Instruction Manual
for
3-Phase 1 Q-Power Controller
Temvar GDE2

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1 SAFETY AND APPLICATION NOTES FOR DRIVE CONVERTERS
(According to the 72/73/EC Low-voltage Guideline)

10.25.96/HX/PT/BLY

1. General
Depending on their protection class, drive converters may have non-isolated and live conductors, possibly moving or rotating parts, and hot surfaces.

There is danger of severe personnel or equipment damage if the required cover is inadmissibly removed, the unit is used in an inadmissible application, improperly installed or operated.

Refer to the documentation for further information.

All work concerning transportation, installation, and commissioning as well as maintenance is to be performed by qualified expert personnel (take also note of the IEC 364 and/or DIN VDE 0100 and national accident prevention regulations).

Expert personnel for electrical devices
Personnel, which is based on his/her professional training, experience and knowledge of the applicable standards and capable to judge the tasks to be performed and to recognize possible sources of danger.

Personnel trained for electro-technical operation
Personnel informed by the expert personnel for electrical devices regarding the tasks assigned to him/her and the possible danger occurring at improper acting's and who is trained if required and instructed about the required safety mechanisms and protective measures.

2. Intended use
Drive converters are components supposed to be included into electrical equipment or machines.

When installing the drive converter into a machine, its commissioning (i.e. taking up its intended operation) is prohibited until it is ascertained that the machine conforms to the regulations described by the EC guideline 93/44/EC (Machine Guideline). Take note of EN 60204.

Commissioning (i.e. taking up its intended operation) is only allowed if the Electromagnetic Compatibility guideline (89/336/EC) is observed.

The drive converters fulfil the requirements of the 73/23/EC Low-voltage Guideline. Drive converters are subject to the harmonized standards of the prEN 50178/DIN VDE 0160 in association with EN 60439-1/VDE 0660 part 500 and EN 60146/VDE 0558.

The specifications and the data concerning the connection conditions are stated on the rating plate and in the documentation of the component. Meeting these data and conditions is compulsory.

3. Transport and storage
The notes regarding transport, storage and appropriate operation must be observed.

Climatic conditions must be complied with as detailed by prEN 50178.

4. Setting up
Setting up and cooling of the devices must be made according to the rules described in the corresponding documentation.

Drive converters are to be protected against inadmissible stress. Particularly, no components may be twisted and/or no isolation distances may be changed. Touching of electrical components and contacts is to be prevented.

Drive converters include components, which can be damaged by electrostatic discharge. When handled improperly, these components can be easily damaged. Electrical components may not be damaged or destroyed by using mechanical force (this may endanger health).

5. Electrical connection
The valid national accident prevention regulations (e. g. VGB4) must be observed when working on drive converts which are connected to the supply voltage.

The electrical set-up has to be performed according to the relevant regulations (e.g. conductor diameter, fusing, protective conductor connection). Furthermore, the documentation contains notes concerning this subject.

Notes relevant to a proper EMC-conforming set-up (e. g. screening, earthing, arrangement of filters, and cable routing) are to be found in the documentation of the drive converters. These notes must always be observed even when working with drive converters with the CE mark. The manufacturer of the plant or of the machine is responsible for the observance of the required limit values as defined by the EMC regulations.

6. Operation
If applicable, plants fitted with drive converts must be equipped with additional monitoring and safety devices according to the currently valid safety regulations, e. g. law concerning work equipment, accident prevention regulations, etc. Modifications of the drive converters using the operating software are admissible.

Touching of equipment parts that are subject to voltage in operating conditions and of wire connections is not allowed directly after disconnecting the supply voltage. There is the danger of still charged capacitors! Fore this, all relevant safety markings on the drive converter must be observed.

During operation, covers and doors must be kept shut.

7. Maintenance
The manufacturer's documentation must be observed.

These safety notes must be kept in a safe place!

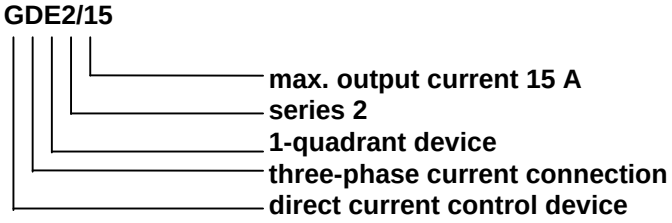
2 DEVICE DESCRIPTION

2.1 General

Three-phase power controllers from the GDE series are compact devices for armature feeding of speed-regulated direct current drives up to 700 A.

The device concept is characterized by the compact design.
The enclosed, galvanized housing and intelligent terminal assignment ensure that electromagnetic compatibility of the device is excellently supported (see Section 4).

The main power connection covers the range from 210 to 550 V without switchover.
The electronics power supply is 230 V 50/60 Hz for all devices. Synchronization of the electronics power supply with the main power supply is not necessary.
The model specification lists the main features of the device, e.g.



2.2 Device Description

The power section comprises a thyristor bridge without circulating current in standard modular technology. The supply connections X3 are located on the top, the outputs and electronics connections X4 and X1, on the bottom of the devices. The electronics consist of a closed-loop controller, an open-loop controller PCB, and a power supply unit.

2.2.1 Closed-loop Controller PCB GDE2 A0114xx

This can be accessed by unscrewing the top plate. This area houses the electronic terminals X1 (setpoint and actual values, enable and signal outputs) and X2 (potential terminals and auxiliary inputs), and everything that is needed for installation (potentiometers, component mounting points, LED signals). The following circuit groups are located on this printed circuit board:

A) Setpoint value integrator
B) Actual speed value alignment
C) Speed controller with current limiting
D) Current controller
E) Signal outputs for speed > 0, current limit reached, field current > 0 and device stand-by.

2.2.2 Open-loop Controller PCB GDE2 A0095xx

This is located on the left sidewall.
The following circuit groups are located on this printed control board.

A) Switchover logic
B) Current measurement
C) DC/AC conversion limitation
D) Firing pulse formation
E) On-off logic in case of power system failure
F) Firing pulse output stages

2.2.3 Power Supply Module

Devices	15 A - 270 A	GDE2	A0033xx
Devices	380 A - 700 A	GDE2	A0112xx

For devices up to 270 A this module is mounted on the right-hand wall.
The following circuit groups are located on the module (A0033xx).

A) Electronics power supply with miniature fuses F1 - F4 (see circuit diagram on page 12)
B) Field current monitoring
C) Generation of synchronous voltage
D) Power system monitoring
E) Temperature monitoring
F) Armature voltage acquisition
G) Overload protection switch with suppressor circuit for thyristors

For devices over 380 A the module (A0112xx) is located under the hinged cover. The overload protection switch with suppressor circuit is housed on a separate PCB directly above the thyristors.

The main elements such as the 60 Hz bridge and miniature fuses for the electronics power supply can be accessed by lifting up the closed-loop controller PCB. Otherwise there is nothing on these PCB's that would need to be adjusted for installation.

Danger

Dangerous voltage is present even when the system switch of the power controller is open. The control module and supply modules contain a number of dangerous live circuits.

Failure to observe the instructions given in this operating manual can cause death, serious injury to persons and damage to equipment.

2.3 Ambient Conditions

The specified nominal device currents are valid up to a maximum ambient temperature of 40℃. Above this level, a reduction in the device current of 1% per ℃ must be allowed for. The absolute temperature limit is 55℃. Heat concentration above the devices should be avoided. The devices have protection type IP 00, meaning that they have to be enclosed in control cabinets or closed control housings.
The surrounding air must be free of electrically conductive dust particles and chemically aggressive vapors. Vibrations can destroy the devices.

2.4 System Conditions

The devices work in a voltage range of 230 to 500 V ± 10%/50Hz. For operation connected to a 60 Hz mains power supply, the JP2 bridge must be fitted on the open-loop controller PCB. The device is ready for operation approx. 200 ms after connecting the electronics power supply. Until then the closed-loop controllers and pulse generator are inhibited. The signal "stand-by" is only given after this interval. Closed-loop controller enable is internally inhibited until the main power is connected.
The devices require a mains power source with U_K = 4% at nominal device current. This is achieved by preconnecting the recommended commutation chokes DD15-700.
For the electronics and fan supply an auxiliary voltage of 230 V ±10%, 50/60 Hz is required.

Attention! The power controller is not suitable for an operation at earth-free supply systems (IT systems). Please do not hesitate to ask for customized execution when required.

3 PRODUCT OVERVIEW

3.1 Device Table

Type	Input Current/fuse		Output Current/fuse	Power loss	Current consumption electronics	Input choke
GDE2/15	12 A	16 A	15 A	150 W	0,2 A	DD 15
GDE2/30	25 A	35 A	30 A	200 W	0,2 A	DD 30
GDE2/60	49 A	63 A	60 A	300 W	0,2 A	DD 60
GDE2/90	74 A	80 A	90 A	320 W	0,2 A	DD 90
GDE2/130	107 A	125 A	130 A	350 W	0,6 A	DD130
GDE2/190	156 A	160 A	190 A	630 W	0,6 A	DD190
GDE2/270	221 A	250 A	270 A	760 W	0,6 A	DD270
GDE2/380	312 A	400 A	380 A	1100 W	1 A	DD380
GDE2/500	410 A	450 A	500 A	1400 W	1 A	DD500
GDE2/700	574 A	630 A	700 A	2000 W	1 A	DD700

3 x

For 500V connection 2 x in series

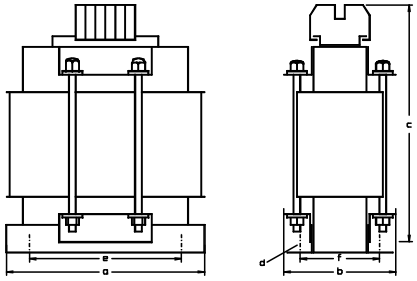
Shared data:

Supply voltage - main power	:	207 - 550 V / D 230 - 500 V ± 10%
Supply voltage - electronics	:	207 - 253 V / 0,2 A E 230 V ± 10%
Supply voltage - field supply	:	max. 400 V / E 400 max.
Frequency of supply voltage	:	48 - 63 Hz
Output - field supply	:	0.9 x UE / DC / max. 7 A
From GDE2/130	:	0.9 x UE / DC/ max. 15 A

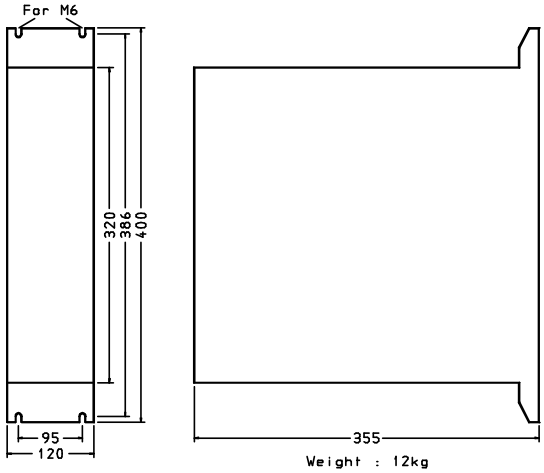
3.2 Dimensions of Chokes and Devices

For 15 - 90 A devices

Type	Rated a.c.	a	b	c	d	e	f
DD15	12 A	123	70	125	4,8	123	49
DD30	24 A	153	74,5	150	4,8	153	54,5
DD60	48 A	180	100,5	175	7,0	180	70,5
DD90	72 A	180	120	175	7,0	180	90

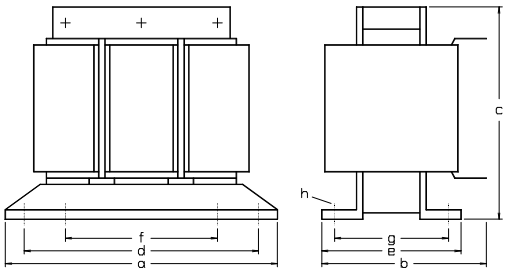


GDE2-15
GDE2-30
GDE2-60
GDE2-90

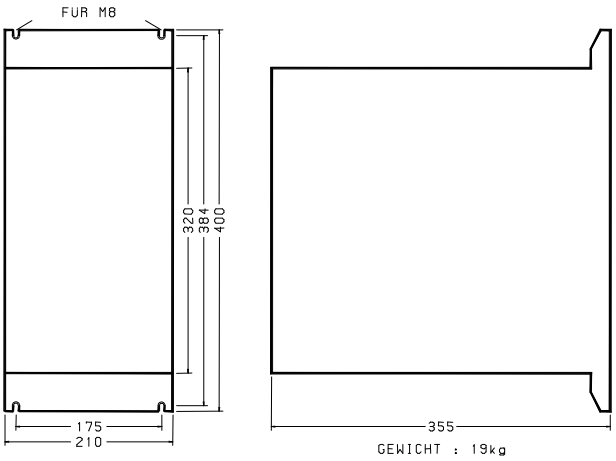


For 130 - 700 A devices

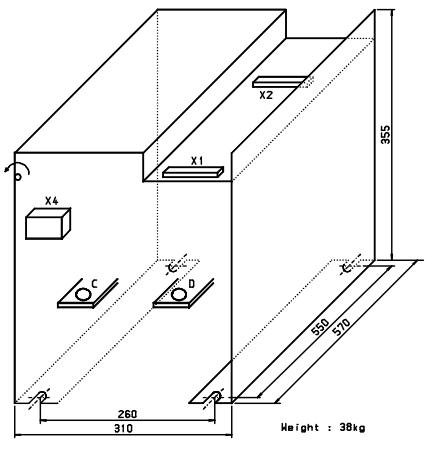
Type	Rated AC	a	b	c	d	e	f	g	h
DD130	160 A	219	150	160	201	115,5	136	90,5	7x12
DD190	160 A	267	170	200	249	133	176	103	7x12
DD270	315 A	316	195	235	292	138	200	98	10x16
DD380	315 A	316	200	235	292	152	200	112	10x16
DD500	500 A	316	215	235	292	164	200	124	10x16
DD700	630 A	352	230	270	328	184	224	144	10x16



GDE2/130
GDE2/190
GDE2/270

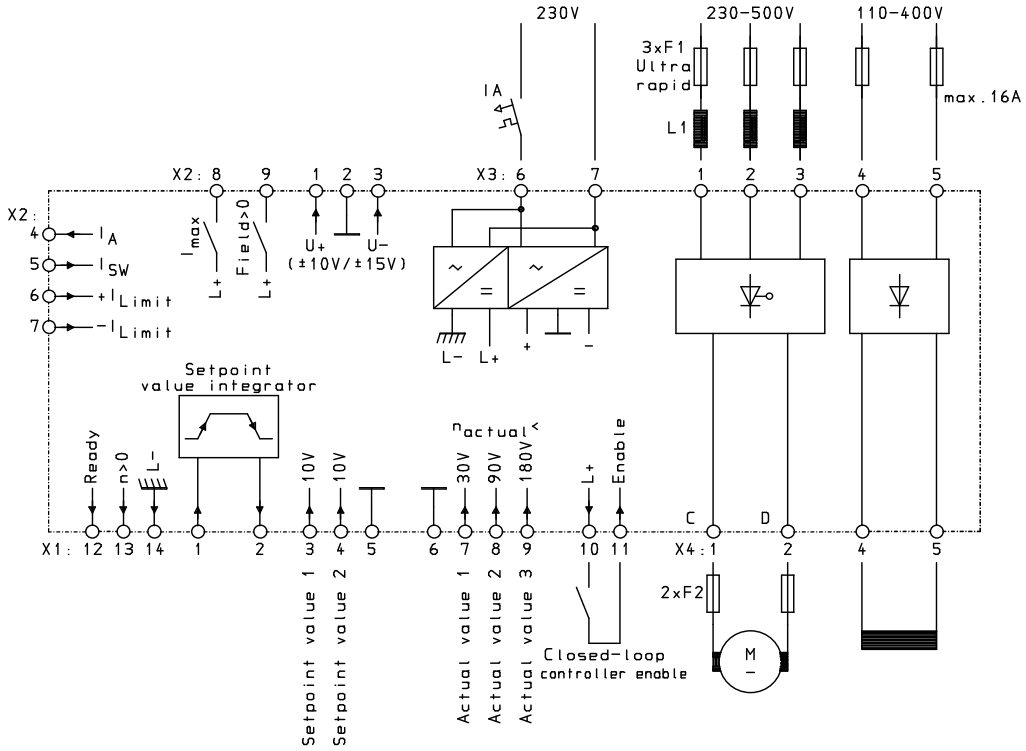


GDE2/380
GDE2/500
GDE2/700



4 DEVICE CONNECTION

4.1 Connection Diagram



Danger

Incorrect connection of the device can lead to damage or destruction.

4.2 Sequence for Switching On/Off

Switching on

1. Field supply X3: 4 + 5
2. Electronics supply X3: 6 + 7
3. Main power X3: 1 + 2 + 3
4. Closed-loop controller enable X1: 10 + 11
5. Setpoint value X1: 1 or 3 or 4

Points 2 to 5 can be switched together, as the device is fitted with an internal inhibition of approx. 200 ms after the electronics supply has been switched on. The "stand-by" signal is also only given after this interval, however.

Point 1 must be switched on at least one second earlier than point 3.

The electronics supply can remain switched on permanently, it does not have to be switched on and off with the drive.

Switching off

1.) Setpoint X1: 1 or 3 or 4
2.) At standstill closed-loop controller enable X1: 10 + 11
3.) Main power X3: 1 + 2 + 3
4.) Field supply X3: 4 + 5
5.) Electronics supply

Points 1 and 2 can be switched together.

Points 3 to 5 can be switched together, but at least one second after point 2.

The electronics supply must not be switched off. The motor is safely isolated when points 1 - 4 have been switched off.

4.3 Terminal Assignment

X1: Electronics plug-in terminal 14-pole

1	Input setpoint value integrator max. ± 10 V. Input resistance 100 K.
2	Output setpoint value integrator max. ± 10 V. Output resistance 44 Ohm.
3	Setpoint value input max. + 10 V. Input resistance 44 K. Filter time constants 22 ms.
4	Setpoint value input max. + 10 V. Input resistance 44 K. Filter constants 22 ms.
5	Closed-loop controller ground
6	Closed-loop controller ground
7	Actual value input max. - 30 V. Input resistance 12 K.
8	Actual value input max. - 90 V. Input resistance 30 K.
9	Actual value input max. - 180 V. Input resistance 48 K.
10	L+, potential-free auxiliary voltage + 24 V for closed-loop controller enable, signal outputs and auxiliary electronics. Load capacity max. 50 mA.
11	Input closed-loop controller enable via optocoupler + 18 to 30 V corresponds to > 12.5 V corresponds to closed-loop controller enable. Input resistance 3K3.
12	Output operational signal. + 24 V corresponds to "device stand-by". Max. load capacity 20 mA.
13	Output operating signal. + 24 V corresponds to "drive turning". Max. load capacity 20 mA.
14	L-, reference point of potential-free auxiliary voltage 24 V for closed-loop controller enable, signal outputs and auxiliary electronics. Load capacity 50 mA.

X2: Electronics plug-in terminal 9-pole

1	Output + 15 V or + 10 V stabilized for auxiliary electronics and setpoint value formation. Max. load capacity 30 mA. The voltage can be determined using the jumper (+15/+10).
2	Closed-loop controller ground
3	Output – 15 V or - 10 V stabilized for auxiliary electronics and setpoint value formation. Max. load capacity 30 mA. The voltage can be determined using the jumper (-15/-10).

4	Output current actual value. Nominal device current corresponds to + 10 V. Output resistance 220 Ohm.
5	Auxiliary input to current controller. + 10 V corresponds to 100% current setpoint value. Input resistance 44 K. Filter time constants 2.2 ms.
6	Input for external current limit setting + or - 10 V corresponds to 100% (R5 right stop) current limit for positive speed setpoint value and drive operation. Input resistance 4K7.
7	Input for external current limit setting for 4Q-device (R6 left stop). Input resistance 4K7.
8	Signal output "current limit“ . + 24 V corresponds to device at current limit. Max. load capacity 20 mA.
9	Signal output "field current“. + 24 V corresponds to field current larger than 0.2 A. For devices above 380 A, field current larger than 0.4 A Max. load capacity 20 mA.

Main power connections X3 + X4

	Main current supply X3: 1 + 2 + 3	Field supply X3: 4 + 5	Electronics supply X3: 6 + 7	Armature connection X4: 1 + 2	Field connection X4: 4 + 5
GDE2-15	4^2 *	2.5^2 *	2.5^2 *	4^2 *	2.5^2 *
GDE2-30	4^2 *	2.5^2 *	2.5^2 *	4^2 *	2.5^2 *
GDE2-60	16^2 *	2.5^2 *	2.5^2 *	16^2 *	2.5^2 *
GDE2-90	16^2 *	2.5^2 *	2.5^2 *	35^2 *	2.5^2 *
GDE2-130	20 x 3/M8 **	4^2 *	2.5^2 *	20 x 5/M8 **	4^2 *
GDE2-190	20 x 3/M8 **	4^2 *	2.5^2 *	20 x 5/M8 **	4^2 *
GDE2-270	20 x 5/M8 **	4^2 *	2.5^2 *	20 x 5/M8 **	4^2 *
GDE2-380	40 x 5/M10 **	4^2 *	2.5^2 *	40 x 5/M10 **	4^2 *
GDE2-500	40 x 5/M10 **	4^2 *	2.5^2 *	40 x 5/M10 **	4^2 *
GDE2-700	40 x 5/M10 **	4^2 *	2.5^2 *	40 x 5/M10 **	4^2 *

*** = Line-up terminals** **** = Conductor rails**

4.4 Assembly

4.4.1 Danger

Incorrect lifting can lead to injury and damage to the equipment.

The device should only be lifted by qualified personnel using suitable equipment.

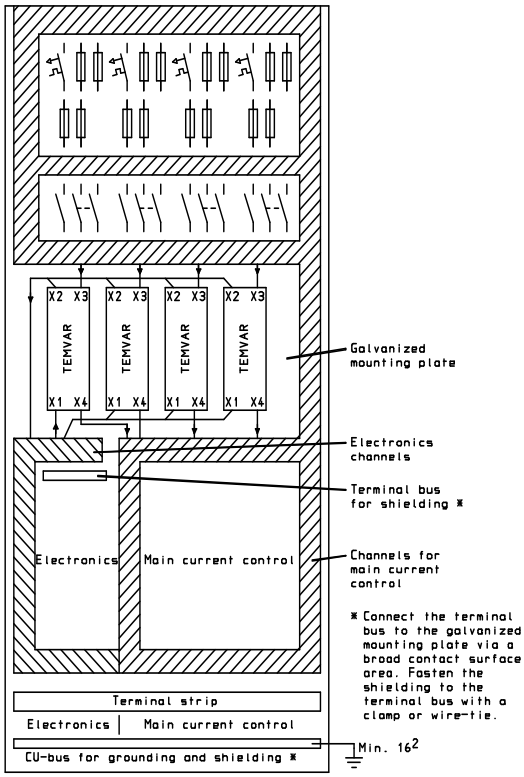
The device must be assembled in accordance with safety regulations (e.g. DIN, VDE) and all other relevant national or local regulations. The device must be properly grounded, with sufficient phase-to-ground clearance and corresponding short-circuit protection, to ensure that a high level of operating safety is maintained.

4.4.2 Mechanical Design

For reasons of electromagnetic compatibility (EMC), the devices have a galvanized steel housing. For the same reason, a galvanized mounting plate is recommended, along with connecting the ground lead to a copper bus connected to the mounting plate via a broad, conductive surface area (see construction suggestions).
In order to ensure an unimpeded flow of cooling air, an interval of at least 100 mm above and below the device must be kept clear of obstruction.

Failure to observe this may lead to the device overheating!

The main power fuses must be ultra fast blowing semiconductor fuses.



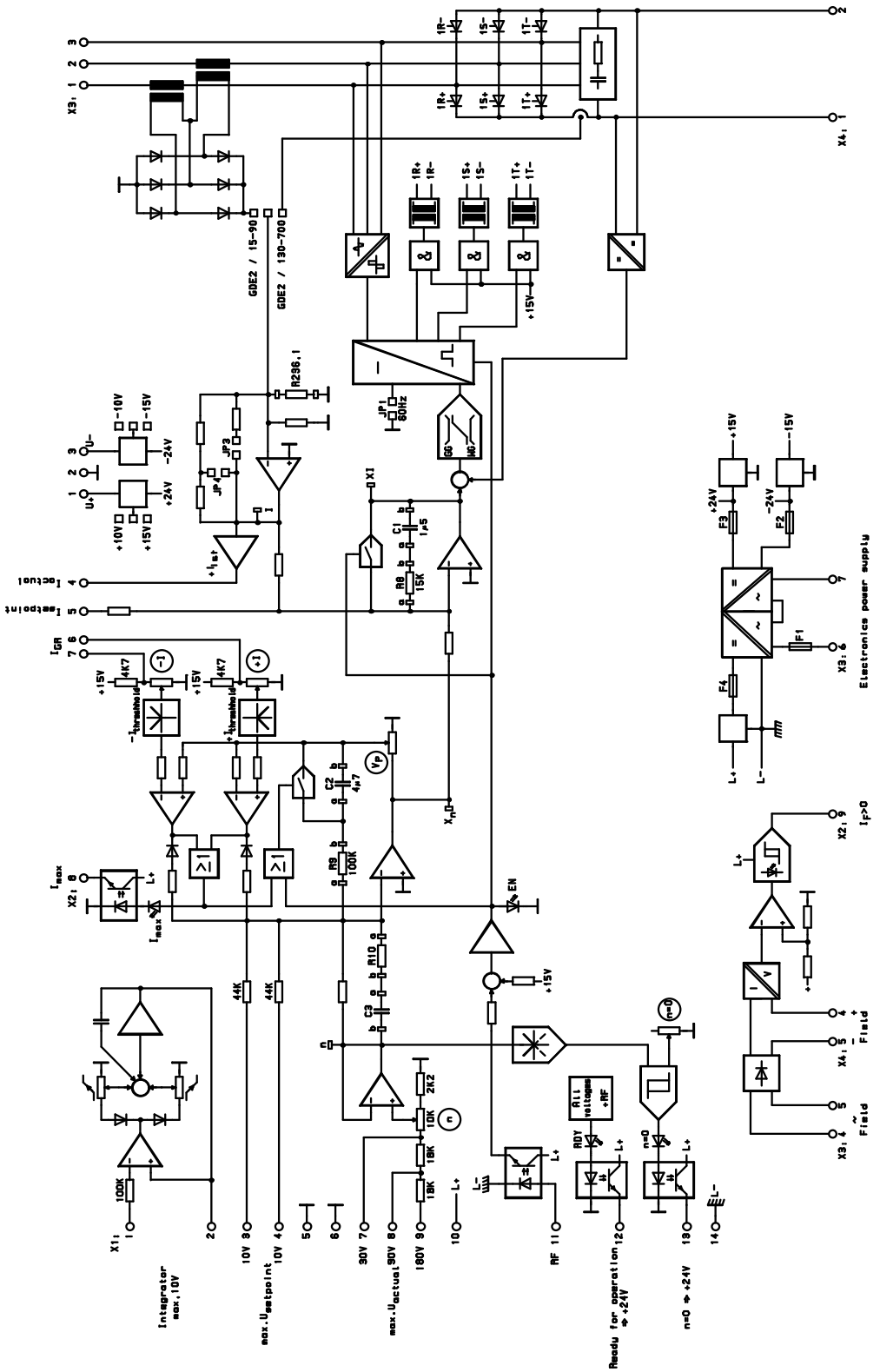
4.4.3 Wiring Instructions

All leads connected to terminal strips X1 and X2 must be shielded. The shielding should be firmly attached using terminals, clips, or binders, across a broad contact surface on the bus bar provided for that purpose. Analog signal leads should only be grounded at one point. Leads with binary control signals can be grounded at several points. The wiring paths should be kept short and the electronics wiring should be strictly isolated from the main current wiring. (see the construction suggestions).

The closed-loop controller ground should be connected to the protective circuit by a short 2.5^2 stranded wire.

5 LAYOUT PLANS

5.1 Circuit Diagram

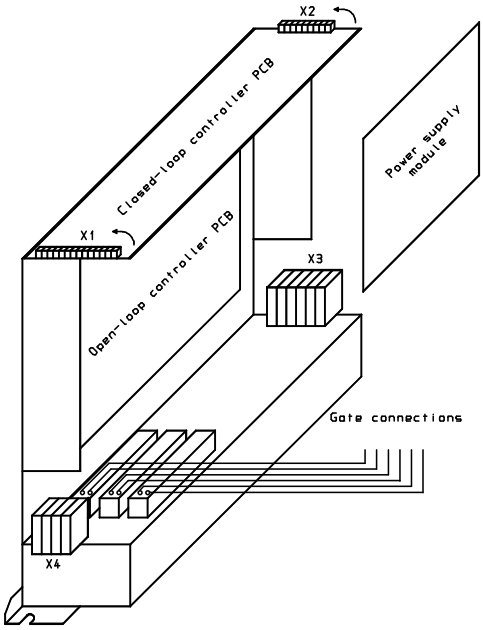


5.2 Equipment Configuration

Thyristor module:

GDE2-15	3 x MCC 19-16io8B
GDE2-30	3 x MCC 19-16io8B
GDE2-60	3 x MCC 44-16io8B
GDE2-90	3 x MCC 44-16io8B

The miniature fuses for the electronic supply are located on the supply module.
This module can be accessed when the closed-loop controller PCB is lifted out the way in the direction of the arrow.



X1: Electronics terminal strip
Main function

X2: Electronics terminal strip
Main function

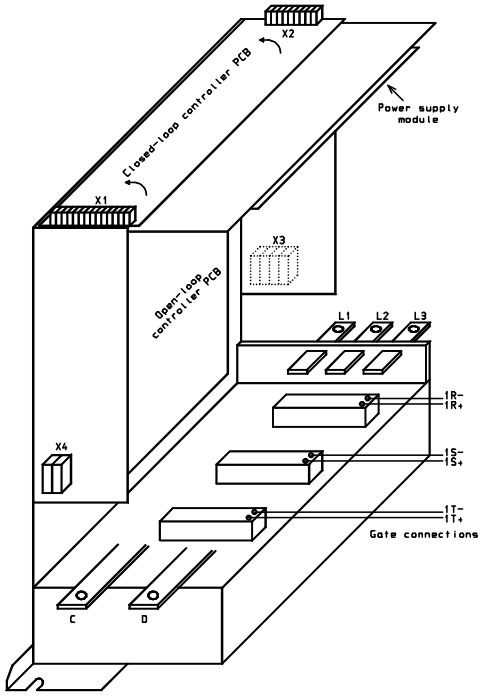
X3: Input terminals
Main power

X4: Output terminals
Main power

Thyristor module:

GDE2-130	3 x MCC 95-16io8B
GDE2-190	3 x MCC 95-16io8B
GDE2-270	3 x MCC 132-16io8B

The miniature fuses for the electronics supply are located on the supply module.
This module can be accessed when the closed-loop controller PCB is lifted out of the way in the direction of the arrow.



X1: Electronics terminal strip
Main function

X2: Electronics terminal strip
Auxiliary function

X3: Input terminals
Main power

X4: Output terminals
Main power

Thyristor module:

GDE2-380	3 x MCC 170-16io8B
GDE2-500	3 x MCC 255-16io8B
GDE2-700	6 x MCC 312-16io8B

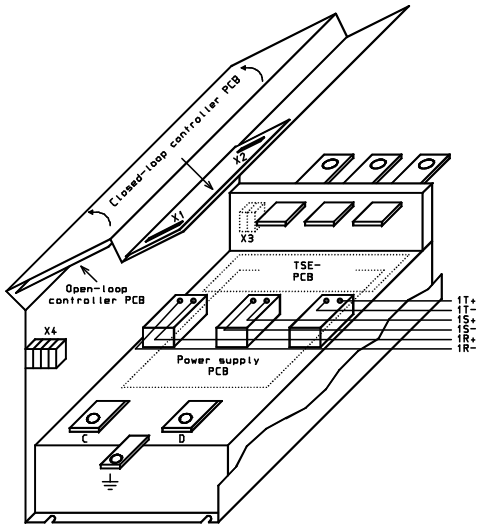
The miniature fuses for the electronics supply are located on the supply module.
This module can be accessed when the closed-loop controller PCB is lifted out of the way in the direction of the arrow.

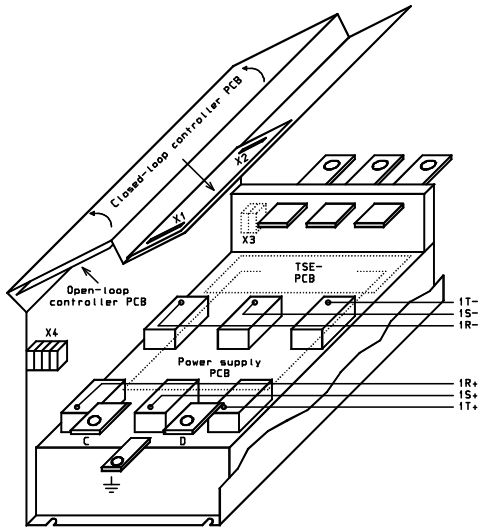
X1: Electronics terminal strip
Main function

X2: Electronics terminal strip
Auxiliary function

X3: Input terminals
Main power

X4: Output terminals
Main power



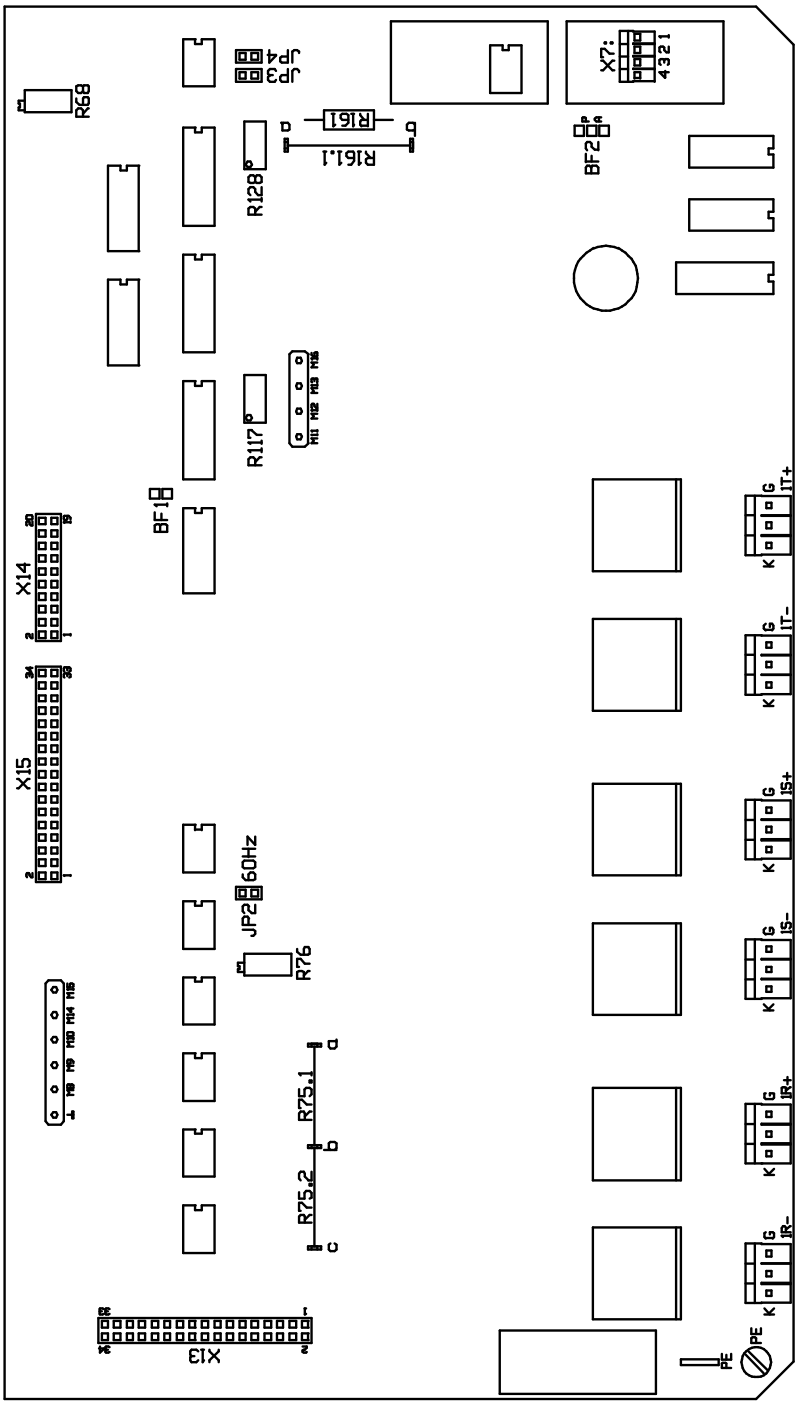


Danger

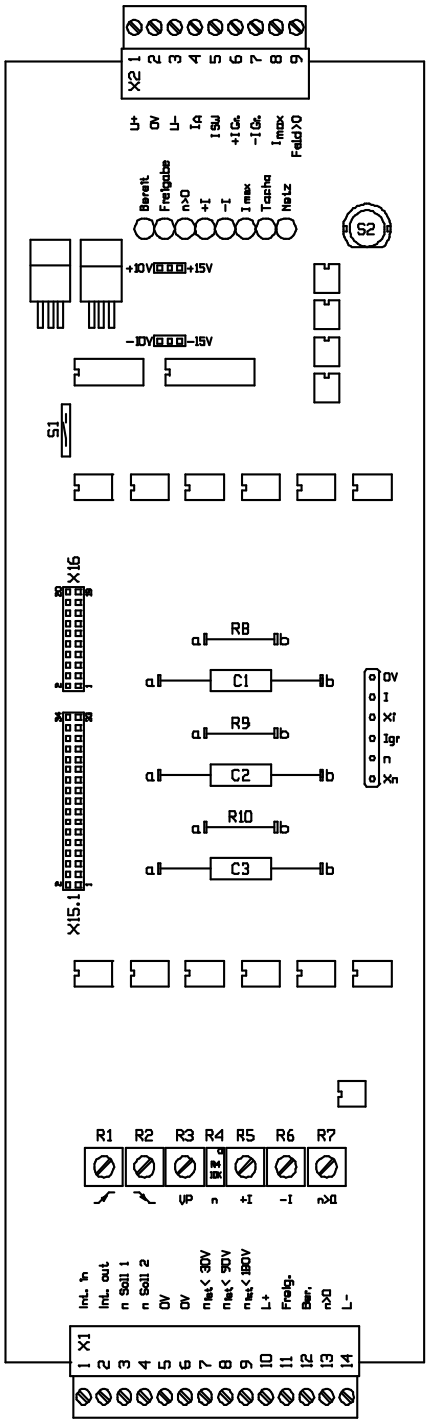
Dangerous voltage is present even when the system switch of the power controller is open. The control module and supply modules contain a number of dangerous live circuits.

Failure to observe the instructions given in this operating manual can cause death, serious injury to persons, and damage to equipment.

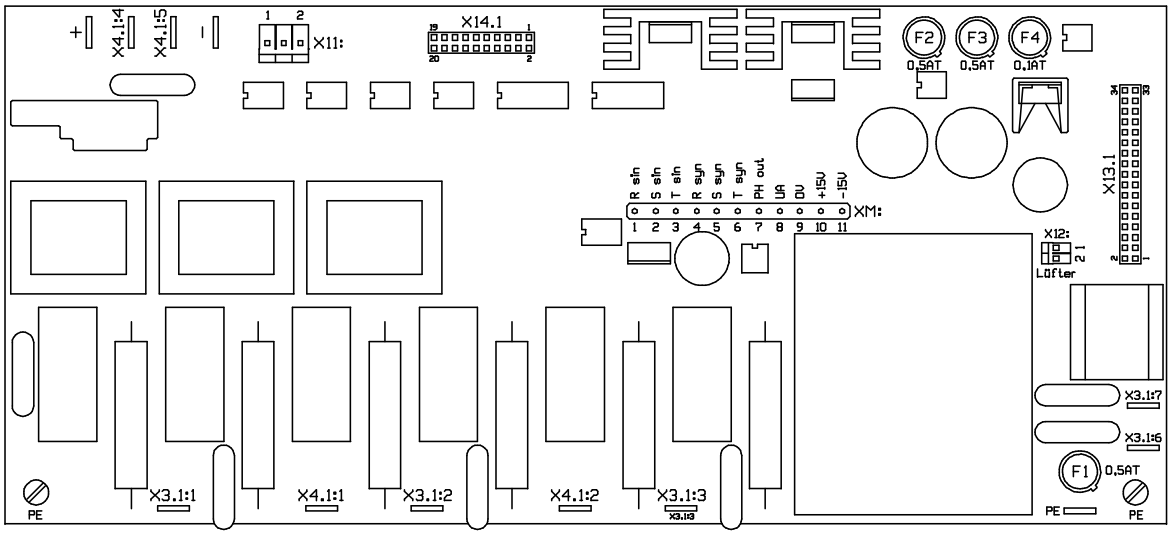
5.3 Component Mounting Diagram for Electronics PCBs



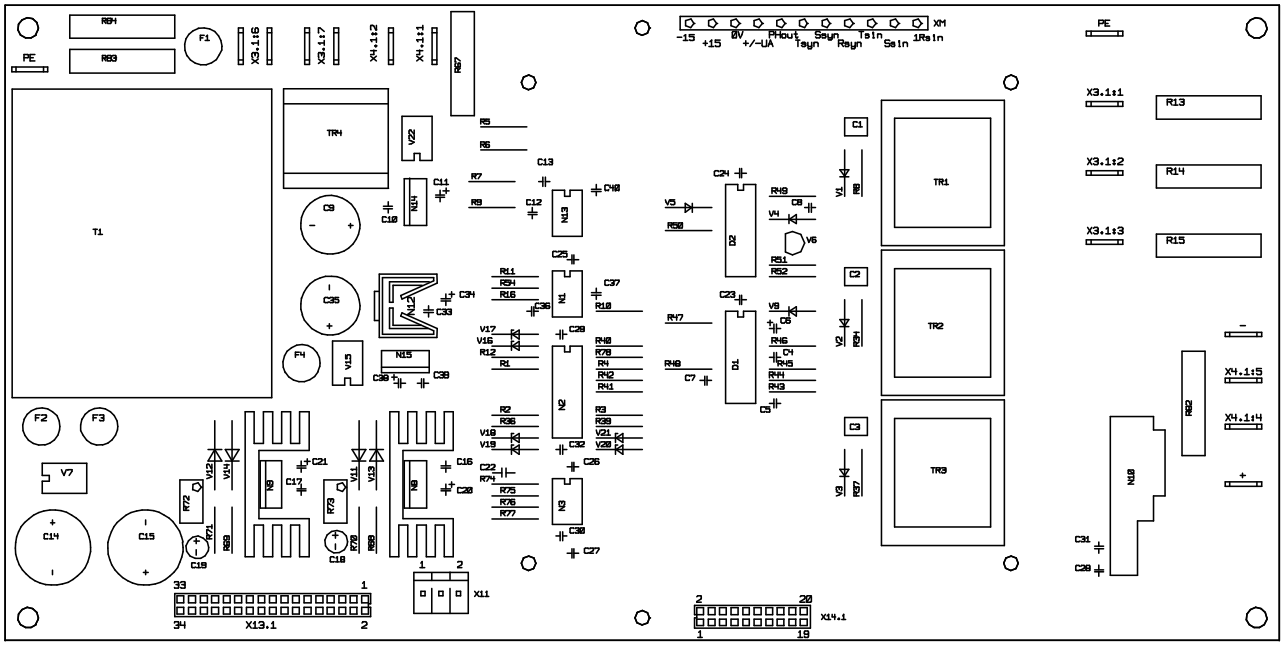
Open-loop controller PCB
GDE2
(A0095xx)



Closed-loop controller PCB
GDE2
(A0114xx)



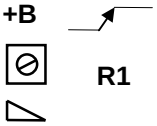
SUPPLY PCB
For devices up to 270 A



SUPPLY MODULE
For devices above 380A

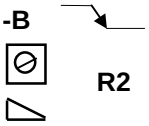
5.4 Potentiometer Settings

+B **R1**



Setpoint value integrator. Acceleration time for positive setpoint value.
Left stop approx. 1.5 seconds, right stop approx. 15 seconds.
Acceleration time from 0 to 10 V.

-B **R2**



Setpoint value integrator. Delay time for positive setpoint value. Effect as with + B.

V_p **R3**

Proportional gain for the speed controller. Left stop = x2.
Right stop = x20. This area is determined by R9 as delivered.

n **R4**

25-turn spindle potentiometer for speed adjustment. Setting range approx. 1 : 4
Right-hand rotation means higher speed.

+I **R5**

Current limit for motor-driven operation and positive speed setpoint value or generator-driven operation and negative speed setpoint value. Left-hand stop causes current limit 0, right-hand stop 100% of the nominal device current.

-I **R6**

Current limit for 4 Q device (left-hand stop).

n > 0 **R7**

Threshold of operating signal 0 to 15% of the maximum speed can be set.
Right stop is equal to 15%.

5.5 LED Displays

STAND-BY

⊗ LED lights up when all internal electronic voltages are okay.
As soon as the closed-loop controller is enabled, the system voltage is also checked.
Main power with clockwise rotating field, phase failure and tacho monitoring.

CLOSED-LOOP CONTROLLER ENABLE

⊗ LED lights up when the device is ready and the closed-loop controller on terminal 11 is enabled by the + 24 V signal.

n > o

⊗ LED lights up if the drive rotates faster than the threshold value set on the potentiometer n > 0.

Current direction "+"

⊗ LED indicates 1Q operation.

Current direction "-"

⊗ This signal is only in use for the 4 Q device.

Current limit

⊗ LED lights up if the motor is driven at the set current limit for at least 15 seconds, i.e., the speed controller is operated up to the stop, which is set with the potentiometer +I.

Tacho

⊗ LED lights up when the tacho voltage is not at the ratio to the armature voltage specified.

System power

⊗ LED lights up if the system power is not with clockwise rotating field, in the event of phase failure or overheating of the heat sink.

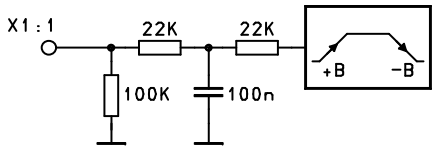
6 FUNCTIONAL DESCRIPTION OF THE INPUTS AND OUTPUTS

6.1 Analog Inputs

The analog inputs may only be connected using shielded leads. The shield should only be connected to the grounding system at one point, across a broad contact surface in close proximity to the device. For reasons of electromagnetic compatibility, these leads may never be operated open-circuit, they must be connected with respect to the electrical ground when the device is switched off.

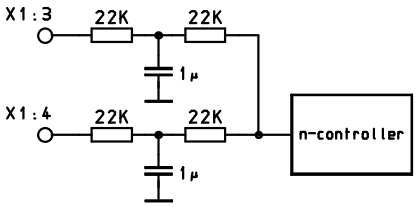
Setpoint value integrator

The input voltage range is ± 0 to 10 V.



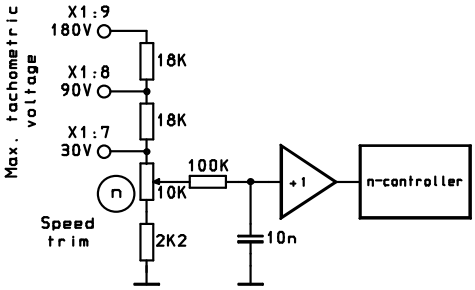
Setpoint value inputs

The two inputs are equal and are added together. The maximum input voltage range is ± 0 to 10 V. Input resistance and filter time constant are 44 K-Ohm and 22 ms respectively.



Actual value inputs

The potentiometer "speed adjustment" is a 25-speed spindle potentiometer with a setting range of approx. n = 4.
Right-hand stop means highest speed.
The filter time constant is selected at a very low level of approx. 2.2 ms for reasons of dynamics, the tacho voltage must therefore be very clean.



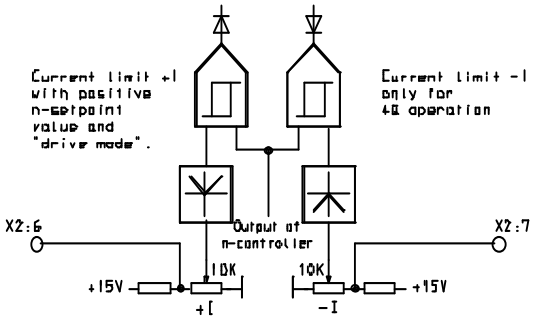
Inputs "external current limit"

The maximum motor current is set using potentiometer +I (right stop 100% nominal device current).
An external voltage of 0 to 10 V at X2: 6 means 0 to 100% motor current.

The input is equipped with an active rectifier and can therefore process + 10 V or - 10 V (input resistance 4K7).

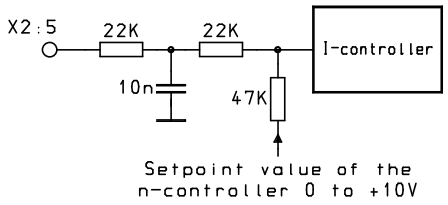
The set current limit can also be reduced by connecting a resistor to ground.

There is only a negative current limit for the 4 Q device. For this device, the potentiometer -I is set to the left stop.



Auxiliary input - current controller

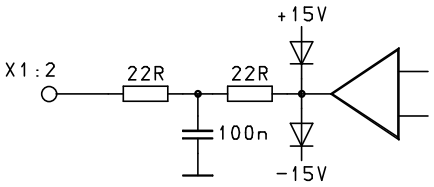
A voltage of + 10 V at terminal X2: 5 means nominal device current.
Caution!
This auxiliary setpoint value is added to the main setpoint value from the speed controller. The current limit must be set low enough to ensure that the sum of the two setpoint values does not exceed + 10V. This input has a very low filter time constant (2.2 ms), the voltage at terminal X2: 5 must therefore be very clean.



6.2 Analog Outputs

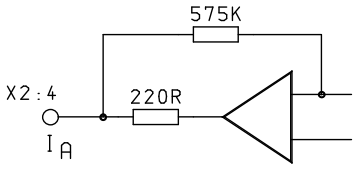
Setpoint value integrator

The output is protected against reverse interference voltage by a lowpass filter and pull-up diodes. This leads to a minimum influence of load variation, which is however completely irrelevant if the load is constant (e.g. with a connection to setpoint value inputs X1: 3 or 4).



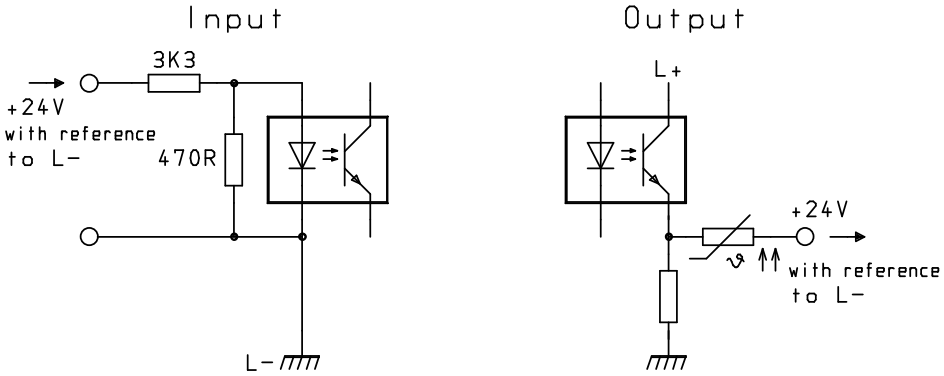
Actual current value

With a nominal device current, a voltage of + 10 V is supplied.
Output resistance 220 Ohm.



6.3 Control Inputs and Signal Outputs

Inputs and outputs are separated from the electronics potential by optocouplers. They have their own 24 V system power supply, designated with +L and -L.



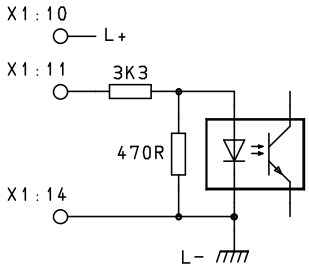
The reference potential -L, terminal X1: 14, is to be connected to the reference potential of the system controls. It is recommended that these inputs and outputs also be connected with shielded wire.

Danger

When controlling the binary control and selection inputs from an external voltage source which is not connected to the device ground (X1: 14 not connected to X1: 5 or 6) the potential difference between device ground and ground of the external voltage must not exceed 50 V (danger for optocouplers).

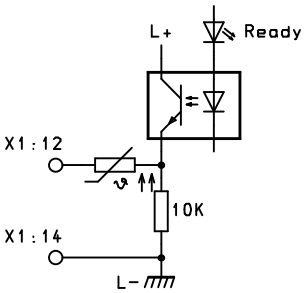
Input - closed-loop controller enable

Closed-loop controller enable means: connect voltage +L to terminal X1: 11, or apply an external voltage of +15 to +30 V, with its reference point connected to -L (terminal X1: 14). For a voltage which is smaller than +10 V, the closed-loop controller is safely inhibited. With an inhibited closed-loop controller, the firing pulses are also suppressed, the drive does not drift at a standstill, but neither can it create torque. When the drive is switched off, the closed-loop controller must be inhibited at least 200 ms before the main power is switched off.



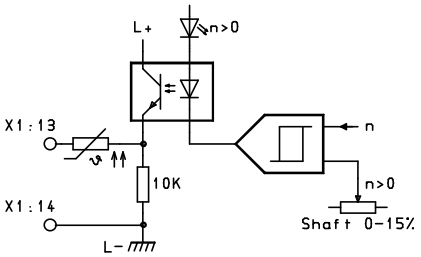
Signal output "stand-by"

Terminal X1: 12 is supplied with voltage +L if the electronics power supply is present. As soon as the closed-loop controller is enabled, the main power is also checked at terminals X3: 1 + 2 + 3. For devices with fans, this stand-by signal also incorporates a temperature switch.
The stand-by signal is cancelled at a heat sink temperature of more than 85° C. The output is short-circuit proof.



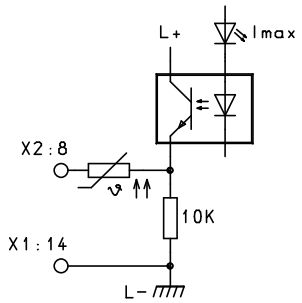
Signal output n > o

Terminal X1: 13 is supplied by +L if the drive turns faster than the threshold value set on the potentiometer n > 0.
The signal is independent of the rotational direction. The output is short-circuit proof.



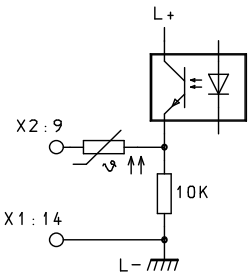
Signal output "I max."

Terminal X2: 8 is supplied by +L if the drive is operated at the maximum set current limit for more than 15 seconds. The output is short-circuit proof.

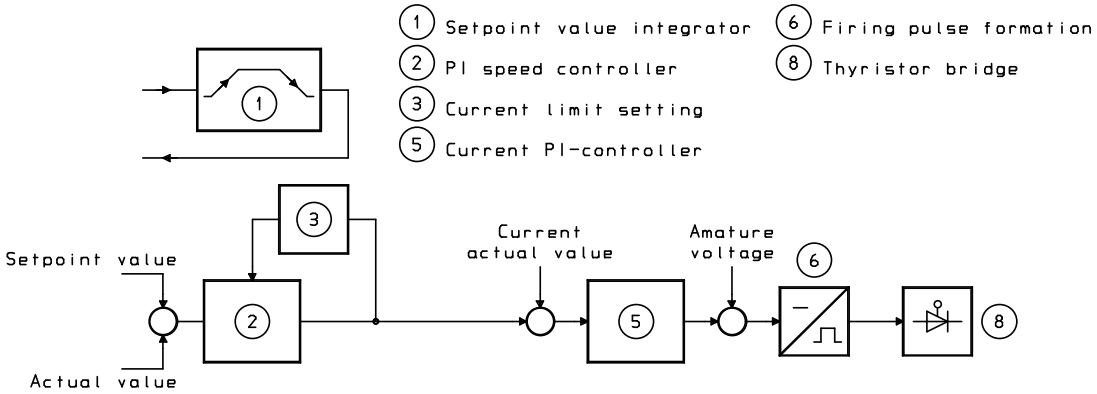


Signal output " field current present"

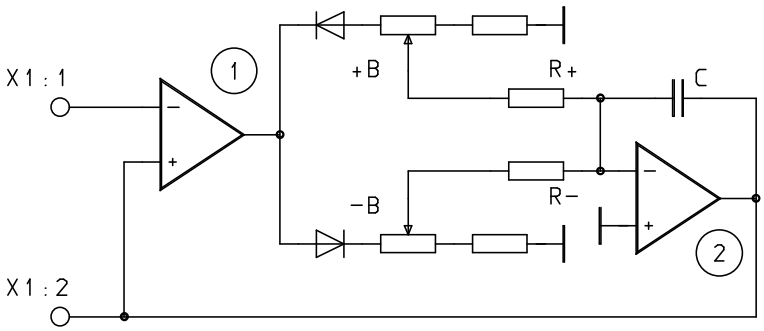
This output is only relevant if the field rectifier in the device - terminals X3: 4 + 5/ X4: 4 + 5 - is used.
Terminal X2: 9 is supplied by +L, if the field current is greater than 0.2 A. For devices above 380 A, for a field current greater than 0.4 A. This signal is not displayed by a light-emitting diode.
The output is short-circuit proof.



7 FUNCTIONAL DESCRIPTION



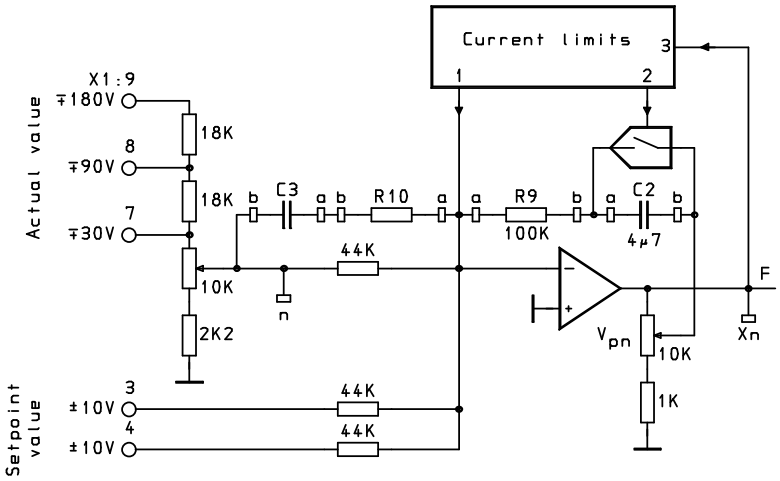
7.1 Setpoint Value Integrator



With a positive setpoint step-change at terminal X1: 1, the comparator (1) inverts into the negative. The capacitor C is charged via resistor R+. The rate of charge depends on the position of the potentiometer +B. When the output voltage on integrator (2) reaches the level of the setpoint value at X1: 1, the comparator (1) returns to 0 and the capacitor C is no longer charged.

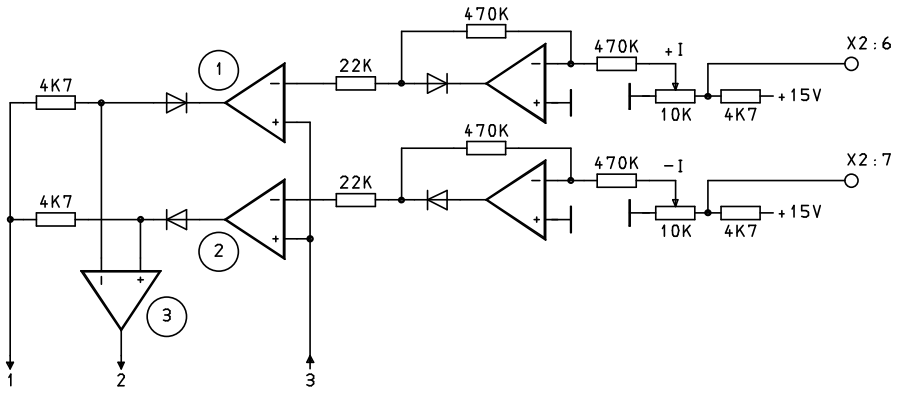
With a negative setpoint value, the same applies via potentiometer -B and charging resistor R-. If a positive setpoint value is reduced abruptly, the comparator (1) tips into the positive range, capacitor C is discharged via potentiometer -B and resistor R-.

7.2 Speed Controller



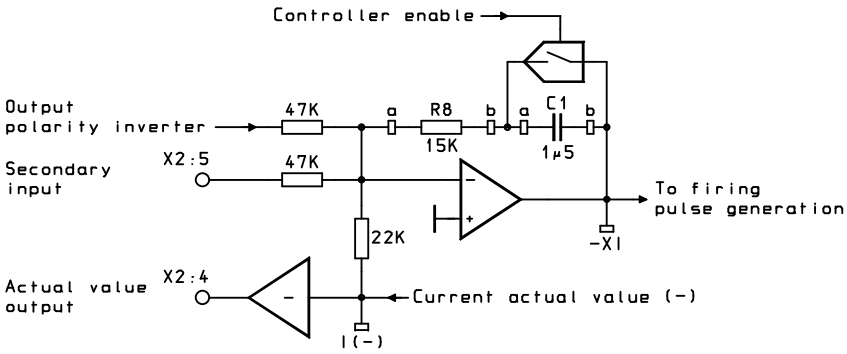
The speed controller is a standard PI-controller. Proportional gain is determined by R9 and potentiometer V_P and the integral-action time by C2. Right-hand stop of the potentiometer V_P is equal to the largest gain. The closed-loop controller output can be measured at test point "X_n". The PI-controller can be expanded to a PID-controller by means of C3 and R10. The current speed, normalized at the level of the setpoint value, can be measured at test point "n".

7.3 Current Limit



Comparators (1) and (2) are set to a bias voltage of between 0 and 10 V via potentiometers +I and -I. Comparator (1) is tipped to positive, comparator (2) to negative. If the speed controller output (point 3) exceeds the bias voltage set, the corresponding comparator is tipped up. Via the corresponding diode and the relatively low resistor 4K7 on the merge point of the speed controller (point 1) the closed-loop controller output is lowered again. At the same time, comparator (3) will tip into the positive and, with a FET-switch, will short circuit capacitor C2 via the speed controller. This circuit is designed for 4Q operation. As the GDE device series only allows 1Q operation, the potentiometer -I is turned to the left-hand stop. The bias voltage of maximum 10 V can also be connected externally to terminals X2: 6 (input resistor 4K7).

7.4 Current Controller

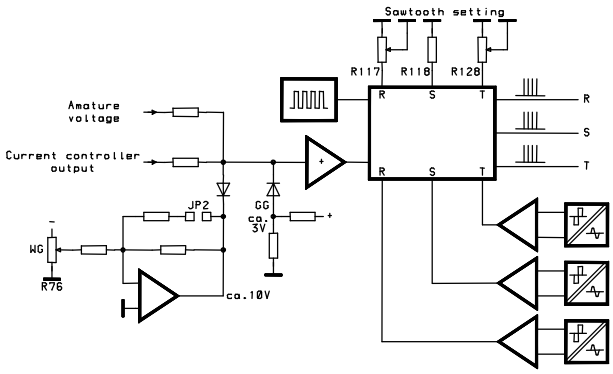


T
he current controller is a standard PI-controller. Proportional gain is determined by R8, the integral-action time by C1. When using auxiliary input X2: 5, it must be taken into consideration that the two setpoint values add up. Together they must not exceed + 10 V. The current controller output can be measured at test point -XI. Terminal X2: 4 is supplied with the actual current value + 10 V at nominal device current. The voltage is equalized with a time constant of 200 ms.
The actual current value is created on the open-loop controller PCB. By increasing the effective load resistance R161/R161.1 and relocating jumpers J3/J4, all values can be kept below the nominal device current level. Decreasing the effective load resistance is not permitted.

Danger

If auxiliary input X2: 5 is used, the device and the motor can be overloaded or the drive run up to excessive speeds. The current limit is not effective at input X2: 5.

7.5 Firing Pulse Formation

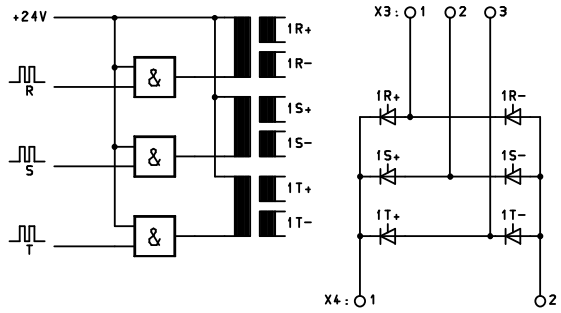


The output voltage of the current controller is added to the actual armature voltage. This relieves the current controller and causes the controller to act more dynamically. The integrated firing pulse module is controlled with the sum of these two voltages. The firing pulses last for approx. 1 ms and are chopped at a 100 µs rate.
The rectifier limit (GG) is fixed, the inverter limit (WG) is set ex works and must not be changed. For 60 Hz operation, bridge JP2 must be fitted on the open-loop controller PCB.

7.6 Thyristor Outputs

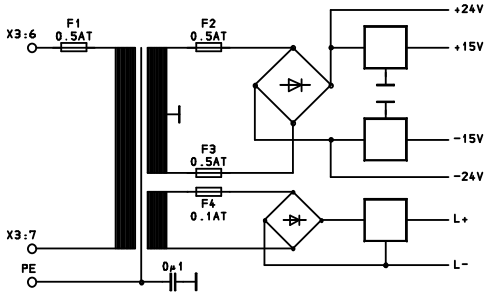
The selected current direction +I activates the corresponding pulse transformers and clears the AND-gates for the firing pulses.

The thyristors require a holding current of approx. 100 mA. If this current is not achieved during the firing phase, the thyristor blocks again after the firing pulse has been removed.



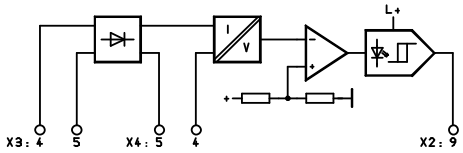
7.7 Electronics Supply

To supply the electronics, a system power source of 230 V/50-60 Hz is required. ± 10% tolerance is permissible. Slow blowing subminiature fuses are used. The ± 15 V and L+ /L- are stabilized with linear regulators.
The ± 24 V are only filtered.



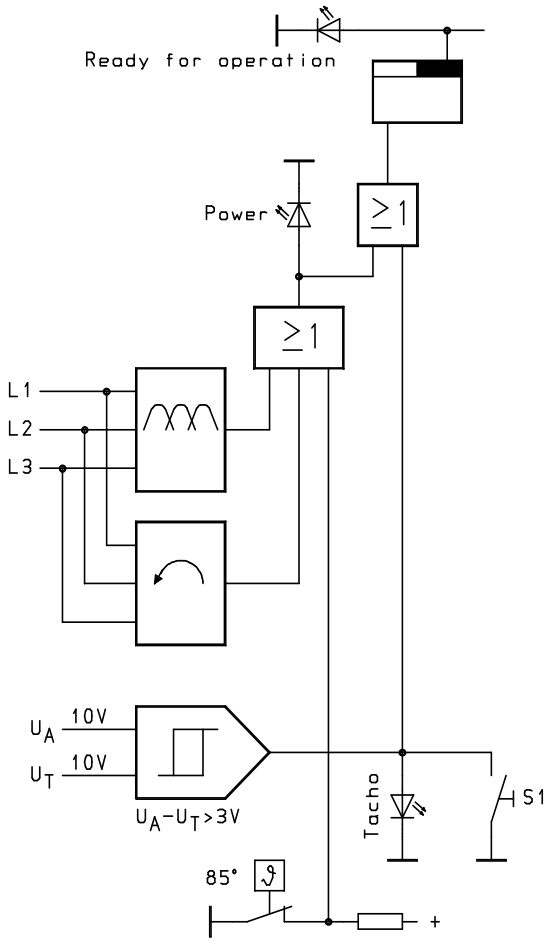
7.8 Field Supply

The rectifier can be connected to a maximum 400 V and carry a maximum load of 5 A (above GDE2/380 max. 15 A). At a current of greater than 0.2 A (for devices above 380 A greater than 0.4 A) potential +L is present at signal output X2: 9. The output is short-circuit proof.



7.9 System Power Supply Monitoring

In the case of an anti-clockwise rotating field or phase failure, a fault alarm flag is set, the closed-loop controller and firing pulse formation are blocked. The "stand-by" signal is cancelled and the red warning lamp "mains“ lights up. The signal flag is reset by switching off the electronics supply for at least 2 seconds or by actuating reset button S2 on the closed-loop controller PCB.



7.10 Tacho Monitoring

The tacho and the closed armature circuit are monitored by the armature voltage being compared with the tacho voltage, normalized at 10 V. With a constant field excitation the tacho voltage is directly proportional to the armature voltage. At the initial set-up, the 10 V tacho voltage has not yet been normalized to 100% armature voltage. Therefore, the device should be switched on for the first time with a speed setpoint value of approx. 1 V. The speed adjustment with 10 V setpoint value can only be made when the tacho monitor is switched off. This is achieved by closing the Dip-Fix switch S1 on the closed-loop controller PCB. If the normalized tacho voltage is approx. 30% below the armature voltage (100% UA = 10 V) or the tacho is incorrectly poled, the fault alarm flag is set (see Section 7.9).

7.11 Fan Monitoring

With the exception of the 15 + 30 A devices, all devices have a fan for cooling purposes. The heat sink temperature is monitored on these devices by an 85° bimetallic thermal switch. The actuated (opened) switch has the same effect on the device as the system power supply monitoring (Section 7.9).

8 INSTALLATION

8.1  Dangers

When this device is operated, certain parts of it are automatically under dangerous voltages, which can lead to serious bodily injury or death. The following precautionary measures must be followed to minimize the risk of injury or death.

1. **Only qualified personnel who are familiar with the device and the information supplied are permitted to assemble and operate the device, to seek and rectify faults and carry out repairs.**

2. **The device must be fitted in accordance with safety regulations (e.g. DIN, VDE) and all other relevant national or local regulations. The device must be properly grounded, with adequate wire sizing, and corresponding short-circuit protection, to ensure that a high level of operating safety is maintained.**

3. **During normal operation, all covers and doors must remain closed.**

4. **Before carrying out checks and maintenance work, it must be ensured that the AC power supply is switched off and locked.**
   Both the power controller device and the motor are live before the AC power supply is switched off. Voltage is present even if the contactor of the power controller is open.

5. **If measurements have to be made when the power supply is switched on, contact with the electrical connection points must be avoided at all times. Remove all jewellery from wrists and fingers. Ensure that the testing equipment is in full and safe working order.**

6. **When working on the live machine, stand on insulated flooring, i.e. make sure that there is no ground connection.**

7. **Follow the instructions given in this manual closely and observe all danger, warning and caution advisories.**

8. **This list is not a comprehensive list of all measures required for the safe operation of the machine. If you require further information or if particular problems arise, please contact the manufacturer.**

8.2 Recommended Procedure

Dangers

Up until installation point 4 the device must remain isolated from the power supply. The drive will start once the closed-loop controller is enabled!

1. Check that all main power ground wires and electronic terminals are connected correctly. Check fuses in accordance with the device table in 3.1.

2. Use an ohmmeter to check the armature connection (1 - 10 OHM), field connection (100 - 500 OHM) and tacho connection (approx. 80 OHM).

3. Set potentiometer +I to approx. 30%, all other potentiometers to the left-hand stop. Release the connection for closed-loop controller enable terminal X1: 11. Disconnect setpoint value (terminal X1: 1 or 3 or 4) and manual potentiometer to terminal X2: 1 + 2. Connect collector ring to X1: 3. Voltage selection terminal X2: 1 to 10 V.

   Determine the maximum tacho voltage expected and check that the correct actual value input is being used. Connect volt meter to this terminal.

4. Switch on the device and measure the main power at terminal X3: 1 + 2 + 3, field supply X3: 4 + 5, electronics supply X3: 6 + 7, field voltage X4: 4 + 5. Set the setpoint value to approx. + 1 V using the manual potentiometer.

5. Briefly tap the free wire "closed-loop controller enable" against terminal X1: 11. The volt meter on the actual value input must deflect negatively. In this case the wire can be fixed in position and the rotational direction of the machine checked. If the rotational direction is incorrect reverse the poles of the field and tacho connections.

6. Set the current limit to the nominal motor current. Set the setpoint value potentiometer to +10 V and deactivate tacho monitoring function (S1). Adjust the speed using spindle potentiometer "n". The armature voltage must not exceed the value on the type plate, if necessary reduce the field current. After adjusting the speed, reactivate the tacho monitoring function.

Danger

Too large an overshoot can lead to the permissible armature voltage being exceeded. Abrupt changes to the setpoint value in the field weakening range can lead to the armature current overshooting.

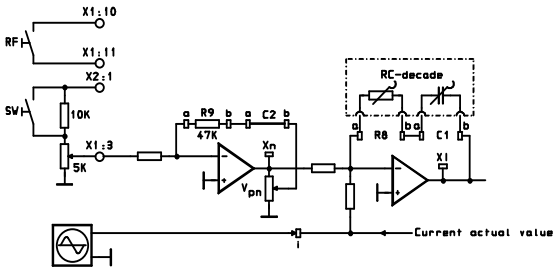
7. Pinch off the manual potentiometer, apply device setpoint value and test the emergency off function with the device setpoint value.

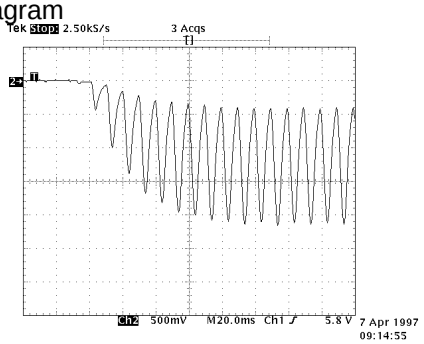
9 OPTIMISATION

For most applications, the standard assignment for the current and speed controllers is fully sufficient. It is advisable, however, to check the transient response of the motor in the event of abrupt changes in the setpoint value and to optimize this using potentiometer V_P . If a critical drive requires more precise optimization, the following procedure is recommended after the drive has been placed in operation.
The speed controller should be optimized with a machine connected.

A) Optimizing the current controller

1. Connect the potentiometer for the setpoint value and switch for closed-loop controller enable according to the following diagram





2. Connect the speed controller according to diagram. V_P-potentiometer to left-hand stop.

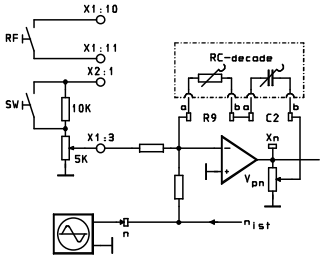
3. Connect RC decade according to diagram. Begin with the standard assignment. Connect oscilloscope to test point "I".

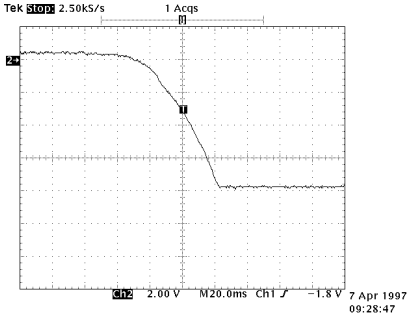
4. Pinch off the field supply. Bridge the field current monitoring function.

5. Switch on the drive, enable the closed-loop controller. Use the potentiometer at terminal 3 to set the even, ripple-free current. Use switch SW to set setpoint value change. Optimize current controller first with R8, then with C1 so that the oscillogram appears similar to the one shown in the diagram.

B) Optimizing the speed controller

1. Connect potentiometer for speed setpoint value, switch for closed-loop controller enable and RC decade according to the following diagram.





2. Connect the field supply. Set the RC decade to standard assignment
V_P-potentiometer to center point.

3. Switch on the drive, enable the closed-loop controller.
Set approx. 30% of the maximum speed and enter the setpoint value change using switch SW. Optimize speed controller first with R9, then with C2 so that the oscillogram appears similar to the one shown in the diagram. The transient response of the speed controller can often be improved using a D-element R10/C3, particularly when accelerating or positioning large masses. Dimensioning guidelines are in the range of 22 K and 1µF.

10 FAULT OCCURRENCE

Dangers

During operation of electrical devices, certain parts are subject to dangerous voltage.

The signal relay of the customer can be subject to dangerous voltage.

Incorrect use of these devices can therefore lead to death or serious injury as well as serious material damage.

For this reason, observe all the instructions in this section and on the device itself when carrying out maintenance work.

Maintenance on the device may only be carried out by authorized personnel, who are fully versed in the safety instructions, assembly, operating and servicing instructions contained in this manual.

Before carrying out checks and maintenance work, it must be ensured that the AC power supply is switched off and locked and that the device is grounded.
Both the power controller device and the motor are live before the AC power supply is switched off. Voltage is present even if the contactor of the power controller is open.

Only spare parts allowed by the manufacturer may be used.

A) Main power fuse defective.

Check the thyristors : Take measurements at terminals X3: 1 + 2, X3: 2 + 3 and X3: 1 + 3 using an ohmmeter.
Resistance must be above 40 K-Ohm.
Measure from X3: 1 to X4.1, then X3: 2 to X4.1 and X3: 3 to X4.1, resistance must be more than 100 K-Ohm.
Measure from X3: 1 to X4.2, then X3: 2 to X4.2 and X3: 3 to X4.2, resistance must be more than 100 K-Ohm.

B) Drive is not turning. Assuming:

Wiring and fuses are okay.
Switch on drive - positive setpoint value.

Light-emitting diodes:

⊗	Stand-by	On	Off	On	On	On	Off	Off
⊗	Cl.-loop controller enable	On	Off	Off	On	On	Off	Off
⊗	n > 0	Off	Off	Off	Off	Off	Off	Off
⊗	Current direction +	On	Off	Off	On	On	On	On
⊗	Current direction -	Off	Off	Off	Off	Off	Off	Off
⊗	Current limit	Off	Off	Off	Off	On	Off	Off
⊗	Tacho	Off	Off	Off	Off	Off	Off	On
⊗	Power system	Off	Off	Off	Off	On	On	Off
	Case	1	2	3	4	5	6	7

Case 1: Setpoint value at terminal X1: 3 or 4 against reference point X1: 5 or 6 probably missing.

Case 2: Measure electronics supply ± 15 V or ± 10 V at terminals X2: 1 + 3. If missing, check supply at X3: 6 + 7 and miniature fuses F1, F2, F3 on the supply module.

Case 3: Closed-loop controller enable missing. Measure + 24V at terminal X1: 11 against reference point X1: 14. If not available, check the miniature fuse F4 on the supply module.

Case 4: Potentiometer current limit +I is turned to zero.

Case 5: Potentiometer current limit +I is not turned up enough. Measure output voltage at X4: 1 + 2. If present, armature line is interrupted.

Case 6: Phase failure, rotational field incorrect**,** measure main connection voltage at X3: 1 + 2. Check the thermal contact for GEV2/40.

Case 7: Normalized tacho actual value 30% smaller than normalized armature voltage, tacho input line interrupted, drive mechanically blocked.