

Manual

Classic Q3 1000-2000A

4 Quadrant

Thyristor Drive

Q3-1000 - 2000A

Teil 1	Thyristor Drive	Q3 x/x- 1000 to 2000A
Teil 2	Analoque Control Electronic	REG4

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Classic Q3 1000-2000A

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1 Basic information

Electronic equipment is not fault proof. This fact should be borne in mind for all possible operating conditions.

ATTENTION - High voltage AC 500V~, DC 650V=
500V~ac, 650V=dc



Before installation or commissioning begins, this manual must be thoroughly read and understood by the technical staff involved.

If any uncertainty arises, the manufacturer or dealer should be contacted.

Q3 devices are power electric parts used for regulating energy flow.

Protection rating IP00.

Standards and guidelines

The device and its associated components can only be installed and switched on where the local regulations and technical standards have been strictly adhered to:

EU Guidelines	89/392/EWG, 84/528/EWG, 86/663/EWG, 72/23/EWG
EN61800-3	EN60204, EN50178, EN60439-1, EN60146,
IEC/UL	IEC364, IEC 664, UL508C, UL840
VDE Regulations	VDE100, VDE110, VDE160
TÜV Regulations	
Trade body guidelines	VGB4

The user must ensure that in the event of:

- device failure
- incorrect operation
- loss of regulation or control

the axis will be safely de-activated.

It must also be ensured that the machine or equipment are fitted with device independent monitoring and safety features.

Setting adjustments

- should only be carried out by suitably trained personnel
- should only be carried out in accordance with health and safety guidelines

Assembly

- should only be carried out when all voltages have been removed.

QS

Test results are archived with the device serial number by the manufacturer.

CE The device adheres to the following: Guideline EU 89/336/EWG. EMC stan-

Attention:

This manual Q3 only describes the basic control unit.

Manual Q3

This device description must be read in conjunction with the manual for

- an analogue control
- an external field control
- options

REG xx

F2 xx

Multi xx



General information

Series Classic Q3

1 Basic information

Build

- switch cabinet mounting
- according to the VDE, DIN and EU regulations
- standard control electronics REG
- intrinsically safe power section with current control loop
- controlled or uncontrolled field supply unit
- optional units

Galvanic isolation between

- the power section and the housing
- the power section and the control electronics

The distance of air gaps and leakage paths adhere to the VDE standards (>8mm).

Components

- only components customary in trade and industrially standardised are used
- high-quality bases for the IC with external connections
- LED displays
- precision potentiometers for fine adjustments
- plug-in jumpers for the system set-up

Characteristics

- * Series Classic Q3
- * Thyristor drive for dc motors
- * Power range 6.75kW to 1.1MW
- * Drive and brake in all 4 quadrants'
- * Energy recovery
- * Intrinsically safe power section
- * Fast analogue current control
- * Temperature watchdog - power section
- * Circular current-free dual bridge circuit
- * Controlled or uncontrolled field rectifier
- * 26-pin interface
- * Features of the control electronics:
see Manual REGxx or third-party product documentation
- * Optional units

Classic Q3 1000-2000A

Q3 400/450-1000-2000

Power connection 360 ... 440V~
 Auxiliary voltage connection 360 ... 440V~, 200 ... 250V~ oder Option
 Output voltage max. \pm 450V=
 Cooling ventilation fan
 Field supply - external Field current controller F2.1 400/340-20

Q3 400/450-		1000	1500	2000
Input current	A~	800	1200	1600
Output current	- peak 5s	A=	2000	3000
	- continuous	A=	1000	1500
El. power	kW	450	675	900
Fuses	ff AFF	installed 6x1000	installed 12x1000	installed 12x1000
Power chokes	Type	3x KU240-1000	3x KU240-1500	3x KU240-2000
	mH	0,05	0,03	0,02
Armature chokes	Armature chokes are necessary only for special applications			
Dimensions w x h x d	mm	550x800x520	550x800x520	550x800x520

Q3 500/550-1000 bis 2000

Power connection 450 ... 550V~
 Auxiliary voltage connection 360 ... 440V~, 200 ... 250V~ oder Option
 Output voltage max. \pm 550V=
 Cooling ventilation fan
 Field supply - external Field current controller Unitek F2.1 400/340-20

Q3 500/550-		1000	1500	2000
Input current	A~	800	1200	1600
Output current	- peak 5s	A=	2000	3000
	- continuous	A=	1000	1500
El. power	kW	550	825	1100
Fuses	ff AFF	Installed 6x1000	Installed 12x1000	Installed 12x1000
Power chokes	Type	3x KU240-1000	3x KU240-1500	3x KU240-2000
	mH	0,05	0,03	0,02
Armature choke	Armature chokes are necessary only for special applications			
Dimensions w x h x d	mm	550x800x520 0	550x800x520 0	550x800x520 0

1 Basic information

Specification

Mains frequency	50 or 60Hz $\pm 5\%$
Protection rating	IP 00
Format	VDE 0100 group C, VDE 0160
Humidity rating	class F acc. to DIN 40040
Site of installation	< 1000m above sea level
Operating temperature range	0 ... 45°C
Extended operating temp. range	up to 60°C reduced by 2%/°C
Storage temperature range	-30°C to + 80°C

Current control loop circuit

Amplification

- input signal	0 to $\pm 10V=$
- output	0 to $\pm 200\%$ type current
Over-current limiting	10s 200% type current
Control precision	$\pm 2\%$
Control range	1:50
Enable	> +10V

Speed control loop circuit (with manual REG)

Control precision (without actual value error)	< $\pm 0.1\%$
Control range	> 1:1000

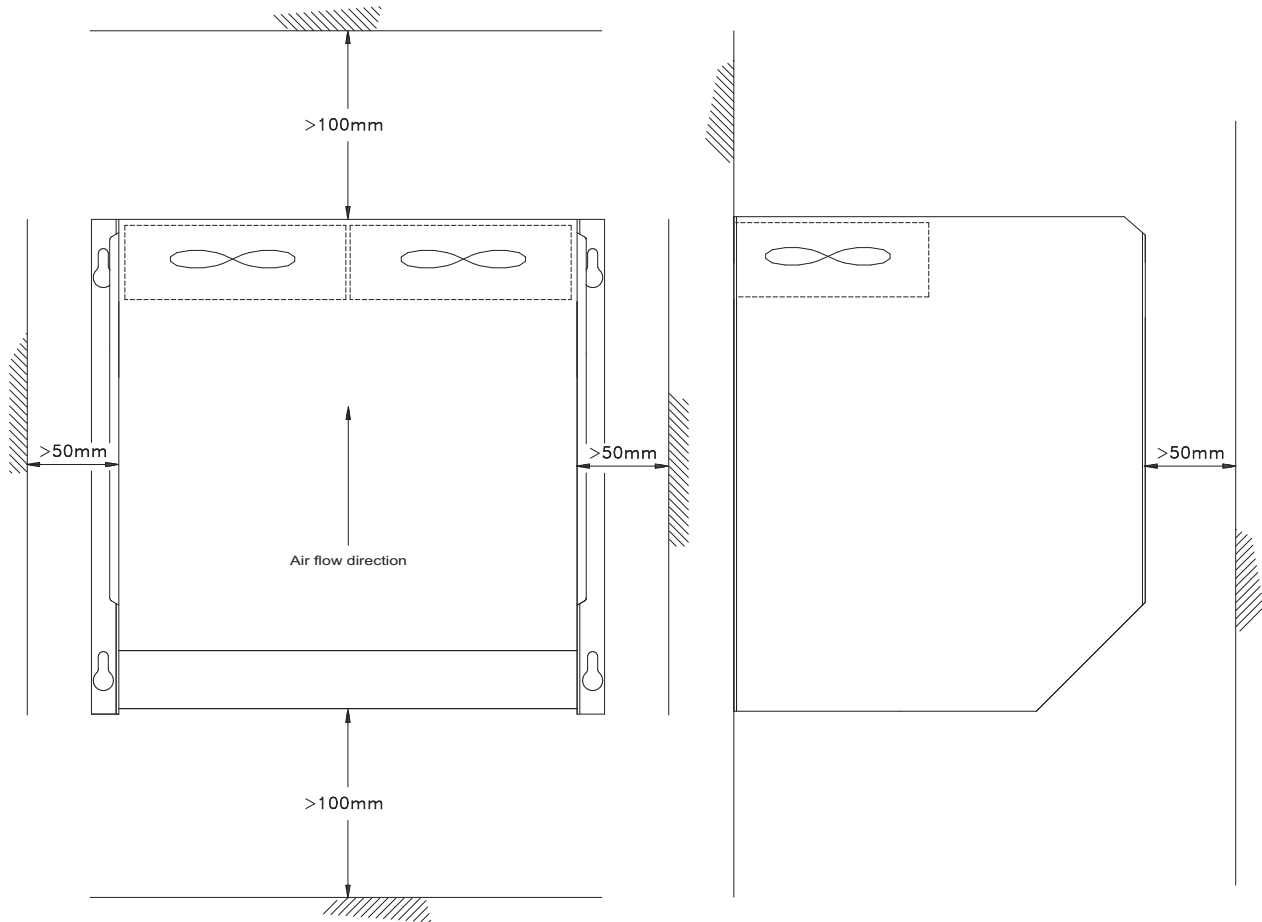
Interface control electronics X3

Function

+ 24V	$\pm 10\%$	Connector no. X3: 1 and 2
+ 15V	$\pm 2\%$	X3: 3 and 4
- 24V	$\pm 10\%$	X3: 5 and 6
- 15V	$\pm 2\%$	X3: 7 and 8
Device	GND	X3: 9, 10, 11, 12, 13, 14
I command value (GND)	0	X3: 15
I command value (signal)	+10V=	X3: 16
Current controller enable	+10V=	X3: 17
Drive disable1	+10V=	X3: 18
Drive disable 2	+10V=	X3: 19
N (speed) actual	+10V=	X3: 20
I (current) actual	+5V=	X3: 21
Over-current power section	+10V=	X3: 22
Option UA	$\pm 10V=$	X3: 23
Option UA	0-10V=	X3: 24
Drive ready BTB	+10V	X3: 25
	+5V	X3: 26

Classic Q3 1000-2000A

Mounting



Ambient temperature 0 to <45°C (reduced, up to 60°C)
max. cooling unit temperature 80°C (internal watchdog)

Air-mass throughput 1000-2000A 2500m³h

Dissipation loss with max. power		
Unit Q3-x/x	Unit W	Mains choke W
1000	3700	1000
1500	5400	1300
2000	7200	1600

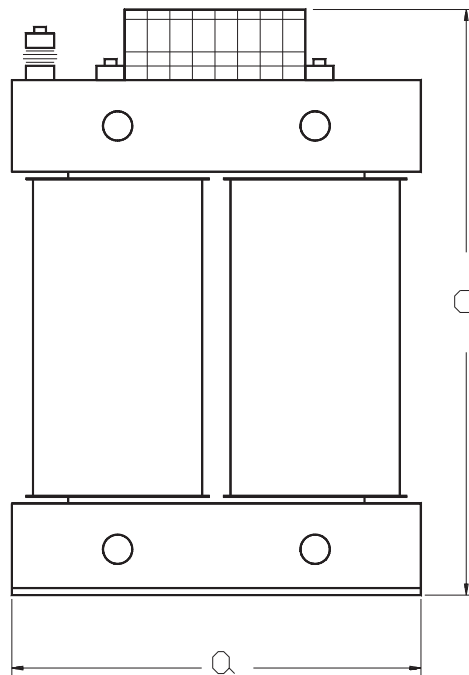
2 Mechanical installation

1-phase mains choke

Features	
UN	400V~50/60Hz
UK	4%
Protection rating	IP00
Isolation class	T40/E
Vertical angle bracket	

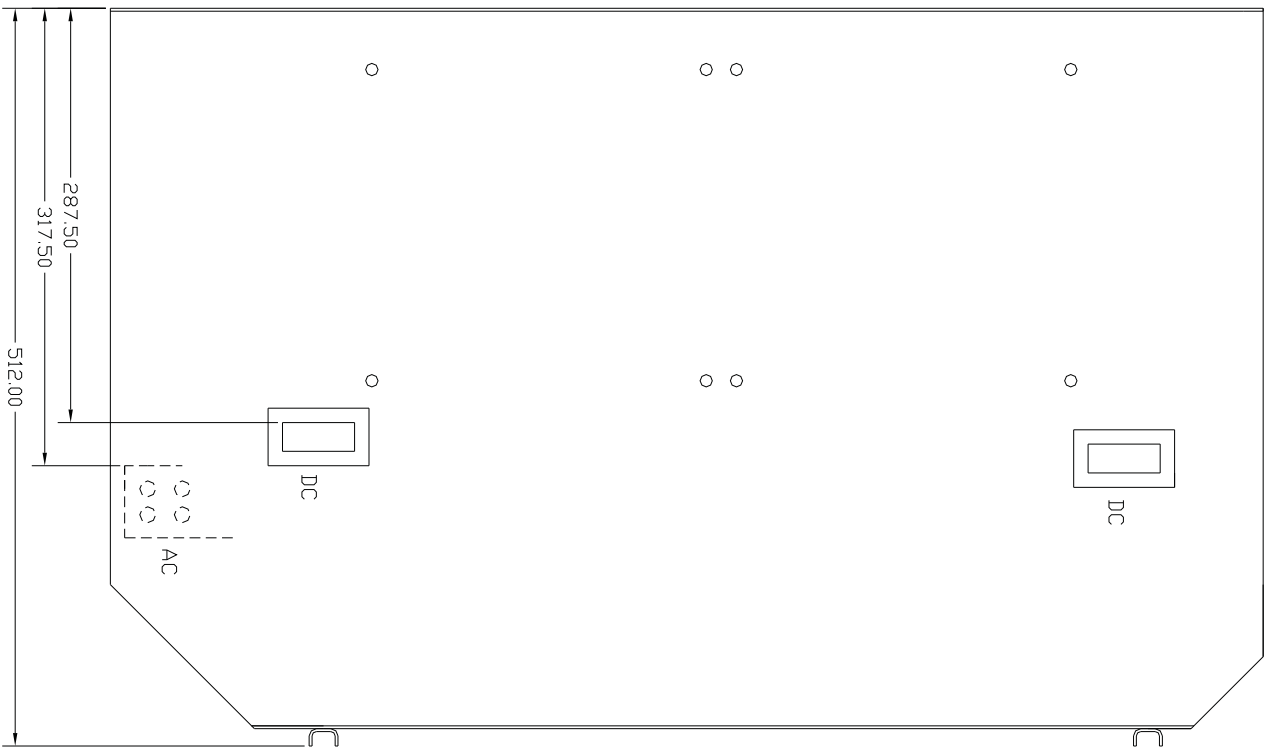
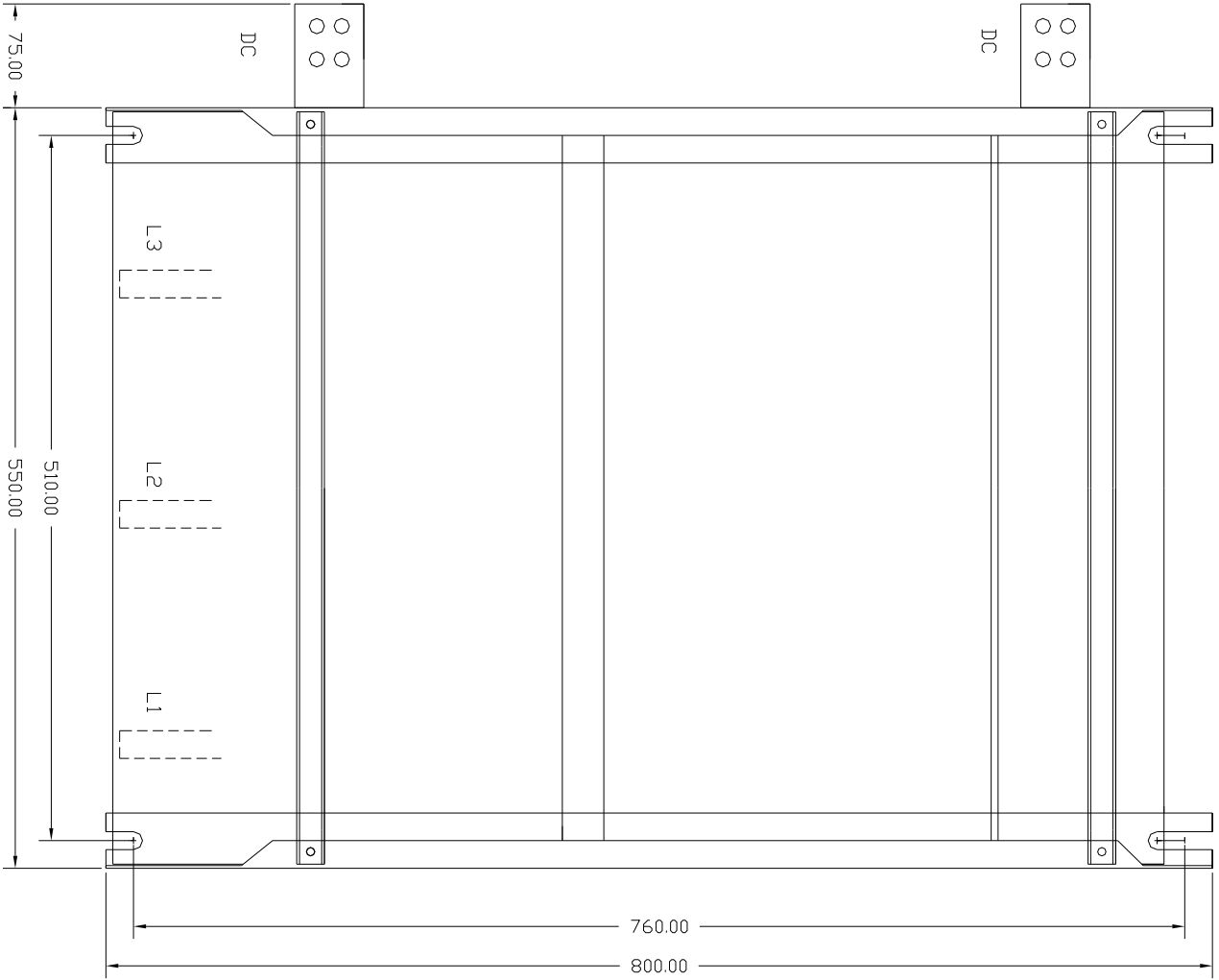
Units Q3-x/x	Choke type	L mH	PV W	Dimensions					Weight kg	Screw M
				a	b	c	d	e		
1000	KU240-10 00	0,05	1000	320	270	470	250	190	98	10
1500	KU240-15 00	0,03	1300	320	270	470	250	190	98	10
2000	KU240-20 00	0,02	1500	320	270	470	250	190	98	10

with filter: KDFxx

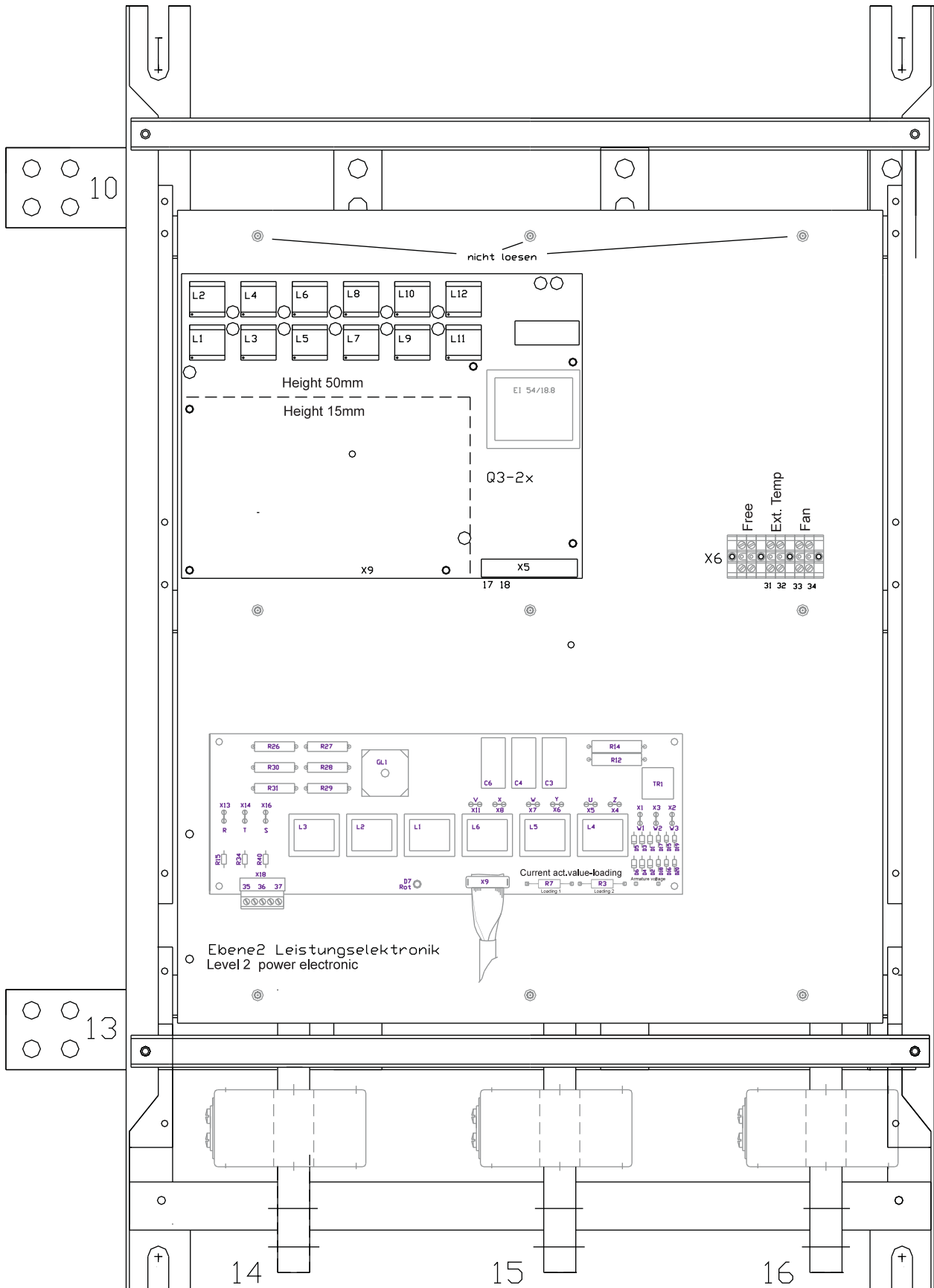


Classic Q3 1000-2000A

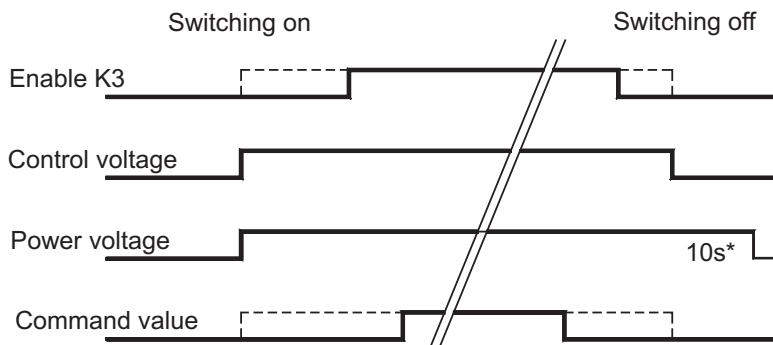
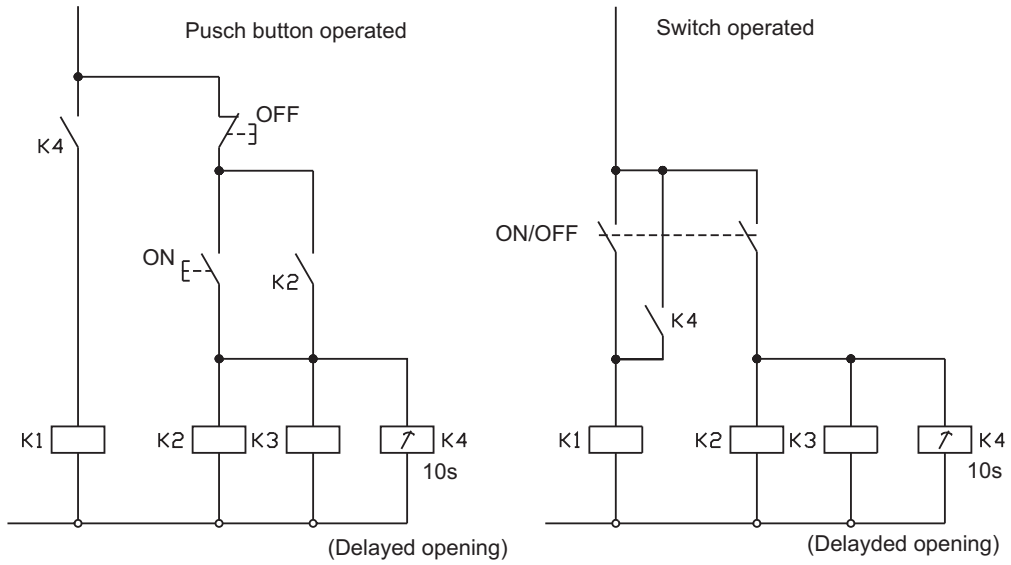
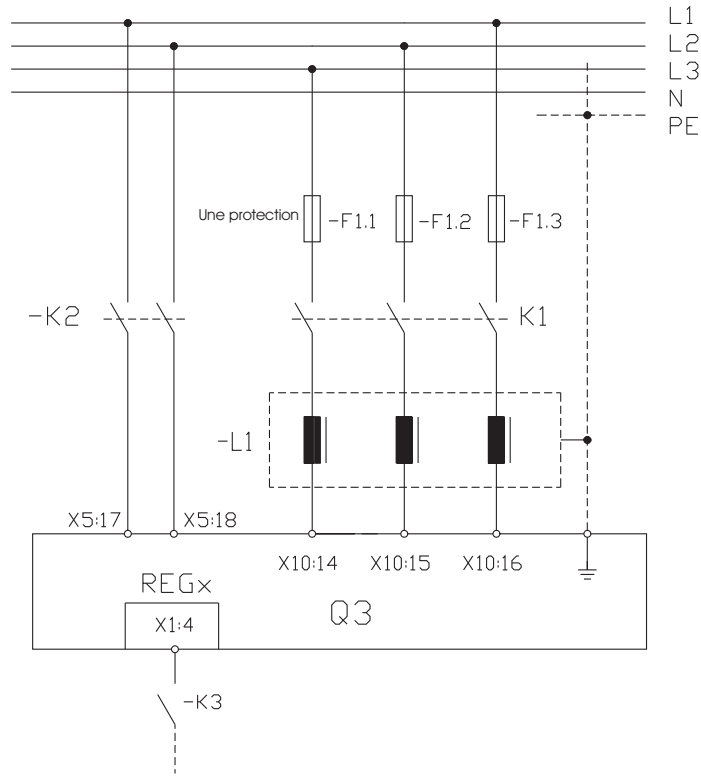
Dimensions



3 Electrical installation

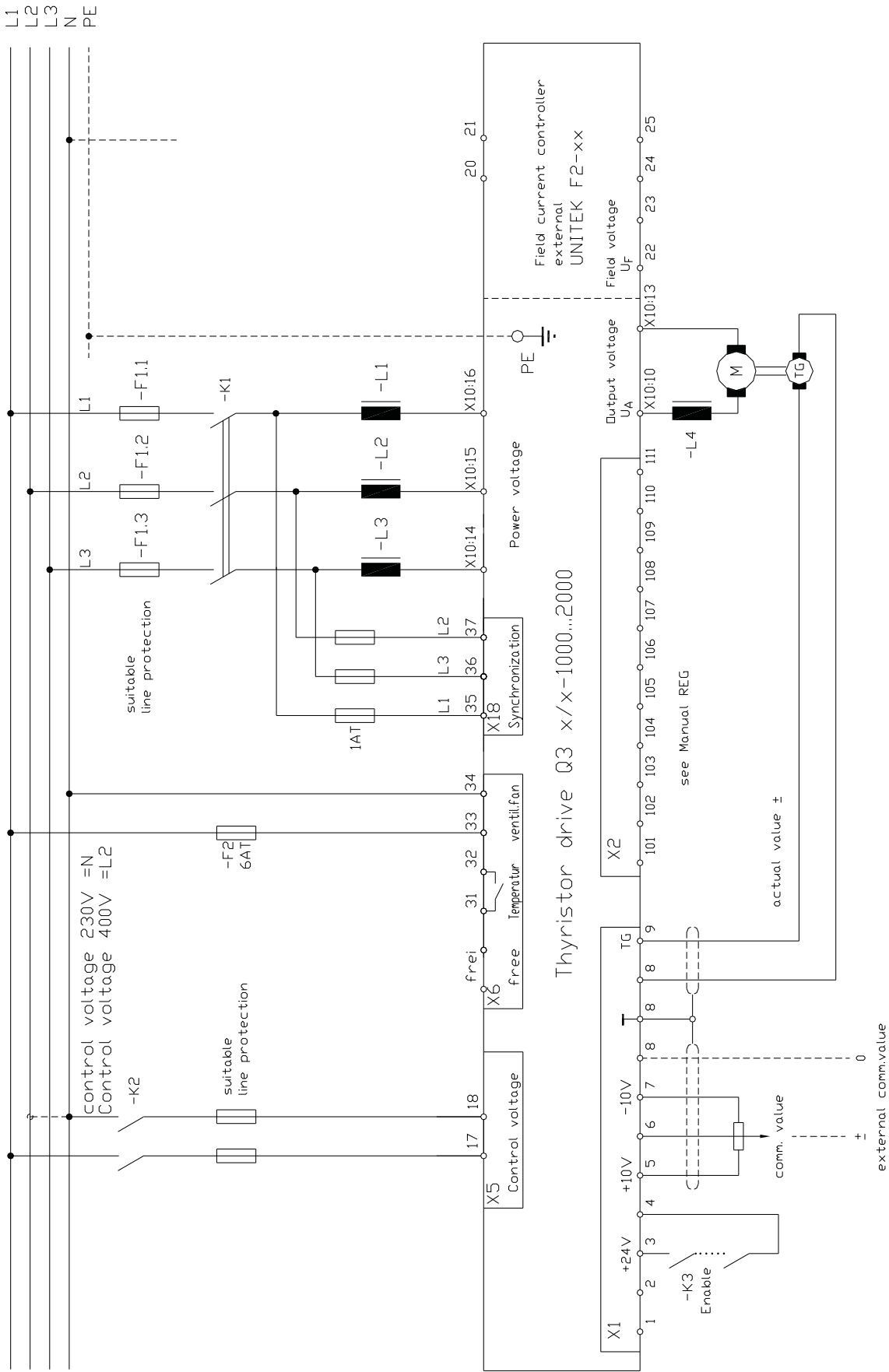


Q3-2AU2



* switching-off delay stand-still 0.3s

3 Electrical installation



EMC-Advice
All control lines have to be shielded
Motor- and Field lines have to be shielded

CE Advice

The devices adhere to the EU guidelines 89/336/EWG and the technical standards EN 61000-2 and 61000-4 provided that the following conditions are observed:

- The device, the transformer, and filter capacitors are mounted on a 500x500x2 mm mounting plate.
- The mounting plate must be connected to ground using a 10mm² wire.
- The motor housing must be connected to ground using a 10mm² wire.
- The device ground X1:8 must be connected to the mounting plate using a 2.5mm² wire.
- Device PE screw must be connected to the mounting plate using a 4mm² wire, l = 50mm.

Three-phase connection:

Power choke type: see technical details

Filter capacitors: 0.5mF/600V~ 3 x 1mF (x) + 1 x 1mF (y)

Conductor length between the device and the power choke <250mm

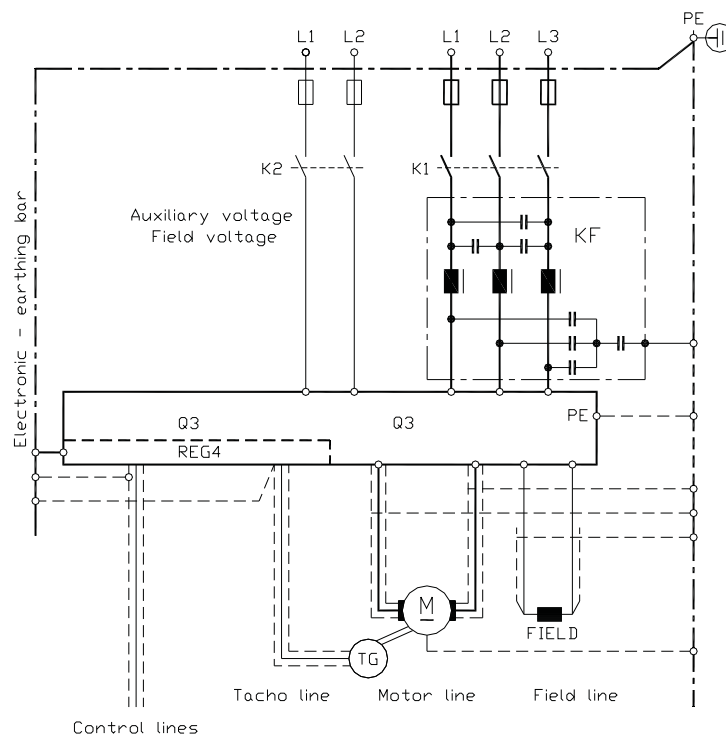
Motor connection:

Motor conductors l = 1.5m, shielded

Tacho and all control lines l = 1.5m, shielded

Shielding connected to PE

Connections diagram



KF = Commutation choke with filter capacitor

3 Electrical installation

Attention:

The order of the connections to the connector numbers or screw terminals is obligatory. All further advice is non-obligatory.

The input and output conductors may be altered or supplemented in accordance with the electrical standards.

Note:

- Connection and operating instructions
- Local regulations
- EU guideline 89/392/EWG
- VDE and TÜV regulations and Trade body guidelines

Switch on the auxiliary voltage and the supply voltage simultaneously.
Switch off the supply voltage after the auxiliary voltage

Input filter

see CE advice, page 14

Short conductor length to be used between the input filter and the device

Auxiliary voltage connection

Connection

terminal X5:17, X5:18

Power supply

400V~ ±15%

Special voltages

24V~, 110V~, 230V~, 500V~

Input current

max. 300mA

Phase position

regardless

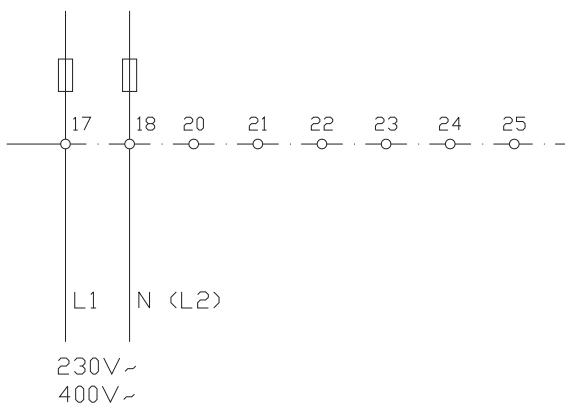
Internal fuses

FE1, FE2 0.8AT

- Min. line cross-section 0.5mm²

- External fuse

- Min. line protection 6A



Note:

Observe the respective type plate.

Control voltage XXX



Q3 1000-2000A

Direct power connection

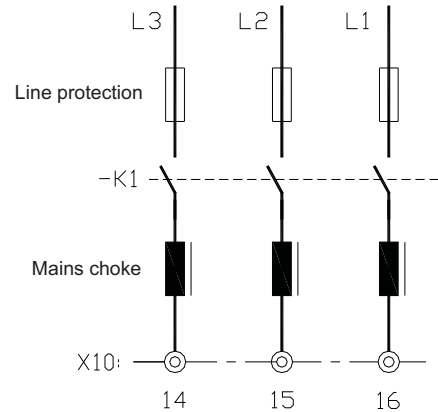
Phase L1 Bolt X10:16
 Phase L2 Bolt X10:15
 Phase L3 Bolt X10:14

Note:

L1,L2,L3 - clockwise rotating field

Protecting earth - PE connection

To work without PE connection is forbidden !!!



Q3 x/x-current type	Power choke KD- three phasecurrent K - phase choke	Fuses A Super fast acting installed
1000	KU240 -1000	6 x 1000 A FF
1500	KU240 -1500	12 x 1000 A FF
2000	KU240 - 2000	12 x 1000 A FF

Power connection with an auto-transformer

Transformer performance

1.1 x continuous motor power

Secondary voltage

0.9 x motor power

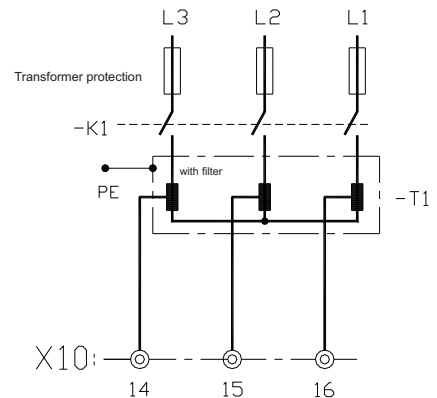
Transformer fuses

Slow acting

Observe the switch-on current!!!

Input fuses F1, F2, F3

rf. to the table above



Attention:

If the secondary voltages produced by the transformer are inferior to 60% the voltage watchdog has to be adapted. These modifications may only be effected in the factory and thus, the voltages have to be indicated on order.

Watchdog power connection

BTB inactive

dark LED

>>> missing phase

>>> wrong rotating field

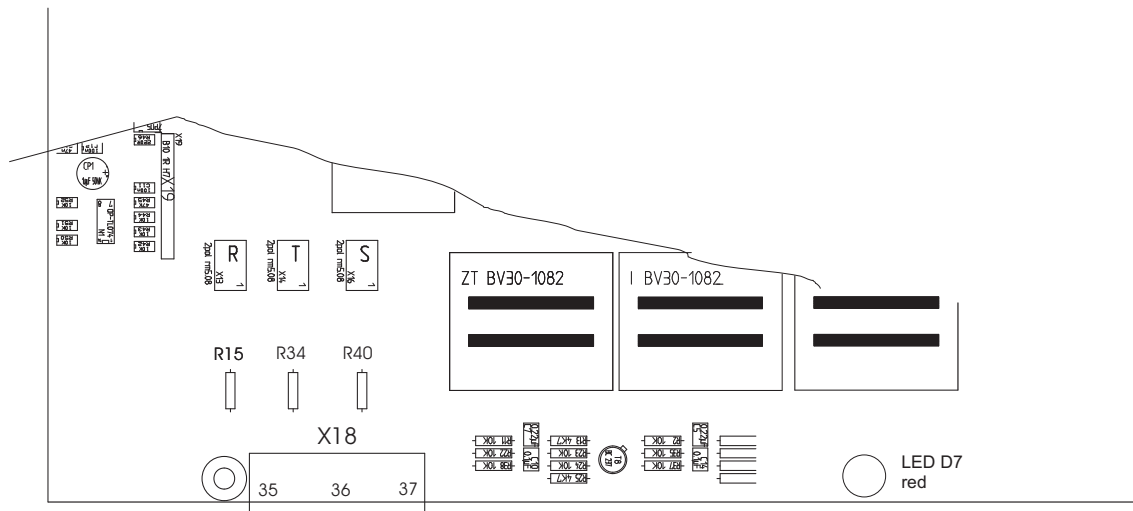
3 Electrical installation

Option - External synchronization

For special applications it might be necessary to tap the synchronization before the power commutating choke, e.g

- when operating via field triggering circuit
- in case of an instable power supply

When changing to external synchronization, the 3 resistors 0Ω (R15, R34, and R40) on the board 'Q3 - Ein3' have to be removed.



Connection across the terminals X18:35, 36, 37

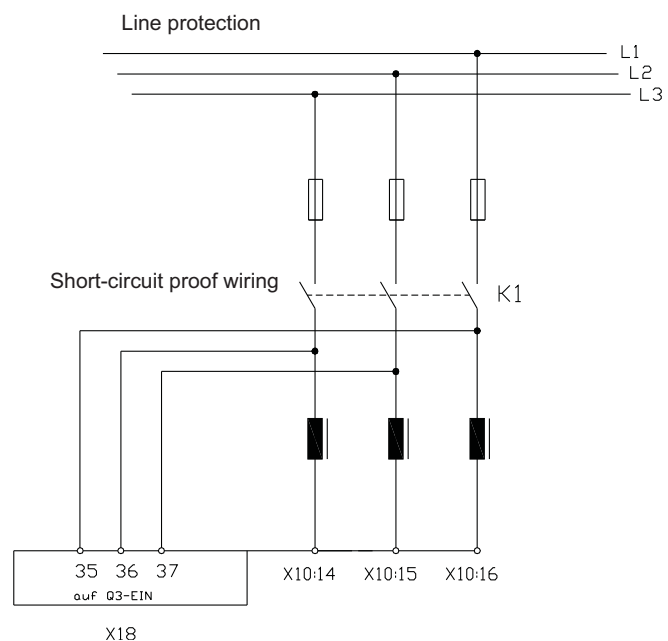
Observe the phase position!

- L3 across X10:14 (via power choke) and directly across terminal X18:36
- L2 across X10:15 (via power choke) and directly across terminal X18:37
- L1 across X10:16 (via power choke) and directly across terminal X18:35

The wiring has to be short-circuit proof or protected by means of a line protection.

The phase position function has a watchdog and in case of wrong connections the LED D7 on the board Q3-on3 will light and the BTB signal on the controller extinguishes when the controller is enabled.

LED D7 also lights if there is a breakage of the installed fuses.



Free



3 Electrical installation

Connection

positive command value

Motor- bolt X10:13

Motor+ bolt X10:10

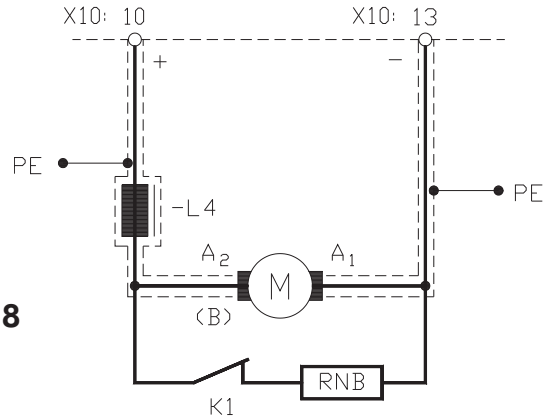
Note:

Armature choke only for a few applications

Inductance: $L \text{ [mH]} = U/I \times 0.8$

Standard version without a choke

Motor lines have to be shielded.



Unit Q3 x/x-	Power choke*	Min. conductor cross-section (mm ²)
Type current	Direct current	
1000	auf Anfrage	2x 240
1500	auf Anfrage	2x 240
2000	auf Anfrage	2x 240

* Chokes are necessary only for special applications

Switching in the armature circuit

- dc circuit current-free
- disable inactive

Warning:

Faulty switching will create arcing across the switch contacts.

Power supply failure - brake resistor



Break contact of the mains contactor K1

Rating: Resistor RNB = max. armature voltage/2 x type current

Attention:

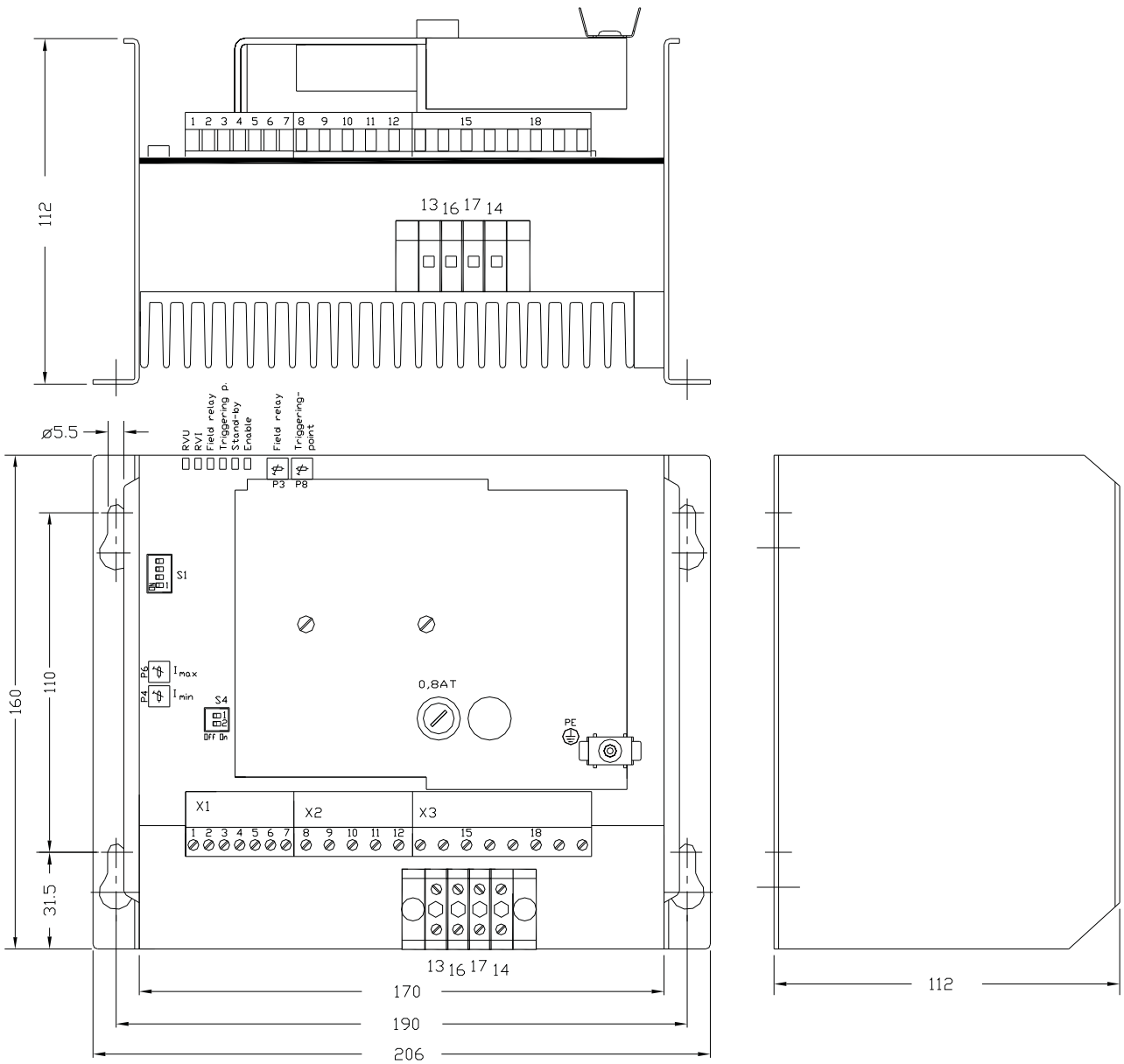
Power lines have to be shielded and routed separately from control lines!

For electro-magnetic interferences please refer to the CE advice.



Field regulator is not installed.

External field current regulator F2.1 xx



5 Adjustments

Actual value connection

Tacho

Suitable actual value encoders:

- DC tacho generator
- Brushless tacho generator with evaluation electronics
- Incremental encoders with evaluation electronics

Note: AC or three-phase tachos with rectification are not suitable

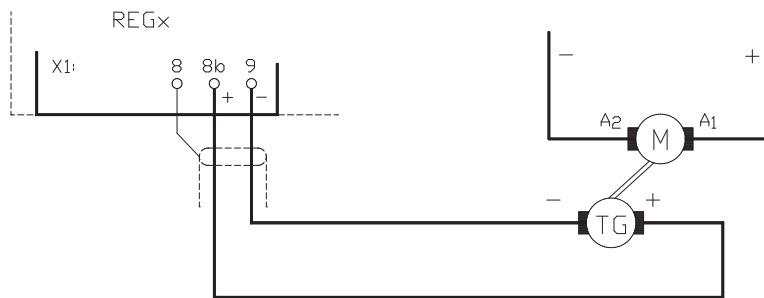


Connection

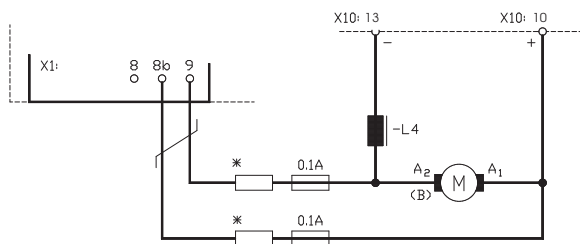
Control electronics (see Manual REG)

In case of a positive command value

- Tacho positive X 1:8b
- Tacho negative X 1:9
- Shield X 1:8



Armature voltage



*Only by $U_A > 180V$

Ground referenced actual value

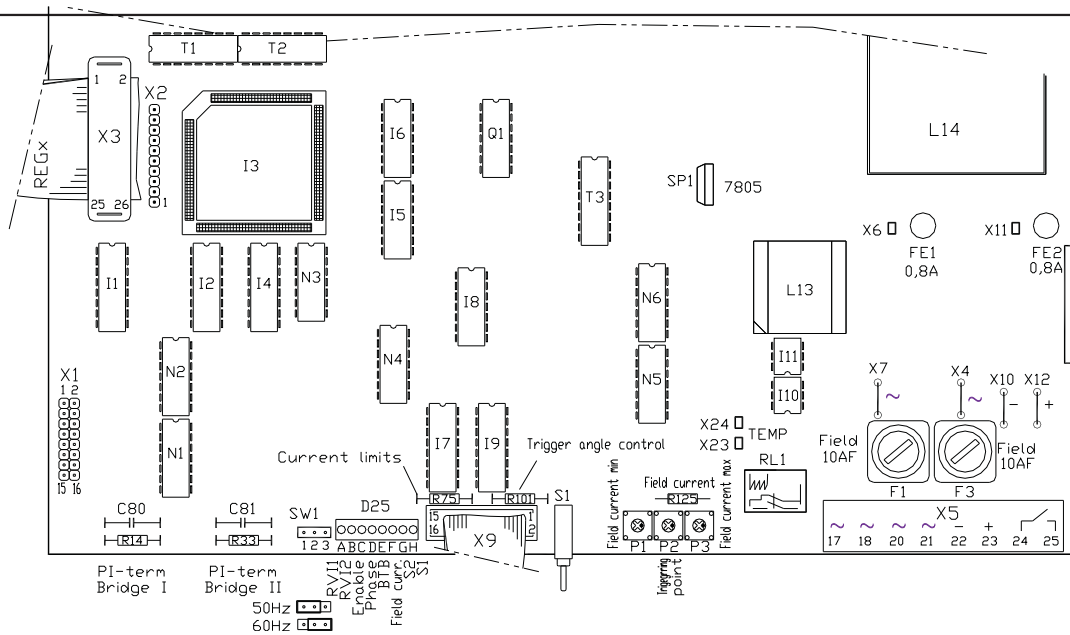
- Fuses 2x 0.1A >>> directly in the armature circuit
- For armature voltage >180V= >>> additional resistors are required
- Use unit UNITEK EXZU-UA1 (two resistors and two fuses in insul. case)

- Note: Observe Manual REG
- Option: In case of internal potential-free armature voltage control please indicate on order.



Q3 1000-2000A

Components



Adjustments

Variable elements

Variable elements	Function	Range
R14	P-amplification current controller 1	18kΩ to 470kΩ
R33	P-amplification current controller 2	18kΩ to 470kΩ
R75	Exact adjustment current limit	100kΩ to 470kΩ
R101	Trigger angle control	240kΩ to 560kΩ
R125	Field current	

C80	Integral term - current controller 1	0.1μF to 2.2μF
C81	Integral term - current controller 2	0.1μF to 2.2μF

Potentiometer

P1	min. field current	0 to 15%
P2	Triggering point for armature/field control	200 to 450V
P3	max. field current	0 to 100%

Jumper

SW1 Pos.1-2	50Hz adjustment
SW1 Pos.2-3	60Hz adjustment

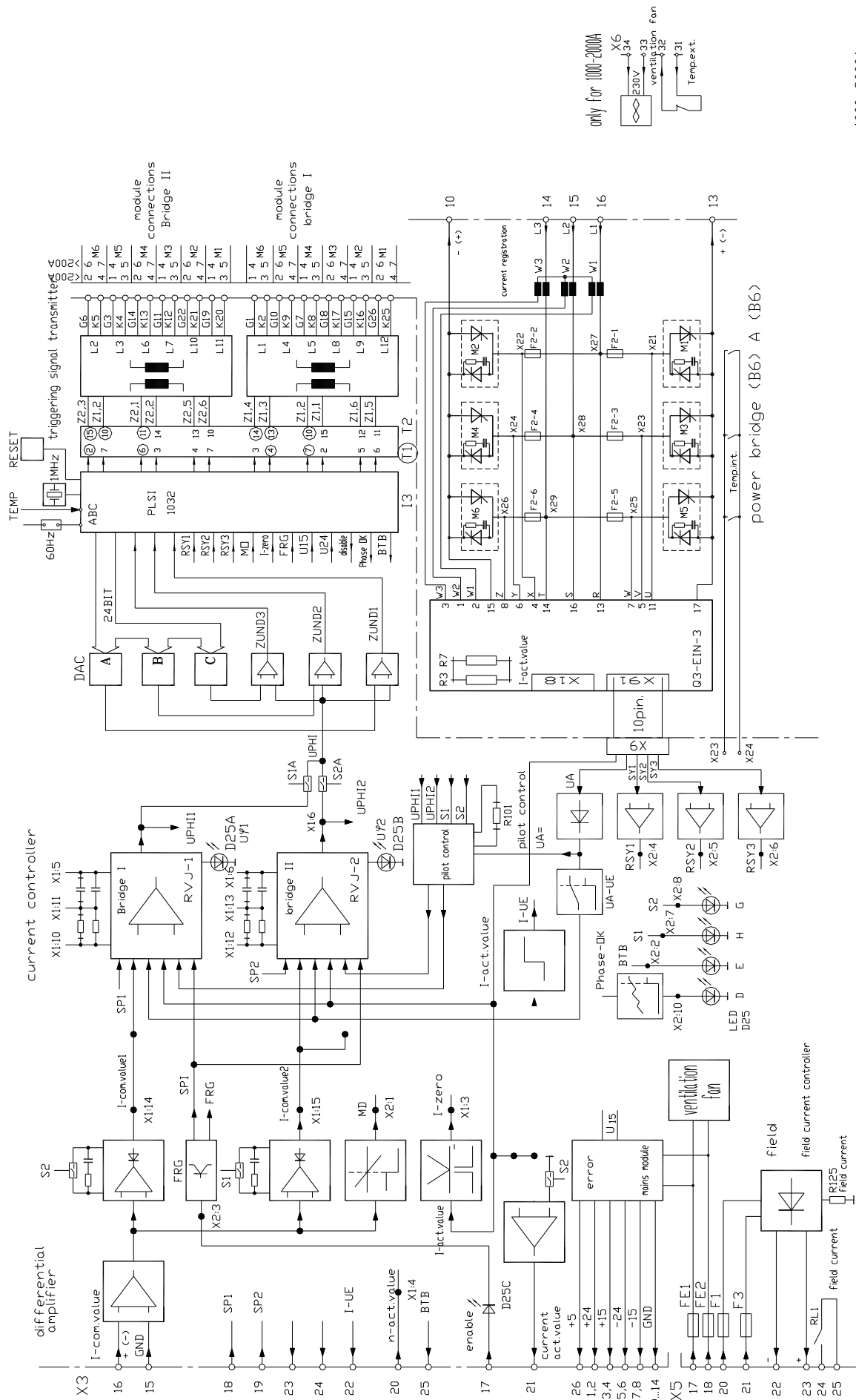
Switch

S1	Reset
----	-------

LED displays

D25A	Current control loop RVI-1	control active
D25B	Current control loop RVI-2	control active
D25C	Enable current controller/triggering	enabled
D25D	Phase error	error
D25E	BTB ready	operational
D25F	Field current	uminous intensity =field current
D25G	Current flow direction S2	active
D25H	Current flow direction S1	active

5 Adjustments



Current controller - PI loop circuit

for a positive command value

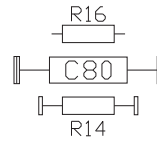
Bridge 1

negative R14, C80

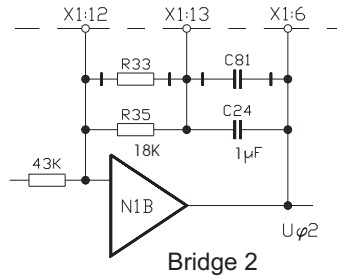
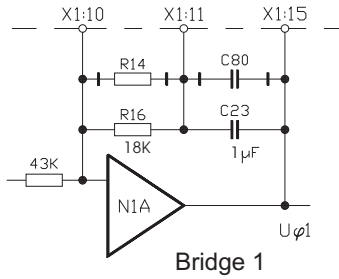
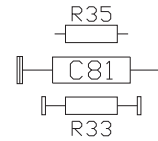
Bridge 2

positive R33, C81

Bridge 1



Bridge 2



Basic set-up

Amplification ~0.4

Integration time ~18m

Changing the amplification

Bridge 1

$$X_p = \frac{18k\Omega \times R14}{18k\Omega + R14} \times \frac{1}{43k\Omega}$$

Bridge 2

$$X_p = \frac{18k\Omega \times R33}{18k\Omega + R33} \times \frac{1}{43k\Omega}$$

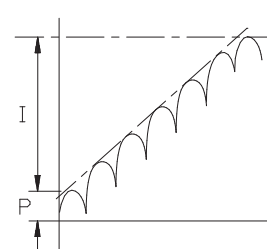
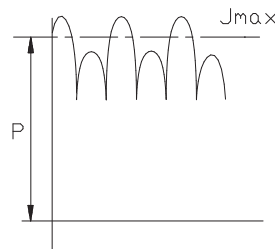
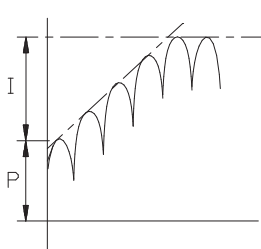
Changing the integration time

$$\tau [ms] = \frac{18k\Omega \times R14}{18k\Omega + R14} \times (1\mu F + C81)$$

$$\tau [ms] = \frac{18k\Omega \times R33}{18k\Omega + R33} \times (1\mu F + C80)$$

Bridge 1

Bridge 2



Optimization of the current controller

- Connect an oscilloscope across the current actual value X3:21
- Current command value step-change ±1V X3:16

5 Adjustments

BTB signal - Drive ready

BTB signal	X3:25	> +5V
Error	X3:25	< +5V

Error

Voltage error	24V, 15V, 5V	saved
Phase error, rotating field		saved
Defective input fuse		saved
Over-temperature		saved

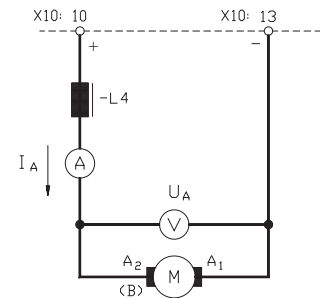
In case of errors or failure the power section is immediately internally disabled without delay.

To clear the saved error re-enable the drive (switch off/on or reset key)

Measurements

Measurement advice

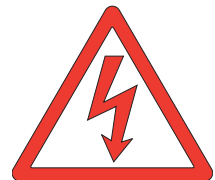
Measuring instruments: multimeters for current and voltage
 shunt or clamp-on ammeter
Measuring faults: mean value > actual value
 acc. to the form factor
 approx. 1 to 5%



Measured values

with a positive command value

Voltage: X10:10 positive X10:13 negative
 max 1.15 x power supply
 For 400V~ >> 460V=



Current: ammeter in the motor circuit

5s 200%, continuously 110% type current

Measured values across REG4 (selectable, see Manual REG4)

Speed	X2:109	±5V or ±10V	for ±100% speed
Current	X2:111	±5V or ±10V	for ±200% current
GND	X2:104		

Q3 1000-2000A

Commissioning Q3 x/x-x with REG4

Check the following connections before commissioning
Observe the type plate!



Basic connection - power connections Q3

Power supply	power	bolts X10:14, X10:15, X10:16
Power supply	auxiliary voltage	terminals X5:17, X5:18
Motor connection	A1/A2	bolts X10:10, X10:13
Protecting earth	PE	earthing screws PE on the housing

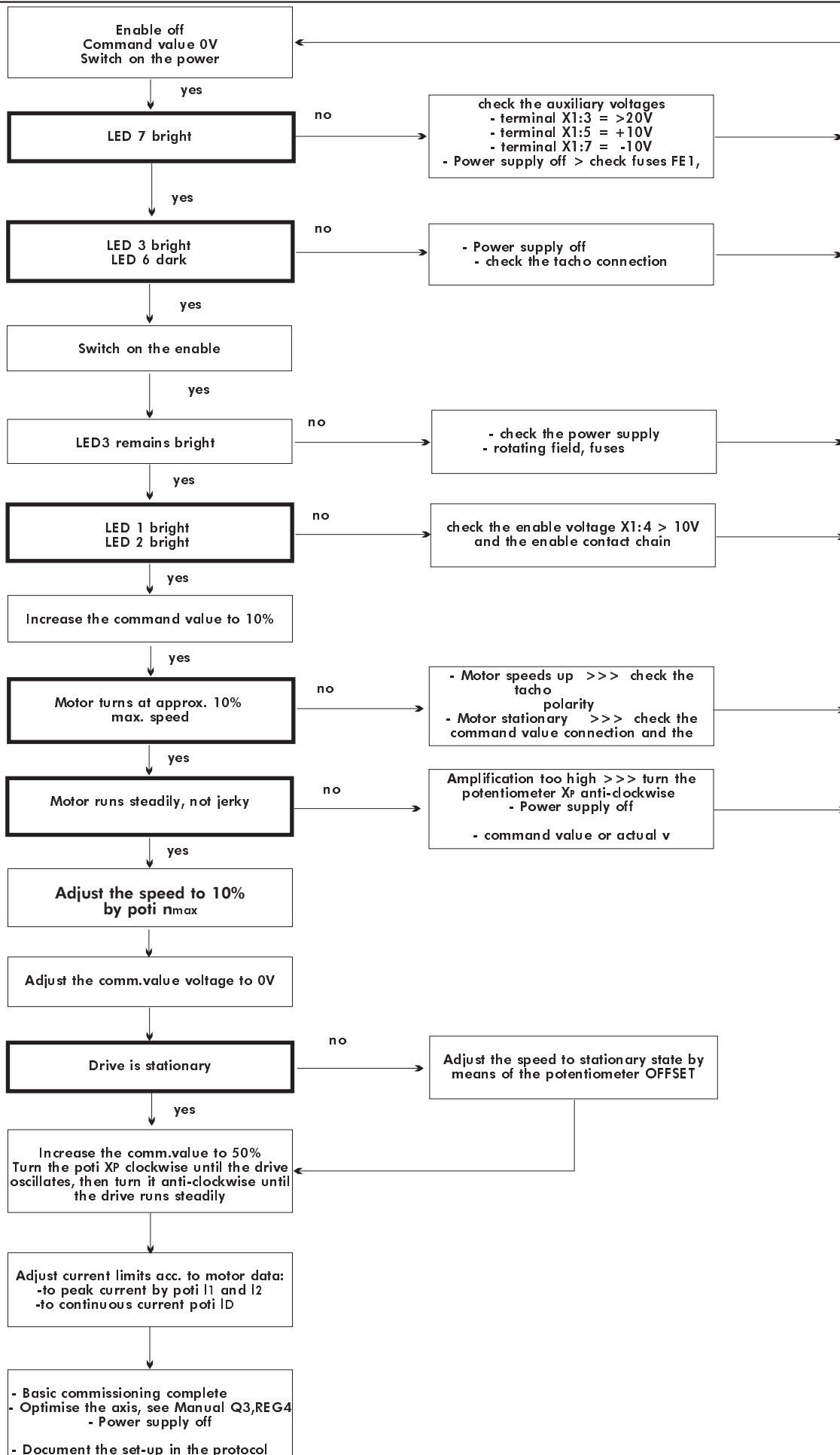
Control connections

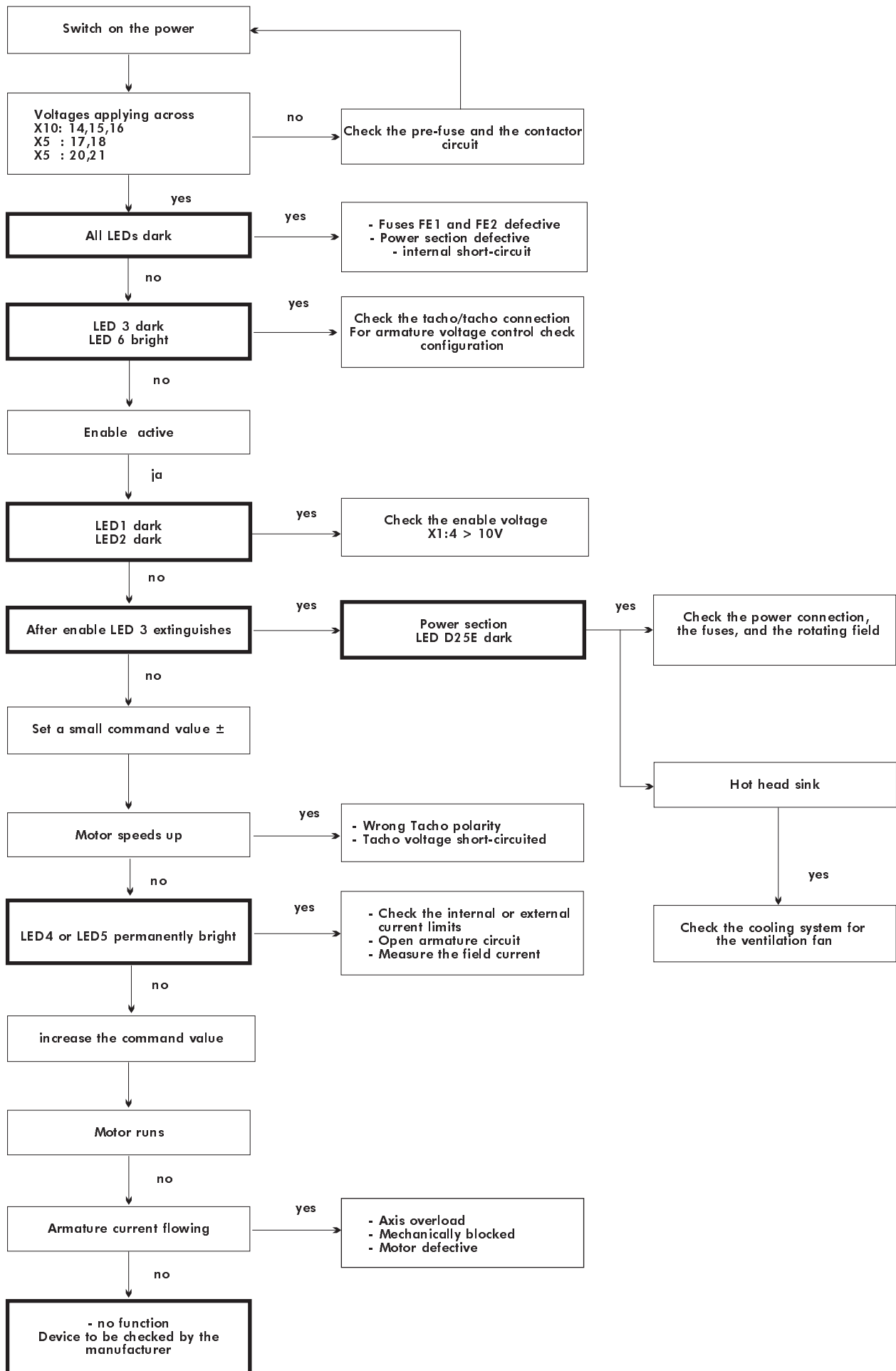
Enable	contact between X1:3 and X1:4		
Command value	signal X1:6, GND X1:8a		
Actual value	signal X1:9, GND X1:8b		
Shields	X1:8		

Control electronics REG4

Switch	S4	PI amplification	position 4
Switch	S5	I-term	position 4
Switch	S8	D amplification	position 8
Switch	S9	actual value	position 8
Potentiometer	I1	peak current	10%
Potentiometer	I2	peak current	10%
Potentiometer	ID	continuous current	100%
Potentiometer	Xp	amplification	50%
Potentiometer	INT	integrato	left full scale
Potentiometer	n _{max}	speed	left full scale
Potentiometer	offset	offset	50%

6 Commissioning





7 Faults

Error diagnosis

Malfunction	Causes
Motor does not run	<ul style="list-style-type: none">- Wrong power supply and motor connections- Activated fuses- Missing enable or command value- Current limit too low- Missing BTB
Motor speeds up	<ul style="list-style-type: none">- Wrong polarity of the actual value (tacho armature voltage)- Values of the tacho switch S9 too low- Command value too high For armature voltage control- Field current too low- Fuses, armature voltage feedback activated
Motor runs unsteadily	<ul style="list-style-type: none">- Mechanical defect of the tacho- Tacho malfunction- Amplification of the speed controller too low or too high- Wrong PID parameter- Command value errors- Amplification of the current controller too low or too high
No motor torque	<ul style="list-style-type: none">- Current limits too low- Field current too low- Mechanical overload of the axis

Guarantee

UNITEK guarantees that the device is free from material and production defects. Test results are recorded and archived with the serial number.

The guarantee time begins from the time the device is shipped, and lasts one year. Unitek undertakes no guarantee for devices which have been modified for special applications.

During the warranty period, UNITEK will, at its option, either repair or replace products that prove to be defective, this includes guaranteed functional attributes. UNITEK specifically disclaims the implied warranties or merchantability and fitness for a particular purpose. For warranty service or repair, this product must be returned to a service facility designated by UNITEK.

For products returned to UNITEK for warranty service, the Buyer shall prepay shipping charges to UNITEK and UNITEK shall pay shipping charges to return the product to the Buyer.

However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to UNITEK from another country.

The foregoing warranty shall not apply to defects resulting from:

- * improper or inadequate repairs effected by the Buyer or a third party,
- * non-observance of the manual which is included in all consignments,
- * non-observance of the electrical standards and regulations
- * improper maintenance
- * acts of nature

All further claims on transformation, diminution, and replacement of any kind of damage, especially damage, which does not affect the UNITEK device, cannot be considered. Follow-on damage within the machine or system, which may arise due to malfunction or defect in the device cannot be claimed.

This limitation does not affect the product liability laws as applied in the place of manufacture (i. e. Germany).

UNITEK reserves the right to change any information included in this MANUAL.

All connection circuitry described is meant for general information purposes and is not mandatory.

The local legal regulations, and those of the Standards Authorities have to be adhered to. UNITEK does not assume any liability, expressively or inherently, for the information contained in this MANUAL, for the functioning of the device or its suitability for any specific application.

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The onus is on the reader to verify that the information here is current.

9 Protocol

Protocol

Q3 x/x-x with REG4

Customer

Machine No.

Device Q3- Serial No

Control voltage [V~]

Power supply voltage [V~]

Field voltage [V=]

Inputs REG4

Enable contact ?		voltage [V=]	. . . . .
Command value	type	voltage [V=]	. . . . .
Command value, additional	type	voltage [V=]	. . . . .
Current command value I_{max1}	external	voltage [V=]	. . . . .
Current command value I_{max2}	external	voltage [V=]	. . . . .

Speed controller settings REG4

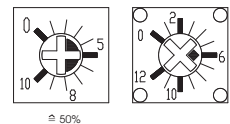
Switches

Tacho adjustment	S9	Position	. . . . .
P-term	S4	Position	. . . . .
I-term	S5	Position	. . . . .
D-term	S8	Position	. . . . .



Potentiometers

Speed	n_{max}	P4	Position	. . . . .
Peak current	I_{max1}	P5	Position	. . . . .
Peak current	I_{max2}	P6	Position	. . . . .
Continuous current	I_D	P7	Position	. . . . .
Integrator	INT	P1	Position	. . . . .
Amplification	XP	P3	Position	. . . . .
I_xR compensation		P2	Position	. . . . .



DIP switch

ON	no.	. . . . .
OFF	no.	. . . . .

Q3 1000-2000A

Protocol

Protocol

Q3 x/x-x with REG4

Current controller settings Q3

P-amplification	R14 = ...	R13 = ...
I-term	C80 = ...	C81 = ...

50/60Hz

Jumper SW1	Pos. 1-2 (50Hz)	Pos. 2-3 (60Hz)
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Measured data Q3 - REG4

Armature voltage	max.	[V=]
------------------	------	------	-------

Armature current	peak	[A=]
------------------	------	------	-------

Armature current	continuous	[A=]
------------------	------------	------	-------

Tacho voltage	max.	[V=]
---------------	------	------	-------

Acceleration	X4:	[V/ms]
--------------	-----	--------	-------

Integrator	X4:	[V/ms]
------------	-----	--------	-------

Motor data

Type plate data

Manufacturer

Type	Serial number
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Motor voltage [V=]	Motor current [A=]
--------------------------	--------------------------

Tacho voltage [V/min-1]	Tacho type
-------------------------------	------------------

Brake [V]	Fan [V]
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