M A N U A L

Classic Q3 1000 - 2000 A
4 quadrant operation
Thyristor motor controller

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Table of contents

1 Basic information 2
1.1 Safety instructions 2
1.2 Regulations and guidelines 2
1.3 Designations and symbols used 3
1.4 The user must ensure that 3
1.5 General information and properties 5
1.6 Technical data 7
1.7 Specifications 8
1.8 Interfaces 8
2 Mechanical installation 9
2.1 Installation 9
2.2 Throttle 10
3 Electrical installation 11
3.1 Dimension drawings 11
3.2 Connection overview 14
3.3 Wiring diagrams 15
3.4 CE notes 16
3.5 Mains connection 17
3.6 Direct power connection 18
3.7 Option - External synchronisation 19
3.8 Motor connection 20
3.9 Field connections 21
3.10 Actual value - connection 22
4 Settings 23
4.1 Component overview / settings 23
4.2 Block diagram 24
4.3 Current controller control parameters 25
4.4 Messages 27
5 Commissioning 28
5.1 Commissioning Q3 x/x-x with REGxx 28
5.2 Protocol (commissioning) 30
6 Troubleshooting 32
6.1 Troubleshooting 32
6.2 Functional error 33

1 Basic information

1.1 Safety instructions

Electronic devices are generally not fail-safe.

Attention - high voltage
AC 500V~, DC 650V=
Danger of shock / danger to life!

This manual must be carefully read and understood by qualified personnel before installation or commissioning. If anything is unclear, please contact the manufacturer or dealer.

The devices are electrical equipment (EB) of power electronics for controlling the flow of energy in power installations.
Protection class IP00.

Control and power connections can be
Apply voltage without the drive operating!

Measure voltage before dismantling!

1.2 Regulations and guidelines

EU Directive	2004/108/EC, 2006/95/EC, 2006/42/EC EN 60204-1, EN292, EN50178, EN60439-1, EN61800-3, ECE-R100 ISO 6469, ISO 26262, ISO 16750, ISO 20653, ISO12100
IEC/UL:	IEC 61508, IEC364, IEC664, UL508C, UL840
VDE regulation/TÜV regulation:	VDE100, VDE110, VDE160
Regulation of the employers' liability insurance association:	VGB4

1.3 Designations and symbols used

Device	Q3 1000-2000 A
Manufacturer:	UNITEK Industrie Elektronik GmbH
	Beware of danger to life! **High voltage**
	Warning! **Important**
	Dangerous electric fields

1.4 The user must ensure that

- that after a failure of the device
- in the event of incorrect operation
- in case of failure of the regulation and control unit, etc.

the drive is brought into a safe operating state.

Machines, systems and vehicles are also equipped with monitoring and safety devices that are independent of the appliance.

Non-earthed systems (e.g. vehicles) must be equipped with independent insulation monitors.

There must be no danger to people or property!!!

Assembly work
- only in de-energised state
- only by trained electrical specialists
- The devices and the associated components must be installed and connected in accordance with local legal and technical regulations.

Installation work
- only in de-energised state
- only by trained electrical specialists
- Observe safety regulations

Setting and programming work
- only by specialised personnel with knowledge of electronic drives and software
- Follow the programming instructions
- Observe safety regulations

CE
When installed in machines, systems and vehicles, the device may not be used for its intended purpose until it has been established that the machine, system or vehicle complies with the provisions of the EC Machinery Directive 2006/42/EC, the EMC Directive 2004/108/EC and ECE-R100.
The EC Directive 2004/108/EC with the EMC standards EN61000-2 and EN61000-4 is complied with under the specified installation and test conditions (see chapter CE notes).
A manufacturer's declaration can be requested.
Compliance with the limit values required by EMC legislation is the responsibility of the manufacturer of the vehicle, system or machine.

QA
The devices are archived by the manufacturer for 5 years via their serial number with the test data. The test reports can be requested.

1.5 General information and properties

This manual describes the basic device and is only available in conjunction with the control electronics manual (e.g. REGxx) are valid.

Use manual in conjunction with:

- **Analogue control electronics REGxx**
- **External field controller F2xx**
- **Options Multi-xx**

Structure
- Enclosure-mounted devices
- in accordance with VDE, DIN and EC directives
- Standardised control electronics REG
- Basic device as intrinsically safe power unit with current regulator
- Option assemblies

Galvanic isolation between
- Power unit and housing
- Power unit and control electronics

The clearances and creepage distances correspond to VDE (>8mm).

Can be used:
- Thyristor modules, generously dimensioned
- Only commercially available industry standard components
- High-quality sockets for IC with external connections
- Light emitting diode displays
- Precision trim pot for fine adjustment
- Plug-in jumper for system setting

Properties

- ✓ Classic Q3 series
- ✓ Thyristor controller for DC motors
- ✓ Power range 6.75kW to 1.1MW
- ✓ Driving and braking in all 4-quadrants
- ✓ Energy recovery
- ✓ Intrinsically safe power unit
- ✓ Fast analogue current control
- ✓ Temperature monitoring power unit
- ✓ Circuit current-free double bridge circuit
- ✓ Field rectifier unregulated or regulated (not for Q3 1000 A-2000 A)
- ✓ 26-pin interface
- ✓ Properties of the control electronics used
- ✓ See MANUAL REGxx or other brand
- ✓ Option assemblies

1.6 Technical data

Q3 400/450-1000 up to 2000

Power connection:	360 ... 440V~
Auxiliary voltage connection:	360 ... 440V~, (200 ... 250 V~ or optional)
Output voltage:	max. ± 450V=
Cooling:	Fan
Field supply not installed.	Field regulator UNITEK F2.x 400/340-20

Q3 400/450 -			1000	1500	2000
Input current		A~	800	1200	1600
Output current	- Tip 5s - Duration	A= A=	2000 1000	3000 1500	4000 2000
Electrical power		kW	450	675	900
Fuses	Entrance	ff Aff	built-in 6 x 1000	built-in 12 x 1000	built-in 12 x 1000
Mains choke		Type	3x KU240-1000	3xKU240-1500	3xKU240-2000
		mH	0,05	0,03	0,02
Armature choke (on request)		Armature chokes are only necessary for a few applications			
Dimensions WxHxD		mm	550x800x520	550x800x520	550x800x520
Weight		kg	137	142	142

Q3 500/550-1000 up to 2000

Power connection:	450 ... 550V~
Auxiliary voltage connection:	360 ... 440V~, (200 ... 250V~ or optional)
Output voltage:	max. ± 550V=
Cooling:	Fan
Field supply not installed.	Field regulator UNITEK F2.x 400/340-20

Q3 500/550 -			1000	1500	2000
Input current		A~	800	1200	1600
Output current	- Tip 5s - Duration	A= A=	2000 1000	3000 1500	4000 2000
Electrical power		kW	550	825	1100
Fuses	- Entrance 6 pcs.	ff Aff	built-in 6 x 1000	built-in 12 x 1000	built-in 12 x 1000
Mains choke		Type	3xKU240-1000	3xKU240-1500	3xKU240-2000
		mH	0,05	0,03	0,02
Armature choke (on request)		Armature chokes are only necessary for a few applications			
Dimensions		mm	550x800x520	550x800x520	550x800x520
Weight		kg	137	142	142

1.7 Specifications

Common specification

Mains frequency	50 or 60Hz ±2%
Protection class	IP 00
Device design	VDE 0100 Group C, VDE 0160
Moisture stress	Class F according to DIN 40040
Installation height	< 1000m above sea level
Operating range	0 ... 45°C
Extended operating range	up to 60°C red. 2 % / °C
Storage area	-30°C to + 80°C

Current regulator

Reinforcement	
- Input signal	0... ± 10V=
- Output	0... ± 200% Type current
Overcurrent limitation	10 sec. 200 % type current
Control accuracy	± 2%
Control range	1:50
Release	> +10V
Speed controller (see MANUAL REG)	
Control accuracy (without actual value error)	< ±0.1%
Control range	> 1:1000

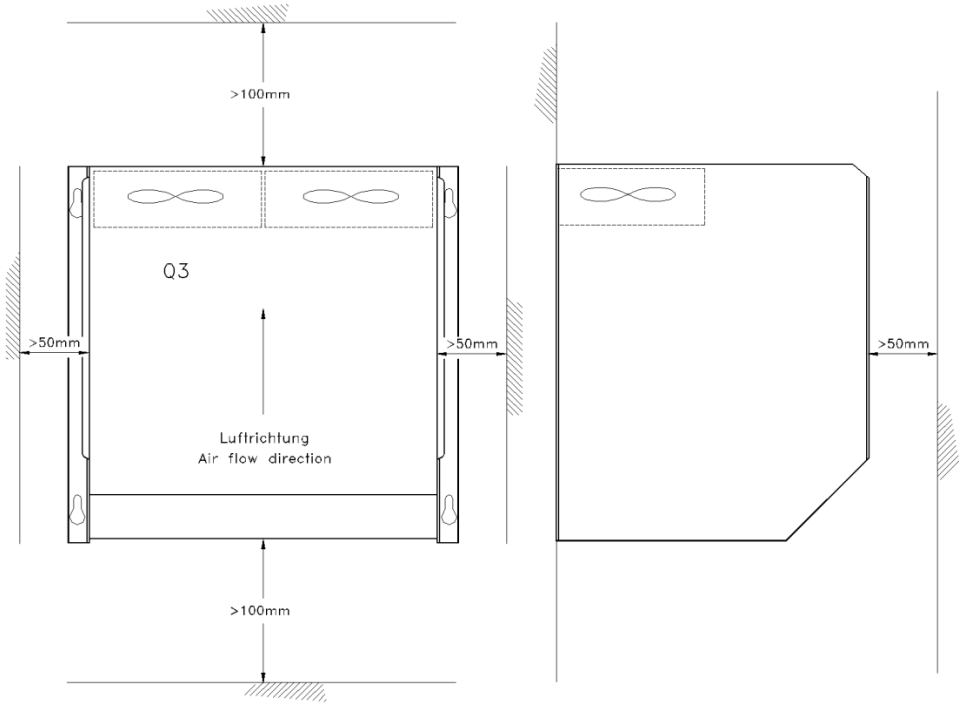
1.8 Interfaces

Control electronics interface X3

Function			**Plug number**
+ 24V		±10%	X3: 1 and 2
+ 15V		±2%	X3: 3 and 4
- 24V		±10%	X3: 5 and 6
- 15V		±2%	X3: 7 and 8
Device zero	GND	0	X3: 9, 10, 11, 12, 13, 14
I setpoint	(GND)	0	X3: 15
I setpoint (signal)		+10V=	X3: 16
Enable current controller		+10V=	X3: 17
Lock 1		+10V=	X3: 18
Lock 2		+10V=	X3: 19
n - Actual		+10V=	X3: 20
I - Actual		±5V=	X3: 21
Overcurrent power unit		+10V=	X3: 22
Option UA		±10V=	X3: 23
Option UA		0 to +10V=	X3: 24
Ready for operation BTB		+10V=	X3: 25
		+5V	X3: 26

2 Mechanical installation

2.1 Installation



1 - Q3 mounting V616

Ambient temperature 0 to <45 °C (reduced to 60 °C)
Max. Heat sink temperature 80°C

Air flow rate 1000-2000 A 2500 m³h

Power losses at maximum power		
Devices Q3-x/X	**Devices W**	**Mains choke W**
1000	3700	1000
1500	5400	1300
2000	7200	1600

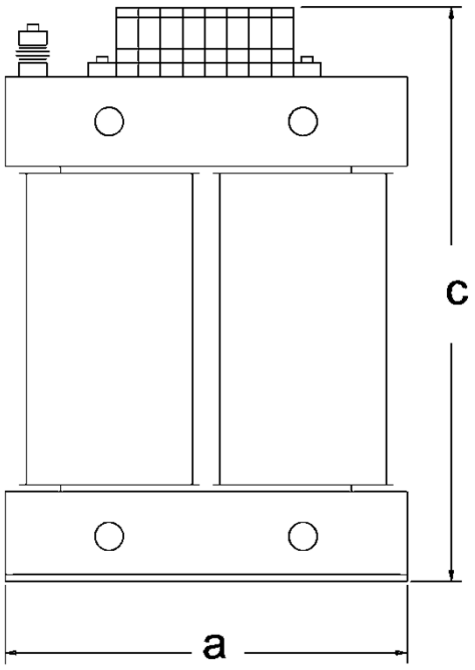
2.2 Throttle

1-phase mains choke

Execution

UN	400 V ~ 50 / 60 Hz
UK	4 %
Protection class	IP00
Isoll. Class	T40/E
Foot angle standing	

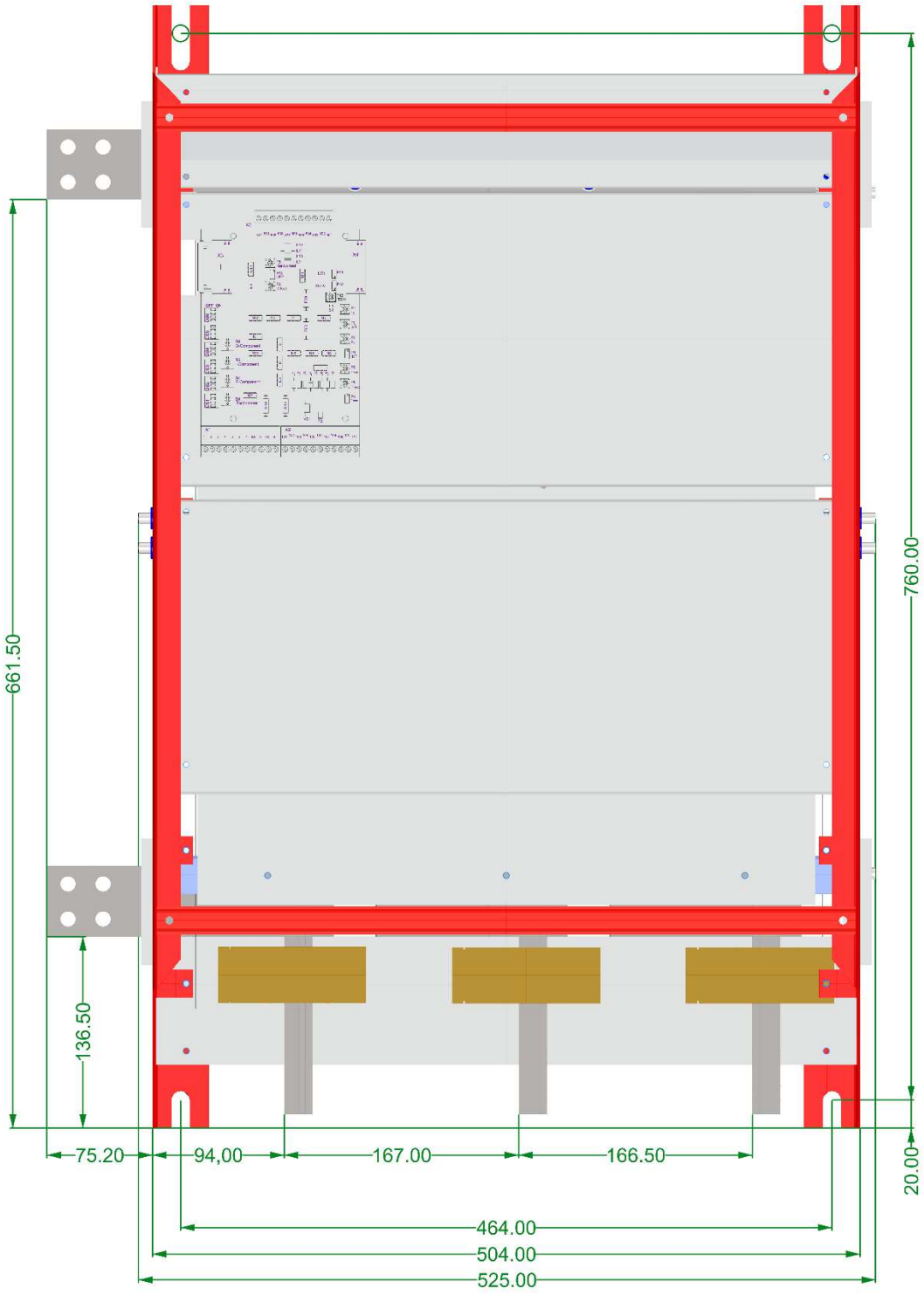
Device Q3-x/x	Throttle Type	L mH	PV W	Mass					Weight kg	Screw M
				a	b	c	d	e		
1000	KU240-1000	0,05	1000	320	270	470	250	190	98	10
1500	KU240-1500	0,03	1300	320	270	470	250	190	98	10
2000	KU240-2000	0,02	1500	320	270	470	250	190	98	10



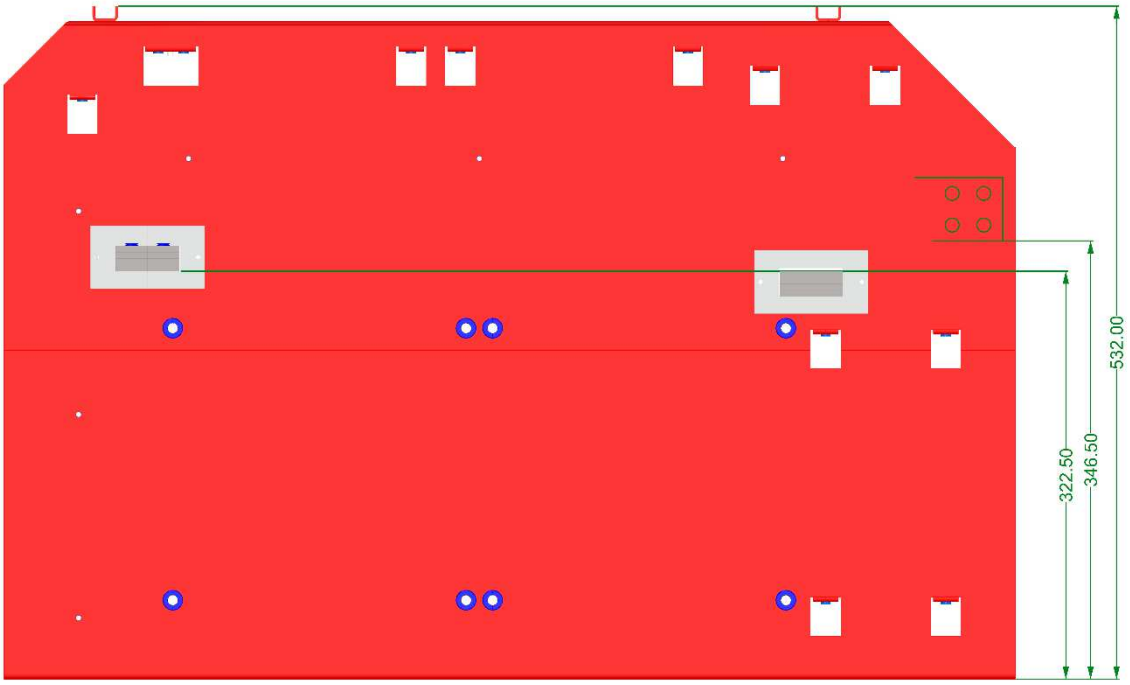
2 - Q3-V256-UI transformer

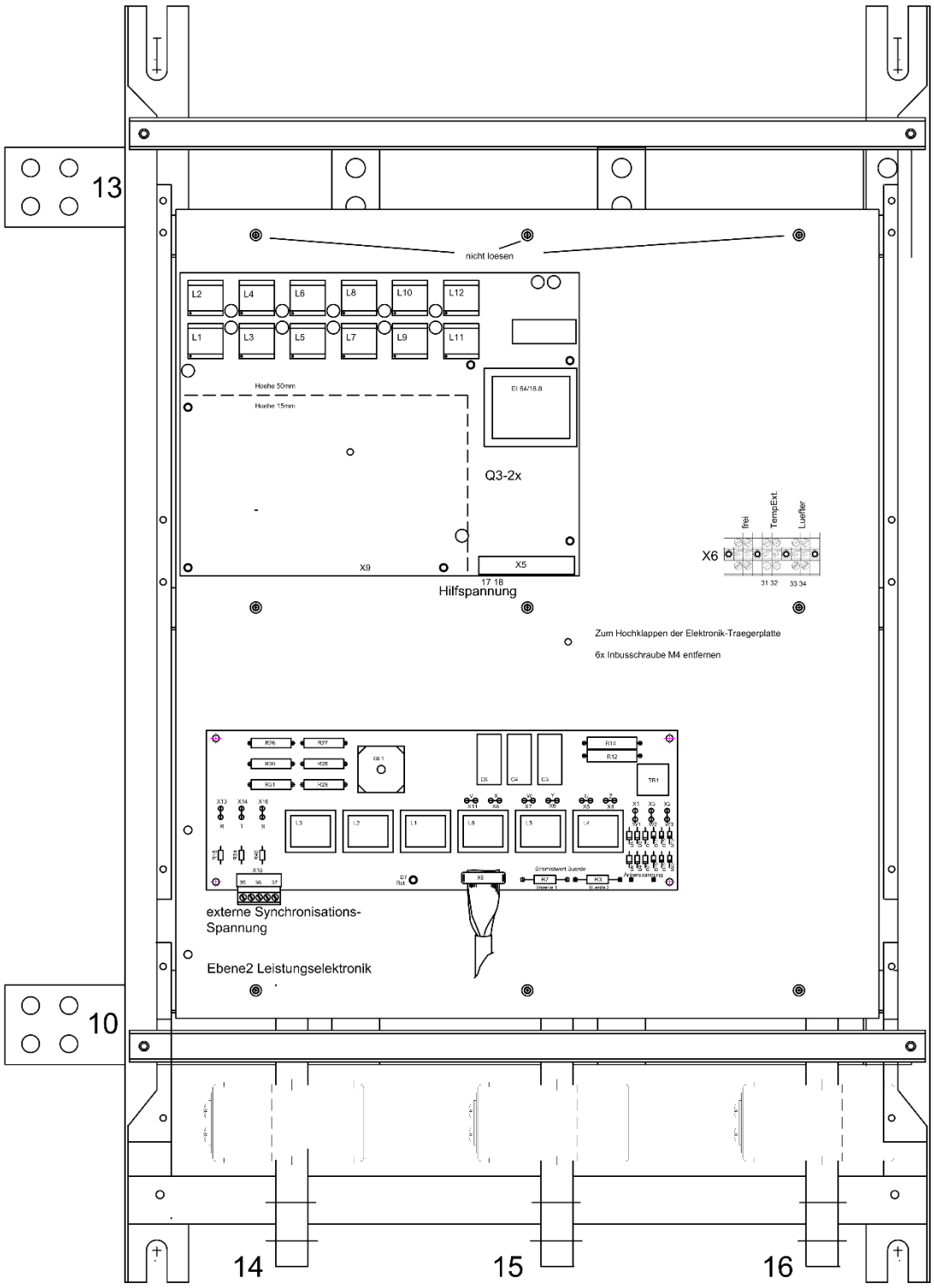
3 Electrical installation

3.1 Dimension drawings

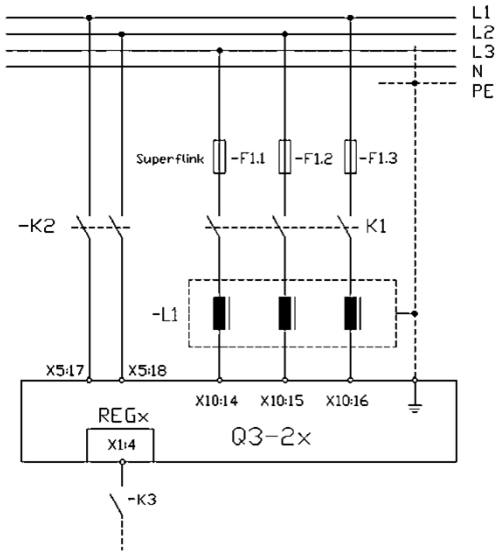


Dimension drawing

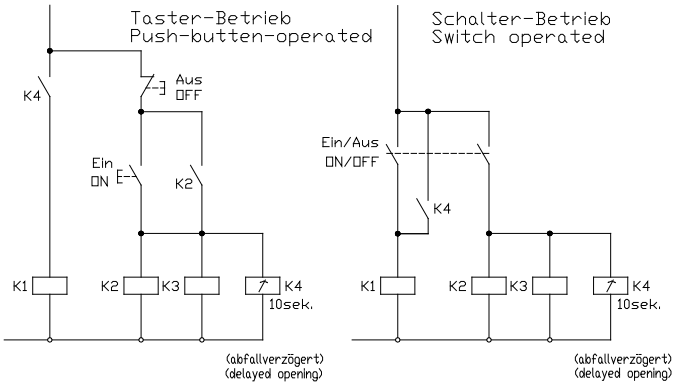



13
10
14
15
16
nicht loesen
L2
L4
L6
L8
L10
L12
L1
L3
L5
L7
L9
L11
Hoehe 50mm
Hoehe 15mm
EI 54/18.8
Q3-2x
X9
X5
17 18
Hilfspannung
X6
frei
TempExt.
Luefter
31 32
33 34
Zum Hochklappen der Elektronik-Traegerplatte
6x Inbusschraube M4 entfernen
externe Synchronisations-
Spannung
Ebene2 Leistungselektronik

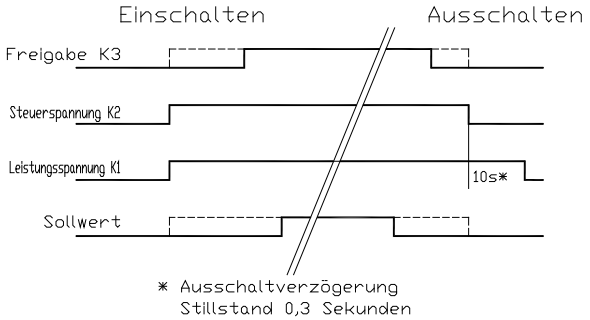
3.2 Connection overview



3 - Q3 connection-647-1

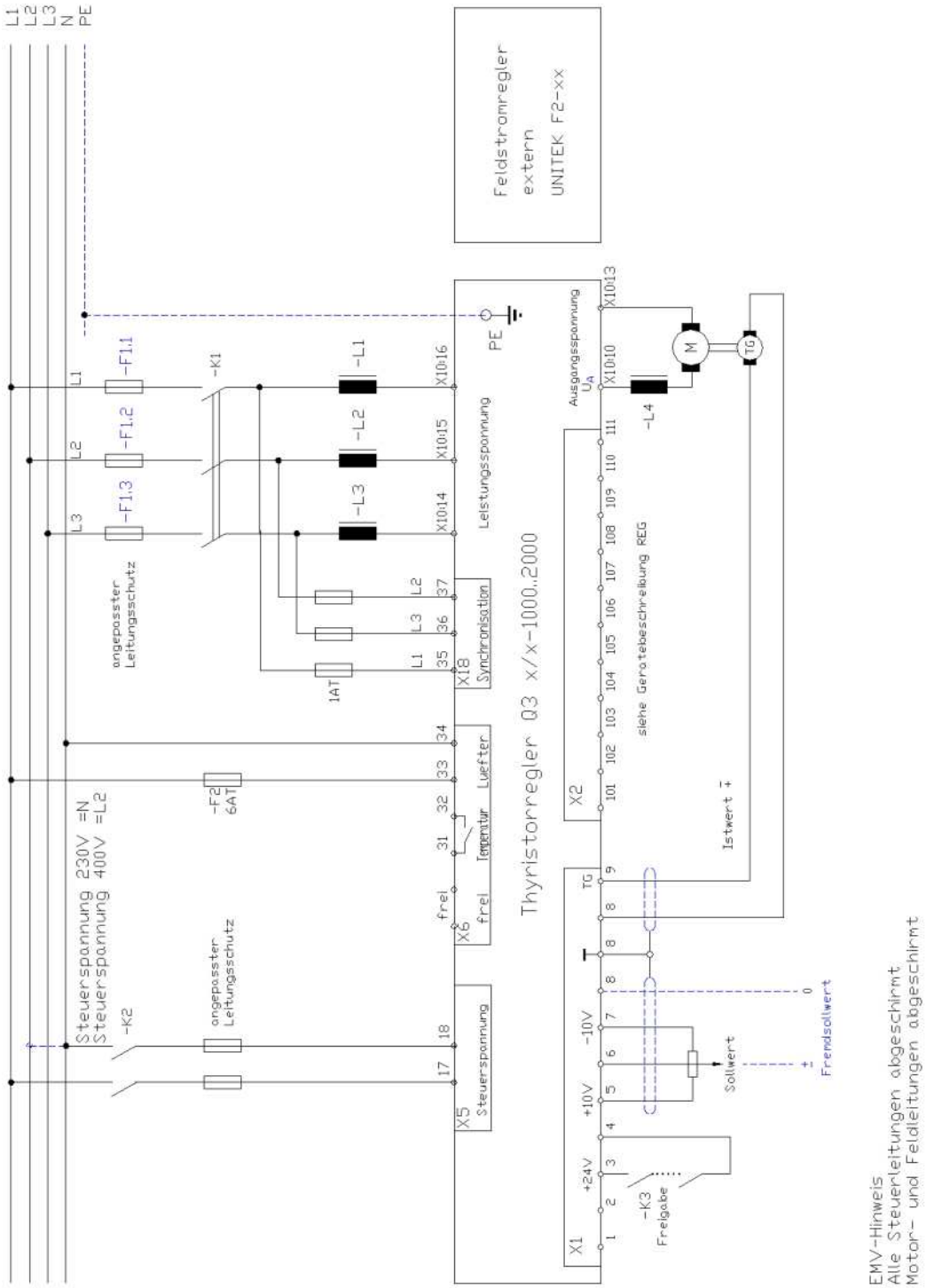


4 - Q3-Relay-1V647



5 - Q3 switching sequence 1-V647

3.3 Wiring diagrams



6 - Q3-2000 connection diagram

3.4 CE notes

The devices comply with EC Directive 89/336/EEC in the EMC standards EN61000-2 and EN61000-4 under the following installation and test conditions.

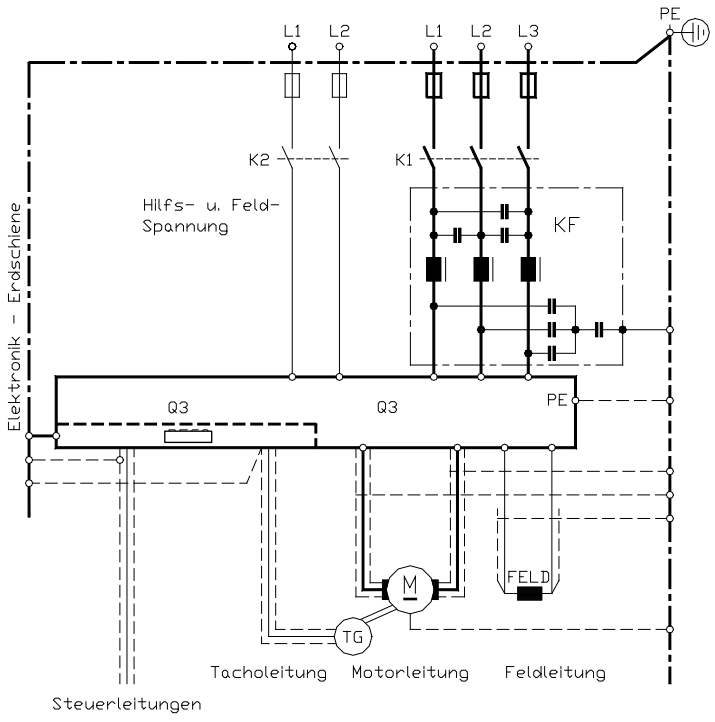
- Device, mains choke, filter capacitors mounted on mounting plate 2000x2000x2
- Mounting plate connected to PE via 10 mm².
- Motor housing connected to PE via 10 mm²
- Device pull X1:8 connected to mounting plate via 2.5 mm²
- Device PE screw connected to mounting plate via 4 mm² cable, l = 50 mm

Three-phase connection:

Mains choke type:	see technical data
Filter capacitors:	3 x 0.5µF/600 V~ 3 x 1µF (x) + 1 x 1µF (y)
Cable between device and mains choke	<250 mm

Motor connection:

Motor cable:	l = 1.5 m, shieldedTacho
and all control cables shielded to PE	l = 1.5 m, shieldedShielding



KF = Kommutierungsdrossel mit Filterkondensatoren

7 - Q3-A639

3.5 Mains connection

Attention:

The connection instructions are binding in their assignment of the connections to the plug numbers or terminals.

All further information is non-binding.
The input and output cables can be modified or supplemented in accordance with the electrical regulations.

Please note:
- Connections and operating instructions
- local regulations
- EC Machinery Directive 89/392/EEC -
VDE, TÜV and Employer's Liability Insurance Association

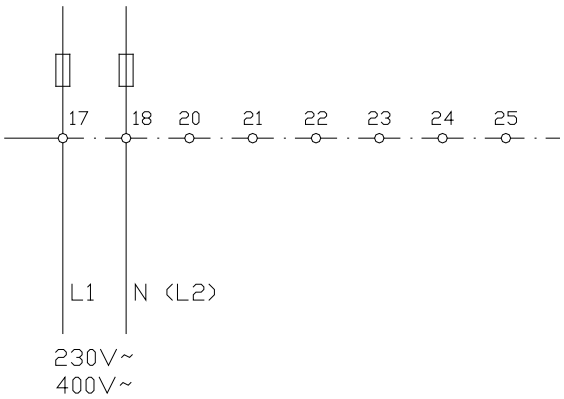
Switching on: Auxiliary voltage and power voltage simultaneously
Switch off: Power voltage after auxiliary voltage

Input filter:
see CE instructions
Short cable length between input filter and device

Auxiliary voltage connection

Connection	Plug-in terminal X5:17, X5:18
Connection voltage	400V~ ±10%
Special voltage	24V~, 110V~, 230V~, 500V~
Input current	max. 300mA
Phase position	indifferent
Internal fuse protection	FE1, FE20 .8AT

Cable cross-section: 0.5mm²
External fuse protection
Line protection 6A



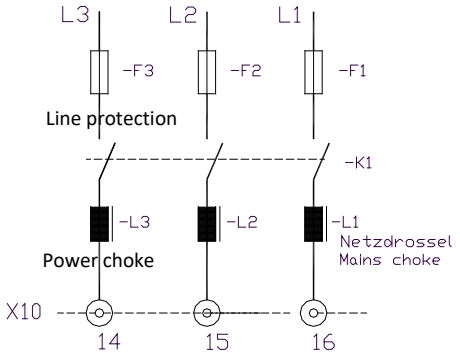
8 - Q3 auxiliary voltage-1-V647

Attention:
Observe rating plate / control voltage XXX

3.6 Direct power connection

Connection

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



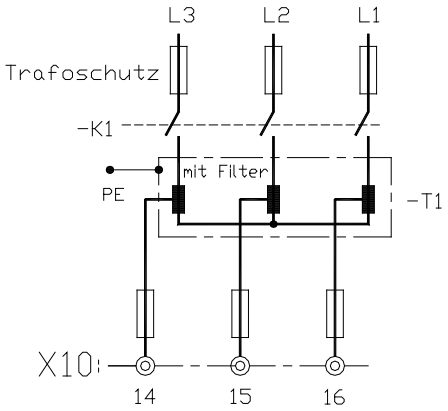
9 - P3-A054-Net

Attention:
L1, L2, L3 - Clockwise rotating field
Protective earth - PE
Operation without PE connection prohibited!

connection

Type current	Mains choke KD three-phase current K-phase choke	Fuses A-Superflink installed	Performance protection
1000	KU240 - 1000	6 x 1000 A FF	3 x 800 A
1500	KU240 - 1500	12 x 1000 A FF	3 x 1200 A
2000	KU240 - 2000	12 x 1000 A FF	3 x 1600 A

Power connection with autotransformer
Transformer power
1.1 x continuous motor power
Secondary voltage
0.9 x motor voltage
Transformer fuses
Inert fuses
Observe inrush current!
Input fuse
See table above



10 - Q3-V747-with filter

Attention:

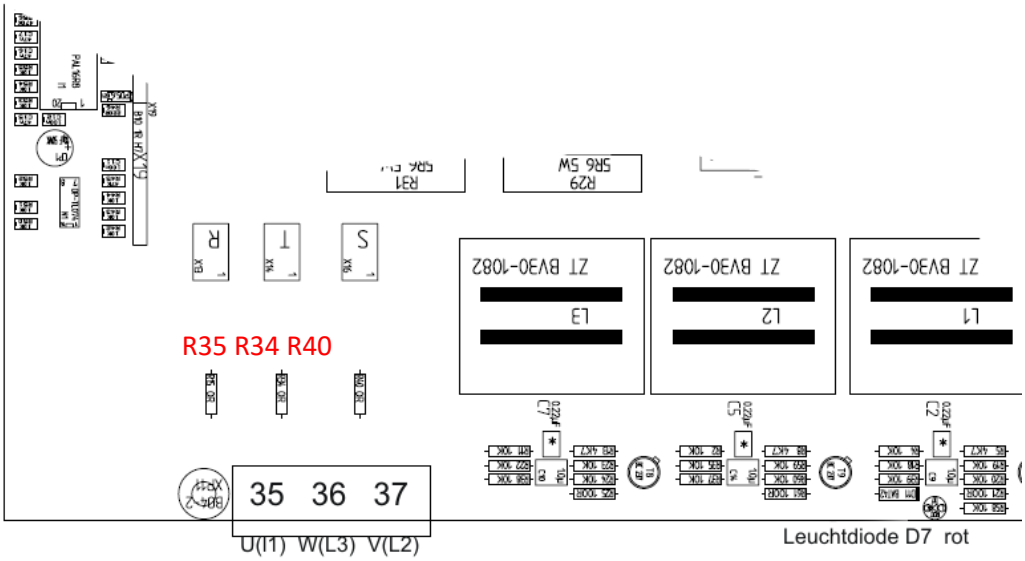
For transformer secondary voltage <60% / change voltage monitoring / change only at the manufacturer's works / specify when ordering.

Power connection monitoring **BTB**
LED goes out when enabled **>>> Missing phase**
>>> Incorrect rotating **field**

3.7 Option - External synchronisation

For certain applications, it may be necessary to synchronise before the
to tap the mains commutation choke, e.g.
- for operation with field disconnection circuit
- with a very poor (soft) power grid

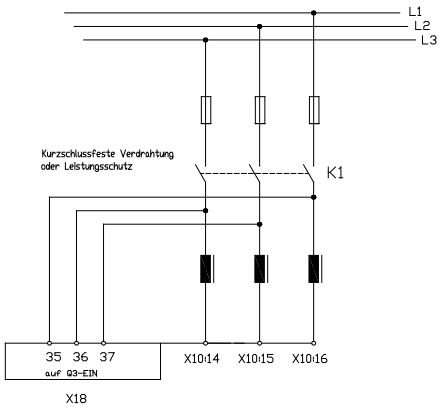
When switching to external synchronisation, the three
0Ω resistors R15, R34 and R40 on the "Q3 - On3" circuit board must be removed.



11 - **Q3-one**

The connection is made to terminals X18: 35, 36, 37, whereby the phase position must be observed:
-L3 to X10:14 (via mains choke) and to terminal X18:36 directly
-L2 to X10:15 (via mains choke) and to terminal X18:37 directly
-L1 to X10:16 (via mains choke) and to terminal X18:35 directly

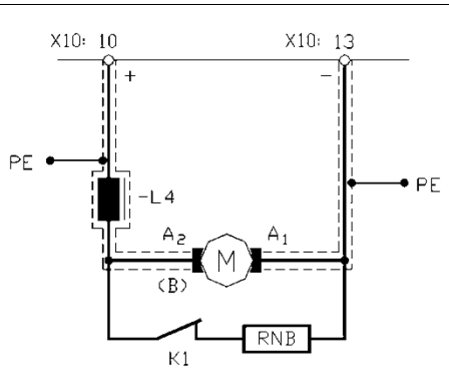
The wiring must be short-circuit-proof or protected by a line protection device.
The phase position is monitored and in the event of a faulty connection the LED D7 on the circuit board Q3-Ein3 and the BTB message on the controller goes out when the controller is enabled.
The LED D7 also lights up when Fuse failure of one of the installed Cell fuses.



Q3-A019-option

3.8 Motor connection

Connection with positive setpoint		
Motor - Motor +	Bolt Bolt	X10:13 X10:10
Attention:		
Anchor choke only for few applications necessary: Dimension: L [mH] = U_A / I_A x 0.8 Standard without throttle Shield motor cables.		



12 - Q3-Motor-V647-1

Device Q3 x/x-	Throttle*	Cable cross-section
Type current	**Direct current**	**min. mm²**
1000	on request	2 x 240
1500	on request	2 x 500
2000	on request	3 x 500

*Throttles are only necessary for special applications!
(e.g. low-noise motor running (stage technology)

Switching in the armature circuit
- DC circuit de-energised
- Release blocked

Attention:
In case of faulty switching >>> switch-off arc

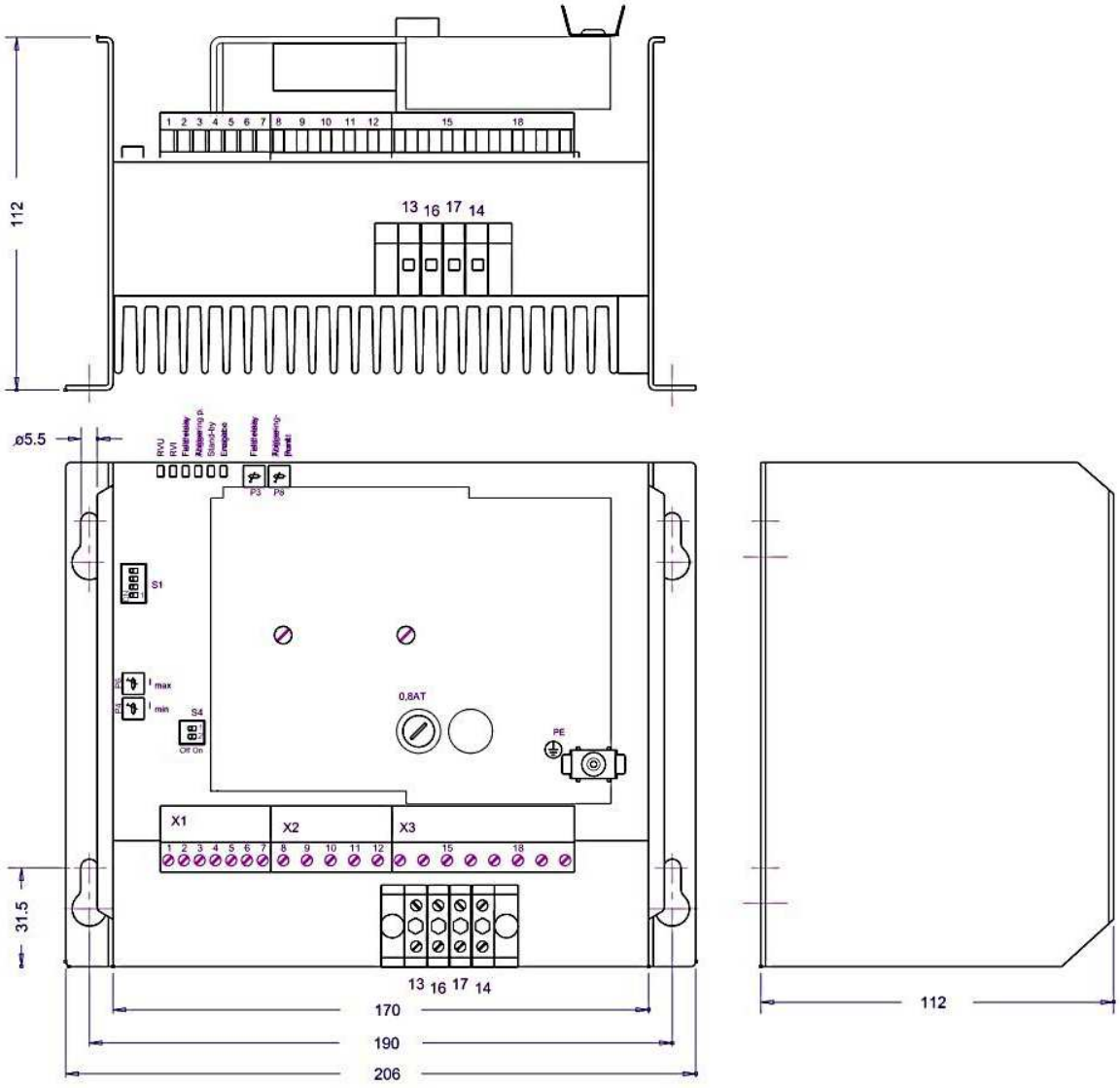
Mains failure - Braking resistor
Break contact of mains contactor K1
Dimension
Resistance RNB = max. armature voltage / 2x type current
Braking effect only with energised field!

Attention:
Power cables shielded and separated from control cables Relocate!
Electromagnetic interference >>> see CE instructions

3.9 Field connections

Field controller is not installed!!!

External field controller F2.x



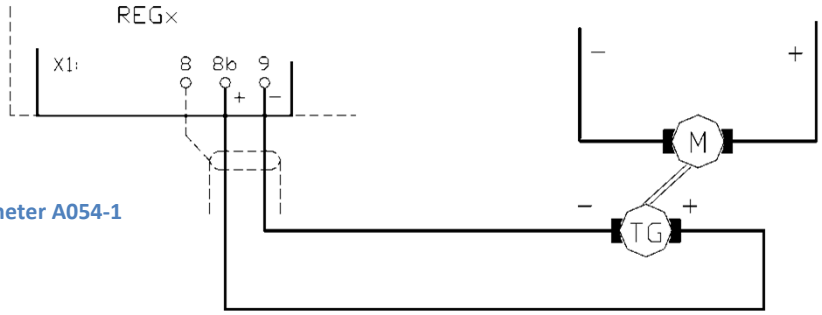
13 - F2-1-20A dimension drawing

3.10 Actual value - connection

Speedometer
Usable actual value transmitters
- Direct current tachogenerators
- Brushless tachogenerators with evaluation electronics
- Incremental encoder with evaluation electronics

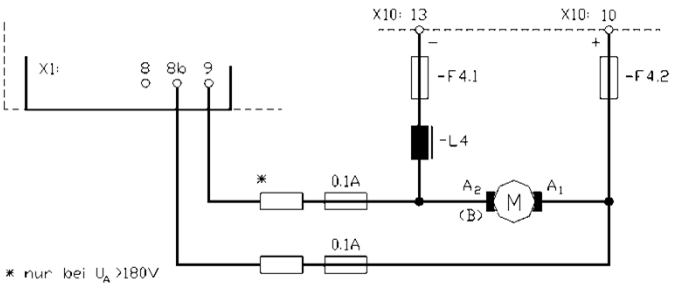
Attention: AC or three-phase tachos with rectification are not suitable.

Connection
Control electronics **(note MANUAL REG)**
With setpoint positive
Speedo plus X 1:8bTacho minus X 1:
9Screen X 1:8



14 - Classic speedometer A054-1

Armature tension



Classic anchor tensioner-A054-1

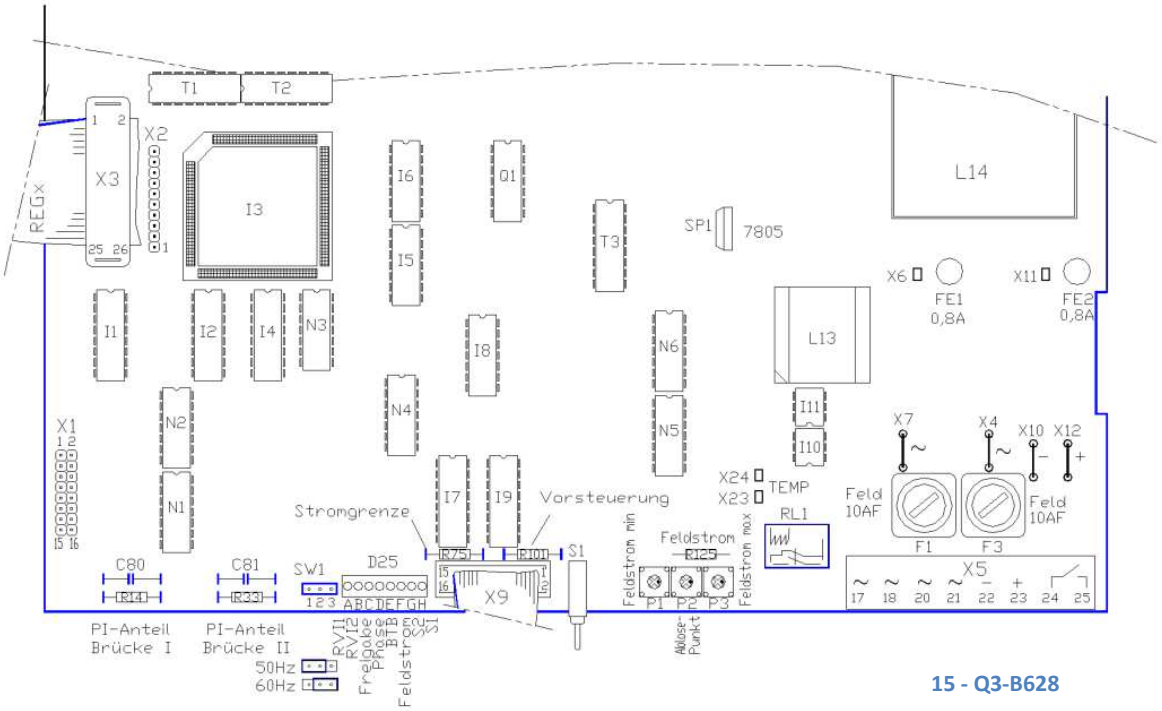
Potential-loaded actual value
Fuse protection 2x 0.1A Directly at the tapping of the armature voltage
Armature voltage >180V= Additional resistors
Use EXZU-UA1 module

Attention:Observe MANUAL REG

Option: Armature voltage control internally potential-free for Specify order.

4 Settings

4.1 Component overview / settings



15 - Q3-B628

Variable elements	Function	Range
R14	P-amplifier current regulator I	18kΩ ... 470kΩ
R33	P-amplifier current regulator II	18kΩ ...
470kΩR75	Fine adjustment current limit	100kΩ ...
470kΩR101	Ignition angle - pilot control	240kΩ ...
560kΩR125	Field current	
C80	Integral component current regulator I	0.1µF ... 2.
2µFC81	Integral component current regulator II	0.1µF ... 2.2µF

Jumper

SW1 Pos.1-2	50Hz settingSW1 Pos.	
2-3	60Hz setting	

Switches

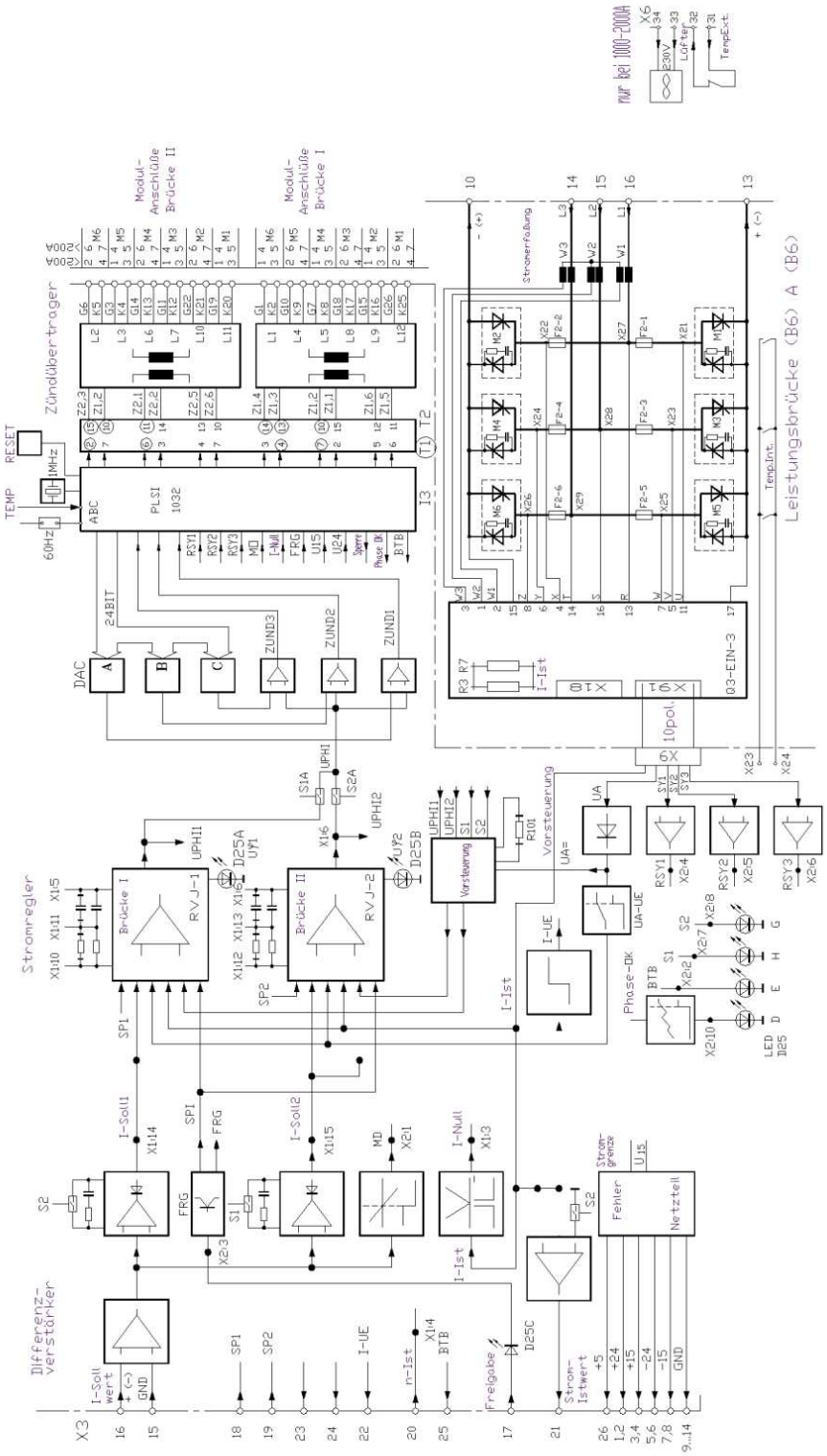
S1	Reset	

LED displays D25A

	Current controller RVI-1	
activatedD25B	Current controller RVI-2	
activatedD25C	Enable current controller/ignition	
enabledD25D	Phase error	
ErrorD25E	BTB Ready for operation	ready for
operationD25F	Field current	Luminosity = field current (Only with regulated field)
D25G	Current direction S2	
activeD25H	Current direction S1	active

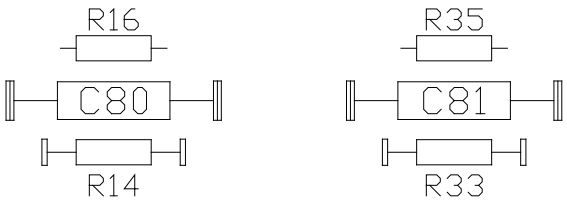
4.2 Block switch picture

16 - Q3-2000 block diagram

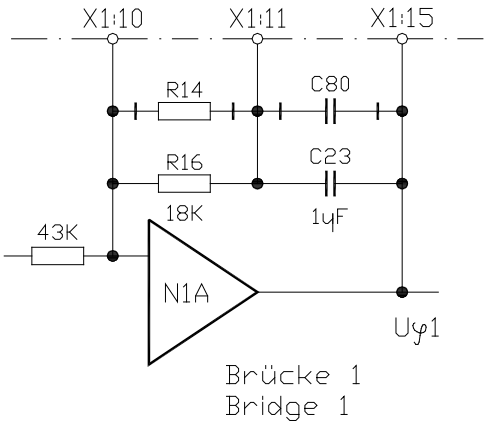


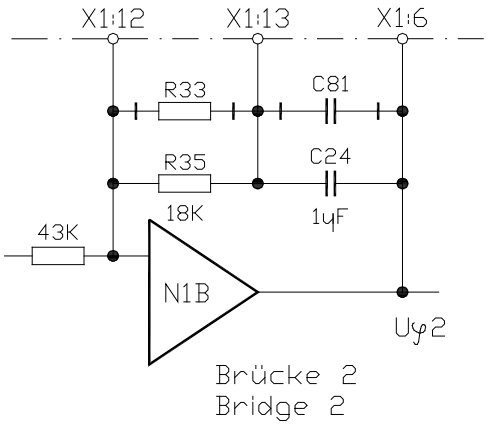
4.3 Control parameters current controller

Current regulator - PI circuit
With setpoint positive
Bridge 1negative R14, C80
Bridge 2 positive R33, C81



17 - Q3-Current-PI-pos-V647-1





Basic

18 - Q3-Current-P1-1V647

setting
Gain ~0.4

Integration time ~ 18ms

Gain change

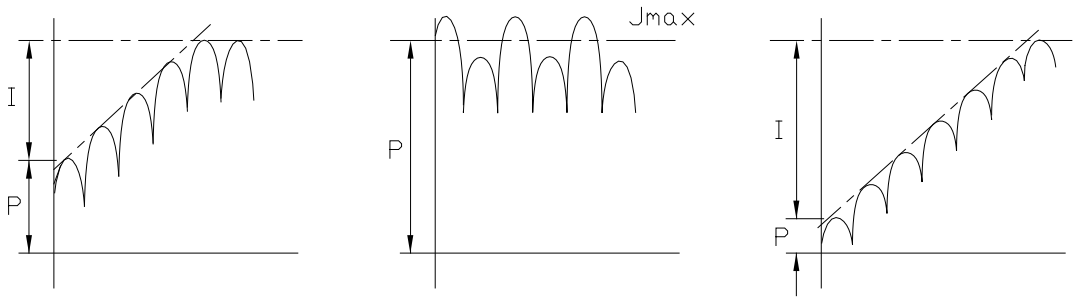
Bridge 1	Bridge 2
$\mathrm{Xp} = \frac{18k\Omega\ x\ R14}{18k\Omega + R14}{43k\Omega}$	$\mathrm{Xp} = \frac{18k\Omega\ x\ R33}{18k\Omega + R33}{43k\Omega}$

Change integration time

Bridge 1	Bridge 2
$\tau[ms] = \frac{18k\Omega\ x\ R14}{18\mathrm{k}\Omega + \mathrm{R}14}\ x\ 1\mu F + C81$	$\tau[ms] = \frac{18k\Omega\ x\ R33}{18\mathrm{k}\Omega + \mathrm{R}33}\ x\ 1\mu F + C80$

Optimise current regulator
- Oscilloscope at actual current value X3:21
- Current setpoint step change ±1 V X3:16
- Increase current setpoint in 1 V steps up to ±10 V
- Change P-amplification with resistor R14 and R33
- Optimum setting Picture 1
- unauthorised setting Figure 2
- Change integral component with capacitor C80, C81

Oscillograms - Current setting



19 - Q3-Current-PF-QSZT-1-V161

Picture 1	Picture 2	Picture 3
Optimum setting	Gain too high	P-amplification small

Attention:

Current regulator optimisation only with oscillographic control

4.4 Messages

BTB message	X2:105	>+5 V
Error	X2:106	<+5 V LED L3 on REGxx

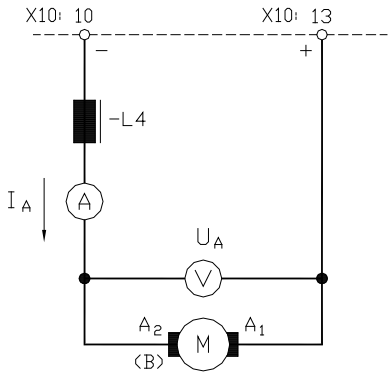
Error

Voltage error	24 V, 15 V, 5 V	saved
Phase error, rotating field		saved
Input fuse defective		saved

In the event of a fault, the power section is disabled internally without delay.
Memory erasure by mains voltage Off>On or reset button

Power measurements

Measuring devices	Multimeter for current and voltage Shunt or current clamp = ~
Measurement error	Mean value >>> effective value corresponding form factor approx. 1 to 5%



20 - Q3-Motor-Measurement-1V647

Measured values
with setpoint positive

Voltage: X10:10 positive X10:13 negative
Maximum 1.15 x power connection
At 400 V~>>>460 V=

Current: Ammeter in motor circuit
5 sec. 200 %, continuous 110 % type current

Measured values at REGxxx (selectable - see MANUAL REGxx)

SpeedX2	:109	±5 V or ±10 V for ±100 % speed
Current	X2:111	±5 V or ±10 Vfor ±200 % current
GND	X2:104	

5 Commissioning

5.1 Commissioning Q3 x/x-x with REGxx

Check connections before commissioning
Observe type plate!

Basic connection Power connections Q3

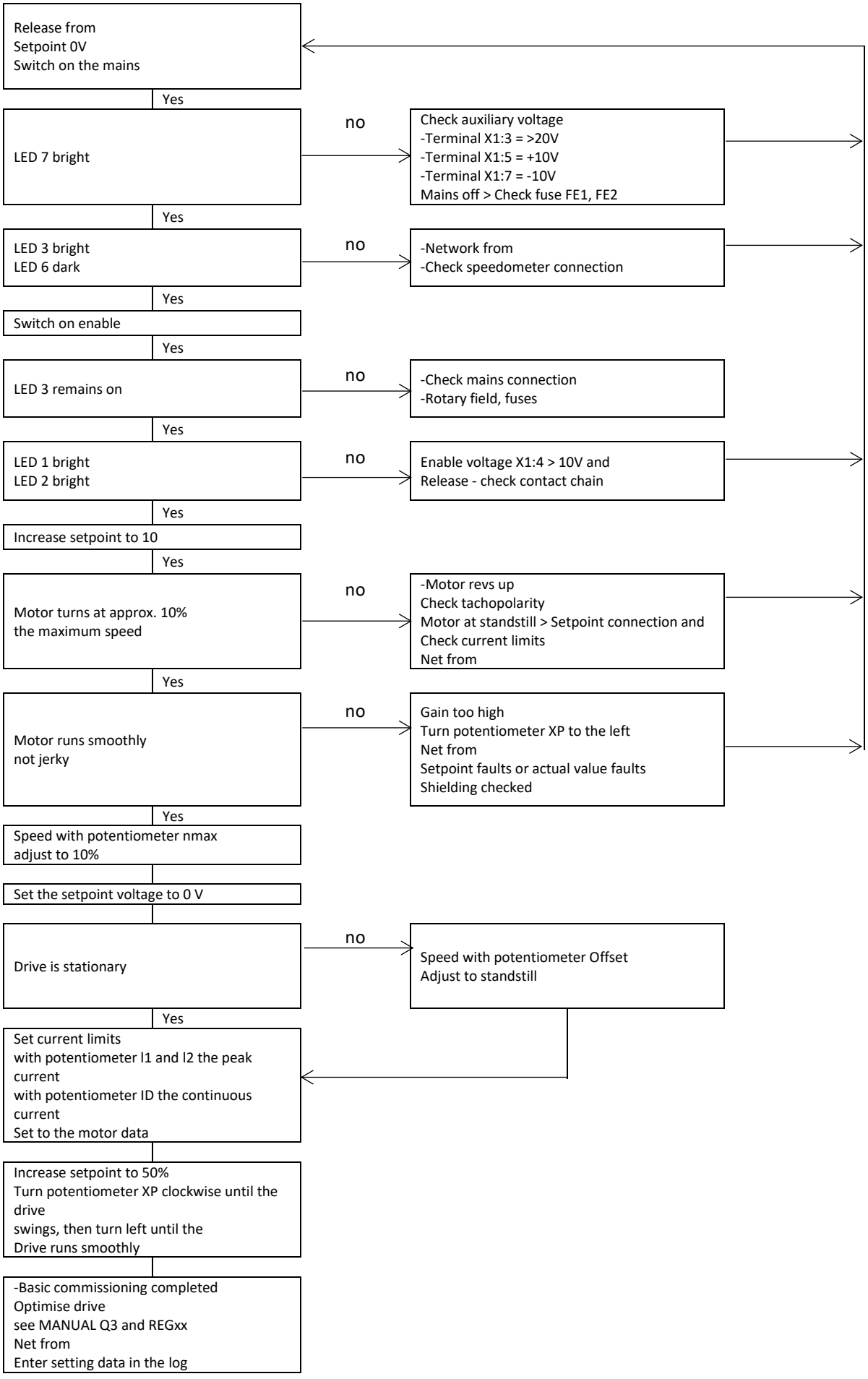
Mains connection	Performance	Bolt	X10:14, X10:15, X10:16
Mains connection	Auxiliary voltage	Clamp	X5:17, X5:18
Motor connection	A1/A2	Bolt	X10:10, X10:13
Protective conductor	PE	PE earth screws on the housing	

Basic connection Control connections REGxx

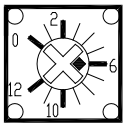
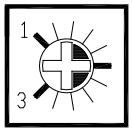
Release	Contact between X1:3 and X1:4	
Setpoint	Signal X1:6	GND X1:8a
Actual value	Signal X1:9	GND X1:8b
Umbrellas	X1:8	

REGxx control electronics

Switches	S4	P-disp.	Position 4
Switches	S5	I-share	Position 4
Switches	S8	D-disp.	Position 8
Switches	S9	Actual value	Position 8
Potentiometer	I1	Peak current	10%
Potentiometer	I2	Peak current	10%
Potentiometer	ID	Continuous current	100%
Potentiometer	XP	Reinforcement	50%
Potentiometer	INT	Integrator	Left stop
Potentiometer	nmax	Speed	Left stop
Potentiometer	Offset	Offset	50%


Release from
Setpoint 0V
Switch on the mains
Yes
LED 7 bright
no
Check auxiliary voltage
-Terminal X1:3 = >20V
-Terminal X1:5 = +10V
-Terminal X1:7 = -10V
Mains off > Check fuse FE1, FE2
Yes
LED 3 bright
LED 6 dark
no
-Network from
-Check speedometer connection
Yes
Switch on enable
Yes
LED 3 remains on
no
-Check mains connection
-Rotary field, fuses
Yes
LED 1 bright
LED 2 bright
no
Enable voltage X1:4 > 10V and
Release - check contact chain
Yes
Increase setpoint to 10
Yes
Motor turns at approx. 10%
the maximum speed
no
-Motor revs up
Check tachopolarity
Motor at standstill > Setpoint connection and
Check current limits
Net from
Yes
Motor runs smoothly
not jerky
no
Gain too high
Turn potentiometer XP to the left
Net from
Setpoint faults or actual value faults
Shielding checked
Yes
Speed with potentiometer nmax
adjust to 10%
Set the setpoint voltage to 0 V
Drive is stationary
no
Speed with potentiometer Offset
Adjust to standstill
Yes
Set current limits
with potentiometer I1 and I2 the peak
current
with potentiometer ID the continuous
current
Set to the motor data
Increase setpoint to 50%
Turn potentiometer XP clockwise until the
drive
swings, then turn left until the
Drive runs smoothly
-Basic commissioning completed
Optimise drive
see MANUAL Q3 and REGxx
Net from
Enter setting data in the log

5.2 Protocol (commissioning)

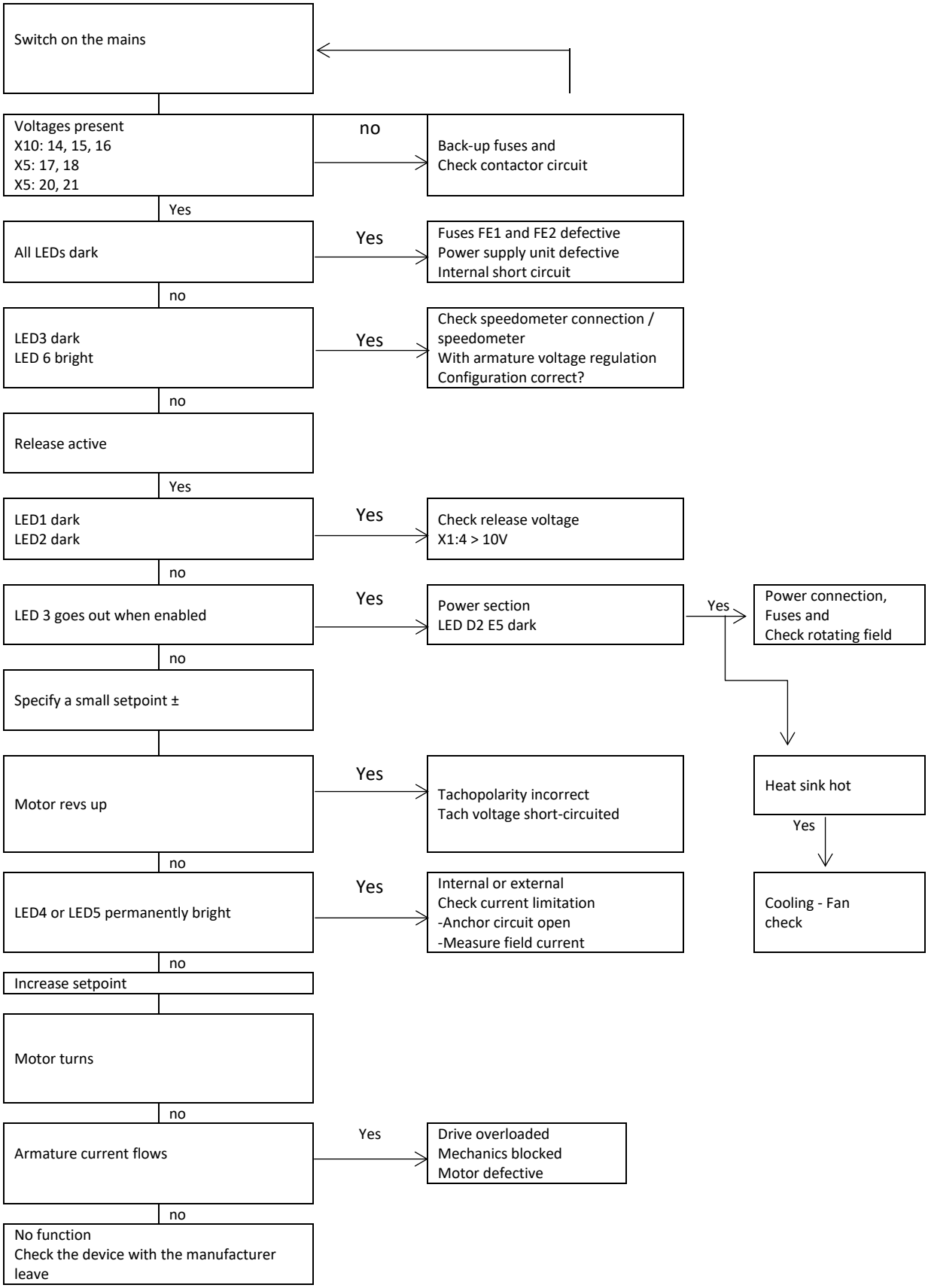
Customer			**Machine no.**		
Device			**Serial no.**		
Control voltage	[V~]				
Power voltage	[V~]				
Field voltage	[V=]				
Inputs REGxx					
Release	Contact?		Voltage [V=]		
Setpoint	Kind		Voltage [V=]		
Setpoint addition	Kind		Voltage [V=]		
Current setpoint	Imax1 external		Voltage [V=]		
Current solar value	Imax2 external		Voltage [V=]		
REGxx speed controller settings					
Switch position					
Speedometer calibration		S9			REG5 - Schotax 1
P-share		S4	Position		
I-share		S5	Position		
D share		S8	Position		
Potentiometer positions					
Speed	nmax	P4	Position		 REG5 - Potentiometer 1
Peak current	Imax1	P5	Position		
Peak current	Imax2	P6	Position		
Continuous current	ID	P7	Position		
Integrator	INT	P1	Position		 REG5 - Potentiometer 2
Reinforcement	Xp	P3	Position		
IxR compensation		P2	Position		
DIP switch					
ON	No.				
OFF	No.				

Commissioning protocol / QS3x/x-x with REGxx

Setting current controller Q3			
P-amplification	R14=....	R13=....	
I-share	C80=....	C81=....	
50/60 Hz			
Jumper SW1	Pos. 1-2 (50Hz)	Pos. 2-3 (60Hz)	
Measured values Q3-REGxx			
Armature tension	max.	[V=]	
Anchor current	top	[A=]	
Anchor current	permanent	[A=]	
Tachometer voltage	max.	[V=]	
Acceleration	X4:16	[V/ms]	
Integrator	X4:14	[V/ms]	
Motor data			
Type plate data			
Manufacturer:			
Type		Serial no.	
Motor voltage [V=]		Motor current [A=]	
Field voltage [V=]		Field current [A=]	
Tacho voltage [V/min]$^{-1}$		Tachotype	
Brake [V]		Fan [V]	
Rated speed [rpm]			

6 Troubleshooting

6.1 Troubleshooting



6.2 Functional error

Functional error	
Error	**Causes**
Motor does not run	Mains connection, motor connection incorrect Fuses tripped Enable or setpoint missing Current limit too small BTB missing
Motor runs up	Actual value (tachometer armature voltage) incorrect polarity Speedometer switch S9 too small values Speedometer short-circuited Setpoint too high with armature voltage regulation Field current too small Armature voltage feedback fuses tripped
Engine runs unevenly	Mechanical speedometer error Speedometer faults Speed controller amplification too high or too small PID parameter incorrect Setpoint errors Current controller amplification too high or too small
Motor has no torque	-Current limits too small -Field current too small -Drive mechanically overloaded