

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

Basic information

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!!!



Basic information

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

Basic information

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

Basic information

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. $\pm$ 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	A=	2000	3000	4000
	- Duration	A=	1000	1500	2000
Electrical power		kW	450	675	900
Fuses	Entrance	ff	built-in	built-in	built-in
		Aff	6 x 1000	12 x 1000	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. $\pm$ 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

Basic information

1.7 Specifications

Common specification

Mains frequency	50 or 60Hz $\pm 2\%$
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... $\pm 10V=$
- Output	0... $\pm 200\%$ Type current
Overcurrent limitation	10 sec. 200 % type current
Control accuracy	$\pm 2\%$
Control range	1:50
Release	> +10V
Speed controller (see MANUAL REG)	
Control accuracy (without actual value error)	< $\pm 0.1\%$
Control range	> 1:1000

1.8 Interfaces

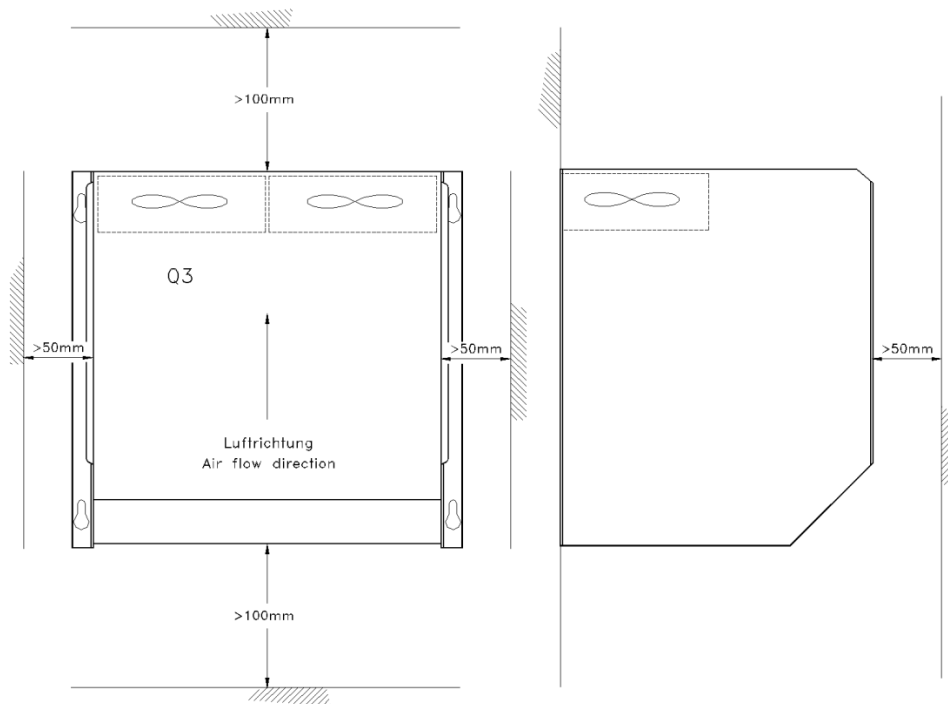
Control electronics interface X3

Function			Plug number
+ 24V	$\pm 10\%$		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 zero GND	0		X3: 9, 10, 11, 12, 13, 14
I setpoint (GND)	0		X3: 15
I setpoint (signal)			X3: 16
Enable current controller			X3: 17
Lock 1			X3: 18
Lock 2			X3: 19
n - Actual			X3: 20
I - Actual			X3: 21
Overcurrent power unit			X3: 22
Option UA			X3: 23
Option UA			X3: 24
Ready for operation BTB			X3: 25
			X3: 26

Mechanical installation

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

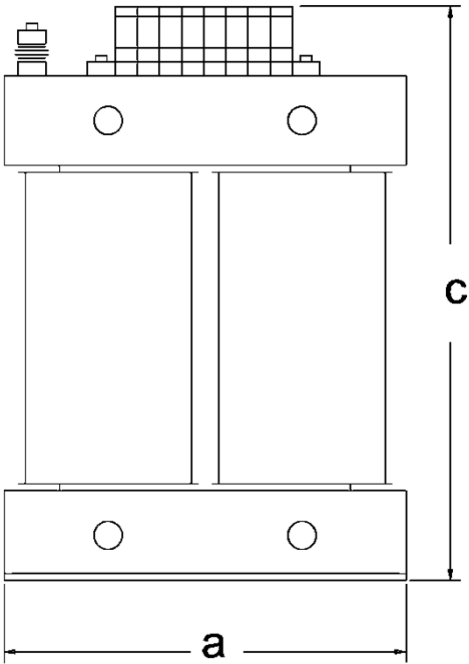
Mechanical installation

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	

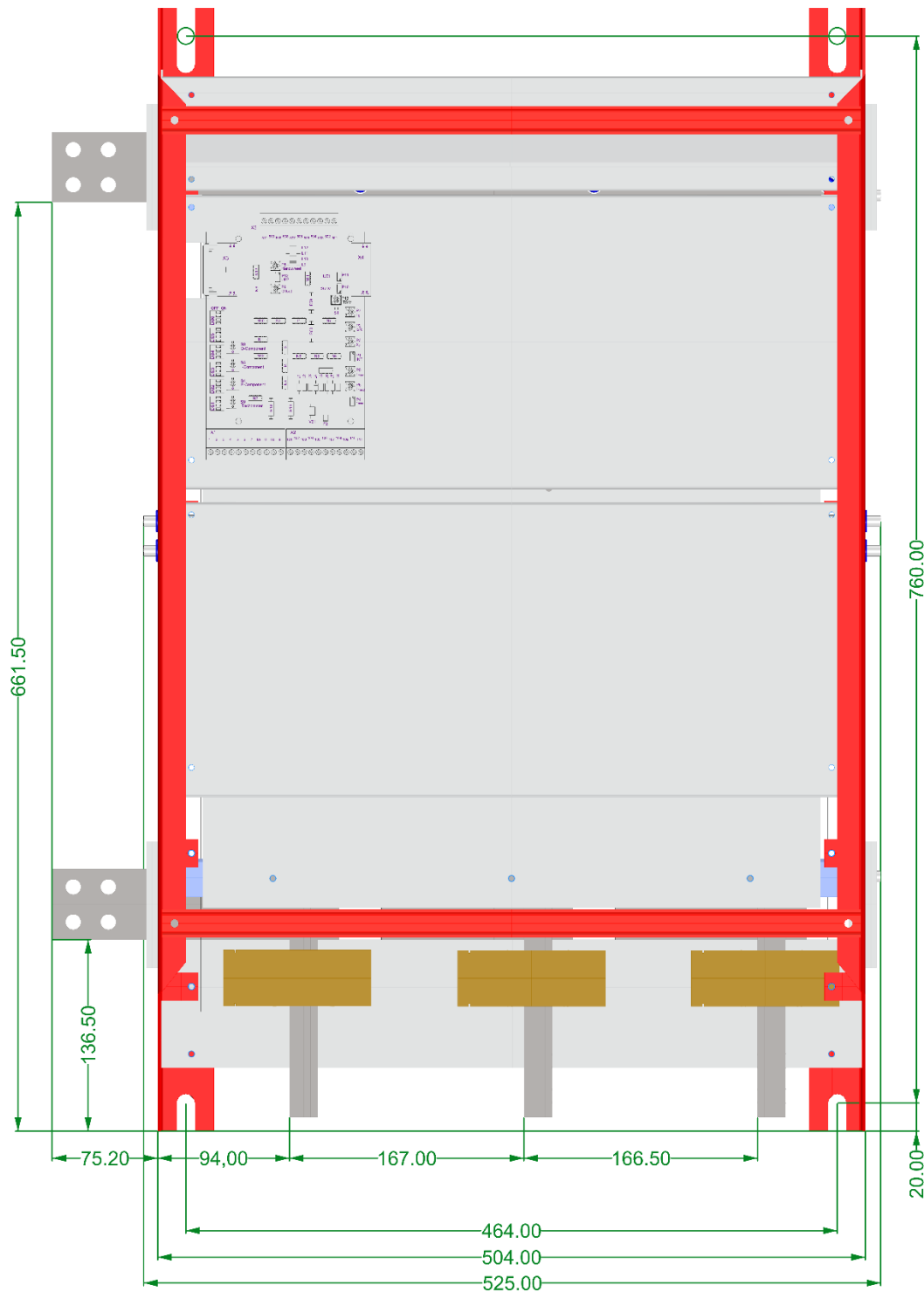
Device Q3-x/x	Throttle Type	L mH	PV W	Mass					Weight kg	Screw M
				a	b	c	d	e		
1000	KU240-1000	0,05	1000	320	270	470	250	190	98	10
1500	KU240-1500	0,03	1300	320	270	470	250	190	98	10
2000	KU240-2000	0,02	1500	320	270	470	250	190	98	10



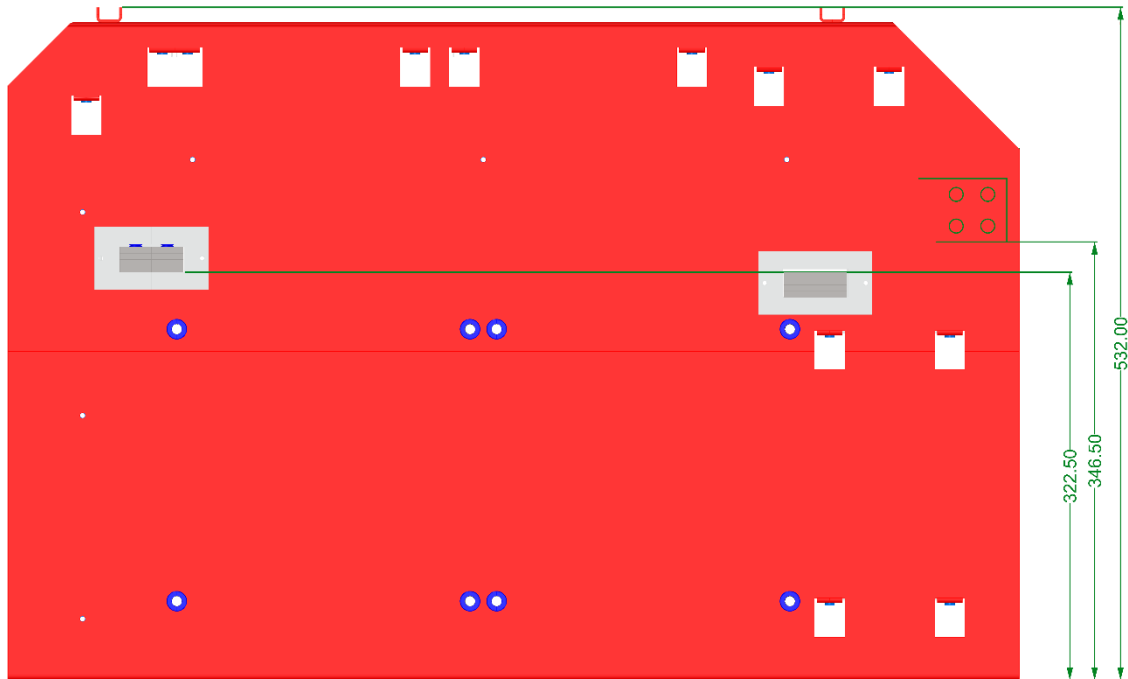
2 - Q3-V256-UI transformer

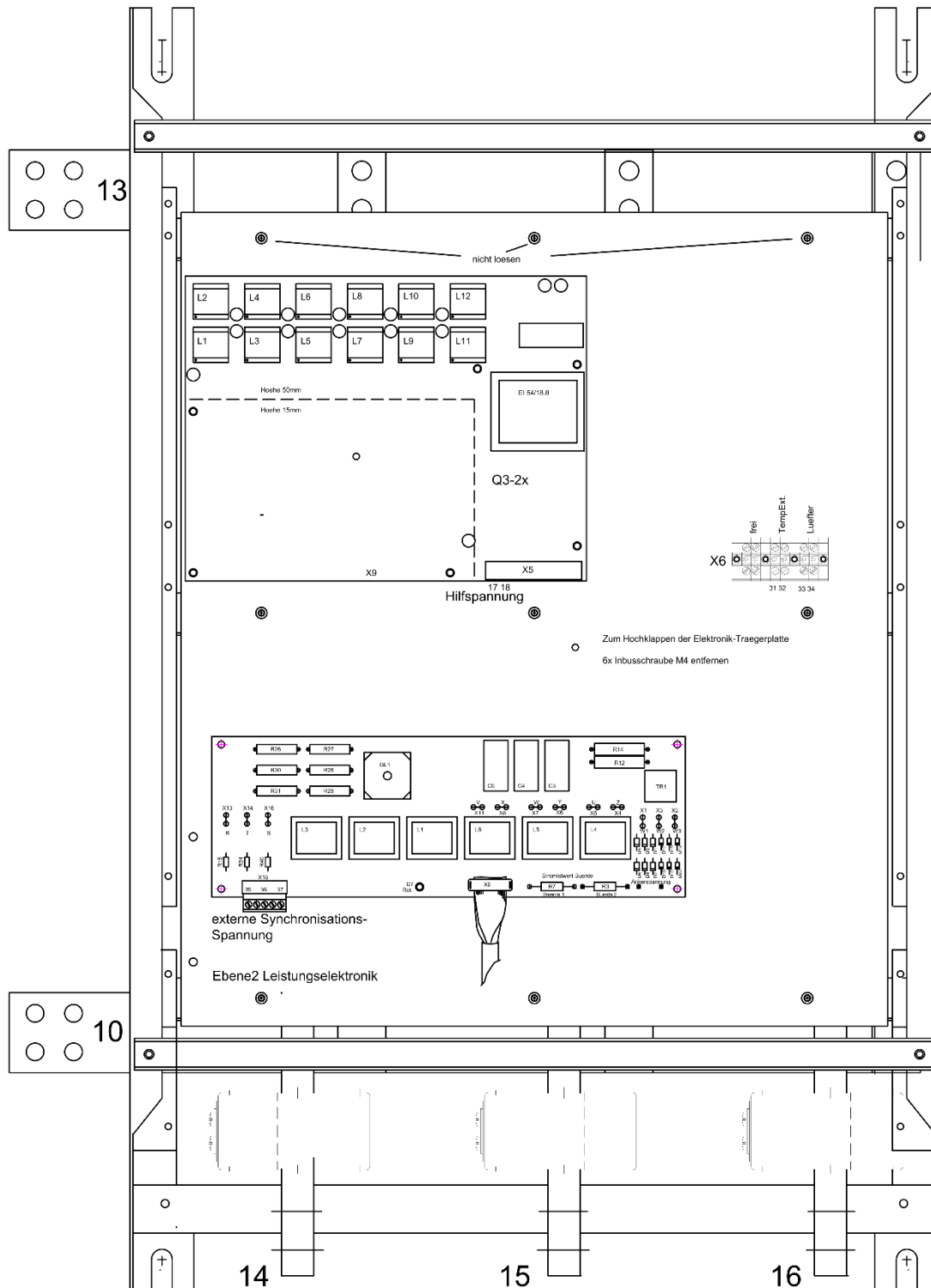
3 Electrical installation

3.1 Dimension drawings

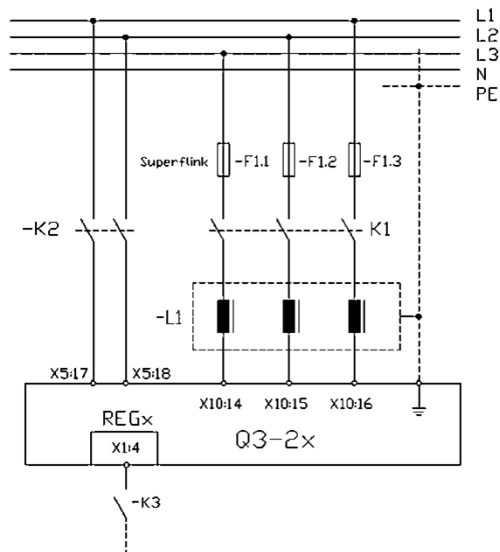


Dimension drawing

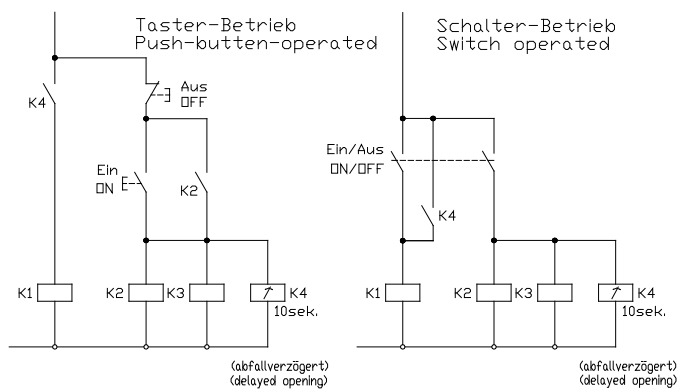




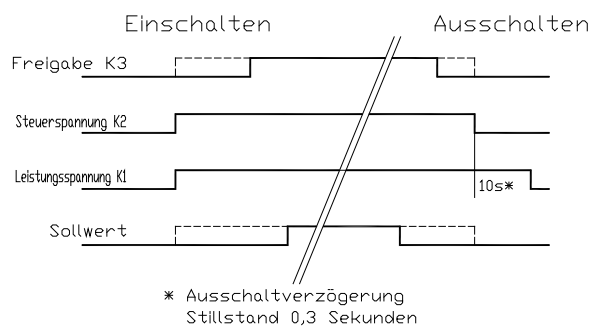
3.2 Connection overview



3 - Q3 connection-647-1



4 - Q3-Relay-1V647



5 - Q3 switching sequence 1-V647

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.

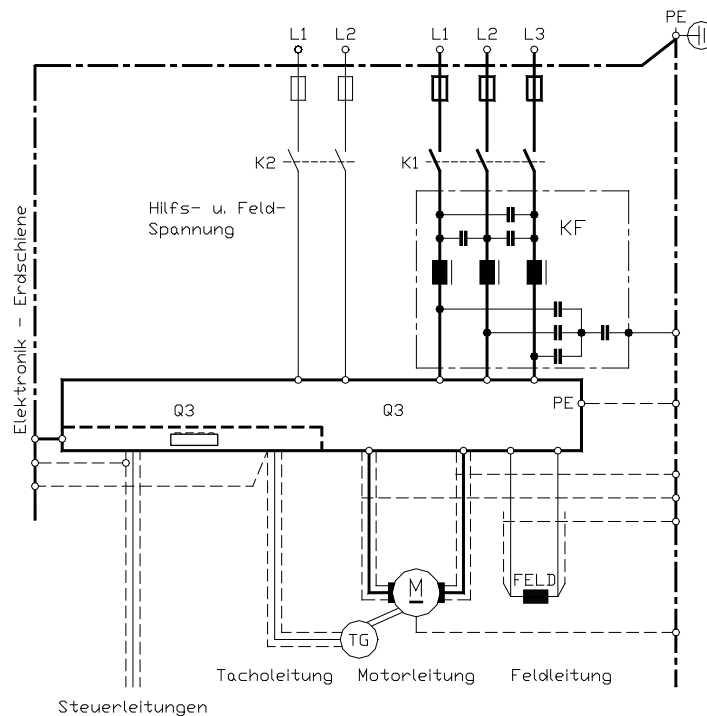
- Device, mains choke, filter capacitors mounted on mounting plate 2000x2000x2
- Mounting plate connected to PE via 10 mm².
- Motor housing connected to PE via 10 mm²
- Device pull X1:8 connected to mounting plate via 2.5 mm²
- Device PE screw connected to mounting plate via 4 mm² cable, l = 50 mm

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 = Kommutierungsdrassel mit Filterkondensatoren

7 - Q3-A639

Electrical installation

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.



with

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

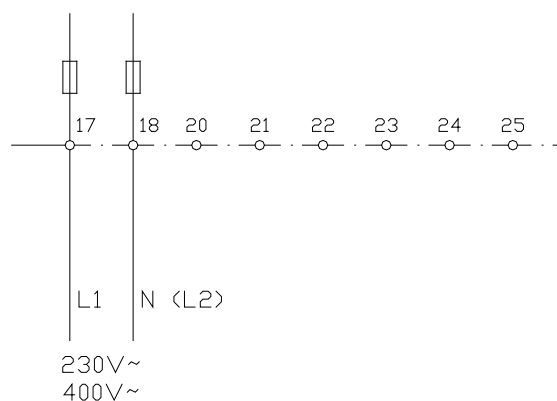
Auxiliary voltage connection

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



Electrical installation

3.6 Direct power connection

Connection

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

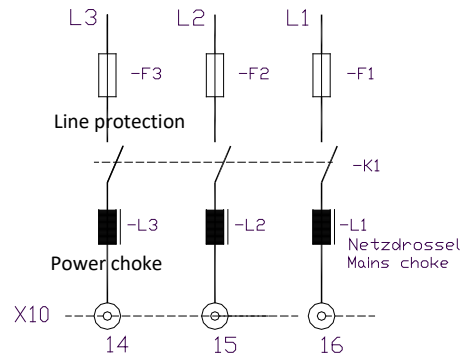
Attention:

L1, L2, L3 - Clockwise rotating
Protective earth - PE

Operation without PE connection prohibited!



field



9 - P3-A054-Net

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

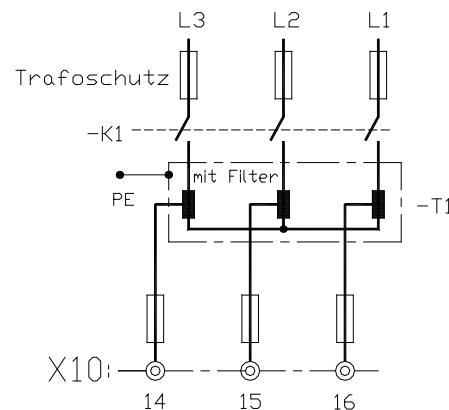
Transformer fuses

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

LED goes out when enabled

>>> Missing phase

>>> Incorrect rotating field

BTB

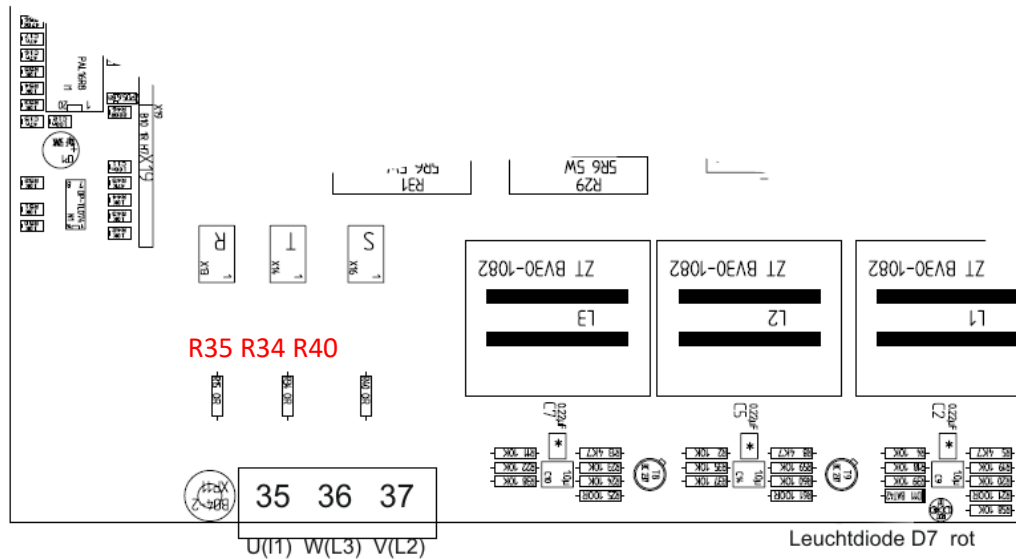


3.7 Option - External synchronisation

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.

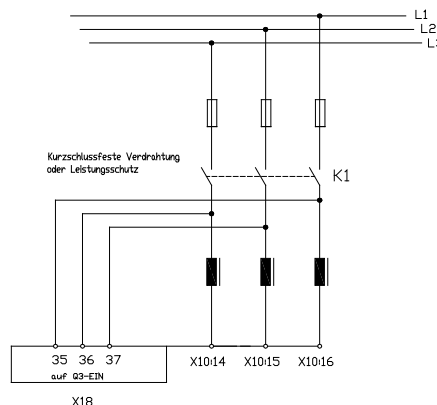


11 - Q3-one

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

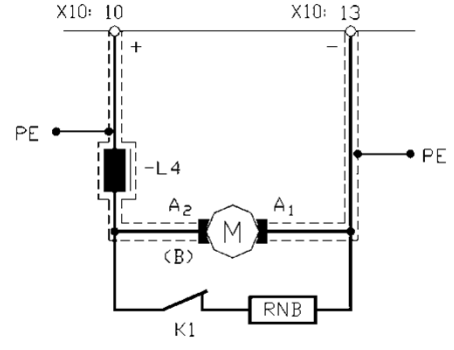
The wiring must be short-circuit-proof or protected by a line protection device. The phase position is monitored and in the event of a faulty connection the LED D7 on the circuit board Q3-Ein3 and the BTB message on the controller goes out when the controller is enabled. The LED D7 also lights up when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



Q3-A019-option

Electrical installation

3.8 Motor connection

Connection with positive setpoint			 12 - Q3-Motor-V647-1
Motor -	Bolt	X10:13	
Motor +	Bolt	X10:10	
Attention: Anchor choke only for few applications necessary: Dimension: $L \text{ [mH]} = U_A / I_A \times 0.8$ Standard without throttle Shield motor cables.			

Device Q3 x/x-	Throttle*	Cable cross-section
Type current	Direct current	min. mm ²
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

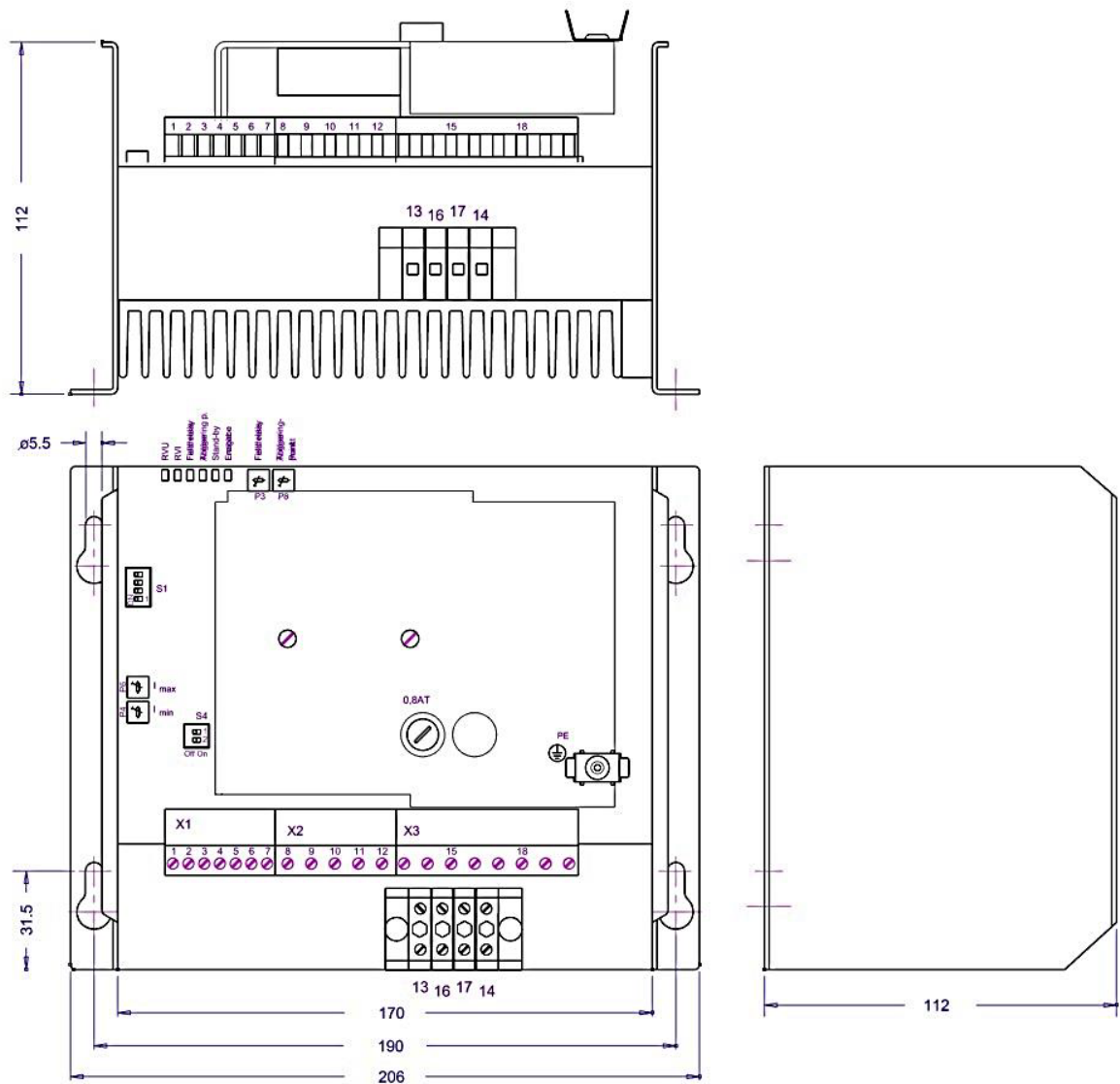


Electrical installation

3.9 Field connections

Field controller is not installed!!!

External field controller F2.x



13 - F2-1-20A dimension drawing

Electrical installation

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

With setpoint positive

Speedo plus

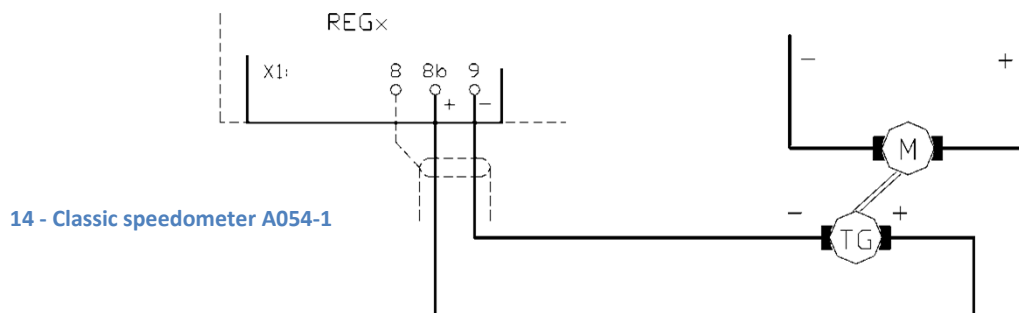
9Screen

(note MANUAL REG)

X 1:8bTacho minus

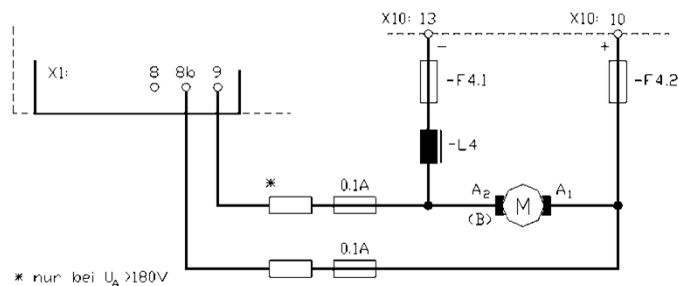
X 1:8

X 1:



Armature tension

Classic anchor tensioner-A054-1



Potential-loaded actual value

Fuse protection
voltage

Armature voltage
Use EXZU-UA1 module

2x 0.1A

>180V=

Directly at the tapping of the armature

Additional resistors

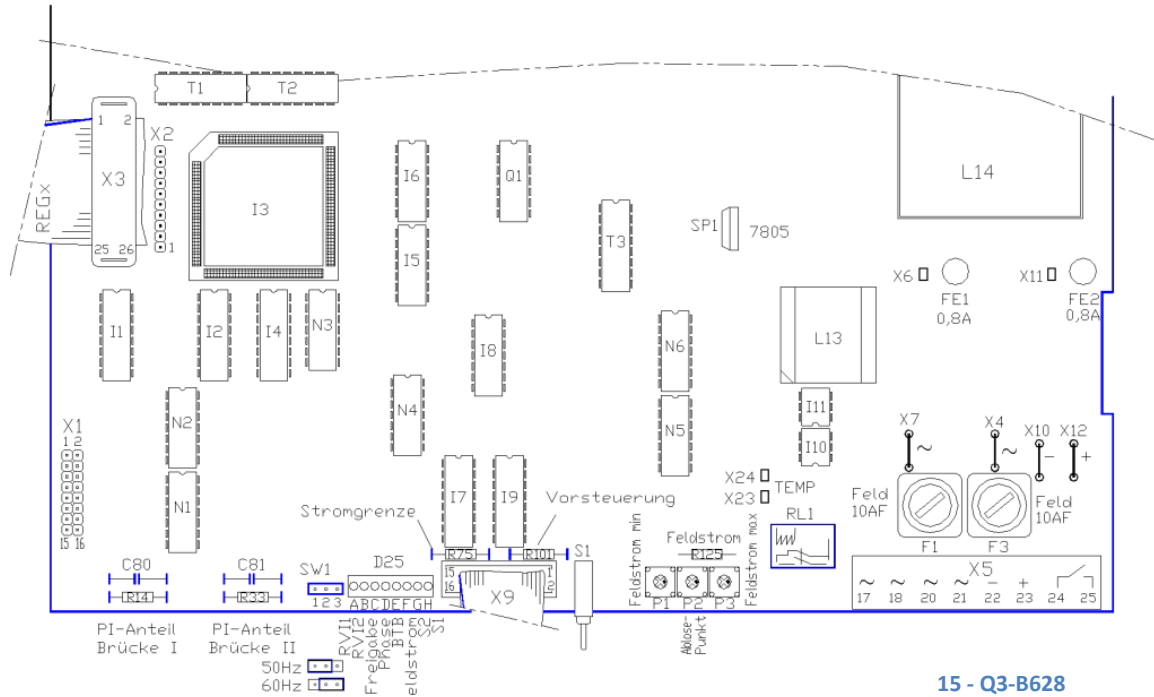
Attention:Observe MANUAL REG

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



4 Settings

4.1 Component overview / settings



Variable elements

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 setting
2-3	60Hz setting

Switches

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

LED displays D25A

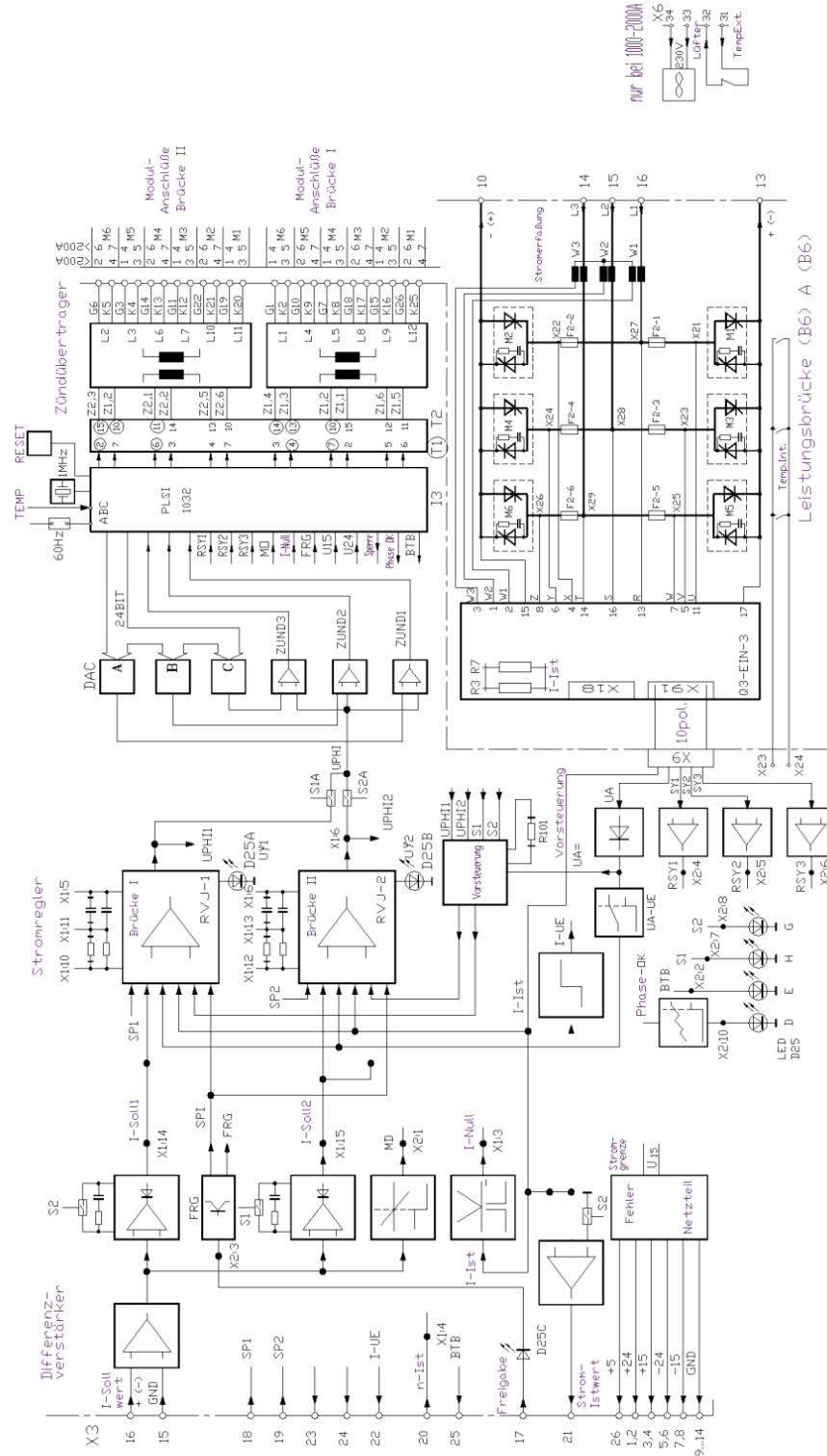
activatedD25B	Current controller RVI-1	
activatedD25C	Current controller RVI-2	
enabledD25D	Enable current controller/ignition	
ErrorD25E	Phase error	
operationD25F	BTB Ready for operation	ready for
	Field current	Luminosity = field current
		(Only with regulated field)

D25G	Current direction S2	
activeD25H	Current direction S1	active

4.2 Block switch picture

16 - Q3-2000 block

diagram



Settings

4.3 Control parameters current controller

Current regulator - PI circuit

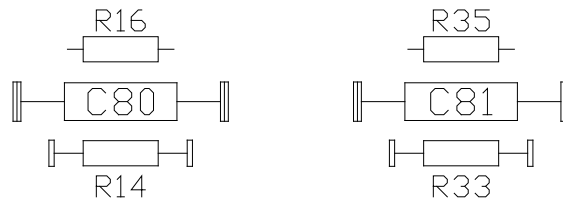
With setpoint positive

Bridge 1 negative

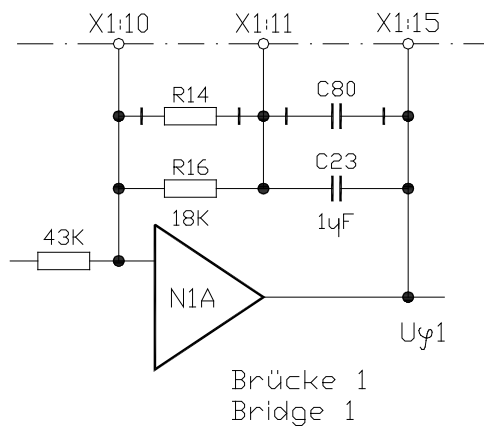
Bridge 2 positive

R14, C80

R33, C81



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

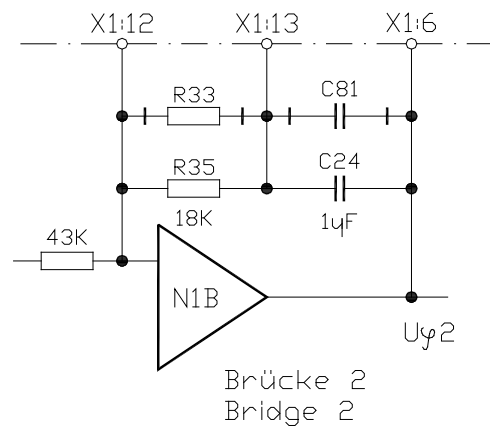


18 - Q3-Current-P1-1V647

setting

Gain ~0.4

Gain change



Basic

Integration time ~ 18ms

Bridge 1	Bridge 2
$X_p = \frac{18k\Omega \times R14}{18k\Omega + R14}$	$X_p = \frac{18k\Omega \times R33}{18k\Omega + R33}$

Change integration time

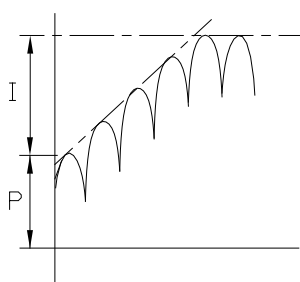
Bridge 1	Bridge 2
$\tau[ms] = \frac{18k\Omega \times R14}{18k\Omega + R14} \times 1\mu F + C80$	$\tau[ms] = \frac{18k\Omega \times R33}{18k\Omega + R33} \times 1\mu F + C81$

Settings

Optimise current regulator

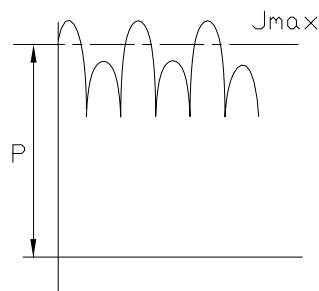
- Oscilloscope at actual current value X3:21
- Current setpoint step change $\pm 1 \text{ V}$ X3:16
- Increase current setpoint in 1 V steps up to $\pm 10 \text{ V}$
- Change P-amplification with resistor R14 and R33
- Optimum setting Picture 1
- unauthorised setting Figure 2
- Change integral component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

Oscillograms - Current setting

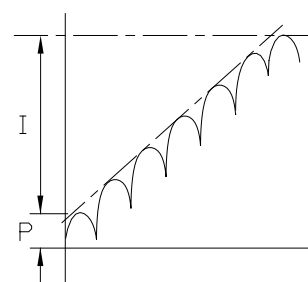


19 - Q3-Current-PF-QSzt-1-V161

Picture 1
Optimum setting



Picture 2
Gain too high



Picture 3
P-amplification small

Attention:

Current regulator optimisation only with oscillographic control



Settings

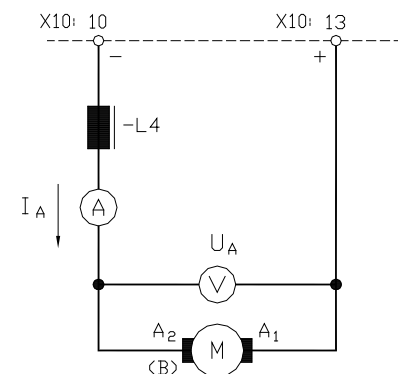
4.4 Messages

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 V for ±200 % current
GND	X2:104	



Commissioning

5 Commissioning

5.1 Commissioning Q3 x/x-x with REGxx

Check connections before commissioning
 Observe type plate!



Basic connection Power connections Q3

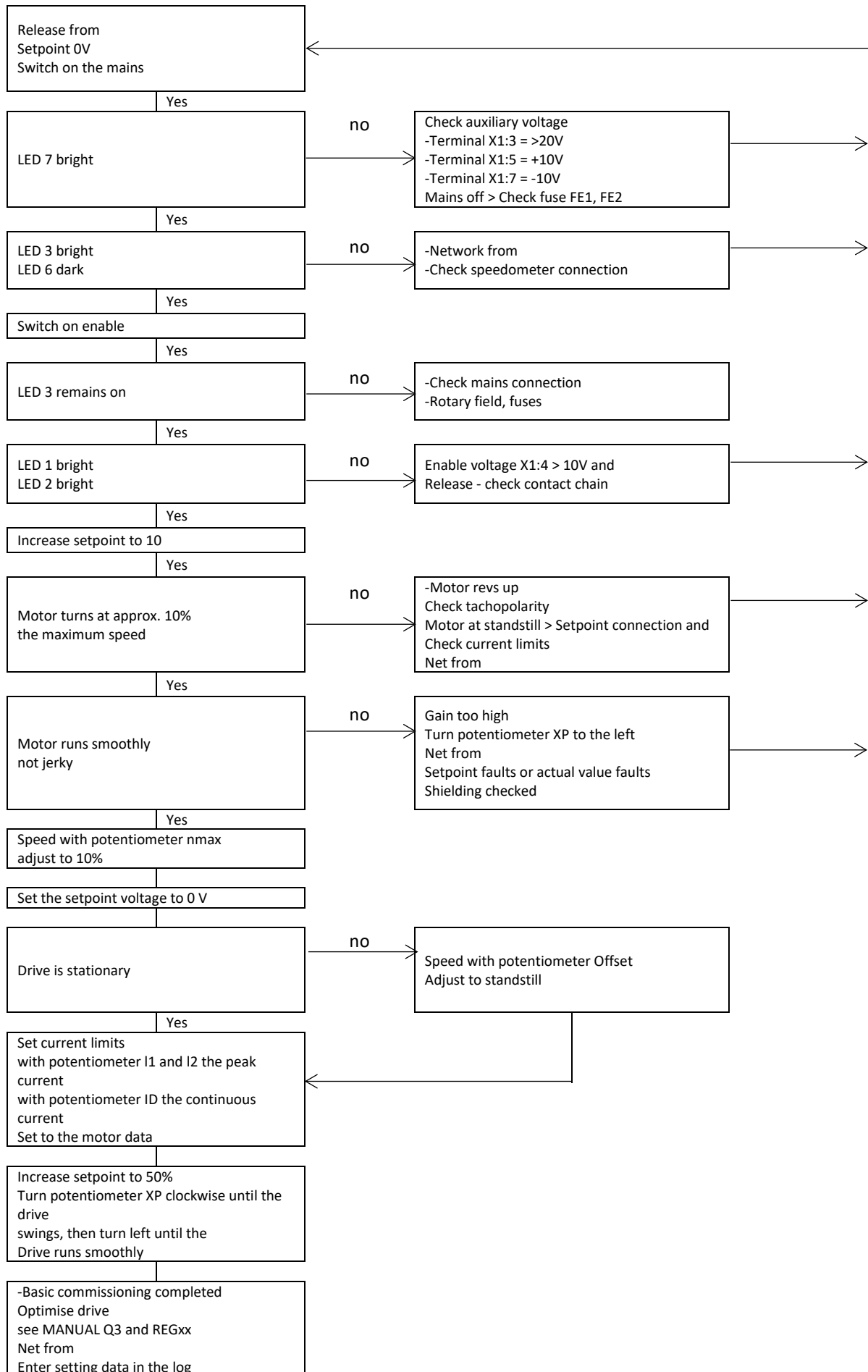
Mains connection	Performance	Bolt	X10:14, X10:15, X10:16
Mains connection	Auxiliary voltage	Clamp	X5:17, X5:18
Motor connection	A1/A2	Bolt	X10:10, X10:13
Protective conductor	PE	PE earth screws on the housing	

Basic connection Control connections REGxx

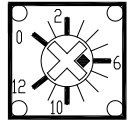
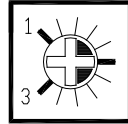
Release	Contact between X1:3 and X1:4		
Setpoint	Signal X1:6	GND X1:8a	
Actual value	Signal X1:9	GND X1:8b	
Umbrellas	X1:8		

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%



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.				

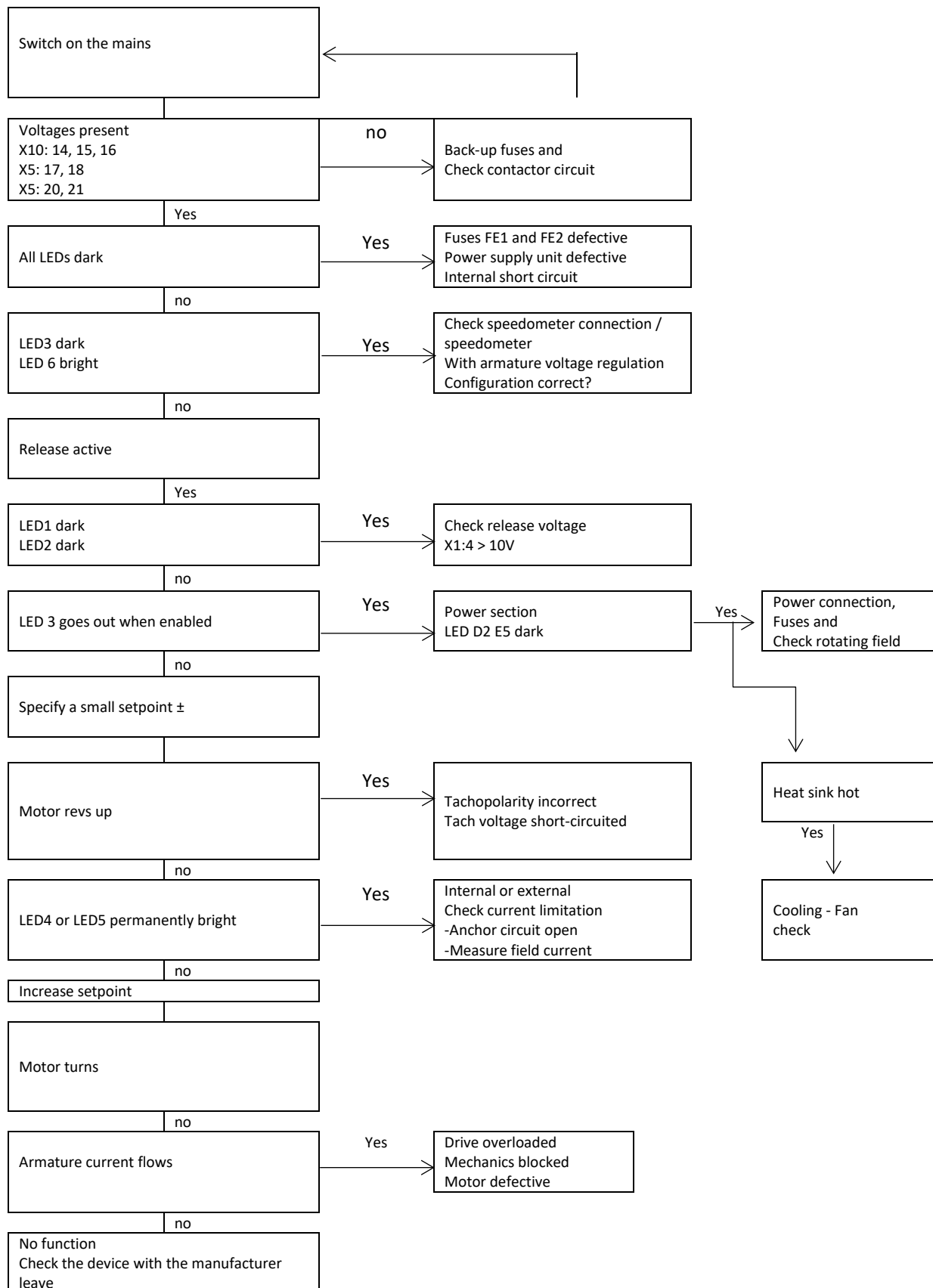
Commissioning protocol / QS3x/x-x with REGxx

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]			

Troubleshooting

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