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Installation and Operating Instructions **ECOVARIO® 616** **ECOVARIO® 616 D**

- preliminary -

- preliminary -

Published editions:

Edition	Comment
April 2013	Preliminary version for prototypes
July 2013	Preliminary version for UL certification
Nov 2013	French translation of safety instructions added because of UL requirements

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Buchaer Straße 1
07745 Jena

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- preliminary -

Installation and Operating Instructions ECOVARIO® 616, 616 D

Jenaer Antriebstechnik  GmbH

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1 About this manual

This original instructions describe the servo amplifier range ECOVARIO® 6xx. It concerns to all persons who project, install and commission ECOVARIO® 616 or ECOVARIO® 616 D drives.

Further information:

- ⇒ Software commissioning: „ECO Studio Operation Manual ECOVARIO®, ECOSTEP®, ECOMPACT“
- ⇒ Programming: manual „Object Dictionary ECOVARIO® and ECOSTEP“, software tool ECO Studio
- ⇒ Application Notes ECOVARIO® and ECOSTEP
- ⇒ Motor data: Product catalogue „ECOSTEP®/ECOVARIO®/ECOLIN® Drives“.

This manual makes the following demands on qualified personnel:

Transport: Personnel trained in handling electrostatic sensitive devices

Installation: Electrotechnically qualified personnel who know the security directives of electrical engineering and automation

Setup/Commissioning: Qualified personnel with a broad knowledge of the fields of electrical engineering, automation and drives.

Knowledge of machine safety legislation is compulsory.

2 Safety instructions / Consignes de sécurité

2.1 Signal words and symbols / Mots d'avertissement et symboles

Table 2.1: Signal words and possible symbols / Mots d'avertissement et symboles

	Description	Description
DANGER  	Warning about a dangerous situation. Disregarding this warning <u>will lead to death or serious, irreversible injuries</u> . Left symbol: General danger Right symbol: Dangerous electrical voltages	<i>Indique une situation dangereuse. Le non-respect de l'indication de danger mènera à la mort ou à des blessures graves ou irréversibles.</i> Pictogramme de gauche : indication générale de danger Pictogramme de droite : Danger du courant électrique
WARNING / AVERTISSEMENT  	Warning about a dangerous situation. Disregarding this warning <u>may lead to death or serious, irreversible injuries</u> Left symbol: General danger Right symbol: Dangerous electrical voltages	<i>Indique une situation dangereuse. Le non-respect de l'indication de danger peut mener à la mort ou à des blessures graves ou irréversibles.</i> Pictogramme de gauche : indication générale de danger Pictogramme de droite : Danger du courant électrique
CAUTION / ATTENTION  	Warning about a dangerous situation. Disregarding this warning <u>may lead to minor injuries</u> Left symbol: General Right symbol: Hot surfaces	<i>Indique une situation dangereuse. Le non-respect de l'indication de danger peut mener à des blessures légères.</i> Pictogramme de gauche : indication générale Pictogramme de droite : Attention aux surfaces chaudes
NOTICE / PRUDENCE	Disregarding this note may lead to damages of things.	<i>Indique une situation qui, si elle n'est pas évitée, peut mener à la détérioration de matériel.</i>
INFO / INDICATION 	Not a safety instruction. However: Important information on the use of the servo amplifier.	<i>N'indique pas de situation de danger, mais une information importante par rapport à l'utilisation de l'amplificateur de servomoteur.</i>

2.2 General notes / Indications générales

CAUTION / ATTENTION 	<p>Improper handling of the servo amplifier may lead to injuries and material damage. Read this documentation carefully before you install and commission the device. The technical data and the information on connection requirements (nameplate and documentation) have to be adhered to. Only properly qualified personnel are permitted to perform activities such as transport, installation, setup and maintenance of the servo amplifier ECOVARIO®.</p>	<p>L'utilisation non conforme des amplificateurs de servomoteurs peut entraîner des blessures et des dégâts matériels. Veuillez lire la documentation avant d'installer et de mettre en route l'appareil. Les données techniques ainsi que les informations concernant le raccordement (Plaque constructeur et documentation) doivent absolument être respectées. Le transport, l'installation, la mise en service de l'amplificateur de servomoteurs ECOVARIO® ne doivent être réalisés que par du personnel autorisé et qualifié.</p>
CAUTION / ATTENTION 	<p>The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property. In case of modifications or retrofits with components of manufacturers other than Jenaer Antriebstechnik, please contact us to clarify that those components are suitable to be assembled with our devices..</p>	<p>Le fabricant d'une machine ou d'une installation doit réaliser une analyse des risques et en tirer les conséquences qui assurent une utilisation en toute sécurité de l'ensemble de l'installation. Lors de modification ou intégration de matériels d'autres fabricants, merci de nous contacter pour que nous puissions vérifier la compatibilité de ces éléments avec nos composants d'entraînement.</p>

2.3 Dangerous voltages / Danger dus à des tensions dangereuses

DANGER 	<p>Never open the units during operation. There is danger of life or a risk of serious health and material damage. Covers and cabinet doors have to be kept closed during operation. With the opening of the device all warranty and liability claims against Jenaer Antriebstechnik GmbH are void.</p>	<p>Ne pas ouvrir l'appareil pendant l'utilisation. Il y a danger de mort ou danger de graves dommages à la santé et au matériel. Les capots et portes d'armoires électriques doivent restés fermés pendant l'utilisation. L'ouverture de l'appareil entraîne la perte de toute garantie et responsabilité de Jenaer Antriebstechnik GmbH.</p>
WARNING / AVERTISSEMENT 	<p>The protective earth conductor has to be properly applied before applying a voltage. If the protective earth conductor is not connected, in case of a failure e.g. the housing of the servo amplifier can be at hazardous voltage level.</p>	<p>Un raccordement à la terre réglementaire doit obligatoirement être raccordé avant la mise sous tension de l'appareil. Si cette mise à la terre n'est pas raccordée, le boîtier de l'amplificateur de servomoteur peut, en cas de problèmes, mener de dangereuses tensions.</p>
WARNING / AVERTISSEMENT 	<p>Never undo electrical connections while they are live! There is a risk of arcing. Arcs can cause injury and damage contacts. During operation logic and power connectors are live.</p>	<p>Ne pas effectuer de débranchements sous tension. Il y a danger d'arc électrique qui peut blesser des personnes et endommager des contacts. Pendant l'utilisation les conducteurs de pilotage et de puissance conduisent des tensions dangereuses.</p>
WARNING / AVERTISSEMENT 	<p>Directly after disconnecting the servo amplifier from the power supply never touch parts of the device which potentially could be live (e.g. contacts). Wait at least six minutes. Capacitors can still have dangerous voltages present. To be sure measure the DC link circuit and wait till it has fallen below 40 V.</p>	<p>Ne touchez pas de pièces de l'amplificateur de servomoteurs directement après l'avoir débranché de l'alimentation électrique qui peuvent être potentiellement conducteur de tension (par exemple des contacts). Attendez au moins 6 minutes. Les condensateurs peuvent rester chargés aussi longtemps de tension dangereuse. Mesurez par sécurité les tensions entre circuits jusqu'à qu'elles soient inférieures à 40V.</p>

2.4 Danger by hot surfaces / *Dangers dus à des surfaces chaudes*

**CAUTION /
ATTENTION****Hot surfaces may cause burns to the skin.**

As the housing of the ECOVARIO 6xx serves also as heat sink during operation the surface temperature may rise to more than 70°C.

Des surfaces chaudes peuvent entraîner des brûlures.

Le boîtier de l'ECOVARIO sert également de radiateur, ceci entraîne qu'il peut atteindre des températures de plus de 70°C pendant l'utilisation.

2.5 Danger by unintentional mechanical movements / *Dangers dus à des mouvements involontaires*

DANGER**Unintentional movements of motors,
tools or axes may lead to death or serious
injuries.**

ECOVARIO® drives can produce strong mechanical powers and high accelerations. Avoid staying in the danger zone of the machine. Never switch off safety equipment! Emergency-off equipment must be workable in all operation modes, especially during setup and maintenance. Malfunctions should be repaired by qualified personnel immediately.

**Des mouvements involontaires de moteurs, d'axes ou
d'outillages entraînent un danger de mort ou de bles-
sures.**

Les entraînements ECOVARIO® peuvent engendrer de très fortes accélérations mécaniques ainsi que des forces très élevées. Il faut éviter de se trouver dans la zone de danger de la machine. Des équipements de sécurité ne doivent jamais être mis hors service. Des équipements d'arrêt d'urgence doivent rester opérationnels dans tous les modes de fonctionnement, aussi pendant la mise en service ainsi qu'en mode maintenance. Des dérangements doivent être résorbés sans délai par du personnel qualifié.

2.6 Prescribed use / *Utilisation conforme*

The servo amplifiers ECOVARIO® are components which are built into electrical equipment or machines and can only be used as integral components of such equipment. The leakage current of ECOVARIO® is higher than 3.5 mA. All notes about technical data and ambient conditions have to be observed. Note the requirements concerning mounting position and reserved space for ventilation given in chapter 5.1.3.

Using the unit in hazardous locations and in ambients containing oil, gas, vapours, dusts, radiations etc. is prohibited if it is not explicitly allowed.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

L'amplificateur de servomoteurs ECOVARIO® est un composant de systèmes d'entraînement, il doit être installé en monte fixe dans une armoire électrique prévue à cet effet. Le courant de terre de l'ECOVARIO® est supérieur à 3,5 mA.

Toutes les indications de données techniques et conditions d'implantation doivent absolument être respectées. Veuillez respecter les positions de montage et les espaces nécessaires à l'aération indiqués dans le chapitre 5.1.3.

L'utilisation de l'appareil est interdite dans des environnements aux risques explosifs, environnements huileux, acide, gazeux, vaporeux, poussiéreux, radiants, etc... s'il n'est pas expressément autorisé pour ces milieux.

Le fabricant de la machine ou de l'installation doit établir une analyse des risques et en tirer les conséquences qui garantissent une utilisation en toute sécurité.

If one or more servo amplifiers ECOVARIO® are built into machines or plants the intended operation of the servo amplifier is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Machinery Directive 2006/42/EC and the EMC Directive 2004/108/EC. Further EN 60204 and EN ISO 12100 parts 1 and 2 have to be observed.

La mise en service d'une installation ou une machine où sont intégrés un ou plusieurs ECOVARIO® est interdite jusqu'à ce qu'il ait été établi que toutes les dispositions des directives européennes et des règles de sécurité de protection contre les accidents spécifiques au pays d'implantation soient remplies. En particuliers, il s'agit en premier ordre de la Directive Machines 2006/42/CE et de la Directive CEM 2004/108/CE. Puis DIN EN 60204 et DIN EN ISO 12100, parties 1 et 2.

Safety function „Safe Torque Off“, STO (cf. chapter 6.4.1) / Fonction de sécurité „Safe Torque Off“, STO, chapitre 6.4.1

The safety function STO must be integrated into a safety circuit that meets the demands of the safety standards of EN 60204, EN ISO 12100-1 and -2 and EN ISO 13849-1. It must only be activated when the motor is not longer rotating. Drives with a suspended load must have an additional safe mechanical blocking.

La fonction de sécurité STO doit être intégrée dans un circuit de sécurité, les exigences des directives DIN EN 60204, DIN EN ISO 12100-1 et -2 et EN ISO 13849-1 sont suffisantes. Elle ne doit être activée que si le moteur est arrêté et isolé de toute force s'exerçant sur lui (par exemple des charges suspendues) qui doivent être bloquées avec un dispositif mécanique complémentaire.

2.7 Foreseeable misuse of the safety function STO / Mauvaises utilisation prévisibles de la fonction de sécurité STO

The safety function STO must **not** be used if the drive is to be made inactive for the following reasons:

- ⌚ cleaning, maintenance and repair operations
- ⌚ long inoperative periods

In such cases the entire system should be disconnected from the supply by the personnel, and secured (main switch).

- ⌚ in emergency-stop situations

In emergency-stop situations the main contactor is switched off (by the emergency-stop button or the BTB-contact in the safety circuit).

La fonction de sécurité STO ne doit pas être utilisée

⌚ pendant la mise à l'arrêt pour travaux de nettoyage, de maintenance, de réparation ainsi que pour de longues interruptions d'utilisation : Dans ces cas, l'installation doit être mise hors tension par le sectionneur principal

⌚ dans une situation d'arrêt d'urgence : dans ce cas, un relais d'arrêt d'urgence doit mettre l'installation hors tension.

3 Legal notes

3.1 Terms of delivery

Our terms of delivery are based on the „The General Terms of Delivery for Products and Services of the Electrical Industry“ (German: ALB ZVEI) of the Central Association of the Electrical and Electronics Industry (ZVEI e.V.) in their current version.

3.2 Liability

The circuits and procedures in this manual are proposals. Every user has to check the suitability for every special case. Jenaer Antriebstechnik GmbH is not responsible for suitability. Especially Jenaer Antriebstechnik is not responsible for the following damage causes:

- ⌚ disregarding the instructions of this manual or other documents concerning ECOVARIO®
- ⌚ unauthorized modifications of drive, motor or accessories
- ⌚ operating or dimensioning faults
- ⌚ Improper use of the ECOVARIO® components

3.3 Standards and directives

ECOVARIO® are components intended to be built into machines or plants for industrial purpose.

The units meet the following standards:

DIN EN 61800-5-1: Adjustable speed electrical power drive systems – Part 5-1: Safety requirements; Electrical, thermal and energy

DIN EN 61800-3: Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods

DIN EN 60 204: Safety of machinery - electrical equipment of machines - Part 1: General requirements.

3.3.1 UL/CSA conformity according to UL 508C (under preparation) / *Conformité UL/CSA d'après UL 508C (en préparation)*

If ECOVARIO® servo amplifiers are to be used in countries where UL (Underwriters Laboratories Inc.) or cUL conformity resp. is required the appropriate type has to be selected (cf. chapter 4.3 „Order key“).

For further information see UL file number E244038 at www.ul.com.

Si les amplificateurs de servomoteur ECOVARIO® sont installés dans des pays où l' UL ou une conformité cUL est requise, le type exact qui est requis doit être précisé lors de la commande en choisissant le type exacte (voir chapitre 4.3 clé du type). Vous trouverez des informations complémentaires sous le numéro de fichier UL - E244038 sur la page web www.ul.com.

The UL(cUL) certification (UL 840 and UL 508C in this case) is related exclusively to the mechanical and electrical design of the device. UL(cUL) certified servo amplifiers are in accordance with the respective american and canadian fire regulations.

La certification UL(cUL) (Dans ce cas UL 840 et UL 508C) se rapporte exclusivement aux caractéristiques de constructions mécaniques et électriques de l'appareil. Les directives UL(cUL) fixent entre autres les exigences techniques minimales pour appareils électriques pour prévenir les risques d'incendie qui émanent d'appareils électriques.

The installation and safety precautions in this documentation have to be observed.

Les indications d'installation et de sécurité de ce document doivent être respectées.

3.3.2 CE conformity

ECOVARIO® servo amplifiers are components that are intended to be built into electrical plant and machines for industrial use. The manufacturer of the machine is responsible that the machine or plant fulfills the requirements of the EMC directive.

The servo amplifiers have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation.

Any divergence from the configuration and installation described in this manual means that you will be responsible for carrying out new measurements to ensure that the regulatory requirements are fulfilled. For servo amplifiers with integrated safety function the conformity assessment is carried out according to the EC machine directive 2006/42/EC.

EG – Konformitätserklärung EC – Declaration of Conformity

Hiermit erklären wir / Herewith we

Jenaer Antriebstechnik GmbH, Buchaer Str. 1, 07745 Jena, Deutschland

in alleiniger Verantwortung, dass das gelieferte Modell / declare under our own responsibility that the supplied model of

Servoerstärker mit Sicherheitsfunktion ECOVARIO® 616 xR-xx-xxx-xxx
Servo amplifier with safety function

den Anforderungen der
EG-Maschinenrichtlinie 2006/42/EC complies with
entspricht.
EC Machinery Directive 2006/42/EC

Hierfür wurden die folgenden harmonisierten Normen angewendet / For this, the following harmonized standards were applied:

**EN 60204-1:2006, EN ISO 13849-1:2008
EN 61800-5-2:2007, EN 61800-5-1 / VDE160
EN 61800-3:2004**

Das Produkt ist nach Artikel 2, Buchstabe c der Richtlinie 2006/42/EG als Sicherheitsbauteil definiert. Es ist ausschließlich für den Einbau in eine Maschine bestimmt. Die Inbetriebnahme ist so lange untersagt, bis die Gesamtmaschine, in die das Produkt eingebaut werden soll, den Bestimmungen der Richtlinie 2006/42/EG entspricht.

The products are defined as safety components according to directive 2006/42/EC. They are exclusively intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conform to the directive 2006/42/EC.

Die Sicherheitshinweise der Betriebsanleitung sind zu beachten.

The safety instructions of the manual are to be considered.

Ort, Datum der Ausstellung
(Place and date of issue)

Geschäftsführer
(General Manager)

Dokumentationsverantwortlicher
(Responsible for documentation)

Jena, 07.01.2013

Dipl.-Ing. (FH) Stephan Preuß

Dipl.-Ing. Gerald Bobe

4 Technical Data

4.1 Equipment

Features:

- ⌚ Supply voltage range from 200 to 528 V_{AC} 3-phase
- ⌚ Integrated support for 1Vp-p SinCos encoder, incremental encoder
- ⌚ Integrated support for BISS B, BISS C or HIPERFACE protocol
- ⌚ Integrated encoder emulation
- ⌚ Support for second feedback input
- ⌚ Internal brake resistor; external brake resistor connector.

Safety:

- ⌚ Integrated Safe Torque Off (STO) function according to EN 61800-5-2 SIL 2
- ⌚ Sufficient isolation distances / creepage distances for safe galvanic isolation according to EN 61800-5-1 between the supply connectors / motor connectors and the signal electronics.
- ⌚ Overvoltage detection, short-circuit protection, phase failure supervision
- ⌚ Temperature monitoring of the servo amplifier and of the motor
- ⌚ Motor overload protection: I²t monitoring.

Parameterization:

- ⌚ Commissioning software ECO Studio with wizard functions.

Controller data:

- ⌚ Digital current, velocity, and position control with position, speed and torque limiting, minimum cycle time for current control: 62,5 µs
- ⌚ Digital filter functions effective on resonant loads
- ⌚ Parameterisable velocity profiles with jerk limiting
- ⌚ 256 motion profiles storable.

In-/outputs:

- ⌚ 8 digital inputs per axis, includes 1 Enable input
- ⌚ 3 digital outputs per axis, includes 1 Ready output
- ⌚ 1 STO input per axis
- ⌚ 1 STO output contact per axis.

Field bus interfaces (dependent on the selected option):

- ⌚ CANopen
- ⌚ EtherCAT
- ⌚ Profibus DP
- ⌚ Profinet (under preparation).

4.2 Rated data of the power stage

Table 4.1: Rated data of the power stage, AC supply at X6

Symb.	Rated data	Unit		
			616 AR	616 DR
3-phase AC supply				
U_{Netz}	Rated supply voltage at AC input connector X6	V_{AC}	3~ 400 (200 ... 528 V)	3~ 400 (200 ... 528 V)
f_{N}	Line frequency	Hz	49 – 61	49 – 61
S_{N}	Rated installed load	kVA	8,2	8,2
P_{VN}	Rated losses	W	280	280
U_{ON}	Rated output voltage ¹⁾	V_{AC}	390	390
I_{ON}	Rated output current ⁴⁾ total	A_{RMS}	3~ 8	3~ 8 ³⁾
P_{ON}	Rated output power ¹⁾ total	W	5400	5400 ³⁾
Losses if diverging from nominal load: $P_v = P_{v0} + P_{vi} + P_{vd}$				
P_{v0}	Basic losses	W	t.b.d.	t.b.d.
P_{vi}/I_0	Current-dependent losses per A	W/A	t.b.d.	t.b.d.
P_{vd}/P_0	Output power-dependent losses per 100 W	W/100 W	t.b.d.	t.b.d.
Power stage				
I_{OP}	Peak output current ²⁾	A_{RMS}	3~ 16	3~ 16 ³⁾
U_{BUSN}	Rated DC link voltage	V_{DC}	560	560
U_{BUSD}	Max. DC link voltage	V_{DC}	850	850
U_p	Overvoltage trip	V_{DC}	850	850
C_L	DC link capacity	μF	470	470
$E_{\text{N-P}}$	Regenerated capacity	Ws	96	96
$R_{\text{B EXT}}$	External ballast resistor	Ω	40	40
$P_{\text{BP EXT}}$	Impulse power ext. ballast resistor	kW	17	17

- 1) The data refers only to the internal data of the servo amplifier. Modifications of the input voltage due to line supply fluctuations are not taken into consideration. That means that with 15 % less input voltage the output data (U_{ON} , P_{ON}) on X5 have to be reduced by 15 %. For motors with a low inductivity the motor dimensioning for the maximum velocity should be 25% to 50% below the specified voltages (otherwise very high ripple current). For motors with a high inductivity even a higher reduction might be required in order to achieve an acceptable dynamic performance.
At a heat sink temperature of more than 75 °C or at an ambient temperature of more than 40°C the power stage is switched off.
- 2) The DC link connection (X4) has no inrush-current limiting. Therefore appropriate circuits have to be integrated in the central power supply. The power supply also has to be resistant against regenerated energy. It must regulate the DC link voltage during dynamic operation under the limit U_p . If the regenerating energy (deceleration of the drive) is higher than the energy consumed by all units connected to the DC bus, the power supply must have a load circuit.
- 3) For the 2-axis servo amplifier ECOVARIO 616 DR the sum of the currents of both axes is listed here. The sharing to the axes can be parameterized.
- 4) Ambient conditions for cabinet dimensioning. The losses P_{vn} refer to nominal operation with I_{ONenn} and the maximum output power P_{DC} . In case of deviations the losses can be estimated as shown here.

4.3 General technical data

Table 4.3: General technical data, control signals

No.		Control signal	Unit	
616 A	616 D			
1	1	24 V supply (current draw without outputs)	V	24 ±10 %
			A	0.8
8	16	Digital control signal inputs	V	0 ... 36 (Switching level: L->H: 11 V; H->L: 7 V acc. to IEC 61131-2 type 3)
			mA	10 (at 24 V)
3	6	Digital control signal outputs	V	24
			A	0.5

Table 4.4: General technical data, external fuses

	616 AR	616 DR
AC supply	16 A (characteristic C)	16 A (characteristic C)
Note: When the device is used in an UL environment the overcurrent protection equipment has to comply to UL Class RK5 or UL489!		
24 V supply	max. 12 A (fast)	
external ballast resistance (not accessory resistors DPRxx-xxx) ¹⁾	t.b.d.	t.b.d.

1) The accessory ECOVARIO® resistors DPRxx-xxx are intrinsically safe and therefore do not have to be fused.

Table 4.5: General technical data, ambient conditions

Ambient conditions			
ECOVARIO® is designed for ambient conditions of class 3K3 following EN 50178.			
Symb.	Condition	Unit	
T _A	Ambient temperature during operation with nominal load	°C	5 – 40
	Degree of humidity (not condensing)	% R.H.	5 – 85
p	Air pressure	mbar	860 – 1060
	Cooling		the closed cubicle has to be sufficiently ventilated.
h	Installation altitude	m	up to 1 000 without restriction of power
	Installation position		The technical data refer to a vertical position.
	Protection class		IP20

Table 4.6: General technical data, dimensions and weight

Dimensions and weight	Unit	ECOVARIO® 616
Dimensions w x h x d	mm	82 x 330 x 225
Weight of unit	kg	4.0

4.4 Order key

Table 4.7: Order key ECOVARIO® 6xx

ECOVARIO®	x	xx	x	x	-	x	x	-	xxx	xxx
No. of parameter set (three digits)										
No. of firmware (three digits)										
Approvals										
A: CE, standard design										
B - I: CE, special design										
J: CE, UL, standard design (UL approval under preparation)										
K - Z: CE, UL, special design (UL approval under preparation)										
Type of field bus										
A: CAN + RS485 + encoder emulation										
F: CAN + RS485 + PROFIBUS DP-V0										
K: CAN + Ethernet + RS485										
B: CAN + RS232 + encoder emulation										
G: CAN + RS232 + PROFIBUS DP-V0										
L: CAN + Ethernet + RS232										
P: CAN + EtherCAT® + RS485										
Q: CAN + EtherCAT® + RS232										
Options										
R: Safety function „Safe torque off“ (STO)										
N: no option										
Supply										
A: 3-phase AC; 1-axis power stage										
D: 3-phase AC; 2-axis power stage										
Current rating (rms for 5 s)										
16: max. 16 A										
Voltage rating (DC bus)										
6: max. 600 V										
Name of the unit										

Example ECOVARIO® 616 DR-AA-000-000:

ECOVARIO® servo amplifier with:

- ⌚ max. 600 V_{DC} DC link voltage
- ⌚ max. 16 A output current (total)
- ⌚ AC supply 3-phase, 2-axis power stage
- ⌚ Safety function „STO“
- ⌚ CAN interface + RS485 interface
+ encoder emulation
- ⌚ CE approval, standard design

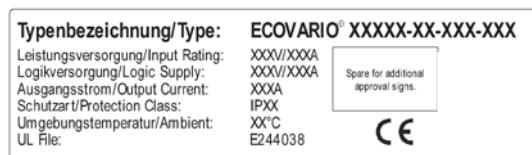


Fig. 4.1: Name plate ECOVARIO®, dimensions 70 x 20 mm

4.5 Suitable types of motors

With ECOVARIO® 6xx servo amplifiers various types of motors can be operated. Rotative and linear 3-phase motors of the motor series ECOSPEED and ECOLIN® as DC motors can be driven. The motors must be equipped with encoders for commutation and for position and speed control. Incremental encoders, SIN-COS encoders and absolute encoders can be evaluated.

It is **not** possible to drive motors with resolvers as measuring system.

The technical data in this manual refer exclusively to the servo motors mentioned in chap. 4.4.1 and 4.4.2. If you want to drive DC motors with ECOVARIO® please contact our technical support (see <http://www.jat-gmbh.de/engl/service/service.html>)

4.5.1 ECOSPEED motors



The motor series 60C, 80C, 110C and 150C contain rotative, 3-phase low-pole servo motors with holding torques between 0.5 and 11 Nm. For technical data and accessories for the motors see our product catalogue „ECOVARIO®-/ECOMPACT®-/ECOSTEP® Drives“ or our web site www.jat-gmbh.de

Fig. 4.1: Motor series 60C, 80C and 110C

4.5.2 Direct linear motors ECOLIN®



Series SLM contains iron core, 3-phase, encoder commutated synchronous linear motors from 220 to 1450 N peak force. Series SLME provides ironless direct linear motors from 150 N to 400 N peak force.

For technical data and accessories of the motors see our product catalogue „ECOVARIO®-/ECOMPACT®-/ECOSTEP® Drives“ or our web site www.jat-gmbh.de.

Fig. 4.2: Direct linear motors SLM, SLME

4.5.3 DC servo motors

DC motors are not part of the delivery range of the Jenaer Antriebstechnik GmbH but can be operated with ECOVARIO® amplifiers. In this case we recommend strongly to contact our technical service. The ECOVARIO® supports DC motors with brushes as well as brushless DC servo motors in conjunction with RS422 compatible standard encoders.

5 Installation

5.1 Mounting

5.1.1 Important notes / Informations importantes

- ➲ Make sure that transport and storage did no damage to the units. /
Veillez à ce que le matériel n'a pas subi de dommages lors du transport ou du stockage.
- ➲ The ambient air must not be polluted by dust, greases, aggressive gas etc. Eventually appropriate countermeasures have to be taken (installation of filters, frequent cleaning). /
L'air de ventilation ne doit pas être souillé (Poussière, graisses, gaz agressifs, etc.). Le cas échéant prendre les mesures nécessaires intégration de filtres, nettoyage régulier)
- ➲ The ECOVARIO with STO function has to be mounted in a cabinet which conforms to protection class IP54 (or in a comparable environment) /
L'ECOVARIO avec fonction STO doit être monté dans une armoire électrique ou un environnement équivalent qui présente un degré de protection minimum IP54.
- ➲ Depending on the power losses an appropriate ventilation should be provided /
Il faut prévoir une ventilation suffisante pour compenser les pertes par échauffement.
- ➲ Observe the mounting spaces. / *Les espaces libres doivent être respectés.*
- ➲ Use 60/75°C copper wire only. The accessory cables provided by Jenaer Antriebstechnik fulfill these requirements. /
N'utiliser que des câbles à âme cuivre qui résistent à une température de 60/75°C. Les câbles proposés par Jenaer Antriebstechnik dans son programme d'accessoires, respectent ces exigences.
- ➲ At installation locations with permanent vibrations or shocks damping measures should be taken into consideration. /
Dans des implantations exposées à des vibrations continues ou des chocs, il faut vérifier si des mesures de réduction des phénomènes vibratoires doivent être prises.

5.1.2 Dimensions

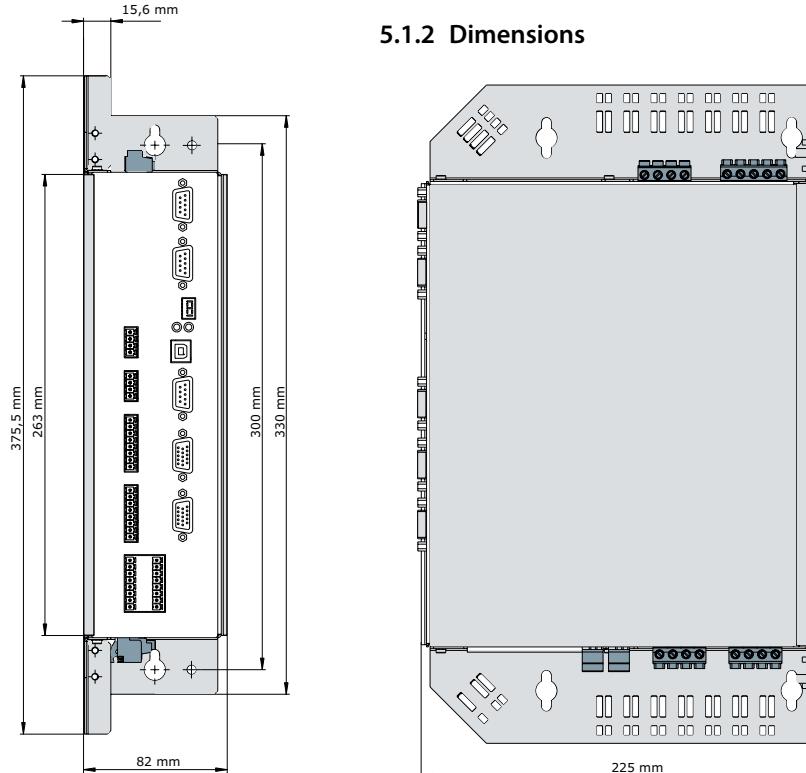


Fig. 5.1: Dimensions of ECOVARIO® 616 [mm], upper shield optional

5.1.3 Assembly

Basically, ECOVARIO® 6xx is intended for **vertical** mounting (motor connectors X5A, X5B on the bottom). In this mounting position devices can be operated with built-in fan unit at ambient temperatures of up to 40°C. The ECOVARIO 6xx with STO function has to be mounted in a cabinet which conforms to protection class IP54 (or in a comparable environment).

Cable clamps and side metal sheets assure that the connecting cables are laid EMC conform by connecting the cable shield extensively to chassis earth.

The shields with cable clamps shown in fig. 5.3 are available as accessories (see table 9.1). It is important that the air flow is not disturbed by components above or below the servo amplifiers. The distance between the servo amplifiers has to be at least 3 mm.

The surface of the mounting plate has to be conductive (e.g. zinc plated). Varnished mounting plates must not be used.

INFO / INDICATION	Make sure that no heat accumulation can occur in the cabinet.	Assurez une ventilation forcée suffisante de l'armoire électrique.
	The servo amplifier switches off at too high temperatures in the cabinet (Error D02 or D03, => p. 57, Motor without torque).	L'amplificateur de servomoteur se coupe en cas de température trop élevée dans l'armoire électrique (Erreur D02 ou D03, => p. 57, Moteur sans couple).

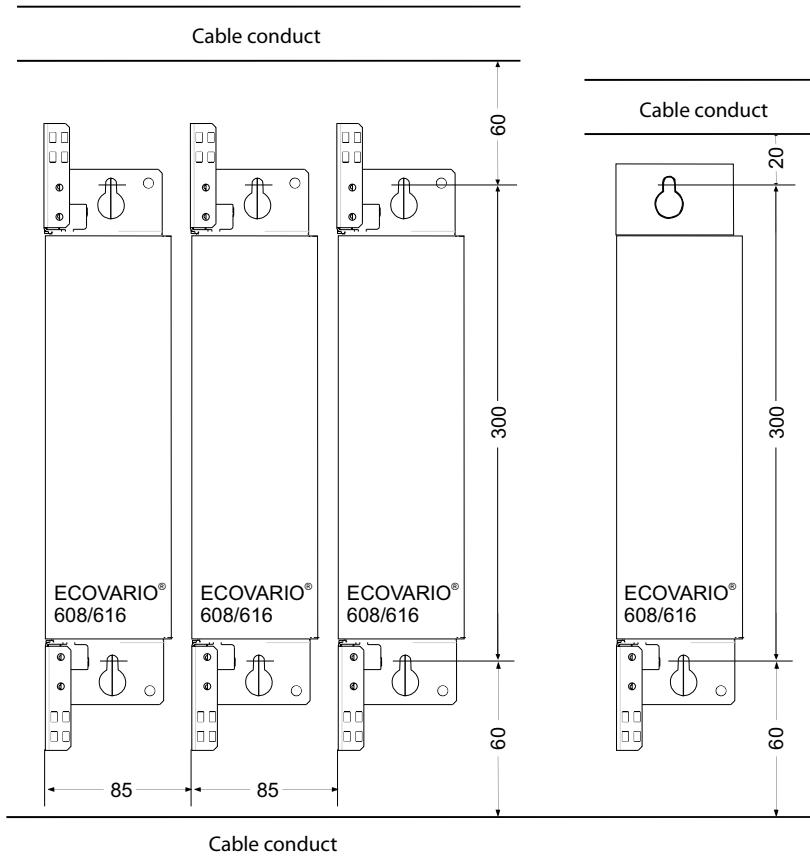


Fig. 5.3: Mounting dimensions cabinet, width, minimum spacing [mm]

To calculate the minimal mounting depth (g. 5.4, dim A) the form of the connectors (cable outlet direction) and the minimum bending radii of the connecting cables at the sub-D connectors have to be regarded.

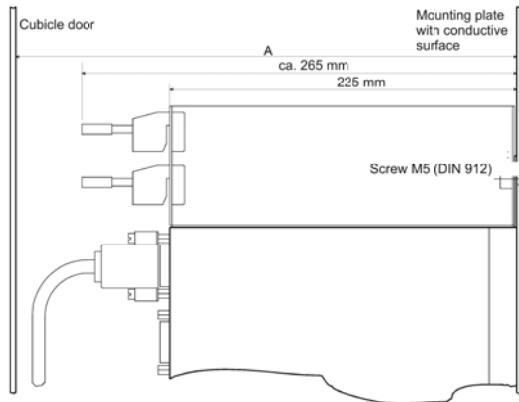


Fig. 5.4: Mounting dimensions cabinet, depth [mm]

5.2 Electrical Installation

5.2.1 Important notes

All installation work may only be carried out if the machine or plant is not live and protected against restart.

Never exceed the maximum rated voltage at the X6 connector!

U_{Netz} max. 3~ 480 V_{AC} (+10 %)

The guarding of the AC supply and the 24 V logic voltage should be carried out by the user.

Servo amplifier and motor have to be properly grounded. The protective earth conductor must have at least the same diameter as the supply cables. The servo amplifier should be mounted onto a conductive (not varnished) metal mounting plate.

When the device is used in an UL environment: ECOVARIO 616 xx-xJ-xxx xxx is suitable for use on a circuit capable of delivering not more than 5 kA_{RMS} symmetrical amperes, 240 VAC maximum when protected by (DIQV) listed circuit breaker rated 240 VAC and 16 A maximum.

5.2.2 EMC compliant installation

The supply connection of the machine should be equipped with an appropriate RFI suppression filter. Always use shielded cables. To connect the shield as effective as possible to earth use the original ECOVARIO® shield set (s. table 9.1 „Original accessories ECOVARIO®“).

Metal parts in the cabinet have to be interconnected extensively and be conductive regarding HF. Used relays, contactors, solenoids etc. have to be protected against overvoltage. Supply cables and motor cables must be laid in a proper distance of control cables.

5.2.3 Connection diagram

Note: The protective earth connection (PE) of the ECOVARIO® can be implemented in two different ways and thus complies to EN 60204-1, Chap. 8.2.8:

- ⦿ via the stud at the bottom of the housing with a wire gauge of min. 10mm²
- ⦿ via two PE wires independent of each other with the power connection wire gauge of the device (1 at the supply, connector X6, the other at the stud at the bottom of the housing)

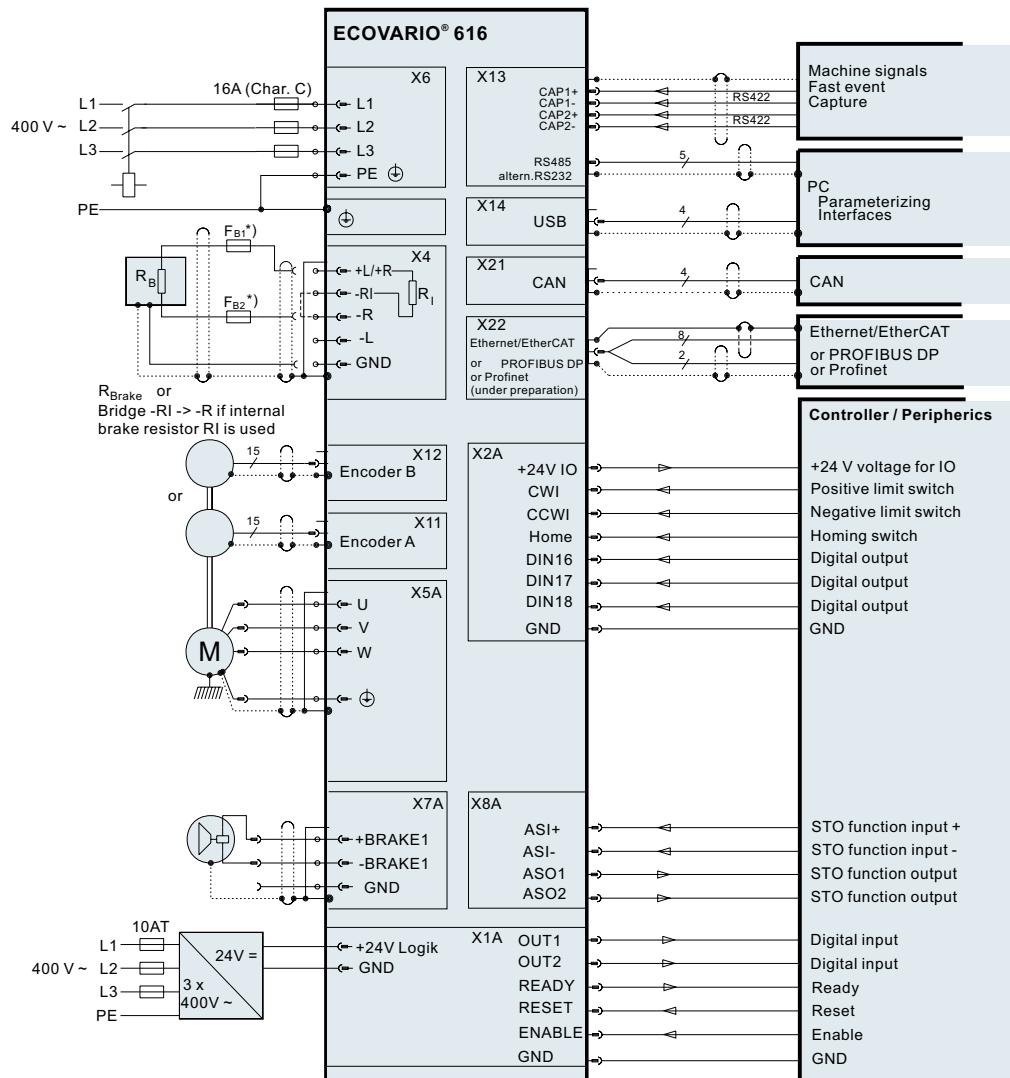


Fig. 5.5: Connection diagram 1-axis servo amplifier ECOVARIO® 616

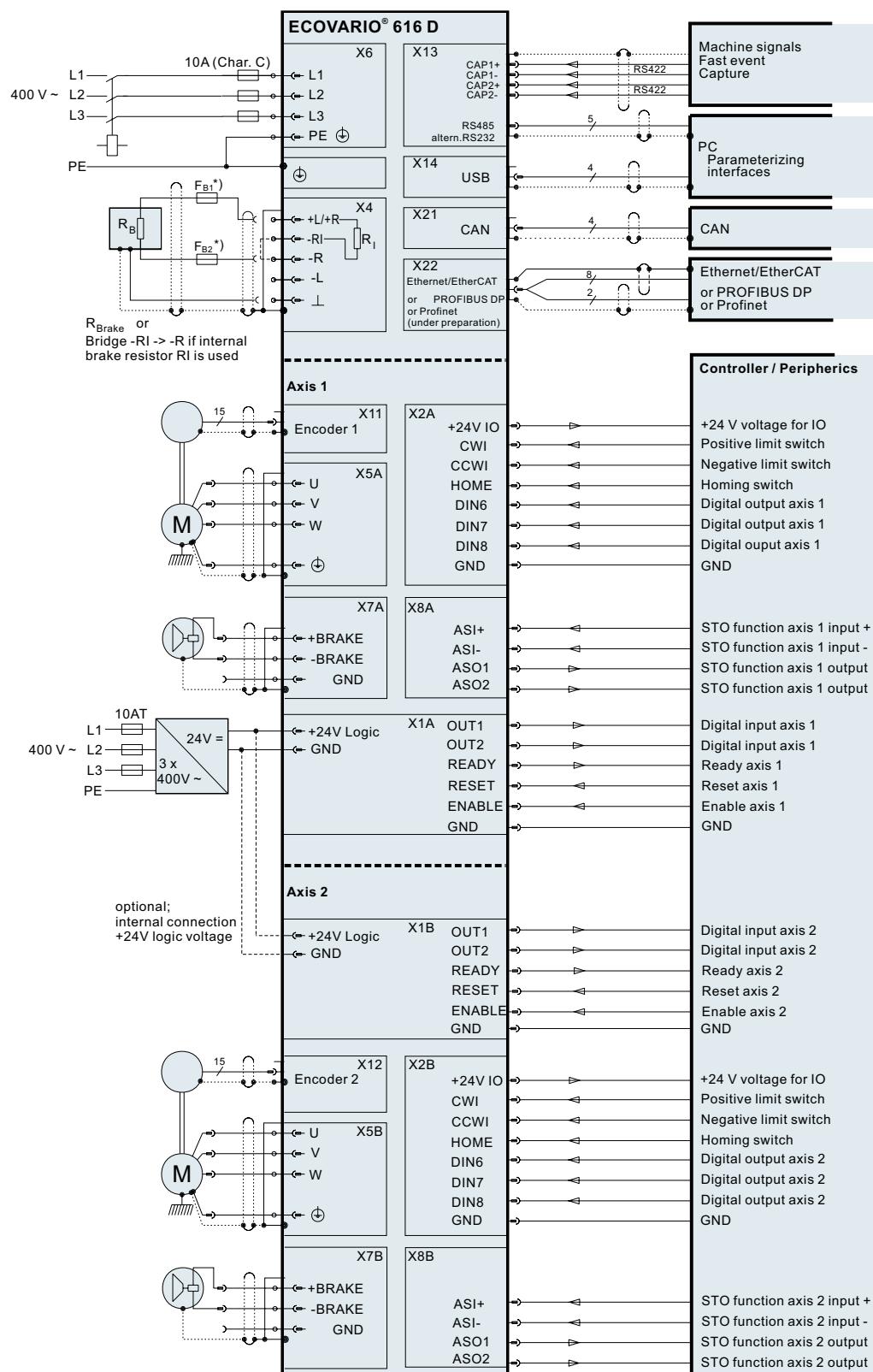


Fig. 5.6: Connection diagram 2-axis servo amplifier ECOVARIO® 616 D

5.2.4 Types of lines

The servo amplifiers series ECOVARIO® 6xx must only be connected 3-phase directly to 400 V_{AC} TN systems or TT systems with earthed neutral.

**NOTICE /
PRUDENCE**

Only 3-phase feed is possible! In case of 1-phase feed the power stage is switched off and the error D16 is displayed. The mains supply voltage has to be in the range 3~ 230V_{AC}-10% to 3~ 480V_{AC}+10% 50-60Hz, the feeding system must be grounded at the center. The voltage to ground must not exceed 300V_{RMS} because of the built-in noise suppression.

Seule une alimentation triphasée est possible, en alimentation monophasée, le défaut D16 coupe l'alimentation. La tension d'alimentation doit être de 3~ 230V_{AC}-10% jusqu'à 3~ 480V_{AC}+10% 50-60Hz, Le réseau d'alimentation doit avoir un centre à la terre. La tension à la terre ne pas dépasser 300V_{RMS} à cause de la protection contre les arcs intégrée.

5.2.5 Operation with residual current devices

In case of a fault to frame over the internal rectifier of a multi-phase driven servo amplifier the residual current may block the protective function of an AC sensitive or pulse current sensitive earth-leakage circuit breaker. Residual currents cause a pre-magnetization of the transformer core and thus increase the tolerance for residual currents.

To meet the requirements of EN 61800-5-1 we recommend therefore the use of the following earth-leakage circuit breakers depending on the application:

- ➲ universal RCDs (type B) in plant with 3-phase power system connection of the servo amplifiers (L1/L2/L3).

If the leakage current is too high it may lead to unintentional activation of the RCD even in faultless operation. High leakage currents may be caused by:

- ➲ capacitative compensating currents over the cable shields if the motor cables are very long
- ➲ simultaneous switch in of several servo amplifiers
- ➲ use of interference filters with high leakage current

Note: The leakage current of ECOVARIO®6xx is higher than 3.5 mA.

Measures to reduce the leakage current:

- ➲ use of EMC filters with low leakage current
- ➲ use of a 4 conductor filter in systems where there is a neutral
- ➲ avoidance of asymmetrical load of the phases; several 1 phase operated units should be shared equally between the three phases
- ➲ shielded motor cables should be as short as possible
- ➲ In plant with several servo amplifiers a sinusoidal filter should be used instead of single EMC filters.
- ➲ In plant with several servo amplifiers not all units should be switched on at the same time.

6 Interfaces

6.1 Overview

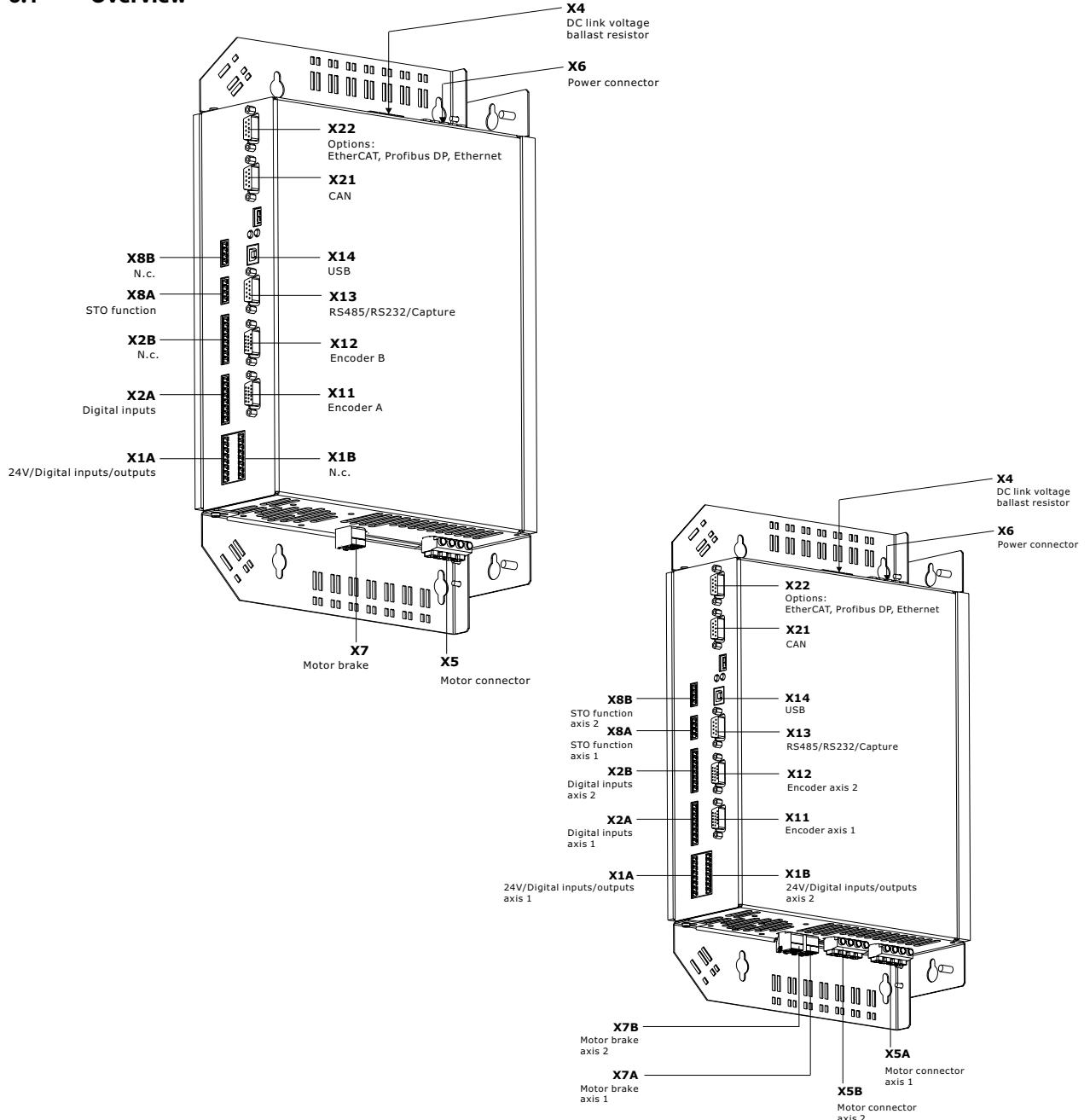


Fig. 6.1: Order of the interfaces of ECOVARIO® 616 (top) and ECOVARIO® 616 D (bottom)

On the next page, the available interfaces for all ECOVARIO®-6xx types are shown in an overview table. Subsequently, detailed descriptions of each interface with pin assignment and block diagram are provided.

For the interfaces X1 to X8 a mating connector set is available (see table 9.1 „Original accessories ECOVARIO®“). To simplify the handling all mating connectors are labelled.

Table 6.1: Overview of interfaces ECOVARIO 616, ECOVARIO 616 D

Order designation	CAN	EtherCAT	Ethernet	Profinet	RS485	RS232	USB	STO function	Encoder input A	Encoder input B	Encoder output	Digital inputs/outputs	Motor connect. axis 1	Motor connect. axis 2	Holding brake axis 1	Holding brake axis 2	AC power supply	Ballast resistor
ECOVARIO®616AN-AJ-000-000	X21				X13	X14		X11	X12	X22		X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-BJ-000-000	X21				X13	X14		X11	X12	X22		X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-AJ-000-000	X21				X13	X14	X8	X11	X12	X22		X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-BJ-000-000	X21				X13	X14	X8	X11	X12	X22		X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-FJ-000-000	X21			X22	X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-GJ-000-000	X21			X22	X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-FJ-000-000	X21			X22	X13	X14	X8	X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-GJ-000-000	X21			X22	X13	X14	X8	X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-KJ-000-000	X21		X22		X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-LJ-000-000	X21		X22		X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-KJ-000-000	X21		X22		X13	X14	X8	X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-LJ-000-000	X21		X22		X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-PJ-000-000	X21	X22			X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AN-QJ-000-000	X21	X22			X13	X14		X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-PJ-000-000	X21	X22			X13	X14	X8	X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616AR-QJ-000-000	X21	X22			X13	X14	X8	X11	X12			X5A	-	X7A	-	X6	X4	
ECOVARIO®616DN-AJ-000-000	X21				X13	X14		X11	X12	X22		X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-BJ-000-000	X21				X13	X14		X11	X12	X22		X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-AJ-000-000	X21				X13	X14	X8	X11	X12	X22		X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-BJ-000-000	X21				X13	X14	X8	X11	X12	X22		X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-FJ-000-000	X21			X22	X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-GJ-000-000	X21			X22	X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-FJ-000-000	X21			X22	X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-GJ-000-000	X21			X22	X13	X14	X8	X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-KJ-000-000	X21		X22		X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-LJ-000-000	X21		X22		X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-KJ-000-000	X21		X22		X13	X14	X8	X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-LJ-000-000	X21		X22		X13	X14	X8	X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-PJ-000-000	X21	X22			X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DN-QJ-000-000	X21	X22			X13	X14		X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-PJ-000-000	X21	X22			X13	X14	X8	X11	X12			X5A	X5B	X7A	X7B	X6	X4	
ECOVARIO®616DR-QJ-000-000	X21	X22			X13	X14	X8	X11	X12			X5A	X5B	X7A	X7B	X6	X4	

6.2 Control signals

6.2.1 X1A, X1B: Digital inputs and outputs, 24 V



INFO / INDICATION

The 2-axis device ECOVARIO 616 D has assigned the interface X1A to axis 1 and X1B to axis 2. In the 1-axis device ECOVARIO 616 X1B is not used.

Sur des appareils 2 axes ECOVARIO 616 D l'interface X1A est affecté à l'axe 1 et X1B à l'axe 2. Sur des appareils à 1 axe ECOVARIO 616 l'interface X1B n'est pas affectée.

Table 6.2: Pin assignment connector X1A/X1B

Signal	Pin	Description
OUT1	1	Digital output 1 $I_{O\max} = 0,5 \text{ A}$
OUT2	2	Digital output 2 $I_{O\max} = 0,5 \text{ A}$
READY	3	Ready $I_{O\max} = 0,5 \text{ A}$
RESET	4	Reset
ENABLE	5	Enable
GND	6	24-V ground
+24V	7	24-V supply
GND	8	24-V ground

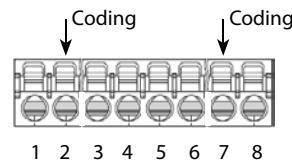


Fig. 6.2: Mating connector X1A/X1B:
Combicon MC 1,5/8-ST-3,81
CN2,7 BDNZX1
Phoenix No.: 17 55 40 2

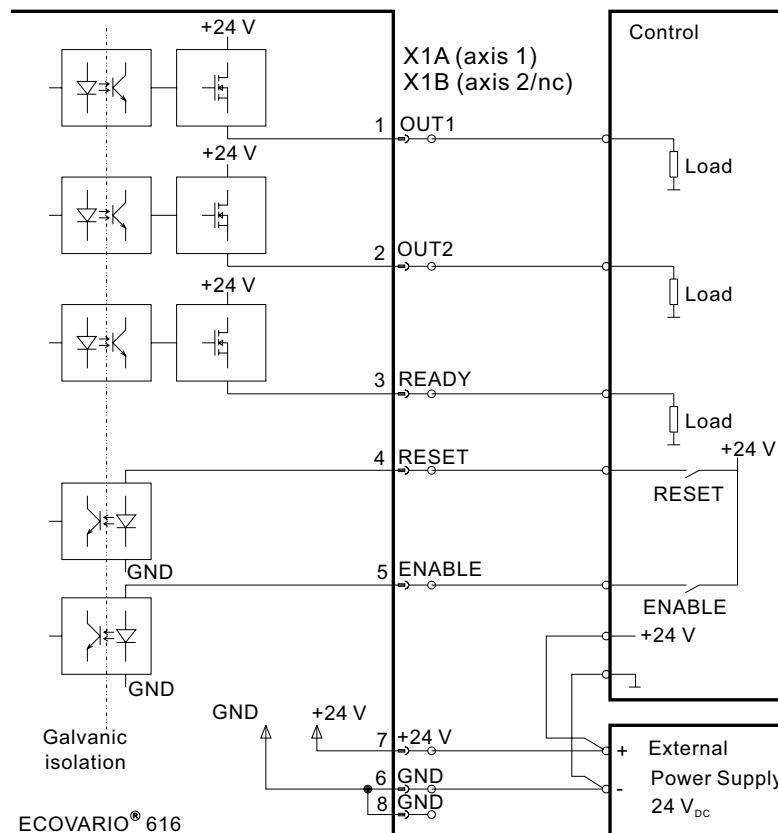


Fig. 6.3: Connector X1A/X1B: Circuit of the digital inputs and outputs axis 1 / axis 2

6.2.2 X2A, X2B: Digital Inputs



INFO

The 2-axis device ECOVARIO 616 D has assigned the interface X2A to axis 1 and X2B to axis 2. In the 1-axis device ECOVARIO 616 X2B is not used.

Sur des appareils 2 axes ECOVARIO 616 D l'interface X2A est affecté à l'axe 1 et X2B à l'axe 2. Sur des appareils à 1 axe ECOVARIO 616 l'interface X2B n'est pas affectée.

Table 6.3: Pin assignment connector X2A/X2B

Signal	Pin	Description	
+24V IO	1	24-V control voltage for I/O (internally connected between X2A and x2B)	
CWI	2	Positive limit switch	Switching threshold: L->H: 11 V H->L: 7 V acc. to IEC 61131-2 type 3
CCWI	3	Negative limit switch	
HOME	4	Homing switch	
DIN6	5	Digital input 6	
DIN7	6	Digital input 7	
DIN8	7	Digital input 8	
GND	8	24 V ground	

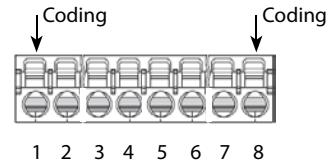


Fig. 6.4: Mating connector X2A/X2B
Combicon MC 1,5/8-ST-3,81 CN1,8
BDNZX2, Phoenix No.: 17 55 41 5

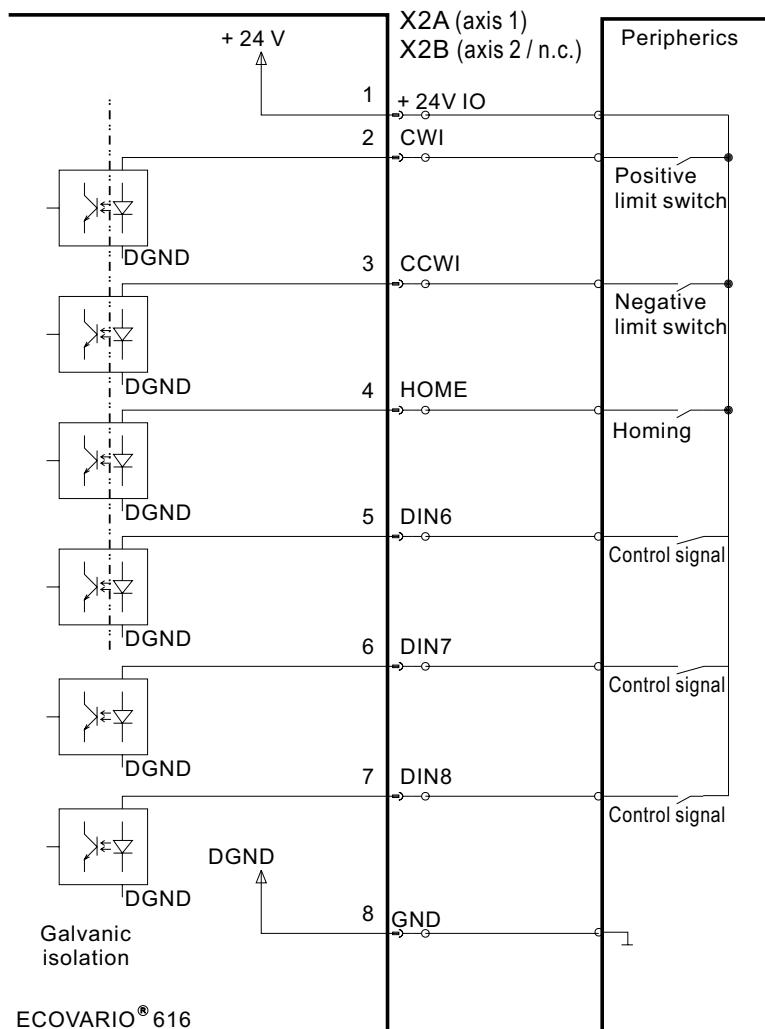


Fig. 6.5: Connector X2A/X2B: Circuit of the digital inputs axis 1 / axis 2

6.3 Power interfaces

6.3.1 X4: Ballast resistor

WARNING



Acute danger of life or risk of injury due to high voltages!

Up to 850 V DC voltage at the DC link clamps +L and -L. Never undo and redo electrical connections while they are live. After disconnection from the supply wait at least six minutes. Capacitors can still have dangerous voltages present.

Danger de mort ou danger de blessures par des tensions élevées!

Des tensions qui peuvent aller jusqu'à 400 V DC sont aux bornes +L et -L du circuit intermédiaire. Avant de connecter ou déconnecter, il faut absolument mettre hors tension. La tension résiduelle reste présente dans la charge des condensateurs jusqu'à 6 minutes. Attendez ce temps avant de retirer la prise.

The connector X4 at the top of the housing can be used for connecting a ballast resistor.



Fig. 6.6: Mating connector X4:
GIC 2,5 HCV/5-ST-7,62,
Nr. 17 45 65 8 Phoenix

Ballast resistor

During braking energy is fed back and the DC link voltage increased.

If a drive is decelerated from speed ω_1 to speed ω_2 the energy difference E_{BR} is fed back.

$$E_{BR} = \frac{1}{2} J (\omega_1^2 - \omega_2^2) \quad (1)$$

The maximum regenerable energy E_{N-P} is calculated according to the following formula (2):

$$E_{N-P} = \frac{1}{2} C_L (U_{BUSH}^2 - U_{BUN}^2) \quad (2)$$

(see chap. 4.1 „Rated data of the power stage“). A ballast resistor will prevent the DC link voltage from rising up to the limit of the overvoltage trip.

ECOVARIO® 616 and 616 D are equipped with a built-in ballast resistor. For using the internal ballast resistor a bridge between -R and -RI is required. Alternatively an external ballast resistor can be connected.

The ECOVARIO® accessory ballast resistors DPRxx-xxx are intrinsically safe, therefore the supply conductors do not have to be fused. Using other ballast resistors both supply conductors have to be equipped with fuses!

Table 6.5: Pin assignment connector X4

Signal	Pin	Description
+	1	GND
+L/+R	2	+ DC link/ + Ballast resistor
- L	3	- DC link
- R	4	- Ballast resistor
- RI	5	- Internal ballast resistor

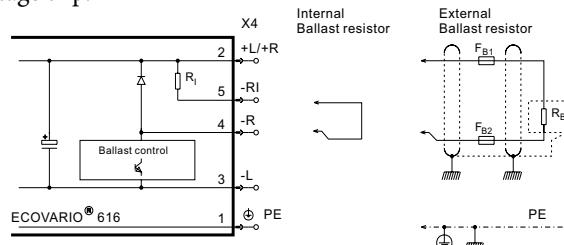


Fig. 6.7: X4: Circuit load resistor and DC link

Table 6.6: Maximum values of ballast circuit

	Ω	
External ballast resistor	40	
Ovvoltage trip	V_{DC}	850
Switch-off threshold ballast	V_{DC}	820
Switch-off threshold ballast	V_{DC}	800
Continuous power internal load circuit	W	30
Continuous power external load circuit	kW	max. 5
Impulse power external load circuit	kW	17

*) For power specifications for the available ECOVARIO® accessory ballast resistors DPRxx-xxx cf. chapter 9.3

Ballast circuit threshold

The switch-on and switch-off thresholds for the ballast resistor shown in Table 6.6 can be reduced by programming.

The objects 0x2701:09 (switch-on threshold) and 0x2701:10 (switch-off threshold) are used for this. The continuous power of the ballast resistor can be set in the objects 0x2701:11 (power) and 0x2701:12 (Ohm value). For more details please refer to the manual „Object Dictionary ECOVARIO®, ECOSTEP®, ECOM-PACT®“.

6.3.2 X5A/X5B: Motor connection

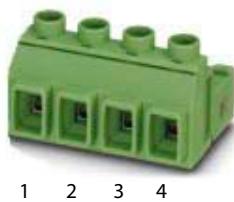


Tabelle 6.7: Pin assignment connector X5A, X5B

Signal	Keying	Pin	3-phase motor
—	—	1	GND
Phase U	U	2	Connection U
Phase V	V	3	Connection V
Phase W	W	4	Connection W

Fig. 6.8: Mating connector X5A/X5B:
GIC 2,5 HCV/4-ST-7,62, Nr. 17 45 64 5 Phoenix

Using long cables (>25 m) the losses rise strongly due to the cable capacity. Therefore with long cables the technical data of the drive are reduced, further too high leakage currents can lead to inadvertent activation of the circuit breakers (see chap. 5.2.5 „Operation with residual current devices“).

For all available types of cable see chap. 9.5.



Fig. 6.9 X5: Example for connection with standard cable, e.g.
MOT-61-133-523-xxx

Connection of motor and brake with one cable

The insulated meshes of the overall shield and of the shield of the brake cable must in any case be connected to the chassis earth or protective earth. Due to improper grounding or free mesh dangerous voltages may occur at the shield.

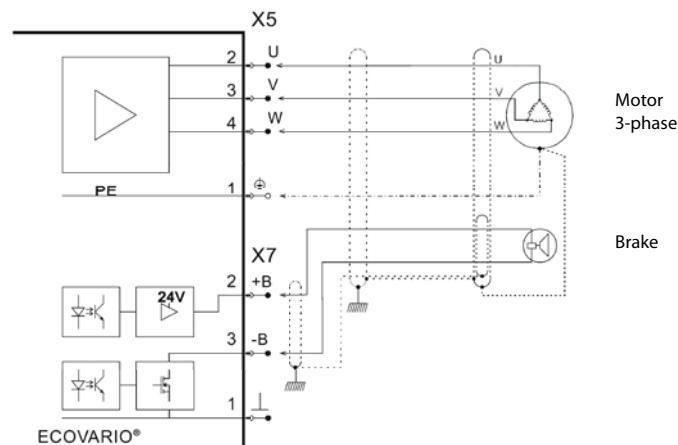


Fig. 6.10: Example for connection with standard cable MOT63-134-523-xxx

6.3.3 X6 Power Connection

**WARNING /
AVERTISSEMENT**



Acute danger of life or risk of injury due to high voltages!

Up to 528 V AC voltage at X6. Never undo and redo electrical connections while they are live. After disconnection from the supply wait at least six minutes. Capacitors can still have dangerous voltages present.

Danger de mort ou danger de blessures par des tensions élevées!

Des tensions qui peuvent aller jusqu'à 528 V AC sont au connecteur X6. Avant de connecter ou déconnecter, il faut absolument mettre hors tension. La tension résiduelle reste présente dans la charge des condensateurs jusqu'à 6 minutes. Attendez ce temps avant de retirer la prise.

Tabelle 6.8: Pin assignment connector X6

Signal	Pin	Description
L3	1	Phase L3
L2	2	Phase L2
L1	3	Phase L1
PE	4	PE conductor



Fig. 6.11: Mating connector X6 (female): GMSTB 2,5 HCV/4-ST-7,62, Nr. 1714294 Phoenix

**INFO /
INDICATION**



Only 3-phase feed is possible. In case of 1-phase feed the power stage is switched off and the error D16 is displayed. The mains supply voltage has to be in the range 3~230V_{AC}-10% to 3~480V_{AC}+10% 50-60Hz, the feeding system must be grounded at the center. The voltage to ground must not exceed 300V_{eff} because of the built-in noise suppression.

Seule une alimentation triphasée est possible, en alimentation monophasée, le défaut D16 coupe l'alimentation. La tension d'alimentation doit être de 3~230V_{AC}-10% jusqu'à 3~480V_{AC}+10% 50-60Hz, Le réseau d'alimentation doit avoir un centre à la terre. La tension à la terre ne pas dépasser 300V_{RMS} à cause de la protection contre les arcs intégrée.

Inrush-current limiting

The peak inrush-current is limited to maximum 50 A by a temperature-depending resistor. After recharging the DC link the limiting resistor is bridged by a relay contact and thus can cool down during normal operation.

Inbetween two switch-on and switch-off sequences must be a delay of at least 10 s. A cyclic switching on and off the servo amplifier by the line contactor is not allowed. During switching on and off the supply voltage the servo amplifier should be in the „ready to switch-on“ state.

Line filter

The user has to make sure to conform to the regulations of the EMC Directive (2004/108/EEC) by appropriate measures (external line filter, EMC compliant wiring).

Fusing

For external fusing please consider the general technical data (cf. chapter 4.2).

When the device is used in an UL environment: ECOVARIO 616 xx-xJ-xxx xxx is suitable for use on a circuit capable of delivering not more than 5 kA_{RMS} symmetrical amperes, 240 VAC maximum when protected by (DIQV) listed circuit breaker rated 240 VAC and 16 A maximum.

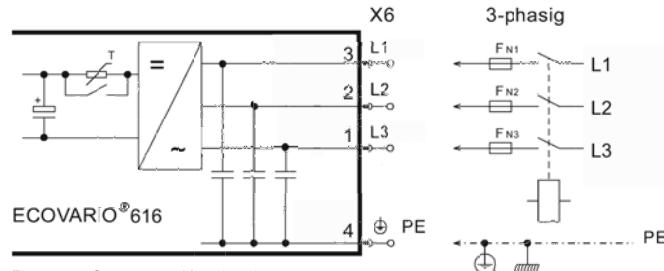


Fig. 6.12: Connector X6, circuit

6.3.4 X7A, X7B: Brake



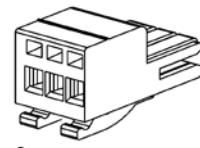
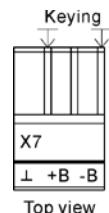
INFO / INDICATION

The 2-axis device ECOVARIO 616 D has assigned the interface X7A to axis 1 and X7B to axis 2. In the 1-axis device ECOVARIO 616 X7B is not used.

Sur des appareils 2 axes ECOVARIO 616 D l'interface X7A est affecté à l'axe 1 et X7B à l'axe 2. Sur des appareils à 1 axe ECOVARIO 616 l'interface X7B n'est pas affectée.

Table 6.9: Pin assignment connector X7A, X7B

Signal	Sign	Pin	
GND	⊥	1	
Brake +	+B	2	$I_{\max \text{ peak}} = 1 \text{ A}$
Brake -	-B	3	$I_{\max \text{ Dauer}} = 0.5 \text{ A}$



If the control mode is choppered the holding current is reduced after pulling the brake.

Fig. 6.13: Mating connector X7A, X7B:
ZEC 1,0/3-ST-3,5 C1,3 R1,3 19 98 20 5 Phoenix

If the current consumption of the brake is higher, the static version is suitable for connecting a relay (cf. fig. 6.15).

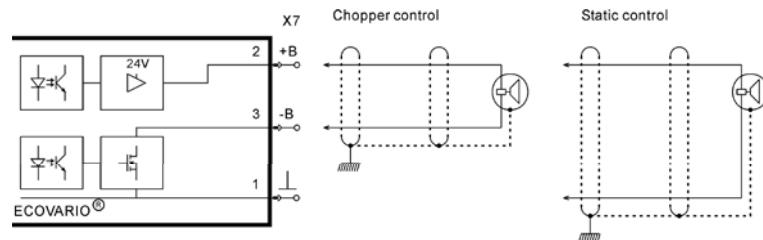


Fig. 6.14: Brake connection, brake current $I_{\max} < 0.5 \text{ A}$

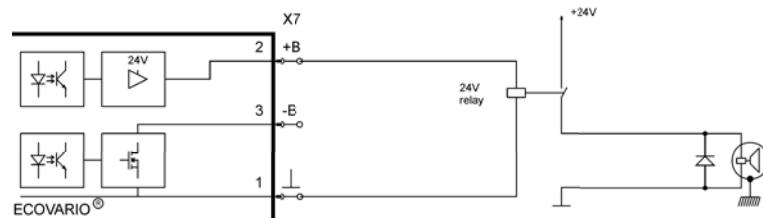


Fig. 6.15: Brake connection, brake current $I_{\max} > 0.5 \text{ A}$

6.4 Safety functions

6.4.1 Restart lock / Safe torque off (STO)

The versions ECOVARIO® 616 xR-xx-xxx xxx contain the safety function Safe Torque Off (STO) according to EN 61800-5-2 and EN ISO 13849-1: 2006. The function also conforms to an uncontrolled stop according to category 0 of IEC 60204-1. The safety function is used to prevent the drive from starting indeliberately.

**WARNING /
AVERTISSEMENT**



The „Safe Torque Off“ function does not switch off the power supply of the DC link voltage of the servo amplifier. Thus, maintenance of electrical parts of the motor or the servo amplifier may only be carried out after the drive system has been disconnected from the power supply.

La fonction „Safe Torque Off“ ne coupe pas la tension du circuit intermédiaire de l'amplificateur de servomoteur. Pour ces raisons, des travaux d'entretien sur les parties électriques de l'amplificateur ou sur le moteur ne doivent être réalisés qu'après avoir coupé l'alimentation électrique du système d'entrainement.

The safety function „Safe Torque Off, STO“ is implemented together with the standard functionality of the ECOVARIO® with only a few components related exclusively to the safety function.

The STO function meets the requirements to SIL2 or PLd respectively according to EN 61800-5-2 or EN ISO 13849-1.

The function is established by means of the circuitry shown in Fig. 6.17. The signals are lead to the connector X8. Further, the signals Enable and Ready of connector X1 are used.



INFO

The 2-axis device ECOVARIO 616 D has assigned the interface X8A to axis 1 and X8B to axis 2. In the 1-axis device ECOVARIO 616 X8B is not used.

Sur des appareils 2 axes ECOVARIO 616 D l'interface X7A est affecté à l'axe 1 et X7B à l'axe 2. Sur des appareils à 1 axe ECOVARIO 616 l'interface X7B n'est pas affectée.

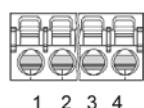


Fig. 6.16:
Mating connector X8A/X8B:
MC 1,5/4-ST-3,81 BD: 1-4,
Phoenix No.: 18 40 722

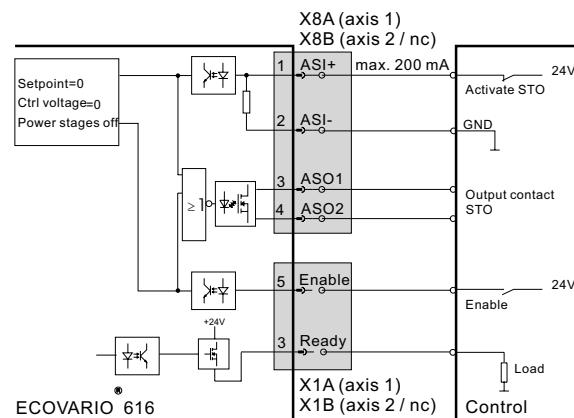


Table 6.10: Pin assignment connector X8A, X8B

Signal	Pin	Description
ASI+	1	Trip contact STO +
ASI-	2	Trip contact STO -
ASO1	3	Message contact STO
ASO2	4	Message contact STO

Table 6.11: Signals used for STO on connector X1A; X1B

Signal	Pin	Description
Ready	3	Ready for operation
Enable	5	Enable operation

Using the STO function

The internal logic circuit safely switches off the power stages of the servo amplifier and zeroes the demand values. The inputs and outputs can be connected to an external safety PLC.

Advantage: The DC link rests charged. Only low voltages are switched, the extend of wiring and components is reduced.

Implementation of the STO function

A block diagram of the components which contribute to the STO function is shown in Fig. 6.18. For 2-axis servo amplifiers the function is implemented for both axes in the same way.

Channel A:

If a voltage of +24V is applied between the inputs ASI+ and ASI- and to the Enable input (channel B) and software enable is set an electronic switch is switched on via an optocoupler and the servo amplifier operates normally. If the voltage at the input ASI+ and ASI- decreases the STO function becomes effective by switching off the 15V voltage of the power stage. A restart is only possible if a 24 V voltage is applied again between the inputs ASI+ and ASI- (channel A) and to the Enable input (channel B), software enable is set and the error status of the servo amplifier has been reset.

The safe status of the restart lock (channel A) is signalled by the contact between ASO1 and ASO2 (if the drive is blocked the contact is closed). The signal can be fed to a higher-level safety PLC and can e.g. be used for enabling a door lock.

Channel B:

If the 24 V voltage is not applied to the Enable input, the power stage is switched off via a FPGA. The STO function protects against a restart. A restart is only possible if a +24 V voltage is applied again between the inputs ASI+ und ASI- (channel A) and to the Enable input (channel B), software enable is set and the error status of the servo amplifier has been reset. The safe status of the restart lockout (channel B) is signalled via the Ready output (if the restart lockout is active, the level at the Ready output is 0 V).

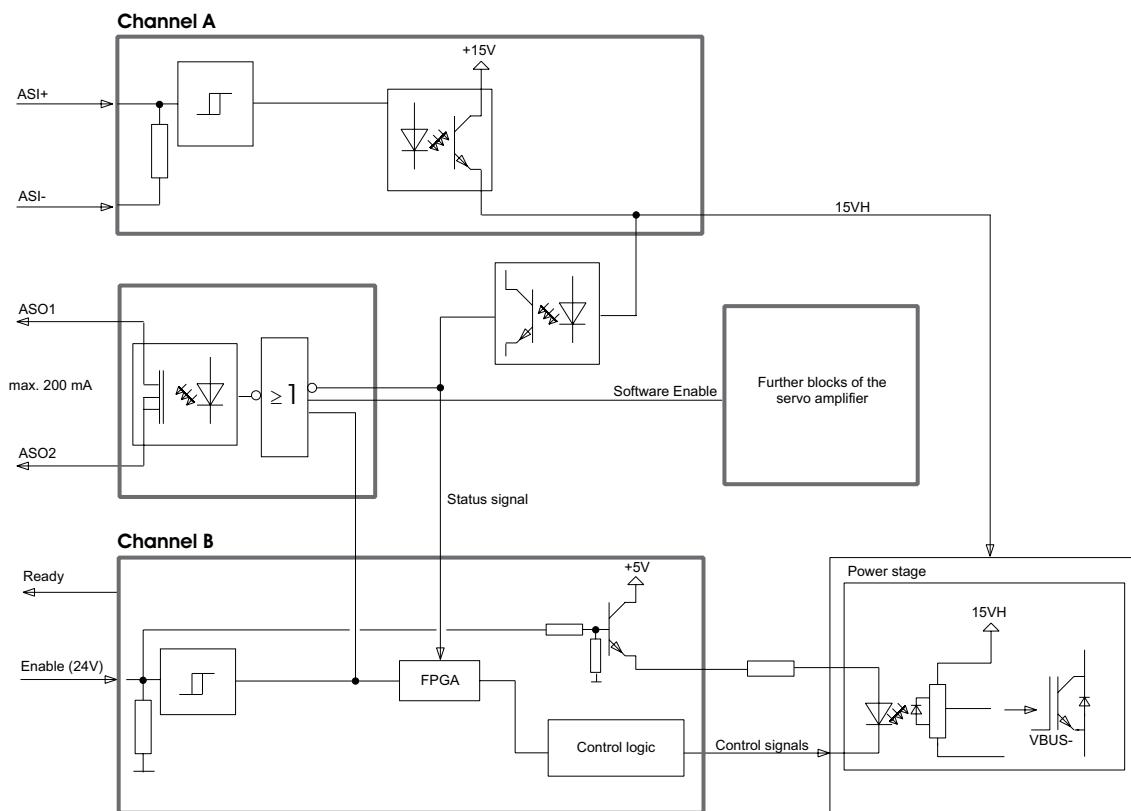


Fig. 6.18: Block diagram: Implementation of the safety function STO (for one axis)

WARNING

The STO function may only be activated (i.e. no voltage between ASI+ and ASI-) by an automatic control or by manual activation if the motor is no longer rotating and the servo amplifier has been switched to „inactive“ (24 V are not applied to „Enable“ input). Drives with a suspended load must have an additional safe mechanical blocking. In the safety circuit the monitoring contact ASO1/ASO2 bridges the safety equipment of the machine (e.g. safety position switches at safety doors). The safety area is protected from inadvertent restart of the device.

La fonction STO ne doit être activée manuellement ou de façon pilotée en retirant la tension entre les entrées ASI+ et ASI- qu'après l'arrêt du freinage et que le frein d'arrêt a pris, que l'amplificateur de servomoteur soit devenu inactif (signal „Enable“ retiré). Le contact de surveillance ASO1/ASO2 ponté dans le circuit de sécurité de l'installation des équipements de sécurité (par exemple des contacteurs de sécurité sur des portes). La zone de sécurité est maintenant protégée contre le redémarrage de l'entraînement

Relevant aspects of safety

See also the prescribed use of the servo amplifier ECOVARIO® described in chap. 2.6 and the operating conditions mentioned there.

As Fig. 6.18 shows the STO function is implemented by two channels. If a single error occurs, the function still remains operative via the other channel.

If the restart lock is active, all driver transistors are in high resistance state. If a current in the motor is produced by damaged driver transistors the high-pole servo motors as well as the 2-phase servo motors cannot start because the necessary rotating field is not created. In the worst case, however, a short hitch can occur at the motor shaft (movement of max. 1/2 pole pair of the motor).

If the internal semiconductor switch is damaged or a cable is broken the safety equipment switches off the drive because in this case the bridging of the safety equipment is not effective.

If the restart lock is activated by an automatic control, the control signal must be monitored to make sure that the restart lock cannot be activated if the motor is rotating.

Commissioning and checking the STO function

During commissioning of the machine, after changing components or restructuring the wiring, after a download of a new Firmware, after modifications of the parameters, however at least once a year the function of the safety equipment including the STO function must always be checked as described below:

Table 6.12: Checking the functions of the safety equipment including the STO-Funktion

Step	Measure	Check
1	Make sure that during the check the drive can run and stop unrestrictedly	
2	Stop drive controlled (target velocity=0)	
3	Disable drive (remove Enable signal)	Measure the signal level at the Ready signal: has to be inactive (0 V).
4	Activate the holding brake, if any	
5	Remove the +24V voltage between ASI+ and ASI- at X8A or X8B (axis 2), i.e. activate the STO function	
6	Open safety equipment (e.g. safety door) without interfering with the safety area.	Line contactor must stay „on“.
7	Pull off mating connector X8A or X8B (axis 2) from the respective servo amplifier.	Line contactor must drop.
8	Pull in mating connector X8A or X8B. Switch on line contactor.	

Maintenance, trouble shooting and diagnosis

The STO function and the STO interface do not require any maintenance.

However, periodical functional checks are necessary.

A check concerning the proper operation of the STO function according to table 6.12 has to be carried out:

- ⇒ During commissioning of the machine
- ⇒ after changing components
- ⇒ after restructuring of the wiring
- ⇒ after a download of a new Firmware
- ⇒ after modifications of the parameters
- ⇒ periodically at least once a year; the required intervals depend on the application.

The following error messages are related to the STO function (list of all errors in Chap. 7.3.2):

D00	Restart lock blocks switch on	Measure: Check STO function
D01	No external Enable	Measure: Check Enable signal

Technical Data

Table 6.13: Technical data with respect to the safety standards

EN 61800-5-2		EN ISO 13849-1	
SIL	2	PL	d
		MTTFd	t.b.d.
		DC _{avg}	t.b.d.
		λ _d	t.b.d.

6.5 Encoders

The 1-axis servo amplifier ECOVARIO 616 provides two encoder connectors. The 2-axis servo amplifier ECOVARIO®616 D provides one encoder connector per axis (X11 for axis 1 and X12 for axis 2).

NOTICE / PRUDENCE	Never plug and pull encoder cables while they are live! Always switch off the logic supply of the ECOVARIO®. Otherwise damages to the encoder can occur.	Ne connectez ou ne déconnectez jamais le câble d'un codeur sous tension ! Toujours éteindre l'alimentation logique de l'ECOVARIO avant. Dans le cas contraire, le codeur pourrait être endommagé
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Encoder inputs X11, X12

Apart from incremental standard encoders also absolute value encoders system HIPERFACE® and BISS® can be connected to the 15-pole High-Density Sub-D socket. As an option, a version for use with sine encoder systems with 1 Vpp signal amplitude for high resolution encoder evaluation is available.

Connection of two encoders per axis at ECOVARIO 616 D

Via a so-called Y encoder cable it is possible to use an additional incremental encoder per axis. If you want to use this option please double-check with our applications department.

Parametrization of the encoder interfaces

For all encoders of the Jenaer Antriebstechnik GmbH complete data sets are available. With the PC software ECO Studio the data set for the selected encoder can be chosen and transmitted to the ECOVARIO®.

6.5.1 2-Axis Servo Amplifiers ECOVARIO 616 D: X11, X12: Encoder

The maximum signal frequency is 2 MHz, that is a count rate of 8 MHz.

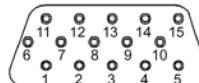


Fig. 6.19: Mating connector X11/X12: 15-pole Sub-D high density connector, view of the solder or crimp side

Table 6.14: Pin assignments connector X11, X12 at ECOVARIO 616 D

	Standard encoder (incremental) optional 2 nd incremental enc.			JAT SinCos encoder (Optolab) optional 2 nd incremental enc.			HIPERFACE® (Stegmann SCS) optional 2 nd incremental enc.			BISS® (Hengstler / IC-Haus) + 2 nd encoder (incremental) or JAT SinCos encoder		
Pin	Signal	1 st encoder	2 nd enc.	Signal	1 st encoder	2 nd enc.	Signal	1 st encoder	2 nd enc.	Signal	BISS encoder	2 nd encoder
1	U _p	5/11 (15) V can be set, 500 mA*		U _p	5/11 (15) V can be set, 500 mA*		U _p	5/11 (15) V can be set, 500 mA*		U _p	5/11 (15) V, can be set, 500 mA*	
2	A	Track A	-	sin+	Sine +	-	Sine	0,8 ... 1,2 V _{pp}	-	A	-	Track A / sin+
3	B	Track B	-	cos+	Cosine +	-	Cosine	0,8 ... 1,2 V _{pp}	-	B	-	Track B / cos+
4	Z	Track N	-	Z	Index track	-	Data	Data channel	-	Data	Daten	-
5	+T _{SENSE}	Temp.sensor	-	+T _{SENSE}	Temp.sensor	-	+T _{SENSE}	Temp.sensor	-	+T _{SENSE}	Temp.sensor	-
6	D _{GND}	Ground		D _{GND}	Ground	-	D _{GND}	Ground	-	D _{GND}	Ground	-
7	/A	Track /A	-	sin-	Sine -	-	RefSin	Reference sine	-	/A	-	Track /A / sin-
8	/B	Track /B	-	cos-	Cosine -	-	RefCos	Reference cosine	-	/B	-	Track /B / cos-
9	/Z	Track /N	-	/Z	Index track	-	/Data	/Data channel	-	/Data	/Daten	-
10	-T _{SENSE}	Temp.sensor	-	-T _{SENSE}	Temp.sensor	-	-T _{SENSE}	Temp.sensor	-	-T _{SENSE}	Temp.sensor	-
11	/B	-	Track /B	/B	-	Track /B	-	-	Track /B	/Z	-	Track /N
12	+V _{ENCSENSE}	Sensor U _p	-	+V _{ENCSENSE}	Sensor U _p	-	+V _{ENCSENSE}	Sensor U _p	-	+V _{ENCSENSE}	Sensor U _p	-
13	B	-	Track B	B	-	Track B	-	-	Track B	Z	-	Track N
14	A	-	Track A	A	-	Track A	-	-	Track A	CLK	CLK	-
15	/A	-	Track /A	/A	-	Track /A	-	-	Track /A	/CLK	/CLK	-

*) the same supply voltage for both encoders

Setting the supply voltage Up

The voltage U_p at the respective encoder interface can be parameterized and is set via the voltage applied to Pin 12 (+V_{ENCSENSE}):

Table 6.15: Setting the encoder supply voltage

V _{ENCSENSE}	U _p
+ 5 V / open	5 V
0 V	11 V

The standard cable ABS 65-300-525-xx for BISS® encoders already contains the settings for the voltage U_p. The maximum length of the cable is 50 m.

INFO



The connection of voltage dividing resistors for setting the encoder supply voltage is not possible at ECOVARIO 616 D. All cables which are no JAT standard cables have to be assessed for their suitability before they are used together with ECOVARIO 616 D.

Connection of a second incremental or JAT SinCos encoder via Y cable

If required, a further incremental or SinCos encoder can be connected to the encoder interface via a Y cable. If you want to use this option please double-check with our applications department. The assignment depends on the encoder type used as first encoder (cf. table above).

- preliminary -

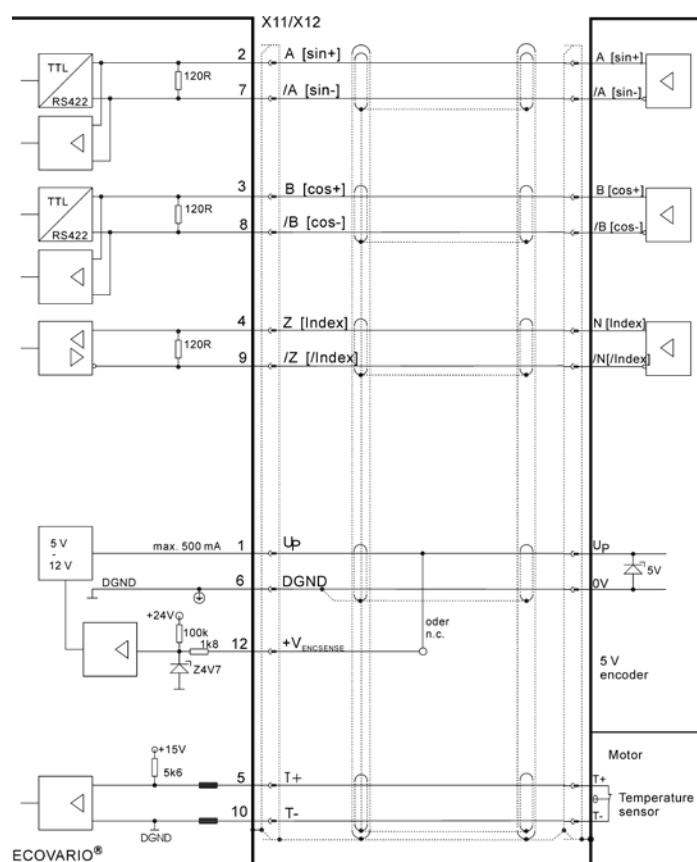


Fig. 6.20: Example for connection for a 5 V incremental encoder / SinCos encoder [deviations in brackets]

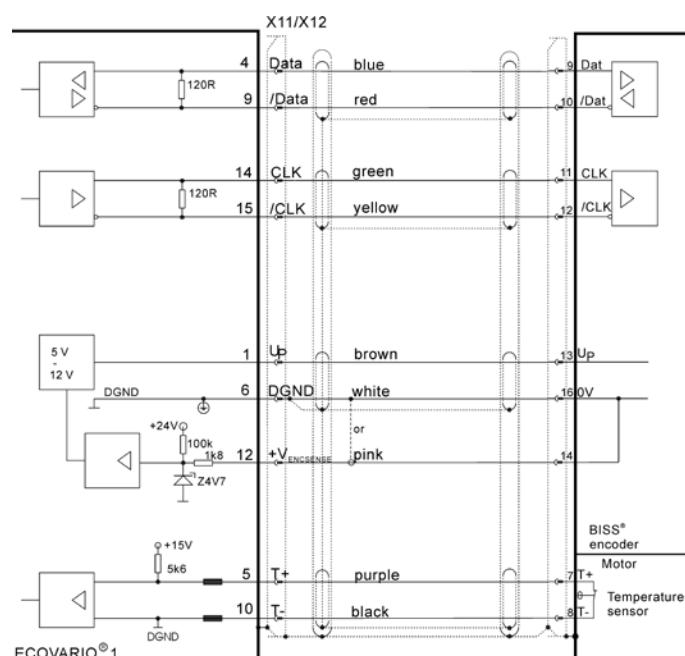


Fig. 6.21: Example for connection for a BISS® encoder via standard cable ABS65-300-525-xx

6.5.2 1-Axis Servo Amplifier ECOVARIO 616: X11, X12: Encoder

The maximum signal frequency is 2 MHz, that is a count rate of 8 MHz.

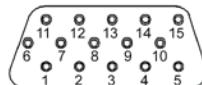


Fig. 6.22: Mating connector X11/X12: 15-pole Sub-D high density connector, view of the solder or crimp side

Table 6.16: Pin assignments connector X11, X12 at 1-axis servo amplifier ECOVARIO 616

	Standard encoder (incremental)		JAT-SinCos-Encoder (Optolab)		HIPERFACE® (Stegmann SCS)		BISS® (Hengstler / IC-Haus)	
Pin	Signal	Description	Signal	Description	Signal	Description	Signal	Description
1	U_p	5/11 (15) V can be set, 500 mA	U_p	5/11 (15) V can be set, 500 mA	U_p	5/11 (15) V can be set, 500 mA	U_p	5/11 (15) V, can be set, 500 mA
2	A	Track A	sin+	Sine +	Sine	0,8 ... 1,2 V_{pp}	A	-
3	B	Track B	cos+	Cosine +	Cosine	0,8 ... 1,2 V_{pp}	B	-
4	Z	Track N	Z	Index track	Data	Data channel	Data	Data
5	$+T_{SENSE}$	Temperature sensor	$+T_{SENSE}$	Temperature sensor	$+T_{SENSE}$	Temperature sensor	$+T_{SENSE}$	Temperature sensor
6	D_{GND}	Ground	D_{GND}	Ground	D_{GND}	Ground	D_{GND}	Ground
7	/A	Track /A	sin-	Sine -	RefSin	Reference sine	/A	-
8	/B	Track /B	cos-	Cosine -	RefCos	Reference cosine	/B	-
9	/Z	Track /N	/Z	Index track	/Data	/Data channel	/Data	/Data
10	$-T_{SENSE}$	Temperature sensor	$-T_{SENSE}$	Temperature sensor	$-T_{SENSE}$	Temperature sensor	$-T_{SENSE}$	Temperature sensor
11	-	-	-	-	-	-	-	-
12	$+V_{ENCSENSE}$	Sensor U_p	$+V_{ENCSENSE}$	Sensor U_p	$+V_{ENCSENSE}$	Sensor U_p	$+V_{ENCSENSE}$	Sensor U_p
13	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	CLK	CLK
15	-	-	-	-	-	-	/CLK	/CLK

Setting the supply voltage Up

The voltage U_p at the respective encoder interface can be parameterized and is set via the voltage applied to Pin 12 ($+V_{ENCSENSE}$):

Table 6.17: Setting the encoder supply voltage

$V_{ENCSENSE}$	U_p
+ 5 V / open	5 V
0 V	11 V

The standard cable ABS 65-300-525-xx for BISS® encoders already contains the settings for the voltage U_p , the maximum length of the cable is 50 m.

INFO



The connection of voltage dividing resistors for setting the encoder supply voltage is not possible at ECOVARIO 616 (D). All cables which are no JAT standard cables have to be assessed for their suitability before they are used together with ECOVARIO 616 (D).

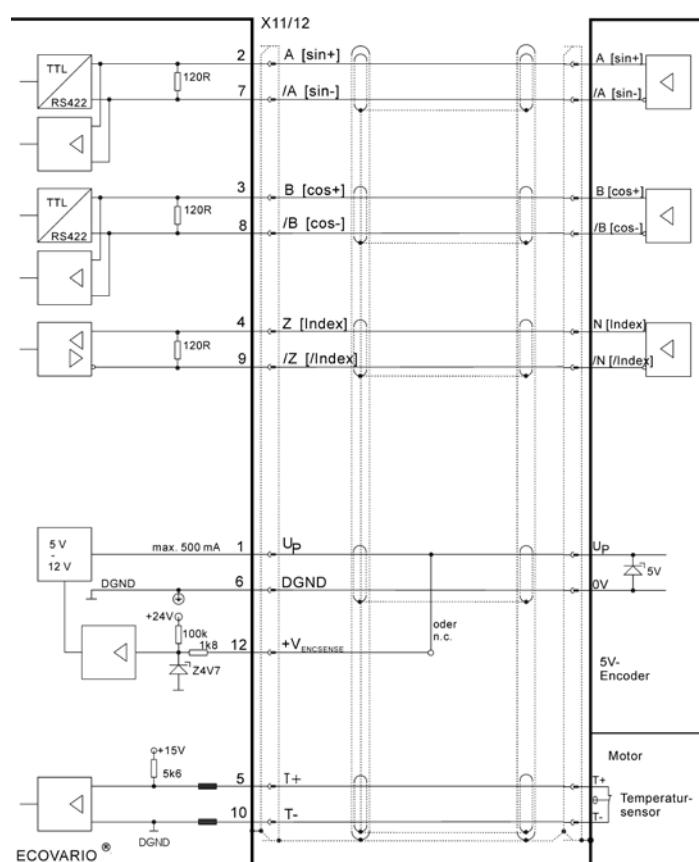


Fig. 6.23: Example for connection for a 5 V incremental encoder / SinCos encoder [deviations in brackets]

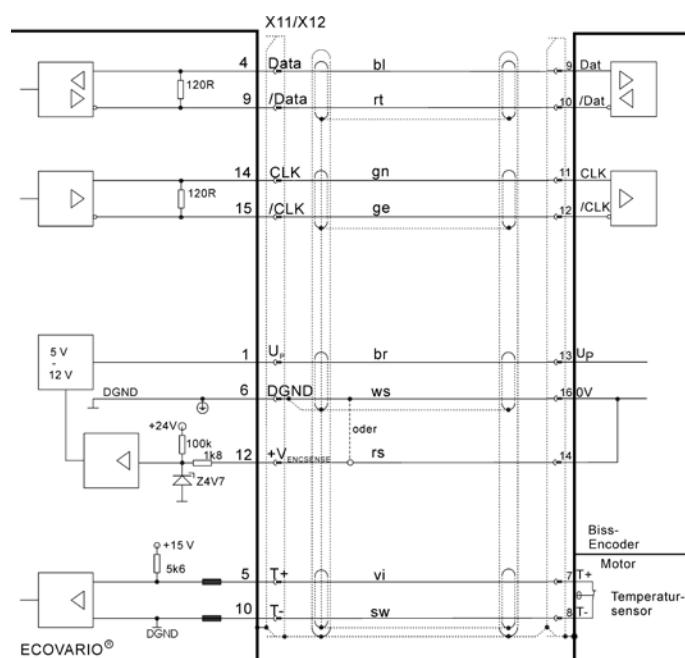


Fig. 6.24: Example for a BISS® encoder via standard cable ABS65-300-525-xx

6.6 Serial interfaces

6.6.1 X13: RS485/RS232 interface with 2 Capture Inputs

The ECOVARIO® is available with RS485 or RS232 interface with 2 capture inputs for fast position capturing.
ECOVARIO® 6 xx x x-A x-xxx xxx: design with RS485 interface
ECOVARIO® 6 xx x x-F x-xxx xxx: design with RS485 interface
ECOVARIO® 6 xx x x-B x-xxx xxx: design with RS232 interface
ECOVARIO® 6 xx x x-G x-xxx xxx: design with RS232 interface

Design with RS485 interface

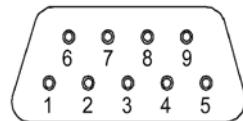


Fig. 6.25: Mating connector X13:
9-poliger D-Sub-Stecker; Ansicht
auf die Löt- bzw. Crimpseite

Table 6.18: Pin assignment connector X13

Pin	Signal	Description
1	CAP1+	Capture input1 (RS422 level)
2	Rx+	Receive RS485
3	Tx+	Transmit RS485
4	CAP2+	Capture input2 (RS422 level)
5	DGND	Digital ground
6	CAP1-	Capture input1 (RS422 level)
7	Rx-	Receive RS485
8	Tx-	Transmit RS485
9	CAP2-	Capture input2 (RS422 level)

Apart from the serial interface the connector X13 provides at ECOVARIO® 6xx additionally two capture inputs with RS422 signal transmission for rapid capture of process events. The capture inputs are not galvanically separated and can also be configured as digital inputs.

The RS485 interface of the ECOVARIO® may as well serve for a 4-conductor (full duplex) as also a 2-conductor (half duplex) connector. Transmitter and receiver of the ECOVARIO® meet the specifications of EIA-RS485 (up to 250 kBaud) and are EMC-protected according to IEC 61 000-4-4.

The communication protocol allows network operation with a master (host) and up to 126 ECOVARIO® units as slaves in an RS485 network. At most 32 participants may take part in one network. The network must have a bus structure.

The address (ID) of an ECOVARIO® is set by the front keys. Each ID may only be allocated once. ID = 0 is reserved and may not be allocated.

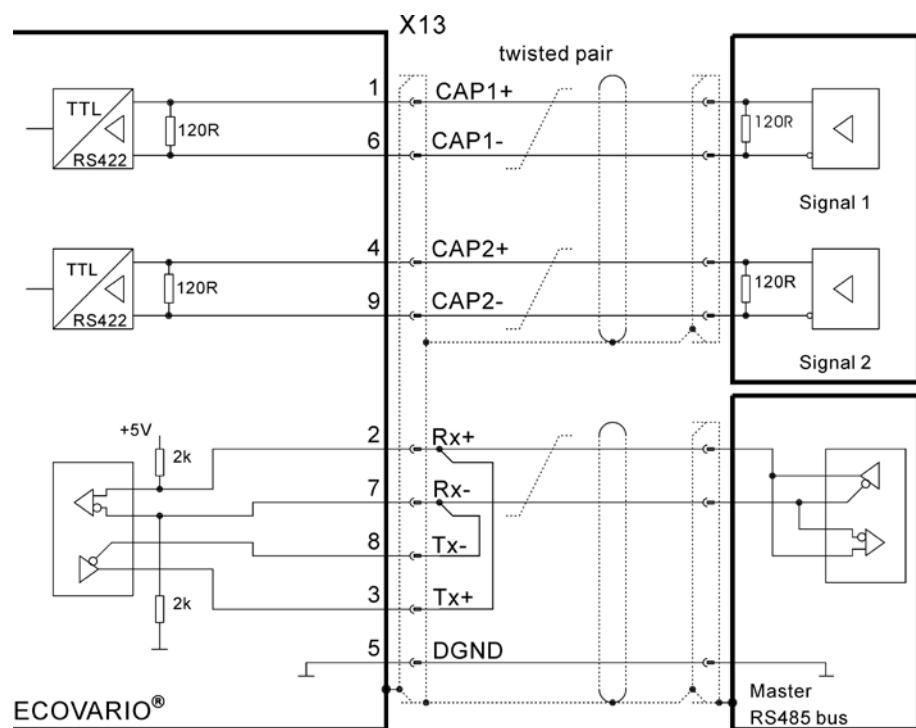


Fig. 6.26: Example for connection RS485: point-to-point connection in half duplex mode

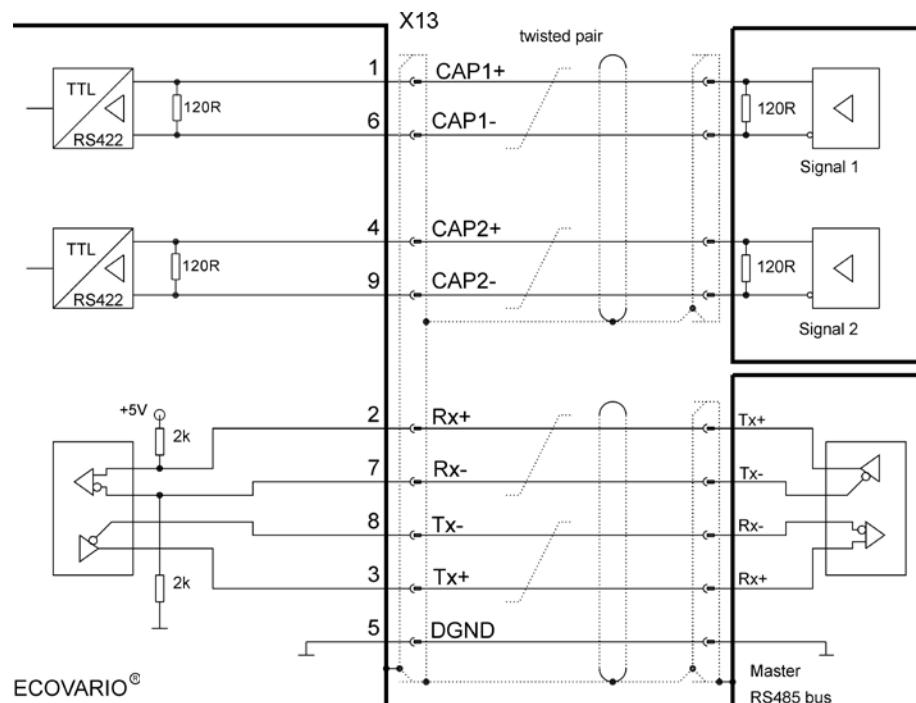


Bild 6.27: Example for connection RS485: point-to-point connection in full duplex mode

Design with RS232 interface

Apart from the serial interface the connector X13 of the ECOVARIO® 6xx provides two capture inputs with RS422 signal transmission for rapid event capture.

Alternatively to the USB interface, via the RS232 interface a PC can be connected for setting the parameter of the ECOVARIO® 114 D. How to set the parameters of the RS232 interface is described in the manual „Object Dictionary ECOVARIO®, ECOSTEP®, ECOMPACT®, ECO-MiniDual“.

For RS232 communication with ECOVARIO® 6xx a 3-core connection to the host is needed. The connector X13 of the ECOVARIO® 6xx is designed in a way that a 1:1 standard cable for communication with a COM port (9-pole Sub-D connector) can be used. Transmitter and receiver of the ECOVARIO® 114 D meet the specifications of EIA-232E and CCITT V.28 and are EMC-protected according to IEC 61000-4-2. The communication protocol allows network operation of up to 126 ECOVARIO® units as slaves in a mono master network. For this option a ring structure of the RS232 network according to the scheme in fig. 6.30 is necessary.

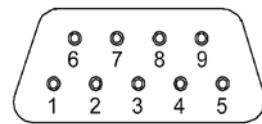


Fig. 6.28: Mating connector X13: 9-pole Sub-D connector, view of the solder or crimp side

Table 6.19: Pin assignment connector X13 in RS232 design

Pin	Signal	Description
1	CAP1+	Capture input 1 (RS422 level)
2	TxD	RS232 TxD
3	RxD	RS232 RxD
4	CAP2+	Capture input 2 (RS422 level)
5	DGND	Digitalground
6	CAP1-	Capture input 1 (RS422 level)
7	-	free
8	-	free
9	CAP2-	Capture input 2 (RS422 level)

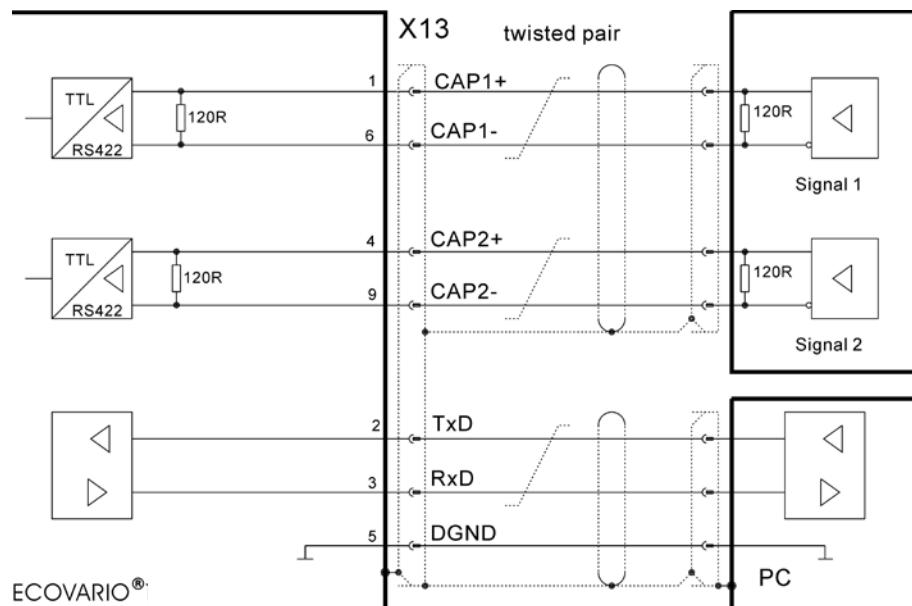


Fig. 6.29: Example for connection of an RS232 interface

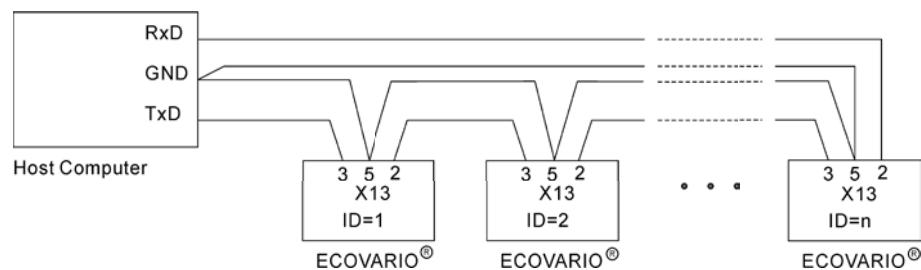


Fig. 6.30: RS232 network in ring structure

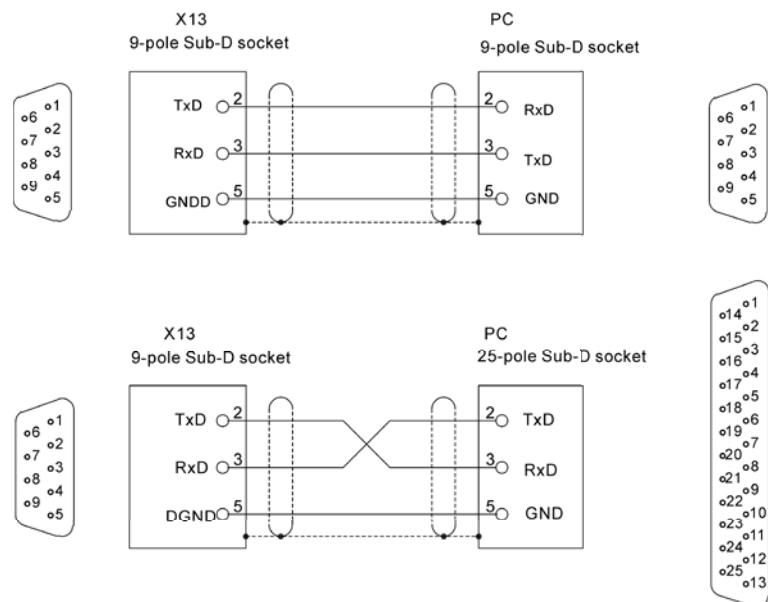


Fig. 6.31: RS232 cable ECOVARIO® – PC; view of the solder or crimp side of the plug connectors at the cable

6.6.2 X14: Parameterizing USB interface

The USB interface serves for setting the parameters of the ECOVARIO® with a PC. a USB cable A – B connects the USB interface of the ECOVARIO® (USB connector type B) to a PC (USB connector type A).

The USB interface is EMC protected according to IEC 61 000-4-2 and is internally supplied. To communicate via the USB interface firstly the unit ID of the ECOVARIO® must be set. The ID is set with the front keys of the ECOVARIO®. Each ID can only be allocated once. ID = 0 is reserved and may not be allocated.

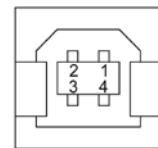


Fig. 6.32: Connector X14: USB connector type B: front view onto the socket at the ECOVARIO®

Table 6.20: Pin assignment connector X14

Pin	Signal	Description
1	USB_VBUS	USB +5V
2	USB_D-	USB data -
3	USB_D+	USB data +
4	DGND	USB ground

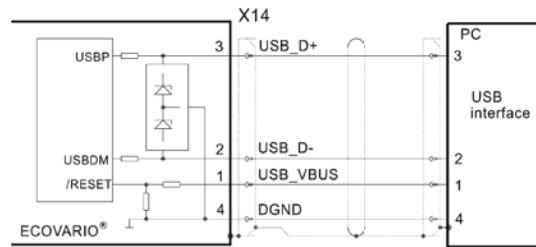


Fig. 6.33: Circuit of the USB interface

6.7 X21: CAN interface

The CAN interface of the ECOVARIO® is based on the communication profile CiA DS 301 and the device profile CiA DSP 402 (drives and motion control). It must be supplied with external voltage. (Exception: ECOVARIO 6xx xx Ax xxx and ECOVARIO 6xx xx Bx xxx xxx).

Terminating resistors for busses are not built in the ECOVARIO®. A CAN bus has to be terminated with a $120\ \Omega$ resistor at the beginning and at the end. If the ECOVARIO® is operated as first or last participant at a CAN bus, it is useful to solder the terminating resistor in the mating connector of X21 between the pins 2 and 7.

The manual „Object Dictionary ECOVARIO® and ECOSTEP®“ contains a detailed description of all available functions.

The Baud rate und the device ID can be set with the front keys of the device (see chap. 7.3.3 „Key operation“) or directly via the appropriate CAN objects.

The following Baud rates are supported: 1 000 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s. These values accord to the register values of the common older 8 or 16 bit CAN controller (ECOSTEP® compatible) and are transformed via table into ECOVARIO® CAN controller values. If point of sampling and scan rate (86.7 %, 3-times sampling at all Baud rates) do not meet the demands please get in touch with the technical service of Jenaer Antriebstechnik.

Table 6.21: Pin assignment connector X21

Pin	Signal	Description
1	-	n.c.
2	CAN_L	CAN data L
3	CAN_GND	reference potential to CAN data
4	-	n.c.
5	-	n.c.
6	CAN_GND	reference potential to CAN_V+
7	CAN_H	CAN data H
8	-	n.c.
9	CAN_V+	+8 ... +18 V _{DC} , max. 50 mA *

*) for ECOVARIO 6xx xx Ax xxx xxx and
ECOVARIO 6xx xx Bx xxx xxx
no external supply voltage for the
CAN interface is required.

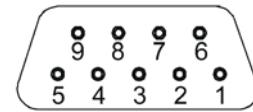


Fig. 6.34: Mating connector X21: 9-pole Sub-D socket; view of the solder or crimp side

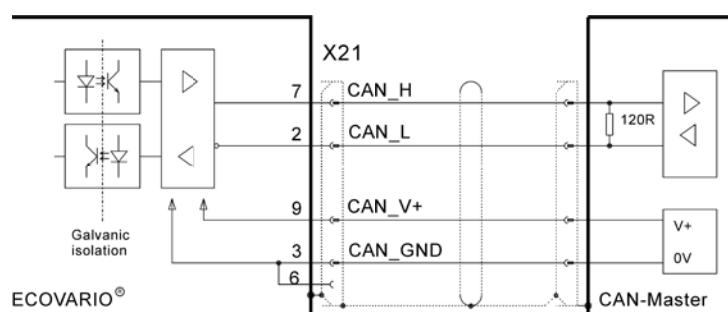


Fig. 6.35: Circuit X21: design with CAN interface

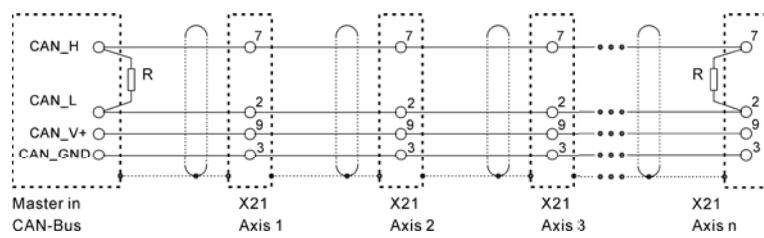


Fig. 6.36: Size terminating resistors R acc. to line impedance; normal: $R = 120 \Omega$

6.8 Optional interfaces

ECOPARIO® 6xx is available with the following options:

ECOVARIO® 6 xx xx-A x-xxx xxx: CAN + RS485 + Encoder emulation
 ECOVARIO® 6 xx xx-B x-xxx xxx: CAN + RS232 + Encoder emulation
 ECOVARIO® 6 xx xx-F x-xxx xxx: CAN + RS485 + PROFIBUS DP-V0
 ECOVARIO® 6 xx xx-G x-xxx xxx: CAN + RS232 + PROFIBUS DP-V0
 ECOVARIO® 6 xx xx-L x-xxx xxx: CAN + RS232 + Ethernet interface
 ECOVARIO® 6 xx xx-P x-xxx xxx: CAN + RS485 + EtherCAT® interface
 ECOVARIO® 6 xx xx-Q x-xxx xxx: CAN + RS232 + EtherCAT® interface

6.8.1 X22: Designs with encoder emulation

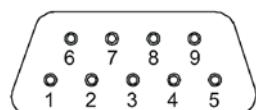


Fig. 6.37: Mating connector X22:
9-pole Sub-D connector; view of
the solder or crimp side

The interface „encoder emulation“ is supplied by an external voltage of $5 V_{DC}$.
The maximum cable length is 10 m.

Table 6.22: Pin assignment connector X22;
design with encoder emulation

Pin	Signal	Description
1	ENC_5V	Stromversorgung (external)
2	A	Track A
3	B	Track B
4	Z	Track N
5	ENC_GND	Encoder ground
6	ENC_GND	Encoder ground
7	/A	Track /A
8	/B	Track /B
9	/Z	Track /N

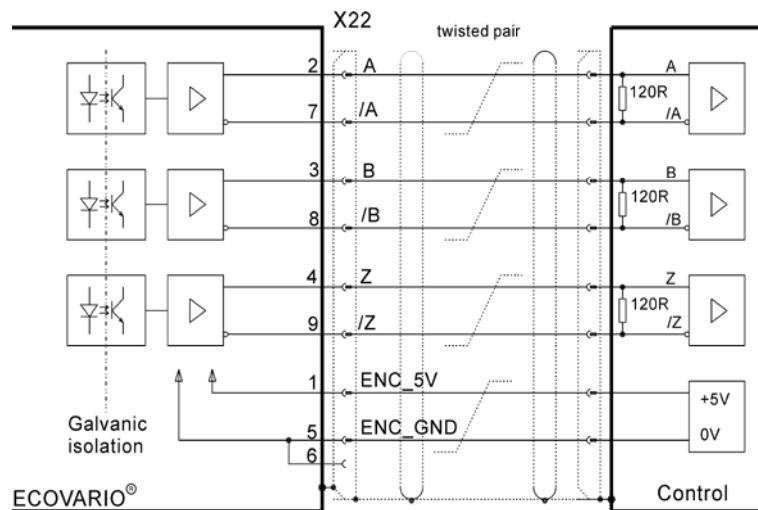


Fig. 6.38: Connector assignment X22 on designs with encoder emulation

6.8.2 X22: Designs with PROFIBUS DP-V0 interface

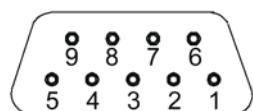


Bild 6.39: Mating connector X22; view of the solder or crimp side

The pin assignment of the design with PROFIBUS DP-V0 meets the requirements of EN 50170.

Additionally to the signals RxD/TxD+, RxD/TxD-, PB_GND and PB_5V the optional signal CNTR (RTS, control of the forward direction of the data) is supported. This signal can be used for controlling a repeater or an fibre optic link converter (OLP, Optical Link Plug). The bus interface of the ECOVARIO® is electrically separated from the rest of the device. But the reference potentials are interconnected via 1 MΩ and 100 nF. The interface is supplied by the unit, an external supply is not necessary. The shroud of the Sub-D connector is connected to chassis earth (GND).

Table 6.23: Pin assignment connector X22 on design with PROFIBUS DP-V0 interface

Pin	Signal	Description
1	-	n.c.
2	-	n.c.
3	RxD/TxD+	PB data
4	CNTR	PB control
5	PB_GND	PB ground
6	PB_5V	PB 5 V
7	-	n.c.
8	RxD/TxD-	PB /Data
9	-	n.c.

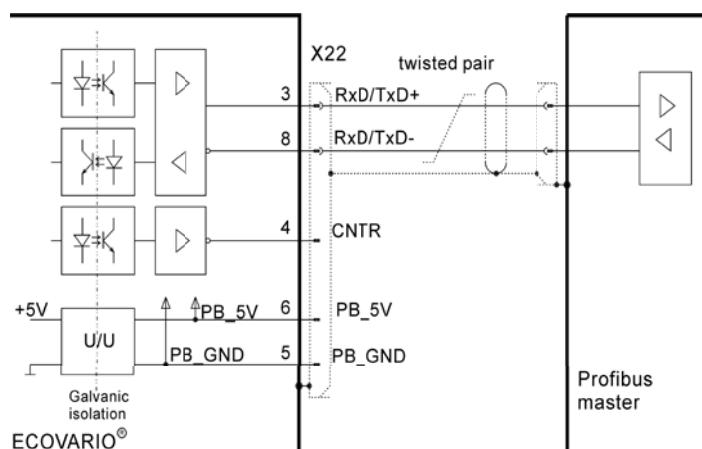


Fig. 6.40: Circuit X22 on design with PROFIBUS DP

All units are connected in a bus structure (line). In one segment up to 32 participants (master or slaves) can be connected. Each segment has an active bus terminating module at the beginning and at the end (cf. Fig. 6.41).

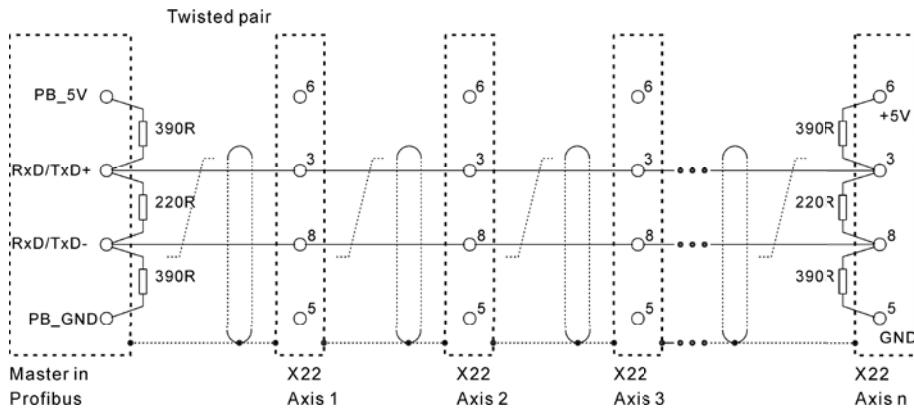


Fig. 6.41: PROFIBUS connection of several ECOVARIO® axes

To obtain faultless operation it has to be made sure that both bus terminating modules are continuously supplied. The bus terminating module is commonly realized in the bus connectors to be switched in. If there are more than 32 participants or for enlarging the network repeaters have to be used to connect the bus segments to each other.

Use only cable with a mesh shield. If the unit is mounted it is an advantage if the cable is stripped without interruption and laid on the shield or PE conductor. This measure increases the reliability in ambients with strong interferences.

For newly installed PROFIBUS DP-V0 cablings we recommend standardized cable type A with the following characteristics:

Wave resistance:	135 – 165 Ω
Capacitance per unit length:	< 30 pF/m
Loop resistance:	110 Ω/km
Core diametre:	0,64 mm
Core cross section:	> 0,34 mm ²

The maximum cable length depends on the transmission rate. E. g. with a transmission rate of 187.5 kBit/s the maximum cable length is 1 200 m, at 12 MBit/s the cable should not be longer than 100 m.

At transmission rates ≥ 1.5 MBit/s spur lines must be avoided. Common connectors provide the possibility to connect incoming and outgoing cables directly in the connector. Thus spur lines are avoided and the bus connector can be plugged in and off the bus without interrupting the data transmission.

Use only bus connectors suitable for PROFIBUS DP-V0 and the respective baud rate. The connectors at both ends should provide a termination to be switched in. Additionally in each connector should be a longitudinal inductance with 100 nH for each outgoing data conductor. These connectors are available from Siemens for example.

The shield of the PROFIBUS DP-V0 cable may not be used for potential compensation. Machines that are grounded at various spots must have a separate PE conductor the impedance of which is at least 10 times smaller than the one of the cable shields.

6.8.3 X22: Designs with Ethernet interface

As an option, ECOVARIO® can be equipped with an Ethernet interface which can be used for parameterization. The interface supports Fast Ethernet according to IEEE-802.3u (100Base-TX), halfduplex, 100Mbps. Physically, the interface is designed as two standardized RJ45-sockets at the front side of the ECOVARIO®.

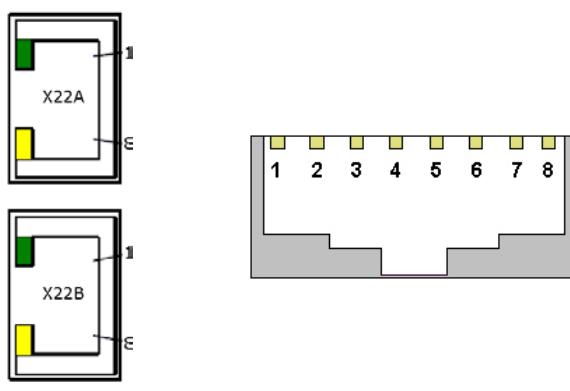


Table 6.24: Pin assignment connector X22A,B on design with Ethernet interface

Pin	Signal	Description
1	RX+	Receive signal +
2	RX-	Receive signal -
3	TX+	Transmit signal +
4	-	n.c.
5	-	n.c.
6	TX-	Transmit signal -
7	-	n.c.
8	-	n.c.

The interfaces X22A and X22B can each be used for the connection to the PC or a server (end of a star-shaped connection) as well as for the connection to further servo amplifiers via a line-shaped connection (uplink, cf. examples below).

Cabling is done via twisted-pair-cables UTP, Cat.5e. Star and line topologies are supported. Not more than 6 ECOVARIO® servo amplifiers should be cabled in line. The cable length between two devices is limited to 100 m.

For using the Ethernet interface the IP address, the subnet mask, the port and, if necessary, a gateway IP address have to be parameterized. The gateway IP address is only necessary if a communication to external network is intended to be set up.

The interfaces X22A and X22B are each equipped with the following display elements:

- ⌚ green LED displays „Link Activity“
- ⌚ orange LED displays „Collision Detection“.

An ECOVARIO® which is operated with the Ethernet interface automatically selects the interface used for message transfer. If a CAN bus connection is available, all messages which the ECOVARIO® intends to transmit, e.g. PDOs, emergencies or the boot-up message are sent on the CAN bus. If no CAN bus voltage can be detected it is assumed that a pure Ethernet application is set up and all messages are sent via Ethernet (if no Ethernet cable is plugged, the messages are lost!). CAN bus has the highest priority, i.e. the messages are transmitted via CAN bus as soon as the CAN connector has been plugged. Ethernet messages are not sent until 5s after power-up, because the hardware requires this time for configuration. During this time up to 8 (via DPM) or up to 32 (via CAN-Bus) received messages are stored temporarily.

There are three ways to implement the operation with Ethernet interface:

- ⌚ as a CAN/Ethernet bridge, where one ECOVARIO® with Ethernet interface serves as a gateway
- ⌚ as a pure Ethernet application, where all ECOVARIOS® are connected to each other by Ethernet interfaces
- ⌚ as a version with parallel bus operation.

The three ways are described in the following.

Gateway operation

In the most common application an ECOVARIO® with Ethernet interface serves as a bus coupler between Ethernet and an existent CAN bus system. Fig. 6.42 shows the resulting topology. In any case the CANopen protocol is used which is „tunneled“ in UDP packages for the transport via Ethernet. The original CAN data is extracted from these packages and is lead to the CAN bus. All bus nodes (also the ECOVARIO® with Ethernet interface) can receive them. In the other direction all CAN messages received via the bus are packed into UDP packages and sent via the Ethernet.

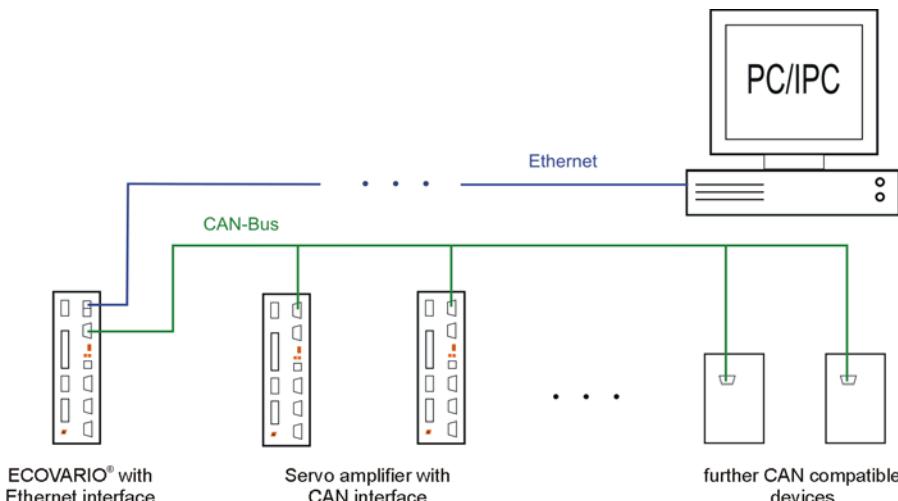


Fig. 6.42: Gateway operation of the ECOVARIO®

The Ethernet function supports full SDO transfer with one or more client applications on PC/IPC side. Therefore, the SDO answers received on the CAN bus are switched through to the respective service (automatic assignment of IP address and port). All other received messages as PDOs and emergencies etc. are sent to an address which has to be defined in the configuration object. For example, this could be the IP address of the PC/IPC or the IP broadcast address (255.255.255.255). The port is freely selectable, however should be adjusted to a respective application on the PC (e.g. for logging).

Ethernet operation

For this version CAN bus wiring is not required at all (cf. Fig. 6.43). The communication is handled exclusively via Ethernet. All CANopen messages and services (PDO, Emergency, NMT etc.) are managed.

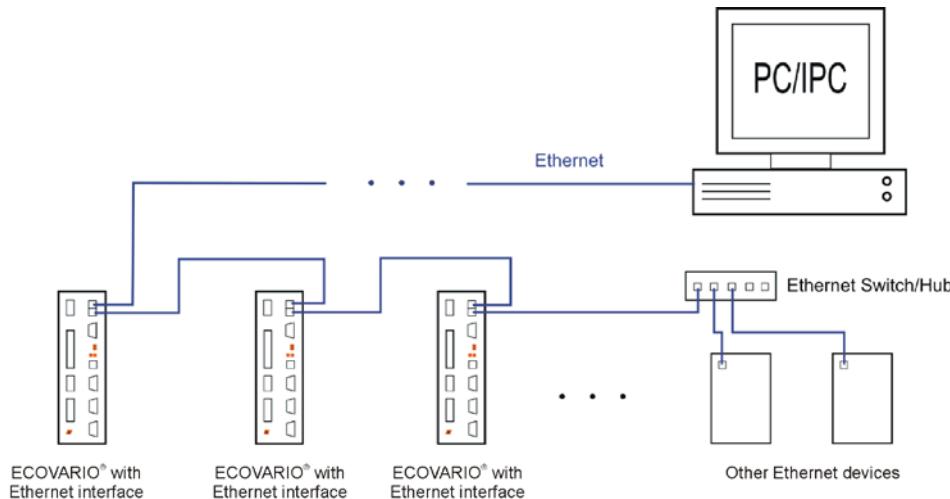


Fig. 6.43: Ethernet operation of the ECOVARIO® without using the CAN bus

Redundant operation

The special feature of this version (Fig. 6.44) is that e.g. service data (via SDO) can be exchanged via Ethernet while process communication is done via the CAN bus. The SDO transfer with the PC/IPC does not reach the CAN bus which is not disturbed (e.g. synchronous motion). In order to change the operation mode the gateway mode has to be deactivated in each device (object 0x2FB2, sub index 12), because otherwise the devices would send the messages to each other continuously. Process data communication is decoupled completely from the Ethernet in this case. All other CANopen messages and services (PDO, Emergency, NMT etc.) are not switched through from the CAN bus to the Ethernet side (and vice versa).

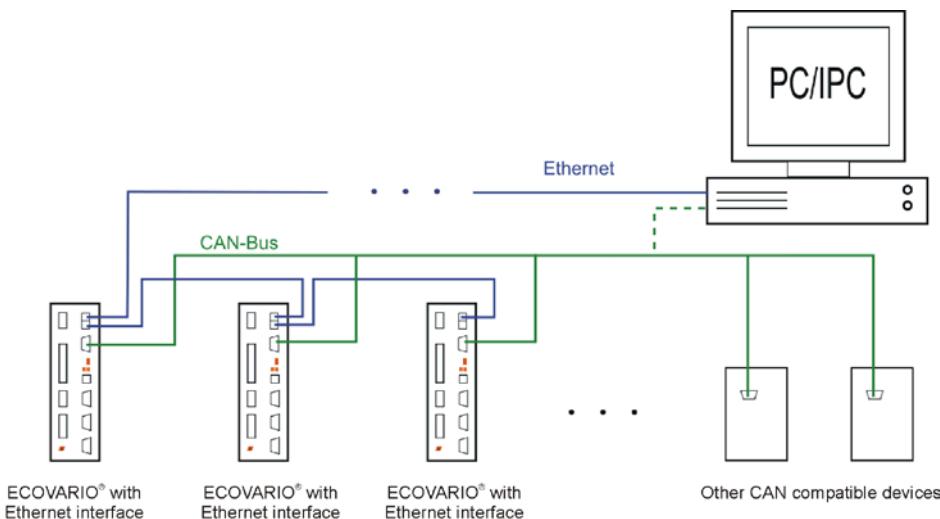


Fig. 6.44: Redundant operation Ethernet/CAN with ECOVARIO®

6.8.4 X22: Designs with EtherCAT® interface

As an option, ECOVARIO® can be equipped with an EtherCAT® interface which can be used for setpoint setting and parameterization. The interface supports the protocol of the EtherCAT® Technology Group and allows for Fast Ethernet according to IEEE-802.3u (100Base-TX), fullduplex, 100Mbps. Physically, the interface is designed as two standardized RJ45-sockets at the front side of the ECOVARIO®. Pin assignment is the same as for the standard Ethernet interface (c.f. Chap. 6.8.3).

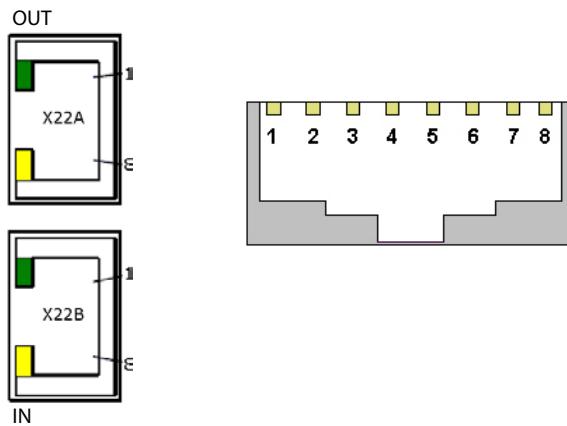


Table 6.25: Pin assignment connector X22A,B on design with EtherCAT® interface

Pin	Signal	Description
1	RX+	Receive signal +
2	RX-	Receive signal -
3	TX+	Transmit signal +
4	-	n.c.
5	-	n.c.
6	TX-	Transmit signal -
7	-	n.c.
8	-	n.c.

The interface X22B is the EtherCAT® „IN“ port and is used for the connection to the PC or a server (end of a star-shaped connection).

The interface X22A is the EtherCAT® „OUT“ port and is intended for the connection to further servo amplifiers via a line-shaped connection (uplink, cf. examples below).

Cabling is done via twisted-pair-cables UTP, Cat.5e. Tree and line topologies are supported. Star topologies are possible as well. The cable length between two devices is limited to 100 m.

For process control and visualization of EtherCAT® devices the operation with the PC software „TwinCAT“ (manufacturer: Beckhoff GmbH) is proposed. For configuration instructions and an application example please refer to Application Note 26.

The objects which are required for the configuration of the EtherCAT® communication are described in the manual „Object Dictionary ECOVARIO, ECOSTEP, ECOMPACT, chapter 5.2.29.“

The interfaces X22A and X22B are each equipped with the following display elements:

- ⌚ green LED displays „Link / Activity“
- ⌚ orange LED displays „Transmission in fullduplex mode“.

The green „RUN“ LED is located in the housing of the ECOVARIO and can be seen through the air slots on the upper side of the housing. The LED has the following functions:

- ⌚ LED off: EtherCAT® State Init
- ⌚ LED flashes (5 Hz): EtherCAT® State Pre-Operational
- ⌚ LED flashes (200ms on/1s off): EtherCAT® State Safe Operational
- ⌚ LED on: EtherCAT® State Operational



- preliminary -

There are two ways to implement the operation with EtherCAT® interface:

- ⦿ as a pure EtherCAT® application, where all ECOVARIOS® are connected to each other by EtherCAT® interfaces
- ⦿ as a version with parallel bus operation EtherCAT® / CAN.

The two ways are described in the following.

Pure EtherCAT® operation

For this version no CAN bus wiring is required (cf. Fig. 6.45). The communication is handled exclusively via EtherCAT®. All CANopen messages and services (PDO, Emergency, NMT etc.) are managed.

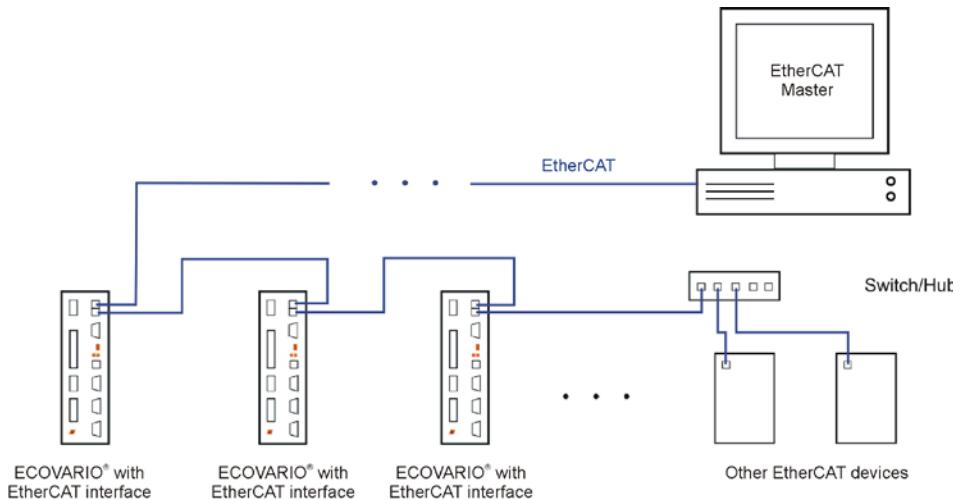


Bild 6.45: EtherCAT® operation of ECOVARIO® without using the CAN bus

Parallel operation

In principle, CAN and EtherCAT® can be operated in parallel (cf. Fig. 6.46), where the CAN bus is used for parameterization while EtherCAT® is used for synchronous (interpolated) operation. As soon as the ECOVARIO® has been configurated successfully by the EtherCAT® master and has been set to preoperational state via EtherCAT®, the NMT telegrams via CAN are ignored. PDOs assigned to the EtherCAT® bus are no longer sent nor received via CAN. Interpolated operation via CAN is not possible in this case. Emergency telegrams are sent via both bus systems. SDO traffic is functional without limitations via all interfaces.

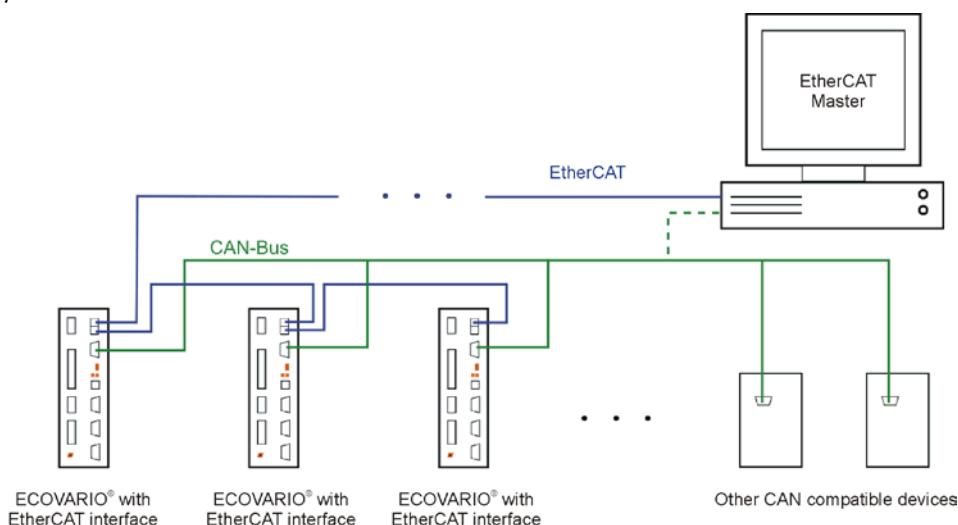


Fig. 6.46: Parallel operation EtherCAT/CAN with ECOVARIO®

7 Commissioning

7.1 Important notes before commissioning

Only qualified personnel with a broad knowledge of the fields of electrical engineering, automation and drives are allowed to commission the servo amplifier ECOVARIO® 6xx. If required, Jenaer Antriebstechnik GmbH offers trainings.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Check the wiring for completeness, short circuit and ground fault.

WARNING / AVERTISSEMENT 	The protective earth conductor has to be properly applied before applying a voltage. If the protective earth conductor is not connected, in case of a failure e.g. the housing of the servo amplifier can be at hazardous voltage level.	Un raccordement à la terre réglementaire doit obligatoirement être raccordé avant la mise sous tension de l'appareil. Si cette mise à la terre n'est pas raccordée, le boîtier de l'amplificateur de servomoteur peut, en cas de problèmes, mener de dangereuses tensions.
WARNING / AVERTISSEMENT 	Never plug or pull electrical connections while they are live! There is a risk of arcing. Arcs can cause injury and damage contacts. During operation logic and power connectors are live.	Ne pas effectuer de débranchements sous tension. Il y a danger d'arc électrique qui peut blesser des personnes et endommager des contacts. Pendant l'utilisation les conducteurs de pilotage et de puissance conduisent des tensions dangereuses.
WARNING / AVERTISSEMENT 	Acute danger of life or risk of injury due to high voltages up to 850 V! All live parts must be protected safely against touching. Even up to six minutes after disconnection from the supply capacitors can still have dangerous voltages present. To be sure measure the DC link circuit and wait till it has fallen below 40 V.	Danger de mort ou danger de blessures par des tensions élevées (850 V) ! Ne touchez pas de pièces de l'amplificateur de servomoteurs qui peuvent être potentiellement conducteur de tension (par exemple des contacts). Attendez au moins 6 minutes. Les condensateurs peuvent rester chargés aussi longtemps de tension dangereuse. Mesurez par sécurité les tensions entre circuits jusqu'à qu'elles soient inférieures à 40V.

If there are several axes in one machine commission one axis after the other. The axes already commisioned should be switched off. Concerning the allocation of the current to the both axes at ECOVARIO 616 D cf. chap. 8.2.

For commissioning of the safety function STO observe chap. 6.4.1.

CAUTION / ATTENTION 	Hot surfaces may cause burns to the skin. As the housing of the ECOVARIO 6xx serves also as heat sink during operation the surface temperature may rise to more than 70°C. Before touching these parts after switching off the unit wait until the temperature has fallen down to 40 °C.	Des surfaces chaudes peuvent entraîner des brûlures. Le boîtier de l'ECOVARIO 6xx sert également de radiateur, ceci entraîne qu'il peut atteindre des températures de plus de 70°C pendant l'utilisation. Avant de toucher ces pièces, vous devez attendre après l'arrêt jusqu'à ce que la température de surface tombe à environ 40 °C.
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7.2 Control and display elements

At the front side of the ECOVARIO® one 7 segment LED display and two keys are located. The display shows state and error messages. If the state or error message has more than one digit the digits are shown one after another in intervals of 0.5 s. For further information cf. chapter 7.3.1.

The following settings can be made with the keys:

- ⌚ Unit ID (Node-ID) in a CAN, USB, RS232, RS485 or PROFIBUS network
- ⌚ Baud rate for the CAN network
- ⌚ Display of the Ethernet IP Address or of the EtherCAT® station address
- ⌚ Restarting the bootloader and the loadware

For detailed instructions on the use of the keys refer to chapter 7.3.3.

7.3 Work schedule commissioning

1. Check installation

The servo amplifier is disconnected from the supply. Check the wiring for completeness, short circuits and ground faults (according to connection diagram in Fig. 6.2.1).

2. Zero enable

Connect the ENABLE input of the respective axis to 0 V (connector X1A (axis 1) or X1B (axis 2)).

3. Switch on 24 V logic supply

Apply the 24 V control voltage at the connector X1A between the pins GND and +24 V; after an initializing phase of about 3 s the LED display shows the operation mode of the servo amplifier.

4. Rectify eventual errors

If the display shows an error, the error has to be rectified before commissioning (cf. chapter 7.3.2).

5. Start commissioning software

Connect a PC to the PC interface (X13) of the ECOVARIO® (or via CAN dongle to the interface X21) and start the commissioning and operation program ECO Studio. Here, establish the logic connection between PC and ECOVARIO® 616.

Note: At ECOVARIO 616 D for each axis a separate ECO Studio session has to be started.

6. Device configuration and mechanical configuration

NOTICE / PRUDENCE

Incorrect parameter settings can cause damage or destruction of machine parts.

Device configuration and mechanical configuration must be adjusted to each specific case.

De mauvais paramétrage peuvent endommager ou détruire des parties de la machine.

Les appareils et la configuration mécanique doivent être individuellement adaptés à chaque cas.

With the help of the ECO Studio device configuration wizard and of the mechanical configuration wizard carry out the basic settings for the operation of ECOVARIO®. A detailed description of software commissioning can be found in the „ECO Studio Operation Manual ECOVARIO®, ECOSTEP® and ECOMPACT®“ and in the ECO Studio help system.

Before switching on the power supply the following items 7 to 10 have to be observed.

7. Check safety equipment



DANGER **High voltages up to 850 V and unintentional movements of motors, tools or axes may lead to death or serious injuries.**

Before switching on the voltage it is vital to check if all safety equipment that protects from touching live parts and from the consequences of inadvertent movements functions properly.

Des tensions pouvant atteindre 850 V et des mouvements involontaires du moteur, des outils ou des déplacements d'axes entraînent des dangers de mort ou de blessures.

Avant la mise sous tension de la partie puissance, il s'assurer que les parties pouvant conduire du courant et les conséquences de de mouvements involontaires soient sécurisées et fonctionnent correctement.

8. Zero demand values

Before switching on the power supply the analog and digital demand values for position and speed should be zeroed.

9. Switch on power supply

The power supply should only be switched on with the on/off switches of a contactor circuit.

10. ENABLE

0.5 s after switching on the power supply, the enable signal of the respective axis can be changed to „high“ (24 V level at input X1A: Enable1 or X1B: Enable2). If the motor vibrates or hums the value of the p-gain should be reduced (ECO Studio: in the navigation area select the „Controller“ entry and then the „Velocity Controller“ tab).

11. Parameter optimization, further programming

NOTICE / PRUDENCE

Incorrect parameter settings can cause damage or destruction of machine parts.

The controller parameters are pre-set by the manufacturer. However, they must be checked and if necessary adjusted to the specific application. A detailed description of how to set the velocity controller and position controller parameters can be found in the ECO Studio help system.

De mauvais paramétrage peuvent endommager ou détruire des parties de la machine.

Les paramètres du régulateur sont prérégisés en usine, cependant, doivent être vérifiées et adaptées à chaque cas spécifique. Une description détaillée de la configuration des paramètres du régulateur de vitesse et de position, est donnée le système d'aide ECO-Studio.

7.3.1 State display

After switching on the servo amplifier, the display shows the letters „Eco“, followed by the type (616) of the ECOVARIO® device (once).

No parameters available

Display shows Uc. If no communication or control parameters are available or if these are invalid, the unit is in the state „not configurated“. After setting or storing the unit must be restarted.

Operation

Display shows . Inactive state (power stage switched off at both axes) display „0“, dot flashes

Display shows . Active state (power stage switched on at axis 1; axis 2 switched off), dot flashes

Display shows . Active state (power stage switched on at axis 2; axis 1 switched off), dot flashes

Display shows . Active state (power stage switched on at both axes) display „8“, dot flashes.

Blocking

Display shows . positive limit switch axis 1 reached

Display shows . negative limit switch axis 1 reached

Display shows . both limit switches axis 1 reached

Display shows . positive limit switch axis 2 reached

Display shows . negative limit switch axis 2 reached

Display shows . both limit switches axis 2 reached

Blockings of both axes are displayed as a combination of the displays shown above.

Save parameters

During saving parameters in the EEPROM the display shows a „P“. Afterwards the prior value is displayed.

Error display

If an error is detected, this is displayed. It is always the last error, that is displayed. If the error on the display is cleared (if possible) the next error on the list is displayed. In ECOVARIO 616 D, for the groups D and E the error code on the display is preceded by an axis code („1.“ or „2.“).

Bootloader mode

The „b.“ on the display indicates that the device is in the bootloader mode. The point indicates that the bootloader is ready for operation.

7.3.2 Error messages

If the loadware recognizes an error, it is displayed. In bootloader mode the error display can be interrupted by pressing a key, afterwards errors can be shown with the display of the error memory (cf. chap. 7.3.3 „Key operation“). It is always the last error that is displayed.

Note for ECOVARIO 616 D: For the groups D and E the error code on the display is preceded by an axis code („1.“ or „2.“). In ECO Studio the error messages of groups D and E are related to the axis which is connected to the individual ECO Studio session.

Table 7.1: Error messages

Code	Error	Countermeasure
Group A General errors		
A00	Incorrect checksum of a bootloader section or overall checksum	Repeat action, if the error reoccurs, send in device to manufacturer
A01	Error during deleting a flash section	Repeat action, if the error reoccurs, send in device to manufacturer
A02	Error during activation of the Flash-Speichers	Repeat action, if the error reoccurs, send in device to manufacturer
A03	Error during programming of the flash memory	Repeat action, if the error reoccurs, send in device to manufacturer
A04	Error during addressing the flash memory	Repeat action, if the error reoccurs, send in device to manufacturer
A10	Error during reading/writing the EEPROM	If the error reoccurs send in the device to manufacturer
A11	Incorrect checksum of an EEPROM section	Communication and/or application parameters have not (yet) been stored. This behaviour is normal with new devices and has been implemented for signalling this to the user.
A12	Error during RAM check	Repeat action, if the error reoccurs, send in device to manufacturer
A20	Incorrect calibration data	Send in device to manufacturer
A21	Watchdog error of standard loadware	If the error reoccurs send in the device to manufacturer
A22	PLD firmware inappropriate for loadware	Send in device to manufacturer
A23	Loadware does not support this device	Contact service hotline of Jenaer Antriebstechnik GmbH
A24	Firmware/Loadware does not fit to device	Load appropriate firmware/loadware. First letter of the file name has to be „D“. If in doubt, contact service hotline of Jenaer Antriebstechnik GmbH.
A25	FPGA could not be started	
A26	Device could not be started	Contact service hotline of Jenaer Antriebstechnik GmbH
A27	Runtime error in FPGA	Contact service hotline of Jenaer Antriebstechnik GmbH
Group B Bus errors		
B00	CAN Nodeguarding error. No messages are sent. Synchronisation window in interpolated mode exceeded.	Check bus connection and device function, check supply voltage of the CAN bus
B01	CAN bus parameters not available, incorrect saving of parameters. No messages are sent	Enter parameters again, check node ID and Baud rate
Group D Device and axis errors: For ECOVARIO 616 D, the error code on the display is preceded by an axis code („1.“ or „2.“)		
D00	Restart lock blocks switch on	Check function of the restart lock
D01	No external enable	Check ENABLE signal
D02	Heat sink temperature >85 °C	Switch off unit and let it cool down. Check whether the device is mounted in the correct mounting position. Make sure that no heat accumulation can occur in the cabinet.
D03	Device temperature >60 °C	
D04	Temperature error motor (Encoder input A (X11))	Let motor cool down. Check temperature sensor connectors.
D05	Temperature error motor (Encoder input B (X12))	Let motor cool down. Check temperature sensor connectors.
D06	Negative limit position reached	Reset if an error message is raised

Code	Error	Countermeasure
D07	Positive limit position reached	Reset if an error message is raised
D10	Short circuit of motor phases or ground fault of the power stage resp.	Check motor and supply cables. Check whether the shield wires are connected correctly.
D11	Oversupply in the supply cables	
D12	Exceeding $i^2 \cdot t$ limitation of device	Check parameters and operating conditions. Check if axis is freely movable.
D13	Exceeding $i^2 \cdot t$ limitation of motor	
D14	ADC reference measurement failure	If error reoccurs send in device to manufacturer
D15	Threshold value DC link voltage reached	
D16	At the mains connector not all three phases are connected; no 3-phase feed	Connect all three phases
D20	External 24 V supply at X1 has fallen below 17 V	Check 24 V power supply. Are there disturbances on the supply line? Check output power specification of power supply whether it is dimensioned sufficiently.
D21	DC link voltage too high, short circuit of ballast circuit	Check DC link and ballast circuit. Is the ballast resistor connected correctly? Check supply voltage (might be too high).
D22	DC link voltage too low	Check power supply and connections. Check output power specification of power supply whether it is dimensioned sufficiently.
D23	Overload ballast circuit	Check dimensioning of ballast resistor. Is the ballast resistor connected correctly? Error cause might be a defective ballast resistor (high-resistance).
D24	Exceeding charging time of DC link	Check voltage
D25	Short circuit or overload of the digital outputs or the brake control resp.	Check READY, OUT1, OUT2 and brake. Check whether the shield wire of the motor cable is connected correctly.
D26	No +5 V OD voltage	If error reoccurs send in device to manufacturer
D27	15 V HOK	If error reoccurs send in device to manufacturer
D30	Following error too high	Check axis parameters and operating conditions. Check whether the axis is freely movable. Check whether the (second) position measuring system still counts correctly.
D31	Commutation not found	Check if axis is freely movable. Check whether the motor phases are connected correctly, whether the encoder counts and whether the commutation settings are correctly.
D32	Internal software reset	If error reoccurs send in device to manufacturer
D33	Fehler Reglerwatchdog	If error reoccurs send in device to manufacturer
D34	Error supervision of external position measuring system	Check adjustment of the machine. If error reoccurs send in device to manufacturer.
D35	Gantry system only: Error of an axis in the gantry interconnection	t.b.d.
Gruppe E Encoder errors: For ECOVARIO 616 D the error code on the display is preceded by an axis code („1.“ or „2.“)		
E00	1. Antivalence error of incremental encoder A 2. No encoder has been selected 3. Signal error absolute value encoder	Check encoder and supply cables for wire breakage. If no encoder is configured, select encoder. Check whether the correct encoder port has been selected. In case of externally powered encoders check supply voltage.
E10	1. Antivalence error of incremental encoder B 2. Error at external encoder input 3. Signal error absolute value encoder	Check encoder and supply cables for wire breakage. Check whether the correct encoder port has been selected. In case of externally powered encoders check supply voltage.
E01	Capture error incremental encoder A	Check whether the monitoring is set correctly. Error reasons might also be disturbances on the lines or a defective encoder.
E11	Capture error incremental encoder B	
E02	Interpolation error SINCOS encoder A	Check encoder and supply cables.
E12	Interpolation error SINCOS encoder B	Error reason might be strong electromagnetic interferences.
E03	Too high speed of encoder A or cannot be read	Check parameters (limit speed of the motor). Error reason might be contamination or damage of the measuring system
E13	Too high speed of encoder B or cannot be read	

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Code	Error	Countermeasure
E14	Selected encoder type is wrong or not supported	Check configuration, enter appropriate encoder type
E15	Invalid motor data (not supported)	-
E16	Error during reading user data	Check encoder and supply cables and configuration, if the error reoccurs send in encoder
E17	Invalid user data or motor and servo amplifier do not fit	Error occurs upon initial commissioning of a new encoder because no user data has been stored yet in the encoder EEPROM. Writing to the object 0x607C „home_offset“ removes the error cause. User data is only stored in multiturn absolute value encoders.
E20	Mismatch between stored position value and actual encoder value (more than 1/2 revolution)	Carry out homing procedure.
E21	Incorrect multiturn value	Error cause is a contamination or a defect of the revolution counter of the multiturn absolute value encoder.
E23	Quadrant correction error of SINCOS encoder A	Check encoder and supply cables for wire breakage. If no encoder is configured, select encoder. Check whether the correct encoder port has been selected. In case of externally powered encoders check supply voltage.
E24	Quadrant correction error of SINCOS encoder B	
E25	Encoder error absolute value encoder (group error)	t.b.d.

7.3.3 Setting and querying displaying parameters via the keys

In ECOVARIO communication settings of the device ID and the CAN baud rate can be made with the keys on the front of the device. Furthermore, Ethernet IP or EtherCAT® addresses can be retrieved.

Functions of the keys

Key S1 ►: select, menu navigation, count up display values

Key S2 ▼: enter, select menu option, accept values

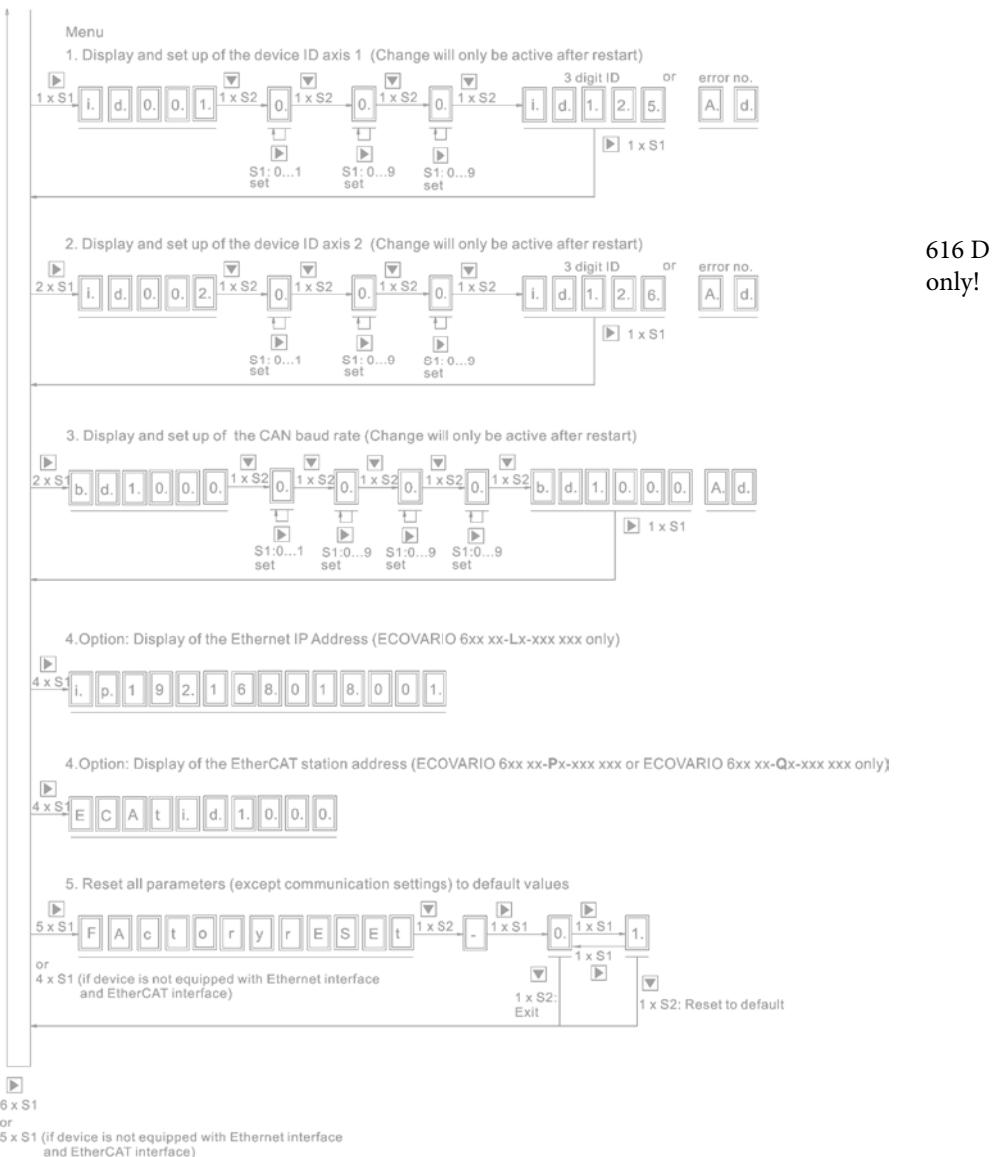


Fig. 7.1: Work schedule key operation

7.3.4 Bootloader mode

The bootloader mode can be selected in three different ways:

- ⇒ press both keys during switching on the 24 V control voltage
- ⇒ if after switching on the 24 V control voltage an error is recognized
- ⇒ by starting the bootloader mode with the commissioning tool from the PC

8 Parameter setting

By setting the parameter the ECOVARIO® is adjusted to the application.

The parameters are set in the PC. The user interface ECO Studio is menu-driven and easy to handle.

There are several interfaces to connect the PC to the ECOVARIO®:

- ⌚ USB interface
- ⌚ CAN interface (with the respective dongle)
- ⌚ RS232 interface (optional)
- ⌚ Ethernet (optional)

8.1 User interface ECO Studio

How to work with the user interface ECO Studio is described in the ECO Studio online documentation. Further information on programming the ECOVARIO® can be found in the manual „Object Dictionary ECOVARIO® and ECOSTEP®“.

8.2 Setting the current allocation to the both axes of the ECOVARIO 616 D

At ECOVARIO 616 D the current allocation to the both axes can be set. For each axis this is done via the object 0x6073 (max_current) or by means of ECO Studio (connected to the respective axis) in the selection tree via **Limits** in the **Maximum Current** field. The total maximum current for both axes must not exceed 16 A. By default a maximum current of 8 A per axis is set.

The i^2t monitoring power stage value (Objekt 0x2701, Sub index 4) has to be set according to the load of the individual axes. The total maximum value must not exceed 8,8 A_{RMS}.

9 Accessories

Table 9.1: Overview of ECOVARIO® original accessories

Order key	Description	For ECOVARIO® type
Ergänzungsteile		
DHZ10	Shield set with 2 shield plates, 5 cable ties and mounting material	ECOVARIO® 616, 616 D
DHK10	Mating connector set	ECOVARIO® 616 D
DHK11	Mating connector set	ECOVARIO® 616 (1-axis)
Ballast resistors		
DPR40-200	Ballast resistor 40 Ω/200 W (500 W cooled)	ECOVARIO® 616, 616 D
Software tools		
	CD with ECO software tools and documentation	all
Power supplies logic voltage		
SV24	1-phase power supply 24 V _{DC}	all
Cables		
INK65-491-525-xxx	Encoder cable for motors with incremental encoders or SinCos encoders	all
ABS65-300-525-xxx	Encoder cable for motors with BiSS® encoders	all
MOT61-133-523-xxx	Motor cable for motors without brake	all
MOT63-134-523-xxx	Motor cable for motors with brake	all

9.1 Supplementary parts

9.1.1 Shield set

The shield set DHZ10 consists of:

- ⌚ 3 shield clips, 14 mm
- ⌚ 2 shield clips, 8 mm
- ⌚ 1 bottom shield plate
- ⌚ 1 top shield plate

Mounting of the shield plate at the bottom of the servo amplifier is generally required because of EMC reasons. The top shield plate and the bottom shield plate are designed differently and cannot be interchanged. Observe Fig. 9.1.

For mounting the shield plate proceed as follows:

1. On the respective side of the servo amplifier loosen the screws (Pos. 1) and screw them approx. 2 mm out.
2. Shift the shield plate with the cutout (Pos. 2) under the screw heads (Pos. 1) and into the studs on the side of the servo amplifier (Pos.3).
3. Tighten the screws (Pos. 1) again.

The fixing of the cables can be achieved by cable ties and shield clamps.

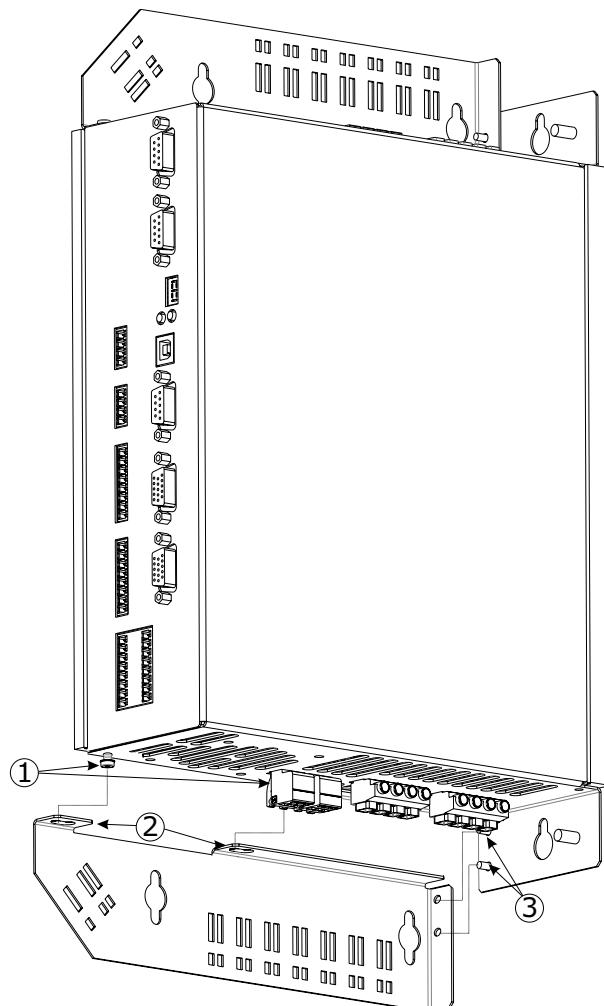


Fig. 9.1: Mounting of the shield plate (example: lower shield plate)

9.2 Ballast resistors

Series DPR ballast resistors are short circuit proof, intrinsically safe resistors with an eloxated aluminium casing.

Intrinsically safe on continuous overload and free convection:

- ⌚ no short circuit
- ⌚ no fault to frame
- ⌚ no fire
- ⌚ no melting of the casing

Protection class: IP65

Approvals: cCSAus, cURus

Note: Mounting in a built-up of heat casing temperatures up to 350 °C may occur.

Braided wire of the connecting cables: length: 510 ±40 mm, Ø AWG16 or 1,5 mm² resp.

The scope of delivery contains elbow joints with mounting elements.

9.2.1 Ballast resistors 200 W (500 W cooled)

DPR40-200: 40 Ω/200 W (500 W cooled)

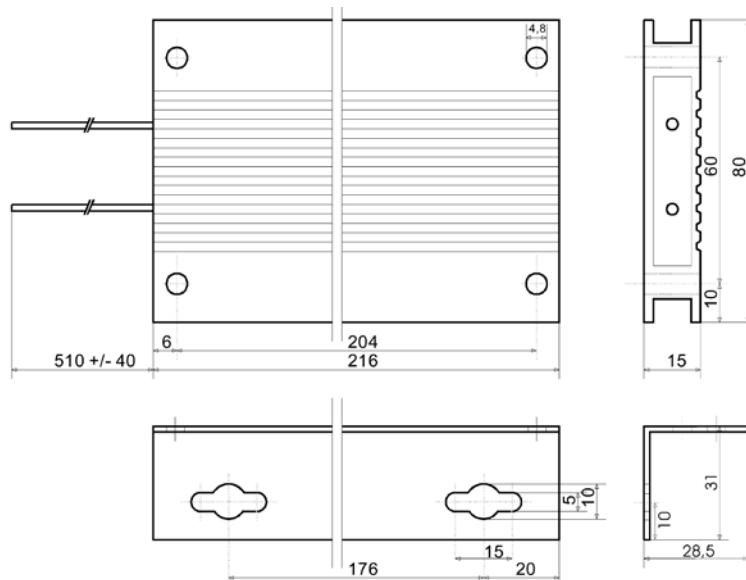


Fig. 9.2: Dimensions of ballast resistor DPRxx-200 (above) and elbow joint (below)

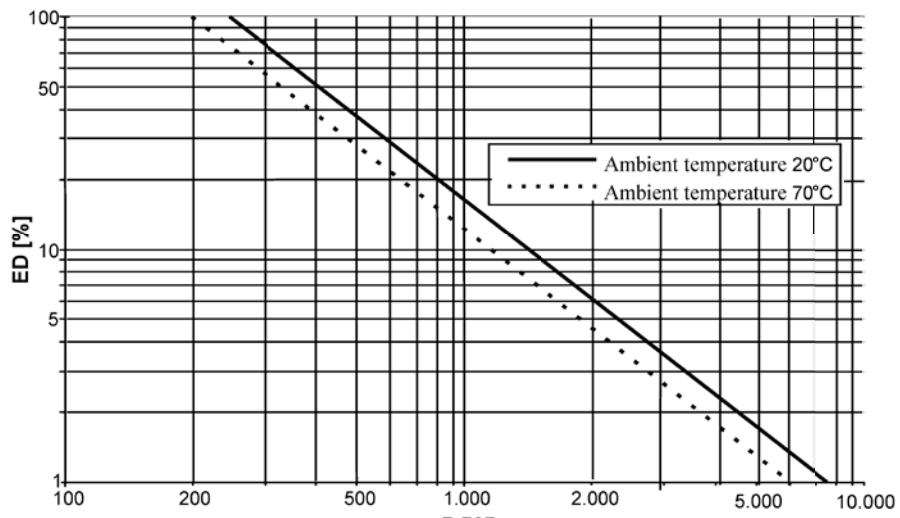


Fig. 9.3: Pulse strength ballast resistors DPRxx-200 (without restriction of durability), ED = duty cycle

All cases on the left side below the characteristics in fig. 9.3 are covered by the ballast resistors DPRxx-200 abgedeckt werden.

Frame conditions:

Basis is the normal cycle time of 120 s. The casing temperature be determined with the temperature diagram in fig. 9.4 on the basis of the average power. The avarage power is calculated according to formula (4). The value taken from fig. 9.4 plus 5 K amounts to the casing temperature at the chosen poulse strength.

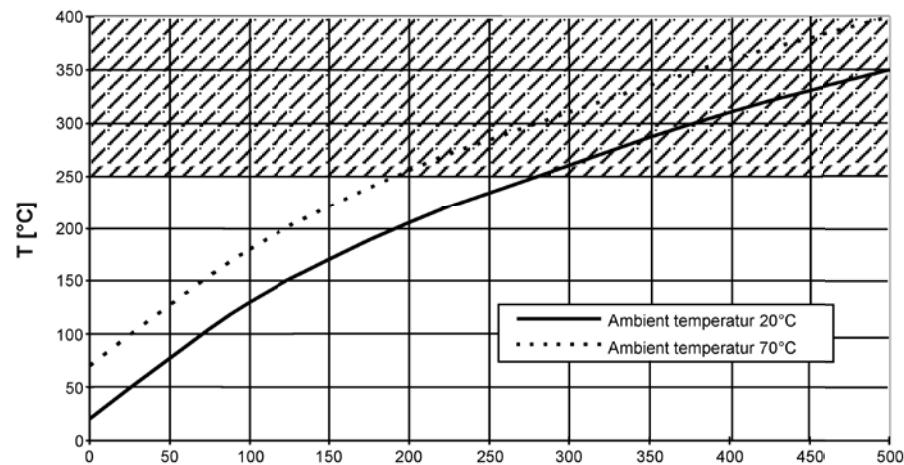


Fig. 9.4: Housing temperature ballast resistor DPRxx-200 at CDF = 100 %, max. T = 250 °C

9.3 Mating connector sets

Mating connetor sets for all interfaces of the ECOVARO® is available. All mating connectors are clearly labelled and designed in a way that there is no danger of mixing them up.

Table 9.2: Composition of ECOVARO® 616 D mating connector set DHK10

Connector	Function	Mating connector designation, Phoenix ID No.	Number
X1A, X1B	24 V/digital inputs and outputs	Combicon MC 1,5/ 8-ST-3,81 CN 2,7 BDNZX1, No. 17 55 40 2	2
X2A, X2B	Digital inputs	Combicon MC 1,5/ 8-ST-3,81, CN 1,8 BDNZX2, No. 17 55 41 5	2
X8A, X8B	STO function	MC 1,5/ 4-ST-3,81, BD: 1-4, No. 18 40 72 2	2
X6	Power connection	GMSTB 2,5 HCV/ 4-ST-7,62, No. 17 14 29 4	1
X7A, X7B	Motor brake	ZEC1,0/3-ST-3,5 C1,3R1,3 No. 19 98 20 5	2
X5A, X5B	Motor connection	GIC 2,5 HCV/ 4-ST-7,62, No. 17 45 64 5	2
X4	DC link / ballast resistor	GIC 2,5 HCV/ 5-ST-7,62, No. 17 45 65 8	1

Table 9.3: Composition of ECOVARIO® 616 mating connector set DHK11

Connector	Function	Mating connector designation, Phoenix ID No.	Number
X1A	24 V/digital inputs and outputs	Combicon MC 1,5/8-ST-3,81 CN 2,7 BDNZX1, No. 17 55 40 2	1
X2A	Digital inputs	Combicon MC 1,5/ 8-ST-3,81, CN 1,8 BDNZX2, No. 17 55 41 5	1
X8A	STO function	MC 1,5/ 4-ST-3,81, BD: 1-4, No. 18 40 72 2	1
X6	Power connection	GMSTB 2,5 HCV/ 4-ST-7,62, No 17 14 29 4	1
X7A	Motor brake	ZEC1,0/3-ST-3,5 C1,3R1,3 No. 19 98 20 5	1
X5A	Motor connection	GIC 2,5 HCV/ 4-ST-7,62, No. 17 45 64 5	1
X4	DC link / ballast resistor	GIC 2,5 HCV/ 5-ST-7,62, No. 17 45 65 8	1

9.4 Cables

The insulated shield mesh of the cables must be connected to the device potential or the PE conductor resp. If the grounding is improper or the mesh lies freely dangerous voltages may occur. The following table lists the cables available for connection of the motors of Jenaer Antriebstechnik GmbH. If other cables are used functional errors of the drive and EMC problems might occur. If you intend to use other cables please double-check with our application department whether your cables are appropriate.

Table 9.4: ECOVARIO® accessories, cables

Cable type	Use	Characteristic
Encoder cables		
INK65-491-525-xxx	Encoder cable for motors with incremental or SINCOS encoders	shielded, twisted in pairs (4x(2x0.14)+(2x0.5)), Ø: 9.5mm,
ABS65-300-525-xxx	Encoder cable for motors with BiSS® encoders	trailing capability from bending radius >120mm
Y-encoder cable	option	
Motor cables		
MOT61-133-523-xxx	Motor cable for motors without brake	shielded, 5xAWG16, up to 12 A, 600 V, Ø: 8.9 mm, trailing capability from bending radius >125 mm
MOT63-134-523-xxx	Motor cable for motors with brake	shielded, (5xAWG16)+(2xAWG16), up to 12 A, 600 V, Ø: 10.8 mm, trailing capability from bending radius >105 mm

All cables in table 9.4 are available up to 50 m. All cables are trailing cables.

10 Appendix

10.1 Glossary

Ballast circuit	A ballast circuit transforms energy that is fed back into the DC link during braking of a motor into heat. Thus it is made sure that the DC link voltage does not increase too much.
Baud rate	Unit of measure for the transmission rate of data in serial interfaces. The baud rate indicates the number of possible changes of state of the transmitted signal per second (1 baud = 1 state change/s). The baud rate can be lower than the bit rate (one bit is coded in several signal states). „Baud rate“ in this document refers to signals in which one bit is defined with the two signal states HIGH and LOW. In this case the bit rate equals the baud rate.
BISS®	Bidirectional sensor interface of iC-Haus GmbH, Bodenheim
Bitrate	Transmission rate of information in bit/second
Bootloader mode	State of the servo amplifier in which a new loadware can be transmitted into the servo amplifier's memory.
Brake chopper	The brake chopper circuit produces a high inrush current, that initiates a quick pulling of the brake. After pulling the brake the current is reduced to a lower holding current.
Capture input	Control input for quick event capture of a machine or plant
Circuit breaker	Switch that cuts the power if an error current limit is exceeded
DC link voltage	Smoothed DC voltage
Disable	Take back ENABLE signal for the servo amplifier: ENABLE input = 0 V
Encoder	Measuring system, that transforms the angular position of a shaft or the position of a linear system into coded data
EMC	Electromagnetic compatibility
Enable	enable signal for the servo amplifier (24 V _{DC} signal)
ESD protection	Protection against electrostatic discharge
Field bus interface	Here: CANopen, EtherCAT, PROFIBUS DP or Profinet (under preparation)
Firmware	Part of the software that is stored to ROM (read-only memory), the firmware contains the start-up routines.
Ground fault	Here: electrically conductive connection between a power system or motor phase and the PE conductor

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HIPERFACE®	Universal interface for electric actuators by SICK STEGMANN GmbH, Dönaueschingen
Host	Computer in a multi computer system that controls the whole system
ID number	Identification number of a special device in a bus structure
Loadware	Part of the software that can be stored to the flash memory of the servo amplifier
Node	Device connection in a bus structure
Positively-opening contacts	Form of relays and contactors that prevents single contacts from switching in case of errors
Repeater	Equipment for reinforcing and regenerating of signals in a network
Restart lock (AS)	Technical measure that prevents actuators safely by mechanical elements (positively driven contacts) from restarting indeliberately.
RMS	Root mean square
Sequencer programming	Programming a work schedule in which a sequence of events is defined depending on external states (input data), internal states (actual values) or time states
Short circuit	Here: electrically conductive connection between two power systems or motor phases
STO function	Safe Torque Off; safety function defined in EN DIN 61800-5-2. The motor is not supplied with energy and cannot generate a rotation. The STO function is used for the implementation of the restart lock.
Token passing	Hybrid access method for multimaster systems; token passing uses a token, or series of bits, to grant a master permission to transmit over the network, while the transmission between master and slave is carried out after the master-slave principle
Token system	In networking, a token is a special series of bits that travels around a token-ring network. As the token circulates, computers attached to the network can capture it. The token acts like a ticket, enabling its owner to send a message across the network. There is only one token for each network, so there is no possibility that two computers will attempt to transmit messages at the same time.
Watchdog	Supervisory software

10.2 Index of formulae

- (1) Energy difference E_{BR} : $E_{BR} = \frac{1}{2} J (\omega_1^2 - \omega_2^2)$
(2) Regenerable energy E_{N-P} : $E_{N-P} = \frac{1}{2} C_L (U_{BUSH}^2 - U_{BUSN}^2)$
(3) Supply voltage U_p : $U_p = 5V ((R1/R2) + 1)$
(4) Average power m_m : $m_m = P[W] \times ED [\%]/100$

10.3 Index of standards and directives

- DIN 912: replaced by DIN EN ISO 4762
DIN 6 798: drawn back without replacement
DIN EN 50 170: General purpose field communication system
DIN EN 50 178 Electronic equipment for use in power installations
DIN EN 60 204: Safety of machinery - electrical equipment of machines - Part 1: General requirements
DIN EN 61 800-3: Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods
DIN EN 61800-5-1: Adjustable speed electrical power drive systems - Part 5-1: Safety requirements; Electrical, thermal and energy
DIN EN 61800-5-2: Adjustable speed electrical power drive systems - Part 5-2: Safety requirements; Functional safety
DIN EN ISO 4762: Hexagon socket head cap screws
DIN EN ISO 12100-1: Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
DIN EN ISO 12100-2: Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
DIN EN ISO 13 849-1:2006 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
IEC 61000-4-2: Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
IEC 61000-4-4: Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrical fast transient/burst immunity test
2006/42/EC: Directive of the European Parliament and the Council on the approximation of the laws of the Member States relating to machinery
2006/95/EC: Council Directive on the harmonization of laws of Member States relating to electrical equipment designed for use within certain voltage limits
2004/108/EC: Council Directive on the approximation of the laws of the Member States relating to Electromagnetic Compatibility