,255,123)`	………Output status of M0(377), MO(365), MO(255) and M0(123) is assigned to variable A%. (If all above signals except M0(15) are 1 (ON), then A%=15.)

Related commands RESET, SET

66 MOTOR

Controls the motor power status

Format	

`MOTOR`	`ON`
	`OFF`
	`PWR`

Explanation This command controls the motor power on/off. The servo on/off of all robots can also be controlled at the same time.

- ON: Turns on the motor power. All robot servos are also turned on at the same time.
- OFF: Turns off the motor power. All robot servos are also turned off at the same time to apply the dynamic brake. For the axis with the brake, the brake is applied to lock it.
- PWR: Turns on only the motor power.

Sample	Description
`MOTOR ON`	………`Turns on the motor power and all robot servos.`

67 MOVE

Moves robot to the absolute position

Format

```
MOVE robot number (axis number,...)  PTP  , point of destination, option,
                                      P   option...
                                      L
                                      C
```

Explanation Executes absolute movement of robot (axis).
It is not enabled for axes of other robots or for auxiliary axes.

Value	Range / Type
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (Multiple axes specifiabl. If not input, all axes are specified.)
PTP, P, L, C	Movement type. PTP/P: PTP, L: Linear interpolation, C: Circular interpolation
Point of Destination	Robot stopping (target) position. Specify the following data format: • Direct numeric value (coordinate data) • Point definition (Point number) • Point name* * For the method of adding/editing point name, refer to "Point editing" in RCX 3 user's manual.
Option multiple options specifiable	Relative Speed setting, Absolute speed setting, Linear speed setting Arch motion setting STOPON condition setting, CONTON condition setting, CONT setting, Acceleration setting, Deceleration setting, Plane coordinate setting, Port output setting

Options	PTP	Linear interpolation	Arch interpolation	Remarks
Relative speed setting (SPEED)	✓	✓	✓	Enabled only in specified MOVE statement
Absolute speed setting (DSPEED)	✓	✓	✓	Enabled only in specified MOVE statement
Linear speed setting (VEL)	–	✓	✓	Enabled only in specified MOVE statement
Arch motion	✓	–	–	Enabled only in specified MOVE statement
STOPON condition setting	✓	✓	✓	Enabled only when program execution
CONTON condition setting	✓	✓	✓	Enabled only when program execution
CONT setting	✓	✓	✓	Enabled only in specified MOVE statement
Acceleration setting	✓	✓	✓	Enabled only in specified MOVE statement
Deceleration setting	✓	✓	✓	Enabled only in specified MOVE statement
Plane coordinate setting	–	–	✓	Enabled only in specified MOVE statement
Port output setting	–	✓	✓	Enabled only in specified MOVE statement

MOVE

Movement type

● PTP (point-to-point) movement (MOVE P)

Robot moves from the currently stopping position to the specified point position along the shortest path for each axis. The path is thus not a straight line.

- Execution START condition: Movement of all specified axes is complete (within the tolerance range*1).
- Execution END condition: All specified axes have entered the OUT position range*2.

When two or more axes are specified, they will reach their target positions simultaneously. The movement path of the axes is not guaranteed.

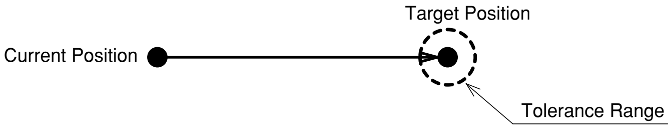
Sample	Description
`MOVE P,P0`	.........`Robot 1 moves from its current position to the position specified by P0. (the same occurs for MOVE PTP, P0).`
`MOVE P,END _ POINT`	.........`Robot 1 moves from its current position to the position specified by point name "END _ POINT".`

MEMO

- PTP movement is faster than interpolation movement, but when executing continuous movement to multiple points, a positioning stop occurs at each point.
- Refer to "Point editing" in RCX3 user's manual for details of adding and editing point names.

***1) Axis parameter "Tolerance <TOLE>"**

This parameter sets the positioning completion range to the target position when the robot moves.
When the current position of the robot enters the specified range, this is judged to the positioning completion.



Note) Depending on the movement type, the timing of the command completion (the timing when the command on the next line is executed) differs from one judged to the positioning completion .

MOVE

***2) Caution regarding commands which follow the MOVE P command; Axis parameter "OUT position <OUTPOS>"**

This parameter sets the execution completion range to the target position when a PTP movement command is executed.

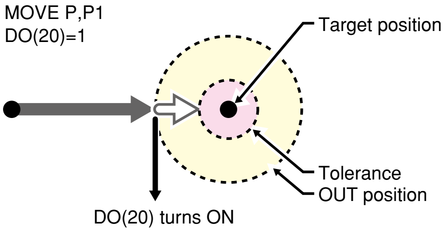
If the next command following the MOVE P command is an executable command such as a signal output command, that next command will start when the movement axis enters the OUT position range. In other words, that next command starts before the axis arrives within the target position tolerance range.

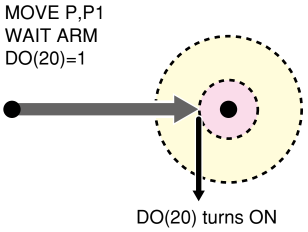
Signal output (DO, etc.)	Signal is output when the axis enters within OUT position range.
DELAY	DELAY command is executed and standby starts, when the axis enters the OUT position range.
HALT	Program stops and is reset when the axis enters the OUT position range. Therefore, the axis movement also stops.
HALTALL	All programs in execution stop when the axis enters the OUT position range, task 1 is reset, and other tasks terminate. Therefore, the movement also stops.
HOLD	Program temporarily stops when the axis enters the OUT position range. Therefore, the axis movement also stops.
HOLDALL	All programs in execution temporarily stop when the axis enters the OUT position range. Therefore, the movement also stops.
WAIT	WAIT command is executed when the axis enters the OUT position range.

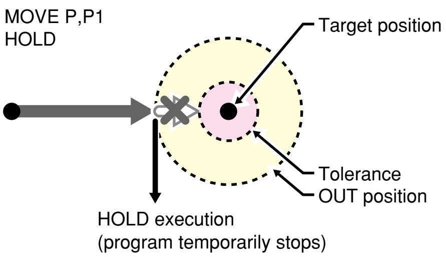
The WAIT ARM statements are used to execute the next command after the axis enters the tolerance range.

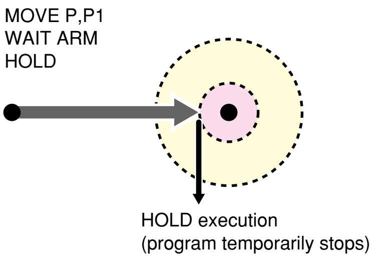
MEMO

The OUT position value is specified by parameter setting. This value can be changed within the program by using the OUTPOS command.


MOVE P,P1
DO(20)=1
Target position
Tolerance
OUT position
DO(20) turns ON


MOVE P,P1
WAIT ARM
DO(20)=1
DO(20) turns ON


MOVE P,P1
HOLD
Target position
Tolerance
OUT position
HOLD execution
(program temporarily stops)


MOVE P,P1
WAIT ARM
HOLD
HOLD execution
(program temporarily stops)

MOVE

● Linear interpolation movement (MOVE L)

Robot follows the linear path made by connecting 2 dots between the currently stopping position and the specified point position.

- Execution START condition: Movement of all specified axes is complete (within the tolerance range).
- Execution END condition: Movement of all specified axes has begun (within the tolerance range).

All movement axes arrive at the same time.

CAUTION

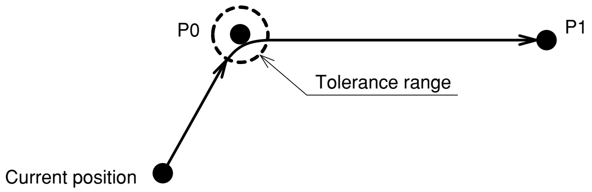
For the continuous motion specified by several points, CONT setting (continuous motion) is required.
In RCX340/RCX320, the motion of interpolation movement command and END condition are different from conventional model. Addition of the CONT setting to the movement command allows to the equivalent movement and END condition in conventional model.

MEMO

On robots with R-axis, the R-axis speed may become too fast and cause an error, depending on the R-axis movement distance.

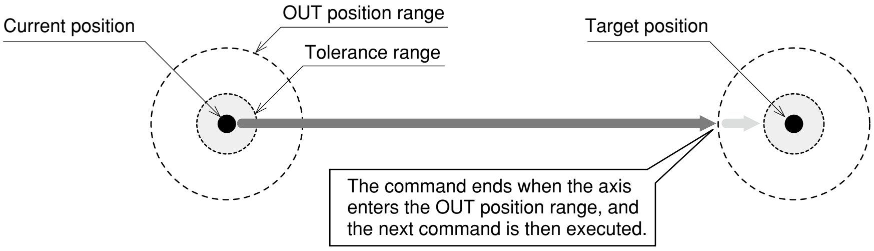
Sample	Description
`MOVE L,P0,P1`	.........The robot 1 moves (linear interpolation movement) from its current position to the position specified by P0, P1.

SAMPLE:MOVE L


P0
P1
Tolerance range
Current position

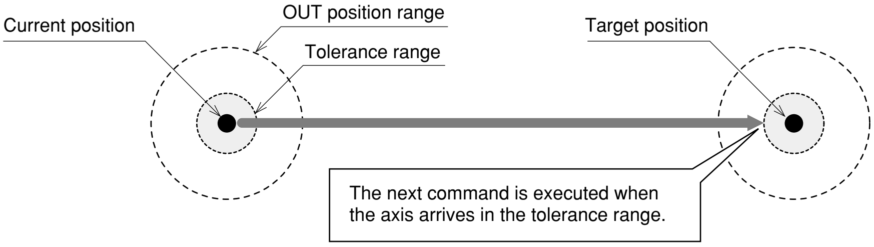
Movement command types and the corresponding movement

1. PTP movement


Current position
OUT position range
Tolerance range
Target position

The command ends when the axis enters the OUT position range, and the next command is then executed.

2. Interpolation movement


Current position
OUT position range
Tolerance range
Target position

The next command is executed when the axis arrives in the tolerance range.

MOVE

Circular interpolation movement (MOVE C)

Robot follows the circular path made by connecting 3 dots between the currently stopping position and the specified point positions.

In circular interpolation, an arc is generated based on 3 points: the current position, an intermediate position, and the target position. **Therefore, circular interpolation must be specified by an even number of points.**

- Execution START condition: Movement of all specified axes is complete (within the tolerance range).
- Execution END condition: Movement of all specified axes has begun.

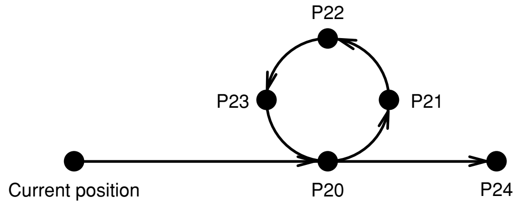
All movement axes arrive at the same time.

CAUTION

In RCX340/RCX320, the motion of interpolation movement command and END condition are different from conventional model. Addition of the CONT setting to the movement command allows to the equivalent movement and END condition in conventional model.

Sample	Description
`MOVE L,P20`	..........`Linear interpolation movement of robot 1 occurs from the current position to P20.`
`MOVE C,P21,P22,P23,P20`	..........`Circular interpolation movement occurs through points P21, P22, P23, P20.`
`MOVE L,P24`	..........`Linear interpolation movement occurs to P24.`

SAMPLE:MOVE C



MEMO

- Circular interpolation is possible within the following range: radius 0.100mm to 5,000.000mm.
- In order to create a locus of closed circle, connect 2 arcs.
- Circle distortion may occur, depending on the speed, acceleration, and the distance between points.
- On robots with an R-axis, the R-axis speed may become too fast and cause an error, depending on the R-axis movement distance.

MOVE

Point data setting types

● Direct numeric value input

PTP Linear interpolation Circular interpolation

Format

```
p1 p2 p3 p4 p5 p6 f f1 f2
```

Notation	Value
p1 to p6	Space-separated coordinate values for each axis
f	Hand system flag (SCARA robot only)
f1	First arm rotation information (YK-TW series only)
f2	Second arm rotation information (YK-TW series only)

Explanation Directly specifies coordinate data by a numeric value. Units for the coordinate is as follows;

- Integer: "pulse" units
- Real number (with decimal point): "mm/deg." units
- Integers and real numbers (mixed): All coordinate values will be handled in "mm/deg." units.

The types of movements in which this specification is possible are the PTP movement and the linear interpolation movement.

Notation: f) SCARA robots with coordinate data in "mm" units --> Hand system flags can be specified. (*1)

To set the hand system flag, set either 1 or 2 at "f".

If a number other than 1 or 2 is set, or if no number is designated, 0 will be set to indicate that there is no hand system flag.

f	0	Hand system flag is not set.
		Any value other than 1 / 2, or no setting.
	1	Right-handed system is used to move to a specified position.
	2	Left-handed system is used to move to a specified position.

Notation: f1,2) YK-TW series with coordinate data in "mm" units --> The first and second arm rotation information can be specified. (*1)

To set the rotation information, set "-1", "0", or "1" at f1 and f2.

Any other value or no setting will be processed as "0".

f1, 2	0	Indicates arm rotation information where movement to the "0" position has been specified.
		Any value other than -1 / 0 / 1, or no setting.
	1	Indicates arm rotation information where movement to the "1" position has been specified.
	-1	Indicates arm rotation information where movement to the "-1" position has been specified.

Reference *1: Chapter 4 "3. Point data format"

CAUTION

- **When performing linear interpolation with a hand system flag specified, be sure that the same hand system is used at the current position and target position. If the hand system are different, an error will occur and robot movement will be disabled.**
- **When performing a linear interpolation, the current position's first arm and second arm rotation information must be the same as the movement destination's first arm and second arm rotation information. If the two are different, an error will occur and movement will be disabled.**

MOVE

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

Sample	Description
`MOVE P,10000 10000 1000 1000 0 0`	.........PTP movement of robot 1 occurs from current position to the specified position.
`MOVE P,100.0 100.0 50.0 45.0 0.0 0.0 2`	.........PTP movement of robot 1 occurs from current position to the specified position with Left-handed system.
`MOVE P,-180.0 -430.0 50.0 180.0 0.0 0.0 1 -1 1`	.........PTP movement of robot 1 occurs from current position to the specified position (first arm: -180°to 360°, second arm: 180° to 360°) with right-handed system.

● Point definition

PTP **Linear interpolation** **Circular interpolation**

Format

```
point expression , point expression...
```

Explanation Specifies a <point expression>. Two or more data items can be designated by separating them with a comma (,).

Circular interpolation must be specified by an even number of points.

CAUTION

When moving the robot by linear or circular interpolation to a point where a hand system flag is specified, be sure that the same hand system is used at both the current and target positions. If the hand system are different, an error will occur and robot movement will be disabled.

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

Sample	Description
`MOVE P,P1`	.........Robot 1 moves from the current position to the position specified by P1.
`MOVE P,P20,P0,P100`	.........Robot 1 moves in sequence from the current position to positions specified by P20, P0, P100.

CAUTION

When performing a linear and circular interpolation, the current position's first arm and second arm rotation information must be the same as the movement destination's first arm and second arm rotation information. If the two are different, an error will occur and movement will be disabled.

MOVE

● Point name definition

PTP **Linear interpolation** **Circular interpolation**

Format

point name *, point name...*

Explanation Specifies a <point name>. Two or more data items can be designated by separating them with a comma (,). Circular interpolation must be specified by an even number of points.

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting

Sample	Description
`MOVE P,PICK_POINT`	........Robot 1 moves from the current position to positions specified by the point name "PICK_POINT".
`MOVE C, CIRCLE_PNT1,CIRCLE_PNT2`	........Robot 1 moves in coordinates specified by the current position and point name "CIRCLE_PNT1" and "CIRCLE_PNT2" in circular interpolation movement.

Option types

● Relative speed setting (SPEED)

PTP **Linear interpolation** **Circular interpolation**

Format

1. SPEED = *expression*
2. S = *expression*

Value	Range
Expression	1 to 100 (units: %)

Explanation Specifies the program speed in an <expression>.

Robot max. speed (mm/sec or deg/sec) × automatic movement speed (%) × program movement speed S (%)

"S" setting superimposes the speed on the current automatic movement speed.

automatic movement speed (%) × program movement speed S (%) = actual speed (%)

100%	50%	50%
50%	50%	25%

NOTE

This option specifies only the maximum speed and does not guarantee the movement at the specified speed.
- Automatic movement speed: Specified by programming box operation or by the ASPEED command.
- Program movement speed: Specified by SPEED commands or MOVE, DRIVE speed settings.

Sample (Automatic movement speed: 80%)	Description
`MOVE P,P0`	........PTP movement to P0 (Actual speed is 80%)
`MOVE P,P1,S=50`	........PTP movement to P1 (Actual speed is 40%)

MOVE

● Absolute speed setting (DSPEED)

PTP Linear interpolation Circular interpolation

Format

```
1. DSPEED = expression
2. DS = expression
```

Value	Range
Expression	0.01 to 100.00 (units: %)

Explanation Specifies the ratio to the maximum speed of the robot. (This setting is enabled only for the specified MOVE statement.)

Robot max. speed (mm/sec. or deg./sec.) × movement speed DS (%)

Movement always occurs at the DSPEED <expression> value (%) without being affected by the automatic movement speed value (%).

NOTE

SPEED option and DSPEED option cannot be used together.

Sample (Automatic movement speed: 80%)	Description
`MOVE P,P0`	………PTP movement to P0 (Actual speed is 80%)
`MOVE P,P1,DS=50`	………PTP movement to P1 (Actual speed is 40%)
`MOVE P,P2,DS=0.1`	………PTP movement to P2 (Actual speed is 0.1%)

● Speed setting (VEL)

PTP Linear interpolation Circular interpolation

Format

```
VEL = expression
```

Value	Range
Expression	0.01 to 100.00 (units: %)

Explanation Specifies the maximum composite speed (in "mm/sec." units) of the XYZ axes in an <expression>. This option is enabled only for the specified MOVE statement.

The setting "VEL=" moves a robot in the specified velocity regardless of automatic movement speed.

NOTE

- This option specifies only the maximum resultant speed and does not guarantee movement at the specified speed.
- Although the values after decimal point can be entered, it is removed when execution and does not affect the motion.

Sample	Description
`MOVE L,P10,VEL=100`	………Robot 1 moves from the current position to the position specified by P10 at the maximum composite speed of 100 mm/sec. of the XYZ axis.

MOVE

● Arch motion setting

PTP Linear interpolation Circular interpolation

Format

```
x = expression {expression 1, expression 2}
```

Value	Contents
x	Specifies an arch axis from A1 to A6
Expression	Arch position (Specify with Direct numeric value / or / Variable) Integer value: "pulse" units. Real number (with decimal point): "mm/deg." units.
Expression 1	Linear distance from the start (current) position; Arch distance 1 Integer value: "pulse" units. Real number (with decimal point): "mm/deg." units.
Expression 2	Linear distance to the end (target) position; Arch distance 2 Integer value: "pulse" units. Real number (with decimal point): "mm/deg." units.

MEMO

- When there is a real value in any of the <*expression*>, <*expression 1*>, and <*expression 2*>, all expressions are handed as real value.
- The Value specified in <*expression*> is based on the robot coordinates. Settings such as hand definition and work definition are not considered.

Explanation

1. The "x" specified axis begins moving toward the position specified by the <expression> ("1" shown in the Fig. below).
2. When the axis specified by "x" moves the arch distance 1 or more, other axes move to their target positions ("2" shown in the figure below).
3. The axis specified by "x" moves to the target position so that the remaining movement distance becomes the arch distance 2 when the movement of other axes is completed ("3" shown in the figure below).
4. The command ends when all axis enter the OUT position range.

This option can be used only for PTP movement.

When the axis specified by "x" is the first arm or second arm of the SCARA robot or the axis 1 or axis 2 of the XY robot, the <expression> and target position value are limited to an integer (pulse units).

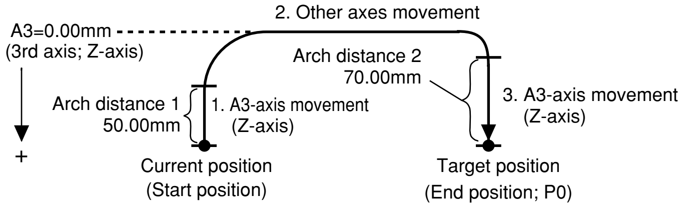
NOTE

The axis arch distance parameters can be changed using ARCHP1/ARCHP2 (arch pulse1 and 2 are equivalent to arch distance 1 and 2. respectively). The smaller the value, the shorter the movement execution time.

Sample **Description**

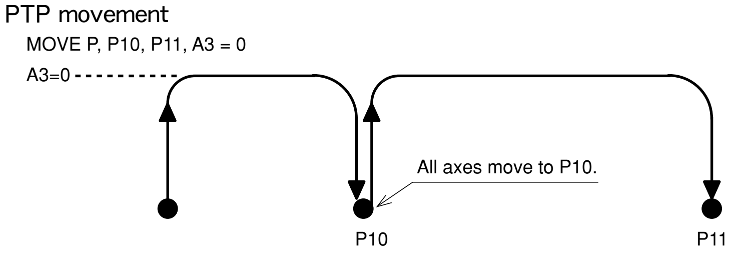
```
MOVE P,P0,A3=0.00 {50.00, 70.00}

            .........The A3-axis moves from the current position to the "0.00 mm" position.
                 After that, other axes move to P0. Finally, the A3-axis moves to P0.
```



MEMO

When multiple points are specified in PTP movement, the axis in arch motion setting also moves to the target position.



● STOPON condition setting

PTP **linear interpolation** **Circular interpolation**

Format

`STOPON conditional expression`

Explanation Stops movement when the conditions specified by the conditional expression are met.

Because this is a deceleration type stop, **there will be some movement (during deceleration) after the conditions are met.**

If the conditions are already met before movement begins, no movement occurs, and the command is terminated.

This option can only be used for PTP movement and linear interpolation movement.

This option is enabled only when program execution.

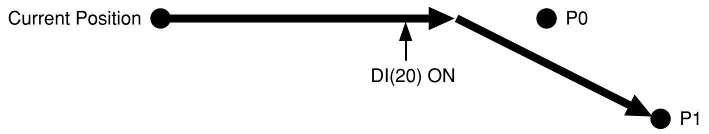
CAUTION

If STOPON condition is simultaneously specified with CONTON and CONT setting, the lower setting will be invalidated as shown below;
STOPON condition setting > CONTON condition setting > CONT setting

Sample **Description**

```
MOVE P,P0,STOPON DI(20)=1
MOVE P, P1

          .........Robot 1 moves from the current position to the position specified
             by P100. If the "DI (20) = 1" condition is met during movement, a
             deceleration and stop occurs.
             The next step (PTP movement to P1) is then executed.
```



MEMO

When the conditional expression used to designate the STOPON condition is a numeric expression, expression value other than "0" indicates a TRUE status, and "0" indicates a FALSE status.

MOVE

● CONTON condition setting (Continuous Motion)

PTP **linear interpolation** **Circular interpolation**

Format

```
CONTON conditional expression
```

Explanation When the conditions specified by the conditional expression are met, the robot starts deceleration stop and executes the next command without waiting the movement completion (entering the tolerance range) of axis.
The deceleration movement distance will be generated during the deceleration stop.

If the next command is a movement command, the 2 movement paths are linked by connecting the deceleration and acceleration sections, enabling continuous movement without intermediate stops.

- If the conditions are not met, the robot moves to the specified target position and terminates the command.
- This option is enabled only when a program execution.

CAUTION

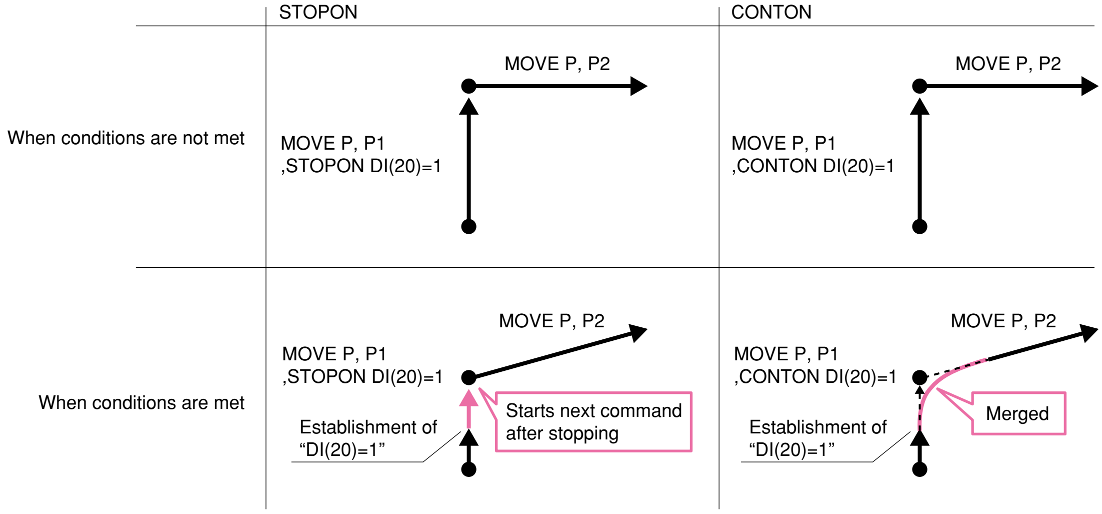
If STOPON condition is simultaneously specified with CONTON and CONT setting, the lower setting will be invalidated as shown below;
STOPON condition setting > CONTON condition setting > CONT setting

Sample **Description**

```
MOVE P,P1,CONTON DI(20)=1

             .........Robot 1 moves from the current position to the position specified by P1.
                  If the "DI (20) = 1" condition is met during movement,
                  the robot starts decelerating and executes the next step.
```

Difference from STOPON condition setting


STOPON
CONTON
When conditions are not met
MOVE P, P2
MOVE P, P1
,STOPON DI(20)=1
MOVE P, P2
MOVE P, P1
,CONTON DI(20)=1
When conditions are met
MOVE P, P2
MOVE P, P1
,STOPON DI(20)=1
Establishment of
"DI(20)=1"
Starts next command
after stopping
MOVE P, P2
MOVE P, P1
,CONTON DI(20)=1
Establishment of
"DI(20)=1"
Merged

MEMO

When < conditional expression > is a numeric expression, expression value other than "0" indicates a TRUE status, and "0" indicates a FALSE status.

● CONT setting (Continuous Motion)

PTP **Linear interpolation** **Circular interpolation**

Format

```
CONT
```

Explanation When movement is executed with CONT setting option, Movable axes will begin to execute the next command without waiting the completion their movement (entering the tolerance range). If the next command is a movement command, the 2 movement paths are linked by connecting the deceleration and acceleration sections, enabling continuous movement without intermediate stops.

This option is enabled only for the specified MOVE statement.

CAUTION

- **In RCX340/RCX320, the motion of interpolation movement command and END condition are different from conventional model. Addition of the CONT setting to the movement command allows to the equivalent movement and END condition in conventional model.**
- **If STOPON condition is simultaneously specified with CONTON and CONT setting, the lower setting will be invalidated as shown below;**
  STOPON condition setting > CONTON condition setting > CONT setting

NOTE

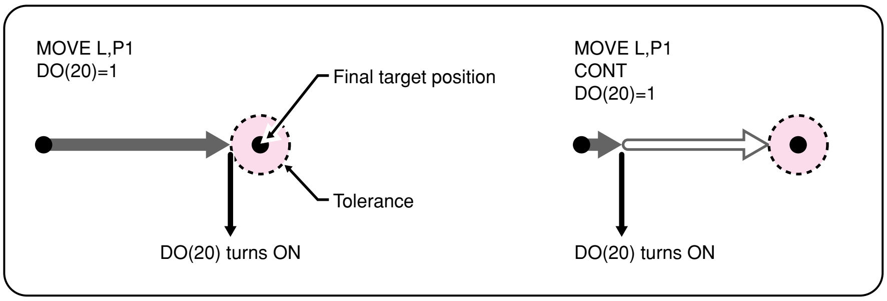
The CONT setting can be used to reduce the movement END positioning time. The path to the target point is not guaranteed.

Caution regarding MOVE L / MOVE C command with CONT setting:

If the next command following the MOVE L / MOVE C command with CONT setting is an executable command such as a signal output command, that next command will start immediately after axis movement begins. In other words, that next command starts before the axis arrives within the target position tolerance range.

Signal output (DO, etc.)	Signal is output immediately after movement along the final path begins.
DELAY	DELAY command is executed and standby starts immediately after movement along the final path begins.
HALT	Program stops and is reset immediately after movement along the final path begins. Therefore, axis movement also stops.
HALTALL	All programs in execution stop immediately after movement along the final path begins, task 1 is reset, and other tasks terminate. Therefore, the movement also stops.
HOLD	Program temporarily stops immediately after movement along the final path begins. Therefore, axis movement also stops.
HOLDALL	All programs in execution temporarily stop immediately after movement along the final path begins. Therefore, the movement also stops.
WAIT	WAIT command is executed immediately after movement along the final path begins.

MOVE command

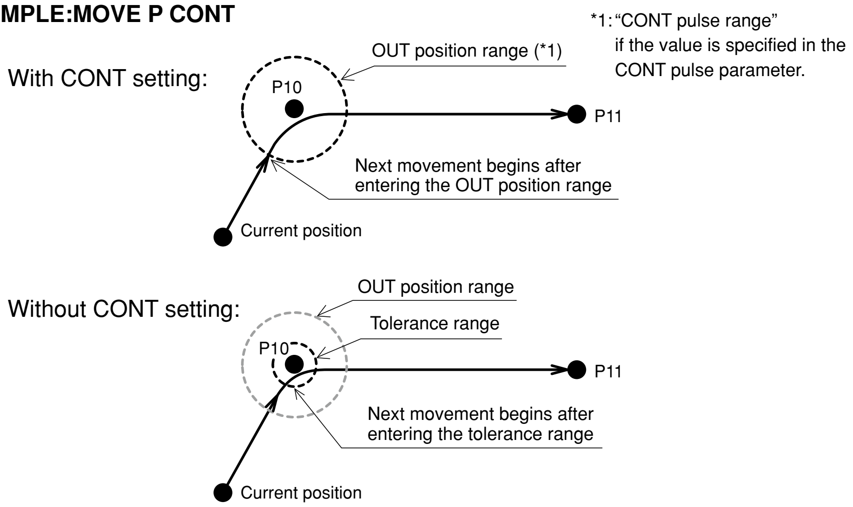


33808-R9-00

MOVE

Sample	Description
MOVE P,P10,P11,CONT	.........Robot 1 Moves from the current position to the position specified by P10, and then moves to P11 without waiting for the moving axes to arrive in the tolerance range.

SAMPLE:MOVE P CONT


With CONT setting:
*1:"CONT pulse range"
if the value is specified in the
CONT pulse parameter.
OUT position range (*1)
P10
P11
Next movement begins after
entering the OUT position range
Current position
Without CONT setting:
OUT position range
Tolerance range
P10
P11
Next movement begins after
entering the tolerance range
Current position

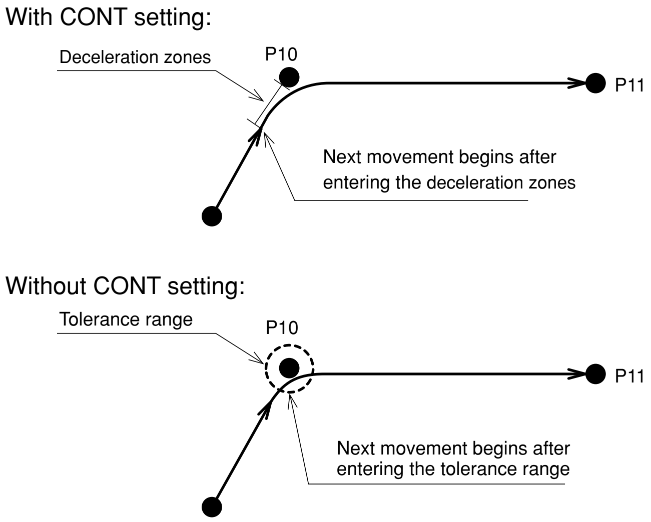
33814-R7-00

Sample	Description
MOVE L,P10,CONT MOVE L,P11	.........Robot 1 Moves from the current position to the position specified by P10, and then moves (linear interpolation movement) to P11 without waiting for the moving axes to arrive in the tolerance range, and completes the movement within the tolerance range.

MEMO

The interpolation movement with CONT setting doesn't stop at intermediate points in the continuous movement.

SAMPLE:MOVE L CONT


With CONT setting:
Deceleration zones
P10
P11
Next movement begins after
entering the deceleration zones
Without CONT setting:
Tolerance range
P10
P11
Next movement begins after
entering the tolerance range

33810-R9-00

Acceleration setting

PTP Linear interpolation Circular interpolation

Format

```
ACC = expression
```

Value	Range
Expression	1 to 100 (units: %)

Explanation Specifies the robot acceleration rate in the <expression>. The actual robot acceleration is determined by the acceleration coefficient parameter setting.

Acceleration coefficient Parameter × Acceleration

This option is enabled only for the specified MOVE statement.

Sample	Description
`MOVE L,P100,ACC=10`	.........Robot 1 moves at an acceleration rate of 10% from the current position to the position specified by P100.

Deceleration setting

PTP Linear interpolation Circular interpolation

Format

```
DEC = expression
```

Value	Range
Expression	1 to 100 (units: %)

Explanation Specifies the robot deceleration rate in an <expression>. The actual robot deceleration is determined by the acceleration coefficient parameter setting (the setting is specified as a percentage of the acceleration setting value (100%).

Acceleration coefficient Parameter × Deceleration

This option is enabled only for the specified MOVE statement.

Sample	Description
`MOVE L,P100,DEC=20`	.........Robot 1 moves at a deceleration rate of 20% from the current position to the position specified by P100.

● Coordinate plane setting

PTP Linear interpolation **Circular interpolation**

Format

```
XY
YZ
ZX
```

Value	Meaning
XY	XY coordinate plane
YZ	YZ coordinate plane
ZX	ZX coordinate plane

Explanation When circular interpolation is executed by setting coordinates, this option executes circular interpolation so that the projection on the specified coordinate plane becomes a circle.

This option can be used for circular interpolation movement and is enabled only for the specified MOVE statement.

NOTE

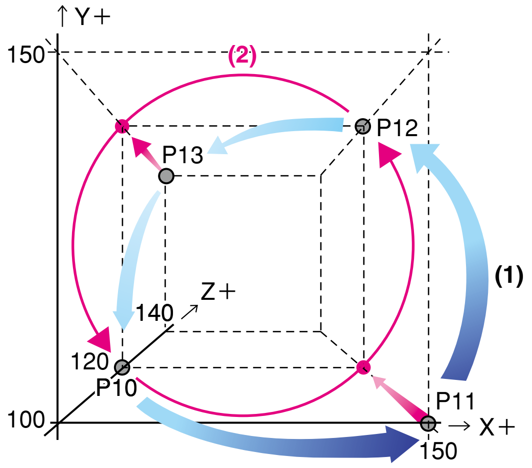
- If no coordinate plane is specified, the robot moves along a 3-dimensional circle.
- When a 2-axis robot is used, the robot moves along a circle on the XY plane.

Sample **Description**

```
P10 =  100.000 100.000 20.000  0.000  0.000  0.000
P11 =  150.000 100.000  0.000  0.000  0.000  0.000
P12 =  150.000 150.000 20.000  0.000  0.000  0.000
P13 =  100.000 150.000 40.000  0.000  0.000  0.000

MOVE  P,P10             .........Robot 1 moves from the current position to the position
                                 specified by P10.
MOVE  C,P11,P12
MOVE  C,P13,P10         .........Moves continuously along a 3-dimensional circle generated at
                                 P10, P11, P12, and P12, P13, P10(1)
MOVE  C,P11,P12,XY
MOVE  C,P13,P10,XY      .........Moves continuously along a circle on an XY plane generated at
                                 P10, P11, P12, and P12, P13, P10. Z-axis moves to the position
                                 specified by P12 and P10 (the circle's target position)(2)
```

SAMPLE
MOVE C coordinate plane



33822-R9-00

A
B
C
D
E
F
G
H
I
J
K
L
M

● Port output setting

PTP **Linear interpolation** **Circular interpolation**

Format

```
DO    m(b,...,b)= expression 1 @ expression 2
MO
SO
```

Format

```
DO    (mb,...,mb)= expression 1 @ expression 2
MO
SO
```

Notation	Value	Range
m	Port Number	2 to 7, 10 to 17, 20 to 27
b	bit Definition(*)	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression 1	Value which is output to the specified port (only integers are valid).
	Expression 2	Position where the port output occurs. This position can be specified in "mm" units down to the 3rd decimal position.

Explanation During linear interpolation or circular interpolation movement, this command option outputs the value of <*expression 1*> to the specified port when the robot reaches the <*expression 2*> distance (units: "mm") from the start position.
The <*expression 2*> numeric value represents a circle radius (not arc length)centered on the movement START point.

This command option can only be used with linear or circular interpolation movement, and it can be specified no more than 2 times per MOVE statement.
If no hardware port exists, nothing is output.

CAUTION

Output to ports "0" and "1" is not allowed at DO and SO.

Reference * Chapter 3 "10 Bit Settings"

Sample 1 **Description**

```
MOVE P,P0
MOVE L,P1,DO2()=105@25.85
            ........During linear interpolation movement of robot 1 to P1, 105 (&B01101001)
                is output to DO2() when the robot reaches a distance of 25.85mm from P0.
```

Sample 2 **Description**

```
A!=10
B!=20
MOVE L,P2,MO(22)=1@A!,MO(22)=0@B!
            ........After the robot 1 starts toward P2, MO(22) switches ON when robot 1
                leaves a distance of 10mm, and switches OFF when robot 1 leaves a
                distance of 20mm.
```

Related commands	MOVEI, MOVET, DRIVE, DRIVEI, WAIT ARM

68

MOVEI

Moves robot to the relative position

Format

```
MOVEI  robot number (axis number,...)  PTP  ,point of destination, option,
                                        P   option...
                                        L
```

Explanation Executes relative position movement of robot (axis).
It is not enabled for axes of other robots or for auxiliary axes.

Value	Range / Type
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (Multiple axes specifiable. If not input, all axes are specified.)
PTP, P, L (*)	Movement type. PTP/P: PTP, L: Linear interpolation
Point of Destination (*)	Robot stopping (target) position. Specify the following data format: • Direct numeric value • Point definition (Point number)
Option (*)	Relative Speed setting, Absolute speed setting, Linear speed setting STOPON condition setting, CONTON condition setting, CONT setting, Acceleration setting, Deceleration setting,

* **Reference** "MOVE" statement (To use Sample program, replace "MOVE" in Sample to "MOVEI".)

Options	PTP	Linear interpolation	Remarks
Relative speed setting (SPEED)	✓	✓	Enabled only in specified MOVEI statement
Absolute speed setting (DSPEED)	✓	✓	Enabled only in specified MOVEI statement
Linear speed setting (VEL)	–	✓	Enabled only in specified MOVEI statement
STOPON condition setting	✓	✓	Enabled only when program execution
CONTON condition setting	✓	✓	Enabled only when program execution
CONT setting	✓	✓	Enabled only in specified MOVEI statement
Acceleration setting	✓	✓	Enabled only in specified MOVEI statement
Deceleration setting	–	✓	Enabled only in specified MOVEI statement

MEMO

If the MOVEI statement is interrupted and then re-executed, the movement target position can be selected at the "MOVEI/DRIVEI start position" setting in the controller parameter. For details, refer to RCX3 user's manual.

1) KEEP (default setting)	Continues the previous (before interruption) movement. The original target position remains unchanged.
2) RESET	Relative movement begins anew from the current position. The new target position is different from the original one (before interruption). (Backward compatibility)

Related commands	MOVE, MOVET, DRIVE, DRIVEI, WAIT ARM

69

MOVET

Performs relative movement of all robot axes in tool coordinates

Format

```
MOVET [robot number](axis number,...) PTP ,point of destination,option,
                                      P   option...
                                      L
```

Explanation Executes relative position movement of the specified axes in the tool coordinates.
It is not enabled for axes of other robots or for auxiliary axes.

Value	Range / Type
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (Multiple axes specifiabl. If not input, all axes are specified.)
PTP, P, L (*)	Movement type. PTP/P: PTP, L: Linear interpolation
Point of Destination (*)	Robot stopping (target) position. Specify the following data format: • Direct numeric value (Coordinate value) • Point definition (Point number)
Option (*)	Relative Speed setting, Absolute speed setting, Linear speed setting STOPON condition setting, CONTON condition setting, CONT setting, Acceleration setting, Deceleration setting,

* **Reference** "MOVE" statement (To use Sample program, replace "MOVE" in Sample to "MOVET".)

Options	PTP	Linear interpolation	Remarks
Relative speed setting (SPEED)	✓	✓	Enabled only in specified MOVET statement
Absolute speed setting (DSPEED)	✓	✓	Enabled only in specified MOVET statement
Linear speed setting (VEL)	–	✓	Enabled only in specified MOVET statement
STOPON condition setting	✓	✓	Enabled only when program execution
CONTON condition setting	✓	✓	Enabled only when program execution
CONT setting	✓	✓	Enabled only in specified MOVET statement
Acceleration setting	✓	✓	Enabled only in specified MOVET statement
Deceleration setting	–	✓	Enabled only in specified MOVET statement

Related commands	MOVE, MOVEI, DRIVE, DRIVEI, WAIT ARM

70 MTRDUTY

Acquires the motor load factor of the specified axis

Format

```
MTRDUTY [robot number](axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the motor load factor (1 to 100 [%]) of the specified axis.

The motor load factor increases when the current value of the specified axis exceeds the rated current value. When the factor reaches 100%, "17.800 Motor overload" error occurs.

Sample	Description
`A=MTRDUTY(1)`	.........The motor load factor of axis 1 of robot 1 is assigned to variable A.

71 OFFLINE

Sets a specified communication port to the "offline" mode

Format

```
OFFLINE    ETH
           CMU
```

Explanation Changes the communication mode parameter in order to switch the communication mode to OFFLINE.

ETH	Changes the Ethernet communication mode parameter to OFFLINE , clears the transmission and reception buffers.
CMU	Changes the RS-232C communication mode parameter to OFFLINE, resets the communication error, and clears the transmission and reception buffers.
No setting	Changes the Ethernet and RS-232C communication mode parameter to OFFLINE, resets the communication error (RS-232C only), and clears the transmission and reception buffers.

MEMO

Online command is invalid in OFFLINE (mode).

Sample

```
OFFLINE
SEND CMU TO A$
SEND CMU TO P10
ONLINE
HALT
```

Reference For details of SEND statements, refer to "112 SEND" in this Chapter.

Related commands	ONLINE

72 ON ERROR GOTO

Jumps to a specified label when an error occurs

Format

```
1. ON ERROR GOTO label
2. ON ERROR GOTO 0
```

Explanation Even if an error occurs during execution of the robot language, this statement allows the program to jump to the error processing routine specified by the <*label*>, allowing the program to continue without being stopped (this is not possible for some serious errors.)

- If "0" is specified instead of the <*label*>, the program stops when an error occurs, and an error message displays.
- If ON ERROR GOTO "0" is executed at any place other than an error processing routine, the ON ERROR GOTO command is canceled (interruption canceled).
- The error processing routine can process an error using the RESUME statement and the error output information (ERR, ERL).

Error Output Information	ERR	Error code number
	ERL	Line number where error occurred

MEMO

- If a serious error such as "17.800: Motor overload" occurs, the program execution stops.
- The most recently executed "ON ERROR GOTO <label>" statement is valid.
- If an error occurs during an error processing routine, the program will stop.
- "ON ERROR GOTO <label>" statements cannot be used within error processing routines.

Sample **Description**

```
ON ERROR GOTO *ER1
FOR A = 0 TO 9
       P[A+10] = P[A]
NEXT A
*L99: HALT
'ERROR ROUTINE
*ER1:
IF ERR = &H000600CC THEN *NEXT1
                   .........Checks to see if a "Point doesn't exist" error has occurred.
IF ERR = &H000600CE THEN *NEXT2
                   .........Checks to see if a "Subscript out of range" error has occurred.
ON ERROR GOTO 0    .........Displays the error message and stops the program.

*NEXT1:            .........Jumps to the next line after the error line and resumes
       RESUME NEXT    program execution.

*NEXT2:            .........Jumps to label *L99 and resumes program execution.
       RESUME *L99
```

Related commands RESUME

73 ON to GOSUB

Executes the subroutine specified by the <*expression*> value

* GOSUB can also be expressed as "GO SUB".

Format

```
ON expression GOSUB label 1, label 2...
```

Value	Meaning
Expression	Expression whose result is 0 or positive integer

Explanation The <*expression*> value determines the program's jump destination.

An <*expression*> value of "1" specifies a jump to <*label 1*>, "2" specifies a jump to <*label 2*>, etc. Likewise, (<*expression*> value "n" specifies a jump to <*label n*>.)

If the <*expression*> value is "0" or if the <expression> value exceeds the number of existing labels, no jump occurs, and the next command is executed.
After executing a jump destination subroutine, the next command after the ON to GOSUB statement is executed.

Sample **Description**

```
'MAIN ROUTINE
*ST:
ON DI3() GOSUB *SUB1,*SUB2,*SUB3
                           .........*SUB1 to *SUB3 are executed.
GOTO *ST                   .........Checks to see if a "Point doesn't exist" error has occurred.

HALT
'SUB ROUTINE
*SUB1:
        MOVE P,P10,Z=0
        RETURN
*SUB2:
        DO(30) = 1
        RETURN
*SUB3:
        DO(30) = 0
        RETURN
```

Related commands	GOSUB, RETURN

74

ON to GOTO

Jumps to the label specified by the <*expression*> value

* GOTO can also be expressed as "GO TO".

Format

```
ON expression GOTO label 1, label 2...
```

Value	Meaning
Expression	Expression whose result is 0 or positive integer

Explanation The <*expression*> value determines the program's jump destination.

An <*expression*> value of "1" specifies a jump to <*label 1*>, "2" specifies a jump to <*label 2*>, etc. Likewise, (<*expression*> value "n" specifies a jump to <*label n*>.)

If the <*expression*> value is "0" or if the <*expression*> value exceeds the number of existing labels, no jump occurs, and the next command is executed.

Sample **Description**

```
'MAIN ROUTINE
*ST:
ON DI3() GOTO *L1,*L2,*L3
                            .........Jumps to *L1 to *L3 in accordance with the DI3() value.
                            .........Returns to *ST
GOTO *ST
HALT
'SUB ROUTINE
*L1:
        MOVE P,P10,Z=0
        GOTO *ST
*L2:
        DO(30) = 1
        GOTO *ST
*L3:
        DO(30) = 0
        GOTO *ST
```

Related commands	GOTO

75

ONLINE

Sets the specified communication port to the "online" mode

Format

```
ONLINE    ETH
          CMU
```

Explanation Changes the communication mode parameter in order to switch the communication mode to ONLINE.

ETH	Changes the Ethernet communication mode parameter to ONLINE , clears the transmission and reception buffers.
CMU	Changes the RS-232C communication mode parameter to ONLINE, resets the communication error, and clears the transmission and reception buffers.
No setting	Changes the Ethernet and RS-232C communication mode parameter to ONLINE, resets the communication error (RS-232C only), and clears the transmission and reception buffers.

MEMO

Online command is valid in ONLINE (mode).

Sample

```
OFFLINE
SEND CMU TO A$
SEND CMU TO P10
ONLINE
HALT
```

Reference For details of SEND statements, refer to "112 SEND" in this Chapter.

Related commands	OFFLINE

76 OPEN

Opens the specified General Ethernet Port

Format

```
OPEN GPm
```

Notation	Value	Range
m	General Ethernet Port Number	2 to 7, 10 to 17, 20 to 27, 30 to 37

Explanation Opens the communication port of the specified General Ethernet Port.

Sample **Description**

```
OPEN GP1          .........Opens the General Ethernet Port 1.
SEND "123" TO GP1 .........Sends the character strings "123" from the General Ethernet Port 1.
SEND GP1 TO A$    .........Receives the data from the General Ethernet Port 1
                           and saves the received data in the variable A$.
CLOSE GP1         .........Closes the General Ethernet Port 1.
```

Related commands	CLOSE, SEND, SETGEP, GEPSTS

77 ORD

Acquires a character code

Format

```
ORD (character string expression)
```

Explanation Acquires the character code of the first character in a <*character string expression*>.

Sample	Description
`A=ORD("B")`	.........66 (=&H42) is assigned to A.

Related commands	CHR$

78 ORGORD

Specifies/acquires the robot's return-to-origin sequence

Format

```
ORGORD [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	n to nnnnnn (n : 0 to 6)

Explanation Sets the axis sequence parameter for return-to-origin and absolute search operation of the robot specified by the <*robot number*>.

The 1 to 6 axes are expressed as "1 to 6" values, respectively, and the <*expression*> value must be 1-digit to 6-digit integer.
The same axis cannot be specified twice.
After the specified axes are returned to their origin points in sequence, from left to right, the remaining axes return to their origin points simultaneously.
If the <*expression*> value is "0", all axes will be returned to their origin points simultaneously.

Functions

Format

```
ORGORD [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the axis sequence parameter for return-to-origin and absolute search operation of the robot specified by the <*robot number*>.

Sample **Description**

```
A=3
ORGORD A   .........Return-to-origin is executed first for axis 3 of robot 1.
ORIGIN     .........After the return-to-origin of axis 3 of robot 1 is completed,
                    return-to-origin is executed for the remaining axes.
MOVE P,P0
A=ORGORD   .........Return-to-origin sequence parameter of robot 1 is assigned to variable A.

HALT
```

Related commands	ORIGIN

79 ORIGIN

Performs return-to-origin

Format

```
ORIGIN robot number, motor type
```

Value	Range / Meaning
Robot Number	0: all robots 1 to 4: specified robot only
Motor Type	0: all types 1: incremental motor only 2: absolute motor only 9: incomplete return-to-origin axis only (If omitted, 0 (all types) is specified.)

Explanation This statement performs return-to-origin of a robot, or absolute search for a semi-absolute axis.

If the movement is stopped at an intermediate point, "incomplete return-to-origin" status will occur.
If <*robot number*> is omitted or "0" is specified during multiple robots setting, the return-to-origin and absolute search are first performed for the robot 1 and then for the robots 2 to 4.

Sample	Description
`ORIGIN 0, 1`	.........`Performs return-to-origin for incremental motor axes only of all robots.`

Related commands	ORGORD, MCHREF

80 OUT

Turns ON the specified port output

Format

`OUT`	`DOm(b, ..., b)`	`, expression`
	`DO(mb, ..., mb)`	
	`MOm(b, ..., b)`	
	`MO(mb, ..., mb)`	
	`SOm(b, ..., b)`	
	`SO(mb, ..., mb)`	
	`LO0(b, ..., b)`	
	`LO(0b, ..., 0b)`	
	`TO0(b, ..., b)`	
	`TO(0b, ..., 0b)`	

Notation	Value	Range / Comtent
m	Port Number	2 to 7, 10 to 17, 20 to 27 If no hardware port exists, nothing is output.
b	Bit definition(*)	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	time 0 to 3600000 (units: ms)

Explanation This statement turns ON the specified port output and terminates the command. (The program proceeds to the next line.) Output to that port is then turned OFF after the time specified by the <expression> has elapsed. If the operation is stopped temporarily at an intermediate point and then restarted, that port's output is turned OFF when the remaining <expression> specified time has elapsed.

If this <expression> is omitted, the specified port's output remains ON.
Up to 16 OUT statements using <expressions> can be executed at the same time. Attempting to execute 17 or more OUT statements will activate error "6.225: No sufficient memory for OUT".

Reference * Chapter 3 "10 Bit Settings"

CAUTION

Output to ports "0" and "1" are not allowed at DO, and SO.

Sample	Description
`OUT DO2(),200`	........`Turns DO(27 to 20) ON, then turns them OFF 200 ms later.`
`OUT DO(37,35,27,20)`	........`Turns DO(37, 35, 27, 20) ON.`

Related commands	DO, MO, SO, TO, LO

81 OUTPOS

Specifies/acquires the OUT enable position parameter of the robot

Format

```
1. OUTPOS [robot number] expression
2. OUTPOS [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axist Number	1 to 6 (If not input, all axes are specified.)
Expression	1 to 9999999 (Unit: pulse

Explanation Changes the "OUT position" parameter of the specified axis to the value of <*expression*>.

Format 1: The change is applied to all axes of the specified robot.
Format 2: The change is applied only to the axis specified by <*axis number*>.

Reference "MOVE" Axis parameter; "OUT position <OUTPOS>"

Functions

Format

```
OUTPOS [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axist Number	1 to 6 (If not input, all axes are specified.)

Explanation Acquires the "OUT position" parameter's value for the specified axis.

Sample 1	Description
`OUTPOS 2000`	......Changes the OUTPOS parameter for all axes of Robot 1 to 2000

Sample 2	Description
`OUTPOS (3) = 2000`	......Changes the OUTPOS parameter for 3rd axis of Robot 1 to 2000

Sample 3	Description
`A% = OUTPOS(3)`	......Acquires the value of the OUTPOS parameter for 3rd axis of robot 1, assigns it to integer variable A%

OUTPOS

Sample

```
'CYCLE WITH DECREASING OUTPOS
DIM SAV(3)
GOSUB *SAVE_OUTPOS
FOR A=1000  TO 10000  STEP 1000
        GOSUB *CHANGE_OUTPOS
        MOVE P,P0
        DO3(0)=1
        MOVE P,P1
        DO3(0)=0
NEXT A
GOSUB *RESTORE_OUTPOS
HALT
*CHANGE_OUTPOS:
        FOR B=1 TO 4
                OUTPOS(B)=A
        NEXT B
        RETURN
*SAVE_OUTPOS:
        FOR B=1 TO 4
                SAV(B-1)=OUTPOS(B)
        NEXT B
        RETURN
*RESTORE_OUTPOS:
        FOR B=1 TO 4
                OUTPOS(B)=SAV(B-1)
        NEXT B
        RETURN
```

82 PATH

Specifies the motion path

Format

```
PATH [robot number](axis number,...)  L  point of destination , option,
                                      C  option...
```

Value	Range / Type
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (Multiple axes specifiabl. If not input, all axes are specified.)
L, C	Movement type. L: Linear interpolation, C: Circular interpolation
Point of Destination	Robot stopping (target) position. Specify the following data format: • Direct numeric value (Coordinate value) • Point definition (Point number)
Option	Speed setting, coordinate plane setting (for circular interpolation only), port output setting

Explanation Sets the motion path for the specified axis.
This command can only be executed between the PATH SET and PATH END commands.
If execution is attempted elsewhere, an error will occur.

CAUTION

- **Be careful not to set the same position in the coordinates as the start point and the following path points. If the position of each point is duplicated, an error might occur.**
- **When "R" axis only is specified in the coordinate attribute parameter, an error will occur.**
- **Only the X, Y and Z coordinate values among the specified points are valid for PATH motion. Any other coordinates use the coordinate values at the START point of the PATH motion; R-axis can not be moved to the specified point even if it is used.**

MEMO

When PATH command is executed on SCARA robots or Cartesian robots with rotation axes, the R-axis holds the coordinates (angles) at execution start.

Path motion types

● Linear interpolation movement

"PATH L..." is set for linear interpolation movement.

● Circular interpolation movement

"PATH C..." is set for circular interpolation movement.

Only the X, Y and Z coordinate values of the specified points are valid for PATH motion. Any other coordinates use the coordinate values of the PATH motion START point.

The motion path can be connected by repeated PATH commands ("PATH L", "PATH C") to allow movement without stopping.

PATH

Point data setting types

● Direct numeric value input

Linear interpolation Circular interpolation

Format

```
p1 p2 p3 p4 p5 p6 f f1 f2
```

Notation	Value
p1 to p6	Space-separated coordinate values for each axis
f	Hand system flag (SCARA robot only)
f1	First arm rotation information (YK-TW series only)
f2	Second arm rotation information (YK-TW series only)

Explanation Directly specifies coordinate data by a numeric value. Units for the coordinate is as follows;

- Integer: "pulse" units
- Real number (with decimal point): "mm/deg." units
- Integers and real numbers (mixed): All coordinate values will be handled in "mm/deg." units.

With this format, only 1 point can be specified as the movement destination coordinates.
The only type of movement specified by this point data setting is linear interpolation.
The hand system / first and second arm rotation information must be the same throughout the movement. They cannot be changed at any point along the path.

Notation: f) SCARA robots with coordinate data in "mm" units --> Hand system flags can be specified. (*1)

To set the hand system flag, set either 1 or 2 at "f". If a number other than 1 or 2 is set, or if no number is designated, 0 will be set to indicate that there is no hand system flag.

f	0	Hand system flag is not set.
		Any value other than 1 / 2, or no setting.
	1	Right-handed system is used to move to a specified position.
	2	Left-handed system is used to move to a specified position.

CAUTION

The hand system used during PATH motion must be the same as the hand system used at the path motion route's start point. The same applies if the path is to pass through points where hand system flags are set. Differing hand systems will cause an error and disable motion.

Notation: f1,2)YK-TW series with coordinate data in "mm" units -->
The first and second arm rotation information can be specified. (*1)

To set the rotation information, set "-1", "0", or "1" at f1 and f2.
Any other value or no setting will be processed as "0".

f1, 2	0	Indicates arm rotation information where movement to the "0" position has been specified.
		Any value other than -1 / 0 / 1, or no setting.
	1	Indicates arm rotation information where movement to the "1" position has been specified.
	-1	Indicates arm rotation information where movement to the "-1" position has been specified.

CAUTION

The first arm and second arm rotation information during PATH movement must be the same as the first arm and second arm rotation information at the PATH movement's START point. If the two are different, an error will occur and movement will be disabled..

Reference *1: Chapter 4 "3. Point data format"

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

Sample	Description
`PATH L,10000 10000 1000 1000 0 0`	………Sets the linear interpolation movement path of robot 1 in "pulse" units.
`IPATH L,150.000 250.000 10.000 30.000 0.000 0.000 1`	………The linear interpolation movement path of robot 1 is set in the coordinate values specified by the right-handed system in "mm" units.

● Point definition

Linear interpolation **Circular interpolation**

Format

point definition *, point definition...*

Explanation Specifies the movement destination as <point expression> value. Two or more data items can be designated by separating them with a comma (,).

For circular interpolation movement, 2 points must be specified for each arc.

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

CAUTION

- **The hand system used during PATH motion must be the same as the hand system used at the path motion route's start point. The same applies if the path is to pass through points where hand system flags are set. Differing hand systems will cause an error and disable motion.**
- **The first arm and second arm rotation information during PATH movement must be the same as the first arm and second arm rotation information at the PATH movement's START point. If the two are different, an error will occur and movement will be disabled.**

Sample	Description
`PATH L,P1,P2,P3`	………Specifies sequential linear interpolation movement of robot 1 from its current position to the positions specified by P1, P2 and P3 from its current position.
`PATH C P5,P6,P7,P8`	………Specifies circular interpolation movement of robot 1 through the following points: current position, P5, P6, and P6, P7, P8.

PATH

Option types

- **Speed setting 1** Linear interpolation Circular interpolation
- **Speed setting 2** Linear interpolation Circular interpolation

Reference "MOVE" statement (To use Sample program, replace "MOVE" in Sample to "PATH".)

- **Coordinate plane setting** Linear interpolation Circular interpolation

Format

```
XY
YZ
ZX
```

Reference "MOVE" statement (To use Sample program, replace "MOVE" in Sample to "PATH".)

- **Port output setting** Linear interpolation Circular interpolation

Format 1

```
DO   m(b, ..., b)= expression 1 @ expression 2
MO
SO
```

Format 2

```
DO   (mb, ... ,mb)= expression 1 @ expression 2
MO
SO
```

Reference "MOVE" statement

Sample **Description**

```
PATH SET
PATH L,P1,DO(20)=1@10
                  .........Specifies to output "1" to DO(20) at a 10mm radius position from the
                      START position during linear interpolation movement of robot 1 from
                      its current position to P1.
PATH L,P2,DO(21)=1@12.5
                  .........Specifies to output "1" to DO(21) at a 12.5mm radius position from P1
                      during linear interpolation movement of robot 1 from its current
                      position to P2.
PATH END
PATH START
```

Related commands	PATH SET, PATH END, PATH START

83

PATH END

Ends the path setting

Format

```
PATH [robot number] END
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Ends the path setting of specified robot's PATH motion.

The PATH END command must always be paired with a PATH SET command. The PATH motion path end-point is the final point specified by the final PATH command (PATH L, PATH C) which exists between the PATH SET and PATH END commands.

Attempting to execute a PATH END command when no PATH SET command has been executed will result in an error.

Sample	Description
`PATH END`	………`Ends the path setting of robot 1's PATH motion`

Related commands	PATH, PATH SET, PATH START

Reference Chapter 9 "PATH Statements"

84

PATH SET

Starts the path setting

Format

```
PATH [point definition] SET point definition
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Starts the path setting of specified robot's PATH motion.
Specifies the <point definition> position as the PATH motion start-point. (This only sets the PATH motion start point and does not actually begin robot motion.) If the <point definition> value is omitted, the current robot position is set as the start point.
However, if robot movement is in progress, the target position of that movement becomes the start point. (Example: The OUT position range is wider for the MOVE command which precedes the PATH SET command, so the robot is still moving when the PATH SET command is executed, etc.)
The PATH SET command must always be paired with a PATH END.

CAUTION

Be careful not to set the same position in the coordinates as the start point and the following path points. If the position of each point is duplicated, an error might occur.

NOTE

The PATH SET statement is available in software version 1.11 onwards.

Point data setting types

● Point definition

Format

```
point expression
```

Explanation The PATH motion's start-point is specified by the <point expression>.

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

CAUTION

- **The hand system used during PATH motion must be the same as the hand system used at the path motion route's start point.Differing hand systems will cause an error and disable motion.**
- **The first arm and second arm rotation information during PATH movement must be the same as the first arm and second arm rotation information at the PATH movement's START point. If the two are different, an error will occur and movement will be disabled.**

Sample	Description
`PATH SET P10`	………The start-point of the PATH motion is set to P10.
`PATH SET WHERE`	………The start-point of the PATH motion becomes the current position.

Reference Chapter 9 "PATH Statements"

PATH SET

- **Direct numeric value input**

Format

```
p1 p2 p3 p4 p5 p6 f f1 f2
```

Notation	Value
p1 to p6	Space-separated coordinate values for each axis
f	Hand system flag (SCARA robot only)
f1	First arm rotation information (YK-TW series only)
f2	Second arm rotation information (YK-TW series only)

Explanation Directly specifies coordinate data by a numeric value. Units for the coordinate is as follows;

- Integer: "pulse" units
- Real number (with decimal point): "mm/deg." units
- Integers and real numbers (mixed): All coordinate values will be handled in "mm/deg." units.

Notation: f) SCARA robots with coordinate data in "mm" units --> Hand system flags can be specified. (*1)

To set the hand system flag, set either 1 or 2 at "f".

If a number other than 1 or 2 is set, or if no number is designated, 0 will be set to indicate that there is no hand system flag.

f	0	Hand system flag is not set.
		Any value other than 1 / 2, or no setting.
	1	Indicates that a right-handed system is specified for the PATH motion's start-point
	2	Indicates that a left-handed system is specified for the PATH motion's start-point.

CAUTION

The hand system used during PATH motion must be the same hand system as that at the PATH motion's start-point. An error will occur if the hand systems are different.

Notation: f1,2)YK-TW series with coordinate data in "mm" units -->
The first and second arm rotation information can be specified. (*1)

To set the rotation information, set "-1", "0", or "1" at f1 and f2.

Any other value or no setting will be processed as "0".

f1, 2	0	Indicates arm rotation information where movement to the "0" position has been specified.
		Any value other than -1 / 0 / 1, or no setting.
	1	Indicates arm rotation information where movement to the "1" position has been specified.
	-1	Indicates arm rotation information where movement to the "-1" position has been specified.

CAUTION

The first arm and second arm rotation information during PATH movement must be the same as the first arm and second arm rotation information at the PATH movement's START point. If the two are different, an error will occur and movement will be disabled.

Reference *1: Chapter 4 "3. Point data format"

MEMO

At SCARA robots with a hand system flag set in the movement destination's coordinate data, the specified hand system will have priority over the current arm type or LEFTY/RIGHTY setting.

PATH SET

Sample	Description
`PATH SET 120 250.000 55.2 20.33 0 0`	………The PATH motion's start-point of robot 1 is specified in "mm" units as follows: 120.000 250.000 55.200 20.330 0.000 0.000.
`PATH SET -51200 80521 7045 204410 0 0`	………The PATH motion's start-point of robot 1 is specified in "pulse" units.

Related commands	PATH, PATH END, PATH START

85 PATH START

Starts the PATH motion

Format

```
PATH [robot number] START, option, option...
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Option	STOPON condition setting, CONTON condition setting, CONT setting

Options	PTP	Remarks
STOPON condition setting	✓	Enabled only while program execution
CONTON condition setting	✓	Enabled only while program execution
CONT setting	✓	Enabled only in specified PATH START statement

Explanation Starts PATH motion of specified robot.
Before PATH START can be executed, the PATH motion path must be specified by the PATH SET command, PATH commands (PATH L, PATH C) and the PATH END command. The robot must also be positioned at the motion path's start-point which was specified by the PATH SET command.

The robot's PATH motion speed is the automatic movement speed (%) which was in effect when the PATH START was executed, multiplied by the program movement speed (%) specified by the SPEED command or the (SPEED or S) option of the PATH command. A speed specified by the "VEL" option of the PATH command does not rely on the automatic movement speed.

After PATH motion begins, the PATH START command is terminated when the robot reaches the PATH motion end-point, or when movement is stopped by a stop input, etc.

PATH START

Option types

● STOPON condition setting

Format

```
STOPON conditional expression
```

Sample **Description**

```
PATH START,STOPON DI(20)=1
          .........Robot 1 starts PATH movement, if the "DI (20) = 1" condition is met
             during movement, a deceleration and stop occurs, and the next step is
             then executed.
```

Reference "MOVE" statement

● CONTON condition setting (Continuous motion)

Format

```
CONTON conditional expression
```

Sample **Description**

```
PATH START,CONTON DI(20)=1
          .........Robot 1 starts PATH movement, if the "DI (20) = 1" conditions are met
             during movement, robot starts decelerating and executes the next step.
```

Reference "MOVE" statement

● CONT setting (Continuous motion)

Format

```
CONT
```

Sample **Description**

```
PATH START,CONT
MOVE P,P10     .........PATH motion starts, and movement to P10 begins after the moving
                  axes enter the deceleration zone of final PATH motion.
```

Reference
- "MOVE" statement
- Chapter 9 "PATH Statements"

Related commands	PATH, PATH SET, PATH END

86 PDEF

Defines the pallet

Format

```
PDEF(Pallet definition number) = expression 1, expression 2
, expression 3, point definition
```

Value	Range / Meaning	
Pallet Definition Number	0 to 39	
Expression 1	Number of elements (NX) between P[1] and P[2]	Total number of elements: *<expression 1>* x *<expression 2>* x *<expression 3>* must be 32,767 or less.
Expression 2	Number of elements (NY) between P[1] and P[3]	
Expression 3	Number of elements (NZ) between P[1] and P[5]	
Point definition	The point used for a pallet definition. Continuous 5 points starting with the specified point are used.	

Explanation Defines the pallets to permit execution of the pallet movement command.

For previously defined pallet data, the contents of definition can be changed.
After specifying the number of points per axis, the equally-spaced points for each axis are automatically calculated and defined in the sequence shown in the figure below.

- If *<expression 3>* (Z-axis direction) is omitted, the value becomes "1".
- The total number of elements defined for a single pallet must not exceed 32,767.

If the point specification is omitted, 5 consecutive points are used, starting with the following points.

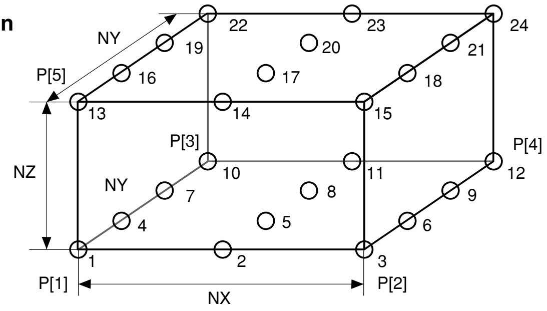
First/Top point = palette definition number x 5 + 10000

Example: PDEF(1)=2, 3, 4

Use 5 consecutive points with P10005 at the top. (P10005 - P10009)

However, if the palette data defined with the point specification is changed without specifying the points, the previously specified points will be used.

Automatic point calculation



Sample / Description

```
PDEF(1)=3,4,2,P3991
                 .........Pallet definition 1 is defined as 3 x 4 x 2 by using P3991 to P3995.
```

Related commands PMOVE

87

PGMTSK

Acquires the task number in which a specified program is registered

Format

```
PGMTSK (program number)
```

Value	Range
Program Number	1 to 100

Explanation Acquires the task number in which the program specified by <*program number*> is registered.

MEMO

If the program number which is not registered in the task is specified, "3.203: Program doesn't exist" error occurs.

Sample	Description
`A = PGMTSK(1)`	.........Assigns the task number in which the program number 1's program is registered to variable A.

Related commands	PGN, TSKPGM

88 PGN

Acquires the program number from a specified program name

Format

```
PGN ("program name")
```

Value	Range
Program Name	32 characters or less consisting of alphanumeric characters and underscore (_)

Explanation Acquires the program number of the program specified by <*program name*>.

The program name must be enclosed in double quotation marks (").

Sample	Description
`A = PGN("PG_SUB")`	………The program number of PG_SUB is assigned to variable A.

Related commands	PGMTSK, TSKPGM

89

PMOVE

Executes a pallet movement command for the robot

Format

```
PMOVE [robot number] (pallet definition number, pallet position number),
option, option...
```

Value	Range / Type
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Pallet Definition Number	0 to 39
Pallet Position Number	1 to 32767
Options	Relative speed setting, arch motion setting, STOPON condition setting, CONTON condition setting, CONT setting

Options	PTP	Remarks
Relative speed setting (SPEED)	✓	Enabled only in specified PMOVE statement
Arch motion	✓	Enabled only in specified PMOVE statement
STOPON condition setting	✓	Enabled only when program execution
CONTON condition setting	✓	Enabled only when program execution
CONT setting	✓	Enabled only in specified PMOVE statement

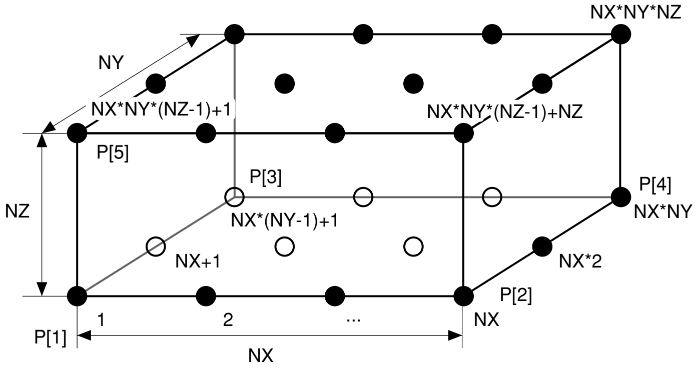
Explanation Executes "pallet move" command of the specified axes. (The specified pallet numbers must be registered in advance.)

It is not enabled for axes of other robots or for auxiliary axes.

- Movement type: PTP **Reference** "MOVE" statement
- Pallet definition number: Numeric expression
- Pallet position number: Numeric expression

The position numbers for each pallet definition are shown below.

Position numbers for each pallet definition



MEMO

Acquires the XYZ axes move to the position determined by calculated values, the R attribute axis moves to the position specified by pallet point data P [1].

Sample	Description
`PMOVE(1,16)`	........Robot 1 moves from its current position to the position specified by pallet position number 16 of pallet definition number 1.

PMOVE

Movement type

● PTP (point-to-point) movement

PTP movement begins after positioning of all movement axes is complete (within the tolerance range*1), and **the command terminates when the movement axes enter the OUT position range*2.** Although the movement axes reach their target positions simultaneously, their paths are not guaranteed.

***1) Axis parameter "Tolerance <TOLE>"**

This parameter sets the positioning completion range to the target position when the robot moves. When the current position of the robot enters the specified range, this is judged to the positioning completion.

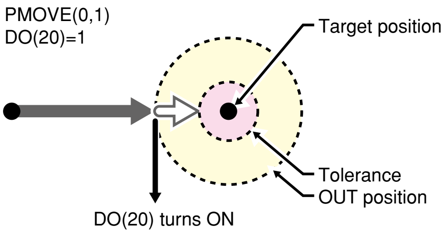
***2) Caution regarding commands which follow the MOVE P command; Axis parameter "OUT position <OUTPOS>"**

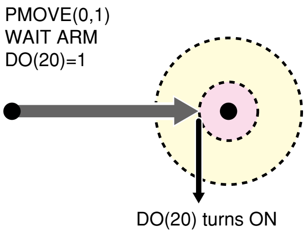
This parameter sets the execution completion range to the target position when a movement command is executed.

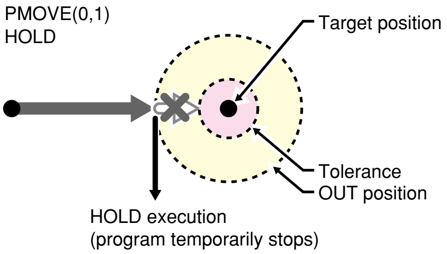
If the next command following the PMOVE command is an executable command such as a signal output command, that next command will start when the movement axis enters the OUT position range. In other words, that next command starts before the axis arrives within the target position OUT position range.

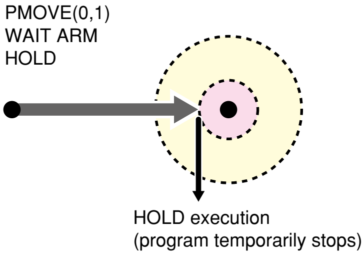
Signal output (DO, etc.)	Signal is output when the axis enters within OUT position range.
DELAY	DELAY command is executed and standby starts, when the axis enters the OUT position range.
HALT	Program stops and is reset when the axis enters the OUT position range. Therefore, the axis movement also stops.
HALTALL	All programs in execution stop when axis enters the OUT position range, task 1 is reset, and other tasks terminate. Therefore, the movement also stops.
HOLD	Program temporarily stops when the axis enters the OUT position range. Therefore, the axis movement also stops.
HOLDALL	All programs in execution temporarily stop when the axis enters the OUT position range. Therefore, the movement also stops.
WAIT	WAIT command is executed when the axis enters the OUT position range.

The WAIT ARM statement is used to execute the next command after the axis enters the tolerance range.


PMOVE(0,1)
DO(20)=1
Target position
Tolerance
OUT position
DO(20) turns ON


PMOVE(0,1)
WAIT ARM
DO(20)=1
DO(20) turns ON


PMOVE(0,1)
HOLD
Target position
Tolerance
OUT position
HOLD execution
(program temporarily stops)


PMOVE(0,1)
WAIT ARM
HOLD
HOLD execution
(program temporarily stops)

PMOVE

Option types

● Relative speed setting

Format

```
1. SPEED = expression
2. S = expression
```

Value	Range
Expression	1 to 100 (units: %)

Explanation Specifies the program speed in an <expression>.

Robot max. speed (mm/sec or deg/sec) × automatic movement speed (%) × program movement speed S (%)

"S" setting superimposes the speed on the current automatic movement speed.

automatic movement speed (%) × program movement speed S (%) = actual speed (%)

100%	50%	50%
50%	50%	25%

NOTE

This option specifies only the maximum speed and does not guarantee the movement at the specified speed.

- Automatic movement speed: Specified by programming box operation or by the ASPEED command.
- Program movement speed: Specified by SPEED commands or MOVE, DRIVE speed settings.

Sample (Automatic movement speed: 80%)	Description
`PMOVE(1,3),S=50`	.........Robot 1 moves from its current position to the position specified by pallet position number 3 of pallet definition number 1 at 50% (Actual speed is 40%) of the program speed.

● Arch motion setting

Format

```
x = expression, x = expression...
```

Value	Range
X	Specifies the Z,R,A,B axis.
Expression	An integer value is processed in "pulse" units. A real number (with decimal point) is process in "mm/deg." units.

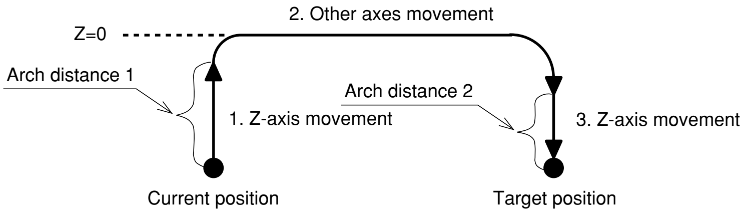
Explanation

1. The "x" specified axis begins moving toward the position specified by the <expression> ("1" shown in the figure below).
2. When the axis specified by "x" moves the arch distance 1 or more, other axes move to their target positions ("2" shown in the figure below).
3. The axis specified by "x" moves to the target position so that the remaining movement distance becomes the arch distance 2 when the movement of other axes is completed ("3" shown in the figure below).
4. The command ends when all axis enter the OUT position range.

MEMO

The Value specified in <*expression*> is based on the robot coordinates. Settings such as hand definition and work definition are not considered.

Sample	Description
`PMOVE(1,A),Z=0`	First the Z-axis of robot 1 moves from the current position to the "0 pulse" position. Then the other axes of robot 1 move to the position specified by pallet position number A of pallet definition number 1. Finally the Z-axis of robot 1 moves to the position specified by pallet position number A.



PMOVE

● STOPON condition setting

Format

STOPON *conditional expression*

Sample	Description
`PMOVE(A,16),STOPON DI(20)=1`	………Robot 1 moves to the position specified by pallet position number 16 of pallet definition number A, then decelerates and stops when DI(20) turns ON (the condition "DI(20) = 1" is met).
`PMOVE(A,17)`	………PTP movement to 17; Execution of the next step

Reference "MOVE" statement

● CONT setting (Continuous Motion)

Format

CONTON *conditional expression*

Sample	Description
`PMOVE(A,16),CONTON DI(20)=1`	………While robot 1 moves to the position specified by pallet position number 16 / pallet definition number A, if DI(20) turns ON (the condition "DI(20) = 1" is met), the robot starts decelerating and executes the next step.

Reference "MOVE" statement

Related commands	PDEF

90

Pn

Defines points within a program

Format

```
LET Pn = p1 p2 p3 p4 p5 p6 f f1 f2
```

Notation	Value	Range
n	Point number	0 to 29999
p1 to p6	Point data	According to the format
f	Hand system flag	1 or 2 (for SCARA robots only)
f1	First arm rotation information	-1, 0, 1 (YK-TW series only)
f2	Second arm rotation information	-1, 0, 1 (YK-TW series only).

Explanation Defines the point data.

1: "n" indicates the point number.
2: Input data for "p1" to "p6" must be separated with a space (blank).
3.: If all input data for "p1" to "p6" are integers (no decimal points), the movement units are viewed as "pulses". "p1" through "p6" then correspond to axis 1 through axis 6.
4: **If there is even 1 real number (with decimal point)** in the input data for "p1" through "p6", **the movement units are recognized as "mm"**.
5: The input data ranges are as follows:

For "pulse" units:	-6,144,000 to 6,144,000 range
For "mm" units:	-99,999.99 to 99,999.99 range

NOTE

If both integers and real numbers are used together (mixed), all coordinate values will be handled in "mm/deg" units.

Notation: f) **SCARA robots with coordinate data in "mm" units --> Hand system flags can be specified. (*1)**

To set the hand system flag, set either 1 or 2 at "f".

If a number other than 1 or 2 is set, or if no number is designated, 0 will be set to indicate that there is no hand system flag.

f	0	Hand system flag is not set.
		Any value other than 1 / 2, or no setting.
	1	Point setting in Right-handed system
	2	Point setting in Left-handed system

Notation: f1,2)YK-TW series with coordinate data in "mm" units -->
The first and second arm rotation information can be specified. (*1)

To set the rotation information, set "-1", "0", or "1" at f1 and f2.

Any other value or no setting will be processed as "0".

f1, 2	0	"0" is set at arm rotation information.
		Any value other than -1 / 0 / 1, or no setting.
	1	"1" is set at arm rotation information.
	-1	"-1" is set at arm rotation information.

Reference *1: Chapter 4 "3. Point data format"

Pn

Sample | **Description**

```
P1 = 0        0        0       0       0       0      ……Defines point data P1 to P3
P2 = 100.000  200.000  50.000  0.000   0.000   0.000
P3 = 10.000   0.000    0.000   0.000   0.000   0.000
P10= P2                                               ……Substitute P2 for P10
FOR A=10 TO 15
   P[A+1]=P[A]+P3
NEXT A
FOR A=10 TO 16
   MOVE P,P1,P[A]                                     ……PTP movement from the position of P1
NEXT A                                                  to the position of P[A]
HALT
```

NOTE

- All input values are handled as constants.
- If controller power is turned off during execution of a point definition statement, a memory-related error such as "9.702: Point data destroyed" may occur.

Related commands	Point assignment statement (LET)

91 PPNT

Creates pallet point data

Format

```
PPNT(pallet definition number, pallet position number)
```

Explanation Creates the point data specified by the pallet definition number and the pallet position number.

Sample	Description
`P10=PPNT(1,24)`	.........Creates, at P10, the point data specified by pallet position number 24 of pallet definition number 1.

Related commands	PDEF, PMOVE

92

PRINT

Displays the specified expression value at the programming box

Format

PRINT *expression*	, ;	*expression...*	, ;

Value	Contents
Expression	Character string, numeric value, variable

Explanation Displays a specified variable on the programming box screen.

Output definitions are as follows:

1: If numbers or character strings are specified in an <expression>, they display as they are. If variables or arrays are specified, the values assigned to the specified variables or arrays display.
2: If no <expression> is specified, only a line-feed occurs.
3: If the data length exceeds the screen width, a line-feed occurs, and the data is displayed on the next line.
4: If a comma (,) is used as a display delimiter, a space (blank) is inserted between the displayed items.
5: If a semicolon (;) is used as a display delimiter, the displayed items appear in succession without being separated.
6: If the data ends with a delimiter, a line-feed does not occur. When not ended with a display delimiter, a line-feed occurs with a display delimiter, a line-feed occurs.

MEMO

- Data communication to the programming box screen occurs in order for the PRINT statement to be displayed there. Therefore, program execution may be delayed when several PRINT statements are executed consecutively.
- On the programming box, the PRINT statement is displayed on "Message" space in "Automatic Operation (ALL TASK)" screen.

Sample	Description
`PRINT A`	.........`Displays the value of variable A.`
`PRINT "A1 =";A1`	.........`Displays the value of variable A1 after "A1 =".`
`PRINT "B(0),B(1) = ";B(0);",";B(1)`	
`PRINT P100`	.........`Displays the P100 value.`

Related commands	INPUT

93 PSHFRC

Specifies/acquires the pushing force parameter

Format

```
1. PSHFRC [robot number] expression
2. PSHFRC [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	-1000 to 1000 (unit: %)

Explanation Changes the "push force" parameter of the specified axis to the value of <expression>.
If the "F" option is omitted in the PUSH statement, the pushing control is executed with the setting of the pushing thrust parameter.

Actual pushing thrust is as follows.

- Rated thrust x <expression> / 100

[Format 1] Changes parameters of all axes.
[Format 2] Changes parameter of the axis specified by the <axis number>.

Sample	Description
`PSHFRC (1) = 10`	.........Changes the pushing thrust parameter of axis 1 of robot 1 to 10%.

Functions

Format

```
PSHFRC [robot number](axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the value of "push force" parameter of the specified axis.

Sample	Description
`A=PSHFRC (1)`	.........The pushing thrust parameter of axis 1 of robot 1 is assigned to variable A.

94 PSHJGSP

Specifies/acquires the push judge speed parameter

Format

```
1. PSHJGSP [robot number] expression
2. PSHJGSP [robot number] (axis number) = expression
```

Value	Range / Meaning
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	0 (Invalid), 1 to 100 (units: %)

Explanation Changes the "push judge speed" parameter of the specified axis to the value of the <*expression*>. If the push judge speed parameter is enabled, a pushing operation is detected only when the movement speed is below <*expression*> with the pushing thrust in the PUSH statement at the specified value.

The setting of <*expression*> can be specified as follows.

0: A pushing operation is detected if the pushing thrust reaches the specified value with the threshold setting invalid.

1 to 100: The movement speed in the PUSH statement is 100% to specify thresholds with a rate.

Sample	Description
`PSHJGSP (1) = 50`	.........Changes the push judge speed parameter of axis 1 of robot 1 to 50%.

Functions

Format

```
PSHJGSP [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the value of "push judge speed" parameter of the axis specified by <*axis number*>.

Sample	Description
`A=PSHJGSP (1)`	.........The pushing detection speed threshold parameter of axis 1 of robot 1 is assigned to variable A.

95 PSHMTD

Specifies/acquires a pushing type parameter

Format

```
1. PSHMTD [robot number] expression
2. PSHMTD [robot number] (axis number) = expression
```

Value	Range / Meaning
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	0: Totalizing method, 1: Resetting method

Explanation Changes the "push method" parameter of the specified axis to the value of the <*expression*>.

The pushing type in the PUSH statement can be specified as follows by the <expression>.

0: The time for the pushing thrust to reach the specified value is totalized to execute the pushing control end detection.

1: The pushing control end detection is executed only when the pushing thrust continuously reaches the specified value. If the pushing thrust is lower than the specified value, the elapsed time is reset to 0.

In format 1, the change occurs at all axes.
In format 2, the change occurs at the parameter of the axis specified by <axis number>.

Sample	Description
`PSHMTD (1) = 1`	.........Changes the push method parameter of axis 1 of robot 1 to the resetting method.

Functions

Format

```
PSHMTD [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the value of "push method" parameter of the axis specified by <*axis number*>.

Sample	Description
`A=PSHMTD (1)`	.........The pushing method parameter of axis 1 of robot 1 is assigned to variable A.

96

PSHRSLT

Acquires the status when PUSH statement ends

Format

`PSHRSLT [robot number] (axis number)`

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the end status of PUSH statement executed for the axis.

0: The PUSH statement was ended for a reason other than the arrival of the pushing time.
1: The PUSH statement was ended by the arrival of the pushing time.

Sample	Description
`PUSH(3,P1)`	.........Moves the axis 3 of robot 1 is under the pushing control to the position specified with P1.
`IF PSHRSLT(3) = 1 THEN`	
	.........Ended by the arrival of the pushing time.
`GOTO *OK`	
`ELSE`	.........Ended for a reason other than the arrival of the pushing time.
`GOTO *NG`	
`ENDIF`	

97 PSHSPD

Specifies/acquires the push speed parameter

Format

```
1. PSHSPD [robot number] expression
2. PSHSPD [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	1 to 100 (units: %)

Explanation Changes the "push speed" parameter of the axis to the value of <*expression*>.

The motion speed in the PUSH statement is as follows.

- Neither "S" nor "DS" is set as an option in the PUSH statement:

Max. speed of robot (mm/sec. or deg./sec.) x Push speed ratio (%) x Auto. movement speed (%) x Program movement speed (%)

- "S" is set as an option in the PUSH statement:

Max. speed of robot (mm/sec. or deg./sec.) x Push speed ratio (%) x Auto. movement speed (%) x Program movement speed specified by S (%)

- "DS" is set as an option in the PUSH statement:

Max. speed of robot (mm/sec. or deg./sec.) x Push speed ratio (%) x Movement speed of an axis specified by DS (%)

Sample	Description
`PSHSPD (1) = 50`	………Changes the push speed parameter of axis 1 of robot 1 to 50%.

Functions

Format

```
PSHSPD [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the "push speed" parameter value of the axis specified by <*axis number*>.

Sample	Description
`A=PSHSPD (1)`	………The push speed parameter of axis 1 of robot 1 is assigned to variable A.

98 PSHTIME

Specifies/acquires the push time parameter

Format

```
1. PSHTIME [robot number] expression
2. PSHTIME [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	1 to 32767 (unit: ms)

Explanation Changes the "push time" parameter of the specified axis to the value indicated in <*expression*>.
If the TIM option is omitted in the PUSH statement, the pushing control is executed with the setting of the push time parameter.
In format 1, the change occurs at all axes.
In format 2, the change occurs at the axis specified by the <axis number>.

Sample	Description
`PSHTIME (1) = 1000`	………Changes the push time parameter of axis 1 of robot 1 to 1000 ms.

Functions

Format

```
PSHTIME [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the value of "push time" parameter of the axis specified by the <*axis number*>.

Sample	Description
`A=PSHTIME (1)`	………The push time parameter of axis 1 of robot 1 is assigned to variable A.

99 PUSH

Executes a pushing operation for specified axes

Format

```
PUSH [robot number](axis number, expression), option, option
```

Value	Range / Meaning
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	Motor position (mm, degree, pulse) or point expression

Explanation Executes an absolute position movement of the specified axis with controlling the pushing thrust in the forwarding direction.

- Movement type : Pushing PTP movement of specified axis
- Point data setting : Direct coordinate data input, point definition
- Options : Pushing thrust setting, pushing time, pushing speed setting, STOPON condition setting, CONTON condition setting

Movement type

● PTP (point-to-point) of specified axis

PTP movement begins after the operation of the axis specified by the <axis number> is completed (within the tolerance range), controlling the pushing thrust in the forwarding direction of the axis.

The conditions to start the pushing control are as follows.
- Immediately after the start of movement of an axis by the PUSH statement
- After the merge operation is completed (when the PUSH statement is specified in the line next to the movement command with CONT specified)

The conditions to terminate the command are as follows.
- The axis arrives within the tolerance range of the target position.
- The status where the pushing thrust of the axis reaches <*pushing thrust value*> elapses the time specified to <*pushing time value*>.

The end status for the PUSH statement can be confirmed with the PSHRSLT statement.

The conditions to cancel the pushing thrust (to cancel the torque value defined by PUSH statement) are as follows.
- When PUSH command finishes and then either of movement commands below is executed. Note that only finishing PUSH command is not enough to cancel the pushing thrust
    1. In push status at PUSH command finish
       When the target axis starts to move in the opposite direction of that specified by PUSH statement
    2. The target axis moves to the target position at PUSH command finish (not in push status)
       When the target axis starts to move either direction
- When a servo off occurs
- When the power source to the controller is interrupted and restarted

PUSH

If the next command following to the PUSH statement is an executable command such as a signal output command, the next command will start when the pushing conditions of an axis to be moved are satisfied, or when an axis arrives within the tolerance range of the target position.

Example:

Signal output (DO, etc.)	Signal is output when the pushing conditions are satisfied or within the tolerance range.
DELAY	DELAY command is executed and standby starts, when the pushing conditions are satisfied or within the tolerance range.
HALT	Program stops and is reset when the axis enters the OUT position range. Therefore, the axis movement also stops.
HALTALL	When the pushing conditions are satisfied or within the tolerance range, the programs in execution are all stopped, task 1 is reset, and other tasks are terminated. Therefore, the axis movement also stops.
HOLD	Program temporarily stops when the axis enters the OUT position range. Therefore, the axis movement also stops.
HOLDALL	When the pushing conditions are satisfied or within the tolerance range, the programs in execution are all temporarily stopped. Therefore, the axis movement also stops.
WAIT	WAIT command is executed, when the pushing conditions are satisfied or within the tolerance range.

Sample	Description
`PUSH(1,P0)`	.........Axis 1 of robot 1 moves from its current position to the position specified by P0.

Point data setting types

● Direct numeric value input

The motor position is specified directly in <*expression*>.

If the motor position's numeric value is an integer, this is interpreted as a "pulse" unit. If the motor position's numeric value is a real number, this is interpreted as a "mm/degrees" unit, and each axis will move from the 0-pulse position to a pulse-converted position.

Sample	Description
`PUSH(1,10000)`	.........Axis 1 of robot 1 moves from its current position to the 100000 pulse position.
`PUSH[2](2,90.000)`	.........Axis 2 of robot 2 moves from its current position to the 90° position (when axis 2 is a rotating axis).

● Point definition

Point data is specified in <*expression*>. The axis data specified by the <*axis number*> is used. If the point expression is in "mm/degrees" units, movement for each axis occurs from the 0-pulse position to the pulse-converted position.

Sample	Description
`PUSH(1,P1)`	.........Axis 1 of robot 1 moves from its current position to the position specified by P1.
`PUSH[2](2,P90)`	.........Axis 2 of robot 2 moves from its current position to the position specified by P90 (deg.) (when axis 2 is a rotating axis.)

PUSH

Option types

● Pushing thrust setting

Format

```
F = expression
```

Value	Range
Expression	-1000 to 1000 (units: %)

Explanation The pushing thrust in the forwarding direction of an axis is specified as an <*expression*>.
The actual pushing thrust is determined as shown below.

- Rated thrust x <*expression*>/100

If <*expression*> is omitted, pushing thrust value specified with the parameter is used.

Sample	Description
`PUSH(1,10000),F=10`	………Axis 1 of robot 1 moves from its current position to the 100000 pulse position with the pushing thrust at 10% of the rated thrust.

● Pushing time setting

Format

```
TIM = expression
```

Value	Range
Expression	1 to 32767 (units: ms)

Explanation The time to keep pushing with the specified pushing thrust is specified as an <*expression*>.
When the status where the pushing thrust reaches the specified value exceeds <expression>, the PUSH statement terminates.
If this option is omitted, the setting of the parameter is used.

Sample	Description
`PUSH(1,10000),TIM=5000`	………Axis 1 of robot 1 moves from its current position to the 100000 pulse position with keeping pushing for 5 seconds.

PUSH

● Pushing speed setting

Format

```
1. SPEED = expression
2. S = expression
```

Value	Range
Expression	1 to 100 (units: %)

Explanation The program movement speed is specified in <expression>.
This option is enabled only for the specified PUSH statement.

The actual speed is determined as shown below.

- Max. speed of a robot (mm/s or deg./s) x Push speed (%) x automatic. movement speed (%) x <expression> (%)

Sample **Description**

```
PUSH(1,10000),S=10
            .........Axis 1 of robot 1 moves from its current position to the 100000 pulse
                position with the speed at 10% of the multiplication of the push speed
                and the automatic movement speed.
```

Format

```
1. DSPEED = expression
2. DS = expression
```

Value	Range
Expression	0.01 to 100.00 (units: %)

Explanation The axis movement speed is specified in <expression>.
This option is enabled only for the specified PUSH statement.
Movement always occurs at the DSPEED <expression> value (%) without being affected by automatic movement speed value (%).

The actual speed is determined as shown below.

- Max. speed of a robot (mm/s or deg./s) x Push speed (%) x <expression> (%)

Sample **Description**

```
PUSH(1,10000),DS=0.1
            .........Axis 1 moves of robot 1 from its current position to the 100000 pulse
                position with the speed at 0.1% of the pushing movement speed.
```

PUSH

STOPON conditions setting

Format

```
STOPON conditional expression
```

Sample	Description
`PUSH(1,10000),STOPON DI(20) = 1`	.........Axis 1 of robot 1 moves from its current position toward the "10000 pulses" position and stops at an intermediate point if the "DI (20) = 1" condition is met. The next step is then executed.

Reference "MOVE" statement

CONT setting (Continuous Motion)

Format

```
CONTON conditional expression
```

Sample	Description
`PMOVE(1,P1),CONTON DI(20)=1`	.........Axis 1 of robot 1 moves from its current position toward the "P1" position. When "DI (20) = 1" conditions are met, the robot starts deceralating and executed the next step.

Reference "MOVE" statement

Related commands	PSHFRC, PSHTIME, PSHMTD, PSHSPD, PSHRSLT, CURTRQ, CURTQST

100 RADDEG

Performs a unit conversion (radians → degrees)

Format

```
RADDEG(expression)
```

Value	Contents
Expression	Angle (units: radians)

Explanation Converts the <expression> value to degrees.

Sample	Description
`LOC4(P0)=RADDEG(ATN(B))`	.........Converts the variable B arctangent value to degrees, and assigns it to 4th-axis data of P0.

Related commands	ATN, COS, DEGRAD, SIN, TAN

101

REFTSK

Acquires the task state

Format

```
REFTSK(task number)
```

Value	Range
Task Number	Variable can be specified

Return Value	Range
Task Status	-1 : NON EXISTENT
	0 : STOP
	1 : READY, RUN
	2 : WAIT
	3 : SUSPEND

Explanation Acquires the state of the specified task.
The return value is acquired depending on the status.

By acquiring the task status on the program using this function,
it makes possible to process according to the task status such as task startup.
REFTSK can also be used as an online command.

Reference for Each task status: Chapter 6 "Task status and transition"

SAMPLE 1: Starting task 2

```
A% = REFTSK(2)                  ......... Acquires the status of task 2
IF A% = -1 THEN                 ......... If task 2 is unregistered (NON EXISTENT),
     START <SUB _ PGM>,T2                 makes task 2 start.
ELSE
     'Processes in case that task 2 is not started
ENDIF
```

SAMPLE 2: Processing the own task after completing the process of task 2

```
WAIT REFTSK(2) <= 0             ......... Waits until task 2 is stopped (STOP) or
'The following:                           unregistered (NON EXISTENT) staus.
 processing for own task
```

102 REM

Inserts a comment

Format

```
1. REM character string

2. ' character string
```

Explanation All characters which follow REM or an apostrophe (') are handled as a comment.
This comment statement is used only to insert comments in the program, and it does not execute any command. REM or an apostrophe (') can be entered at any point in the line.

Sample **Description**

```
                                All are comment examples
REM *** MAIN PROGRAM ***        .........Comment; *** MAIN PROGRAM ***
       '*** SUBROUTINE ***      .........Comment; *** SUBROUTINE ***
HALT    'HALT COMMAND           .........Comment; HALT COMMAND
```

103

RESET

Turns OFF the bits of specified ports, or clears variables

Format 1

```
RESET    DOm(b, ..., b)
         DO(mb, ..., mb)
         MOm(b, ..., b)
         MO(mb, ..., mb)
         TOn(b, ..., b)
         TO(nb, ..., nb)
         LOn(b, ..., b)
         LO(nb, ..., nb)
         SOm(b, ..., b)
         SO(mb, ..., mb)
```

Format 2

```
RESET TCOUNTER
```

Notation	Value	Range
m	Port Number	2 to 7, 10 to 17, 20 to 27
n	Port Number	0, 1
b	Bit definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).

Reference Bit definition: Chapter 3 "10 Bit Settings"

CAUTION

Output to ports "0" and "1" is not allowed at DO and SO.

Explanation Format 1: Turns the bits of specified ports OFF.

Format 2: Clears the 1ms counter variables

(1ms counter variables are used to measure the time in 1ms units).

Sample	Description
`RESET DO2()`	.........`Turns OFF DO(27 to 20).`
`RESET DO2(6,5,1)`	.........`Turns OFF DO(26, 25, 21).`
`RESET (37,35,27,20)`	.........`Turns OFF DO(37, 35, 27, 20).`
`RESET TCOUNTER`	.........`Clears the 1ms counter variables.`

Related commands	SET, DO, MO, SO, TO, LO

104 RESTART

Restarts another task during a temporary stop

Format

RESTART	Tn *<program name>* PGm

Notation	Value	Range
n	Task Number	1 to 16
m	Program Number	1 to 100

Explanation Restarts another task that has been temporarily stopped (SUSPEND status).
A task can be specified by the name or the number of a program in execution.
The program name must be enclosed in < > (angle brackets).

MEMO

If a task (program) not temporarily stopped is specified and executed, an error occurs.

Sample **Description**

```
                                    Main task
START <SUB_PGM>,T2                  ......Registers program i.e. SUB_PGM in Task 2 and starts it
   FLAG=1                           ......Execution set for exclusive control flag 1
*L0:
   IF FLAG=1 AND DI2(0)=1 THEN      ......If flag 1 and DI2(0) are ON
       SUSPEND T2                   ......Pauses Task 2
       FLAG=2                       ......Substitutes 2 for FLAG
                                       (execution set for exclusive control flag 2)
   WAIT DI2(0)=0                    ......Waits until DI2(0) turns OFF
   ENDIF
   IF FLAG=2 AND DI2(0)=1 THEN      ......If flag 2 and DI2(0) are ON
       RESTART T2                   ......Restarts Task 2
       FLAG=1                       ......Execution set for exclusive control flag 1
       WAIT DI2(1)=0                ......Waits until DI2(1) turns OFF
   ENDIF
   MOVE P,P0
   MOVE P,P1
   GOTO *L0
   HALTALL
```

```
'SUBTASK ROUTINE                    Sub Task (Program name: SUB_PGM)
*SUBTASK:
   DO2(0)=1
   DELAY 1000
   DO2(0)=0
   DELAY 1000
   GOTO *SUBPGM
   EXIT TASK                        ......Ends the task
```

Reference "Multi-Task" item in Chapter 6

Related commands	CUT, EXIT TASK, START, SUSPEND

105 RESUME

Resumes program execution after error recovery processing

Format

```
1. RESUME
2. RESUME NEXT
3. RESUME label
```

Explanation Resumes program execution after recovery from an error.
Depending on its location, a program can be resumed in the following 3 ways:

1. RESUME	The program resumes from the command which caused the error.
2. RESUME NEXT	The program resumes from the next command after the command which caused the error.
3. RESUME label	The program resumes from the command specified by the <label>.

MEMO

- The RESUME statement can also be executed in an error processing routine..
- Error recovery processing is not possible for serious errors such as "17.800 : Motor overload".

Reference "ON ERROR GOTO"

Related commands	ON ERROR GOTO

106 RETURN

Processing which was branched by GOSUB, is returned to the next line after GOSUB

* GOSUB can also be expressed as "GO SUB".

Format

```
GOSUB label
   :
label:
   :
RETURN
```

Explanation Ends the subroutine and returns to the next line after the jump source GOSUB statement.

- Jump to a subroutine by a GOSUB statement;
  the subroutine (jump destinations) must end by a RETURN statement.
- Jump from a routine by a GOTO statement; an error such as "5.212: Stack overflow" may occur.

Sample **Description**

```
*ST:                      .........Main program (label definition)
       MOVE P,P0
       GOSUB *CLOSEHAND .........Jumps to Subroutine *CLOSEHAND
       MOVE P,P1
       GOSUB *OPENHAND  .........Jumps to Subroutine *OPENHAND
GOTO *ST                  .........Jumps to Main program *ST
HALT
'SUB ROUTINE               (Comment) The following is a subroutine
*CLOSEHAND:               .........Subroutine *CLOSEHAND label definition
       DO(20) = 1         .........When DO(20) is turned ON
RETURN                    .........Executes from the next line of GOSUB statement *CLOSEHAND
*OPENHAND:                .........Subroutine *OPENHAND label definition
       DO(20) = 0         .........When DO(20) is turned OFF
RETURN                    .........Executes from the next line of GOSUB statement *OPENHAND
```

Related commands	GOSUB

107

RIGHT$

Extracts a character string from the right end of another character string

Format

```
RIGHT$ (character string expression , expression)
```

Value	Range
Expression	0 to 255

Explanation This function extracts a character string with the digits specified by the <expression> from the right end of the character string specified by <character string expression>.

- If the <expression> value is out of the range of 0 - 255; an error will occur.
- If the <expression> value is 0; the extracted character string will be a null string (empty character string).
- If the <expression> value has more characters than the <character string expression>; extracted character string will become the same as the <character string expression>.

Sample	Description
`B$=RIGHT$(A$,4)`	………`4 characters from the right end of A$ are assigned to B$.`

Related commands	LEFT$, MID$

108 RIGHTY

Sets the SCARA robot hand system as a right-handed system

Format

```
RIGHTY [robot number]
```

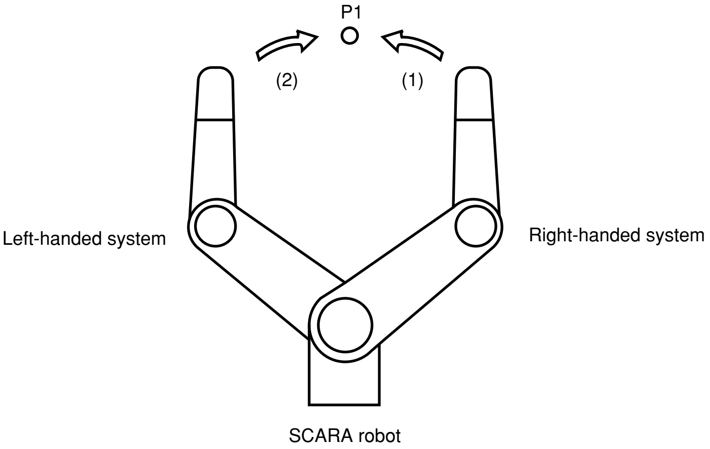
Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.

Explanation Specifies the robot as a right-handed system.
The robot moves to a point specified in the Cartesian coordinates.

- This statement only selects the hand system, and does not move the robot. If executed.
- While the robot arm is moving, execution waits until movement is complete (positioned within tolerance range).
- This command is only valid for SCARA robots.

Sample	Description
`RIGHTY`	.........Specifies the hand system of robot 1 as a right-handed system.
`MOVE P,P1`	.........(1)
`LEFTY`	.........Specifies the hand system of robot 1 as a left-handed system.
`MOVE P,P1`	.........(2)
`RIGHTY`	.........Specifies the hand system of robot 1 as a right-handed system.
`HALT`	

SAMPLE:LEFTY/RIGHTY



Related commands	LEFTY

109 RSHIFT

Shifts a bit value to the right

Format

```
RSHIFT(expression 1, expression 2)
```

Explanation Shifts the <*expression 1*> bit value to the right by the amount of <*expression 2*>.
Spaces left blank by the shift are filled with zeros (0).

Sample Description

```
A=RSHIFT(&B10111011,2)
          .........The 2-bit-right-shifted &B10111011 value (&B00101110) is assigned to A.
```

Related commands LSHIFT

110 SCRINR

Specifies/acquires R axis inertia for SCARA parameter.

Format

```
SCRINR [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	Value of R axis inertia for SCARA parameter 0 to 32767 (units: kgm^2 × 10^{-4})

Explanation Changes the value of "R axis inertia for SCARA" parameter of specified robot to the <expression> value. This command is invalid for robots other than the SCARA robot.

Sample	Description
`SCRINR 100`	.........Sets "R axis inertia for SCARA" parameter of robot 1 to 100.
`SCRINR[2] 200`	.........Sets "R axis inertia for SCARA" parameter of robot 2 to 200.

Functions

Format

```
SCRINR [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function acquires the value of "R axis inertia for SCARA" parameter of specified robot.

Sample	Description
`A% = SCRINR`	.........The "R axis inertia for SCARA" parameter of robot 1 is assigned to the variable A%.
`A% = SCRINR[2]`	.........The "R axis inertia for SCARA" parameter of robot 2 is assigned to the variable A%.

111 SELECT CASE to END SELECT

Executes the specified command block in accordance with the <expression> value

Format

```
SELECT CASE expression
      CASE expression list 1
            command block 1
      CASE expression list 2
            command block 2
            :
      CASE ELSE
            command block n
END SELECT
```

Value	Range / Meaning (Setting Method)
Expression	General purpose input signals or Variables
Expression List	Decimal value or string. Multiple items are specifiable by separating with comma ","
Command Block	One command should be written within one line

MEMO **Sample of <expression>**

`DI(24,23,22,21,20):`
Recognizes the specified I/O for 5 bit in binary and executes the corresponding <command block> in the <expression list>.

`ABC%:` Specifies a variable. It executes the <command block> in the <expression list> according to the variable value.

Explanation These statements execute multiple command blocks in accordance with the <*expression*> value.

If the <Expression> value matches one of expressions contained in the <*expression list*>
The specified command block is executed. After executing the command block, the program jumps to the next command which follows the END SELECT statement.

If the <*expression*> value does not match any of the expressions contained in the <*expression list*>
The command block indicated after the CASE ELSE statement is executed. After executing the command block, the program jumps to the next command which follows the END SELECT statement.

If the <*expression*> value does not match any of the expressions contained in <*expression list*> and no CASE ELSE statement exists
The program jumps to the next command following the END SELECT statement.

Sample **Description**

```
WHILE 1
  SELECT CASE DI3(7,6,5,4,3,2,1,0)      .........Executes each command block according to
    CASE &B00000001                              the input status of DI3(8 bits)
      MOVE P,P1                         .........Command block when DI3(0) is ON
    CASE &B00000010                     .........When DI3(1) is ON
      MOVE P,P2
    CASE &B00000011                     .........When DI3(0) and DI3(1) is ON
      MOVE P,P3
    CASE ELSE                           .........Case other than the above
      MOVE P,P0
  END SELECT                            .........Ends SELECT CASE statement
WEND
```

112 SEND

Sends readout file data to the write file

Format

```
SEND read-out file TO write file
```

Explanation Sends <read-out file> data to the <write file>.

- An entire DO, MO, TO, LO, SO, or SOW port (DO(), MO(), etc.), cannot be specified as a write file.
- Some individual files (DOn(), MOn(), etc.) cannot be specified as a write file.
  Reference Chapter 10 "Data file description"
- Writing to read-only files (indicated by a "--" in the "Write" column of the table shown below) is not permitted.
- Even if the read-out/write files are specified correctly, it may not be possible to execute them if there is a data format mismatch between the files.

NOTE

1. Examples of erroneous writing to a read-only file:
   - SEND CMU TO DIR
   - SEND PNT TO SI()

2. Examples of data format mismatches:
   - SEND PGM TO PNT
   - SEND SI() TO SFT

Type	File Name		Definition Format		Read-out	Write
			All	Individual File		
User	All file		ALL	———	✓	✓
	Program		PGM	<bbbbbbbb> PGn	✓	✓
	Point		PNT	Pn	✓	✓
	Point comment		PCM	PCn	✓	✓
	Point name		PNM	PNn	✓	✓
	Parameter		PRM	/cccccccc/ #cccccccc# \cccccccc\	✓	✓
	Shift coordinate definition		SFT	Sn	✓	✓
	Hand definition		HND	Hn	✓	✓
	Work definition		WRKDEF	Wn	✓	✓
	Pallet definition		PLT	PLn	✓	✓
	General Ethernet Port		GEP	GPn	✓	✓
	Input/output name		ION	iNMn(n)	✓	✓
	Area check output		ACO	ACn	✓	✓
	Real time output		RTO	RTn	✓	✓
Variable, Constant	Variable		VAR	ab...by	✓	✓
	Array variable		ARY	ab...by(x)	✓	✓
	Constant		——	"cc...c"	✓	–
Status	Program directory		DIR	<<bbbbbbbb>>	✓	–
	Parameter directory		DPM	———	✓	–
	Machine reference	sensor, stroke-end	MRF	———	✓	–
		mark	ARP	———	✓	–

Type	File Name	Definition Format		Read-out	Write
		All	Individual File		
Status	Accumulated data (*)	ACD	———	✓ (*)	–
	System configuration information	CFG	———	✓	–
	Version information	VER	———	✓	–
	Option board	OPT	———	✓	–
	Self check	SCK	———	✓	–
	Alarm history	LOG	———	✓	–
	Remaining memory size	MEM	———	✓	–
Device	DI port	DI()	DIn()	✓	–
	DO port	DO()	DOn()	✓	✓
	MO port	MO()	MOn()	✓	✓
	TO port	TO()	TOn()	✓	✓
	LO port	LO()	LOn()	✓	✓
	SI port	SI()	SIn()	✓	–
	SO port	SO()	SOn()	✓	✓
	SIW port	SIW()	SIWn()	✓	–
	SOW port	SOW()	SOWn()	✓	✓
	RS-232C	CMU	———	✓	✓
	Ethernet	ETH	———	✓	✓
Other	File END code	EOF	———	✓	–

✓: Permitted –: Not Permitted

n: number a: Alphabetic character b: Alphanumeric character or underscore (_)
c: Alphanumeric character or special symbol x: Expression (array argument) y: Variable type
i: Input/output type

*) While Accumulated data files is supported with software Ver. 1.73 or later,
Read-out of Accumulated data files is only supported with Ver. 2.04 or later.

MEMO

The following cautions apply when a restart is performed after a stop occurred during execution of the SEND statement.

1. When reading from RS-232C / Ethernet (SEND CMU TO XXX, SEND ETH TO XXX):
   When the SEND statement is stopped during data reading from the reception buffer, the data acquired up to that point is discarded.
2. When writing to RS-232C / Ethernet (SEND XXX TO CMU, SEND XXX TO ETH):
   When the SEND statement is stopped during data writing to the transmission buffer, the data is written from the beginning.

Sample	Description
`SEND PGM TO CMU`	.........Outputs all user programs from the RS-232C port.
`SEND <PRG1> TO CMU`	.........Outputs the PRG1 program from the RS-232C port.
`SEND CMU TO PNT`	.........Inputs a point data file from the RS-232C port.
`SEND "T1" TO CMU`	.........Outputs the "T1" character string from the RS-232C port.
`SEND CMU TO A$`	.........Inputs character string data to variable A$ from the RS-232C port.

Reference Chapter 10 "Data file description"

Related commands	OPEN, CLOSE, SETGEP, GEPSTS

113 SERVO

Controls the servo status

Format

```
SERVO [robot number]   ON    (axis number)
                       OFF
                       FREE
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (• Multiple axes not specifiable • If not input, all axes are specified.)

Explanation This command controls the servo ON/OFF at the specified axes or all axes.

SERVO command	SERVO	Motor power	Dynamic brake	Electromagnetic brake
ON	ON	ON	OFF	OFF
OFF	OFF	OFF (During all axes servo OFF)	ON	ON
FREE	OFF	Continues the previous status	OFF	OFF

CAUTION

- **Always check that the Emergency Stop is ON and Servo is OFF when working within the robot movement range.**
- **Electromagnetic brake is the brake to prevent the vertical axis from sliding downward. The vertical axis will slide downward when the servo is FREE, causing a hazardous situation.**

MEMO

- This command is executed after the operation of all axes of the specified robot has been complete (after positioned within the tolerance).
- The motor power is a power supply unit for robot (motor) in the controller.
- The dynamic brake controls the motor by using the electric power which is generated in the motor when the servo is turned OFF.

Sample	Description
`SERVO ON`	.........Turns servos ON at all axes of robot 1.
`SERVO OFF`	.........Turns the servo OFF and applies the dynamic brake at all axes of robot 1. Axes equipped with brakes are all locked by the brake.
`SERVO FREE(3)`	.........Turns servos OFF at axis 3 (Z-axis) of robot 1, and releases the brake.

114 SET

Turns the bit at the specified output port ON

Format

```
SET       DOm(b, ..., b)       , time
          DO(mb, ..., mb)
          MOm(b, ..., b)
          MO(mb, ..., mb)
          TOn(b, ..., b)
          TO(nb, ..., nb)
          LOn(b, ..., b)
          LO(nb, ..., nb)
          SOm(b, ..., b)
          SO(mb, ..., mb)
```

Notation	Value	Range
m	Port Number	2 to 7, 10 to 17, 20 to 27
n	Port Number (TO, LO)	0, 1
b	Bit definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Time	10 to 3600000 (units: ms)

Reference Bit definition: Chapter 3 "10 Bit Settings"

CAUTION

Output to ports "0" and "1" are NOT allowed at DO and SO.

Explanation Turns ON the bits of specified ports.

The pulse output time (unit: ms) is specified by the <*time*> value.
The program execution is WAIT status while the output is ON. When the specified time elapses, the output is turned OFF, and the execution ends.

If no hardware port exists, nothing is output.

Sample	Description
`SET DO2()`	.........`Turns OFF DO(27 to 20).`
`SET DO2(6,5,1),200`	.........`DO(26,25,21) switches ON for 200 ms.`
`SET DO(37,35,27,20)`	.........`Turns DO(37, 35, 27, 20) ON.`

Related commands	RESET, DO, MO, SO, TO, LO

115 SETGEP

Sets the General Ethernet Port

Format

```
SETGEP m, n, "IP address", ppppp, e, t
```

Notation	Value	Range / Meaning
m	General Ethernet Port number	0 to 7
n	Mode	0: server, 1: client
	IP address	0.0.0.0 to 255.255.255.255
ppppp	Port Number	0 to 65535
e	Termination code	0: CRLF, 1: CR
t	Port Type	0: TCP

Explanation Sets the specified General Ethernet Port. The General Ethernet Port can open/ close the communication port by OPEN/ CLOSE commands.

<*IP address*> must be enclosed in " " (double quotation marks).

When "0: server" is selected at "n: mode", although <IP address> can be omitted, " " (double quotation marks) must be written.

MEMO

When Server mode is selected,

- IP address: IP address already set on the controller is used to communicate, so IP address setting is unnecessary. (The IP address set by <*IP address*> is invalid in this case.)
- Port number: Set a port number which differs from the one on the controller.

When Client mode is selected,

- IP address and port number: Set the IP address and port number of the connection destination server.

Sample	Description

```
IPADRS$="192.168.0.100"
                         .........Assigns the IP address(192.168.0.100) of the server to
                             connect to variable IPADRS$.
SETGEP 1, 1, IPADRS$, 100, 0, 0
                         .........Sets the conditions below on General Ethernet Port 1.
                             • Mode: client
                             • IP address of the server to connect to:
                               192.168.0.100
                             • Port number of the server to connect to: 100
                             • Termination code : CRLF
OPEN GP1                 .........Connects the server specified at General Ethernet Port 1.
                         .........Sends the character strings "123" from General Ethernet Port
                             1.
SEND "123" TO GP1        .........Disconnects from the server specified at General Ethernet
                             Port 1.
CLOSE GP1
```

Related commands	OPEN, CLOSE, SEND, GEPSTS

116 SGI

Assigns /acquires the value to a specified integer type static variable

Format

```
1. SGIn=xxxxxx
2. SGI(n)=xxxxxx
```

Notation	Value	Range
n	Integer Type Static Variable Number	0 to 31
xxxxxx		Integer of -2147483648 to 2147483647

Explanation Assigns xxxxxx to the integer type static variable (SGI) specified by "n". If a real number with decimal point is specified at xxxxxx, assigns a value with decimal fractions truncated.

Sample	Description
`SGI1=300`	………Assigns 300 to SGI1.

Functions

Format

```
1.SGIn
2.SGI(n)
```

Notation	Value	Range
n	Integer Type Static Variable Number	0 to 31

Explanation Acquires the value of the integer type static variable (SGI) specified by "n".

Sample	Description
`A%=SGI1`	………Assigns the value of SGI1 to variable A%.

Related commands	SGR

117 SGR

Assigns /acquires the value to a specified real type static variable

Format

```
1.SGRn=xxxxxx
2.SGR(n)=xxxxxx
```

Notation	Value	Range
n	Real Type Static Variable Number	0 to 31
xxxxxx	1. Single-precision Real Numbers	-999999.9 to +999999.9 Note: 7 digits including integers and decimals. (For example, ".0000001" may be used.)
	2. Single-precision Real Numbers in Exponent Form	-1.0×1038 to +1.0×1038 Note: Mantissas should be 7 digits or less, including integers and decimals.

Explanation Assigns xxxxxx to the real type static variable (SGR) specified by "n".

Sample	Description
`SGR1=1320.355`	.........`Assigns 1320.355 to SGR1.`

Functions

Format

```
1.SGRn
2.SGR(n)
```

Notation	Value	Range
n	Real Type Static Variable Number	0 to 31

Explanation Acquires the value of the real type static variable (SGR) specified by "n".

Sample	Description
`A!=SGR1`	.........`Assigns the value of SGR1 to variable A!.`

Related commands	SGI

118 SHARED

Enables sub-procedure referencing without passing on the variable

Format

```
SHARED variable(), variable()...
```

Explanation This statement allows variables declared with a program level code to be referenced with a sub-procedure without passing on the variables as dummy arguments.
The program level variable used by the sub-procedure is specified by the <*variable*> value.
A simple variable or an array variable followed by parentheses is specified. If an array is specified, that entire array is selected

NOTE

The program level code is a program written outside the sub-procedure.

MEMO

- Normally, a dummy argument passes along the variable to a sub-procedure, but the SHARED statement allows referencing to occur without passing along the dummy argument.
- The SHARED statement allows variables to be shared only between a program level code and sub-procedure which are within the same program level

Sample **Description**

```
DIM Y!(10)
X!=2. 5
Y!(10)=1. 2
CALL *DISTANCE
CALL *AREA
HALT
SUB *DISTANCE
  SHARED X!,Y!( )           .........Variable referencing is declared by SHARED.
  PRINT X!^2+Y!(10)^2       .........The variable is shared.
END SUB
SUB *AREA
  DIM Y!(10)
  PRINT X!*Y!(10)           .........The variable is not shared.
END SUB
```

Related commands	SUB, END SUB

119 SHIFT

Sets the shift coordinates

Format

`SHIFT [robot number]`	`shift variable` `OFF`	

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Sets the shift coordinates specified by <shift variable> to the robot specified by <*robot number*>.
When OFF is specified, the coordinates shift by <shift variable> does not occur.

MEMO

- This statement is executed after axis positioning is complete (within the tolerance range).
- When OFF is specified, it is the same as the setting: 0.000 at each X, Y, Z and rotation direction-offset by the <*shift variable*>.

Sample	Description
`SHIFT S1`	.........Shifts the coordinate of robot 1 to the "shift 1" coordinate.
`MOVE P,P10` `SHIFT S[A]`	.........Shifts the coordinate of robot 1 to the coordinate specified by variable A.
`MOVE P,P20` `HALT`	

Related commands	Shift definition statement, shift assignment statement

120

SI

Acquires specified SI status

Format

```
LET expression = SIm(b, ..., b)
LET expression = SI(mb, ..., mb)
```

Notation	Value	Range
m	Port Number	0 to 7, 10 to 17, 20 to 27
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).

Explanation Acquires SI port input status specified by "m".

Sample	Description
`A%=SI2()`	………The input status from SI (27) to SI (20) is assigned to variable A%.
`A%=SI0(6,5,1)`	………The SI (06), SI (05), SI (01) input status is assigned to variable A% (when all the above signals are "1" (ON), A% = 7).
`A%=SI(37,35,27,10)`	………The SI (37), SI (35), SI (27) SI(10) input status is assigned to variable A% (when all the above signals except SI (27) are "1" (ON), A% = 13).

121 SID

Acquires a specified serial input's double-word information

Format

```
LET SID(m)
```

Notation	Value	Range
m	port number	2, 4, 6, 8, 10, 12, 14*

The output (acquisition) range is -2,147,483,648(&H80000000) to 2,147,483,647(&H7FFFFFFF).

*When SIOW extension is enabled, the range of port number is extended to 2, 4, 6 -14, 24, 26, 28 -126.
For details, refer to RCX3 user's manual "Option board related parameters".

Explanation Acquires the value at the SID port specified by "m".

MEMO

- The information is handled as signed double word data.
- "0" is input if the specified port does not exist.
- The lower port number data is placed at the lower address.
  For example, if SIW(2) =&H2345,SIW(3) =&H0001, then SID(2) =&H00012345.

Sample	Description
`A%=SID(2)`	.........`The input status of SIW(2), SIW(3) is assigned to variable A%.`
`A%=SID(14)`	.........`The input status of SIW(14), SIW(15) is assigned to variable A%.`

Related commands	SIW

122

SIN

Acquires the sine value for a specified value

Format

```
SIN(expression)
```

Value	Contents
Expression	Angle (units: radians)

Explanation This function gives the sine value for the <*expression*> value.

Sample	Description
`A(0)=SIN(B*2+C)`	.........Assigns the expression B*2+C sine value to array A (0).
`A(1)=SIN(DEGRAD(30))`	.........Assigns a 30.0° sine value to array A (1).

Related commands	ATN, COS, DEGRAD, RADDEG, TAN

123 SIW

Acquires a specified serial input's word information

Format

```
LET SIW(m)
```

Notation	Value	Range
m	port number	2 to 15*

The output (acquisition) range is 0 (&H0000) to 65,535 (&HFFFF).
*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

Explanation Acquires the value at the SIW port specified by "m".

MEMO

- The information is handled as unsigned word data
- "0" is input if the specified port does not exist.

Sample **Description**

```
A%=SIW(2)     .........The input status of SIW (2) is assigned to variable A%.
A%=SIW(15)    .........The input status of SIW (15) is assigned to variable A%.
```

Related commands	SID

124 Sn

Defines the shift coordinates in the program

Format

```
Sn = x y z r
```

Value	Range
n	0 to 39
x, y, z, r	-99,999.99 to 99,999.99

Explanation Defines shift coordinate values in order to shift the coordinates for robot movement. Only "mm" units can be used for these coordinate values ("pulse" units cannot be used).

1: "n" indicates the shift number.
2: The "x" to "r" input data must be separated with spaces (blanks).
3: The "x" to "r" input data is recognized as "mm" unit data.
4: "x" to "z" correspond to the Cartesian coordinate system's x, y, z coordinate shift values, and "r" corresponds to the xy coordinates' rotational shift values.

NOTE

- All input values are handled as constants.
- If the controller power is turned off during execution of a shift coordinate definition statement, a memory-related error such as "9.706: Shift data destroyed" may occur.

Sample	Description
`S0 = 0.000 0.000 0.000 0.000`	...Defines shift coordinates for S0
`S1 = 100.000 200.000 50.000 90.000`	...Defines shift coordinates for S1
`P3 = 100.000 0.000 0.000 0.000 0.000 0.000`	...Defines P3 point data
`SHIFT S0`	...Changes the coordinates of Robot 1 to S0
`MOVE P,P3`	...Moves to P3 in PTP
`SHIFT S1`	...Changes the coordinates of Robot 1 to S1
`MOVE P,P3`	...Moves to P3 in PTP
`HALT`	

Related commands Shift assignment statement, SHIFT

125 SO

Outputs a specified value to serial port or acquires the output status

Format

```
1. LET SOm(b, ..., b) = expression
2. LET SO (mb, ..., mb) = expression
```

Notation	Value	Range
m	Port Number	2 to 7, 10 to 17, 20 to 27
b	Bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits beyond the number of bit whom an assignment destination is required are ignored. (If the port number is specified, the lower 8 bits are valid. if the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

Explanation Outputs a specified value to the SO port.
Only the <value> data's integer-converted lower bits corresponding to the bits defined at the left side can be output. If the port which does not exist is specified, nothing is output.

Reference Bit Definition: Chapter 3 "10 Bit Settings"

⚠ **CAUTION**

Outputs to SO0() and SO1() are not possible.

Sample **Description**

```
SO2()=&B10111000 .........SO (27, 25, 24, 23) are turned ON, and SO (26, 22, 21, 20) are turned OFF.
SO2(6,5,1)=&B010 .........SO (25) are turned ON, and SO (26, 21) are turned OFF.
SO3()=15         .........SO (33, 32, 31, 30) are turned ON, and SO (37, 36, 35, 34) are turned OFF.
SO(37,35,27,20)=A.........The lower 4 bits of integer-converted variable A are output to SO (37, 35,
                          27, 20).
```

Functions

Format

```
1. LET expression = SOm (b, ..., b)
2. LET expression = SO (mb, ..., mb)
```

Explanation Indicates SO port output status.

Sample **Description**

```
A%= SO2()          .........Output status of ports SO(27) to SO(20) is assigned to variable A%.
A%= SO0(6, 5, 1)   .........Output status of SO(06), SO(05) and SO(01) is assigned to variable A%.
                            (If all above signals are 1(ON), then A%=7.)
A%= SO(37,35,27,10).........Output status of S0(37), SO(35) , SO(27) and S0(10) is assigned to
                            variable A%.(If all above signals except S0(27) are 1 (ON), then A%=13.)
```

Related commands	RESET, SET

SO

Functions

Format

```
1. LET SOm (b, ..., b)
2. LET SO (mb, ..., mb)
```

Explanation Indicates SO port output status.

Sample	Description
`A%= SO2()`	.........Output status of ports SO(27) to SO(20) is assigned to variable A%.
`A%= SO0(6, 5, 1)`	.........Output status of SO(06), SO(05) and SO(01) is assigned to variable A%. (If all above signals are 1(ON), then A%=7.)
`A%= SO(37,35,27,10)`	.........Output status of S0(37), SO(35) , SO(27) and S0(10) is assigned to variable A%. (If all above signals except S0(27) are 1 (ON), then A%=13.)

Related commands RESET, SET

126 SOD

Outputs a specified serial output's double-word information or acquires the output status

Format

```
LET SOD(m) = expression
```

Notation	Value	Range
m	port number	2, 4, 6, 8, 10, 12, 14 (*1)
	Expression (*2)	Integer value (If real number is specified, rounds to an integer.) Bits that exceed the number of bits required for the assignment destination are discarded. (If the port number is specified, the lower 8 bits are valid. If the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

*1) When SIOW extension is enabled, the range of port number is extended to 2, 4, 6 -14, 24, 26, 28 -126.
For details, refer to RCX3 user's manual "Option board related parameters".

*2) The output range is -2,147,483,648(&H80000000) to 2,147,483,647(&H7FFFFFFF).

Explanation Outputs the value to the SOD port specified by "m".

MEMO

- The information is handled as signed double word data.
- If a serial port does not actually exist, the information is not output externally
- The lower port number data is placed at the lower address.
  For example, if SOW(2) =&H2345,SOW(3) =&H0001, then SOD(2) =&H00012345.

Sample	Description
`SOD(2)=&H12345678`	.........`Outputs &H12345678 to SOD(2).`
`SOD(4)=1048575`	.........`Outputs 1048575(&HFFFFF) to SOD(4).`
`SOD(2)=A%`	.........`Outputs the value of variable A% to SOD(2).`

Functions

Format

```
LET expression = SOD(m)
```

Notation	Value	Range
m	Port Number	2, 4, 6, 8, 10, 12, 14

Explanation Acquires the SOD port output status specified by "m".

Sample	Description
`A%=SOD(2)`	.........`The output status of SOD(2) is assigned to variable A%.`

Related commands	SOW

127 SOW

Outputs a specified serial output's word information or acquires the output status

Format

```
LET SOW(m) = expression
```

Notation	Value	Range
m	port number	2 to 15*
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits that exceed the number of bits required for the assignment destination are discarded. (If the port number is specified, the lower 8 bits are valid. If the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

Explanation Outputs the value to the SOW port specified by "m".

The output range is 0 (&H0000) to 65535 (&HFFFF).
Note that if a negative value is output, the low-order word information will be output after being converted to hexadecimal.
Example: SOW(2)=-255
The contents of -255 (&HFFFFFF01) are assigned to SOW (2).
-255 is a negative value, so the low-order word information (&HFF01) is assigned.

MEMO

- The information is handled as unsigned word data.
- If a serial port does not actually exist, the information is not output externally.
- If a value exceeding the output range is assigned, the low-order 2-byte information is output.

Sample	Description
`SOW(2)=&H0001`	.........Outputs &H0001 to SOW(2).
`SOW(3)=255`	.........Outputs 255(&H00FF) to SOW(3).
`SOW(15)=A%`	.........The contents of variable A% are assigned in SOW (15). If the variable A% value exceeds the output range, the low-order word information will be assigned.

Functions

Format

```
LET expression = SOW(m)
```

Explanation Acquires the SOW port output status specified by "m".

Sample	Description
`A%=SOW(2)`	.........The output status of SOW (2) is assigned to variable A%.

Related commands	SOD

128 SPEED

Changes the program movement speed

Format

`SPEED [robot number] expression`

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	1 to 100 (units: %)

Explanation Changes the program movement speed to the value indicated by <expression>.
This speed change applies to all robot axes and auxiliary axes of the specified robot.

The operation speed is determined by multiplying the automatic movement speed (specified from the programming box and by the ASPEED command), by the program movement speed (specified by SPEED command).

Operation speed = automatic movement speed × program movement speed

Example:
Automatic movement speed ... 80%
Program movement speed ... 50%
Movement speed = 40% (80% × 50%)

NOTE

- Automatic movement speed
  Specified by programming box operation or by the ASPEED command
- Program movement speed
  Specified by SPEED commands or MOVE, DRIVE speed options.

Sample	Description
`ASPEED 100`	.........Changes the Automatic movement speed of robot 1 to 100%.
`SPEED 70`	.........Changes the Program movement speed of robot 1 to 70%.
`MOVE P,P0`	.........Moves robot 1 from current position to P0 at a speed of 70% (=100 × 70).
`SPEED 50`	.........Changes the Program movement speed of robot 1 to 50%.
`MOVE P,P1`	.........Moves robot 1 from current position to P1 at a speed of 50% (=100 × 50).
`MOVE P,P2,S=10`	.........Moves robot 1 from current position to P2 at a speed of 10% (=100 × 10).
`HALT`	

Related commands	ASPEED

129

SQR

Acquires the square root of a specified value

Format

```
SQR(expression)
```

Value	Range
Expression	0 or positive number.

Explanation Gives the square root of the <*expression*> value. An error occurs if the <expression> value is a negative number.

Sample	Description
`A=SQR(X^2+Y^2)`	.........`The square root of X^2+Y^2 is assigned to variable A.`

130 START

Starts a new task

Format

```
START        <program name>        ,Tn, p
             PGm
```

Notation	Value	Range
m	Program Number	1 to 100
n	Task Number	1 to 16
p	Task priority ranking	1 to 64

Explanation Starts task "n" specified by the program with the "p" priority ranking.
The program name must be enclosed in < > (angle brackets).

Priority ranking
The smaller the priority number, the higher the priority (high priority: 1 to low priority: 64).
If a priority ranking is not specified, "32" is adopted as the priority ranking for this task.

If task number "n" is omitted;
The task with the smallest number among the tasks yet to be started is automatically specified.

If a higher ranked task is RUNNING;
All tasks with lower priority also remain in READY status.

Sample **Description**

```
START <SUB_PGM>,T2              …Registers the task program SUB_PGM in task No. 2 and starts it.
*ST:                            …Defines Main program *ST
  MOVE P,P0,P1
GOTO *ST
HALT
                                Program name:SUB_PGM
'SUBTASK ROUTINE                (Comment) Subtask routine
*SUBTASK:                       …Defines Task program *SUBTASK
  P100 = WHERE
  IF LOC3(P100) > 10000 THEN
      DO(20) = 1
  ELSE
      DO(20) = 0
  ENDIF
GOTO *SUBTASK
EXIT TASK                       …Exits the task program SUB_PGM
```

Related commands	CUT, EXIT TASK, RESTART, SUSPEND, CHGPRI

131 STR$

Converts a numeric value to a character string

Format

```
STR$(expression)
```

Explanation Converts the value specified by the <*expression*> to a character string. The <*expression*> specifies an integer or real value.

Sample

```
B$=STR$(10.01)
```

Related commands VAL

132 SUB to END SUB

Defines a sub-procedure

Format

```
SUB label (dummy argument, dummy argument...)
        command block
END SUB
```

Explanation Defines a sub-procedure.

The sub-procedure can be executed by a CALL statement. When the END SUB statement is executed, the program jumps to the next command after the CALL statement that was called. Definitions are as follows.

1: All variables declared within the sub-procedure are local variables, and these are valid only within the sub-procedure. Local variables are initialized each time the sub-procedure is called up.
2: Use a SHARED statement in order to use global variables (program level).
3: Use a <*dummy argument*> when variables are to be passed on. If two or more dummy arguments are used, separate them by a comma (,).
4: A valid <*dummy argument*> consists of a name of variable and an entire array (array name followed by parentheses). An error will occur if array elements (a <subscript> following the array name) are specified.

MEMO

- Sub-procedures cannot be defined within a sub-procedure.
- A label can be defined within a sub-procedure, but it cannot jump (by a GOTO or GOSUB statement) to a label outside the sub-procedure.
- Local variables cannot be used with PRINT and SEND statements.

Sample 1 **Description**

```
A=1
CALL *TEST             .........Calls sub-procedure *TEST
PRINT A
HALT
'SUB ROUTINE: TEST     (Comment: Sub-procedure name is "TEST")
SUB *TEST              .........Defines sub-procedure *TEST (NOTE)
        A=50

END SUB                .........Ends the definition of the sub-procedure
```

(NOTE) Handled as a different variable than the "A" shown above.

MEMO

In the above example, the program level variable "A" is unrelated to the variable "A" within the sub-procedure. Therefore, the value indicated in the 3rd line PRINT statement becomes "1".

SUB to END SUB

Sample 2 **Description**

```
X% = 4
Y% = 5
CALL *COMPARE(REF X%, REF Y%)…Calls sub-procedure *COMPARE (pass by reference)
PRINT X%,Y%                  …The value of X% is changed to 5 and the value of Y%
Z% = 7                        is changed to 4. (Changes value in sub-procedure =>
W% = 2                        Changes value of variable)
CALL *COMPARE(REF Z%, REF W%)…Calls sub-procedure *COMPARE (pass by reference)
PRINT Z%,W%                  …The value of Z% remains 7 and the value of W% remains 2
HALT                          (No change in value; Comparison in sub-procedure is
                               false and command is not executed)
'SUB ROUTINE: COMPARE        (Comment: Sub-procedure name is "COMPARE")
SUB *COMPARE(A%, B%)         …Starts defining sub-procedure *COMPARE
       IF A% < B% THEN
              TEMP% = A%
              A% = B%
              B% = TEMP%
       ENDIF
END SUB                      …Finishes defining sub-procedure
```

MEMO

In the above example, different variables are passed along as arguments to call the sub-procedure 2 times.

Related commands	CALL, EXIT SUB, SHARED

133 SUSPEND

Temporarily stops another task which is being executed

Format

SUSPEND	Tn *<program name>* PGm

Notation	Value	Range
n	Task Number	1 to 16
m	Program Number	1 to 100

Explanation Temporarily stops (suspends) another task which is being executed.

- A task can be specified by the name or the number of a program in execution.
- This statement can also be used for tasks with a higher priority ranking than this task itself.
- The program name must be enclosed in < > (angle brackets).

MEMO

If a task (program) not active is specified for the execution, an error occurs.

Sample **Description**

```
                            Main Task
START <SUB _ PGM>,T2        ......Registers SUB _ PGM in Task 2 and starts it
SUSFLG=0                    ......Turns OFF SUSFLG
*L0:
        MOVE P,P0
        MOVE P,P1
        WAIT SUSFLG=1       ......Waits until SUSFLG turns ON
        SUSPEND T2          ......Pauses Task 2
        SUSFLG=0            ......Turns OFF SUSFLG
GOTO *L0
HALT
```

```
'SUBTASK ROUTINE            Sub Task (Program name: SUB _ PGM)
*SUBTASK:
        WAIT SUSFLG=0       ......Waits until SUSFLG turns OFF
        DO2(0)=1
        DELAY 1000
        DO2(0)=0
        DELAY 1000
        SUSFLG=1            ......Turns ON SUSFLG
        GOTO *SUBTASK       ......Jumps to *SUBTASK
        EXIT TASK           ......Exits Task 2 (own task: *SUBTASK)
```

Related commands	CUT, EXIT TASK, RESTART, SUSPEND

134 SWI

Switches the program being executed

Format

```
SWI <program name>
```

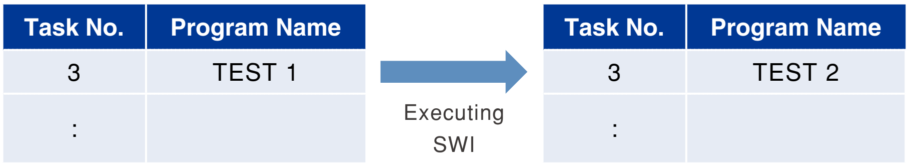
Explanation This statement switches from the current program to the specified program, starting from the first line.

- Although the output variable status is not changed when the program is switched, the dynamic variables and array variables are cleared.
- The program name must be enclosed in < > (angle brackets).

MEMO

If the program specified as the switching target does not exist, a "3.203: Program doesn't exist" (code: &H0003 &H00CB) error occurs and operation stops.

Sample	Description
`MOVE P,P1`	
`SWI <TEST2>`	………`Switches the execution program to TEST 2.`



Task No.	Program Name
3	TEST 1
:	

Task No.	Program Name
3	TEST 2
:	

TEST 2 is executed at Task No. 3.

135 TAN

Acquires the tangent value for a specified value

Format

```
TAN(expression)
```

Value	Contents
Expression	Angle (units: radians)

Explanation Gives a tangent value for the <*expression*> value.
An error will occur if the <expression> value is a negative number.

Sample	Description
`A(0)=B-TAN(C)`	………The difference between the tangent values of variable B and variable C is assigned to array A (0).
`A(1)=TAN(DEGRAD(20))`	………The 20.0° tangent value is assigned to array A (1).

Related commands	ATN, COS, DEGRAD, RADDEG, SIN

136 TCOUNTER

Timer & counter

Format

```
TCOUNTER
```

Explanation Outputs count-up values at 1ms intervals starting from the point when the TCOUNTER variable is reset. After counting up to 2,147,483,647, the count is reset to 0.

Sample

Description

```
MOVE P,P0
WAIT ARM
RESET TCOUNTER
MOVE P,P1
WAIT ARM
A = TCOUNTER
PRINT TCOUNTER     ………Displays the P0 to P1 movement time until the axis enters the
                      tolerance range on the programming box.
```

Related commands	RESET

137 TIME$

Acquires the current time

Format

```
TIME$
```

Explanation Acquires the current time in an hh:mm:ss format character string.
("hh" is the hour, "mm" is the minutes, and "ss" is the seconds.)
The clock can be set in the SYSTEM mode's initial processing.

Sample	Description
`A$=TIME$`	………Assigns the current time to the character type variable A$ as a character string in the format of hh: mm: ss.
`PRINT TIME$`	………Displays the current time on the programming box etc. in the format of hh: mm: ss

Related commands	DATE$, TIMER

138 TIMER

Acquires the current time

Format

```
TIMER
```

Explanation Acquires the current time in seconds, counting from midnight. This function is used to measure a program's run time, etc.

The clock can be set in the SYSTEM mode's initial processing.

CAUTION

The time indicated by the internal clock may differ somewhat from the actual time.

Sample	Description
`A%=TIMER`	………Assigns the current time to the integer variable A% in seconds from midnight
`FOR B=1 TO 10`	
`MOVE P,P0`	
`MOVE P,P1`	
`NEXT`	
`A%=TIMER-A%`	………Assigns current time - A% to the variable A%
`PRINT A%/60;":";A% MOD 60`	………"A% ÷ 60: A% ÷ 60" is displayed
`HALT`	

Related commands	TIME$

139 TO

Outputs a specified value to the TO port or acquires the output status

Format

```
1. LET TOm(b, ..., b) = expression
2. LET TO (mb, ..., mb) = expression
```

Notation	Value	Range
m	Port Number	0, 1
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).
	Expression	Integer value (If real number is specified, rounds to an integer.) Bits that exceed the number of bits required for the assignment destination are discarded. (If the port number is specified, the lower 8 bits are valid. If the number of bit specified on bit definition is 1 to 8, the lower 1 to 8 bit corresponding to the bits specified on the left side are valid.)

Explanation Outputs the specified value to the TO port. The output value is the <*expression*>'s integer-converted lower bits corresponding to the bit definition specified at the left side.

The OFF/ON settings for bits which are being used in a SEQUENCE program have priority while the SEQUENCE program is running.

Sample

```
TO0() = &B00000110
```

Functions

Format

```
1. LET expression = TOm (b, ..., b)
2. LET expression = TO (mb, ..., mb)
```

Notation	Value	Range
m	Port Number	0, 1
b	bit Definition	0 to 7 (If omitted, all 8 bits are processed.) If multiple bits are specified, they are expressed from the left in descending order (high to low).

Explanation Indicates the parallel port signal status.

Sample **Description**

```
A%= TO0()        .........Output status of ports TO(07) to TO(00) is assigned to variable A%.
A%= TO0(6, 5, 1) .........Output status of TO(06), TO(05) and TO(01) is assigned to variable A%.
                          (If all above signals are 1(ON), then A%=7.)
A%=TO(17, 15, 00) .........Output status of TO(17), TO(15) and TO(00) is assigned to variable A%.
                          (If all above signals except TO(15) are 1 (ON), then A%=5.)
```

Related commands	RESET, SET

140 TOLE

Specifies/acquires the tolerance parameter

Format

```
1. TOLE [robot number] expression
2. TOLE [robot number] (axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	Varies according to the motor which has been specified (unit: pulse)

Explanation Change the "tolerance" parameter of the specified axis to the <*expression*> value (unit: pulse).

Format 1: The change is applied to all axes of the specified robot.
Format 2: The change is applied to only the axis specified by the <*axis number*> of the specified robot.

MEMO

This statement is executed after positioning of the specified axes is complete (within the tolerance range).

Functions

Format

```
TOLE [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the "tolerance" parameter values for the axis specified by <*axis number*>.

Sample **Description**

```
'CYCLE WITH DECREASING TOLERANCE
DIM TOLE(5)
FOR A=200 TO 80 STEP -20
       GOSUB *CHANGE_TOLE
       MOVE P,P0
       MOVE P,P1
NEXT A
C=TOLE(2)HALT     .........The tolerance parameter of axis 2 of robot 1 is assigned to
*CHANGE_TOLE:          variable C.
FOR B=1 TO 4
   TOLE(B)=A
NEXT B
RETURN
```

141 TORQUE

Specifies/acquires the maximum torque command value

Format

```
TORQUE [robot number](axis number) = expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6
Expression	1 to 100 (units: %)

Explanation Changes the maximum torque command value of the specified axis to the <*expression*> value. The new value is valid when the next movement command (MOVE or DRIVE statement, etc.) is executed. The parameter value does not change.

The conditions to cancel a torque limit are as follows.

- The TORQUE command for the same axis is executed.
- The controller power turned off and then on again.
- The axis polarity parameter is changed or the parameter is initialized.
- The servo is turned off.

The maximum torque command value becomes temporarily invalid in execution below.

- Return- to-origin is in execution.
- The PUSH statement is in execution.

Only the torque value in the moving direction is changed to the value specified by the PUSH statement, the value in the opposite direction is hold and not changed.

After these movements, the value backs to the maximum torque command value when a next movement command (MOVE statement, for example) is executed.

CAUTION

- **If the specified torque limit is too small, the axis may not move. Never enter within the robot movement range to avoid danger even though the robot is in stop status. In this case, press the emergency stop button before proceeding with the operation.**
- **If the specified value is less than the rated torque, an error may not occur even if the robot strikes an obstacle.**

MEMO

- TORQUE statement limits the torque in the both (rotation and opposite) direction of axis.
- PUSH statement limits the torque in its rotation direction only.

136 TORQUE

Functions

Format

```
TORQUE [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6

Explanation Acquires the maximum torque command value for the axis specified by <*axis number*>.

Sample	Description
`TORQUE (1) = 50`	………Changes the max. torque of axis 1 of robot 1 to 50%.
`DRIVE (1,P1)`	………Moves the axis 1 of robot 1 from its current position to the point specified by P1. (Changes the max. torque at the same time with the start of the movement.)
`WAIT ARM`	………Waits for the completion of an operation of axis 1 of robot 1.
`TORQUE (1) = 100`	………Returns the max. torque of axis 1 of robot 1 to the original value (100%).
`MOVE P,P0`	………Moves the robot 1 from its current position to the point specified with P0. (Returns the max. torque of axis 1 to the original value (100%) at the same time with the start of a movement.)

Related commands CURTRQ, PUSH

142 TSKPGM

Acquires the program number which is registered in a specified task number

Format

```
TSKPGM (task number)
```

Value	Meaning
Task Number	Task number which acquires the program number

Explanation Acquires the program number which is registered in the task specified by the <*task number*>.

Sample	Description
`A=TSKPGM(1)`	………Assigns a program number registered in task 1 to variable A.

Related commands	PGMTSK, PGN

143 VAL

Converts character strings to numeric values

Format

```
VAL (character string expression)
```

Explanation Converts the numeric value of the character string specified in the <character string expression> into an actual numeric value.

- The value may be expressed in integer format (binary, decimal, hexadecimal), or real number format (decimal point format, exponential format).
- The VAL value becomes "0" if the first character of the character string is "+", "-", "&" or anything other than a numeric character.
- If there are non-numeric characters or spaces elsewhere in the character string, all subsequent characters are ignored by this function.
  However, for hexadecimal expressions, "A" to "F" are considered numeric characters.

[Integer]	Hexadecimal format:	&Hnnnn
	Decimal format:	nnnn
	Binary format:	&Bnnnn
[Real number]	Decimal point format:	nnn.nnn
	Exponential format:	nnEmm

Sample

```
A=VAL("&B100001")
```

144

WAIT

Waits until the conditional expression is met

Format

`WAIT` *conditional expression* , *expression*

Value	Range/Description
conditional expression	Specify with Input/Output signals or variables
Expression	0 to 2147483647 (units: ms)

Explanation Waits until the <conditional expression> is met.
Set the time-out period (unit: ms) in the <expression>.

- This command will terminate if the time-out period elapses before the WAIT condition is met.
- The minimum wait time is 1ms but changes depending on the execution status of other tasks.

CAUTION

If the time-out setting is omitted, robot will stop without alarm unless you stop the program from the outside (by an interlock or an emergency stop, etc.) while the conditional expression is not met.

MEMO

When the conditional expression is a numeric expression, an expression value other than "0" indicates TRUE status, and "0" indicates FALSE status.

Sample	Description
`WAIT A=10`	.........Wait status continues until variable A becomes 10.
`WAIT DI2( )=&B01010110`	.........Waits until DI(21),(22),(24),(26) are turned on, and DI(20),(23),(25),(27) is turned off.
`WAIT DI2(4,3,2)=&B101`	.........Waits until DI(22) and DI(24) are turned on, and DI(23) is turned off.
`WAIT DI(31)=1 OR DO(21)=1`	.........Wait status continues until either DI (31) or DO(21) turns ON.
`WAIT DI(20)=1,1000`	.........Wait status continues until DI(20) turns ON. If DI(20) fails to turn ON within 1 second, the command is terminated.
`WAIT END_SENSOR = 1`	.........IO Name* Waits until "END_SEMSOR" is turned on.

* IO Name: Users can name specific bits of DI and DO as they desire.

MEMO

IO Name can be added and edited on the support software only (not with a programming box)

Related commands	DRIVE, DRIVEI, MOVE, MOVEI, MOVET

145

WAIT ARM

Waits until the robot axis operation is completed

Format

```
WAIT ARM [robot number] (axis number)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Axis Number	1 to 6 (• Multiple axes not specifiable • If not input, all axes are specified.)

Explanation Establishes "wait" status until the axis movement is completed (is positioned within the tolerance range).

Sample	Description
`WAIT ARM`	.........`Waits for the movement completion of robot 1.`
`WAIT ARM[2](2)`	.........`Waits for the movement completion of axis 2 of robot 2.`

Related commands	DRIVE, DRIVEI, MOVE, MOVEI, MOVET, PMOVE

146 WEIGHT

Specifies/acquires the tip weight (kg) parameter

Format

```
WEIGHT [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	The range varies according to the robot which has been specified.

Explanation Changes the "tip weight (kg)" parameter of the robot to the <*expression*> value.
This change does not apply to auxiliary axes.

Functions

Format

```
WEIGHT [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the "tip weight (kg)" parameter value of the robot specified by <*robot number*>.

Sample **Description**

```
A=5
B=2
C=WEIGHT   .........The tip weight(kg) parameter of robot 1 is assigned to variable C.
WEIGHT A   .........The tip weight(kg) parameter of robot 1 is changed to value (5) of
                    variable A.
MOVE P,P0
WEIGHT B   .........The tip weight(kg) parameter of robot 1 is changed to value (2) of
                    variable B.
MOVE P,P1
WEIGHT C   .........The tip weight(kg) parameter of robot 1 is replaced to the origin
                    value (the value of variable C).
D=WEIGHT   .........The tip weight(kg) parameter of robot 1 is assigned to variable D.
HALT
```

MEMO

If both of Tip weight parameters; <WEIGHT> and <WEIGHTG> are set, a total value will be set.

Related commands	WEIGHTG

147 WEIGHTG

Specifies/acquires the tip weight (g) parameter

Format

```
WEIGHTG [robot number] expression
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)
Expression	The range varies according to the robot which has been specified.

Explanation Changes the "tip weight (g)" parameter of the robot to the <expression> value.
This change does not apply to auxiliary axes.

Functions

Format

```
WEIGHTG [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the "tip weight (g)" parameter value of the robot specified by <robot number>.

Sample **Description**

```
A=5
B=2
C=WEIGHTG    .........The tip weight(g) parameter of robot 1 is assigned to variable C.
WEIGHTG A    .........The tip weight(g) parameter of robot 1 is changed to value (5) of
                      variable A.
MOVE P,P0
WEIGHTG B    .........The tip weight(g) parameter of robot 1 is changed to value (2) of
                      variable B.
MOVE P,P1
WEIGHTG C    .........The tip weight(g) parameter of robot 1 is replaced to the origin value
                      (the value of variable C).
D=WEIGHTG    .........The tip weight(g) parameter of robot 1 is assigned to variable D.
HALT
```

MEMO

If both of Tip weight parameters; <WEIGHT> and <WEIGHTG> are set, a total value will be set.

Related commands	WEIGHT

148

WEND

Ends the WHILE statement's command block

Format

```
WHILE conditional expression
   command block
WEND
```

Explanation Ends the command block which begins with the WHILE statement. A WEND statement must always be paired with a WHILE statement.
Jumping out of the WHILE to WEND loop is possible by using the GOTO statement, etc.

Sample **Description**

```
A=0
WHILE DI3(0)=0              .........Repeats between WHILE and WEND while DI3(0) is OFF
       A=A+1
       MOVE P,P0
       MOVE P,P1
       PRINT "COUNTER=";A
WEND                        .........Ends the command block of WHILE statement
HALT
```

Related commands	WHILE

149

WHERE

Acquires the arm's current position (pulse coordinates)

Format

```
WHERE [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the arm's current position in the joint coordinates.

Sample	Description
`P10=WHERE`	.........The current position's pulse coordinate value of robot 1 is assigned to P10.

Related commands	WHRXY

150

WHILE to WEND

Repeats an operation for as long as a condition is met

Format

```
WHILE conditional expression
   command block
WEND
```

Explanation Executes the command block between the WHILE and WEND statements when the condition specified by the <*conditional expression*> is met, and then returns to the WHILE statement to repeat the same operation.

When the <*conditional expression*> condition is no longer met (becomes false), the program jumps to the next command after the WEND statement.

If the <*conditional expression*> condition is not met from the beginning (false), the command block between the WHILE and WEND statements is not executed, and a jump occurs to the next statement after the WEND statement.

Jumping out of the WHILE to WEND loop is possible by using the GOTO statement, etc.

MEMO

When the conditional expression is a numeric expression, an expression value other than "0" indicates TRUE status, and "0" indicates FALSE status.

Sample 1 **Description**

```
A=0
WHILE DI3(0)=0                .........Repeats between WHILE and WEND while DI3(0) is OFF
       A=A+1
       MOVE P,P0
       MOVE P,P1
       PRINT "COUNTER=";A
WEND                          .........Ends the command block of WHILE statement
HALT
```

Sample 2 **Description**

```
A=0
WHILE -1    .........Becomes an endless loop because the conditional expression is always
                     TRUE (other than 0).
   A=A+1
   MOVE P,P0
   IF DI3(0)=1 THEN *END
   MOVE P,P1
   PRINT "COUNTER=";A
   IF DI3(0)=1 THEN *END
WEND        .........Ends the command block of WHILE statement
*END
HALT
```

151 WHRXY

Acquires the arm's current position in Cartesian coordinates

Format

```
WHRXY [robot number]
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation Acquires the arm's current position in the Cartesian coordinates.

MEMO

For YK-TW robot, the first and the second arm rotation information is also acquired.

Sample 1	Description
`P10=WHRXY`	.........The current position Cartesian coordinate value of robot 1 is assigned to P10.

Sample 2	Description
`LOC3(P10)=LOC3(WHRXY)`	.........The current position data of the third axis is assigned to the third axis at P10 in the cartesian coordinate system.

Related commands	WHERE

152 WRKDEF

Defines the work data (creates the work data of the specified number)

Format

Statement for Definition:

```
WRKDEF Wn = X-coordinate Offset  Y-coordinate Offset
            Z-coordinate Offset  R-coordinate Offset
```

Statement for Selection:

```
CHGWRK [robot number]
```

Notation	Value	Range	Unit
	Robot Number	1 to 4 (If not input, robot 1 is specified.)	
n	*Work Number*	0 to 39	
	X-coordinate Offset	Numeric value consisting of an integer portion of up to 4 digits and having 3 or less places below the decimal point	mm
	Y-coordinate Offset		mm
	Z-coordinate Offset		mm
	R-coordinate Offset		degree

Explanation WRKDEF statement defines the work data.

Note that this command executes the definition only.
Use the CHGWRK statement to actually switch the work data.

Reference "CHGWRK", User's Manual "Work definitions"

MEMO

"9.708: Work data destroyed" error may occur if the power of controller is turned off during the execution of WRKDEF.

● Parameter Value

X-coordinate Offset :	The offset amount from the robot tip (the tool tip; in use of the hand data) of the work "n" on X-coordinates is specified in real number.
Y-coordinate Offset :	The offset amount from the robot tip (the tool tip; in use of the hand data) of the work "n" on Y-coordinates is specified in real number.
Z-coordinate Offset :	The offset amount from the robot tip (the tool tip; in use of the hand data) of the work "n" on Z-coordinates is specified in real number.
R-coordinate Offset :	The angle of + X direction and the work "n" in the Cartesian coordinates is specified in real number when the current position of the robot tip (the tool tip; in use of the hand data) is "0.000" on R-coordinates. Enter positive value in counterclockwise.

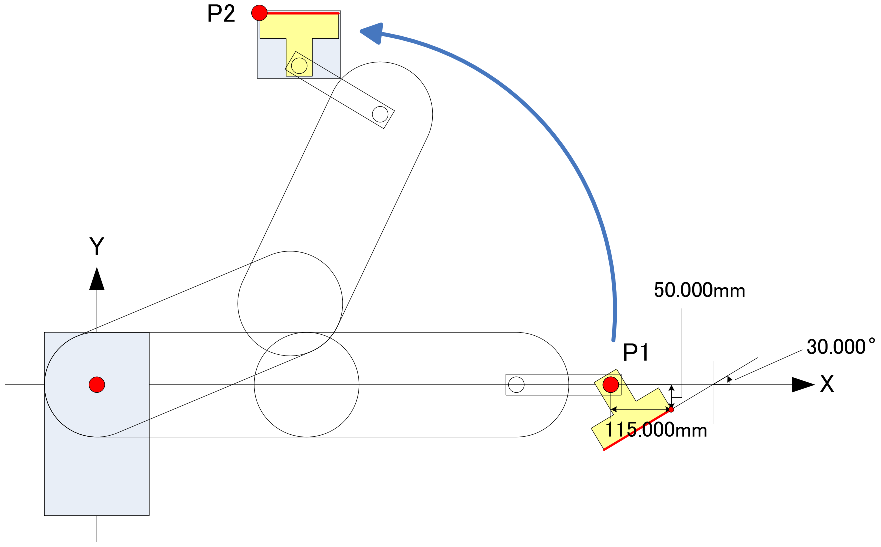
Related commands	CHGWRK, CREWRK

WRKDEF

Sample	Description

```
CHANGE H1      .........Changes the hand data of the robot 1 to hand 1.
MOVE P,P1      .........Moves the hand 1 tip of the robot 1 to P1.
WRKDEF W1 = 115.000  -50.000  0.000  30.000
CHGWRK W1      .........Changes the work data of the robot 1 to work 1.
MOVE P,P2      .........Moves the work 1 tip of the robot 1 to P2.
HALT
```

SAMPLE: WRKDEF



153

XYTOJ

Converts the Cartesian coordinate data ("mm") to joint coordinate data ("pulse")

Format

```
XYTOJ [robot number] (point expression)
```

Value	Range
Robot Number	1 to 4 (If not input, robot 1 is specified.)

Explanation This function converts the Cartesian coordinate data (unit: mm, deg.) of <point expression> to the joint coordinate data (unit: pulse).

The data is converted based on the shift (offset) format that is already set; standard coordinates, shift coordinates and hand definition.

- On SCARA robots, the converted result differs depending on whether right-handed or left-handed is specified.
- On the YK-TW series, the result varies, depending on the first arm and the second arm rotation information settings.
- To convert joint coordinate data to Cartesian coordinate data, use the JTOXY statement.

Sample	Description
`P10=XYTOJ(P10)`	………P10 is converted to joint coordinate data of robot 1.

Chapter 9

PATH Statements

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2 Features 9-1

3 How to use 9-1

4 Cautions when using this function 9-2

1 Overview

This function moves the robot at a specified speed along a path composed of linear and circular segments. Because speed fluctuations during movement are minimal, the PATH function is ideal for applications such as sealing, etc.

2 Features

- Moves the robot at a constant speed along the entire movement path (except during acceleration from a stop, and during deceleration just prior to the operation end).
- Permits easy point teaching because the robot speed is not affected by the point teaching positions' level of precision.
- Permits movement speed changes for the entire movement path, or speed changes for only one portion of the path (using the speed option).
- Using the DO option permits signal outputs to a specified port at any desired position during movement.

3 How to use

The following robot language commands must be used as a set in order to use the PATH function.

- PATH SET   Starts path setting.
- PATH (PATH L, PATCH C)   Specifies the path to be used.
- PATH END   Ends path setting.
- PATH START   Starts actual movement along the path.

As shown below, the motion path is specified between the PATH SET and PATH END statements.
Simply specifying a path, however, does not begin robot motion.
Robot motion only occurs when the PATH START statement is executed after the path setting procedure has been completed.

Sample **Description**

```
MOVE P,P0,Z=0               ............Start of robot 1's path setting
PATH SET
PATH L,P1,DO(20)=1@10.0
PATH L,P2
       :
       :
       :
PATH C,P12,P13
PATH L,P14,DO(20)=0@20.0
PATH END                    ............End of robot 1's path setting
MOVE P,P1,Z=0
       :
       :
       :
MOVE P,P0,Z=0
PATH START                  ............Executiong Path motion of robot 1
HALT
```

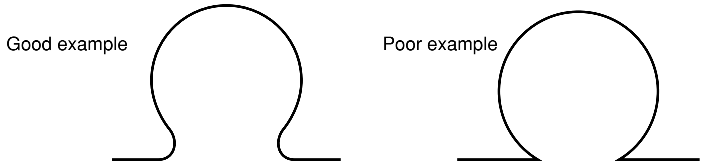
4 Cautions when using this function

- Paths may comprise no more than 1000 points (total) linear and circular segments. 1 point forms 1 linear segment by PATH L command and 2 points form 1 circular segment by PATH C command.

$$\text{Number of points specified by PATH L} + \frac{\text{Number of points specified by PATH C}}{2} \leqq 1000$$

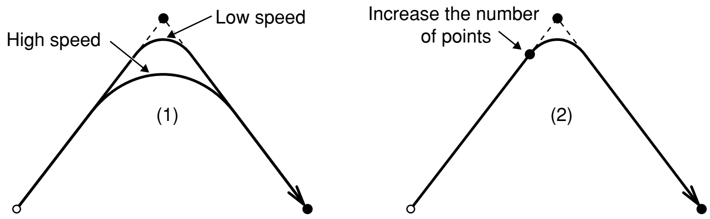
- The robot must be positioned at the path start point when PATH motion is executed (by PATH START statement).
- At points where circular and linear segments connect, the motion direction of the two connecting segments should be a close match (as close as possible). An excessive difference in their motion directions could cause vibration and robot errors.

Circular and linear segment connection point:
if there is a large difference between the motion directions of the connecting segments



- Where a linear segment connects to another linear segment, the motion path passes to the inner side of the connection point. Moreover, as shown in fig. (1) below, the faster the speed, the further to the inner side the path becomes. To prevent significant speed-related path shifts, add more points as shown in fig. (2). Note also, that in some cases, the speed may have to be reduced in order to prevent errors from occurring.

Linear segments connection point: Prevents a deviation



- If an error occurs due the robot's inability to move at the specified speed:
- Robot acceleration/deceleration occurs if the speed setting is changed when PATH motion begins, stops, or at some point along the path. At such times, an error may occur before motion begins if the distance between points is too short for the specified speed to be reached. In such cases, a slower speed must be specified. If the error still occurs after the speed is lowered, adjust the PATH points to increase the length of the linear or circular segments which contain acceleration or deceleration zones.
- The hand system used during PATH motion must be the same as the hand system used at the path's start point. The same applies if the path is to pass through points where hand flags are set. Differing hand systems will cause an error and disable motion.
- The first arm and second arm rotation information during PATH movement must be the same as the first arm and second arm rotation information at the PATH movement's START point. If the two are different, an error will occur and movement will be disabled.
- If the robot is stopped by a stop signal, etc., during PATH motion, this is interpreted as an execution termination, and the remaining path motion will not be completed even if a restart is executed.
- Only the X, Y and Z coordinate values among the specified points are valid for PATH motion.
  Any other coordinates use the coordinate values at the START point of the PATH motion; R-axis can not be moved to the specified point even if it is used.

Chapter 10

Data file description

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1 Overview

1.1 Data file types

This section explains data files used with a SEND statement and READ/WRITE online commands.

Type	File Name		Definition Format		Read-out	Write
			All	Individual File		
User	All file		ALL	———	✓	✓
	Program		PGM	<bbbbbbbb> PGn	✓	✓
	Point		PNT	Pn	✓	✓
	Point comment		PCM	PCn	✓	✓
	Point name		PNM	PNn	✓	✓
	Parameter		PRM	/cccccccc/ #cccccccc# \cccccccc\	✓	✓
	Shift coordinate definition		SFT	Sn	✓	✓
	Hand definition		HND	Hn	✓	✓
	Work definition		WRKDEF	Wn	✓	✓
	Pallet definition		PLT	PLn	✓	✓
	General Ethernet Port		GEP	GPn	✓	✓
	Input/output name		ION	iNMn(n)	✓	✓
	Area check output		ACO	ACn	✓	✓
	Real time output		RTO	RTn	✓	✓
Variable, Constant	Variable		VAR	ab...by	✓	✓
	Array variable		ARY	ab...by(x)	✓	✓
	Constant		——	"cc...c"	✓	–
Status	Program directory		DIR	<<bbbbbbbb>>	✓	–
	Parameter directory		DPM	———	✓	–
	Machine reference	sensor, stroke-end	MRF	———	✓	–
		mark	ARP	———	✓	–
	Accumulated data (*)		ACD	———	✓ (*)	–
	System configuration information		CFG	———	✓	–
	Version information		VER	———	✓	–
	Option board		OPT	———	✓	–
	Self check		SCK	———	✓	–
	Alarm history		LOG	———	✓	–
	Remaining memory size		MEM	———	✓	–
Device	DI port		DI()	DIn()	✓	–
	DO port		DO()	DOn()	✓	✓
	MO port		MO()	MOn()	✓	✓
	TO port		TO()	TOn()	✓	✓
	LO port		LO()	LOn()	✓	✓
	SI port		SI()	SIn()	✓	–
	SO port		SO()	SOn()	✓	✓
	SIW port		SIW()	SIWn()	✓	–
	SOW port		SOW()	SOWn()	✓	✓
	RS-232C		CMU	———	✓	✓
	Ethernet		ETH	———	✓	✓
Other	File END code		EOF	———	✓	–

n: Number a: Alphabetic character b: Alphanumeric character or underscore (_)

c: Alphanumeric character or special symbol x: Expression (array argument) y: Variable type

i: Input/output type

✓: Permitted –: Not Permitted

*) While Accumulated data files is supported with software Ver. 1.73 or later, Read-out of Accumulated data files is only supported with Ver. 2.04 or later.

1.2 Cautions

Observe the following cautions when handling data files.

- Only one-byte characters can be used.
- All data is handled as character strings conforming to ASCII character codes.
- Only upper-case alphabetic characters may be used in command statements (lower case characters are prohibited).
- Line lengths must not exceed 255 characters.
- A [cr/lf] data format designation indicates CR code (0Dh) + LF code (0Ah).
- The terms "reading out" and "writing" used in this manual indicate the following data flow;
  Reading out: Controller → external communication device
  Writing: External communication device → controller

2 Program file

2.1 All programs

Read-out	✓	When used as a read-out file, all programs currently stored are read out.
Write	✓	Write files are registered at the controller under the program name indicated at the "NAME = *program name*" line.

Format

```
PGM
```

Meaning

- Expresses all programs.
- If there is a specification of a program number in the case of a write file, the new program overwrites.
- If the program number is omitted in the case of a write file, the assignment is made to the smallest free number.
  If there are programs with the same name and with different program numbers, the older program is deleted.

Data Format

```
NAME = program name [cr/lf]
PGN=mmm[cr/lf]
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
               :
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
               :
NAME = program name [cr/lf]
PGN=mmm[cr/lf]
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
               :
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
[cr/lf]
```

Notation	Value	Range
a	Character code	0 to 7, 10 to 17, 20 to 27
mmm	Program number	1 to 100

- *Program names* are shown with 32 characters or less consisting of alphanumeric characters and _ (underscore).
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND PGM TO CMU ......Outputs all programs from the communication port.
SEND CMU TO PGM ......Inputs all programs from the communication port.

Response:
RUN [cr/lf]
NAME=TEST[cr/lf]
PGN=1[cr/lf]
PGN=1
A=1[cr/lf]
RESET DO2()[cr/lf]
    :
HALT[cr/lf]
[cr/lf]
END [cr/lf]
```

2.2 Each program

Read-out	✓
Write	✓

Format

```
1.<program name>
2.PGmmm
```

Meaning

- Expresses a specified program.
- "mmm" represents a number from 1 to 100.
- *Program names* are shown with 32 characters or less consisting of alphanumeric characters and _ (underscore), and must be enclosed in < > (angle brackets).
- If a program name is omitted and written as <> in format 1, the current program is specified.
- In the case of write file, an error occurs if the specified program name (<*program name*>) differs from one on the data (NAME=program name).

Data Format

```
NAME=program name[cr/lf]
PGN=mmm
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
                :
aaaaa ...aaaaaaaaaaaaaa[cr/lf]
[cr/lf]
```

Notation	Value	Range
a	Character code	0 to 7, 10 to 17, 20 to 27
mmm	Program number	1 to 100
	Program name	32 characters or less consisting of alphanumeric characters and _ (underscore)

MEMO

- At program writing operations, be sure to specify the program name after NAME=.
  Program writing cannot occur if the program name is not specified.
- When there is a program number with the different program, the older one will be overwritten.
- When there is no program number specified, the smallest free number will be specified automatically.
- Writing into the currently selected program is not possible.
- When a sequence program is being executed, writing into the program name "SEQUENCE" is not possible.

- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND <TEST1> TO CMU      ......Outputs program TEST1 from the communication port.
SEND CMU TO <TEST1>      ......Inputs program TEST1 from the communication port.

Response:
RUN [cr/lf]
NAME=TEST1[cr/lf]
PGN=1[cr/lf]
A=1[cr/lf]
RESET DO2()[cr/lf]
       :
HALT[cr/lf]
[cr/lf]
```

3 Point file

3.1 All points

Read-out	✓	When used as a read-out file, all points currently stored are read out.
Write	✓	When used as a write file, writing is performed with a point number.

Format

```
PNT
```

Meaning Expresses all point data.

Data Format

```
Pmmmm= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr [cr/lf]
Pmmmm= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr [cr/lf]
                 :
Pmmmm= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr [cr/lf]
Pmmmm= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr [cr/lf]
[cr/lf]
```

NOTE
- Integer point data is recognized in "pulse" units, and real number point data is recognized in "mm" units.
- When a dot is included, this is treated as point data in "mm" units.
- Each piece of data is separated by one or more spaces.

Notation	Value	Range / Meaning
mmmm	Point number	0 to 29999
f	Coordinate sign	+ / - / space
xxxxxx/../bbbbbb	Numeric value of 8 digits or less	
t	Extended hand system flag setting for SCARA robots	1: RIGHT / 2:LEFT
xr	The first arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data x (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data x (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data x (*1) range –540.00° < x < = -180.00°.
yr	The second arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data x (*1) range –180.00° < y < = 180.00°. 1: The "mm → pulse" converted pulse data x (*1) range 180.00° < y < = 540.00°. -1: The "mm → pulse" converted pulse data x (*1) range –540.00° < y < = -180.00°.

*1: The joint-coordinates-converted pulse data represents each arm's distance (converted to angular data) from its mechanical origin point.

- Hand system flags are valid only for SCARA robots, with the coordinate data specified in "mm" units.
- If a number other than "1" or "2" is specified for a hand system flag, or if no number is specified, this is interpreted as "0" setting (no hand system flag).
- The first arm and the second arm rotation information settings are available only on the YK-TW series robot model where a "mm"-unit coordinate system has been set.
- The first arm and the second arm rotation information is processed as "0" if a numeral other than 0, 1, -1 has been specified, or if no numeral has been specified.

Point file

A line containing only [cr/lf] is added at the end of the file to indicate the end of the file.

Sample **Description**

```
SEND PNT TO CMU         ............Outputs all points from the communication port.

Response:
RUN [cr/lf]
P0    =            1          2        3          4        5        6     [cr/lf]
P1    =      426.200   -160.770    0.001    337.210    0.000    0.000    0    1    0 [cr/lf]
P2    =      -27.570   -377.840    0.360    193.220    0.000    0.000    0   -1    0 [cr/lf]
      :
P29999=     -251.660   -419.510    0.000   -127.790    0.000    0.000    2   -1   -1 [cr/lf]
[cr/lf]
END [cr/lf]
```

3.2 One point data

Read-out	✓
Write	✓

Format

```
Pmmmm
```

Meaning Expresses a specified point data.

Data Format

```
Pmmmm= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr [cr/lf]
```

NOTE

- Integer point data is recognized in "pulse" units, and real number point data is recognized in "mm" units.
- When a dot is included, this is treated as point data in "mm" units.
- Each piece of data is separated by one or more spaces.

Notation	Value	Range / Meaning
mmmm	Point number	0 to 29999
f	Coordinate sign	+ / - / space
xxxxxx/../ bbbbbb	Numeric value of 8 digits or less	
t	Extended hand system flag setting for SCARA robots	1: RIGHT / 2:LEFT
xr	The first arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data x (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data x (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data x (*1) range –540.00° < x < = -180.00°.
yr	The second arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data y (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data y (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data y (*1) range –540.00° < x < = -180.00°.

*1: The joint-coordinates-converted pulse data represents each arm's distance (converted to angular data) from its mechanical origin point.

- Hand system flags are valid only for SCARA robots, with the coordinate data specified in "mm" units.
- If a number other than "1" or "2" is specified for a hand system flag, or if no number is specified, this is interpreted as "0" setting (no hand system flag).
- The first arm and the second arm rotation information settings are available only on the YK500TW robot model where a "mm" units coordinate system has been set.
- The first arm and the second arm rotation information is processed as "0" if a numeral other than 0, 1, -1 has been specified, or if no numeral has been specified.
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND P100 TO CMU .........Outputs the specified point data from the communication port.
SEND CMU TO P100 .........Inputs the specified point data from the communication port.
Response:
RUN [cr/lf]
P100= 1.000 2.000 3.000 4.000 5.000 6.000 0 1 0 [cr/lf]
END [cr/lf]
```

4 Point comment file

4.1 All point comments

Read-out	✓	When used as a read-out file, all point comments currently stored are read out.
Write	✓	When used as a write file, writing is performed with a point comment number.

Format

```
PCM
```

Meaning Expresses all point comments.

Data Format

```
PCmmmm= ssssssssssssssss[cr/lf]
PCmmmm= ssssssssssssssss[cr/lf]
            :
PCmmmm= ssssssssssssssss[cr/lf]
PCmmmm= ssssssssssssssss[cr/lf]
[cr/lf]
```

Notation	Value	Range
mmmm	Point comment number	0 to 29999
ss...ss	Comment data	This value can be up to 16 one-byte characters. If comment data exceeds 16 characters, then the 17th character onward will be deleted.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
SEND PCM TO CMU	Outputs all point comments from the communication port.
SEND CMU TO PCM	Inputs all point comments from the communication port.

```
Response:
RUN [cr/lf]
PC1 = ORIGIN POS[cr/lf]
PC3 = WAIT POS[cr/lf]
       :
PC3999 = WORK100[cr/lf]
[cr/lf]
END [cr/lf]
```

4.2 One point comment

Read-out	✓
Write	✓

Format

```
PCmmmm
```

Meaning Expresses a specified point comment.

Data Format

```
PCmmmm= ssssssssssssssss[cr/lf]
```

Notation	Value	Range
mmmm	Point comment number	0 to 29999
ss...ss	Comment data	This value can be up to 16 one-byte characters. If comment data exceeds 16 characters, then the 17th character onward will be deleted.

Sample	Description

```
SEND PC1 TO CMU ...................Outputs the specified point comment from the communication port.
SEND CMU TO PC1 ...................Inputs the specified point comment from communication port.

Response:
RUN [cr/lf]
PC1 = ORIGIN POS[cr/lf]
END [cr/lf]
```

5 Point name file

5.1 All point names

Read-out	✓	When used as a read-out file, all point names currently stored are read out.
Write	✓	When used as a write file, writing is performed with a point name number.

Format

```
PNM
```

Meaning Expresses all point names.

Data Format

```
PNmmmm= asssssssss [cr/lf]
PNmmmm= asssssssss [cr/lf]
               :
PNmmmm= asssssssss [cr/lf]
PNmmmm= asssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range
mmmm	Point comment number	0 to 29999
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

MEMO

Name data must not be duplicate. If name data were duplicate, delete the name data with the earlier point name number and save the name data to newly specified point name number.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND PNM TO CMU ................ Outputs all point names from the communication port.
SEND CMU TO PNM ................ Inputs all point names from the communication port.

Response:
RUN [cr/lf]
PN1=ORIGIN_POS [cr/lf]
PN3=WAIT_POS [cr/lf]
       :
PN 3999=WORK 100 [cr/lf]
[cr/lf]
END [cr/lf]
```

5.2 One point name

Read-out	✓
Write	✓

Format

```
PNmmmm
```

Meaning Expresses a specified point name.

Data Format

```
PNmmmm= asssssssssssssss [cr/lf]
```

Notation	Value	Range
mmmm	Point comment number	0 to 29999
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

Sample **Description**

```
SEND PN1 TO CMU ........................ Outputs the specified point name from the communication port.
SEND CMU TO PN1 ........................ Inputs the specified point name from the communication port.

Response:
RUN [cr/lf]
PN1=ORIGIN_POS [cr/lf]
END [cr/lf]
```

6 Parameter file

6.1 All parameters

Read-out	✓	When used as a read-out file, all parameters currently stored are read out.
Write	✓	When used as a write file, only the parameters specified by labels are written.

Format

```
PRM
```

Meaning Expresses all parameters.

Data Format

```
/parameter label/ [cr/lf]
RC=xxxxxx [cr/lf]
/parameter label/ [cr/lf]
R?=xxxxxx[cr/lf]
/parameter label/ [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
\parameter label\ [cr/lf]
C?=xxxxxx [cr/lf]
\parameter label\ [cr/lf]
R?=xxxxxx[cr/lf]
\parameter label\ [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
#parameter label# [cr/lf]
R?=xxxxxx[cr/lf]
#parameter label# [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
/parameter label/ [cr/lf]
C?O=xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
   :
[cr/lf]
```

Notation	Value	Remarks
RC	Entire controller	
R? ?	Robot setting Robot number	
C? ?	Controller setting Controller number	
A	Axis parameter	Each data is separated by a comma.
O	Option board parameter	Each data is separated by a comma.

- Parameter labels are shown with 8 alphabetic characters.
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Parameter file

MEMO

- When writing parameter data, be sure that the servo is off.
- Parameters are already compatible with upper versions. However, parameters might not always be compatible with lower versions (upward compatibility).
- When you attempt to load a parameter file of new version into a controller of an earlier version, "10.214: Undefined parameter found" error may occur. In this case, you may load the parameter by setting the "PRM SKIP" parameter to "VALID".
- As parameters whose labels are enclosed in "\" are controller configuration parameters, take care when editing them.
- As parameters whose labels are enclosed in "#" affect robot control, take care when editing them.
- "\" symbols may be displayed as "¥" depending on the computer environment.

Sample	Description
`SEND PRM TO CMU`	Outputs all parameters from the communication port.
`SEND CMU TO PRM`	Inputs all parameters from the communication port.

```
Response:
RUN [cr/lf]
' V1.22,R0191-V1.000-V1.09,R0015/V1.09,R0015 [cr/lf]
' Gripper,V0.32/Gripper,V0.32///[cr/lf]
' PRM(0)[cr/lf]
\CNTTYP\[cr/lf]
C1=340[cr/lf]
\YCEADR\[cr/lf]
C1=0[cr/lf]
\DRVASGN\[cr/lf]
R1A=101,102,103,104,0,0[cr/lf]
R2A=0,0,0,0,0,0[cr/lf]
R3A=0,0,0,0,0,0[cr/lf]
R4A=0,0,0,0,0,0[cr/lf]
\RBTNUM\[cr/lf]
R1=2203[cr/lf]
    :
[cr/lf]
END [cr/lf]
```

6.2 One parameter

Read-out	✓	When used as a read-out file, only the parameter specified by a label is read out.
Write	✓	When used as a write file, only the parameter specified by a label is written.

Format

```
/parameter label/, \parameter label\, #parameter label#
```

Meaning Parameter labels are shown with 8 alphabetic characters.

Data Format 1

```
/parameter label/ [cr/lf]
RC= xxxxxx [cr/lf]
[cr/lf]
```

Data Format 2

```
/parameter label/ [cr/lf]
R?= xxxxxx [cr/lf]
[cr/lf]
```

Data Format 3

```
/parameter label/ [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
[cr/lf]]
```

Data Format 4

```
\parameter label\ [cr/lf]
C?=xxxxxx [cr/lf]
[cr/lf]
```

Data Format 5

```
\parameter label\ [cr/lf]
R?=xxxxxx[cr/lf]
[cr/lf]
```

Data Format 6

```
\parameter label\ [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
[cr/lf]
```

Data Format 7

```
#parameter label# [cr/lf]
R?=xxxxxx[cr/lf]
[cr/lf]
```

Parameter file

Data Format 8

```
#parameter label# [cr/lf]
R?A=xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
[cr/lf]
```

Data Format 9

```
/parameter label/ [cr/lf]
C?O=xxxxxx,xxxxxx,xxxxxx,xxxxxx [cr/lf]
[cr/lf]
```

Notation	Value	Remarks
RC	Entire controller	
R? ?	Robot setting Robot number	
C? ?	Controller setting Controller number	
A	Axis parameter	Each data is separated by a comma.
O	Option board parameter	Each data is separated by a comma.

- Parameter labels are shown with 8 alphabetic characters.
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

MEMO

- When writing parameter data, be sure that the servo is off.
- Parameters are already compatible with upper versions. However, parameters might not always be compatible with lower versions (upward compatibility).
- When you attempt to load a parameter file of new version into a controller of an earlier version, "10.214: Undefined parameter found" error may occur. In this case, you may load the parameter by setting the "PRM SKIP" to "VALID". (For detail, refer to RCX3 user's manual.
- As parameters whose labels are enclosed in "\" are controller configuration parameters, take care when editing them.
- As parameters whose labels are enclosed in "#" affect robot control, take care when editing them.
- "\" symbols may be displayed as "¥" depending on the computer environment.

Sample **Description**

```
SEND /ACCEL / TO CMU ............ Outputs the acceleration parameter from
                                  the communication port.
SEND CMU TO /ACCEL / ............ Inputs the acceleration parameter from
                                  the communication port.


Response:
RUN [cr/lf]
/ACCEL / [cr/lf]
R1A=100, 100, 100, 100 [cr/lf]
[cr/lf]
END [cr/lf]
```

7 Shift coordinate definition file

7.1 All shift coordinate data

Read-out	✓	When used as a read-out file, all shift coordinate data currently stored are read out.
Write	✓	When used as a write file, writing is performed with a shift number.

Format

```
SFT
```

Meaning Expresses all shift coordinate data.

Data Format

```
Sm  = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
SPm = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
SMm = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
     :
Sm  = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
SPm = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
SMm = fxxxxxx  fyyyyyy  fzzzzzz  frrrrrr [cr/lf]
[cr/lf]
```

Notation	Value	Range
m	Shift number	0 to 39
f	Coordinate sign	+ / - / space
xxxxxx/yyyyyy/../rrrrrr	Represent a numeric value of 7 digits or less, having 3 or less places below the decimal point.	

- The SPm and SMm inputs are optional in writing files.
  SPm: shift coordinate range plus-side
  SMm: shift coordinate range minus-side
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND SFT TO CMU ..................... Outputs all coordinate shift data from the communication port.
SEND CMU TO SFT ..................... Inputs all shift coordinate data from the communication port.

Response:
RUN [cr/lf]
S0  = 0.000 0.000 0.000 0.000 [cr/lf]
SP0= 0.000 0.000 0.000 0.000 [cr/lf]
SM0= 0.000 0.000 0.000 0.000 [cr/lf]
S1  = 1.000 1.000 1.000 1.000 [cr/lf]
              :
SM39= 9.000 9.000 9.000 9.000 [cr/lf]
[cr/lf]
END [cr/lf]
```

7.2 One shift definition

Read-out	✓
Write	✓

Format

```
Sm
```

Meaning Expresses a specified shift definition.

Data Format

```
Sm  = fxxxxxxx  fyyyyyyy  fzzzzzz  frrrrrr[cr/lf]
```

Notation	Value	Range
m	Shift number	0 to 39
f	Coordinate sign	+ / - / space
xxxxxx/yyyyyy/../rrrrrr	Represent a numeric value of 7 digits or less, having 3 or less places below the decimal point.	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND S0 TO CMU`	Outputs the specified shift coordinate data from the communication port.
`SEND CMU TO S0`	Inputs the specified shift coordinate data from the communication port.

```
Response:
RUN [cr/lf]
S0 = 0.000 0.000 0.000 0.000[cr/lf]
SP0= 0.000 0.000 0.000 0.000[cr/lf]
SM0= 0.000 0.000 0.000 0.000[cr/lf]
[cr/lf]
END [cr/lf]
```

8 Hand definition file

8.1 All hand data

Read-out	✓	When used as a read-out file, all hand data currently stored are read out.
Write	✓	When used as a write file, writing is performed with a hand number.

Format

```
HND
```

Meaning Expresses all hand data.

Data Format

```
Hm  = n,fxxxxxx, fyyyyyy, fzzzzzz ,{R}[cr/lf]
      :
Hm  = n,fxxxxxx, fyyyyyy, fzzzzzz ,{R}[cr/lf]
[cr/lf]
```

Notation	Value	Range
m	Hand number	0 to 31
n	Robot number	1 to 4
f	Coordinate sign	+ / - / space
{R}	Whether a hand is attached to the R-axis.	
xxxxxx/yyyyyy/zzzzzz	Represent a real numeric value of 7 digits or less, having 3 or less places below the decimal point, or an integer of 7 digits or less. (This numeric format depends on the robot type setting and hand definition type.)	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND HND TO CMU ............. Outputs all hand data from the communication port.
SEND CMU TO HND ............. Intputs all hand data from the communication port.

Response:
RUN [cr/lf]
H0 = 1, 0.000, 0.000, 0.000 [cr/lf]
H1 = 1, 1.000, 1.000, 1.000 [cr/lf]
H2 = 2, 2.000, 2.000, 2.000 [cr/lf]
H3 = 2, 3.000, 3.000, 3.000 [cr/lf]
H4 = 3, 4.000, 4.000, 4.000 [cr/lf]
H5 = 3, 5.000, 5.000, 5.000 [cr/lf]
H6 = 4, 6.000, 6.000, 6.000 [cr/lf]
H7 = 4, 7.000, 7.000, 7.000 [cr/lf]
[cr/lf]
END [cr/lf]
```

8.2 One hand definition

Read-out	✓
Write	✓

Format

```
Hm
```

Meaning Expresses a specified hand definition.

Data Format

```
Hm = n,fxxxxxx, fyyyyyy, fzzzzzz ,{R}[cr/lf]
```

Notation	Value	Range
m	Hand number	0 to 31
n	Robot number	1 to 4
f	Coordinate sign	+ / - / space
{R}	Whether a hand is attached to the R-axis.	
xxxxxx/yyyyyy/zzzzzz	Represent a real numeric value of 7 digits or less, having 3 or less places below the decimal point, or an integer of 7 digits or less. (This numeric format depends on the robot type setting and hand definition type.)	

Sample **Description**

```
SEND H3 TO CMU ......... Outputs the specified hand definition data from the communication port.
SEND CMU TO H3 ......... Inputs the specified hand definition data from communication port.

Response:
RUN [cr/lf]
H3=2, 3.000, 3.000, 3.000, R [cr/lf]
END [cr/lf]
```

9 Work definition file

9.1 All work data

Read-out	✓	When used as a read-out file, all work data currently stored are read out.
Write	✓	When used as a write file, writing is performed with a work number.

Format

```
WRKDEF
```

Meaning Expresses all work data.

Data Format

```
Wm = fxxxx.xxx fyyyy.yyy fzzzz.zzz frrrr.rrr [cr/lf]
        :
Wm = fxxxx.xxx fyyyy.yyy fzzzz.zzz frrrr.rrr [cr/lf]
[cr/lf]
```

Notation	Value	Range
m	Work number	0 to 39
f	Coordinate sign	+ / - / space
xxxx.xxx/yyyyy.yy zzzz.zzz/rrrr.rrr	Numeric value consisting of an integer portion of up to 4 digits and having 3 or less places below the decimal point [Unit] xxxx.xxx/yyyyy.yy/zzzz.zzz: mm rrrr.rrr: degree	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND WRKDEF TO CMU ........................ Outputs all work data from the communication port.
SEND CMU TO WRKDEF......................... Intputs all work data from the communication port.

Response:
RUN [cr/lf]
W0 = 0.000, 0.000, 0.000, 0.000 [cr/lf]
W1 = 1.000, 1.000, 1.000, 1.000 [cr/lf]
W2 = 2.000, 2.000, 2.000, 2.000 [cr/lf]
W3 = 3.000, 3.000, 3.000, 3.000 [cr/lf]
W4 = 4.000, 4.000, 4.000, 4.000 [cr/lf]
W5 = 5.000, 5.000, 5.000, 5.000 [cr/lf]
[cr/lf]
END [cr/lf]
```

9.2 One work definition

Read-out	✓
Write	✓

Format

```
Wm
```

Meaning Expresses a specified work definition.

Data Format

```
Wm = fxxxx.xxx fyyyy.yyy fzzzz.zzz frrrr.rrr [cr/lf]
```

Notation	Value	Range
m	Work number	0 to 39
f	Coordinate sign	+ / - / space
xxxx.xxx/yyyyy.yy zzzz.zzz/rrrr.rrr	Numeric value consisting of an integer portion of up to 4 digits and having 3 or less places below the decimal point [Unit] xxxx.xxx/yyyyy.yy/zzzz.zzz: mm rrrr.rrr: degree	

Sample	Description
`SEND W3 TO CMU`	`Outputs the specified work data from the communication port.`
`SEND CMU TO W3`	`Inputs the specified work data from communication port.`

```
Response:
RUN [cr/lf]
W3= 3.000, 3.000, 3.000, 3.000 [cr/lf]
END [cr/lf]
```

10 Pallet definition file

10.1 All pallet definitions

Read-out	✓	When used as a read-out file, all pallet definitions currently stored are read out.
Write	✓	When used as a write file, writing is performed with a pallet number.

Format

```
PLT
```

Meaning Expresses all pallet definitions.

Data Format

```
PLm [cr/lf]
PLN = XY [cr/lf]
NX = nnn [cr/lf]
NY = nnn [cr/lf]
NZ = nnn [cr/lf]
PLP = ppppp [cr/lf]
P[1]  = fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr[cr/lf]
              :
P[5]  = fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr[cr/lf]
PLm [cr/lf]
   :
[cr/lf]
```

Notation	Value	Range / Meaning
m	Pallet number	0 to 39
XY	Coordinate plane setting	XY Coordinate plane
nnn	Number of points for each axis	Positive integer
ppppp	Point number for pallet definition	Continuous 5 points starting with the specified point are used.
f	Coordinate sign	+ / - / space
xxxxxx/ yyyyyy/../ bbbbbb	Numeric value of 8 digits or less (*2)	
t	Extended hand system flag setting for SCARA robots	1: RIGHT / 2:LEFT
xr	The first arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data x (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data x (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data x (*1) range –540.00° < x < = -180.00°.
yr	The second arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data y (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data y (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data y (*1) range –540.00° < x < = -180.00°.

*1: The joint-coordinates-converted pulse data represents each arm's distance (converted to angular data) from its mechanical origin point.

*2: Integers indicate point data in "pulse" units, and real numbers in "mm" units.
When a dot is included, this is treated as point data in "mm" units.
Each piece of data is separated by one or more spaces.

- Hand system flags are enabled only when specifying the coordinate data in "mm" units for SCARA robots.
- Hand system flags and the first arm and the second arm rotation information are ignored during movement where pallet definitions are used.
- If a number other than 1 or 2 is set, or if no number is designated, then 0 will be set to indicate that there is no hand system flag.
- The first arm and the second arm rotation information settings are available only on the YK-TW series robot model where a "mm" units coordinate system has been set.
- If a value other than "0", "1", "-1" is specified at the first arm and the second arm rotation information, or if no value is specified, this will be processed as "0".
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND PLT TO CMU ..................Outputs all pallet definitions from the communication port.
SEND CMU TO PLT ..................Inputs all pallet definitions from the communication port.

Response:
RUN [cr/lf]
PL0[cr/lf]
PLN=XY[cr/lf]
NX = 3 [cr/lf]
NY = 4 [cr/lf]
NZ = 2 [cr/lf]
PLP= 3996[cr/lf]
P[1]= 0.000 0.000 0.000 0.000 0.000 0.000 [cr/lf]
P[2]= 100.000 0.000 0.000 0.000 0.000 0.000 [cr/lf]
P[3]= 0.000 100.000 0.000 0.000 0.000 0.000 [cr/lf]
P[4]= 100.000 100.000 0.000 0.000 0.000 0.000 [cr/lf]
P[5]= 0.000 0.000 50.000 0.000 0.000 0.000 [cr/lf]
PL1[cr/lf]
PLN= XY[cr/lf]
NX = 3[cr/lf]
NY = 4[cr/lf]
NZ = 2[cr/lf]
PLP= 3991[cr/lf]
P[1]= 0.000 0.000 0.000 0.000 0.000 0.000 [cr/lf]
P[2]= 100.000 100.000 0.000 0.000 0.000 0.000 [cr/lf]
P[3]= 0.000 200.000 0.000 0.000 0.000 0.000 [cr/lf]
P[4]= 100.000 200.000 0.000 0.000 0.000 0.000 [cr/lf]
P[5]= 0.000 0.000 100.000 0.000 0.000 0.000 [cr/lf]
[cr/lf]
END [cr/lf]
```

10.2 One pallet definition

Read-out	✓
Write	✓

Format

```
PLm
```

Meaning Expresses a specified pallet definition.

Data Format

```
PLm [cr/lf]
PLN  =  XY [cr/lf]
PLP = ppppp [cr/lf]
NX   =  nnn [cr/lf]
NY   =  nnn [cr/lf]
NZ   =  nnn [cr/lf]
P[1]  = fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr[cr/lf]
                 :
P[5]  = fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t xr yr[cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
m	Pallet number	0 to 39
XY	Coordinate plane setting	XY Coordinate plane
nnn	Number of points for each axis	Positive integer
ppppp	Point number for pallet definition	Continuous 5 points starting with the specified point are used.
f	Coordinate sign	+ / - / space
xxxxxx/ yyyyyy/../ bbbbbb	Numeric value of 8 digits or less (*2)	
t	Extended hand system flag setting for SCARA robots	1: RIGHT / 2:LEFT
xr	The first arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data x (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data x (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data x (*1) range –540.00° < x < = -180.00°.
yr	The second arm rotation information for YK-TW series robot	0: The "mm → pulse" converted pulse data y (*1) range –180.00° < x < = 180.00°. 1: The "mm → pulse" converted pulse data y (*1) range 180.00° < x < = 540.00°. -1: The "mm → pulse" converted pulse data y (*1) range –540.00° < x < = -180.00°.

*1: The joint-coordinates-converted pulse data represents each arm's distance (converted to angular data) from its mechanical origin point.

*2: Integers indicate point data in "pulse" units, and real numbers in "mm" units.
When a dot is included, this is treated as point data in "mm" units.
Each piece of data is separated by one or more spaces.

Pallet definition file

- Hand system flags are enabled only when specifying the coordinate data in "mm" units for SCARA robots.
- Hand system flags and the first arm and the second arm rotation information are ignored during movement where pallet definitions are used.
- If a number other than 1 or 2 is set, or if no number is designated, then 0 will be set to indicate that there is no hand system flag.
- The first arm and the second arm rotation information settings are available only on the YK-TW series robot model where a "mm" units coordinate system has been set.
- If a value other than "0", "1", "-1" is specified at the first arm and the second arm rotation information, or if no value is specified, this will be processed as "0".
- A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND PL2 TO CMU ........... Outputs the specified pallet definition from the communication port as
                            shown below.
SEND CMU TO PL2 ........... Inputs the specified pallet definition from the communication port as
                            shown below.

Response:
RUN [cr/lf]
PL2[cr/lf]
PLN=XY[cr/lf]
NX= 3[cr/lf]
NY= 3[cr/lf]
NZ= 2[cr/lf]
PLP= 3986[cr/lf]
P[1]= 100.000 100.000 50.000 90.000 0.000 0.000 [cr/lf]
P[2]= 200.000 100.000 50.000 90.000 0.000 0.000 [cr/lf]
P[3]= 100.000 200.000 50.000 90.000 0.000 0.000 [cr/lf]
P[4]= 200.000 200.000 50.000 90.000 0.000 0.000 [cr/lf]
P[5]= 100.000 10.000 100.000 90.000 0.000 0.000 [cr/lf]
[cr/lf]
END [cr/lf]
```

11 General Ethernet port file

Read-out	✓	When used as a read-out file, all general Ethernet port definitions are read out.
Write	✓	When used as a write file, writing is performed with a general Ethernet port number.

Format

```
GEP
```

Meaning Expresses all general Ethernet port definitions.

Data Format

```
GPm [cr/lf]
MODE=n [cr/lf]
IPADRS= aaa.aaa.aaa.aaa [cr/lf]
PORT=ppppp [cr/lf]
EOL=e [cr/lf]
TYPE=t [cr/lf]
        :
TYPE=t [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
m	General Ethernet port number	0 to 7
n	Mode	0: Server / 1: Client
aaa	IP address	0 to 255
ppppp	Port number	0 to 65535
e	Termination character code	0: CRLF / 1: CR
t	Port type	0: TCP

MEMO

When Client mode is selected in the write file,

- IP address and port number: Set the IP address and port number of the connection destination server.

When Server mode is selected in the write file,

- IP address: IP address already set on the controller is used to communicate, so IP address setting is unnecessary.
- Port number: Set a port number which differs from the one on the controller.

General Ethernet port definition file

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND GEP TO CMU`	Outputs all files of the general Ethernet port from the communication port.
`SEND CMU TO GEP`	Inputs all files of the general Ethernet port from the communication port.

```
Response:
RUN [cr/lf]
GP0 [cr/lf]
MODE=1 [cr/lf]
IPADRS=192.168.0.1 [cr/lf]
PORT=100 [cr/lf]
EOL=0 [cr/lf]
TYPE=0 [cr/lf]
GP1 [cr/lf]
MODE=1 [cr/lf]
IPADRS=192.168.0.100 [cr/lf]
PORT=200 [cr/lf]
EOL=0 [cr/lf]
TYPE=0 [cr/lf]
[cr/lf]
END [cr/lf]
```

12 Input/output name file

12.1 All input/output name data

Read-out	✓	When used as a read-out file, all input/output data currently stored are read out.
Write	✓	When used as a write file, writing is performed with a input/output number.

Format

```
ION
```

Meaning Expresses all input/output name data.

Data Format

```
ioNMpp(b)=assssssssssssssss [cr/lf]
ioNMpp(b)=assssssssssssssss [cr/lf]
        :
ioNMpp(b)=assssssssssssssss [cr/lf]
ioNMpp(b)=assssssssssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range
io	Input/output type	DI / DO / SI / SO
pp	Port number	2 to 7 / 10 to 15
b	Bit number	0 to 7
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND ION TO CMU`	Outputs all input/output name data from the communication port.
`SEND CMU TO ION`	Inputs all input/output name data from the communication port.

```
Response:
RUN [cr/lf]
DONM2(0)=DO_PORT2_0 [cr/lf]
DONM2(1)=DO_PORT2_1 [cr/lf]
              :
SINM15(6)=SI_PORT15_6 [cr/lf]
SINM15(7)=SI_PORT15_7 [cr/lf]
[cr/lf]
END [cr/lf]
```

MEMO

Name data must not be duplicate. When duplicate name data is saved, delete the name data with the earlier point number and save the name data to the point number which is specified as the new destination to save to.

12.2 One input/output type

Read-out	✓
Write	✓ Restricted*

Format

```
ioNM()
```

Meaning Expresses a specified input/output type.

Data Format

```
ioNMpp(b)=assssssssssssssss [cr/lf]
        :
ioNMpp(b)=assssssssssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range
io	Input/output type	DI / DO / SI / SO
pp	Port number	2 to 7 / 10 to 15 *Readable input/output type and Port number DI: Up to Port14 / DO: Up to Port 10 / SI, SO: Up to Port 15
b	Bit number	0 to 7
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND DONM() TO CMU ..................... Outputs the specified input/output name data from
                                         the communication port.

Response:
RUN [cr/lf]
DONM2(0)=DO_PORT2_0 [cr/lf]
DONM2(1)=DO_PORT2_1 [cr/lf]
              :
DONM10(6)=DO_PORT10_6 [cr/lf]
DONM10(7)=DO_PORT10_7 [cr/lf]
[cr/lf]
END [cr/lf]
```

12.3 One input/output port

Read-out	✓
Write	✓ Restricted*

Format

```
ioNMpp()
```

Meaning Expresses a specified input/output type and port number.

Data Format

```
ioNMpp(b)=assssssssssssssss [cr/lf]
              :
ioNMpp(b)=assssssssssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range
io	Input/output type	DI / DO / SI / SO
pp	Port number	2 to 7 / 10 to 15 *Readable input/output type and Port number DI: Up to Port14 / DO: Up to Port 10 / SI, SO: Up to Port 15
b	Bit number	0 to 7
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND DONM2() TO CMU ................ Outputs the specified input/output name data from
                                     the communication port.

Response:
RUN [cr/lf]
DONM2(0)=DO_PORT2_0 [cr/lf]
DONM2(1)=DO_PORT2_1 [cr/lf]
              :
DONM10(6)=DO_PORT10_6 [cr/lf]
DONM10(7)=DO_PORT10_7 [cr/lf]
[cr/lf]
END [cr/lf]
```

12.4 One input/output bit

Read-out	✓
Write	✓ Restricted*

Format

```
ioNMpp(b)
```

Meaning Expresses a specified input/output type and bit number.

Data Format

```
ioNMpp(b)=asssssssssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range
io	Input/output type	DI / DO / SI / SO
pp	Port number	2 to 7 / 10 to 15 *Readable input/output type and Port number DI: Up to Port14 / DO: Up to Port 10 / SI, SO: Up to Port 15
b	Bit number	0 to 7
a	Name data (the first character)	Use only one-byte alphabetic character. Otherwise, "4.202: Input format error" occurs.
ss...ss	Name data (the second character onward)	Use one-byte alphanumeric characters and _ (underscore). Otherwise, "4.202: Input format error" occurs. If name data exceeds 16 characters, then the 17th character onward will be deleted.

Sample	Description
`SEND DONM2(0) TO CMU`	Outputs the specified input/output name data from the communication port.

```
Response:
RUN [cr/lf]
DONM2(0)=DO_PORT2_0 [cr/lf]
END [cr/lf]
```

13 Area check output file

13.1 All area check output data

Read-out	✓	When used as a read-out file, all area check output data currently stored are read out.
Write	✓	When used as a write file, writing is performed with an area check output number.

Format

```
ACO
```

Meaning Expresses all area check output data.

Data Format

```
ACm=r,p1,p2,t,n,l [cr/lf]
ACm=r,p1,p2,t,n,l [cr/lf]
              :
ACm=r,p1,p2,t,n,l [cr/lf]
ACm=r,p1,p2,t,n,l [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
m	Area check output number	0 to 31
r	Robot number	0 to 4 (0: Invalid)
p1	Comparison point number 1	0 to 29999
p2	Comparison point number 2	0 to 29999
t	Port type	0: DO/SO 1: DO 2: SO 3: MO
n	Port number	20 to 277
l	Logic	0: OFF / 1: ON

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND ACO TO CMU`	Outputs all area check output data from the communication port.
`SEND CMU TO ACO`	Inputs all area check output data from the communication port.

```
Response:
RUN [cr/lf]
AC0=1,0,1,0,20,0 [cr/lf]
AC1=2,100,110,0,50,0 [cr/lf]
              :
AC30=1,20,21,0,20,0 [cr/lf]
AC31=1,50,51,0,100,0 [cr/lf]
[cr/lf]
END[cr/lf]
```

13.2 One area check output definition

Read-out	✓	
Write	✓	When used as a write file, writing is performed with an area check output number.

Format

```
ACm
```

Meaning Expresses a specified area check output definition.

Data Format

```
ACm=r,p1,p2,t,n,l [cr/lf]
```

Notation	Value	Range / Meaning
m	Area check output number	0 to 31
r	Robot number	0 to 4 (0: Invalid)
p1	Comparison point number 1	0 to 29999
p2	Comparison point number 2	0 to 29999
t	Port type	0: DO/SO 1: DO 2: SO 3: MO
n	Port number	20 to 277
l	Logic	0: OFF / 1: ON

Sample **Description**

```
SEND AC0 TO CMU .............................. Outputs specified area check output data from
                                               the communication port.
SEND CMU TO AC0 .............................. Inputs specified area check output data from
                                               the communication port.

Response:
RUN [cr/lf]
AC0=1,0,1,0,20,0 [cr/lf]
END[cr/lf]
```

7
8
9
10
11
12
13

14 Real time output file

Real time output files is supported with software Ver. 1.73 or later.

14.1 All real time output setting

Read-out	✓	When used as a read-out file, all real time output setting currently stored are read out.
Write	✓	When used as a write file, writing is performed with an real time output number.

Format

```
RTO
```

Meaning Expresses all real time output setting.

Data Format

```
RTz = n, o, p [cr/lf]
:
RTz = n, o, p [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
z	Port number for Real time output	24 to 127
n	Output string	**Reference** "14.3 Real time output setting list"
o	Option 1	
p	Option 2	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND RTO TO CMU`	Outputs all real time output data from the communication port.

```
Response:
RUN [cr/lf]
RT24=UCURPLS,1,1[cr/lf]
RT25=LCURPLS,1,1[cr/lf]
        :
RT127=LPWRONCNT[cr/lf]
[cr/lf]
END [cr/lf]
```

14.2 One real time output setting

Read-out	✓
Write	✓

Format

```
RTz
```

Meaning Expresses a specified real time output setting.

Data Format

```
RTz = n, o, p [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
z	Port number for Real time output	24 to 127
n	Output string	**Reference** "14.3 Real time output setting list"
o	Option 1	
p	Option 2	

Sample	Description
`SEND RT24 TO ETH`	Outputs the specified real time output data from the communication port.

```
Response:
RUN [cr/lf]
RT24=UCURPLS,1,1[cr/lf]
[cr/lf]
END [cr/lf]
```

14.3 Real time output setting list

No. (m)	Output string (n)	Output item	Unit	Data type	Option 1 (o)		Option 2 (p)	
					Target	Range	Target	Range
1	UCURPLS	Current Pulse (upper)	pulse	high order LONG	Robot	1 to 4	Axis	1 to 6
2	LCURPLS	Current Pulse (lower)	pulse	low order LONG	Robot	1 to 4	Axis	1 to 6
3	UREFPLS	Reference Pulse (upper)	pulse	high order LONG	Robot	1 to 4	Axis	1 to 6
4	LREFPLS	Reference Pulse (lower)	pulse	low order LONG	Robot	1 to 4	Axis	1 to 6
5	UCURVEL	Current Speed (upper)	pulse/10ms	high order LONG	Robot	1 to 4	Axis	1 to 6
6	LCURVEL	Current Speed (lower)	pulse/10ms	low order LONG	Robot	1 to 4	Axis	1 to 6
7	UREFVEL	Reference Speed (upper)	pulse/10ms	high order LONG	Robot	1 to 4	Axis	1 to 6
8	LREFVEL	Reference Speed (lower)	pulse/10ms	low order LONG	Robot	1 to 4	Axis	1 to 6
9	FDBCUR	Feedback Current	0.01Arms	SHORT	Robot	1 to 4	Axis	1 to 6
10	REFCUR	Reference Current	0.01Arms	SHORT	Robot	1 to 4	Axis	1 to 6
11	INPOS	Tolerance (1)	–	USHORT	Robot	1 to 4	Axis	1 to 6
12	OUTPOS	Out Valid Position (1)	–	USHORT	Robot	1 to 4	Axis	1 to 6
13	MTRDUTY	Motor Duty	%	USHORT	Robot	1 to 4	Axis	1 to 6
14	DRVDUTY	Driver Duty	%	USHORT	Robot	1 to 4	Axis	1 to 6
15	DRVMOD	Driver Mode (2)	–	USHORT	Robot	1 to 4	Axis	1 to 6
16	GRPPLS	Gripper Current Pulse	pulse	LONG	Gripper	1 to 4	–	–
17	UGRPPOS	Gripper Current Position (upper)	0.00001mm	high order LONG	Gripper	1 to 4	–	–
18	LGRPPOS	Gripper Current Position (lower)	0.00001mm	low order LONG	Gripper	1 to 4	–	–
19	GRPSTS	Gripper Status (3)	–	USHORT	Gripper	1 to 4	–	–
20	USGI	SGI (upper)	–	high order LONG	SGI	0 to 31	–	–
21	LSGI	SGI (lower)	–	low order LONG	SGI	0 to 31	–	–
22	USGR	SGR (upper)	0.001	high order LONG	SGR	0 to 31	–	–
23	LSGR	SGR (lower)	0.001	low order LONG	SGR	0 to 31	–	–
24	TEMP	Temperature	℃	USHORT	–	–	–	–
25	TASK	Taks Number	–	USHORT	–	–	–	–
26	STEP	Step Number	–	USHORT	Task	1 to 16	–	–
27	TSKSTS	Task Status (4)	–	USHORT	Task	1 to 16	–	–
28	ALRMGRP	Alarm Group	–	USHORT	–	–	–	–
29	ALRMCTG	Alarm Category	–	USHORT	–	–	–	–
30	UCCORPOS	Current Cartesian Coordinates Position (upper)	0.001mm or deg	high order LONG	Robot	1 to 4	Axis	1 to 6
31	LCCORPOS	Current Cartesian Coordinates Position (lower)	0.001mm or deg	low order LONG	Robot	1 to 4	Axis	1 to 6
32	UCCORSPD	Current Cartesian Coordinates Speed (upper)	mm/s	high order LONG	Robot	1 to 4	Axis	1 to 6
33	LCCORSPD	Current Cartesian Coordinates Speed (lower)	mm/s	low order LONG	Robot	1 to 4	Axis	1 to 6
34	UMOVDIS	Moving Distance (upper)	m or 1000 deg	high order ULONG	Robot	1 to 4	Axis	1 to 6
35	LMOVDIS	Moving Distance (lower)	m or 1000 deg	low order ULONG	Robot	1 to 4	Axis	1 to 6
36	UPWRONCNT	Power On Count (upper)	Times	high order ULONG	–	–	–	–
37	LPWRONCNT	Power On Count (lower)	Times	low order ULONG	–	–	–	–
38	UMTRONCNT	Motor Power On Count (upper)	Times	high order ULONG	–	–	–	–
39	LMTRONCNT	Motor Power On Count (lower)	Times	low order ULONG	–	–	–	–
40	USRVONCNT	Servo On Count (upper)	Times	high order ULONG	Robot	1 to 4	Axis	1 to 6
41	LSRVONCNT	Servo On Count (lower)	Times	low order ULONG	Robot	1 to 4	Axis	1 to 6
42	USRVONTIM	Servo On Time (upper)	s	high order ULONG	Robot	1 to 4	Axis	1 to 6
43	LSRVONTIM	Servo On Time (lower)	s	low order ULONG	Robot	1 to 4	Axis	1 to 6
44	UOPRTIM	Total Operating Time (upper)	s	high order ULONG	–	–	–	–
45	LOPRTIM	Total Operating Time (lower)	s	low order ULONG	–	–	–	–

Accumulated motor data (Servo ON Count, Servo ON Time, Moving Distance), accumulated controller data (Power ON Count, Motor Power ON Count, Total Operating Time) are initialized at the first boot in Ver.1.73 of RCX3 controller host CPU. Thereafter, the value is retained and accumulated even if the power is turned off. The Motor and the Controller Accumulated Data can be reset by remote commands, respectively.

Reference Field Network manual "Remote command"

The table below shows the allocation of values for each state.

(1) INPOS (Tolerance) / OUTPOS (Out Valid Position)

Output item	State of specified axis when movement command is executed	Value	
		0	1
Tolerance	Whether the axis is within the tolerance range for the target position	Out of range	Within range
OUT-Position	Whether the axis is within the tolerance range for the OUT-position		

(2) DRVMOD (Driver Mode)

Driver mode	Value (*)
Servo HOLD	0x0030
Servo OFF	0x0031
Servo FREE	0x0032
in Operation	0x0033
	0x0034
	0x0035
Return-to-Origin Operation	0x0036
Servo BRAKING	0x0037
Analysis Mode	0x0038
Speed control Mode	0x0039
Severe Alarm	0x0050
	0x0051
Magnetic pole estimation	0x0052

* Values are in hexadecimal notation.

(3) GRPSTS (Gripper Status)

Bit	Signal Name	Value	
		0	1
7	Servo Status	OFF	ON
6	Origin (Home return) Status	Uncompleted	Completed
5	Unused	–	–
4	READY signal	in Preparation	Normal
3	ZON signal	Out of range	Within range
2	HOLD signal	Open	Gripping
1	INPOS signal	Out of range	Within range
0	BUSY signal	Completed	in Operation

(4) TSKSTS (Task Status)

Task status	Value (*)
Unregistered	0x0000
RUN	0x0002
WAIT	0x0004
SUSPEND	0x0008
STOP	0x0010

* Values are in hexadecimal notation.

15 All file

15.1 All file

Read-out	✓
Write	✓

Format

```
ALL
```

Meaning Expresses the minimum number of data files required to operate the robot system.

NOTE
For details of each file, refer to that file's explanation.

Data Format

```
[PGM] ............................................................. All program format

NAME=< program name>
PGN=mmm
aaaa .... aaaaaaaa [cr/lf]
       :
aaaa .... aaaaaaaa [cr/lf]
[cr/lf]

[PNT] ............................................................. All point format

Pmmmm=fxxxxxx fyyyyyy fzzzzzz faaaaaa fbbbbbb t [cr/lf]
       :
Pmmmm=fxxxxxx fyyyyyy fzzzzzz faaaaaa fbbbbbb t [cr/lf]
[cr/lf]

[PCM] ............................................................. All point comment format

PCmmmm= ssssssssssssssss [cr/lf]
       :
PCmmmm= ssssssssssssssss [cr/lf]
[cr/lf]

[PNM] ............................................................. All point name format

PNmmmm= asssssssssssssss [cr/lf]
       :
PNmmmm= asssssssssssssss [cr/lf]
[cr/lf]

[PRM] ............................................................. All parameter format

/parameter label/ [cr/lf]
RC=xxxxxx [cr/lf]
       :
#parameter label# [cr/lf]
R?=xxxxxx [cr/lf]
[cr/lf]

[SFT] ............................................................. All shift format
```

Data Format

```
Sm= fxxxxxx fyyyyyy fzzzzzz frrrrrr [cr/lf]
        :
SMm= fxxxxxx fyyyyyy fzzzzzz frrrrrr [cr/lf]
[cr/lf]

[HND] ............................................................ All hand format

Hm= n, fxxxxxx, fyyyyyy, fzzzzzz ,{R} [cr/lf]
        :
Hm= n, fxxxxxx, fyyyyyy, fzzzzzz ,{R} [cr/lf]
[cr/lf]

[PLT] ............................................................ All pallet format

PLm [cr/lf]
        :
P[5]= fxxxxxx fyyyyyy fzzzzzz frrrrrr faaaaaa fbbbbbb t [cr/lf]
[cr/lf]

[GEP] ...........................................   All general Ethernet port format

MODE=n [cr/lf]
        :
TYPE=t [cr/lf]
[cr/lf]

[ION] ...........................................   All input/output name format

ioNMpp(b)=asssssssssssssss [cr/lf]
        :
ioNMpp(b)=asssssssssssssss [cr/lf]
[cr/lf]

[ACO] ...........................................   All area check output format

ACm=r,p1,p2,t,n,l [cr/lf]
        :
ACm=r,p1,p2,t,n,l [cr/lf]
[cr/lf]

[END] ............................................................ All file end
```

MEMO

- In readout files, only items whose data is saved in the controller is readout.
- In writing files, [xxx] determines the data file's format, and this format is saved at the controller.
  Example: [HND]…All text data up the next [xxx] is saved at the controller as "all hand" format data.

Sample	Description
`SEND ALL TO CMU`	Outputs all files of the entire system from the communication port.
`SEND CMU TO ALL`	Inputs all files of the entire system from the communication port.

16 Program directory file

16.1 Entire program directory

Read-out	✓	When used as a read-out file, information on entire program directory is read out.
Write	–	This file cannot be used as a write file.

Format

```
DIR
```

Meaning Expresses entire program directory.

Data Format

```
nnn, yy/mm/dd, hh:mm, bbbbbbb, llll, xx, ff, sssss…sssssssss [cr/lf]
         :
nnn, yy/mm/dd, hh:mm, bbbbbbb, llll, xx, ff, sssss…sssssssss [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
nnn	Program number	0 to 100
yy/mm/dd	Date of update	
hh:mm	Time of update	
bbbbbb	Byte size of program (7 digits)	
xx	File attribute	RW: Readable/writable RO: Not writable (read only) H: Hidden file
ff	Flag	m: Main program c: Current program s: Sequence program
sss...ssssss	Program name	32 characters or less consisting of alphanumeric characters and _ (underscore).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND DIR TO CMU ................. Outputs information on all program directory
                                  from the communication port.

Response:
RUN [cr/lf]
1, 15/01/10,10:14,100,24,RW,m,SAMPLE1 [cr/lf]
2, 15/01/18,18:00,50,18,RO,,SAMPLE2 [cr/lf]
3, 15/02/11,20:15,200,58,RW,c,SAMPLE3 [cr/lf]
4, 15/02/11,19:03,28,15,H,,SAMPLE4 [cr/lf]
10, 15/03/02, 20:21,592,288,RW,,SAMPLE10 [cr/lf]
24, 15/01/18,13:19,10,3,RW,,SAMPLE24 [cr/lf]
[cr/lf]
END [cr/lf]
```

16.2 One program directory

Read-out	✓
Write	–

Format

```
<<program name>>
```

Meaning

- Expresses information on one program.
- The program name is enclosed in << >> (double brackets).

Data Format

```
nnn, yy/mm/dd, hh:mm, bbbbbbb, llll, xx, ff, sssss…sssssssss [cr/lf]
```

Notation	Value	Range / Meaning
nnn	Program number	0 to 100
yy/mm/dd	Date of update	
hh:mm	Time of update	
bbbbbb	Byte size of program (7 digits)	
xx	File attribute	RW: Readable/writable RO: Not writable (read only) H: Hidden file
ff	Flag	m: Main program c: Current program s: Sequence program
sss...ssssss	Program name	32 characters or less consisting of alphanumeric characters and _ (underscore).

Sample	Description
`SEND <<SAMPLE1>> TO CMU` ……………	Outputs information on the specified program from the communication port.

```
Response:
RUN [cr/lf]
1, 15/01/10,10:14,100,24,RW,m,SAMPLE1 [cr/lf]
END [cr/lf]
```

17 Parameter directory file

17.1 Entire parameter directory

Read-out	✓	When used as a read-out file, information on entire parameter directory is read out.
Write	–	This file cannot be used as a write file.

Format

```
DPM
```

Meaning Expresses entire parameter directory.

Data Format

```
\mmmmmmmm\ a m n1 n2 n3 … n10 n11 n12 uuuuuu [cr/lf]
/mmmmmmmm/ a m n1 n2 n3 … n10 n11 n12 uuuuuu [cr/lf]
#mmmmmmmm# a m n1 n2 n3 … n10 n11 n12 uuuuuu [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
mmmmmmmm	Parameter label	8 characters or less having some symbols
a	Attribute	
m	Input method (*)	0: Direct input / 1 to 12: Selective input
n	Input range (*)	n1: Minimum value / n2: Maximum value
uuuuuu	Units	

* m: 0 .... n: n1 (Minimum value) / n2 (Maximum value)
m: 1 to 12 ...... n: Enumerate all options input at "m" (Ex) "m" and "n" when "m" is 4: 4 0 1 2 3

MEMO

- As parameters whose labels are enclosed in "\" are controller configuration parameters, take care when editing them.
- As parameters whose labels are enclosed in "#" affect robot control, take care when editing them.
- "\" symbols may be displayed as "¥" depending on the computer environment.

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
SEND DPM TO CMU	Outputs information on all parameter directory from the communication port.

```
Response:
RUN [cr/lf]
'PRM(0) [cr/lf]
\CNTTYP\ 16460 0 0 2147493647 [cr/lf]
\YCEADR\ 16396 0 0 99 [cr/lf]
\DRVASGN\ 16398 0 0 9906 [cr/lf]
    :
/ARMTYP/ 0 3 0 1 2 [cr/lf]
#CPVMAX# 16 0 1 32767 mm/s [cr/lf]
    :
/IOORGOUT/ 2052 0 0 27 [cr/lf]
/IOSRVOUT/ 2052 0 0 27 [cr/lf]
/GRPORGIN/ 2052 0 0 27 [cr/lf]
[cr/lf]
END [cr/lf]
```

18 Machine reference file

18.1 Machine reference (axes: sensor method, stroke-end method)

Read-out	✓
Write	–

Format

```
MRF
```

Meaning Expresses all machine reference values of axes whose return-to-origin method is set as "Sensor" or "Stroke-end".

Data Format

```
RnA=mmm,mmm,mmm,mmm,mmm,mmm [cr/lf]
                 :
RnA= mmm,mmm,mmm,mmm,mmm,mmm [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Robot number	1 to 4
mmm	Machine reference value	0 to 100

MEMO

This file reads out the machine reference values of the axes set to the robots.

Example: When the 1st through 6th axes of the robot 1 and 1st and 3rd axes of the robot 2 are connected, the data is shown as follows.

R1A = mmm, mmm, mmm, mmm, mmm, mmm

R2A = mmm, mmm

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
SEND MRF TO CMU	Outputs all machine reference data from the communication port.

```
Response:
RUN[cr/lf]
R1A=53,47,58,25,55,59 [cr/lf]
                 :
R4A=52,58,41,38,61,50 [cr/lf]
[cr/lf]
END[cr/lf]
```

18.2 Machine reference (axes: mark method)

Read-out	✓
Write	–

Format

```
ARP
```

Meaning Expresses all machine reference values of axes whose return-to-origin method is set as "Mark".

Data Format

```
RnA=mmm,mmm,mmm,mmm,mmm,mmm [cr/lf]
              :
RnA= mmm,mmm,mmm,mmm,mmm,mmm [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Robot number	1 to 4
mmm	Machine reference value	0 to 100

MEMO

This file reads out the machine reference values of the axes set to the robots.

Example: When the 1st through 6th axes of the robot 1 and 1st and 3rd axes of the robot 2 are connected, the data is shown as follows.

R1A = mmm, mmm, mmm, mmm, mmm, mmm

R2A = mmm, mmm

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND ARP TO CMU ..........Outputs all machine reference data from the communication port.

Response:
RUN[cr/lf]
R1A=53,47,58,25,55,59 [cr/lf]
              :
R4A=52,58,41,38,61,50 [cr/lf]
[cr/lf]
END[cr/lf]
```

19 Accumulated data file

Read-out	✓ (*)
Write	–

Format

```
ACD
```

Meaning Expresses all accumulated data.

The accumulated data is the accumulated value such as the number of times the controller power is turned on, the number of times the motor servo is turned on, the distance traveled and so on since the controller was first turned on. For details, refer to "14.3 Real time output setting list" in this chapter and "Real time output" in Field Network Manual.

Data Format

```
/PWRONCNT/[cr/lf]
RC=xxxxxxxxxx[cr/lf]
/MPWRONCNT/[cr/lf]
RC=xxxxxxxxxx[cr/lf]
/OPTIME/[cr/lf]
RC=xxxxxxxxxx[cr/lf]
/SRVONCNT/[cr/lf]
R?A=xxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxx[cr/lf]
/SRVONTIME/[cr/lf]
R?A=xxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxx[cr/lf]
/DISTTRVLD/[cr/lf]
R?A=xxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxxx,xxxxxxxxxx,xxxxxxxxxx[cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
RC	Entire controller	
R?	Specifying robot	
?	Robot number	1 to 4
A	All axes	
xxxxxxxxxx	Numerical value	0 ≤ xxxxxxxxxx ≤ 4294967295

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND ACD TO CMU    ......... Outputs all accumulated data from the communication port.

Response:
RUN [cr/lf]
/PWRONCNT/[cr/lf]  ........... Count of times the controller power is turned on
RC=1[cr/lf]
/MPWRONCNT/[cr/lf] ........... Count of times the controller motor power is turned on
RC=0[cr/lf]
/OPTIME/[cr/lf]    ........... Total operating time of the controller
RC=2500[cr/lf]
/SRVONCNT/[cr/lf]  ........... Count of times of Servo ON for all axes of Robot 1
R1A=0,0,0,0[cr/lf]
/SRVONTIME/[cr/lf] ........... Total servo ON time for all axes of Robot 1
R1A=0,0,0,0[cr/lf]
/DISTTRVLD/[cr/lf] ........... Total travel distance of all axes of robot 1
R1A=0,0,0,0[cr/lf]
[cr/lf]
END [cr/lf]
```

* While Accumulated data files is supported with software Ver. 1.73 or later, Read-out of Accumulated data files is only supported with Ver. 2.04 or later.

20 System configuration information file

Read-out	✓
Write	–

Format

```
CFG
```

Meaning Expresses all system configuration information.

Data Format

```
Cm:nnnn, s, b, kkkkk, ff-ff-ff-ff-ff-ff [cr/lf]
Cm:nnnn, s, b, kkkkk, ff-ff-ff-ff-ff-ff [cr/lf]
                 :
Rr:aaaa,hhhhhh [cr/lf]
Rr:aaaa,hhhhhh [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
m	Controller number	1 onward
nnn	Controller ID number	
s	Specification	G: CE / L: Normal
b	Brake power	I: Internal / E: External
kkkkkk	Memory size	
ff	MAC address	
r	Robot number	1 to 4
aaaa	Robot ID number	
hhhhhh	Connected axis number	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND CFG TO CMU`	Outputs all the system configuration file from the communication port.

```
Response:
RUN [cr/lf]
C1:340,L,I,2.1MB,00-04-C6-FF-83-12[cr/lf]
R1:MULTI,1234[cr/lf]
[cr/lf]
END [cr/lf]
```

21 Version information file

Read-out	✓
Write	–

Format

```
VER
```

Meaning Expresses version information.

Data Format

```
Cm:cv, cr-mv-dv1, dr1/dv2, dr2 [cr/lf]
        :
Cm:cv, cr-mv-dv1, dr1/dv2, dr2 [cr/lf]
[cr/lf]
```

Notation	Value	Range
m	Controller number	1 onward
cv	Host version	
cr	Host revision (Rxxxx)	
mv	PLD version (Vx.xx)	
dv?	Driver version (Vx.xx)	?: 1,2
dr?	Driver revision (Rxxx)	?: 1,2

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND VER TO CMU`	Outputs all files of the version information from the communication port.

```
Response:
RUN [cr/lf]
C1:V1.22,R0191-V1.000-V1.09,R0015/V1.09,R0015 [cr/lf]
C2:V1.22,R0191-V1.000-V1.09,R0015/V1.09,R0015 [cr/lf]
C3:V1.22,R0191-V1.000-V1.09,R0015/V1.09,R0015 [cr/lf]
C4:V1.22,R0191-V1.000-V1.09,R0015/V1.09,R0015 [cr/lf]
[cr/lf]
END [cr/lf]
```

22 Option board file

Read-out	✓
Write	–

Format

```
OPT
```

Meaning Expresses all option boards.

Data Format

```
CmOn:aaaaaa,Vb.bb [cr/lf]
CmOn:aaaaaa,Vb.bb [cr/lf]
       :
CmOn:aaaaaa,Vb.bb [cr/lf]
CmOn:aaaaaa,Vb.bb [cr/lf]
[cr/lf]
```

Notation	Value	Range
m	Controller number	1 onward
n	Option board number inside the controller	Slot number: 1 to 4
aaaaaa	Option board name	
b.bb	Option board version	

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND OPT TO CMU`	`Outputs all files of the option boards from the communication port.`

```
Response:
RUN [cr/lf]
C1O1:Gripper,V0.32 [cr/lf]
C1O2:Gripper,V0.32 [cr/lf]
[cr/lf]
END [cr/lf]
```

23 Self check file

Read-out	✓
Write	–

Format

```
SCK
```

Meaning Expresses self check file.

Data Format

```
gg.bbb:mmmm [cr/lf]
gg.bbb:mmmm [cr/lf]
  :
gg.bbb:mmmm [cr/lf]
gg.bbb:mmmm [cr/lf]
[cr/lf]
```

Notation	Value	Meaning
gg	Alarm group number	
bbb	Alarm classification number	
mmmm	Alarm occurrence location	RC: Entire controller R?: Robot (?: Robot number) C?: Controller (?: Controller number) A?: Axis (?: Axis number) M?: Driver (?: Driver number) R?: Option board (?: Option board number inside the controller) T?: Task (?: Task number) ETH: Ethernet CMU: RS-232C

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND SCK TO CMU`	Outputs all files of the self check information from the communication port.

```
Response:
RUN [cr/lf]
12.600:C1M1 [cr/lf]
12.600:C1M2 [cr/lf]
12.600:C1M3 [cr/lf]
12.600:C1M4 [cr/lf]
[cr/lf]
END [cr/lf]
```

24 Alarm history file

Read-out	✓
Write	–

Format

```
LOG
```

Meaning Expresses all alarm history.

Data Format

```
nnn:yy/mm/dd, hh:mm:ss, gg.bbb : aaaa,c, eee : ffff,
iiiii, jjjjjjjj, kkkkkkkk, llllllll, oooooooo, pppppppp,
pppppppp, pppppppp, pppppppp, pppppppp, pppppppp, q [cr/lf]
nnn:yy/mm/dd, hh:mm:ss, gg.bbb : aaaa,c, eee : ffff,
iiiii, jjjjjjjj, kkkkkkkk, llllllll, oooooooo, pppppppp,
pppppppp, pppppppp, pppppppp, pppppppp, pppppppp, q [cr/lf]
               :
nnn:yy/mm/dd, hh:mm:ss, gg.bbb : aaaa,c, eee : ffff,
iiiii, jjjjjjjj, kkkkkkkk, llllllll, oooooooo, pppppppp,
pppppppp, pppppppp, pppppppp, pppppppp, pppppppp, q [cr/lf]
[cr/lf]
```

Alarm history file

Notation	Value	Range / Meaning
nnn	Alarm history number	1 to 500
yy/mm/dd	Date of alarm occurrence	
hh:mm:ss	Time of alarm occurrence	
gg	Alarm group number	
bbb	Alarm classification number	
aaaa	Alarm occurrence location	RC: Entire controller R?: Robot (?: Robot number) C?: Controller (?: Controller number) A?: Axis (?: Axis number) M?: Driver (?: Driver number) R?: Option board (?: Option board number inside the controller) T?: Task (?: Task number) ETH: Ethernet CMU: RS-232C
c	Operation mode	I: Illegal M: Manual mode A: Automatic mode (with programming box) O: Automatic mode (with other devices)
eee	Program number	
ffff	Program execution line	
iiiii	Point number	
jjjjjjjj	Parallel input	Port 0 to 3 (hexadecimal)
kkkkkkkk	Parallel output	Port 0 to 3 (hexadecimal)
llllllll	Serial input	Port 0 to 3 (hexadecimal)
oooooooo	Serial output	Port 0 to 3 (hexadecimal)
pppppppp	Alarm occurrence location	A1 to A6
q	Hand system	0: NONE / 1: RIGHT / 2: LEFT

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND LOG TO CMU………… Outputs all files of the alarm history from the communication port.

Response:
RUN [cr/lf]
1:15/03/30,08:23:05,1.100:RC,O,:,0,00000000,00000012,00000000,00000112,,,,,,, [cr/lf]
2:15/03/30,08:23:05,5.288: RC,O,:,0,00000000,00000010,00000000,00000110,,,,,,, [cr/lf]
   :
500:15/03/18,10:23:04,5.228:T01,O,17:3,,00000000,00000010,00000000,00000110,40119,100000,99996,39375,0,0,0 [cr/lf]
[cr/lf]
END [cr/lf]
```

25 Remaining memory size file

Read-out	✓
Write	–

Format

```
MEM
```

Meaning Expresses remaining memory size

Data Format

```
PGM+PNT AREA=mmmmmmm/nnnnnnn[cr/lf]
VAR AREA=xxxxx/yyyyy[cr/lf]
[cr/lf]
```

Notation	Value
mmmmmmm	Remaining memory size of program and point area
nnnnnnn	Total memory size of program and point area
xxxxx	Remaining memory size of variable area
yyyyy	Total memory size of variable area

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
SEND MEM TO CMU	Outputs all files of the remaining memory size from the communication port.

```
Response:
RUN [cr/lf]
PGM+PNT AREA=2088547 / 2100000 [cr/lf]
VAR AREA=23220 / 24000 [cr/lf]
[cr/lf]
END [cr/lf]
```

26 Variable file

26.1 Dynamic variables

26.1.1 All dynamic variables

Read-out	✓	When used as a read-out file, all dynamic variables currently stored are read out.
Write	✓	When used as a write file, a specified dynamic variable is written.

Format

```
VAR
```

Meaning Expresses all dynamic variables.

Data Format

```
variable name t = xxxxxx [cr/lf]
variable name t = xxxxxx [cr/lf]
                :
variable name t = xxxxxx [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
Variable name	Global variable defined in the program	Variable name is shown with 32 characters or less consisting of alphanumeric characters and _ (underscore).
t	Type of variable	!: Real number / %: Integer / $: Character string
xxxxxx	Value of variable	Integer type: Integer of -2147483647 to 2147483647 Real type: Real number of 7 digits or less including decimal fractions Character type: Character string of 255 characters or less

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND VAR TO CMU ..................Outputs all global variables from the communication port.
SEND CMU TO VAR ..................Inputs all global variables from the communication port.

Response:
RUN [cr/lf]
A%=150 [cr/lf]
B!=1.0234E1 [cr/lf]
C1$=“SAMPLE1” [cr/lf]
C2$=“SAMPLE2” [cr/lf]
[cr/lf]
END [cr/lf]C1$="CNS_1"[cr/lf]
C2$="CNS_2"[cr/lf]
[cr/lf]
END [cr/lf]
```

26.1.2 One dynamic variable

Read-out	✓
Write	✓

Format

```
variable name t
```

Meaning Expresses one dynamic variable.

Data Format

```
xxxxxx [cr/lf]
```

Notation	Value	Range / Meaning
Variable name	Global variable defined in the program	Variable name is shown with 32 characters or less consisting of alphanumeric characters and _ (underscore).
t	Type of variable	!: Real number / %: Integer / $: Character string
xxxxxx	Value of variable	Integer type: Integer of -2147483647 to 2147483647 Real type: Real number of 7 digits or less including decimal fractions Character type: Character string of 255 characters or less

MEMO

Dynamic global variables are registered during program execution.
Variables cannot be referred to unless they are registered.

Sample 1 **Description**

```
SEND A% TO CMU [cr/lf] ..................Outputs the specified variable A% from the communication
                                         port.

Response:
150 [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO A% [cr/lf] ............ Inputs the specified variable A% from the communication port.

Response:
300 [cr/lf]  ........................................... Data input to the controller.
OK [cr/lf]   ........................................... Result output from the controller.
```

26.2 Static variables

26.2.1 Integer type static variables (SGI)

26.2.1.1 All integer type static variables

Read-out	✓	When used as a read-out file, all integer type static variables currently stored are read out.
Write	✓	When used as a write file, a specified integer type static variable is written.

Format

```
SGI
```

Meaning Expresses all integer static variables.

Data Format

```
SGIn=xxxxxx [cr/lf]
SGIn=xxxxxx [cr/lf]
       :
SGIn=xxxxxx [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Integer type static variable number	0 to 31
xxxxxx	Integer	-2147483647 to 2147483647

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description

```
SEND SGI TO CMU ..........Outputs all integer type static variables from the communication
                          port.
SEND CMU TO SGI ..........Inputs all integer type static variables from the communication
                          port.

Response:
RUN [cr/lf]
SGR0=0 [cr/lf]
SGR1=0 [cr/lf]
       :
SGR31=0 [cr/lf]
[cr/lf]
END [cr/lf]
```

26.2.1.2 One integer type static variables

Read-out	✓
Write	✓

Format

```
SGIn
```

Meaning Expresses a specified integer type static variable.

Data Format

```
xxxxxx [cr/lf]
```

Notation	Value	Range
n	Integer type static variable number	0 to 31
xxxxxx	Integer	-2147483647 to 2147483647

Sample	Description
`SEND SGI1 TO CMU`	Outputs the specified integer type static variables (SGI1) from the communication port.
`SEND CMU TO SGI1`	Inputs the specified integer type static variables (SGI1) from the communication port.

```
Response:
RUN [cr/lf]
0 [cr/lf]
END [cr/lf]
```

26.2.2 Real type static variables (SGR)

26.2.2.1 All real type static variables

Read-out	✓	When used as a read-out file, all real type static variables currently stored are read out.
Write	✓	When used as a write file, a specified real type static variable is written.

Format

```
SGR
```

Meaning Expresses all real type static variables.

Data Format

```
SGRn=xxxxxx [cr/lf]
SGRn=xxxxxx [cr/lf]
       :
SGRn=xxxxxx [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Real type static variable number	0 to 31
xxxxxx	Real number	7 digits or less including decimal fractions

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND SGR TO CMU`	Outputs all real type static variables from the communication port.
`SEND CMU TO SGR`	Inputs all real type static variables from the communication port.

```
Response:
RUN [cr/lf]
SGI0=0 [cr/lf]
SGI1=0 [cr/lf]
       :
SGI31=0 [cr/lf]
[cr/lf]
END [cr/lf]
```

26.2.2.2 One real type static variables

Read-out	✓
Write	✓

Format

```
SGRn
```

Meaning Expresses a specified real type static variable.

Data Format

```
xxxxxx [cr/lf]
```

Notation	Value	Range
n	Real type static variable number	0 to 31
xxxxxx	Real number	7 digits or less including decimal fractions

Sample **Description**

```
SEND SGR1 TO CMU ........................ Outputs the specified real type static variables (SGR1)
                                          from the communication port.
SEND CMU TO SGR1 ........................ Inputs the specified real type static variables (SGR1)
                                          from the communication port.

Response:
RUN [cr/lf]
0 [cr/lf]
END [cr/lf]
```

27 Constant file

27.1 One character string

Read-out	✓	When used as a read-out file, the specified character string is read out.
Write	–	This file cannot be used as a write file.

Format

```
"character string"
```

Meaning Expresses a specified character string.

Data Format

```
sssss...ssssss[cr/lf]
```

Notation	Value	Range
sssss...ssssss	Character string	255 characters or less

Output of " symbol (double quotation) is shown with successive " symbol.

Sample	Description
`SEND """YAMAHA ROBOT""" TO CMU`	Outputs the specified character string from the communication port.

```
Response:
"YAMAHA ROBOT"[cr/lf]
```

28 Array variable file

28.1 All array variables

Read-out	✓	When used as a read-out file, all array variables are read out.
Write	✓	When used as a write file, a specified array variable is written.

Format

```
ARY
```

Meaning Expresses all array variables.

Data Format

```
variable name t(l{,m{,n}}) = xxxxxx [cr/lf]
variable name t(l{,m{,n}}) = xxxxxx [cr/lf]
                :
variable name t(l{,m{,n}}) = xxxxxx [cr/lf]
[cr/lf]
```

Notation	Value	Range / Meaning
Variable name	Global variable defined in the DIM statement	Variable name is shown with 32 characters or less consisting of alphanumeric characters and _ (underscore).
t	Type of variable	!: Real number / %: Integer / $: Character string
l, m, n	Array arguments	
xxxxxx	Value of variable	Integer type: Integer of -2147483647 to 2147483647 Real type: Real number of 7 digits or less including decimal fractions Character type: Character string of 255 characters or less

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND ARY TO CMU ..................Outputs all global array variables from the communication port.
SEND CMU TO ARY ..................Inputs all global array variables from the communication port.

Response:
RUN [cr/lf]
A!(0)=0 [cr/lf]
A!(1)=1.E2 [cr/lf]
A!(2)=2.E2 [cr/lf]
B%(0,0)=0 [cr/lf]
B%(0,1)=1111 [cr/lf]
B%(1,0)=2222 [cr/lf]
B%(1,0)=3333 [cr/lf]
C$(0,0,0)= “ARY1” [cr/lf]
C$(0,0,1)= “ARY2” [cr/lf]
C$(0,1,0)= “ARY3” [cr/lf]
C$(0,1,1)= “ARY4” [cr/lf]
C$(1,0,0)= “ARY5” [cr/lf]
C$(1,0,1)= “ARY6” [cr/lf]
C$(1,1,0)= “ARY7” [cr/lf]
C$(1,1,1)= “ARY8” [cr/lf]
[cr/lf]
END [cr/lf]
```

28.2 One array variable

Read-out	✓
Write	✓

Format

```
variable name t(l {,m {,n }})
```

Meaning Expresses one array variable.

Data Format

```
xxxxxx [cr/lf]
```

Notation	Value	Range / Meaning
Variable name	Global variable defined in the DIM statement	Variable name is shown with 32 characters or less consisting of alphanumeric characters and _ (underscore).
t	Type of variable	!: Real number / %: Integer / $: Character string
l, m, n	Array arguments	
xxxxxx	Value of variable	Integer type: Integer of -2147483647 to 2147483647 Real type: Real number of 7 digits or less including decimal fractions Character type: Character string of 255 characters or less

MEMO

Array variables defined by the DIM statement are registered during compiling. Array variables cannot be referred to unless they are registered.

Sample 1	Description
`SEND C1$(2) TO CMU`	Outputs the specified array variable C1$(2) from the communication port.

```
Response:
YAMAHA ROBOT [cr/lf]
```

Sample 2	Description
`SEND CMU TO C1$(2)`	Inputs the specified array variable C1$(2) from the communication port.

```
Response:
OK [cr/lf]
```

29 DI file

29.1 All DI information

Read-out	✓	When used as a read-out file, all DI information is read out.
Write	–	This file cannot be used as a write file.

Format

```
DI()
```

Meaning Expresses all DI (parallel input variable) information.

Data Format

```
DI0()=&Bnnnnnnnn [cr/lf]
DI1()=&Bnnnnnnnn [cr/lf]
      :
DI27()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND DI() TO CMU`	Outputs all DI information from the communication port.

```
Response:
DI0()=&B10001001[cr/lf]
DI1()=&B00000010[cr/lf]
DI2()=&B00000000[cr/lf]
              :
DI7()=&B00000000[cr/lf]
DI10()=&B00000000[cr/lf]
DI11()=&B00000000[cr/lf]
DI12()=&B00000000[cr/lf]
              :
DI17()=&B00000000[cr/lf]
DI20()=&B00000000[cr/lf]
              :
DI26()=&B00000000[cr/lf]
DI27()=&B00000000[cr/lf]
[cr/lf]
END [cr/lf]
```

29.2 One DI port

Read-out	✓	When used as a read-out file, the specified DI port status is read out.
Write	–	This file cannot be used as a write file.

Format

```
DIm()
```

Meaning Expresses the status of one DI port.

Data Format

```
DIm()=&Bnnnnnnnn[cr/lf]
```

Notation	Value	Range
m	Port number	0 to 7 / 10 to 17 / 20 to 27
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

Sample **Description**

```
SEND DI5() TO CMU .............. Outputs the DI5 port status from the communication port.

Response:
RUN [cr/lf]
DI15()=&B00000000 [cr/lf]
END [cr/lf]
```

30 DO file

30.1 All DO information

Read-out	✓	When used as a read-out file, all DO information is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified DO port. *Writing to DO0() and DO1() is prohibited.

Format

```
DO()
```

Meaning Expresses all DO (parallel output variable) information.

Data Format

```
DO0()=&Bnnnnnnnn [cr/lf]
DO1()=&Bnnnnnnnn [cr/lf]
      :
DO27()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND DO() TO CMU` ……………	Outputs all DO information from the communication port.

```
Response:
RUN [cr/lf]
DO0()=&B10001001[cr/lf]
DO1()=&B00000010[cr/lf]
DO2()=&B00000000[cr/lf]
              :
DO7()=&B00000000[cr/lf]
DO10()=&B00000000[cr/lf]
DO11()=&B00000000[cr/lf]
DO12()=&B00000000[cr/lf]
              :
DO17()=&B00000000[cr/lf]
DO20()=&B00000000[cr/lf]
              :
DO26()=&B00000000[cr/lf]
DO27()=&B00000000[cr/lf]
[cr/lf]
END [cr/lf]
```

30.2 One DO port

Read-out	✓	When used as a read-out file, the specified DO port status is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified DO port. *Writing to DO0() and DO1() is prohibited.

Format

```
DOm()
```

Meaning Expresses the status of one DO port.

MEMO

Writing to DO0() and DO1() is prohibited. Only referencing is permitted.

Readout file

Data Format

```
DOm()=&Bnnnnnnnn[cr/lf]
```

Write file

Data Format

```
&Bnnnnnnnn[cr/lf] or k[cr/lf]
```

Notation	Value	Range
m	Port number	0 to 7 / 10 to 17 / 20 to 27
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).
k	Port status (Decimal counting)	Integer from 0 to 255

Sample 1 **Description**

```
SEND DO5() TO CMU ..............Outputs the DO5 port status from the communication port.

Response:
RUN [cr/lf]
DO5()=&B00000000[cr/lf]
END [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO DO5() ..............Inputs the DO5 port status from the communication port.

&B00000111

Response:
OK [cr/lf]
```

31 MO file

31.1 All MO information

Read-out	✓	When used as a read-out file, all MO information is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified MO port. *Writing to MO30() and DO37() is prohibited.

Format

```
MO()
```

Meaning Expresses all MO (internal output variable) information.

Data Format

```
MO0()=&Bnnnnnnnn [cr/lf]
MO1()=&Bnnnnnnnn [cr/lf]
              :
MO37()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND MO() TO CMU ............. Outputs all MO information from the communication port.

Response:
RUN [cr/lf]
MO0()=&B10001001 [cr/lf]
MO1()=&B00000010 [cr/lf]
MO2()=&B00000000 [cr/lf]
 :
MO7()=&B00000000 [cr/lf]
MO10()=&B00000000 [cr/lf]
MO11()=&B00000000 [cr/lf]
MO12()=&B00000000 [cr/lf]
 :
MO17()=&B00000000 [cr/lf]
MO20()=&B00000000 [cr/lf]
 :
MO27()=&B00000000 [cr/lf]
MO30()=&B00000000 [cr/lf]
 :
MO36()=&B00000000 [cr/lf]
MO37()=&B00000000 [cr/lf]
[cr/lf]
END [cr/lf]
```

31.2 One MO port

Read-out	✓	When used as a read-out file, the specified MO port status is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified MO port. *Writing to MO30() to MO37() is prohibited.

Format

```
MOm()
```

Meaning Expresses the status of one MO port.

MEMO

Writing to MO30() to MO37() is prohibited. Only referencing is permitted.

Readout file

Data Format

```
MOm()=&Bnnnnnnnn[cr/lf]
```

Write file

Data Format

```
&Bnnnnnnnn[cr/lf] or k[cr/lf]
```

Notation	Value	Range
m	Port number	0 to 7 / 10 to 17 / 20 to 27 / 30 to 37
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).
k	Port status (Decimal counting)	Integer from 0 to 255

Sample 1 **Description**

```
SEND MO5() TO CMU ..............Outputs the MO5 port status from the communication port.
Response:
RUN [cr/lf]
MO5()=&B00000000[cr/lf]
END [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO MO5() ..............Inputs the MO5 port status from the communication port.
&B00000111

Response:
OK [cr/lf]
```

32 LO file

32.1 All LO information

Read-out	✓	When used as a read-out file, all LO information is read out.
Write	✓	When used as a write file, the value is written to the specified LO port.

Format

```
LO()
```

Meaning Expresses all LO (internal output variable) information.

Data Format

```
LO0()=&Bnnnnnnnn [cr/lf]
LO1()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND LO() TO CMU`	Outputs all LO status from the communication port.

```
Response:
RUN [cr/lf]
LO0()=&B10001001 [cr/lf]
LO1()=&B00100100 [cr/lf]
[cr/lf]
END [cr/lf]
```

32.2 One LO port

Read-out	✓	When used as a read-out file, the specified LO port status is read out.
Write	✓	When used as a write file, the value is written to the specified LO port.

Format

```
LOm()
```

Meaning Expresses the status of one LO port.

Readout file

Data Format

```
LOm()=&Bnnnnnnnn[cr/lf]
```

Write file

Data Format

```
&Bnnnnnnnn[cr/lf] or k[cr/lf]
```

Notation	Value	Range
m	Port number	0, 1
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).
k	Port status (Decimal counting)	Integer from 0 to 255

Sample 1 **Description**

```
SEND LO0() TO CMU ...............Outputs the LO0 port status from the communication port.

Response:
RUN [cr/lf]
LO0()=&B00000000[cr/lf]
END [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO LO0() ...............Inputs the LO0 port status from the communication port.
&B00000111

Response:
OK [cr/lf]
```

33 TO file

33.1 All TO information

Read-out	✓	When used as a read-out file, all TO information is read out.
Write	✓	When used as a write file, the value is written to the specified TO port.

Format

```
TO()
```

Meaning Expresses all TO (timer output variable) information.

Data Format

```
TO0()=&Bnnnnnnnn [cr/lf]
TO1()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND TO() TO CMU`	Outputs all TO status from the communication port.
`SEND CMU TO TO()`	Inputs all TO status from the communication port.

```
Response:
RUN [cr/lf]
TO0()=&B10001001 [cr/lf]
TO1()=&B10001001 [cr/lf]
[cr/lf]
END [cr/lf]
```

33.2 One TO port

Read-out	✓	When used as a read-out file, the specified TO port status is read out.
Write	✓	When used as a write file, the value is written to the specified TO port.

Format

```
TOm()
```

Meaning Expresses the status of one TO port.

Readout file

Data Format

```
TOm()=&Bnnnnnnnn[cr/lf]
```

Write file

Data Format

```
&Bnnnnnnnn[cr/lf] or k[cr/lf]
```

Notation	Value	Range
m	Port number	0, 1
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).
k	Port status (Decimal counting)	Integer from 0 to 255

Sample 1 **Description**

```
SEND TO0() TO CMU .............. Outputs the TO0 port status from the communication port.

Response:
RUN [cr/lf]
TO0()=&B00000000[cr/lf]
END [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO TO0() .............. Inputs the TO0 port status from the communication port.
&B00000111

Response:
OK [cr/lf]
```

34 SI file

34.1 All SI information

Read-out	✓	When used as a read-out file, all SI information is read out.
Write	–	This file cannot be used as a write file.

Format

```
SI()
```

Meaning Expresses all SI (serial input variable) information.

Data Format

```
SI0()=&Bnnnnnnnn [cr/lf]
SI1()=&Bnnnnnnnn [cr/lf]
      :
SI27()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample **Description**

```
SEND SI() TO CMU ..................... Outputs all SI status from the communication port.

Response:
RUN [cr/lf]
SI0()=&B10001001[cr/lf]
SI1()=&B00000010[cr/lf]
SI2()=&B00000000[cr/lf]
               :
SI7()=&B00000000[cr/lf]
SI10()=&B00000000[cr/lf]
SI11()=&B00000000[cr/lf]
SI12()=&B00000000[cr/lf]
               :
SI17()=&B00000000[cr/lf]
SI20()=&B00000000[cr/lf]
               :
SI26()=&B00000000[cr/lf]
SI27()=&B00000000[cr/lf]
[cr/lf]
END [cr/lf]
```

34.2 One SI port

Read-out	✓	When used as a read-out file, the specified SI port status is read out.
Write	–	This file cannot be used as a write file.

Format

```
SIm()
```

Meaning Expresses the status of one SI port.

Data Format

```
SIm()=&Bnnnnnnnn[cr/lf]
```

Notation	Value	Range
m	Port number	0 to 7/ 10 to 17/ 20 to 27
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

Sample **Description**

```
SEND SI5() TO CMU ........................ Outputs the SI5 port status from the communication port.

Response:
RUN [cr/lf]
SI5()=&B00000000 [cr/lf]
END [cr/lf]
```

35 SO file

35.1 All SO information

Read-out	✓	When used as a read-out file, all SO information is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified SO port. *Writing to SO0() and SO1() is prohibited.

Format

```
SO()
```

Meaning Expresses all SO (serial output variable) information.

Data Format

```
SO0()=&Bnnnnnnnn [cr/lf]
SO1()=&Bnnnnnnnn [cr/lf]
              :
SO27()=&Bnnnnnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
`SEND SO() TO CMU`	Outputs all SO status from the communication port.

```
Response:
RUN [cr/lf]
SO0()=&B10001001[cr/lf]
SO1()=&B00000010[cr/lf]
SO2()=&B00000000[cr/lf]
              :
SO7()=&B00000000[cr/lf]
SO10()=&B00000000[cr/lf]
SO11()=&B00000000[cr/lf]
SO12()=&B00000000[cr/lf]
              :
SO17()=&B00000000[cr/lf]
SO20()=&B00000000[cr/lf]
              :
SO26()=&B00000000[cr/lf]
SO27()=&B00000000[cr/lf]
[cr/lf]
END [cr/lf]
```

35.2 One SO port

Read-out	✓	When used as a read-out file, the specified SO port status is read out.
Write	✓ Restricted*	When used as a write file, the value is written to the specified SO port. *Writing to SO0() and SO1() is prohibited.

Format

```
SOm()
```

Meaning Expresses the status of one SO port.

MEMO

Writing to SO0() and SO1() is prohibited. Only referencing is permitted.

Readout file

Data Format

```
SOm()=&Bnnnnnnnn[cr/lf]
```

Write file

Data Format

```
SOm()=&Bnnnnnnnn[cr/lf]
```

Notation	Value	Range
m	Port number	0 to 7 / 10 to 17 / 20 to 27
n	Port status (Binary counting)	"0" or "1" (total of 8 digits) Corresponds to m7, m6, …,m0, reading from the left ("m": port No.).
k	Port status (Decimal counting)	Integer from 0 to 255

Sample 1 **Description**

```
SEND SO5() TO CMU .............. Outputs the SO5 port status from the communication port.
Response:
RUN [cr/lf]
SO5()=&B00000000[cr/lf]
END [cr/lf]
```

Sample 2 **Description**

```
SEND CMU TO SO5() .............. Inputs the SO5 port status from the communication port.
&B00000111

Response:
OK [cr/lf]
```

36 SIW file

36.1 All SIW data

Read-out	✓	When used as a read-out file, all SIW information is read out in hexadecimal digit.
Write	–	This file cannot be used as a write file.

Format

```
SIW()
```

Meaning Expresses all SIW (serial word input) data.

Data Format *

```
SIW(0)=&Hnnnn [cr/lf]
SIW(1)=&Hnnnn [cr/lf]
              :
SIW(15)=&Hnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Hexadecimal counting)	0 to 9 and A to F: 4 digits (hexadecimal)

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample *	Description

```
SEND SIW() TO CMU ........................ Outputs all SIW data from the communication port.

Response:
RUN [cr/lf]
SIW(0)=&H1001[cr/lf]
SIW(1)=&H0010[cr/lf]
SIW(2)=&H0000[cr/lf]
              :
SIW(15)=&H0000[cr/lf]
[cr/lf]
END [cr/lf]
```

* When SIOW extension is enabled, SIW(24) - SIW(127) are also read-out.
For details, refer to RCX3 user's manual "Option board related parameters".

36.2 One SIW data

Read-out	✓	When used as a read-out file, the specified SIW status is read out in hexadecimal digit.
Write	–	This file cannot be used as a write file.

Format

```
SIW(m)
```

Meaning Expresses one SIW status.

Data Format

```
SIW(m)=&Hnnnn [cr/lf]
```

Notation	Value	Range
m	Port number	2 to 15 *
n	Port status (Hexadecimal counting)	0 to 9 and A to F: 4 digits (hexadecimal)

*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

Sample **Description**

```
SEND SIW(5) TO CMU .............................. Outputs SIW(5) from the communication port.

Response:
RUN [cr/lf]
SIW(5)=&H1001[cr/lf]
END [cr/lf]
```

37 SOW file

37.1 All SOW

Read-out	✓	When used as a read-out file, all SOW information is read out in hexadecimal digit.
Write	✓ Restricted*1	When used as a write file, the value is written to the specified SOW port *1) Writing to SOW(0) and SOW(1) is prohibited.

Format

```
SOW()
```

Meaning Expresses all SOW (serial word output) data.

Data Format *2

```
SOW(0)=&Hnnnn [cr/lf]
SOW(1)=&Hnnnn [cr/lf]
              :
SOW(15)=&Hnnnn [cr/lf]
[cr/lf]
```

Notation	Value	Range
n	Port status (Hexadecimal counting)	0 to 9 and A to F: 4 digits (hexadecimal)

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample *2 **Description**

```
SEND SOW() TO CMU ............................ Outputs all SOW data from the communication port.

Response:
RUN [cr/lf]
SOW(0)=&H1001[cr/lf]
SOW(1)=&H0010[cr/lf]
SOW(2)=&H0000[cr/lf]
              :
SOW(15)=&H0000[cr/lf]
[cr/lf]
END [cr/lf]
```

*2) When SIOW extension is enabled, SIW(24) - SIW(127) are also read-out.
For details, refer to RCX3 user's manual "Option board related parameters".

37.2 One SOW data

Read-out	✓	When used as a read-out file, the specified SOW port status is read out in hexadecimal digit.
Write	✓ Restricted *1	When used as a write file, the value is written to the specified SOW port. *1) Writing to SOW(0) and SOW(1) is prohibited.

Format

```
SOW(m)
```

Meaning Expresses one SOW status.

Readout file

Data Format

```
SOW(m)=&Hnnnn [cr/lf]
```

Write file

Data Format

```
&Hnnnn
```

Notation	Value	Range
m	Port number	2 to 15 *2
n	Port status (Hexadecimal counting)	0 to 9 and A to F: 4 digits (hexadecimal)

*When SIOW extension is enabled, the range of port number is extended to 2 -15, 24 - 127.
For details, refer to RCX3 user's manual "Option board related parameters".

A line containing only [cr/lf] is added at the end of the file, indicating the end of the file.

Sample	Description
SEND SOW(5) TO CMU	Outputs SOW(5) from the communication port.

```
Response:
RUN [cr/lf]
SOW(5)=&H1001[cr/lf]
END [cr/lf]
```

38 EOF file

Read-out	✓	When used as a read-out file, ^Z (=1Ah) is read out.
Write	–	This file cannot be used as a write file.

Format

```
EOF
```

Meaning This file is a special file consisting only of a ^Z (=1Ah) code.
When transmitting data to an external device through the communication port, the EOF data can be used to add a ^Z code at the end of file.

Data Format

```
^Z (=1Ah)
```

Sample	Description
`SEND PGM TO CMU`	
`SEND EOF TO CMU`	`Outputs EOF data from the communication port.`

```
NAME=TEST1[cr/lf]
A=1[cr/lf]
        :
HALT[cr/lf]
[cr/lf]
^Z
```

MEMO

A "^Z" code may be required at the end of the transmitted file, depending on the specifications of the receiving device and application.

39 Serial port communication file

Read-out	✓
Write	✓

Format

```
CMU
```

Meaning

- Expresses the serial communication port.
- Depends on the various data formats.

Sample	Description
`SEND PNT TO CMU`	Outputs all point data from the communication port.
`SEND CMU TO PNT`	Inputs all point data from the communication port.

40 Ethernet port communication file

Read-out	✓
Write	✓

Format

```
ETH
```

Meaning

- Expresses the Ethernet port.
- Depends on the various data formats.

Sample	Description
`SEND PNT TO ETH`	Outputs all point data from the Ethernet port.
`SEND ETH TO PNT`	Inputs all point data from the Ethernet port.

Chapter 11

User program examples

1 Basic operation.. 11-1
2 Application 11-8

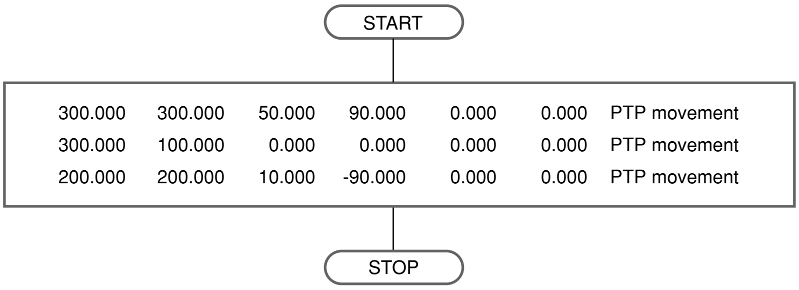
1 Basic operation

1.1 Directly writing point data in program

- **Overview**

  The robot arm can be moved by PTP (point-to-point) motion by directly specifying point data in the program.

Processing flow


START
300.000 300.000 50.000 90.000 0.000 0.000 PTP movement
300.000 100.000 0.000 0.000 0.000 0.000 PTP movement
200.000 200.000 10.000 -90.000 0.000 0.000 PTP movement
STOP

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Sample

```
MOVE P,      300.000     300.000      50.000      90.000      0.000      0.000
MOVE P,      300.000     100.000       0.000       0.000      0.000      0.000
MOVE P,      200.000     200.000      10.000     -90.000      0.000      0.000
HALT
```

1.2 Using point numbers

- **Overview**

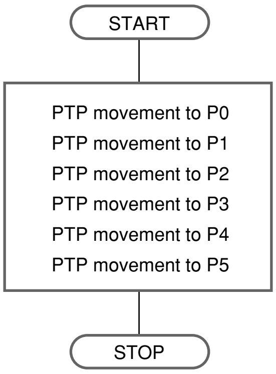
Coordinate data can be specified by using point numbers in a program. Coordinate data should be entered beforehand from the programming box or the support software, for example as shown below.

Reference For details, refer to RCX3 user's manual or the RCX-Studio software manual

Point Data

```
P0=       0.000     0.000     0.000     0.000    0.000    0.000
P1=     100.000     0.000   150.000    30.000    0.000    0.000
P2=       0.000   100.000    50.000     0.000    0.000    0.000
P3=     300.000   300.000     0.000     0.000    0.000    0.000
P4=     300.000   100.000   100.000    90.000    0.000    0.000
P5=     200.000   200.000     0.000     0.000    0.000    0.000
```

Processing flow


START
PTP movement to P0
PTP movement to P1
PTP movement to P2
PTP movement to P3
PTP movement to P4
PTP movement to P5
STOP

33C02-R7-00

Sample 1

```
MOVE P,P0
MOVE P,P1
MOVE P,P2
MOVE P,P3
MOVE P,P4
MOVE P,P5
HALT
```

Sample 2

```
FOR J=0 TO 5
       MOVE P,P[J]
NEXT J
HALT
```

Although the same operation is executed by both SAMPLE 1 and SAMPLE 2, the program can be shortened by using point numbers and the FOR statement.

1.3 Using shift coordinates

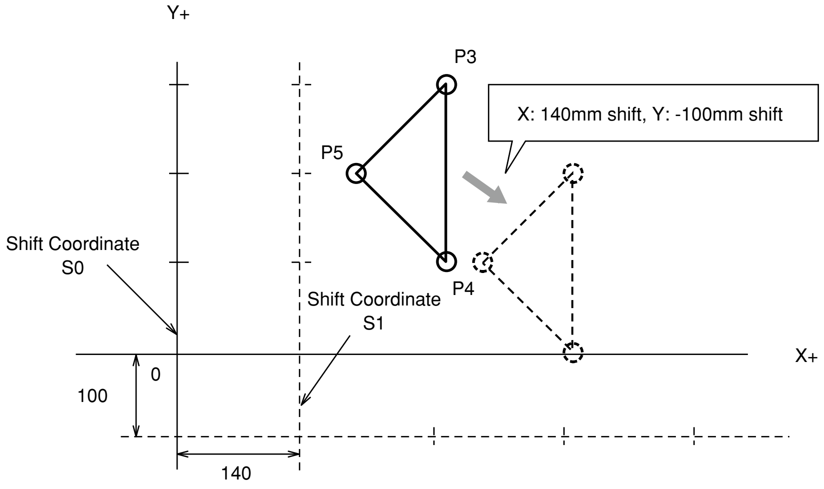
- **Overview**

  In the example shown below, after PTP movement from P3 to P5, the coordinate system is shifted +140mm along the X-axis and -100mm along the Y-axis, and the robot then moves from P3 to P5 again. The shift coordinate data is set in S1 and P3, P4, P5 are set as described in the previous section ("1.2 Using point numbers").

Shift Data

```
S0=         0.000         0.000      0.000      0.000
S1=       140.000      -100.000      0.000      0.000
```

Shift Coordinate


Y+
P3
P5
X: 140mm shift, Y: -100mm shift
Shift Coordinate
S0
Shift Coordinate
S1
P4
X+
0
100
140

33C03-R7-00

Sample **Description**

```
SHIFT  S0 ................................. Shift 0.
FOR J=3 TO 5 .......................... Repeated movement from P3 to P5.
       MOVE P, P[J]
NEXT J
SHIFT S1 .................................. Changed to "shift 1".
FOR K=3 TO 5.......................... Repeated movement occurs in the same manner from P3 to P5.
       MOVE P,P[K]
NEXT K
HALT
```

1.4 Palletizing

1.4.1 Calculating point coordinates

- **Overview**

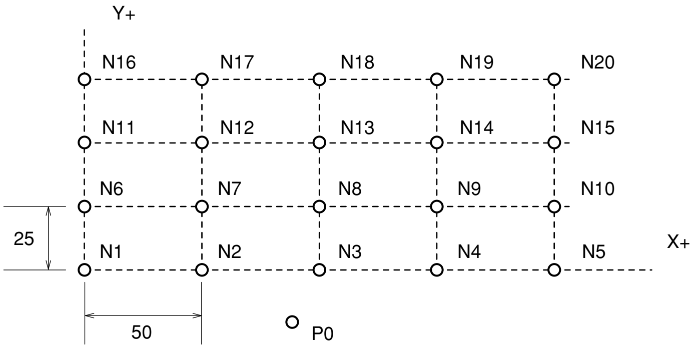
  Repetitive movement between a fixed work supply position P0 and each of the equally spaced points on a pallet can be performed with the following program.

  In the drawing below, points N1 to N20 are on Cartesian coordinates, consisting of 5 points positioned at a 50mm pitch in the X-axis direction and 4 points at a 25mm pitch in the Y-axis direction. The robot arm moves from point to point in the order of P0-N1-P0-N2...N5-P0-N6-P0... while repeatedly moving back and forth between point P0 and each pallet.

Point Data

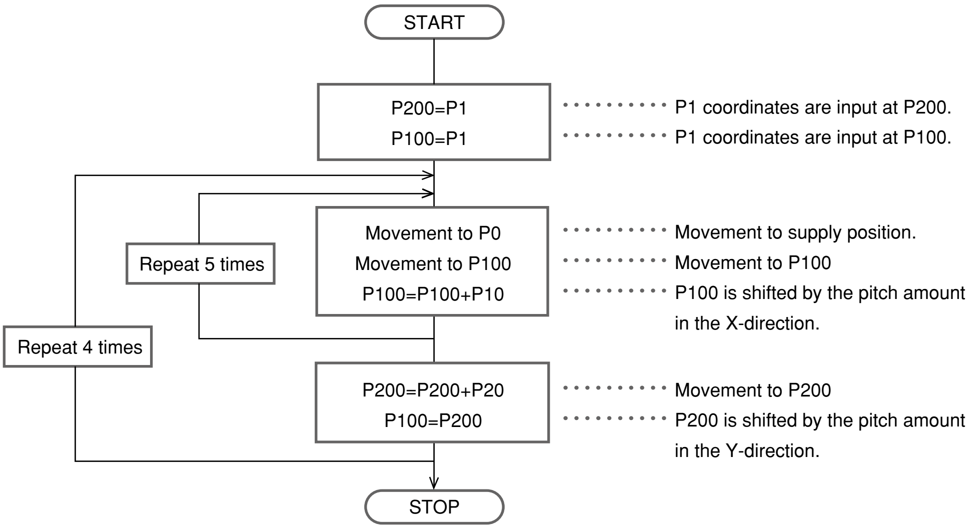
```
Work supply position:
   P0=      0.000        0.000        0.000        0.000        0.000        0.000
X-axis pitch:
   P10=    50.000        0.000        0.000        0.000        0.000        0.000
Y-axis pitch:
   P20=     0.000       25.000        0.000        0.000        0.000        0.000
N1 position:
   P1 =   100.000       50.000        0.000        0.000        0.000        0.000
```

Calculating point coordinates


Y+
N16
N17
N18
N19
N20
N11
N12
N13
N14
N15
N6
N7
N8
N9
N10
25
N1
N2
N3
N4
N5
X+
50
P0

33C04-R7-00

Processing flow


START
P200=P1
P100=P1
P1 coordinates are input at P200.
P1 coordinates are input at P100.
Repeat 5 times
Repeat 4 times
Movement to P0
Movement to P100
P100=P100+P10
Movement to supply position.
Movement to P100
P100 is shifted by the pitch amount in the X-direction.
P200=P200+P20
P100=P200
Movement to P200
P200 is shifted by the pitch amount in the Y-direction.
STOP

31C05-R7-00

Sample

```
P100=P1
P200=P1
FOR J=1 TO 4
       FOR K=1 TO 5
              MOVE P,P0
              MOVE P,P100
              P100=P100+P10
       NEXT K
       P200=P200+P20
       P100=P200
NEXT J
HALT
```

1.4.2 Utilizing pallet movement

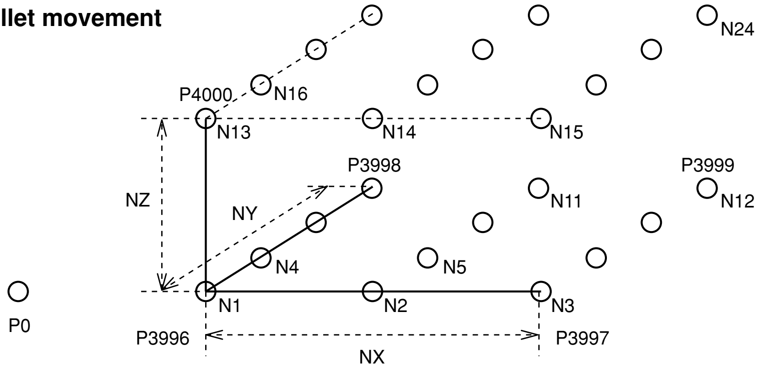
- **Overview**

Repetitive movement between a fixed work supply position P0 and each of the equally spaced points on a pallet can be performed with the following program. In the drawing below, points N1 to N24 are on Cartesian coordinates, consisting of 3 points positioned at a 50mm pitch in the X-axis direction, 4 points at a 50mm pitch in the Y-axis direction, and 2 points at 100mm pitch in the Z-axis direction. The robot arm moves from point to point in the order of P0-N1-P0-N2...-N5-P0-N6... while repeatedly moving back and forth between point P0 and each pallet.

Point Data

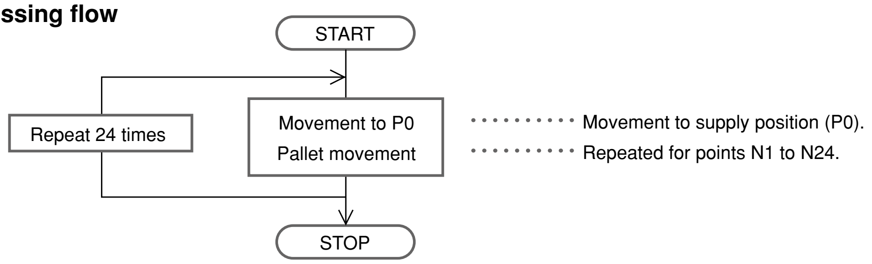
```
Work supply position:
P0=        0.000       0.000     200.000        0.000      0.000     0.000
Pallet definition:
PL0
NX= 3
NY= 4
NZ= 2
PLP=3996  (P3996 to P4000 are used)
P[1]=    100.000      50.000     200.000        0.000      0.000     0.000
P[2]=    200.000      50.000     200.000        0.000      0.000     0.000
P[3]=    100.000     200.000     200.000        0.000      0.000     0.000
P[4]=    200.000     200.000     200.000        0.000      0.000     0.000
P[5]=    100.000      50.000     100.000        0.000      0.000     0.000
```

Utilizing pallet movement


N24
P4000
N16
N13
N14
N15
P3998
P3999
NZ
NY
N11
N12
N4
N5
P0
N1
N2
N3
P3996
P3997
NX

33C06-R9-00

Processing flow


START
Repeat 24 times
Movement to P0
Pallet movement
Movement to supply position (P0).
Repeated for points N1 to N24.
STOP

33C07-R7-00

Sample **Description**

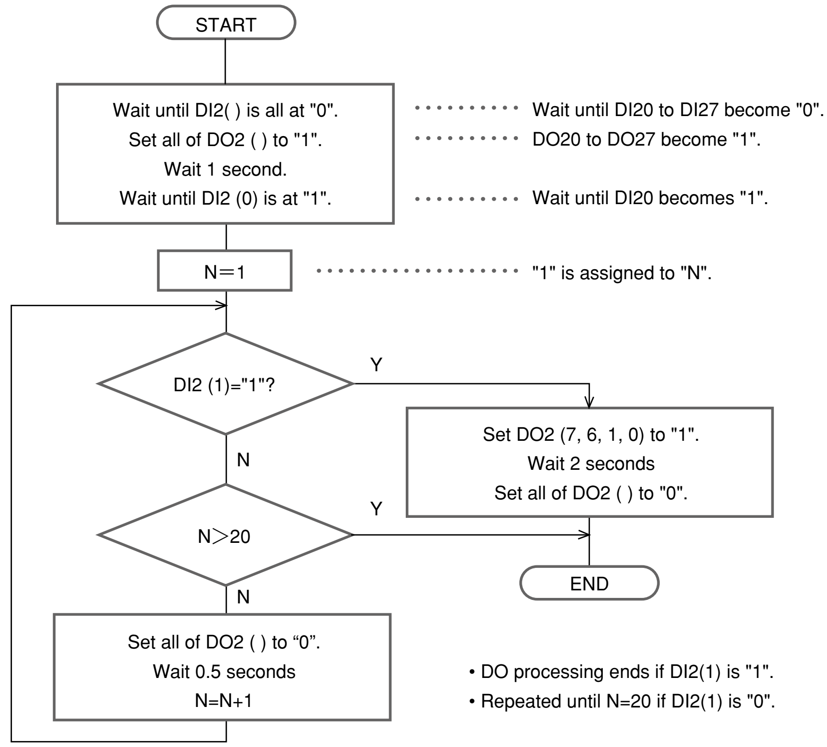
```
FOR I=1 TO 24 ........................... Repeated for I = 1 to 24.
       MOVE P,P0,Z=0.000 ............... Movement of robot 1 to supply position.
       PMOVE (0,I),Z=0.000 ............. Movement of robot 1 to pallet point.
NEXT I
MOVE P,P0,Z=0.000
HALT
```

1.5 DI/DO (digital input and output) operation

- **Overview**

The following example shows input/ output signal operations through the general-purpose input/ output device.

Processing flow


START
Wait until DI2( ) is all at "0".
Set all of DO2 ( ) to "1".
Wait 1 second.
Wait until DI2 (0) is at "1".
Wait until DI20 to DI27 become "0".
DO20 to DO27 become "1".
Wait until DI20 becomes "1".
N=1
"1" is assigned to "N".
DI2 (1)="1"?
Y
N
Set DO2 (7, 6, 1, 0) to "1".
Wait 2 seconds
Set all of DO2 ( ) to "0".
N>20
Y
N
END
Set all of DO2 ( ) to "0".
Wait 0.5 seconds
N=N+1
• DO processing ends if DI2(1) is "1".
• Repeated until N=20 if DI2(1) is "0".

33C08-R7-00

Sample	Description
`WAIT DI2()=0`	Waits until DI20 to DI27 become "0".
`DO2()=&B11111111`	DO20 to DO27 become "1".
`DELAY 1000`	
`WAIT DI2(0)=1`	Waits until DI20 becomes "1".
`N=1`	
`*LOOP1:`	
`IF DI2(1)=1 THEN *PROGEND`	Jumps to *PROGEND if DI21 = 1.
`IF N>20 THEN *ALLEND`	Ended in N > 20 (jumps to *ALLEND).
`DO2()=0`	DO20 to DO27 become "0".
`DELAY 500`	
`N=N+1`	
`GOTO *LOOP1`	Loop is repeated.
`'END ROUTINE`	
`*PROGEND:`	End processing.
`DO2(7,6,1,0)=&B1111`	Sets DO27, 26, 21, 20 to "1".
`DELAY 2000`	Waits 2 seconds.
`DO2()=0`	Sets DO20 to "0".
`*ALLEND:`	
`HALT`	

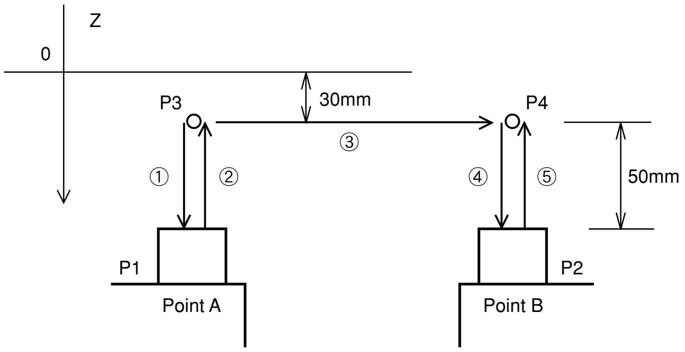
2 Application

2.1 Pick and place between 2 points

- **Overview**

  The following is an example for picking up a part at point A and placing it at point B.

Pick and place between 2 points



33C09-R7-00

- **Precondition**

1. Set the robot movement path.
   - Movement path: P3→P1→P3→P4→P2→P4
   - Locate P3 and P4 respectively at a position 50mm above P1 and P2 and set the P1 and P2 positions by teaching.
2. I/O signal

DO (20)	Chuck (gripper) open/close	0: open, 1: close

A 0.1 second wait time is set during chuck open and close.

When calculating to find P3 and P4

Sample **Description**

```
       P3=P1 ..................... P1 coordinates are assigned to P3.
       P4=P2 ..................... P2 coordinates are assigned to P4.
       LOC3(P3)=LOC3(P3)-50.000 .. Axis 3 data of P3 is shifted 50mm in upper direction.
       LOC3(P4)=LOC3(P4)-50.000 .. Axis 3 data of P4 is shifted 50mm in upper direction.
       MOVE P,P3
       GOSUB *OPEN
       MOVE P,P1
       GOSUB *CLOSE
       MOVE P,P3
       MOVE P,P4
       MOVE P,P2
       GOSUB *OPEN
       MOVE P,P4
       HALT
*OPEN: ........................... Chuck OPEN routine.
       DO2(0)=0
       DELAY 100
       RETURN
*CLOSE: .......................... Chuck CLOSE routine.
       DO2(0)=1
       DELAY 100
       RETURN
```

When using arch motion

Sample | **Description**

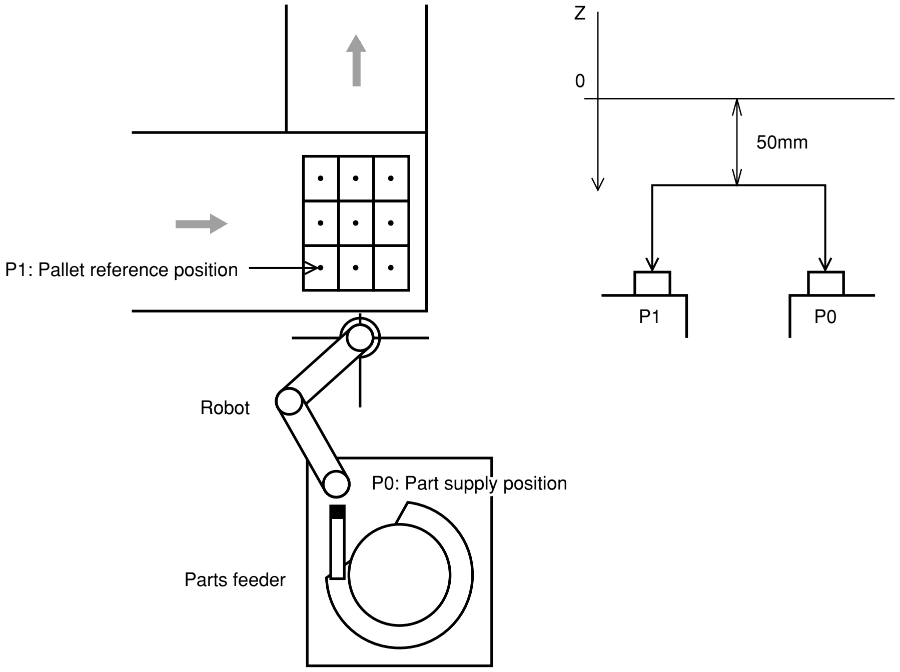
```
       P4=P2 ......................... P2 coordinates are assigned to P4.
       LOC3(P4)=LOC3(P4)-50.000 ...... Axis 3 data of P4 is shifted 50mm in upper direction.
       GOSUB *OPEN
       MOVE P,P1,A3=30.000 ........... Arch motion at A3 = 30mm.
       GOSUB *CLOSE
       MOVE P,P2,A3=30.000 ........... Arch motion at A3 = 30mm.
       GOSUB *OPEN
       MOVE P,P4
       HALT
*OPEN: ............................... Chuck OPEN routine.
       DO2(0)=0
       DELAY 100
       RETURN
*CLOSE: .............................. Chuck CLOSE routine.
       DO2(0)=1
       DELAY 100
       RETURN
```

2.2 Palletizing

- **Overview**

The following is an example for picking up parts supplied from the parts feeder and placing them on a pallet on the conveyor. The pallet is ejected when full.

Palletizing


P1: Pallet reference position
Robot
P0: Part supply position
Parts feeder
Z
0
50mm
P1
P0

33C10-R7-00

- **Precondition**

1. I/O signal

DI (30)	Component detection sensor	1: Parts are supplied
DI (31)	Pallet sensor	1: Pallet is loaded

DO (30)	Robot hand open/close	0: Open / 1: Close
DO (31)	Pallet eject	1: Eject

Robot hand open/close time is 0.1 seconds and pallet eject time is 0.5 seconds.

2. The points below should be input beforehand as point data.

P0	Part supply position
P1	Pallet reference position
P10	X direction pitch
P11	Y direction pitch

3. Vertical movement is performed to a position Z=50mm above the pallet and parts feeder.

When point is calculated

Sample **Description**

```
WHILE -1 ............................. All repeated (-1 is always TRUE).
   FOR A=0 TO 2
      FOR B=0 TO 2
         WAIT DI(31)=1 ............... Wait until a pallet "present" status occurs.
         WAIT DI(30)=1 ............... Wait until the supplied component "present" status occurs.
         DO(30)=0 .................... Robot hand OPENS.
         DELAY 100
         MOVE P,P0,A3=50.000 ......... Movement of robot 1 to supply position.
         DO(30)=1 .................... Robot hand CLOSES.
         DELAY 100
         P100=P1+P10*B+P11*A ......... Next point is calculated.
         MOVE P,P100,A3=50.000 ....... Movement of robot 1 to calculated point.
         DO(30)=0 .................... Robot hand OPENS.
         DELAY 100
      NEXT
   NEXT
   DRIVE (3,0) ....................... Only 3 axis of robot 1 moves to 0.
   DO(31)=1 .......................... Pallet is ejected.
   DELAY 500
   DO(31)=0
WEND ................................. Loop is repeated.
HALT
```

When using the palletizing function

Sample **Description**

```
*Precondition:
 define at pallet "0". ............... All repeated.
WHILE -1
   FOR A=1 TO 9
       WAIT DI(31)=1 ................. Wait until a pallet "present" status occurs.
       WAIT DI(30)=1 ................. Wait until the supplied component "present" status occurs.
       DO(30)=0 ...................... Robot hand OPENS.
       DELAY 100
       MOVE P,P0,A3=50.000 ........... Movement of robot 1 to supply position.
       DO(30)=1 ...................... Robot hand CLOSES.
       DELAY 100
       PMOVE(0,A),A3=50.000 .......... Movement of robot 1 to pallet point.
       DO(30)=0 ...................... Robot hand OPENS.
       DELAY 100
   NEXT
   DRIVE(3,0) ........................ Only 3 axis of robot 1 moves to 0.
   DO(31)=1 .......................... Pallet is ejected.
   DELAY 500
   DO(31)=0
WEND ................................. Loop is repeated.
HALT
```

2.3 Pick and place of stacked parts

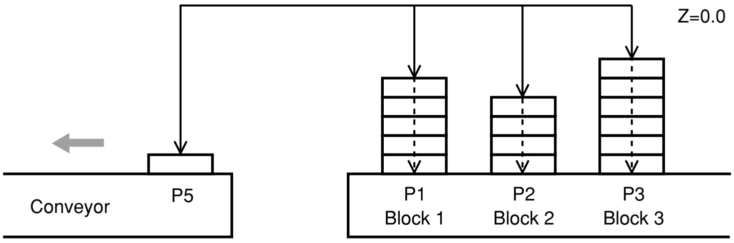
- **Overview**

The following is an example for picking up parts stacked in a maximum of 6 layers and 3 blocks and placing them on the conveyor.

The number of parts per block may differ from others.

Parts are detected with a sensor installed on the robot hand.

Pick and place of stacked parts


Z=0.0
Conveyor
P5
P1
Block 1
P2
Block 2
P3
Block 3

33C11-R7-00

- **Precondition**

1. I/O signal

DI (30)	Component detection sensor	1: Parts are supplied
DI (31)	Robot hand open/close	0: Open / 1: Close

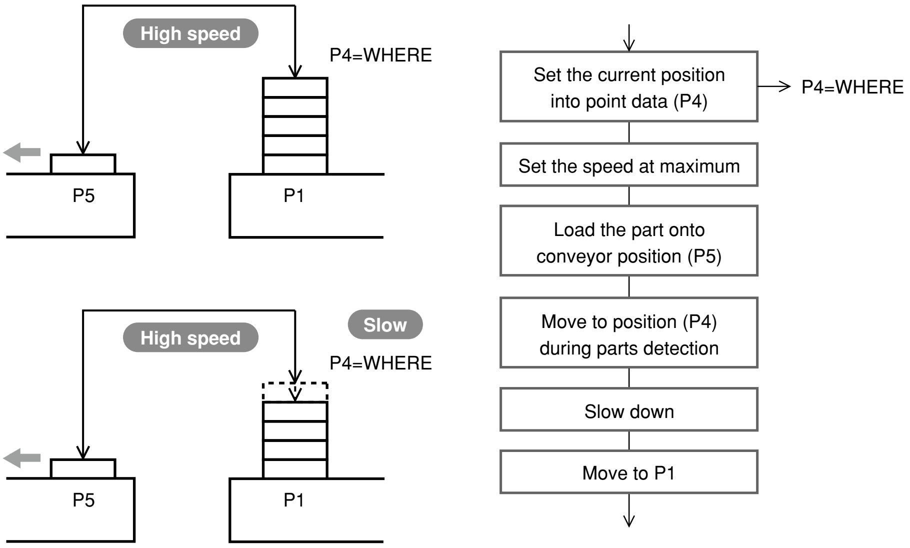
Robot hand open/close time is 0.1 seconds.

2. The points below should be input beforehand as point data.

P1	Bottom of block 1
P2	Bottom of block 2
P3	Bottom of block 3
P5	Position on conveyor

3. Movement proceeds at maximum speeds but slows down when in proximity to the part.

Processing flow


High speed
P4=WHERE
P5
P1
High speed
Slow
P4=WHERE
P5
P1
Set the current position into point data (P4)
P4=WHERE
Set the speed at maximum
Load the part onto conveyor position (P5)
Move to position (P4) during parts detection
Slow down
Move to P1

33C12-R7-00

4. Use a STOPON condition in the MOVE statement for sensor detection during movement.

Point Data

```
FOR A=1 TO 3
       SPEED 100
       GOSUB *OPEN
       P6=P[A]
       LOC3(P6)=0.000
       MOVE P,P6,A3=0.000
       WHILE -1
              SPEED 20
              MOVE P,P[A],STOPON DI3(0)=1
              IF DI3(0)=0 THEN *L1
              ’SENSOR ON
              P4=JTOXY(WHERE)
              GOSUB *CLOSE
              SPEED 100
              MOVE P,P5,A3=0.000
              GOSUB *OPEN
              MOVE P,P4,A3=0.000
       WEND
       *L1: ’SENSOR OFF
NEXT A
SPEED 100
DRIVE (3,0)
HALT
*OPEN:
DO3(0)=0
DELAY 100
RETURN
*CLOSE:
DO3(0)=1
DELAY 100
RETURN
```

2.4 Parts inspection (Multi-tasking example)

- **Overview**

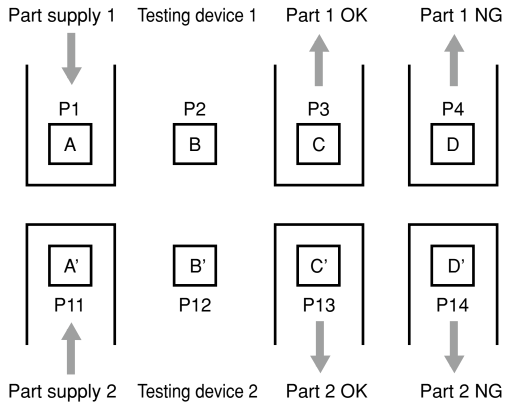
  One robot is used to inspect two different parts and sort them according to the OK/NG results judged by a testing device.

  The robot picks up the part at point A and moves it to the testing device at point B. The testing device checks the part and sends it to point C if OK or to point D if NG.

  The part at point A′ is picked up and moved to the testing device at point B' in the same way. The testing device checks the part and sends it to point C′ if OK or to point D′ if NG.

  It is assumed that 10 to 15 seconds are required for the testing device to issue the OK/NG results.

Parts inspection (Multi-tasking example)

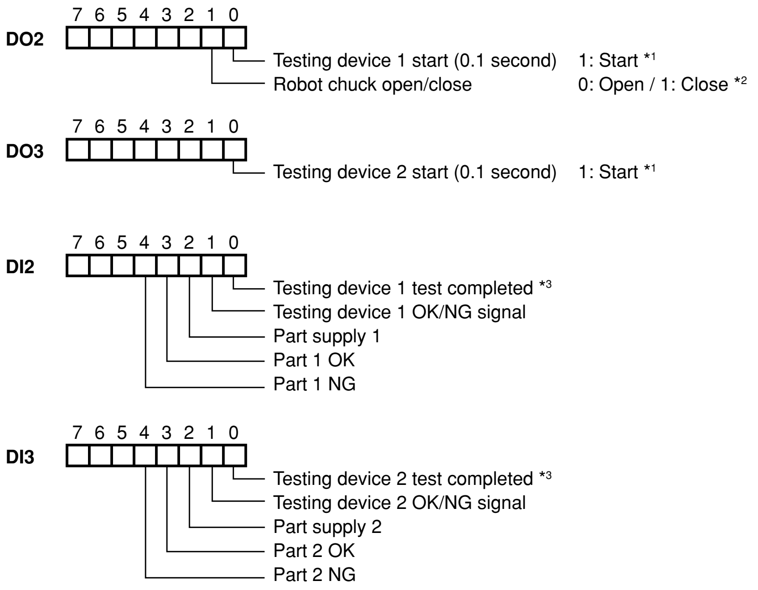

Part supply 1
Testing device 1
Part 1 OK
Part 1 NG
P1
A
P2
B
P3
C
P4
D
A'
P11
B'
P12
C'
P13
D'
P14
Part supply 2
Testing device 2
Part 2 OK
Part 2 NG

33C13-R7-00

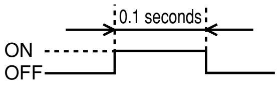
- **Precondition**

  1. I/O signal

I/O signal


7 6 5 4 3 2 1 0
DO2
Testing device 1 start (0.1 second)
1: Start *1
Robot chuck open/close
0: Open / 1: Close *2
7 6 5 4 3 2 1 0
DO3
Testing device 2 start (0.1 second)
1: Start *1
7 6 5 4 3 2 1 0
DI2
Testing device 1 test completed *3
Testing device 1 OK/NG signal
Part supply 1
Part 1 OK
Part 1 NG
7 6 5 4 3 2 1 0
DI3
Testing device 2 test completed *3
Testing device 2 OK/NG signal
Part supply 2
Part 2 OK
Part 2 NG

33C14-R7-00



*1: As the start signal, supply a 0.1 second pulse signal to the testing device.

*2: Chuck open and close time is 0.1 seconds.

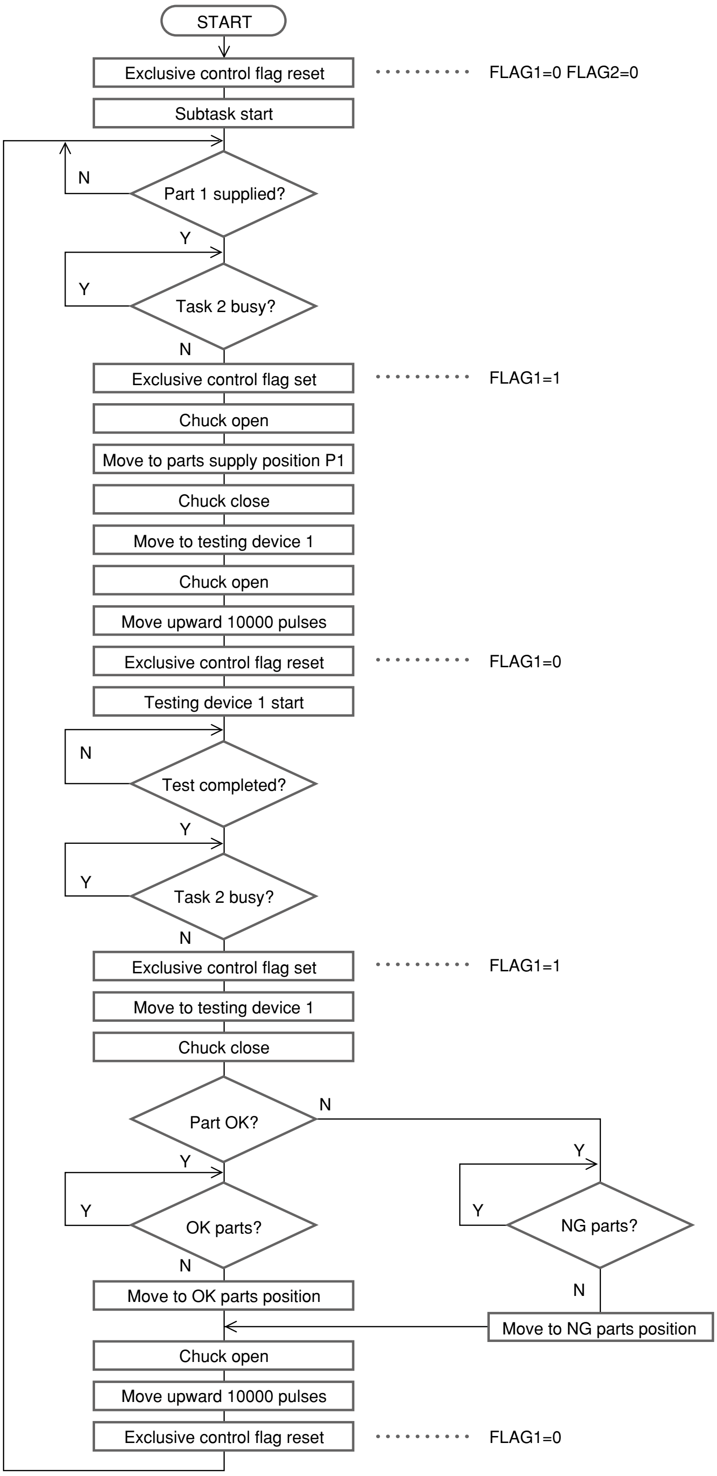
*3: Each time a test is finished, the test completion signal and OK/NG signal are sent from the testing device.
After testing, the test completion signal turns ON (=1), and the OK/ NG signal turns ON (=1) when the result is OK and turns OFF (=0) when NG.

2. The main task (task 1) is used to test part 1 and the subtask (task 2) is used to test part 2.
3. An exclusive control flag is used to allow other tasks to run while waiting for the test completion signal from the testing device.

FLAG1	0: Task 1 standby	(Task 2 execution enabled)
	1: Executing Task 1	(Task 2 execution disabled)
FLAG2	0: Task 2 standby	(Task 1 execution enabled)
	1: Executing Task 2	(Task 1 execution disabled)

4. Flow chart   Note that Task 2 (subtask) runs in the same flow.

Processing flow


START
Exclusive control flag reset
FLAG1=0 FLAG2=0
Subtask start
N
Part 1 supplied?
Y
Y
Task 2 busy?
N
Exclusive control flag set
FLAG1=1
Chuck open
Move to parts supply position P1
Chuck close
Move to testing device 1
Chuck open
Move upward 10000 pulses
Exclusive control flag reset
FLAG1=0
Testing device 1 start
N
Test completed?
Y
Y
Task 2 busy?
N
Exclusive control flag set
FLAG1=1
Move to testing device 1
Chuck close
Part OK?
N
Y
Y
OK parts?
N
Y
Y
NG parts?
N
Move to OK parts position
Move to NG parts position
Chuck open
Move upward 10000 pulses
Exclusive control flag reset
FLAG1=0

33C15-R7-00

Sample

```
<Maintask>
FLAG1=0
FLAG2=0
UPPOS=0.000
START <SUB_PGM>,T2   …… Subtask Start========================>
*L1:
WAIT DI2(2)=1        …… Part supply standby
WAIT FLAG2=0         …… Other tasks waiting for standby status
FLAG1=1              …… Exclusive control flag set
GOSUB *OPEN          …… Chuck open
MOVE P,P1,Z=UPPOS    …… Move to part supply position
GOSUB *CLOSE         …… Chuck close
MOVE P,P2,Z=UPPOS    …… Move to testing device
GOSUB *OPEN          …… Chuck open
DRIVEI (3,-10000)    …… Move axis 3 upward 10,000 pulses
FLAG1=0              …… Exclusive control flag reset
DO2(0)=1             …… Testing device start
DELAY 100
DO2(0)=0
WAIT DI2(0)=1        …… Test completion standby
WAIT FLAG2=0         …… Task completion standby
FLAG1=1              …… Exclusive control flag set
MOVE P,P2,Z=UPPOS    …… Move to testing device
GOSUB *CLOSE         …… Chuck close
IF DI2(1)=1 THEN     …… Test
'GOOD
WAIT DI4(2)=0        …… Part movement standby
MOVE P,P3,Z=UPPOS    …… Move to OK parts position
ELSE
'NG
WAIT DI2(4)=0        …… Part movement standby
MOVE P,P4,Z=UPPOS    …… Move to NG parts position
ENDIF
GOSUB *OPEN          …… Chuck open
DRIVEI (3,-10000)    …… Move axis 3 upward 10,000 pulses
FLAG1=0              …… Exclusive control flag reset
GOTO *L1
```

```
<Subtask>
Program name:SUB_PGM



*S1:
WAIT DI3(2)=1
WAIT FLAG1=0
FLAG2=1
GOSUB *OPEN
MOVE P,P11,Z=UPPOS
GOSUB *CLOSE
MOVE P,P12,Z=UPPOS
GOSUB *OPEN
DRIVEI (3,-10000)
FLAG2=0
DO3(0)=1
DELAY 100
DO3(0)=0
WAIT DI3(0)=1
WAIT FLAG1=0
FLAG2=1
MOVE P,P12,Z=UPPOS
GOSUB *CLOSE
IF DI3(1)=1 THEN
'GOOD
WAIT DI3(3)=0
MOVE P,P13,Z=UPPOS
ELSE
'NG
WAIT DI3(4)=0
MOVE P,P14,Z=UPPOS
ENDIF
GOSUB *OPEN
DRIVEI (3,-10000)
FLAG2=0
GOTO *S1
```

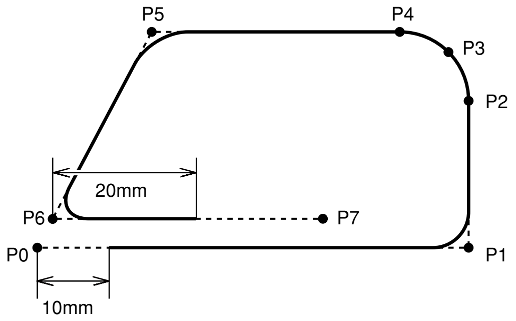
```
<common routine>
Program name:COMMON
*OPEN:
DO2(1)=0
DELAY 100
RETURN
*CLOSE:
DO2(1)=1
DELAY 100
RETURN
```

2.5 Sealing

- **Overview**

  The following is an example for sealing a part.

Sealing



33C11-R9-00

- **Precondition**

  1. I/O signal

DO (20)	Valve open/close	1: Open / 0: Close

2. Positions of P0 to P7 are set by teaching.

Sample **Description**

```
MOVE P,P0,Z=0
SPEED 40
PATH SET                  ......Starts setting path
PATH L,P1,DO(20)=1@10.000 ......Starts sealing at the point of 10mm
PATH L,P2                                                             Setting
PATH C,P3,P4                                                          the motion path
PATH L,P5                                                             (Robot doesn't move)
PATH L,P6,S=30
PATH L,P7,DO(20)=0@20.000 ......Ends sealing at the point of 20mm
PATH END                  ......Ends setting path
PATH START                ......Executes Path motion
                           (Robot 1 starts moving from P0 and
                            stops at P7).
HALT
```

2.6 Connection to an external device through RS-232C (example 1)

- **Overview**

Point data can be written in a program by using an external device connected to the controller via the RS-232C port.

- **Precondition**

1. Input to the external device from the controller

SDATA/X/Y [cr/lf]

NOTE

(cr/lf) indicates CR code (=0Dh) + LF code (=0Ah).

2. Output to the controller from the external device

Point Data

```
P10=      156.420      243.910      0.000      0.000      0.000      0.000     [cr/lf]
```

Sample **Description**

```
'INIT
    VCMD$="SDATA/X/Y" ............................................ A request for the position to move
    P0=0.000  0.000  0.000  0.000  0.000  0.000... An initial position
'MAIN ROUTINE
        MOVE P, P0 ......................................................... Moves to the initial position.
*ST:
        SEND VCMD$ TO CMU ................................................ Sends the command.
        SEND CMU TO P10 ....................................................Receives the destination point.
        MOVE P, P10 ......................................................... Moves to the reception position.
GOTO *ST
```

MEMO

- "SEND xxx TO CMU" outputs the contents specified by "xxx" through the RS-232C.
- "SEND CMU TO xxx" sends data into the files specified by "xxx" through the RS-232C.

2.7 Connection to an external device through RS-232C (example 2)

- **Overview**

  Point data can be created from the desired character strings and written in a program by using an external device connected to the controller via the RS-232C port.

- **Precondition**

  1. Input to the external device from the controller

     SDATA/X/Y [cr/lf]

  2. Output to the controller from the external device

     X=156.420, Y=243.910 [cr/lf]

NOTE

(cr/lf) indicates CR code (=0Dh) + LF code (=0Ah).

MEMO

- "SEND xxx TO CMU" outputs the contents specified by "xxx" through the RS-232C.
- "SEND CMU TO xxx" sends data into the files specified by "xxx" through the RS-232C.
- The LEN ( ) function obtains the length of the character string.
- The MID$ ( ) function obtains the specified character string from among the character strings.
- The VAL ( ) function obtains the value from the character string.

Sample **Description**

```
'INIT
   VCMD$="SDATA/X/Y" ........................................ A request for the position to move
   P0=    0.000    0.000 0.000 0.000 0.000 0.000 ... An initial position
   P11=100.000 100.000 0.000 0.000 0.000 0.000 ... A reception position
'MAIN ROUTINE
   MOVE P,P0 ................................................ Moves to the initial position.

*ST:
   SEND VCMD$ TO CMU ........................................ Sends the command.
   SEND CMU TO VIN$ ......................................... Receives the Response:
                                                               "X=156.420,Y=243.910".
   FOR I%=1 TO LEN(VIN$)-2
       IF MID$(VIN$,I%,2)="X=" THEN EXIT FOR ......... If "X=", then exits from the roop.
   NEXT I%
   LOC1(P11)=VAL(MID$(VIN$,I%+2)) ....................... Converts "X=" downward to the numeric
                                                               value and assigns to axis 1 of P11.
   FOR I%=1 TO LEN(VIN$)-2
       IF MID$(VIN$,I%,2)="Y=" THEN EXIT FOR ......... If "Y=", then exits from the roop.
   NEXT I%
   LOC2(P11)=VAL(MID$(VIN$,I%+2)) ....................... Converts "Y=" downward to numeric
                                                               value and assigns to axis 2 of P11.
   MOVE P,P11 ............................................... Moves to the reception position.
   GOTO *ST
```

Sample

```
’INT
       VCMD$="SDATA/X/Y"
       VIN$=""
       VX$=""
       VY$=""
       P0=    0.000  0.000  0.000  0.000  0.000  0.000
       P11=   100.000100.0000.000  0.000  0.000  0.000
’MAIN ROUTINE
       MOVE P, P0
*ST:
       SEND VCMD$ TO CMU
       SEND CMU TO VIN$
       I=1
       VMAX=LEN(VIN$)
*LOOP:
       IF I>VMAX THEN GOTO *E_LOOP
       C$=MID$(VIN$,I ,1)
       IF C$="X" THEN
              I=I+2
              J=I
*X_LOOP:
              C$=MID$(VIN$, J, 1)
              IF C$="," THEN
*X1_LP:
                     L=J-I
                     VX$=MID$(VIN$, I, L)
                     I=J+1
                     GOTO *LOOP
              ENDIF
              J=J+1
              IF J>VMAX  THEN  GOTO  *X1_LP
              GOTO  *X_LOOP
       ENDIF
       IF C$="Y"  THEN
              I=I+2
              J=I
*Y_LOOP:
              C$=MID$(VIN$, J, 1)
              IF C$=","THEN
*Y1_LP:
                     L=J-I
                     VY$=MID$(VIN$, I, L)
                     I=J+1
                     GOTO  *LOOP
              ENDIF
              J=J+1
              IF  J>VMAX  THEN  GOTO  *Y1_LP
              GOTO *Y_LOOP
       END IF
       I=I+1
       GOTO *LOOP
*E_LOOP:
       WX=VAL(VX$)
       WY=VAL(VY$)
       LOC1(P11)=WX
       LOC2(P11)=WY
       MOVE P, P11
GOTO  *ST
HALT
```

Chapter 12

Online commands

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1 Online Command List

Online commands can be used to operate the controller via an RS-232C interface or via an Ethernet.
This Chapter explains the online commands which can be used. For details regarding the RS-232C and Ethernet connection methods, refer to the user's manual.

1.1 About termination codes

During data transmission, the controller adds the following codes to the end of a line of transmission data.

RS-232C

- CR (0Dh) and LF (0Ah) are added to the end of the line when the "Termination code" parameter of communication parameters is set to "CRLF".
- CR (0Dh) is added to the end of the line when the "Termination code" parameter of communication parameters is set to "CR".

Ethernet

CR (0Dh) and LF (0Ah) are added to the end of the line.

When data is received, then the data up to CR (0Dh) is treated as one line regardless of the "Termination code" parameter setting, so LF (0Ah) is ignored.
The termination code is expressed as [cr/lf] in the detailed description of each online command stated in "2 Operation and setting commands" onwards in this Chapter.

1.2 Key operation

(*) Conditions: 1. Always executable.
2. Not executable during inputs from the programming box.
3. Not executable during inputs from the programming box, and while the program is running.
4. Not executable during inputs from the programming box, while the program is running, and when specific restrictions apply.

Operation type		Command	Option		Condition
Register program in the task		LOAD	*<program name>* PGm	,Tn , p	2 (*)
			(m: 1-100, n : 1-16, p : 1-64)		
Program	Reset program Execute program Stop program	RESET RUN STOP	Tn *<program name>* PGm		2
			(m: 1-100, n: 1-16)		
Program	Execute one line Skip one line Execute to next line	STEP SKIP NEXT	Tn *<program name>* PGm		2
			(m: 1-100, n: 1-16)		
Program	Execute before specified line Skip before specified line	RUNTO SKIPTO	Tn *<program name>* PGm	, k	2
			(m: 1-100, n: 1-16, k: 1-9999)		
Set break point		BREAK	*<program name>* PGm 0	(n , n, n, ...), k 0	2
			(m: 1-100, n: 1-9999, k : 0 / 1)		

Operation type	Command	Option	Condition
Change manual movement speed	MSPEED	[*robot number*] k (robot number: 1-4, k: 1-100)	2
Move to absolute reset position	ABSADJ	[*robot number*] k, f (robot number: 1-4, k: 1-6, f: 0/1)	3
Absolute reset	MRKSET	[*robot number*] k (robot number: 1-4, k: 1-6)	3
Return-to-origin	ORGRTN	[*robot number*] k (robot number: 1-4, k: 1-6)	3
Change inching movement amount	IDIST	[*robot number*] k (robot number: 1-4, k: 1-10000)	2
Manual movement (inching)	INCH INCHXY INCHT	[*robot number*] km (robot number: 1-4, k: 1-6, m: +/-)	3
Manual movement (jog)	JOG JOGXY JOGT	[*robot number*] km (robot number: 1-4, k: 1-6, m: +/-)	3
Point data teaching	TEACH TCHXY	[*robot number*] m (robot number: 1-4, m: 0-29999)	2

1.3 Utility

Operation type	Command	Option	Condition
Copy program	COPY	*<program name1>* PGm TO *<program name2>* (m : 1-100)	2 (*Refer to previous page)
Copy points "m - n" to point "k"		Pm-Pn TO Pk (m : 0-29999, n : 0-29999, k : 0-29999)	
Copy point comments "m - n" to point comment "k"		PCm-PCn TO PCk (m : 0-29999, n : 0-29999, k : 0-29999)	
Delete program	ERA	*<program name>* PGm (m : 1-100)	2
Delete points "m - n"		Pm-Pn (m : 0-29999, n : 0-29999)	
Delete point comments "m - n"		PCm-PCn (m : 0-29999, n : 0-29999)	
Delete point names "m - n"		PNm-PNn (m : 0-29999, n : 0-29999)	
Delete pallet "m"		PLm (m : 0-39)	
Delete general Ethernet port "m"		GPm (m : 0-15)	
Delete real time output "m - n"		RTm-RTn (m : 24-127, n : 24-127)	
Rename "program 1" to "program 2"	REN	*<program 1>* TO *<program 2>*	2
Check program syntax	SYNCHK	*<program name>* PGm , k (m : 1-100, k : 1-100)	2
Compile sequence program	SEQCMPL		2
Change program attribute	ATTR	*<program name>* PGm TO s (m : 1-100, s: RW / RO / H)	2
Setting main program	MAINPG	m (m : 1-100)	2

Operation type		Command	Option	Condition
Initialize data	Program	INIT	PGM	3
	Point		PNT	
	Point comment		PCM	
	Point name		PNM	
	Shift coordinate		SFT	
	Hand		HND	
	Work		WRKDEF	
	Pallet		PLT	
	General Ethernet port		GEP	
	Input/output name		ION	
	Area check output		ACO	
	Real time output		RTO	
	All data except parameters		MEM	
	Parameter		PRM	
	All data (MEM+PRM)		ALL	
Initialize data	Communication parameter	INIT	CMU ETH	3
Initialize data	Alarm history	INIT	LOG	3
Setting	Input data	INPUT	SET d CAN CLR (d: input data)	2
Buffer clear	Output message	MSGCLR		2
Change access level		ACCESS	k , pppppppp (k: 0/1, p: alphanumeric characters of 8 characters or less)	2
Setting password		SETPW		2
Setting Sequence execution flag		SEQUENCE	k (k: 0 / 1 / 3)	2
Reset alarm		ALMRST		2
Check or set date		DATE	yy / mm / dd (yy: 00-99, mm: 01-12, dd: 00-31)	2
Check or set time		TIME	hh : mm : ss (hh: 00-23, mm: 00-59, ss: 00-59)	2

1.4 Data handling

Operation type		Command	Option	Condition
Acquiring status	Access level	?	ACCESS k , pppppppp (k: 0/1, p: alphanumeric characters of 8 characters or less)	1
	Alarm status		ALM	
	Break point status		BREAK *<program name>* PGm (m : 1-100)	
	Last (Current) point number reference		CURPNT	
	Emergency stop status		EMG	
	Selected hand status		HAND [*robot number*] (robot number: 1-4)	
	Hand data		HND [*hand number*] (hand number: 0-31)	
	Inching movement amount status		IDIST [*robot number*] (robot number: 1-4)	
	Input data		INPUT	
	Online/offline status		LINEMODE ETH CMU	
	Main program number		MAINPG	
	Remaining memory capacity		MEM	
	Mode status		MODE	

Operation type		Command	Option	Condition
	Motor power status		MOTOR	
	Output message		MSG	
	Manual movement speed		MSPEED [*robot number*] (robot number: 1-4)	
	Return-to-origin status		ORIGIN [*robot number*] (robot number: 1-4)	
	Work status		RBTWRK [*robot number*] (robot number: 1-4)	
	Sequence program compilation status		SEQCMPSTS	
	Sequence program execution status		SEQUENCE	
	Servo status		SERVO [*robot number*] (robot number: 1-4)	
	Selected shift status		SHIFT [*robot number*] (robot number: 1-4)	
	Acquire task in RUN or SUSPEND status		TASKS	
	Task end condition		TSKECD Tk (k : 1-16)	
	Task operation status		TSKMON Tk (k : 1-16)	
	Version information		VER	
	Work data		WRKDEF [*work number*] (work number: 0-39)	
	Numerical data		*numerical expression*	
	Character string data		*character string expression*	
	Point data		*point expression*	
	Shift coordinate data		*shift expression*	
Read-out data		READ	*read-out file*	2
Write data		WRITE	*write file*	2

1.5 Robot language independent execution

The Robot languages executable independently are the commands/functions with "✓" at "Online" column in Chapter 8 "robot language table".

1.6 Control code

Operation type	Command	Option	Condition
Execution language interruption	^C(=03H)		1

Conditions:
1. Always executable.
2. Not executable during inputs from the programming box.
3. Not executable during inputs from the programming box, and while the program is running.
4. Not executable during inputs from the programming box, while the program is running, and when specific restrictions apply.

2 Operation and setting commands

2.1 Program operations

2.1.1 Register task

Command Format

@LOAD	*<program name>* PGm	,Tn, p [cr/lf]

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
m	Program number	1 to 100
n	Task number	1 to 16
p	Task priority ranking	1 to 64

Meaning Registers the specified program into "task n" with "priority p".
The registered program enters the STOP status.

[When "task number n" is omitted] The task with the smallest number of those that have not been started is specified automatically.
[When "task priority p" is omitted] "32" is specified.

[Task priority ranking] The smaller value, the higher priority. The larger value, the lower priority (high 1 to low 64).
When the task with a high task priority is in the RUNNING status, the task with a low task priority still remains in the READY status.

	Sample	Description
Command	@LOAD <PG_MAIN>, T1[cr/lf] ……	Registers the program to task 1.
Response	OK[cr/lf]	

2.1.2 Reset program

Command Format 1

```
@RESET[cr/lf]
```

Command Format 2

`@RESET`	`Tn`
	`<program name>`
	`PGm`
		`[cr/lf]`

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Resets the program.

[Command Format 1] Resets all programs.
When restarting the program, the main program or the program that has been executed last in task 1 is executed from its beginning.

[Command Format 2] Resets only the specified program.
When restarting the program that has been reset, this program is executed from its beginning.

	Sample 1	Description
Command	`@RESET[cr/lf]`	`Resets all programs.`
Response	`OK[cr/lf]`	

	Sample 2	Description
Command	`@RESET T3[cr/lf]`	`Resets only the program that is executed in T3.`
Response	`OK[cr/lf]`	

2.1.3 Program execution

Command Format 1

```
@RUN[cr/lf]
```

Command Format 2

`@RUN`	`Tn`
	`<program name>`
	`PGm`
		`[cr/lf]`

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Executes the current program.
[Command Format 1] Executes all programs in the STOP status.
[Command Format 2] Executes only the specified program in the STOP status.

	Sample 1	Description
Command	`@RUN[cr/lf]`	Executes all programs in the STOP status.
Response	`OK[cr/lf]`	

	Sample 2	Description
Command	`@RUN T3[cr/lf]`	Executes only the program in the STOP status that is registered in T3.
Response	`OK[cr/lf]`	

2.1.4 Stop program

Command Format 1
`@STOP[cr/lf]`

Command Format 2		

`@STOP`	`Tn`
	`<`*`program name`*`>`
	`PGm`
		`[cr/lf]`

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Stops the program.
[Command Format 1] Stops all programs.
[Command Format 2] Stops only the specified program.

	Sample 1	Description
Command	`@STOP[cr/lf]`..........................	`Stops all programs.`
Response	`OK[cr/lf]`	

	Sample 2	Description
Command	`@STOP T3[cr/lf]`.................	`Stops only the program that is executed in T3.`
Response	`OK[cr/lf]`	

2.1.5 Execute one program line

Command Format

`@STEP`	`Tn`
	`<program name>`
	`PGm`
		`[cr/lf]`

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Executes one line of the specified program.
When executing one line of the GOSUB statement or CALL statement, the program operation enters the subroutine or sub-procedure.

	Sample	Description
Command	`@STEP T3[cr/lf]`	Executes one line of the program that is executed in T3.
Response	`OK[cr/lf]`	

2.1.6 Execute program to the next line

Command Format

@NEXT	Tn *<program name>* PGm	[cr/lf]

Response Format

OK[cr/lf]

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Executes the specified program to the next line.
Executing @NEXT on the line in the GOSUB or in the CALL statement make the program execute and return through the sub-procedure processing, then stop at the next line.

MEMO

This is a same processing as setting the breakpoint on the next line in the program currently suspended and executing the program (@RUN).

@STEP stops the program at the beginning line of the sub-procedure called by GOSUB or CALL statement.

	Sample	Description
Command	@NEXT T3[cr/lf]	Executes the program in execution at T3 until the next line.
Response	OK[cr/lf]	

2.1.7 Execute program to line before specified line

Command Format

RUNTO	Tn *<program name>* PGm	k[cr/lf]

Response Format

OK[cr/lf]

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100
k	Specified line number	1 to 9999

Meaning Executes the specified program to the line before the specified line.

	Sample	Description
Command	@RUNTO T3, 15[cr/lf]	Executes the program that is executed by T3 to the 14th line and stops at the 15th line.
Response	OK[cr/lf]	

2.1.8 Skip one program line

Command Format

`@SKIP`	`Tn`
	`<program name>`
	`PGm`
		`[cr/lf]`

Response Format

`OK[cr/lf]`

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100

Meaning Skips one line of the specified program.
When skipping one line of the GOSUB statement or CALL statement, all subroutines or sub-procedures are skipped.

	Sample	Description
Command	`@SKIP T3[cr/lf]`	`Skips one line of the program that is executed by T3.`
Response	`OK[cr/lf]`	

2.1.9 Skip program to line before specified line

Command Format

`@SKIPTO`	`Tn`
	`<program name>`
	`PGm`
		`k[cr/lf]`

Response Format

`OK[cr/lf]`

Notation	Value	Range
n	Task number	1 to 16
m	Program number	1 to 100
k	Specified line number	1 to 9999

Meaning Skips the specified program to the line before the specified line.

	Sample	Description
Command	`@SKIPTO T3, 15[cr/lf]`	`Skips the program that is executed by T3 to the 14th line and stops at the 15th line.`
Response	`OK[cr/lf]`	

2.1.10 Set break point

Command Format 1

`@BREAK`	*<program name>* `PGm`	`(n,n,n,...), k[cr/lf]`

Command Format 2

`@BREAK`	*<program name>* `PGm`	`0[cr/lf]`

Command Format 3

```
@BREAK 0[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range / Meaning
m	Program number	1 to 100
n	Specified line number	1 to 9999
k	Set/Cancel	0: Set / 1: Cancel

Meaning Sets a break point to pause the program during program execution.

[Command Format 1] Sets or cancels a break point in the specified line of the specified program. Multiple lines can also be specified.

[Command Format 2] Cancels all break points set in the specified program.

[Command Format 3] Cancels all break points.

	Sample	Description
Command	`@BREAK PG3(1, 3), 1[cr/lf]`	Sets a break point at the first and third lines of PG3.
Response	`OK[cr/lf]`	

2.1.11 Check program syntax

Command Format

```
@SYNCHK     <program name>     ,k[cr/lf]
            PGm
```

Response Format

```
RUN [cr/lf]
nnnn:gg.bbb [cr/lf]
nnnn:gg.bbb [cr/lf]
 :
nnnn:gg.bbb [cr/lf]
nnnn:gg.bbb [cr/lf]
END [cr/lf]
```

Notation	Value	Range
m	Program number	1 to 100
k	Maximum number of error	1 to 100
nnnn	Line number where error occurred	1 to 9999
gg	Alarm group number	
bbb	Alarm classification number	

Meaning Checks syntax of the program specified by <*program name*> or program number. If there are syntax errors in the specified program, line number where error occurred, alarm group number and alarm classification number are output.

Reference For details regarding alarm group number and alarm classification number, refer to RCX3 user's manual.

Sample / **Description**

Command

```
@SYNCHK PG1, 100[cr/lf]..........  Sets a Maximum number of error at 100
                                   and checks syntax of the program 1.
```

Response

```
RUN[cr/lf]
       1:5.239 [cr/lf] ..........  Detects syntax errors
       2:5.239 [cr/lf]             "5.239: Illegal identifier"
       3:5.239 [cr/lf]             at 1th, 2nd, 3rd and 8th lines.
       8:5.239 [cr/lf]
       6:5.222 [cr/lf] ..........  Detects syntax error "5.222:IF without
END [cr/lf]                        ENDIF" at 6th line.
```

2.1.12 Set main program

Command Format

```
@MAINPG[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
m	Program number	1 to 100

Meaning Specifies the program which is always selected when all programs are reset. When "0" is specified at the main program number or program specified at the main program number doesn't exist, the program that has been executed last (current program) in the task 1 is selected after resetting all programs.

NOTE

"Main program" corresponds conventional function "_SELECT" of RCX240, etc.

	Sample	Description
Command	`@MAINPG 1[cr/lf]`	`Sets program number 1 at the main program.`
Response	`OK[cr/lf]`	

2.1.13 Compile sequence program

Command Format

```
@EQCMPL[cr/lf]
```

Response Format

```
RUN[cr/lf]
END[cr/lf]
```

Meaning Compiles the sequence program.
When the program named "SEQUENCE" doesn't exist or syntax errors exist in the program, an error message appears.
The execution program is created after successful termination of compiling and the letter "s" appears in Flag.

Reference Chapter 7 "Sequence function"

	Sample	Description
Command	`@SEQCMPL[cr/lf]`	`Compiles the sequence program.`
Response	`RUN[cr/lf]` `END[cr/lf]`	

2.2 MANUAL mode operation

2.2.1 Change the MANUAL mode speed

Command Format

```
@MSPEED [robot number] k[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	Manual movement speed	1 to 100

Meaning Changes the manual mode movement speed of the robot specified by the <*robot number*>.

	Sample
Command	`@MAINPG 50[cr/lf]`
Response	`OK[cr/lf]`

2.2.2 Point data teaching

Command Format

```
@TEACH [robot number] mmmmm[cr/lf]
```

```
@TCHXY [robot number] mmmmm[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
mmmmm	Point number for registering point data	0 to 29999

Meaning Registers the current robot position as point data for the specified point number. If point data is already registered in the specified point number, then that point data will be overwritten.

The unit of the point data may vary depending on the command.

TEACH	"pulse" units
TCHXY	"mm" units

	Sample
Command	`@TEACH[2] 100[cr/lf]`
Response	`OK[cr/lf]`

2.2.3 Change inching movement amount

Command Format

```
@IDIST [robot number] mmmmm[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
mmmmm	Inching movement amount	1 to 10000

Meaning Changes the inching movement amount of the robot specified by the <*robot number*>.

The unit of the movement amount may vary depending on the command.

INCH	"pulse" units: 1 to 10000 pulse
INCHXY	"mm" units: 0.001 to 10.000mm
INCHXT	"mm" units: 0.001 to 10.000mm

	Sample
Command	`@IDIST[2] 100[cr/lf]`
Response	`OK[cr/lf]`

2.3 Alarm reset

Command Format

```
@ALMRST[cr/lf]
```

Response Format

```
RUN[cr/lf]
END[cr/lf]
```

Meaning Resets the alarm.
However, this command cannot be used for the alarms which require the restart of system.
In this case, turn off the controller and turn it on again.

	Sample
Command	`@ALMRST[cr/lf]`
Response	`RUN[cr/lf]` `OK[cr/lf]`

2.4 Clearing output message buffer

Command Format

```
@MSGCLR[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Values Clears the output message buffer of the controller. After the messages have been output by the PRINT statement, etc., the messages remaining in the buffer are cleared.

	Sample
Command	`@MSGCLR[cr/lf]`
Response	`OK[cr/lf]`

2.5 Setting input data

Command Format

`@INPUT`	`SET d`
	`CAN`
	`CLR`
		`[cr/lf]`

Response Format

```
OK[cr/lf]
```

Notation	Value	Meaning
d	Input data	Value that is matched to the type of the variable specified by the INPUT statement. (Character string is enclosed by " ")

Meaning Sets the input data for responding to a data request by INPUT statement of robot program. The controller parameter "INPUT/PRINT using channel" should be set a current communication channel (CMU, ETH or iVY).

SET: Sets the data which is input to the variable when INPUT statement is executed.
CAN: Cancels the data request by INPUT statement.
CLR: Clears the data specified @INPUT SET downward.

Sample	Description

`<Online command>`
`@INPUT SET 10[cr/lf]`
`@INPUT SET 5[cr/lf]`
 	
`OK[cr/lf]`
`@?MSG[cr/lf]`
`10[cr/lf]`
`OK[cr/lf]`
	`<Robot program>`
	
	`INPUT A%[cr/lf]`
	`PRINT A%[cr/lf]`

`<Online command>`
`@INPUT SET 10[cr/lf]`
`OK[cr/lf]`
`@INPUT CLR[cr/lf]`
`OK[cr/lf]`
`@INPUT SET 5[cr/lf]`
`OK[cr/lf]`
`@?MSG[cr/lf]`
`5[cr/lf]`
`OK[cr/lf]`
	`<Robot program>`
	
	`INPUT A%[cr/lf]`
	`PRINT A%[cr/lf]`

2.6 Changing access level

Command Format

```
@ACCESS k , pppppppp [cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range / Meaning
k	Access level	0: Maintainer level, 1: Operator level
pppppppp	Password	Alphanumeric characters of 8 characters or less

Meaning Changes access level. If password is omitted, sets without password.
When changes access level to the maintainer level and entered password is incorrect, "6.235: Password error" will occur.

Reference RCX3 user's manual

	Sample	Description
Command	`@ACCESS 0,password[cr/lf]`	Sets "password" as password, and changes the level to "maintainer level".
Response	`OK[cr/lf]`	

2.7 Changing password

Command Format

```
@SETPW[cr/lf]
```

Response Format

```
READY[cr/lf]
pppppppp[cr/lf]
kkkkkkkk[cr/lf]
nnnnnnnn[cr/lf]
[cr/lf]  .................................. line-feed
OK[cr/lf]
```

Notation	Value	Range
pppppppp	old password (current password)	Alphanumeric characters of 8 characters or less
kkkkkkkk	new password	Alphanumeric characters of 8 characters or less
nnnnnnnn	new password (confirmation)	Alphanumeric characters of 8 characters or less

Meaning Changes the password for the access level changing to the maintainer level.

- The current password is input for the old password, and the revised password is input for the new password and for the new password of confirmation.
  In the next line of the new password (confirmation), inserts line feeds only.
- When input password as the old password is different from the current password or new password and new password (confirmation) are not same, "6.235: Password error" will occur.

Reference RCX3 user's manual

	Sample	Description
Command	`@SETPW[cr/lf]`	
Response	`READY[cr/lf]`	
	`oldpass[cr/lf]`	`Inputs "oldpass" as old password.`
	`newpass[cr/lf]`	`Inputs "newpass" as new password.`
	`newpass[cr/lf]`	`Inputs "newpass" as new password (confirmation).`
	`[cr/lf]`	`line-feed`
	`ok[cr/lf]`	

3 Reference commands

3.1 Acquiring return-to-origin status

Command Format 1

```
@?ORIGIN[cr/lf]
```

Response Format 1

```
x[cr/lf]
OK[cr/lf]
```

Command Format 2

```
@?ORIGIN robot number[cr/lf]
```

Response Format 2

```
x y{,y{,{...}}}[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
x	Robot return-to-origin status	0: Incomplete, 1: Complete
y	Axis return-to-origin status	Shows the status of the axis 1, axis 2, …, axis 6 from the left. 0: Incomplete, 1: Complete (Omitted when the axis is not connected.)

Meaning Acquires return-to-origin status.
[Command Format 1] Acquires the return-to-origin status of all robots.
[Command Format 2] Acquires the status of the specified robot.

	Sample	Description
Command	`@?ORIGIN 2[cr/lf]`	
Response	`0 1,1,0,1[cr/lf]` .... `OK[cr/lf]`	`Axis 3 of the robot 2 is in the return-to-origin incomplete status.`

3.2 Acquiring servo status

Command Format

```
@?SERVO[robot number][cr/lf]
```

Response Format

```
x y,y,y,y,y,y[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
x	Robot servo status	0: Servo off status, 1: Servo on status
y	Axis servo status	Shows the status of the axis 1, axis 2, …, axis 6 from the left. 0: Mechanical brake on + dynamic brake on status 1: Servo on status 2: Mechanical brake off + dynamic brake off status (Omitted when the axis is not connected.)

Meaning Acquires the servo status.

	Sample	Description
Command	`@?SERVO[3][cr/lf]`	
Response	`0 0,1,0,0[cr/lf]` .... `OK[cr/lf]`	Only the axis 2 of robot 3 is in the servo on status.

3.3 Acquire motor power status

Command Format

```
@?MOTOR[cr/lf]
```

Response Format

```
x[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
x	Motor power status	0: Motor power off status 1: Motor power on status 2: Motor power on + all robot servo on status

Meaning Acquires the motor power status.

	Sample
Command	`@?MOTOR[cr/lf]`
Response	`2[cr/lf]` `OK[cr/lf]`

3.4 Acquiring access level

Command Format 1

```
@?ACCESS[cr/lf]
```

Response Format 1

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
k	Access level	0: Maintainer level, 1: Operator level

Meaning Acquires the access level.

Reference RCX3 user's manual

	Sample
Command	@?ACCESS[cr/lf]
Response	1[cr/lf] OK[cr/lf]

3.5 Acquiring break point status

Command Format

@?BREAK	*<program name>* PGm	[cr/lf]

Response Format

```
n{,n{,{...}}}[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
n	Line number on which break point "n" is set	1 to 9999
Program name	Program name to delete	32 characters or less consisting of alphanumeric characters and _ (underscore).
m	Program number	1 to 100

Meaning Acquires the break point status.

	Sample
Command	@?BREAK <TEST>[cr/lf]
Response	12,35[cr/lf] OK[cr/lf]

3.6 Acquiring mode status

Command Format

```
@?MODE[cr/lf]
```

Response Format

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
k	Mode status	0: MANUAL mode 1: AUTO mode (Control source: Programming box) 2: AUTO mode (Control source release) -1: Restricted mode

Meaning Acquires the controller mode status.

	Sample
Command	`@?MODE[cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.7 Acquiring communication port status

Command Format

`@?LINEMODE`	`ETH` `CMU`	`[cr/lf]`

Response Format

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
k	Communication port status	0: OFFLINE, 1: ONLINE

Meaning Acquires the specified communication port status.
ONLINE / OFFLINE commands allow to change a specified communication port to the "online" / "offline" mode, respectively.

	Sample
Command	`@?LINEMODE ETH [cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.8 Acquiring main program number

Command Format

```
@?MAINPG[cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
m	Program number	0 to 100 (If not registered in the main program, 0 is returned.)

Meaning Acquires the program number which is registered in the main program.

	Sample
Command	@?MAINPG[cr/lf]
Response	1[cr/lf] OK[cr/lf]

3.9 Acquiring sequence program execution status

Command Format

```
@?SEQUENCE[cr/lf]
```

Response Format

```
1,s[cr/lf]
OK[cr/lf]
```

```
3,s[cr/lf]
OK[cr/lf]
```

```
0[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
s	Execution status of sequence program	1: Program execution is in progress. 0: Program execution is stopped.

Meaning Acquires the sequence program execution status.
Response output means as follows:

1: Enabled
3: Enabled and output is cleared at emergency stop
0: Disabled

	Sample
Command	@?SEQUENCE[cr/lf]
Response	0[cr/lf] OK[cr/lf]

3.10 Acquiring sequence compilation status

Command Format

```
@?SEQCMPSTS[cr/lf]
```

Response Format

```
x[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
x	sequence program status being compiled	0: Incomplete, 1: Complete

Meaning Acquires the sequence program compilation status.

	Sample	Description
Command	`@?SEQCMPSTS[cr/lf]` ……	Acquires the compilation status of the sequence program.
Response	`1[cr/lf]` ……………………… `OK[cr/lf]`	The sequence program is compiled.

3.11 Acquiring the version information

Command Format

```
@?VER[cr/lf]
```

Response Format

```
cv,cr-mv-dv1,dr1/dv2,dr2[cr/lf]
```

Notation	Value
cv	Host version number
cr	Host revision number (Rxxxx)
mv	PLO version number (Vx.xx)
dv? (?: 1, 2)	Driver version number (Vx.xx)
dr? (?: 1, 2)	Driver revision number (Rxxxx)

Meaning Acquires the version information.

	Sample
Command	`@?VER[cr/lf]`
Response	`V8.02,R1021-V5.10-V1.01,R0001/V1.01,R0001[cr/lf]` `OK[cr/lf]`

3.12 Acquiring the tasks in RUN or SUSPEND status

Command Format

```
@?TASKS[cr/lf]
```

Response Format

```
n{,n{,{...}}}[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
n	Task number	1 to 16 (Task currently run or suspended)

Meaning Acquires the tasks in RUN or SUSPEND status.

	Sample
Command	@?TASKS[cr/lf]
Response	1,3,4,6[cr/lf] OK[cr/lf]

3.13 Acquiring the tasks operation status

Command Format

```
@?TSKMON Tk[cr/lf]
```

Response Format

```
m,n,f,p[cr/lf]
OK [cr/lf]
```

Notation	Value	Range / Meaning
k	Task number	1 to 16
m	Execution program number	1 to 100
n	Task execution line number	1 to 9999
f	Each task status	R: RUN, U: SUSPEND, S: STOP, W: WAIT
p	Priority level of each task	1 to 64

Meaning Acquires the status of specified task.

	Sample
Command	@?TSKMON T3[cr/lf]
Response	5,11,R,32[cr/lf] OK[cr/lf]

3.14 Acquiring the task end condition

Command Format

```
@?TSKECD Tk[cr/lf]
```

Response Format

```
gg.bbb[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
k	Task number	1 to 16
gg	Alarm group number of the task end condition	
bbb	Alarm classification number of the task end condition	

Meaning Acquires the specified task end condition.

Reference For details about alarm group number and classification number of the task end condition, refer to RCX3 user's manual.

MEMO

When the specified task ends by error, acquires this alarm number.

	Sample	Description
Command	`@?TSKECD T1[cr/lf]`	Acquires the end condition of task 1.
Response	`1.5[cr/lf]` `OK[cr/lf]`	The end condition of task 1 is 1.5: Program ended by "HALT".

3.15 Acquiring the shift status

Command Format

```
@?SHIFT[robot number][cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
m	Shift number selected for the specified robot	0 to 39 Shift not selected: -1

Meaning Acquires the shift status of the robot specified by the <*robot number*>.

	Sample
Command	`@?SHIFT[cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.16 Acquiring the hand data

Command Format

```
@?HND[hand number][cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	hand number	0 to 31
m	Hand data	

Meaning Acquires the hand data specified by the <*hand number*>.

	Sample
Command	`@?HND[0][cr/lf]` …… `Acquires the data of hand 0.`
Response	`1,0,0.000,60.000[cr/lf]` `OK[cr/lf]`

3.17 Acquiring the hand status

Command Format

```
@?HAND[robot number][cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
m	Hand number selected for the specified robot	0 to 31 Hand not selected: -1

Meaning Acquires the hand status of the robot specified by the <*robot number*>.

	Sample
Command	`@?HAND[cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.18 Acquiring the work data

Command Format

```
@?WRKDEF[work number][cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	work number	0 to 39
m	work data	

Meaning Acquires the work data specified by the <*work number*>.

	Sample	Description
Command	`@?WRKDEF[0][cr/lf]`	…… `Acquires the data of work 0.`
Response	`0.000 0.000 0.000 0.000[cr/lf]` `OK[cr/lf]`	

3.19 Acquiring the work status

Command Format

```
@?RBTWRK[robot number][cr/lf]
```

Response Format

```
m[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
m	Work number selected for the specified robot	0 to 39 Work not selected: -1

Meaning Acquires the work status of the robot specified by the <*robot number*>.

	Sample
Command	`@?RBTWRK[cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.20 Acquiring the remaining memory capacity

Command Format

```
@?MEM[cr/lf]
```

Response Format

```
k/m[cr/lf]
```

Notation	Value
k	Remaining source area (unit: bytes)
m	Remaining global identifier area (unit: bytes)

Meaning Acquires the remaining memory capacity.

	Sample
Command	`@?MEM[cr/lf]`
Response	`102543/1342[cr/lf]` `OK[cr/lf]`

3.21 Acquiring the alarm status

Command Format

```
@?ALM[cr/lf]
```

Response Format

```
gg.bbb[cr/lf]
OK[cr/lf]
```

Notation	Value
gg	Alarm group number
bbb	Alarm classification number

Meaning Acquires the alarm which occurs in the controller.

Reference For details regarding the alarm group number and alarm classification number, refer to RCX3 user's manual.

MEMO

The requirable alarms are number 400 or more of alarm classification number. If multiple alarms occur, the alarm with larger alarm classification number (more serious alarm) is acquired.

	Sample
Command	`@?ALM[cr/lf]`
Response	`12.600[cr/lf]` `OK[cr/lf]`

3.22 Acquiring the emergency stop status

Command Format

```
@?EMG[cr/lf]
```

Response Format

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range / Meaning
k	Emergency stop status	0: normal operation, 1: emergency stop

Meaning Acquires the emergency stop status by checking the internal emergency stop flag.

	Sample
Command	`@?EMG[cr/lf]`
Response	`1[cr/lf]` `OK[cr/lf]`

3.23 Acquiring the manual movement speed

Command Format

```
@?MSPEED[robot number][cr/lf]
```

Response Format

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	manual movement speed	1 to 100 (unit: %)

Meaning Acquires the value of the manual movement speed specified by <*Robot number*>.

	Sample
Command	`@?MSPEED[cr/lf]`
Response	`50[cr/lf]` `OK[cr/lf]`

3.24 Acquiring the inching movement amount

Command Format

```
@?IDIST[robot number][cr/lf]
```

Response Format

```
mmmmm[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
mmmmm	Inching movement amount	1 to 10000

Meaning Acquires the inching movement amount specified by <*Robot number*>.

	Sample
Command	`@?IDIST[2][cr/lf]`
Response	`100[cr/lf]` `OK[cr/lf]`

3.25 Acquiring the last reference point number (current point number)

Command Format

```
@?CURPNT[cr/lf]
```

Response Format

```
k[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
k	Current point number	0 to 29999

Meaning Acquires the point number which is referred last. The current point number (the point number of last reference) is renewed by operations which uses the point data (point edit, for example).

MEMO

The current point number is renewed by following operations: the point reference and the point setting movement by remote commands, the trace movement or teaching by programming box or RCX-Studio Pro, etc.

	Sample
Command	`@?CURPNT[cr/lf]`
Response	`100[cr/lf]` `OK[cr/lf]`

3.26 Acquiring the output message

Command Format

```
@?MSG[cr/lf]
```

Response Format

```
sssss ...... ssssss[cr/lf]
OK[cr/lf]
```

Notation	Value
s	Message character string

Meaning Acquires one line of message which is input from the output message buffer of the controller by the PRINT statement, etc.

	Sample	Description
Command	`@?MSG[cr/lf]`	
Response	`MESSAGE[cr/lf]` `OK[cr/lf]`	`PRINT "MESSAGE" is executed in a program.`

MEMO

- For executing this command, it is required that the "INPUT/PRINT using channel" parameter is set at the port to execute command.
- When the output message buffer is empty, only "OK" is output as the response.

3.27 Acquiring the input data

Command Format

```
@?INPUT[cr/lf]
```

Response Format

```
d[cr/lf]
OK[cr/lf]
```

Notation	Value
d	Input data

Meaning Acquires the input data by the INPUT statement.

	Sample
Command	`@?INPUT[cr/lf]`
Response	`INPUT_SAMPLE[cr/lf]` `OK[cr/lf]`

3.28 Acquiring various values

3.28.1 Acquiring the value of a numerical expression

Command Format

```
@?numerical expression[cr/lf]
```

Response Format

```
numerical value[cr/lf]
OK[cr/lf]
```

Meaning Acquires the value of the specified numerical expression.
The numerical expression's value format is "decimal" or "real number".

	Sample 1
Command	`@?SQR(100*5)[cr/lf]`
Response	`2.236067E01[cr/lf]` `OK[cr/lf]`

	Sample 2
Command	`@?LOC1(WHERE)[cr/lf]`
Response	`102054[cr/lf]` `OK[cr/lf]`

3.28.2 Acquiring the value of a character string expression

Command Format

```
@?character string expression[cr/lf]
```

Response Format

```
character string[cr/lf]
OK[cr/lf]
```

Meaning Acquires the value (character string) of the specified character string expression.

	Sample: The case of A$="ABC" and B$="DEF".
Command	`@?A$+B$+"123"[cr/lf]`
Response	`ABCDEF123[cr/lf]` `OK[cr/lf]`

3.28.3 Acquiring the value of a point expression

Command Format

```
@?point expression[cr/lf]
```

Response Format

```
point data[cr/lf]
OK[cr/lf]
```

Meaning Acquires the value (point data) of the specified point expression.

	Sample
Command	`@?P1+WHRXY[cr/lf]`
Response	`10.410  -1.600  52.150  3.000  0.000  0.000   0   0   0[cr/lf]` `OK[cr/lf]`

3.28.4 Acquiring the value of a shift expression

Command Format

```
@?shift expression[cr/lf]
```

Response Format

```
shift data[cr/lf]
OK[cr/lf]
```

Meaning Acquires the value (shift coordinate data) of the specified shift expression.

	Sample
Command	`@?s1[cr/lf]`
Response	`25.000  12.600  10.000  0.000[cr/lf]` `OK[cr/lf]`

4 Operation commands

4.1 Absolute reset

Command Format

```
@ABSADJ[robot number] k,f[cr/lf]
@MRKSET[robot number] k[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At movement start
END[cr/lf] .......................... At movement end
```

Notation	Value	Range / Meaning
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	Axis number	1 to 6
f	Movement direction	0: + direction, 1: – direction

Meaning Performs the absolute reset operation of the specified axis of the robot specified by <*robot number*>. This command is available only to axes whose return-to-origin method is set as "Mark".

ABSADJ: Moves the specified robot axis to an absolute reset position.
MRKSET: Performs absolute reset on the specified robot axis.

	Sample	Description
Command	`@ABSADJ 1,0[cr/lf]`	
Response	`RUN[cr/lf]`	Movement start
	`END[cr/lf]`	Movement end

4.2 Return-to-origin operation

Command Format

```
@ORGRTN[robot number] k[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At movement start
END[cr/lf] .......................... At movement end
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	Axis number	1 to 6

Meaning Performs the return-to-origin operation of the specified axis of the robot specified by <*robot number*>. For the axis with the semi-absolute specifications, when the return-to-origin is executed, the absolute search operation is performed.

	Sample Description
Command	`@ORGRTN 1[cr/lf]`
Response	`RUN[cr/lf].......................... Movement start` `END[cr/lf].......................... Movement end`

4.3 Manual movement: inching

Command Format

```
@INCH[robot number] km[cr/lf]
@INCHXY[robot number] km[cr/lf]
@INCHT[robot number] km[cr/lf]
```

Response Format

```
RUN[cr/lf] ........................ At movement start
END[cr/lf] ........................ At movement end
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	Axis number	1 to 6
m	Movement direction	+, –

Meaning Manually moves (inching motion) the specified axis of the robot specified by the <*robot number*>. The robot performs the same motion as when moved manually in inching motion with the programming box's jog keys (moves a fixed distance each time a jog key is pressed).

The unit of the movement amount and operation type by command are shown below.

INCH:	"pulse" units. Only the specified axis moves.
INCHXY:	"mm" units. According to the robot configuration, the arm tip of the robot moves in the direction of the Cartesian coordinate system.
INCHT:	"mm" units. According to the robot configuration, the hand attached to the arm tip of the robot moves.

	Sample	Description
Command	`@INCH 1+[cr/lf]`	
Response	`RUN[cr/lf]` `END[cr/lf]`	Movement start Movement end

4.4 Manual movement: jog

Command Format

```
@JOG[robot number] km[cr/lf]
@JOGXY[robot number] km[cr/lf]
@JOGT[robot number] km[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At movement start
END[cr/lf] .......................... At movement end
```

Notation	Value	Range
	robot number	1 to 4 (If not input, robot 1 is specified.)
k	Axis number	1 to 6
m	Movement direction	+, –

Meaning Manually moves (jog motion) the specified axis of the robot specified by the <*robot number*>.
The robot performs the same motion as when holding down the programming box's jog keys in manual mode.

To continue the operation, it is necessary for the JOG command to input the execution continue process (^V(=16H)) by the online command at intervals of 200ms. If not input, the error stop occurs.

Additionally, after the movement has started, the robot stops when any of the statues shown below arises.

- When software limit was reached.
- When stop signal was turned off.
- When STOP key on the programming box was pressed.
- When an online command (^C (=03H)) to interrupt execution was input.

The unit of the movement amount and operation type by command are shown below.

JOG :	"pulse" units. Only the specified axis moves.
JOGXY:	"mm" units. According to the robot configuration, the arm tip of the robot moves in the direction of the Cartesian coordinate system.
JOGT:	"mm" units. According to the robot configuration, the hand attached to the arm tip of the robot moves.

	Sample	Description
Command	`@JOG 1+[cr/lf]`	
Response	`RUN[cr/lf]`.......................... `END[cr/lf]`..........................	Movement start Movement end

5 Data file operation commands

5.1 Copy operations

5.1.1 Copying a program

Command Format

`@COPY`	*<program name 1>* `PGn`	`TO` *<program name 2>* `[cr/lf]`

Response Format

```
RUN[cr/lf] ......................... At prosess start
END[cr/lf] ......................... At prosess end
```

Notation	Value	Range
Program name 1	Program name in copy source	32 characters or less consisting of alphanumeric characters and underscore
Program name 2	Program name in copy destination	
n	Program number	1 to 100

Meaning Copies the program specified by *<program name 1>* or program number to *<program name 2>*.

	Sample	Description
Command	`@COPY <TEST1> TO <TEST2>[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	`Process start` `Process end`

5.1.2 Copying point data

Command Format

```
@COPY Pmmmmm-Pnnnnn TO Pkkkkk[cr/lf]
```

Response Format

```
RUN[cr/lf] ......................... At prosess start
END[cr/lf] ......................... At prosess end
```

Notation	Value	Range
mmmmm	Top point number in copy source	0 to 29999
nnnnn	Last point number in copy source	
kkkkk	Top point number in copy destination	

Meaning Copies the point data between Pmmmmm and Pnnnnn to Pkkkkk.

	Sample	Description
Command	`@COPY P101-P200 TO P1101[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	`Process start` `Process end`

5.1.3 Copying point comments

Command Format

```
@COPY PCmmmmm-PCnnnnn TO PCkkkkk[cr/lf]
```

Response Format

```
RUN[cr/lf] ............ At prosess start
END[cr/lf] ............ At prosess end
```

Notation	Value	Range
mmmmm	Top point comment number in copy source	0 to 29999
nnnnn	Last point comment number in copy source	
kkkkk	Top point comment number in copy destination	

Meaning Copies the point comments between PCmmmmm and PCnnnnn to PCkkkkk.

	Sample	Description
Command	`@COPY PC101-PC200 TO PC1101[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	`Process start` `Process end`

5.2 Erase

5.2.1 Erasing a program

Command Format

`@ERA`	`<`*`program name`*`>` `PGn`	`[cr/lf]`

Response Format

```
RUN[cr/lf] ............ At prosess start
END[cr/lf] ............ At prosess end
```

Notation	Value	Range
Program name	Program name to be erased	32 characters or less consisting of alphanumeric characters and underscore
n	Program number	1 to 100

Meaning Erases the designated program.

	Sample	Description
Command	`@ERA <TEST1>[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	`Process start` `Process end`

5.2.2 Erasing point data Command format

Command Format

```
@ERA  Pmmmmm-Pnnnnn[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
mmmmm	Top point number to be erased	0 to 29999
nnnnn	Last point number to be erased	

Meaning Erases the point data between Pmmmmm and Pnnnnn.

	Sample	Description
Command	`@ERA P101-P200[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	Process start Process end

5.2.3 Erasing point comments

Command Format

```
@ERA  PCmmmmm-PCnnnnn[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
mmmmm	Top point comment number to be erased	0 to 29999
nnnnn	Last point comment number to be erased	

Meaning Erases the point comments between PCmmmmm and PCnnnnn.

	Sample	Description
Command	`@ERA PC101-PC200[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	Process start Process end

5.2.4 Erasing point name

Command Format

```
@ERA PNmmmmm-PNnnnnn[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
mmmmm	Top point name number to be erased	0 to 29999
nnnnn	Last point name number to be erased	

Meaning Erases the point names between PNmmmmm and PNnnnnn.

	Sample Description
Command	`@ERA PC101-PC200[cr/lf]`
Response	`RUN[cr/lf]......................... Process start` `END[cr/lf]......................... Process end`

5.2.5 Erasing pallet data

Command Format

```
@ERA PLm[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
m	Pallet number to be erased	0 to 39

Meaning Erases the PLm pallet data.

	Sample Description
Command	`@ERA PL1[cr/lf]`
Response	`RUN[cr/lf]......................... Process start` `END[cr/lf]......................... Process end`

5.2.6 Erasing general-purpose Ethernet port

Command Format

```
@ERA GPm[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
m	General-purpose Ethernet port number to be erased	0 to 15

Meaning Erases the general-purpose Ethernet port of "GPm".

	Sample	Description
Command	`@ERA GP5[cr/lf]`	
Response	`RUN[cr/lf]`.......................... `END[cr/lf]`..........................	Process start Process end

5.2.7 Erasing real time output

Command Format

```
@ERA RTmmm-RTnnn[cr/lf]
```

Response Format

```
RUN[cr/lf] .......................... At prosess start
END[cr/lf] .......................... At prosess end
```

Notation	Value	Range
mmm	Top real time output number to be erased	24 to 127
nnn	Last real time output number to be erased	

Meaning Erases the real time output setteng between RTmmm and RTnnn.

	Sample	Description
Command	`@ERA RT24-RT80[cr/lf]`	
Response	`RUN[cr/lf]`.......................... Process start `END[cr/lf]`.......................... Process end	

5.3 Rename program

Command Format

@REN	*<program name 1>* PGn	TO *<program name 2>* [cr/lf]

Response Format

```
RUN[cr/lf] ......................... At prosess start
END[cr/lf] ......................... At prosess end
```

Notation	Value	Range
Program name 1	Program name before renaming	32 characters or less consisting of alphanumeric characters and underscore
Program name 2	Program name after renaming	
n	Program number	1 to 100

Meaning Changes the name of the specified program.

	Sample	Description
Command	`@REN <TEST1> TO <TEST2>[cr/lf]`	
Response	`RUN[cr/lf ........................` `END[cr/lf]........................`	`Process start` `Process end`

5.4 Changing the program attribute

Command Format

@ATTR	*<program name>* PGn	TO s[cr/lf]

Response Format

```
OK[cr/lf]
```

Notation	Value	Range / Meaning
Program name	Program name to change the attribute	32 characters or less consisting of alphanumeric characters and _ (underscore)
s	Attribute	RW: Readable/writable RO: Not writable (read only) H: Hidden
n	Program number	1 to 100

Meaning Changes the attribute of the program specified by the <*program name*> or program number.

	Sample
Command	`@ATTR <TEST1> TO RO[cr/lf]`
Response	`OK[cr/lf]`

5.5 Initialization process

5.5.1 Initializing the memory area

Command Format

```
@INIT memory area[cr/lf]
```

Response Format

```
RUN[cr/lf] ........................ At prosess start
END[cr/lf] ........................ At prosess end
```

Notation	Value	Meaning
Memory area	PGM	Initializes the program area.
	PNT	Initializes the point data area.
	SFT	Initializes the shift data area.
	HND	Initializes the hand data area.
	WRKDEF	Initializes the work data area.
	PLT	Initializes the pallet data area.
	PCM	Initializes the point comment area.
	PNM	Initializes the point name area.
	ION	Initializes the input/output name area.
	ACO	Initializes the area check output setting area.
	RTO	Initializes the real time output setting area.
	GEP	Initializes the general-purpose Ethernet port setting area.
	MEM	Initializes the above areas (PGM ... all data up to GEP).
	PRM	Initializes the parameter area.
	ALL	Initializes all areas (MEM+PRM).

Meaning Initializes the memory area.
To Initialize, specify any memory area among "Value" above.

	Sample	Description
Command	`@INIT PGM[cr/lf]`	
Response	`RUN[cr/lf]` .... Process start `END[cr/lf]` .... Process end	

5.5.2 Initializing the communication port

Command Format

```
@INIT communication port[cr/lf]
```

Response Format

```
RUN[cr/lf] ........................ At prosess start
END[cr/lf] ........................ At prosess end
```

Notation	Value	Meaning
Communication port	CMU	Initializes the RS-232C port
	ETH	Initializes the Ethernet port

Meaning Initializes the communication port.
To Initialize, specify any port between "Value" above.

Reference For information about the communication port initial settings,
refer to RCX3 user's manual.

	Sample	Description
Command	`@INIT CMU[cr/lf]`	
Response	`RUN[cr/lf]........................ Process start` `END[cr/lf]........................ Process end`	

5.5.3 Initializing the alarm history

Command Format

```
@INIT LOG[cr/lf]
```

Response Format

```
RUN[cr/lf] ........................ At prosess start
END[cr/lf] ........................ At prosess end
```

Meaning Initializes the alarm history.

	Sample	Description
Command	`@INIT LOG[cr/lf]`	
Response	`RUN[cr/lf]........................ Process start` `END[cr/lf]........................ Process end`	

5.6 Data readout processing

Command Format

```
@READ read-out file[cr/lf]
```

Response Format

```
BEGIN[cr/lf] ..........................     At prosess start
(Data output: The contents may vary depending on the read-out file.)
END[cr/lf] ................................ At prosess end
```

Meaning Reads out the data from the designated file.

- Online commands that input through the RS-232C port have the same meaning as the following command.

  SEND <*read-out file*> TO CMU

- Commands via Ethernet have the same meaning as the following command.

  SEND <*read-out file*> TO ETH

Reference Chapter 10 "Data file description"

Type	Read-out file name	Definition format	
		All	Individual file
User memory	All file	ALL	--------
	Program	PGM	<bb…b>>
	Point data	PNT	Pn
	Point comment	PCM	PCn
	Point name	PNM	PNn
	Parameter	PRM	/cccccccc/
	Shift definition	SFT	Sn
	Hand definition	HND	Hn
	Work definition	WRKDEF	Wn
	Pallet definition	PLT	PLn
	General Ethernet port	GEP	GPn
	Input/output name	ION	iNMn(n)
	Area check output	ACO	ACn
	Real time output	RTO	RTn
Variable, constant	Variable	VAR	ab...by
	Array variable	ARY	ab...by(x)
	Constant	———	"cc...c"
Status	Program directory	DIR	<<bb…b>>
	Parameter directory	DPM	———
	Machine reference (sensor or stroke-end)	MRF	———
	Machine reference (mark)	ARP	———
	Accumulated data	ACD	———
	System configuration information	CFG	———
	Controller	CNT	———
	Robot	RBT	———
	Driver	DRV	———
	Option board	OPT	———
	Self check	SCK	———
	Alarm history	LOG	———
	Remaining memory size	MEM	———
Device	DI port	DI()	DIn()
	DO port	DO()	DOn()
	MO port	MO()	MOn()
	TO port	TO()	TOn()
	LO port	LO()	LOn()
	SI port	SI()	SIn()
	SO port	SO()	SOn()
	SIW port	SIW()	SIWn()
	SOW port	SOW()	SOWn()
Others	File end code	EOF	———

a: Alphabetic character b: Alphanumeric character or underscore (_) c: Alphanumeric character or symbol
i: I/O type n: Number x: Expression (Array argument) y: variable type

	Sample	Description
Command	`@READ PGM[cr/lf]`	Reads out all programs.
	`@READ P100[cr/lf]`	Reads out the point 100.
	`@READ DINM2(0)[cr/lf]`	Reads out the input/output name of DI2(0).

5.7 Data write processing

Command Format

```
@WRITE write file[cr/lf]
```

Response Format

```
READY[cr/lf] ........................ Input request display
OK [cr/lf]   ........................ After input is completed
```

Meaning Writes the data in the designated file.

- Online commands that input through the RS-232C port have the same meaning as the following command.

  SEND CMU TO <*write file*>
- Commands via Ethernet have the same meaning as the following command.

  SEND ETH TO <*write file*>

Reference Chapter 10 "Data file description"

MEMO

- At the DO, MO, TO, LO, SO, SOW ports, an entire port (DO(), MO(), etc.) cannot be designated as a WRITE file.
- Some separate files (DOn(), MOn(), etc.) cannot be designated as a WRITE file. For details, refer to Chapter 10 "Data file description".

Type	Write file name	Definition format	
		All	Separate file
User memory	All file	ALL	—
	Program	PGM	<bb...b>>
	Point data	PNT	Pn
	Point comment	PCM	PCn
	Point name	PNM	PNn
	Parameter	PRM	/cccccccc/
	Shift definition	SFT	Sn
	Hand definition	HND	Hn
	Work definition	WRKDEF	Wn
	Pallet definition	PLT	PLn
	General Ethernet port	GEP	GPn
	Input/output name	ION	iNMn(n)
	Area check output	ACO	ACn
	Real time output	RTO	RTn
Variable, constant	Variable	VAR	ab...by
	Array variable	ARY	ab...by(x)
Device	DO port	—	DOn()
	MO port	—	MOn()
	TO port	—	TOn()
	LO port	—	LOn()
	SO port	—	SOn()
	SOW port	—	SOWn()

a: Alphabetic character b: Alphanumeric character or underscore (_) c: Alphanumeric character or symbol
i: I/O type n: Number x: Expression (Array argument) y: variable type

	Sample	Description
Command	`@WRITE PRM[cr/lf]`	Writes all parameters.
	`@WRITE P100[cr/lf]`	Writes the point 100.
	`@WRITE DINM2(0)[cr/lf]`	Writes the input/output name of DI2(0).

6 Utility commands

6.1 Setting the sequence program execution flag

Command Format

`@SEQUENCE k[cr/lf]`

Response Format

`OK[cr/lf]`

Notation	Value	Range / Meaning
k	Execution flag	0: disable, 1: enable, 3: enable (DO reset)

Meaning Sets the sequence program execution flag.

	Sample	Description
Command	`@SEQUENCE 1[cr/lf]`	
Response	`OK[cr/lf]`	

6.2 Setting the date

Command Format

`@DATE yy/mm/dd[cr/lf]`

Response Format

`OK[cr/lf]`

Notation	Value	Range
yy/mm/dd	Date to be set	year, month, day
yy	Lower 2 digits of the year	00 to 99
mm	Month	01 to 12
dd	Day	01 to 31

Meaning Sets a date in the controller.

NOTE

To change only the year or month, the slash (/) following it can be omitted.
Example:

- To set the year to 2016, enter 16(cr/lf).
- To set the month to June, enter /06(cr/lf).

MEMO

- The currently set values are used for the omitted items.
- If only [cr/lf] is transmitted, then the date remains unchanged.
- If an improbable date is entered, then "5.202: Data error" occurs.

	Sample 1 : To change only the day,
Command	`//15[cr/lf]` .... `Day is set to 15th.`

	Sample 2	Description
Command	`@DATE 16/01/14[cr/lf]`	
Response	`OK[cr/lf]`	

6.3 Setting the time

Command Format

```
@TIME hh:mm:ss[cr/lf]
```

Response Format

```
OK[cr/lf]
```

Notation	Value	Range
hh:mm:ss	Current time	
hh	Hour	00 to 23
mm	Minute	00 to 59
ss	Second	00 to 59

Meaning Sets the time of the controller.

MEMO

- The currently set values are used for the omitted items.
- If only [cr/lf] is transmitted, then the time remains unchanged.
- If an improbable time is entered, then "5.202: Data error" occurs.

Sample 1: To change only the minute,

Command

```
:20:[cr/lf].........................Minute is set to 20.
```

Sample 2

Command

```
@TIME 10:21:35[cr/lf]
```

Response

```
OK[cr/lf]
```

7 Individual execution of robot language

7.1 Command

Command Format

```
@robot language[cr/lf]
```

Response Format 1

```
OK[cr/lf] or NG=gg.bbb[cr/lf]
```

Response Format 2

```
RUN[cr/lf] or NG=gg.bbb[cr/lf] ............ At process start
END[cr/lf] or NG=gg.bbb[cr/lf] ............ At process end
```

Notation	Value	Range
OK, END	Command ended correctly	
NG	An error occurred	
RUN	Command starts correctly	
gg	Alarm group number	0 to 99
bbb	Alarm classification number	0 to 999

Meaning Robot language commands can be executed.

- Only independently executable commands are executed.
- Command format depends on each command to be executed.

	Sample 1
Command	`@SET DO(20) [cr/lf]`
Response	`OK[cr/lf]`

	Sample 2	Description
Command	`@MOVE P,P100,S=20[cr/lf]`	
Response	`RUN[cr/lf]` .... `END[cr/lf]`	Process start Process end

7.2 Function

Command Format

```
@?robot language[cr/lf]
```

Response Format

```
X[cr/lf]
OK[cr/lf]
```

Notation	Value	Range
X	Return value	
OK, END	Command ended correctly	
NG	An error occurred	
gg	Alarm group number	0 to 99
bbb	Alarm classification number	0 to 999

Meaning Robot language Functions can be executed.

- Only independently executable functions are executed.
- Function format depends on each function to be executed.

	Sample	Description
Command	`@?REFTSK(1)[cr/lf]`	Acquires the status of Task 1.
Response	`0[cr/lf]` `OK[cr/lf]`	Task 1 is in STOP staus.

8 Control codes

Command Format

```
^C (=03H)
```

Response Format

```
NG=1.8
```

Meaning Interrupts execution of the current command.

	Sample	Description
Command	`@MOVE P,P100,S=20[cr/lf]` `^C`	
Response	`NG=1.8[cr/lf]`	

Chapter 13

Appendix

1 Reserved word list.................................... 13-1
2 Changes from conventional models...... 13-3

1 Reserved word list

The words shown below are reserved for robot language and cannot be used as identifiers (variables, etc.).

A

- ABS
- ABSADJ
- ABSRPOS
- ACCEL
- ACCESS
- ACD
- ACO
- ALL
- ALM
- ALMRST
- AND
- ARCHP1
- ARCHP2
- ARM
- ARMCND
- ARMSEL
- ARMTYP
- ARP
- ARY
- ASPEED
- ATN
- ATN2
- ATTR
- AXWGHT

B

- BIN
- BREAK

C

- CALL
- CASE
- CFG
- CHANGE
- CHGPRI
- CHGWRK
- CHR
- CLOSE
- CMU
- CNT
- CORRECTXY
- CONTPLS
- COPY
- COS
- CREWRK
- CURPNT
- CURTQST
- CURTRQ
- CUT

D

- DATE
- DBP
- DECEL
- DEF
- DEGRAD
- DELAY
- DI
- DIM
- DIR
- DIST
- DO
- DPM
- DRIVE
- DRIVEI
- DRV

E

- ELSE
- ELSEIF
- EMG
- END
- ENDIF
- EOF
- EQV
- ERA
- ERL
- ERR
- ERROR
- ETH
- ETHSTS
- EXIT
- EXITTASK

F

- FN
- FOR

G

- GEP
- GEPSTS
- GO
- GOSUB
- GOTO

H

- HALT
- HALTALL
- HAND
- HEX
- HND
- HOLD
- HOLDALL

I

- IDIST
- IF
- IMP
- INCH
- INCHT
- INCHXY
- INIT
- INPUT
- INROFST
- INT
- ION

J

- JOG
- JOGT
- JOGXY
- JTOXY

L

- LEFT
- LEFTY
- LEN
- LET
- LINEMODE
- LO
- LOAD
- LOC1
- LOC2
- LOC3
- LOC4
- LOC5
- LOC6
- LOCF
- LOG
- LSHIFT

M

- MAINPG
- MCHREF
- MEM
- MID
- MO
- MOD
- MODE
- MOTOR
- MOVE
- MOVEI
- MOVET
- MRF
- MRKSET
- MSG
- MSGCLR
- MSPEED
- MTRDUTY

N

- NAME
- NEXT
- NOT

O

- OFFLINE
- ON
- ONLINE
- OPEN
- OPT
- OR
- ORD
- ORGORD
- ORGRTN
- ORIGIN
- OUT
- OUTPOS

P

- P
- PATH
- PCM
- PDEF
- PGM
- PGMTSK
- PGN
- PLT
- PMOVE
- PNM
- PNT
- PPNT
- PRINT
- PRM
- PSHFRC
- PSHJGSP
- PSHMTD
- PSHRSLT
- PSHSPD
- PSHTIME
- PUSH

R

- RADDEG
- RBT
- RBTWRK

READ
REF
REM
REN
RESET
RESTART
RESUME
RETURN
RIGHT
RIGHTY
RSHIFT
RTO
RUN
RUNTO
S
S
SCK
SCRINR
SELECT
SEND
SEQCMPL
SEQCMPSTS
SEQUENCE
SERVO
SET
SETGEP
SETPW
SFT
SGI
SGR
SHARED
SHIFT
SI
SID
SIN
SIW
SKIP
SKIPTO
SO
SOD
SOW
SPEED
SQR
START
STEP
STOP
STR
SUB
SUSPEND
SWI
SYNCHK
T
TAG
TAN
TASKS
TCHXY
TCOUNTER
TEACH
THEN
TIME
TIMER
TO
TOLE
TORQUE
TSKECD
TSKMON
TSKPGM
V
VAL
VAR
VER
VMCDEF
VMCPNO
VMCORRECT
VMCSTS
W
WAIT
WEIGHT
WEIGHTG
WEND
WHERE
WHILE
WHRXY
WHRXYEX
WRITE
WRKDEF
X
XOR
XYTOJ

Since the following names are used as system variable names, they cannot be used at the beginning of other variable names

ACn
DIn
DINMn
DOn
DONMn
FN
GPn
Hn
LOn
MOn
PCn
Pn
PNn
SGIn
SGRn
SIn
SINMn
Sn
SOn
SONMn
TOn

n: numeric value

Variable name usage examples

- Although keywords which are reserved as robot language words cannot be used as they are, **they can be used as variable names if alphanumeric characters are added to them.**

Example: "ABS" cannot be used, but "ABS1" or "ABSX" can be used.

- **Keywords reserved as system variables cannot be used at the beginning of other variable names**, even if alphanumeric characters are added to them.

Example: "FN" cannot be used. "FNA" and "FN123" also cannot be used.

2 Changes from conventional models

1 Program name

For RCX340/RCX320, the following two program names which have been special for conventional models (RCX240, etc.) don't have a special meaning.

A) FUNCTION
B) _SELECT

A) FUNCTION

In conventional models (RCX240, etc.), "FUNCTION" has been a special program for registering a user function. RCX340/RCX320 doesn't have a user function, thus it doesn't have a special meaning.

B) _SELECT

In conventional models (RCX240, etc.), the "_SELECT" program has been selected and executed every time robot programs were reset.
In RCX340/RCX320, the program specified at the main program number (or the program executed last if there is no specified program there) is selected and executed when robot programs are reset.
For details regarding the main program, refer to "12. Set main program" in "2.1 Program operations" in Chapter 12.

2 Multiple Robot Control

In conventional models (RCX240, etc.), robot has consisted of a main group (one main robot, main auxiliary axes) and a sub group (one sub robot, sub auxiliary axes).
In RCX340/RCX320, robot consists of robot 1 to 4 (normal axes, auxiliary axes).
Due to this change, commands for each group have changed to ones for each robot.
For details regarding the command for each robot, refer to "2. Command list with a robot setting" in Chapter 5 of this manual for RCX340/RCX320, and regarding the command for each group, refer to "Command list for each group" of the programming manual for conventional models (RCX240, etc.), respectively.

Command to each robot group by conventional controller (RCX240, etc.)

Sample	Description
`MOVE P, P1`	Axes of a main group move to the position specified at P1.
`MOVE2 P, P5`	Axes of a sub group move to the position specified at P5.

Command to specified robot by RCX340/RCX320

Sample	Description
`MOVE P, P1`	Axes of the robot 1 move to the position specified at P1.
`MOVE[2] P, P5`	Axes of the robot 2 move to the position specified at P5.

MEMO

Robot number can be omitted in the commands with a robot setting. When omitted, robot 1 is specified.

3 Multi-tasking

The differences between RCX340/RCX320 and conventional models (RCX240, etc.) are shown below.

	Conventional models	RCX340/RCX320
Maximum number of task	8	16
Priority	17 to 47	1 to 63
Task definition	During the program	In another program
Starting tasks	Task is assigned in Task 1 automatically and placed in RUN status	Task is assigned in a specified task number and placed in RUN status
Command execution for Task 1 (restart, etc.)	Not executable	Executable

Reference For details regarding the multi-tasking, refer to Chapter 6 "Multi-tasking" in this manual or in a programming manual for conventional models (RCX240, etc.).

4 Robot Language

The following robot languages are not supported in RCX340/RCX320.

ABSINIT	ABSINIT2	ABSRST	ABSRPOS2
ACCEL2	ARMCND2	ARMTYP2	ASPEED2
AXWGHT2	CHANGE2	CURTRQ2	DECEL2
DECLARE	DRIVE2	DRIVEI2	HAND2
JTOXY2	LEFTY2	MCHREF2	MOVE2
MOVEI2	ORGORD2	OUTPOS2	PMOVE2
RIGHTY2	SERVO2	SHIFT2	SPEED2
TOLE2	TORQUE2	TRQSTS	TRQSTS2
TRQTIME	TRQTIME2	WAIT ARM2	WEIGHT2
WHERE2	WHRXY2	XYTOJ2	_SYSFLG

Reference For details regarding the robot Languages above,
refer to the programming manual for conventional models (RCX240, etc.).

5 Online commands

The following online commands are not supported in RCX340/RCX320.

AUTO	EMGRST	EXELV	MANUAL
? ARM	? CONFIG	? EXELVL	? OPSLOT
? SELFCHK	? WHRXYEX		

Reference For details regarding the online commands above,
refer to the programming manual for conventional models (RCX240, etc.).

6 Data file

- "Alarm history file" replaced "Error message history file" and "Error message history details file" of conventional models.
- In RCX340/RCX320, the point number ranges from 0 to 29999 (0 to 9999: Conventional models).

Reference Chapter 10 "Data file description"

Revision record

Version	Issue date	Description
Ver. 1.00	Apr. 2014	First edition
Ver. 1.10	Aug. 2014	Clerical error corrections, etc.
Ver. 1.20	Mar. 2016	Chapter 7 "Sequence function" was added. "PATH control" and "Torque control" were added to robot language in Chapter 8. Chapter 9 "PATH Statements" was added. "2.5 Sealing" was added in Chapter 11. "2 Changes from conventional models" was added in Chapter 13.
Ver. 1.21	Feb. 2017	Contact information was changed.
Ver. 1.31	Mar. 2017	Conditions of PUSH statement were changed in Chapter 8. Descriptions on " I/O name" were added in Chapter 10.
Ver. 1.33	Mar. 2018	Descriptions of current value were added to CURTQST/CURTRQ/MTRDUTY statements, descriptions of online/offline modes were added to OFFLINE/ONLINE statements in Chapter 8.
Ver. 1.37	Nov. 2018	Commands for work definition were added.
Ver. 1.38	Aug. 2019	WEIGHTG statement was added.
Ver. 2.00	Oct. 2019	Controller "RCX320" was added.
Ver. 2.03	Apr. 2020	Added the functions (real time output/SIOW area extension) and commands (CONTPLS/CORRECTXY/SCRINR/INROFST).
Ver. 2.06	Feb. 2021	Added the function (Task status acquisition REFTSK) and the online commands (HND/WRKDEF).
Ver. 2.07	Oct. 2021	Added the work data as the usable target of LOCx (Ch. 8).
Ver. 2.09	Apr. 2022	Added ACD (Data file/ Online command) and SEQCMPSTS (Online command). Added the descriptions of sample programs to Ch. 8
Ver. 2.10	Oct. 2022	Added the followings; Descriptions to ACD (Ch. 8/ 10), Formats to SGI/ SGR (Ch. 8), Descriptions when omitting the point No. to PDEF (Ch. 8).
Ver. 2.11	Feb. 2023	Clerical error corrections.

Programming Manual

4-axis/2-axis Robot Controller

RCX3 Series

February 2023
Ver. 2.11

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