

# Instruction Manual

## for

# 3-Phase 4Q-Power Controller

## Temvar GDV2

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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 actings 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 fulfill 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 to 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 setup 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 setup (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.

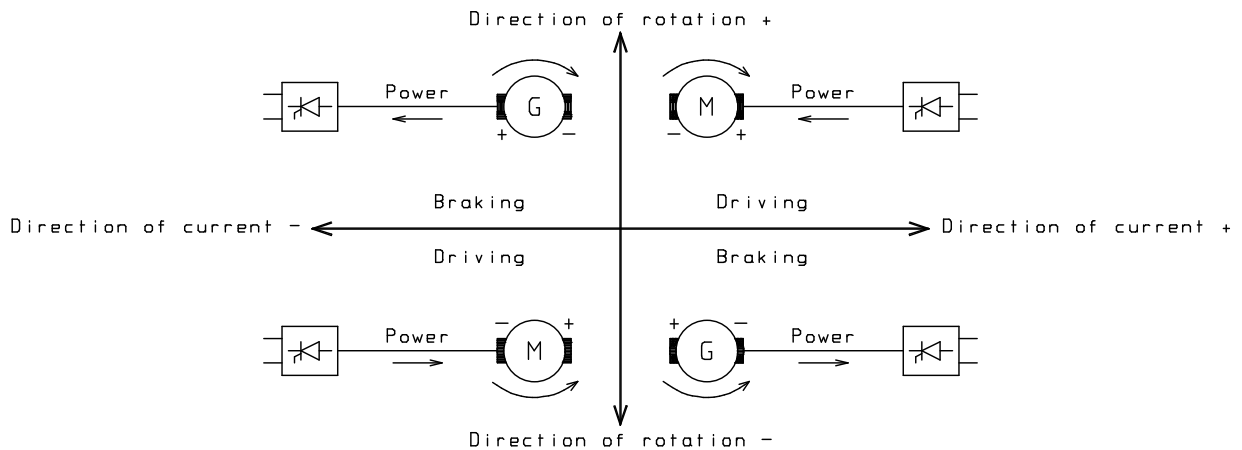
**These safety notes must be kept in a safe place!**

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## 2 DEVICE DESCRIPTION

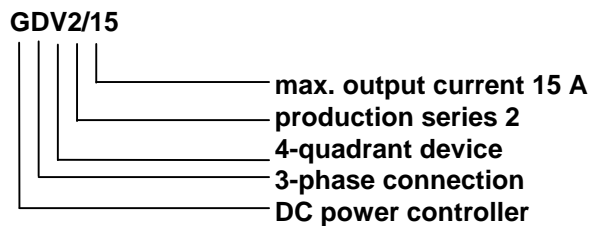
### 2.1 General

The GDV series of 3-phase DC power controllers are compact devices for armature feeding of speed-regulated DC drives up to 700A. The devices allow alternating operation between driving and braking as shown in the following diagrams:



The conceptualization of the device is distinguished by its compact design. An EMC-standard construction (see Chapter 4) is further supported by an enclosed, galvanized housing and the well designed terminal layout.

The main current connection spans a range of from 210 to 550V without switch-over. The electronics power supply for all devices is 230V 50/60 Hz. The electronics power supply is not required to be synchronized with the main current. The essential characteristics of the device can be determined by breaking out its type designator. Example:



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## 2.2 Device Construction

The power section consists of two circulating-current free, inversely parallel thyristor bridges in typical modular construction. The supply connections (X3) are arranged on the upper side of the device. The outputs and electronics connections (X4 and X1) are located on the underside. The electronics consist of a closed-loop controller and open-loop controller PCB, and a supply subassembly.

### 2.2.1 Closed-Loop Controller PCB GDV2 AO114xx

This can be accessed by unscrewing the upper metal panel. Here you will find the electronics terminals X1 (setpoint and actual values, release, and indicating outputs), X2 (potential terminals and secondary inputs), and everything necessary for start-up (Potentiometers, component mounts, LED-indicators). The following circuit groups are located on this board:

- A) Setpoint value integrator
- B) Speed (RPM) actual value adaptation
- C) Speed controller with current limitation
- D) Current controller
- E) Indicating outputs for RPM > 0, current limit reached, field current > 0 and device ready.

### 2.2.2 Open-Loop Controller PCB GDV2 AOO95xx

This board is mounted on the left side wall.  
The following circuit groups are located on this circuit board:

- A) Directional polarity converter between speed and current controller.
- B) Current determination
- C) Rectifier and inverter limitation
- D) Firing pulse generation
- E) On-off switching logic during system power loss
- F) Switch-over logic
- G) Firing pulse output stage

### 2.2.3 Supply Subassembly

Devices:                    15 A - 270 A   GDV2   A0033xx  
Devices:                    380 A - 700 A   GDV2   A0112xx

In devices rated to 270 A, this subassembly is mounted on the right side wall.  
The following circuit groups are located on the subassembly (A00033xx).

- A) Electronics supply with the miniature fuses F1 - F4 (see current diagram, page 12)
- B) Field current monitoring
- C) Synchronous voltage generation
- D) Main power grid monitoring
- E) Temperature monitoring
- F) Armature voltage determination
- G) Overload protection circuit breakers with TSE-wiring for the thyristors

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In devices above 380 A, the subassembly (A0112xx) is mounted under the hinged cover. The overload protection circuit with TSE - wiring is situated on a separate PCB directly off the thyristors.

The important elements, such as the 60 Hz bridge and the miniature fuses for the electronics supply, can be accessed by folding up the closed-loop controller PCB. Other than these, there is nothing on these PCBs that needs to be adjusted before putting the device into operation.



## Danger

**This power controller is subject to dangerous voltages even when the main circuit breaker switch of the device is open. The open-loop controller subassembly and the supply subassembly contain many dangerous, high-voltage circuits.**

**Failure to adhere to the instructions in this operating manual can lead to death, serious bodily injury, and material damage.**

## 2.3 Ambient Conditions

The specified device's rated currents are valid up to a maximum ambient temperature of 40°C. Once this has been exceeded, a reduction of 1% per degree Celsius in the device's rated (or nominal) current must be taken into consideration. The absolute temperature limit is 55°C. Heat accumulation above the device is to be avoided. The devices have IP 00 degree of protection, i.e. they should be housed in enclosed electrical control cabinets or switch boxes. Ambient air must be kept free of electrically conductive dust particles and chemically active vapors. Vibration can ruin the devices.

## 2.4 System Power Relationships

The devices operate in a voltage range of from 230 to 500V  $\pm$  10%/50 Hz. For use with 60Hz power supply, the JP2 jumper must be placed onto the open-loop controller PCB. The signal „ready status“ is served 200 ms after switching on the electronics supply, condition is that the main current supply is on. The enable control is only possible for a unit in ready status. The devices require a system power supply with  $U_K = 4\%$  (with device rated current). This is achieved by interposing the recommended commutating chokes DD15-700. An auxiliary or secondary voltage of 230V  $\pm$ 10%, 50/60Hz is needed for the electronics and cooling fan supply.

**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.

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## 3 PRODUCT OVERVIEW

### 3.1 Device Table

Type	Input Current/Fuse		Output Current/Fuse		Power Loss	Current consumption Electronics	Input Choke
GDV2/15	12 A	16 A	15 A	16 A	150 W	0,2 A	DD 15
GDV2/30	25 A	35A	30 A	32 A	200 W	0,2 A	DD 30
GDV2/60	49 A	63A	60 A	63 A	300 W	0,2 A	DD 60
GDV2/90	74 A	80A	90 A	100 A	320 W	0,2 A	DD 90
GDV2/130	107 A	125A	130 A	160 A	350 W	0,6 A	DD130
GDV2/190	156 A	160A	190 A	200 A	630 W	0,6 A	DD190
GDV2/270	221 A	250A	270 A	315 A	760 W	0,6 A	DD270
GDV2/380	312 A	400A	380 A	400 A	1100 W	1 A	DD380
GDV2/500	410 A	450A	500 A	630 A	1400 W	1 A	DD500
GDV2/700	574 A	630A	700 A	800 A	2000 W	1 A	DD700

↑  
3 x

↑  
For 500V connection 2 x in series

#### Common Data:

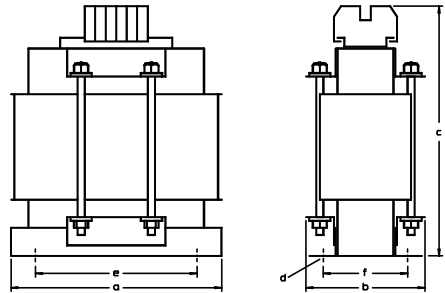
Supply voltage Main current	:	207 - 550V / 48 - 63 Hz D230 - 500 V ± 10 %
Supply voltage Electronics	:	207 - 253V / 48 - 63 Hz / 0.2 A E 230 V ± 10 %
Supply voltage Field supply	:	max. 400V / 48 - 63 Hz E 400 max.
Frequency of supply voltage	:	48 -63 Hz
Output Field supply	:	0.9 x UE / DC / max. 7 A
after GDV2/130	:	0.9 x UE / DC / max. 15 A

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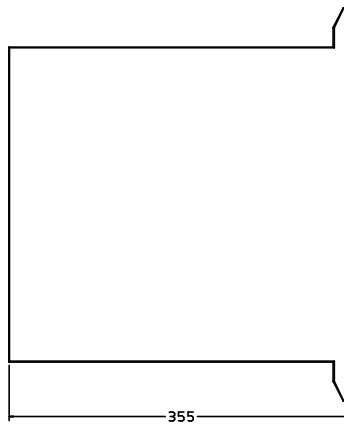
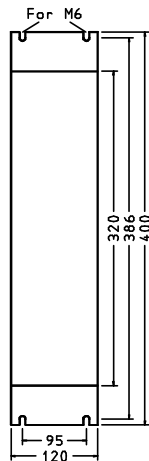
## 3.2 Dimensions of Chokes and Devices

### For devices from 15 - 90A

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



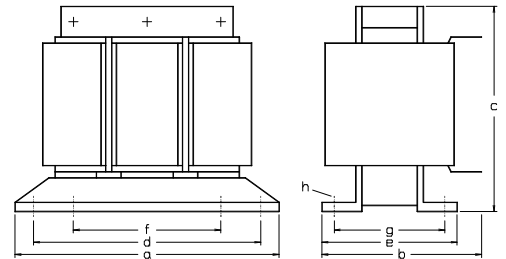
GDV2-15  
GDV2-30  
GDV2-60  
GDV2-90



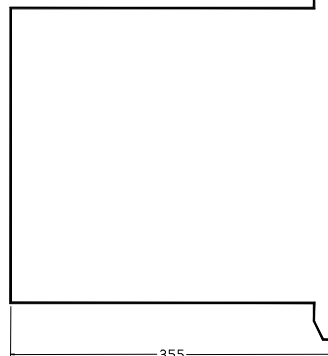
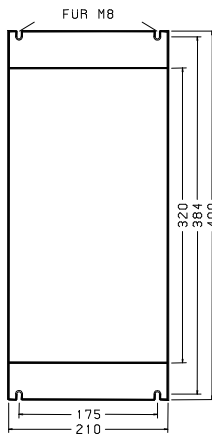
Weight : 12kg

### For devices from 130 - 700A

Type	Rated-A.C.	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

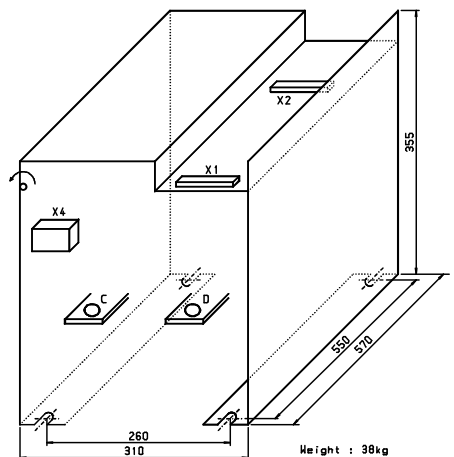


GDV2/130  
GDV2/190  
GDV2/270



GEWICHT : 19kg

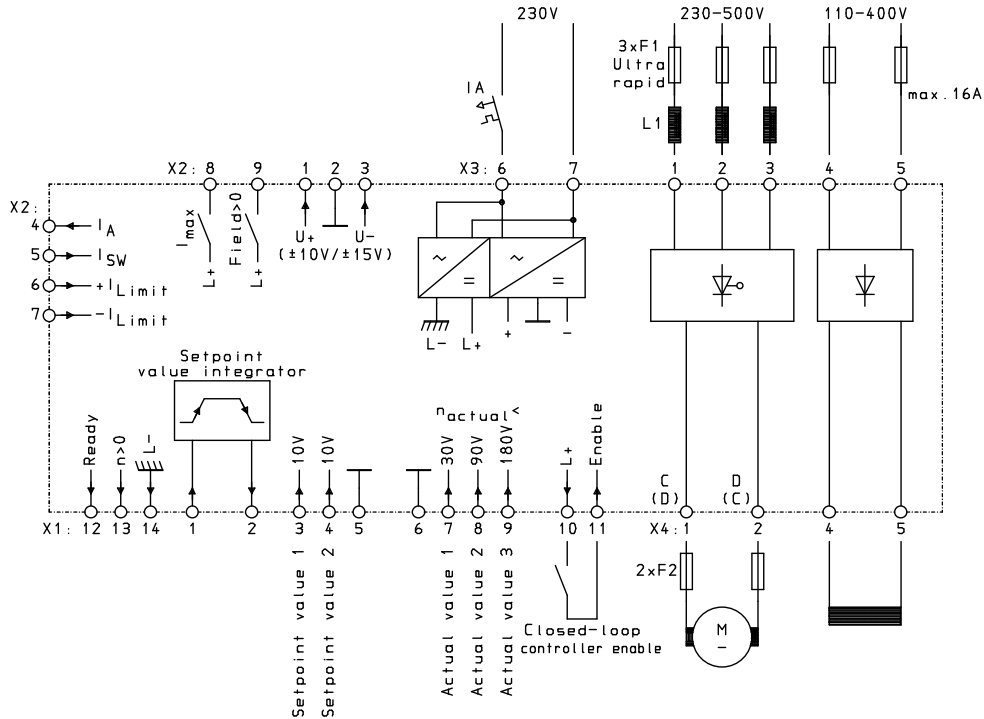
GDV2/380  
GDV2/500  
GDV2/700



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## 4 DEVICE CONNECTION

### 4.1 Terminal Diagram



**Danger**

Improperly connecting the device can cause it to be damaged or destroyed.

### 4.2 Switch ON/OFF Sequence

#### Switching ON

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

Items 2 through 5 may be engaged simultaneously since the device has an internal inhibitor lasting approx. 200ms after the electronics power supply is engaged. The “ready” indicator only stays lit after this time period has elapsed.

Item 1 must be engaged at least 1 second prior to engaging item 3.

The electronics supply can also be left on continuously. It does not have to be switched on and off with each operation.



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## Switching OFF

- 1.) Setpoint value X1: 1 or 3 or 4
- 2.) During stoppage closed-loop controller enable X1: 10 + 11
- 3.) Main current X3: 1 + 2 + 3
- 4.) Field supply X3: 4 + 5
- 5.) Electronics supply

Items 1 and 2 may be switched on simultaneously. The motor does not brake, but spins to a stop.

Items 3 through 5 can be switched on together, but in any event, they must follow item 2 by at least 1 second.

The electronics supply does not have to be switched off. The motor is safely de-energized when items 1 through 4 are switched off.

## 4.3 Terminal Allocation

### **X1: Electronics 14-pin plug-in terminal**

1	Input setpoint value integrator max. $\pm 10V$ . Input resistance 100k $\Omega$ .
2	Output setpoint value integrator max. $\pm 10V$ . Output resistance 44 $\Omega$ .
3	Setpoint value input max. $\pm 10V$ . Input resistance 44k $\Omega$ . Filter time constant 22 ms.
4	Setpoint value input max. $\pm 10V$ . Input resistance 44k $\Omega$ . Filter time constant 22 ms.
5	Closed-loop controller ground
6	Closed-loop controller ground
7	Actual value input max. $\pm 30V$ . Input resistance 12k $\Omega$ .
8	Actual value input max. $\pm 90V$ . Input resistance 30k $\Omega$ .
9	Actual value input max. $\pm 180V$ . Input resistance 48k $\Omega$ .
10	L+, + 24V secondary voltage (independent from main power) for closed-loop controller enable, indicating outputs, and auxiliary electronics. Max. load 50 mA.
11	Input closed-loop controller enable via optocoupler + 18 to 30V corresponds > 12,5 V to closed-loop controller enable. Input resistance 3K3.
12	Output ready signal. + 24V corresponds to "device ready to operate." Max. load capacity 20 mA.
13	Output "running" indication. + 24V corresponds to "drive turning." Max. load capacity 20 mA.
14	L-, Reference point of the 24V secondary voltage (independent from main power) for closed-loop controller enable, indicating outputs, and auxiliary electronics. Max. load 50 mA.

### **X2: Electronics 9-pin plug-in terminal.**

1	Output + 15V stabilized for auxiliary electronics and formation of setpoint values. Max. load 30mA. The voltage can be defined using the jumper (+15/+10).
2	Controller ground
3	Output - 15V or - 10 V stabilized for auxiliary electronics and formation of setpoint values. Max. load 30mA. The voltage can be defined using the jumper (-15/-10).

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- 4 Output current actual value. Device rated current corresponds to + 10 V. Output resistance 220Ω.
- 5 Secondary input to the current controller. + 10 V corresponds to 100% of the current setpoint value.  
Input resistance 44kΩ. Filter time constant 2.2 ms.
- 6 Input for external current limit setting. + or - 10 V corresponds to 100% of the (R5 right stop) current limit with positive RPM setpoint value and “drive” mode.  
Input resistance 4K7.
- 7 Input for external current limit + oder - 10 V corresponds to 100% (R6 right stop) current limit with positive RPM setpoint value and “brake” mode.  
Input resistance 4K7.
- 8 Indicator output “current limit.” + 24V corresponds to device at the current limit.  
Max. load capacity 20 mA.
- 9 Indicating output “field current present.” +24V corresponds to field current greater than 0.2A.  
In devices beyond 130 A, field current greater than 0.4 A.  
Max. load capacity 20 mA.

## Main current connections X3 + X3

	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
GDV2-15	4 <sup>2</sup> *	2,5 <sup>2</sup> *	2,5 <sup>2</sup> *	4 <sup>2</sup> *	2,5 <sup>2</sup> *
GDV2-30	4 <sup>2</sup> *	2,5 <sup>2</sup> *	2,5 <sup>2</sup> *	4 <sup>2</sup> *	2,5 <sup>2</sup> *
GDV2-60	16 <sup>2</sup> *	2,5 <sup>2</sup> *	2,5 <sup>2</sup> *	16 <sup>2</sup> *	2,5 <sup>2</sup> *
GDV2-90	16 <sup>2</sup> *	2,5 <sup>2</sup> *	2,5 <sup>2</sup> *	35 <sup>2</sup> *	2,5 <sup>2</sup> *
GDV2-130	20 x 3/M8 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	20 x 5/M8 **	4 <sup>2</sup> *
GDV2-190	20 x 3/M8 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	20 x 5/M8 **	4 <sup>2</sup> *
GDV2-270	20 x 5/M8 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	20 x 5/M8 **	4 <sup>2</sup> *
GDV2-380	40 x 5/M10 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	40 x 5/M10 **	4 <sup>2</sup> *
GDV2-500	40 x 5/M10 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	40 x 5/M10 **	4 <sup>2</sup> *
GDV2-700	40 x 5/M10 **	4 <sup>2</sup> *	2,5 <sup>2</sup> *	40 x 5/M10 **	4 <sup>2</sup> *

\* = Line-up terminals

\*\* = Current busses

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## 4.4 Assembly

### 4.4.1 Danger

Improper lifting can lead to bodily injury or material damage.

Only lift the device with the appropriate gear and using appropriately qualified personnel.

Device fitting must be conducted in accordance with the safety regulations (e.g. DIN, VDE) and all other relevant governmental or local regulations. Sufficient grounding, wire sizing, and appropriate short-circuit protection must be present in order to ensure operational safety.

### 4.4.2 Mechanical Construction

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 from a copper bus 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 100mm above and below the device must be kept clear of obstruction.

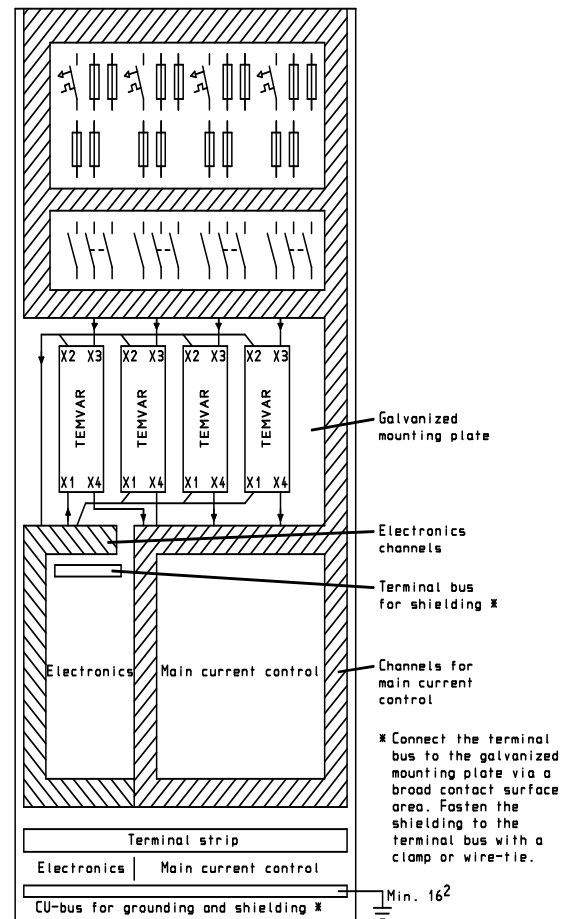
Failure to maintain this interval will result in the device overheating!

The main current fuses must be ultrafast semiconductor fuses.

### 4.4.3 Wiring Notes

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).

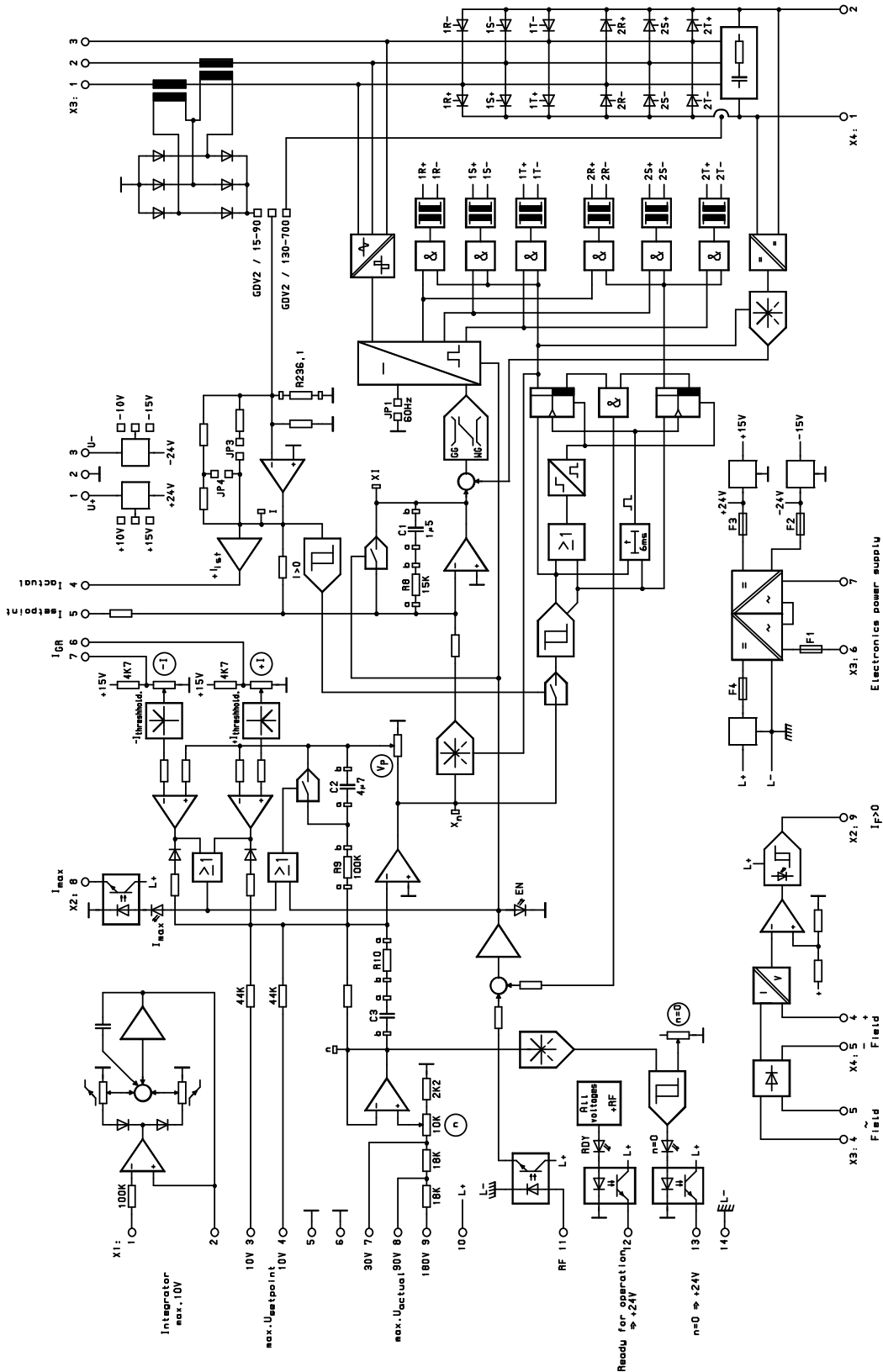
The closed-loop controller ground should be connected to the protective ground system by a short 2.5<sup>2</sup> litz wire.



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## 5 OVERVIEW DIAGRAMS

### 5.1 Circuit Diagram



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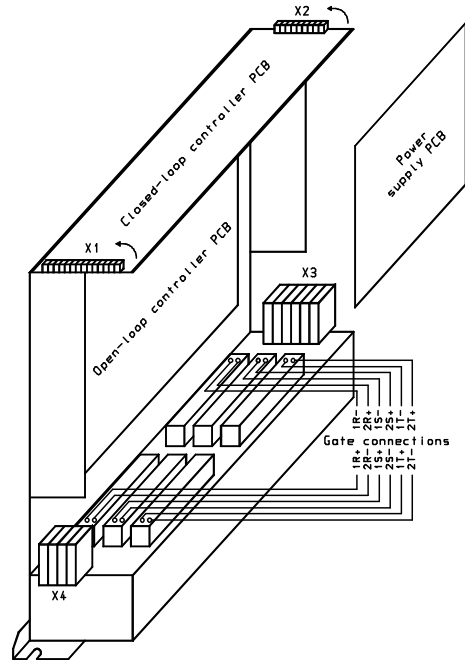
## 5.2 Device Mounting

### Thyristor module:

GDV2-15	6 x MCC 19-16io8B
GDV2-30	6 x MCC 19-16io8B
GDV2-60	6 x MCC 44-16io8B
GDV2-90	6 x MCC 44-16io8B

The miniature fuses for the electronics supply are located on the supply subassembly. This subassembly can be accessed by folding back the closed-loop controller PCB in the direction indicated by the arrow.

- X1: Electronics terminal strip  
Primary function
- X2: Electronics terminal strip  
Secondary function
- X3: Input terminals  
Main current
- X4: Output terminals  
Main current

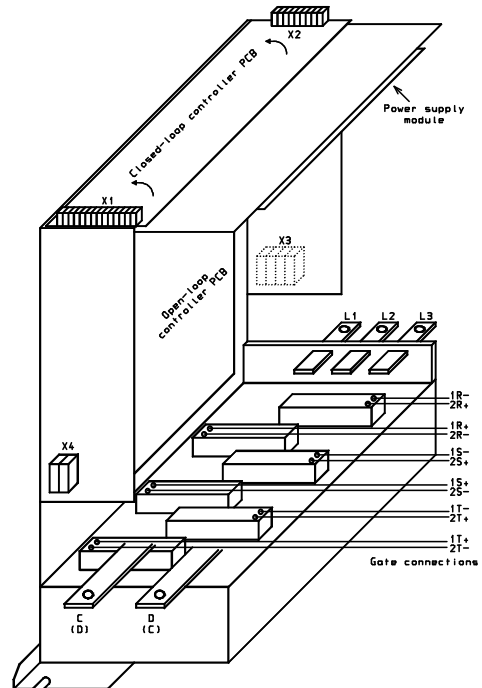


### Thyristor module:

GDV2-130	6 x MCC 95-16io8B
GDV2-190	6 x MCC 95-16io8B
GDV2-270	6 x MCC 132-16io8B

The miniature fuses for the electronic supply are located on the supply subassembly. This subassembly can be accessed by folding back the closed-loop controller PCB in the direction indicated by the arrow.

- X1: Electronics terminal strip  
Primary function
- X2: Electronics terminal strip  
Secondary function
- X3: Input terminals  
Main current
- X4: Output terminals  
Main current



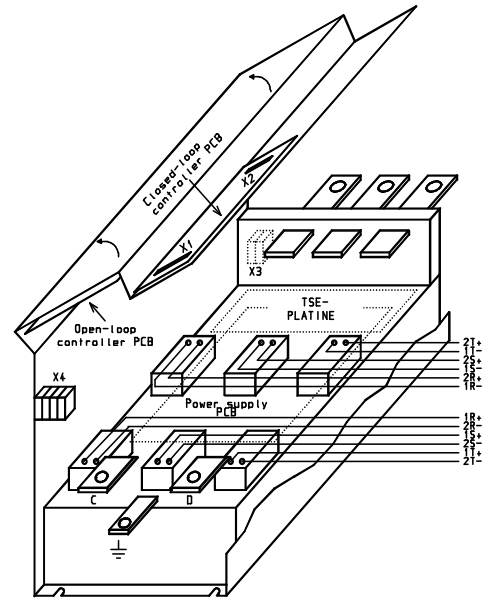
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## Thyristor module:

GDV2-380	6 x MCC 170-16io8B
GDV2-500	6 x MCC 255-16io8B
GDV2-700	6 x MCC 312-16io8B

The miniature fuses for the electronics supply are located on the supply subassembly. This subassembly can be accessed by folding back the closed-loop controller PCB in the direction indicated by the arrow.

- X1: Electronics terminal strip  
Primary function
- X2: Electronics terminal strip  
Secondary function
- X3: Input terminals  
Main current
- X4: Output terminals  
Main current



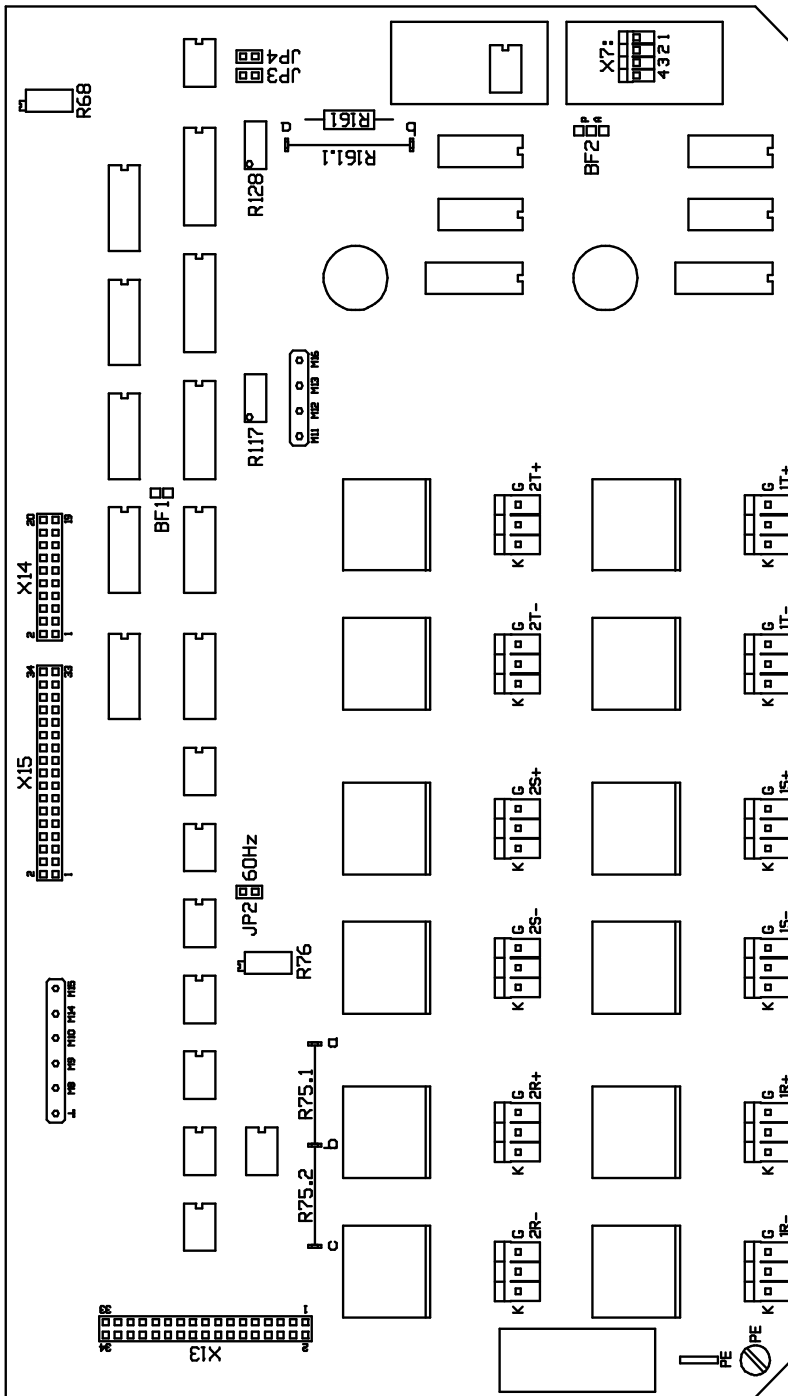
## **Danger**

**This power controller is subject to dangerous voltages even when the main system circuit breaker of this converter unit is open. The controller subassembly contains many dangerous, high-voltage electrical circuits.**

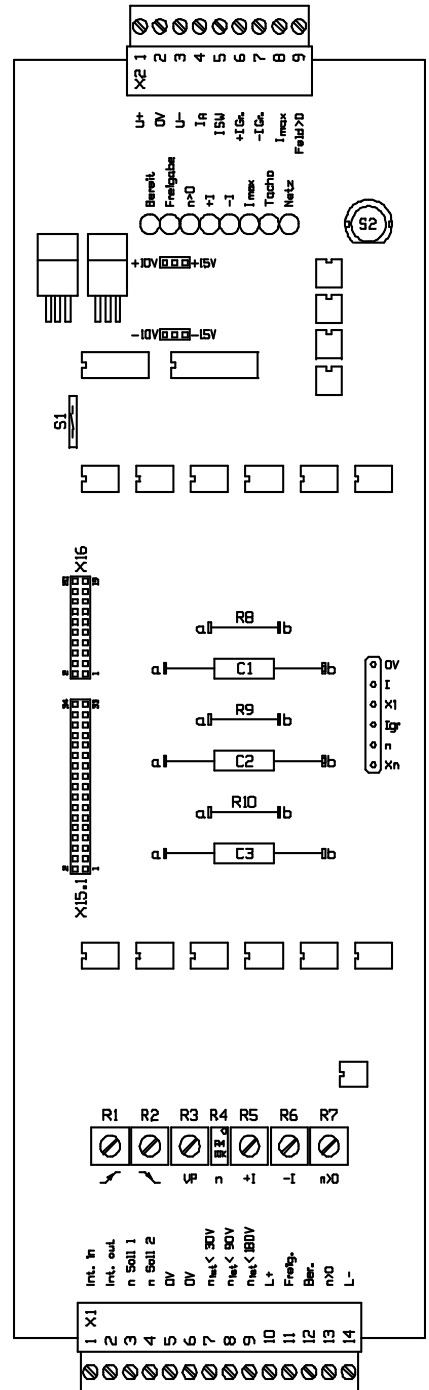
**Failure to adhere to the instructions in this operating manual can lead to death, serious bodily injury, and material damage.**

# Temvar GDV2

## 5.3 Component Mounting Diagram for the Electronics Circuit Boards

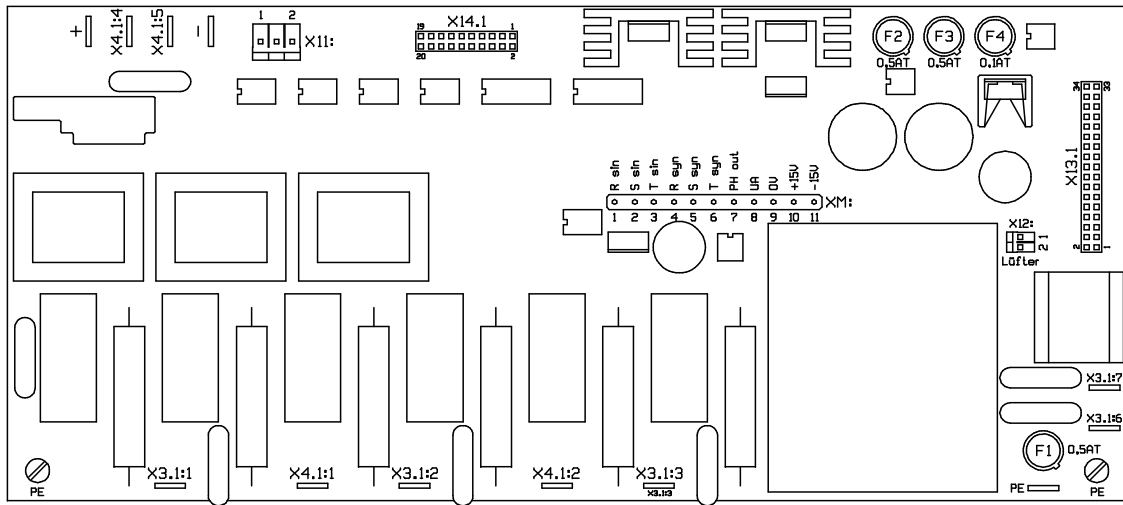


Open-loop controller circuit board  
GDV2  
(A0095xx)

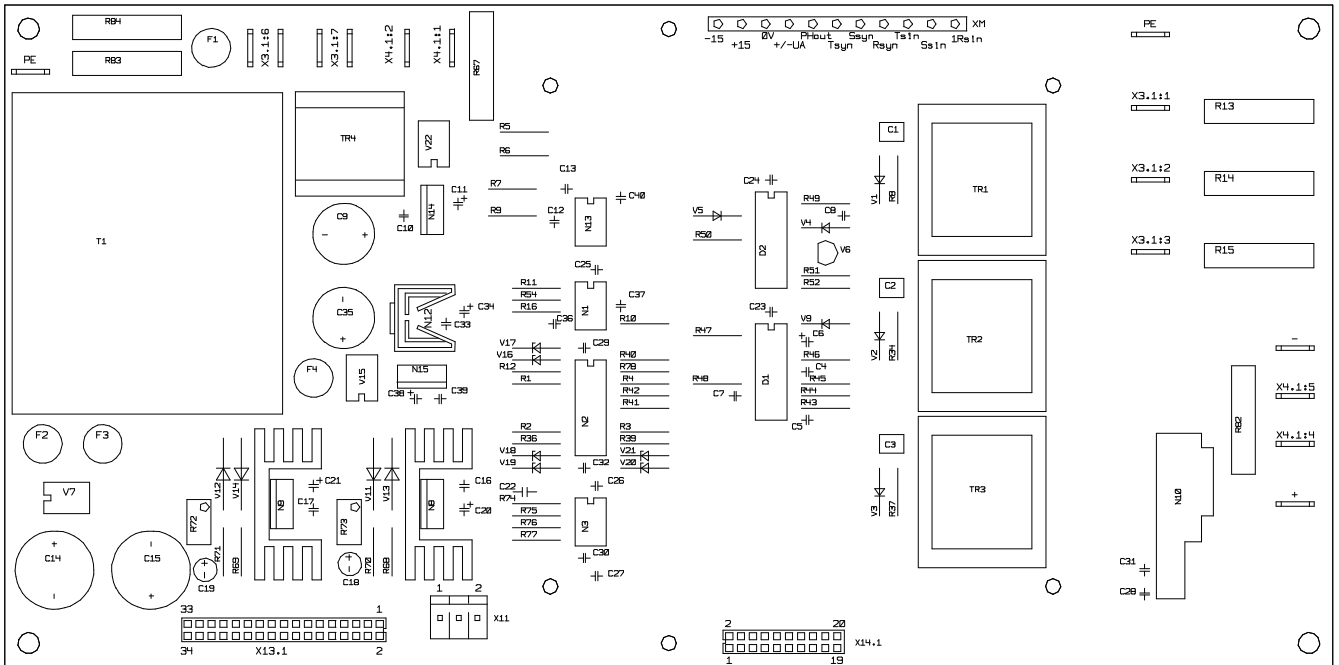


Closed-loop controller circuit board  
GDV2  
(A0114xx)

# Temvar GDV2



**SUPPLY CIRCUIT BOARD**  
For devices up to 270 A

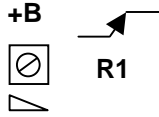


**SUPPLY SUBASSEMBLY**  
For devices above 380 A

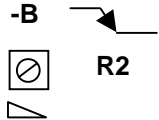


# Temvar GDV2

## 5.4 Potentiometer Settings

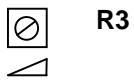


Setpoint value integrator. Acceleration time with positive setpoint value. Left stop, approx. 1.5 seconds, right stop, approx. 15 seconds, Run-up time from 0 to 10V.



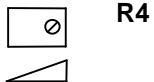
Setpoint value integrator. Deceleration time with positive setpoint value. Same effect as +B.

**V<sub>p</sub>**



Proportional amplification for the speed controller. Left stop = 2 times. Right stop = 20 times. This range is determined by R9 as delivered.

**n**



25-gang spindle trimmer for speed trim. Setting range approx. 1 : 4 Turning toward the right means a higher speed.

**+I**



Current limit in "motor mode" with positive speed setpoint value or "generator mode" with negative speed setpoint value. Left stop results in current limit 0, right stop results in current limit 100% of the device rated current.

**-I**



Current limit during motor mode with negative speed setpoint value or generator mode with positive speed setpoint value. Same effect as I+.

**n > 0**



Running indicator threshold adjustable from 0 to 15% of the maximum speed. Right stop means 15%.

# Temvar GDV2

---

## 5.5 LED Indicators

### READY



LED illuminates when all internal electronic voltages are in order and the main current is switched on.

### CLOSED-LOOP CONTROLLER ENABLE



LED illuminates when the device is ready and the closed-loop controller is enabled by a +24V signal at terminal 11

### $n > 0$



LED illuminates when the drive is turning faster than the potentiometer shaft setting.  
 $n > 0$ .

### Current Direction “+”



LED illuminates when the drive is working in “motor mode” when the setpoint value is positive or “generator mode” when the setpoint value is negative (thyristor bridge 1 in operation).

### Current Direction “-”



LED illuminates when the drive is working in “generator mode” when the setpoint value is positive or in “motor mode” when the setpoint value is negative (thyristor bridge 2 in operation).

### Current Limit



LED illuminates when the motor is operated at the set current limit for at least 15 seconds, i.e., the speed controller is operated at the stops that are set using the potentiometer +I and -I.

### Tachometer



LED illuminates when the tachometric voltage is not in the prescribed ratio to the armature voltage.

### System power



LED illuminates when the main current fails, anti-clock rotating field or phase breakdown or the radiator temperature is too high. This signal blocks the unit and switches off the ready status.

# Temvar GDV2

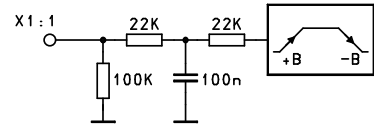
## 6 DESCRIPTION OF THE INPUT AND OUTPUT FUNCTIONS

### 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.

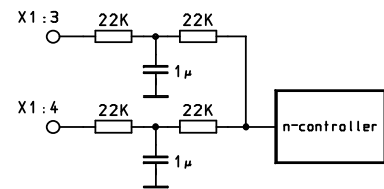
#### Setpoint Value Integrator

The input voltage range is  $\pm 0$  to 10V.



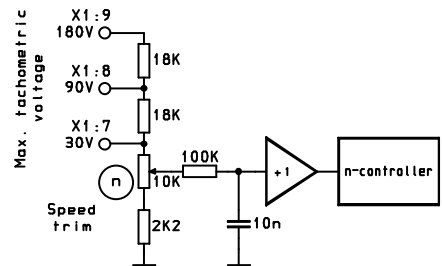
#### Setpoint Value Inputs

The two inputs are equal and cumulative. The maximum input voltage range is  $\pm 0$  to 10V. Input resistance and filter time constant are 44k $\Omega$  and 22ms, respectively.



#### Actual Value Inputs

The “speed trim” potentiometer is a 25-gang spindle trimmer with a setting range starting at approx.  $n = 4$ . Right stop means the highest rate of speed. For dynamic reasons, the filter time constant is set very low (approx. 2.2 ms). The tachometer voltage must therefore be very clean.



#### Inputs “external current limit”

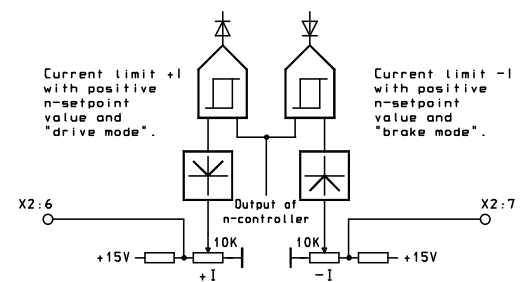
The maximum motor current is set at potentiometers +I and -I (right stop 100% of device rated current). An external voltage of from 0 to +10V at X2: 6 or 0 to 10 V at X2: 7 means 0 to 100% device current.

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

The set current limit can also be reduced by switching-in a resistance to ground.

Terminal 6 and potentiometer +I: current limit with positive speed setpoint value and “drive mode.”

Terminal 7 and Potentiometer -I: current limit with negative speed setpoint value and “brake mode.”



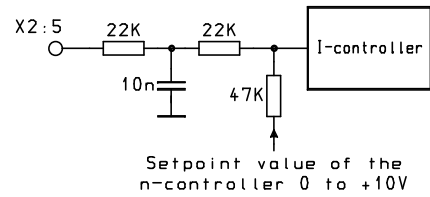
# Temvar GDV2

## Secondary Input Current Controller

A voltage of +10V at terminal X2: 5 means device rated current.

### Attention!

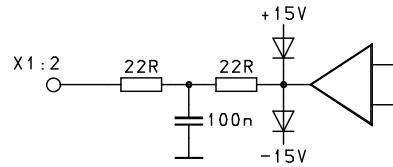
This secondary setpoint value adds itself to the main setpoint value from the speed controller. The two current limits must be set low enough that the sum of the two setpoint values is + 10V max. This input has a very short filter time constant (2.2 ms). Therefore, a very clean voltage must be maintained at terminal X2: 5.



## 6.2 Analog Outputs

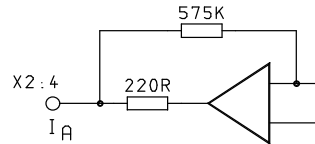
### Setpoint Value Integrator

The output is protected from back interference voltages by a low-pass filter and 2 pull-up/pull-down diodes. This results in a negligible degree of load control which is completely inconsequential, however, under a constant load (e.g. when a connection is made to the setpoint inputs X1: 3 or 4).



### Current Actual Value

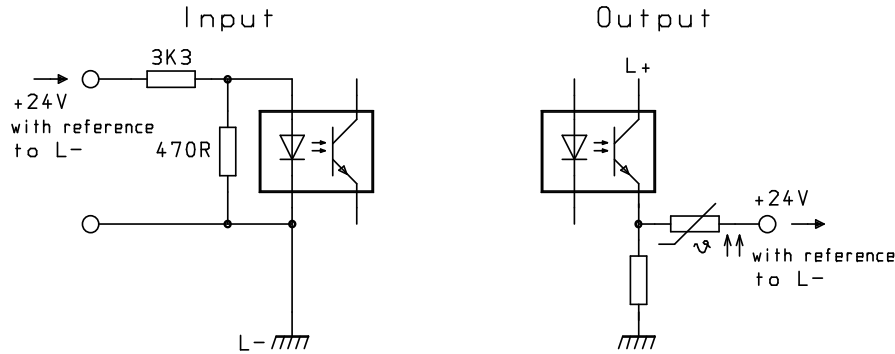
Where the current is the device rated current, a voltage of +10V in both current directions results. Output resistance 220Ω.



# Temvar GDV2

## 6.3 Control Inputs and Indicator Outputs

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



The reference potential -L, terminal X1: 14, is to be connected to the reference potential of the system control unit. It is recommended that the input and output wiring be shielded.

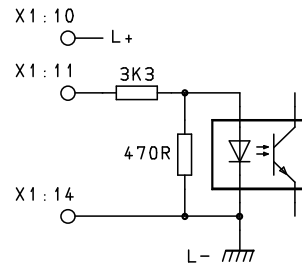


### Danger

When controlling the binary control and selection inputs via an external voltage source which is independent of ground (do not connect X1: 14 with X1:5 or 6), the difference in potential between device ground and the ground of the external voltage is not allowed to not exceed 50V (danger to optical coupler).

### Input Controller Enable

Controller release means: Apply voltage +L to terminal X1: 11, or apply an external voltage of +15 to +30V whose reference point is connected to -L (terminal X1:14). When a voltage is less than +10V, the controller is safely inhibited. When the controller is inhibited, the firing pulses are also suppressed. The drive does not drift when it is shut off, but it also does not produce any momentum. When disengaging the drive, the controller must be inhibited for a period of at least 200ms before switching off the main current.

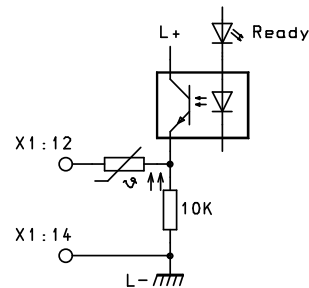


### Indicator Output "Ready for Operation"

At terminal X1: 12, the voltage +L is applied when the electronics power supply and the main current at terminals X3: 1+ 2 + 3 are switched on. In the devices equipped with cooling fans, a temperature switch is included in this ready indication.

When the heat sink temperature exceeds 85° C, the ready indication is extinguished. The output is short-circuit proof.

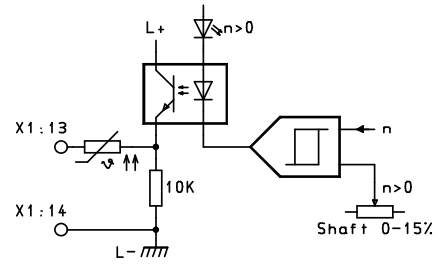
After the controller enable, the memory modules of fault signalisations „mains control“ and „tachy control“ are set, the signal „ready status“ will be permanently cancelled. The memories may be resetted by means of button S2 on the controller pcb.



# Temvar GDV2

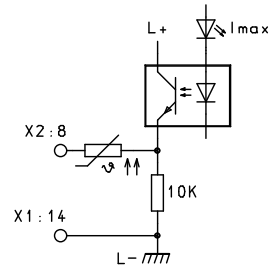
## Indicator Output $n > 0$

+L is applied at terminal X1: 13, when the drive turns faster than the  $n > 0$  threshold which was set at the potentiometer. The indication is not dependent on direction of rotation. The output is short-circuit proof.



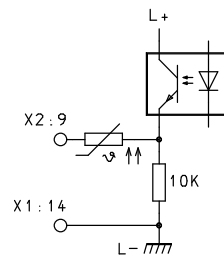
## Indicator Output "I max."

+L is applied at terminal X2: 8, when the drive is operated longer than 15 seconds at the set current limit. The output is short-circuit proof.



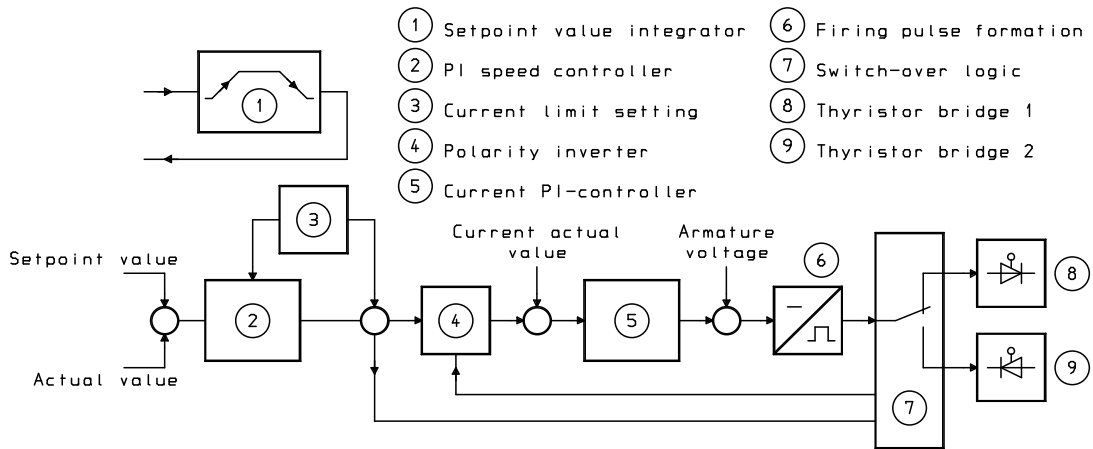
## Indicator Output "field current present"

This output only pertains when the field rectifier built into the device is used. (Terminals X3: 4 + 5/ X4: 4 + 5). +L is applied to terminal X2: 9 when the field current is greater than 0.2A. In devices beyond 380 A, a field current greater than 0.4A. This is not indicated by an LED. The output is short-circuit proof.

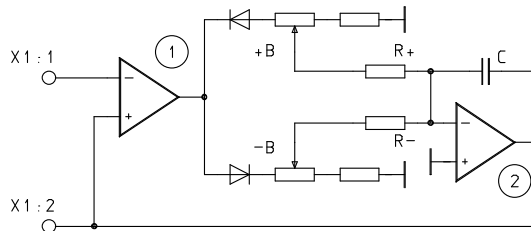


# Temvar GDV2

## 7 DESCRIPTION OF FUNCTIONS



### 7.1 Setpoint Value Integrator

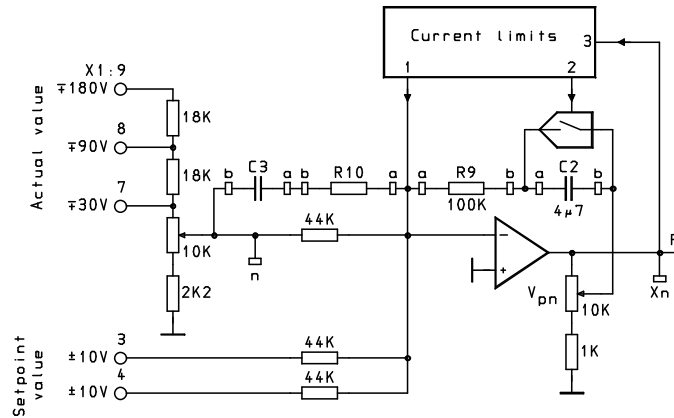


When a positive jump in setpoint value occurs at terminal X1: 1, the comparator (1) trips over to negative. Capacitor C becomes charged via resistance R+. The rate of charging is dependent upon the potentiometer setting +B. When the output voltage at the integrator (2) has reached the level of the setpoint value at X1: 1, the comparator (1) again trips over to 0 and capacitor C is no longer charged.

When the setpoint value is negative, the same applies using potentiometer -B and charging resistance R-. Whenever a positive setpoint value is reduced, the comparator (1) trips over to positive and capacitor C is discharged via potentiometer -B and resistance R-.

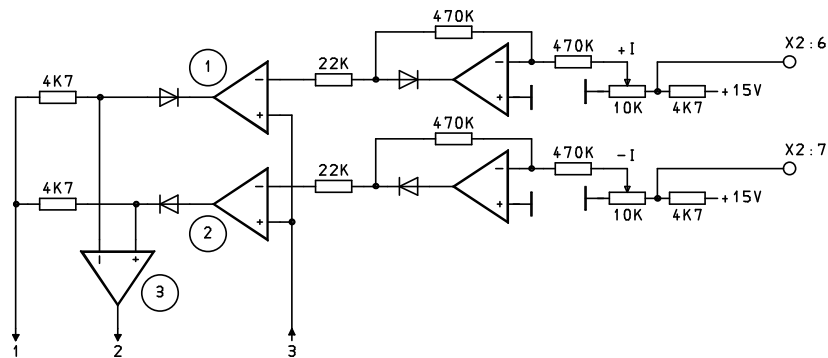
# Temvar GDV2

## 7.2 Speed Closed-Loop Controller



The speed controller is an ordinary closed-loop PI-controller. The proportional amplification is determined by R9 and potentiometer  $V_{pn}$  and the integral-action time by C2. The right stop of potentiometer  $V_{pn}$  means the greatest amplification. The controller output can be measured at measurement test point "X." The PI-controller can be expanded to a PID-controller via C3 and R10. The actual speed, normalized to the setpoint value level, can be measured at measurement test point "n."

## 7.3 Current Limits

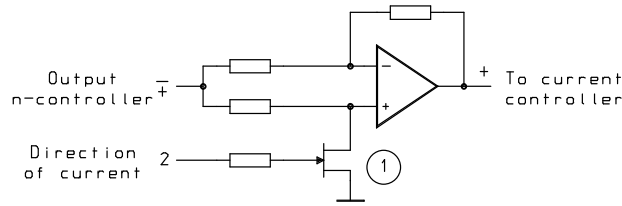


Comparators (1) and (2) are biased between 0 and 10V using potentiometers +I and -I. Comparator (1) is tripped over to positive, comparator (2) to negative. If the speed controller output (item 3) exceeds the set bias voltage, then the affected comparator trips over. The controller output is again taken back to the mixing point of the speed controller (item 1) via the corresponding diode and the relatively low resistance 4K7. At the same time, the comparator (3) will trip over to positive and short the capacitor C2 via the speed controller using an FET-switch. The bias voltage of max. 10V can also be externally connected to terminals X2: 6 + 7 (input resistance 4K7). The device maximum current can also be set in this case using the potentiometers +I and -I.



# Temvar GDV2

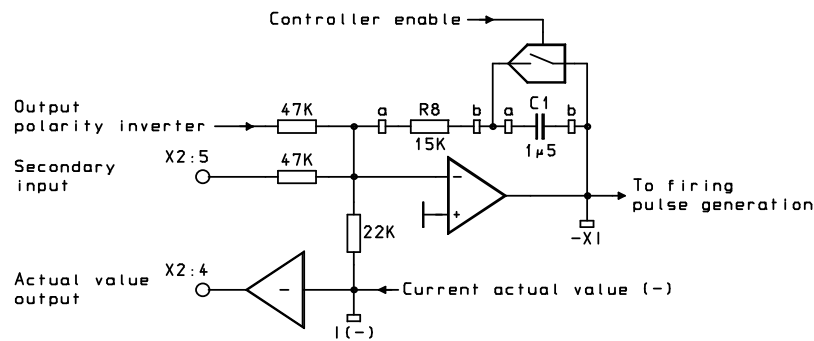
## 7.4 Polarity Inverter



When thyristor bridge 1 is in operation, i.e. in motor mode with positive setpoint speed value (speed controller output negative), then the transistor (1) is conducting and the amplifier inverts the input voltage with the amplification  $-1$ . In the opposite current direction (speed controller output positive) the transistor (1) is inhibited and the amplifier does not function as an inverter with  $V = +1$ .

In this way, the current controller receives a positive setpoint value in every current direction.

## 7.5 Closed-Loop Current Controller



The current controller is an ordinary closed-loop PI-controller. The proportional amplification is determined using R8, the integral-action time using C1. When using the secondary input X2: 5, care must be taken that both setpoint value inputs are cumulative. The sum may not exceed +10V. The current controller output can be measured at measurement test point XI. The current actual value (+ 10V with device rated current in both current directions) is applied to terminal X2: 4. The voltage is smoothed with a time constant of 200 ms.

Formation of the current actual value takes place on the open-loop controller circuit board. By increasing the load resistance R161/R161.1, or by plugging the jumper J3/J4 to a different location, every value can be limited to a value below the device rated current. Decreasing the load resistance is not permitted.

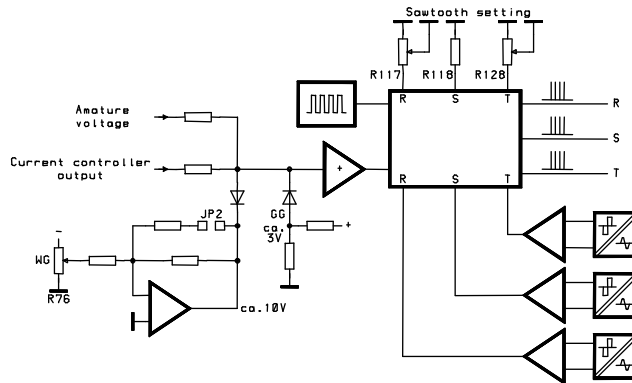


### Danger

When using the secondary input X2: 5, the device and the motor can be overloaded or the drive can exceed RPM during run-up. The current limit has no effect on the X2:5 input.

# Temvar GDV2

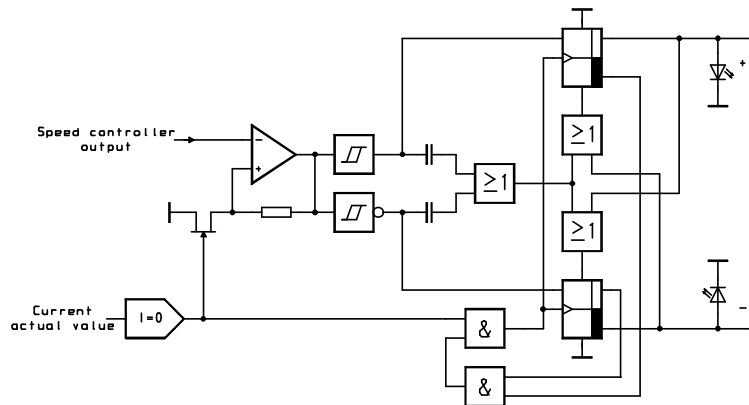
## 7.6 Firing Pulse Formation



The instantaneous armature voltage is added to the output voltage of the current controller. In this way, the current controller is relieved and control becomes more dynamic. The integrated firing pulse element is controlled by the sum of these two voltages. The firing pulses have a length of approx. 1 ms and are divided into 100 $\mu$ s-cycles.

The rectifier limit (GG) is fixed, the inverter limit (WG) is set at the factory and may not be altered. For use with 60 Hz systems, the jumper JP2 must be placed on the open-loop controller circuit board.

## 7.7 Switch-over Logic



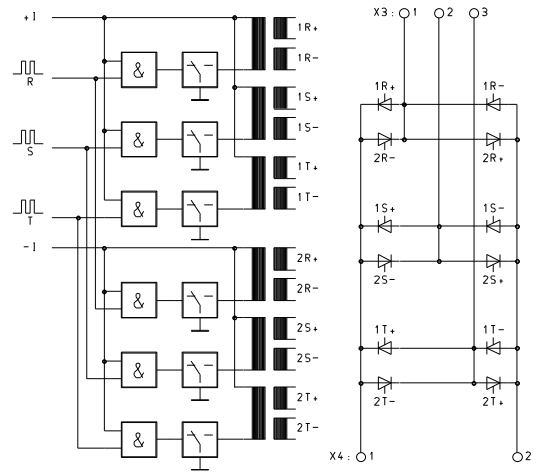
The polarity of the speed controller output indicates the current direction. As long as current flows, the comparator (1) has a 100% hysteresis due to the inhibited transistor (2), and therefore does not detect a polarity change in the speed controller output. At first, however, the polarity inverter is misaligned for the changed polarity. The current controller is aligned using a negative setpoint value. When the current has sunk to below 5%, the hysteresis is switched to zero, the comparator trips over and the flags +1 and -1 are reset. The new directional flag is prepared at the same time. After approx. 6ms, a set pulse via the AND-gate resets both flags, the preselected flag switches to the new current direction, the polarity inverter receives a suitable switch-over signal, and the current controller is run-up again.

# Temvar GDV2

## 7.8 Thyristor Output Stage

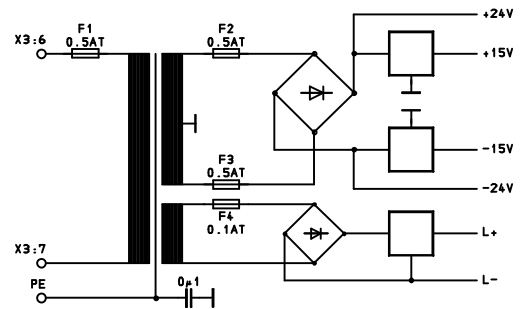
In each case, the presently selected current direction +I or -I activates the corresponding pulse transformer and enables the AND-gate for the firing pulse.

The thyristors require a holding current of approximately 100 mA. If this current is not reached during the firing phase, the thyristor ceases conducting after the firing pulse is removed.



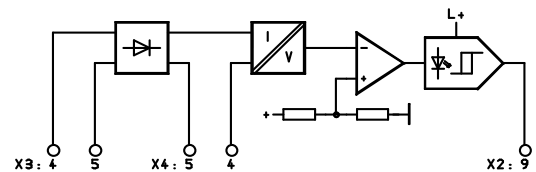
## 7.9 Electronics Supply

A system power supply of 230V/50-60 Hz is needed for the electronics power supply. A tolerance of  $\pm 10\%$  is allowed. Slow-blowing miniature fuses (TR5) 5 x 25mm are used. The  $\pm 15V$  and  $L+ / L-$  are stabilized with linear controllers. The  $\pm 24V$  is only filtered.



## 7.10 Field Supply

The rectifier can be connected to a maximum voltage of 400V and bear a max. current load of 7 A (after GDV2/130 max. 15 A). When a current is greater than 0.2 A, (in devices after 130 A - greater than 0.4 A) the potential +L is applied to indicator output X2: 9. The output is short-circuit proof.



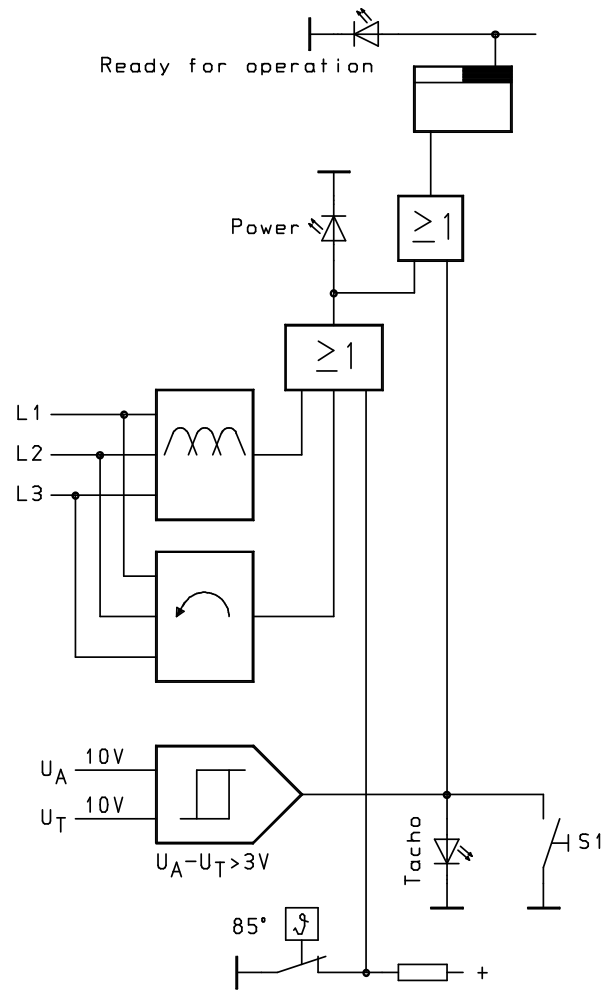
# Temvar GDV2

## 7.11 System Power Supply Monitoring

With a counter-clockwise rotating field or phase loss, a fault indicating flag is set, and the controller and firing pulse are inhibited. The indication "ready for operation" disappears and the red error indicator "system power" illuminates. The flag is reset, while the reset switch S2 on the closed-loop controller PCB is actuated.

## 7.12 Speed Monitoring

The speed monitoring and the closed armature circuit are monitored, while the armature voltage is compared to the tachometer voltage (normalized at 10V). With constant field excitation, the tachometer voltage behaves directly proportional to the armature voltage. During the initial start-up, the normalization of "10V tachometric voltage = 100% armature voltage" has not yet been realized. Therefore, the first time the device is turned on, it should be done with a speed setpoint value of approximately 1V and rpm adjustment at appr. 10 % of the max. rpm's. The speed trim with 10V setpoint value can only be undertaken with tachometric supervision switched off. This is accomplished by closing the Dip-switch S1 on the closed-loop controller circuit board. If the normalized tachometer voltage is approximately 30% under the armature voltage (100%  $U_A = 10V$ ) or the tachometer is incorrectly poled, then the fault flag is set. (see Chapter 7.11).



## 7.13 Cooling Fan Monitoring

All the devices, with the exception of the 15 + 30A devices have a cooling fan. The heat sink temperature in these devices is monitored by a 85° bimetall switch. The actuated (open) switch has the same effect on the device as activating the system power monitoring. (Chapter 7.11).

## 8 START-UP

### 8.1 Danger

When this device is in operation, certain components are subject to dangerous voltages, which can lead to serious bodily injury or death. The following precautionary measures should be taken in order to reduce the danger of death or injury.

1. Only qualified personnel who are familiar with this device and the accompanying information should be allowed to assemble, operate, trouble-shoot, clear, or repair it.
2. Device fitting must be carried out in accordance with safety regulations (e.g. DIN, VDE) and all other relevant state or local regulations. In order to ensure operational safety, the device must be equipped with regulation grounding, wire sizing, and appropriate short circuit protection.
3. Keep all panels and doors closed during normal operations.
4. Before carrying out visual inspections and servicing, ensure that the AC power supply is switched off and locked. Both the power controller and the motor are subject to dangerous voltages prior to switching off the AC power supply. Dangerous voltages are present even when the circuit breaker to the power controller is open.
5. Under no circumstances may the terminals be touched when measurements are being taken while the main power supply is switched on. Remove all jewelry from wrists and hands. Ensure that meters and other test devices are in good working order.
6. When working on an energized device, stand on an isolated surface, i.e. ensure that you are not grounded.
7. Follow the instructions in this operating manual exactly and observe all danger, warning, and cautionary notices.
8. This list does not represent a complete listing of all measures required for safe operation of this device. If you need further information or should special problems arise, please consult the manufacturer.

## 8.2 Recommended Actions



### Danger

**No supply voltage may be applied to the device until step 4 of the start-up procedures. When controller enable is input, the drive runs up!**

1. Check all main current, protective conductors, and electronics connectors for correct connection. Check fuses against device table 3.1.
2. Using an ohmmeter, check the armature connection (1 - 10  $\Omega$ ), the field connection (100 - 500  $\Omega$ ), and the tachometric connection (approx. 80  $\Omega$ ).
3. Set potentiometer I+ to approx. 30%. Set all other potentiometers to the left stop. Disconnect the controller enable terminal KI X1: 11. Disconnect setpoint value (terminal X1: 1 or 3 or 4) and connect manual potentiometer to terminal X2: 1 + 2. Connect collector ring to X1: 3. Voltage preselection terminal X2: 1 to 10V.  
  
Determine the maximum expected tachometer voltage and check to see if the correct actual value input is used. Connect the voltmeter to this terminal.
4. Switch on the device and measure the main current at terminal X3: 1 + 2 + 3, the field infeed at X3: 4 + 5, the electronics power supply at X3: 6 + 7, and the field voltage at X4: 4 + 5. Using the manual potentiometer, set the setpoint value to approx. + 1V.
5. Briefly touch the free "controller enable" wire to terminal X1: 11. The voltmeter must show a negative deflection upon sensing the actual value input. If this is the case, the wire can be firmly connected and the machine's direction of rotation can be checked. If the direction of rotation is incorrect, swap out or reverse the field and tachometer connections.
6. Set current limits to the motor's rated current. Set the setpoint value potentiometer to +10V and deactivate the tachometric supervision (S1). Trim the speed with spindle trimmer "n." While trimming, the armature voltage may not exceed the value on the serial no. plate. Reduce the field current if necessary. Reactivate the tachometric supervision after successfully trimming the speed.



### Danger

**Too great an overshoot can cause the allowable armature voltage to be exceeded. Jumps in the setpoint value in field suppressed areas can cause an overshoot of the armature current.**

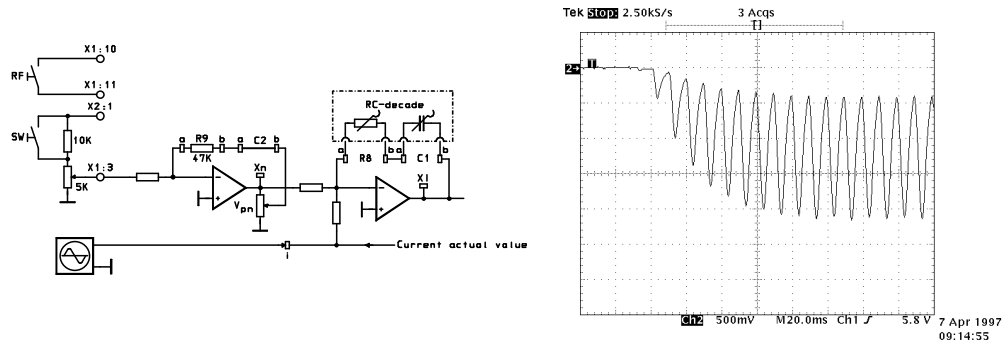
7. Disconnect manual potentiometers, apply system setpoint values, and test the emergency shut-off function with system setpoint values.

## 9 OPTIMIZING

For most applications, the standard arrangement of the current and speed controllers is completely sufficient. It is advisable, however, to check the motor's transient response for jumps in setpoint value and to optimize it using the  $V_p$  potentiometer. Should a critical drive be in need of more precise optimization, it is recommended that the following steps be taken once the drive is in operation. Speed controller optimization should be carried out with the machine engaged.

### A) Current controller optimization

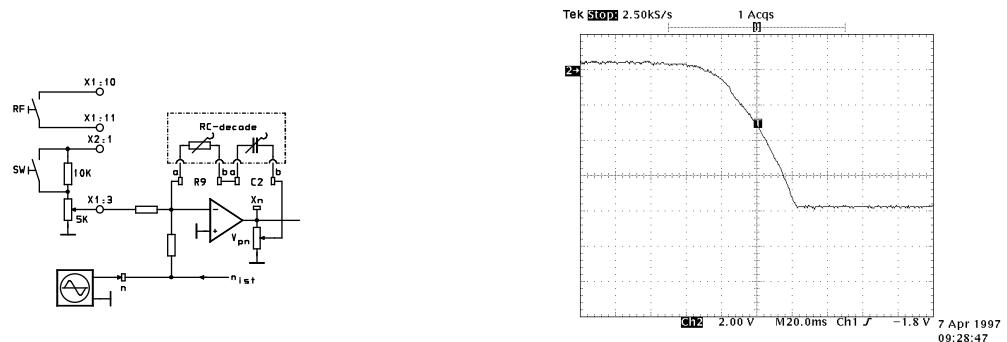
1. Connect the current setpoint value potentiometer and controller enable switch according to the following diagram.



2. Wire the speed controller according to the diagram. Turn potentiometer  $V_p$  to left stop
3. Connect RC-decade according to diagram. Beginning with the standard arrangement. Connect oscilloscope to test point "I."
4. Disconnect field supply. Bridge the field current monitoring.
5. Engage drive, release the controller. Set the potentiometer at terminal 3 so that a non-pulsing current is just present. Input the setpoint value jump with the SW switch. Optimize the current controller, first with R8, then with C1, so that the oscillogram appears as it does in the example.

### B) Speed Controller Optimization

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



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2. Connect the field power supply. Set the RC decade to standard arrangement, and the potentiometer  $V_P$ - to mid-range.
3. Engage the drive, then enable the controller.  
Set approx. 30% of the maximum speed and input the setpoint value jump with switch SW. Optimize the speed controller, first with R9, then with C2, so that the oscillogram appears as it does in the example. The transient response of the speed controller, particularly when accelerating or positioning large masses, can often be improved using a D-element R10/C3. Reference values for dimensioning are approx.  $22k\Omega$  and  $1\mu F$ .

## 10 MALFUNCTIONS



### Danger

When electrical devices are in operation, certain device components will naturally be subject to dangerous voltages.

Dangerous voltages can be present at the user end of indicator relays.

Improper use of this equipment can therefore lead to death, serious bodily injury, or considerable material damage.

Observe all notices listed in this chapter and located on the product itself when performing maintenance on this device.

Maintenance of the device may only be carried out by appropriately qualified personnel who have previously read and understood all safety, assembly, operation, and servicing instructions contained in this description.

Before carrying out visual inspections or servicing work, ensure that the AC power supply is switched off and locked and that the device is grounded. The power controller and the motor are both subject to dangerous voltages prior to switching off the AC power supply. Dangerous voltages are present even when the power controller's circuit breaker is open.

Only replacement parts approved by the manufacturer may be used.

A) Main current fuse is defective.

Check the thyristors: Measure terminals X3: 1 + 2, X3: 2 + 3 and X3: 1 + 3 with an ohmmeter. Resistance must be greater than  $40k\Omega$ .  
Measure X3: 1, then X4.1, then X3: 2, then X4.1 and X3: 3, then X4.1.  
Resistance must be greater than  $100k\Omega$ .  
Measure X3: 1, then X4.2, then X3: 2, then X4.2 and X3: 3, then X4.2.  
Resistance must be greater than  $100k\Omega$ .



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B) Drive is not turning. Presupposing that:

Wiring and fuses are in order.  
Engage the drive (positive setpoint value).

LEDs:

⊗	Controller enable	On	Off	Off	On	On	On	On	Off	Off
⊗	Ready	On	Off	On	On	On	On	On	Off	Off
⊗	n > 0	Off	Off	Off	Off	Off	Off	Off	Off	Off
⊗	Current direction+	On	Off	Off	Off	On	Off	Off	On	On
⊗	Current direction-	Off	Off	Off	Off	Off	Off	On	Off	Off
⊗	Current limit	Off	Off	Off	Off	On	Off	On	Off	Off
⊗	Tachometer	Off	Off	Off	Off	On	Off	On	Off	On
⊗	Power grid	Off	Off	Off	Off	Off	Off	On	On	Off
	Case	1	2	3	4	5	6	7	8	9

Case 1: Setpoint value at terminal X1: 3 or 4 (against reference point X1: 5 or 6) probably not present.

Case 2: Measure electronics power supply  $\pm 15V$  or  $\pm 10 V$  at terminal X2: 1 + 3. If not present - check the supply at X3: 6 + 7 and miniature fuses F1, F2, F3 on the supply subassembly.

Case 3: No command given for controller enable. Measure + 24V at terminal X1: 11 against reference point X1: 14. If not present, check miniature fuse F4 on the supply subassembly.

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

Case 5: Potentiometer current limit I+ not turned up far enough. Measure the output voltage at X4: 1 + 2. If present - armature wire is broken.

Case 6: Potentiometer current limit -I is turned to zero.

Case 7: Potentiometer current limit -I not turned up far enough. Measure the output voltage at X4: 1 + 2. If present - armature wire is broken.

Case 8: Loss of phase, phase sequence incorrect, measure main terminal voltage at X3: 1 + 2 +3. Check thermocontact in the GDV2/60-700.

Case 9: Normalized speed actual value 30% less than the normalized armature voltage, tachometer feed interrupted, drive is mechanically blocked.