

MANUAL

Classic Q6

4Quadrant Circular Current

ThyristorDrive



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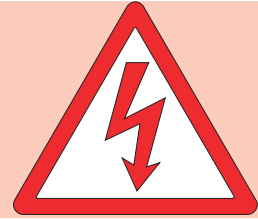
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1 Basic -Information

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

ATTENTION-HighVoltage

AC250/440V~,DC180/300V=



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.

Classic Q6 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 laws and technical standards have been strictly adhered to:

- | | |
|--|--|
| EU-Guidelines | 89/392/EWG, 84/528/EWG, 86/663/EWG, 72/23/EWG
EN60204, EN50178, EN60439-1, EN60146, EN61800-3 |
| - IEC/UL | IEC364, IEC 664, UL508C, UL840 |
| - VDE-regulations | VDE100, VDE110, VDE160 |
| - TÜV-regulations | |
| - Regulations of Professional and Occupational bodies: | 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 be 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

Installation

- 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. EMV standards EN61000-2 and EN61000-4.

Attention:

This device description MANUAL Q6 refers to the power section, and must be read in conjunction with the regulation (REG) description. The following regulation sections for 4 quadrant control are available:

Analog Regulation REGx.



General

In conjunction with a regulation board (for example REGx) the Classic Q6 range of thyristor Drives acts as Current controllers. (Moment of inertia controllers).

A 26-pin connector, common to all boards, is used to connect the power and regulation boards.

Using this interface it is possible for any external control arrangement including third party equipment to drive the power section.

Q6 Drives are used to control the speed, voltage or moment of inertia of dc motors in current circulating 4 quadrant mode.

Moment of inertia is applied continuously to the motor without interruption.

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
- optional units

Galvanicisolationbetween

- 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

- fully insulated thyristor modules, comfortably over-dimensioned
- only components customary in trade and industrially standardised are used
- LED displays
- DIP switches for the P-I adjustment of the current control loop
- precision potentiometers for fine adjustments
- DIP switches for the system set-up

Characteristics

- * Series Classic Q6
- * Thyristor drive for dc motors
- * Power range 2.7kW to 15kW
- * 4-quadrant control
- * Energy recovery
- * intrinsically safe power section
- * Fast analogue current control
- * 26-pin interface
- * Features of the control electronics:
see Manual REGx or third-party product documentation
- * Optional units

Q6160/180-x					
Power connection	6x 140 ... 180V~				
Auxiliary voltage conn.	360 ... 440V~ od. 200 ... 250V~				
Output Voltage	max. $\pm 180V=$				
Cooling	self cooling				
Drive Q6 160/180-		15	25	40	60
Input current phase	A~	6.12	10.2	16.32	24.48
Output current Peak	A=	30	50	80	120
Contin.	A=	15	25	40	60
El. power	kW	2.7	4.5	7.2	10.8
Input fuses (fast acting)	A	10	16	35	50
Mains transformer (UID std.)	Type	150 A	180 B	180 C	210 C
Circulating current chokes	Type	EI 120A-16	EI 120A-24	EI 135B-40	EI 170B-60
	mH	10	8	3,1	3
Dimensions WxHxD	mm	102x102x130		115x130x145	140x162x200
Weight	kg	4.3		8.2	12.5

Q6230/250-x					
Power connection	6x 180 ... 260V~				
Auxiliary voltage conn.	360 ... 440V~ od. 200 ... 250V~				
Output voltage	max. $\pm 250V=$				
Cooling	self cooling				
Drive Q6 230/250-		15	25	40	60
Input current phase	A~	6,12	10,2	16,32	24,48
Output current Peak	A=	30	50	80	120
Contin.	A=	15	25	50	60
El. power	kW	3,75	6,25	12,5	15
Input fuses (fast blow)	A	10	16	35	50
Mains transformer (UID std.)	Type	150 A	180 B	180 C	210 C
Circulating current chokes	Type	EI 120A-16	EI 120A-24	EI 150B-40	EI 170B-60
	mH	18	8	6	3
Dimensions WxHxD	mm	102x102x130		128x132x185	140x162x200
Weight	kg	4.3		10.6	12.5

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

Amplification

- input signal		0 to $\pm 10V=$
- output		0 to $\pm 200\%$ type current

Enable

Current control loop circuit		+10V
- control precision		$\pm 2\%$
- control range	1:50	

SpeedcontrolloopcircuitwithREG

- control precision (without actual value error)		$\pm 0.1\%$
- control range	1:1000	

InterfacecontrolelectronicsX3

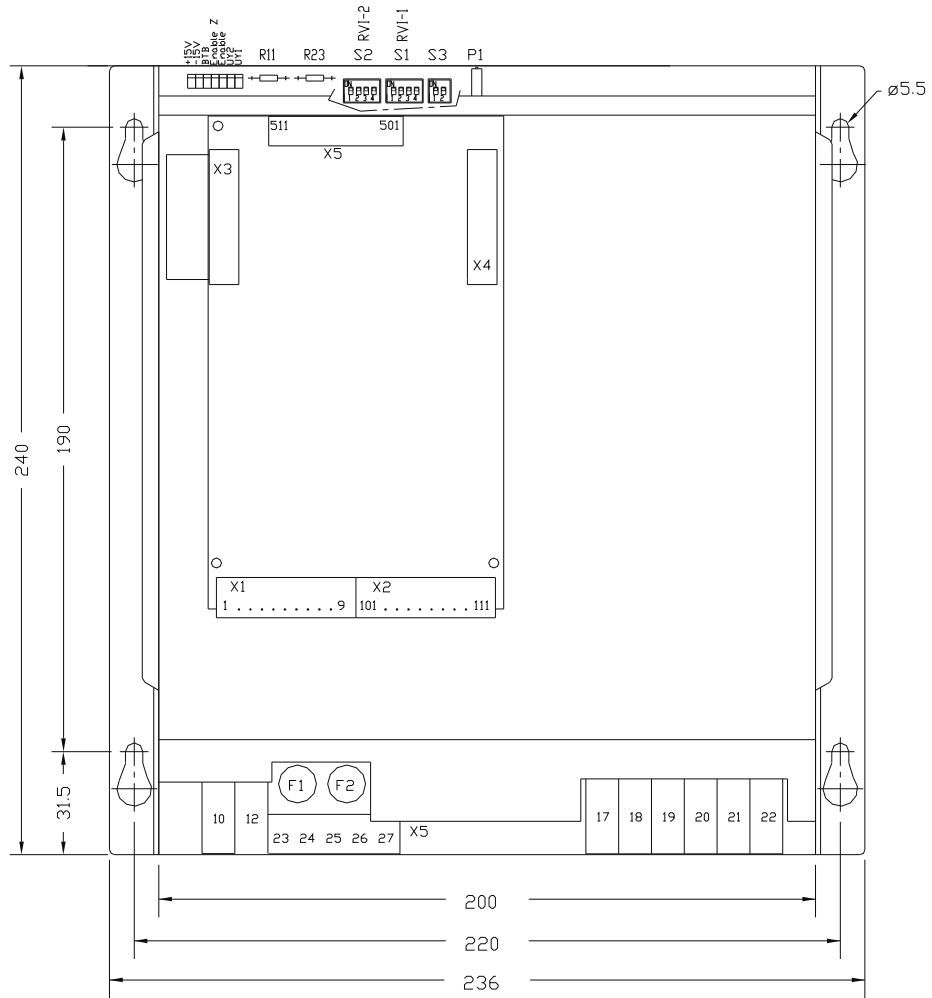
Function

+24V	$\pm 10\%$	
+15V	$\pm 2\%$	
-24V		$\pm 10\%$
-15V		$\pm 2\%$
DeviceGND	0	
Icommandvalue(GND)	0	
Icommandvalue(signal)	$\pm 10V=$	
Currentcontrollerenable	+10V=	
Drivedisable1	+10V=	
Drivedisable2	+10V=	
N(speed)actual	+10V=	
I(current)actual	+10V=	
Over-currentpowersection	n/a	
Triggerangle1	+10V=	
Triggerangle2	+10V=	
DrivereadyBTB	+10V=	
Free	n/a	

Connectorno.

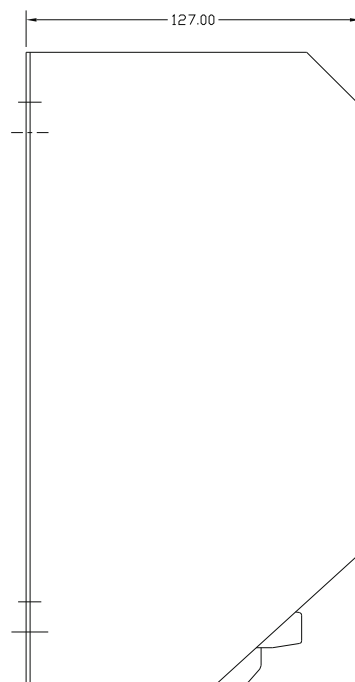
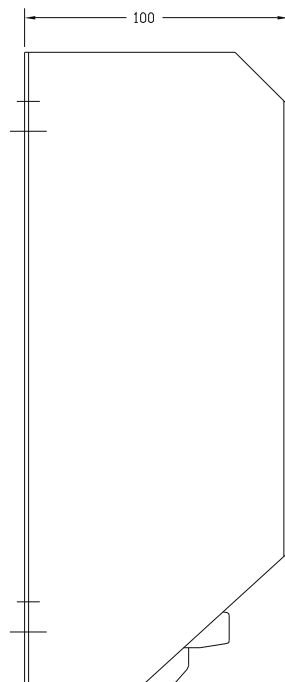
X3:1and2
X3:3and4
X3:5and6
X3:7and8
X3:9,10,11,12,13,14
X3:15
X3:16
X3:17
X3:18
X3:19
X3:20
X3:21
X3:22
X3:23
X3:24
X3:25
X3:26

Classic Q6X/X



Q6 15/25A

Q6 40/60A



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:

- Connectionandoperatinginstructions
- Localregulations
- EUguideline89/392/EWG,84/528/EWG,86/663/EWG
- VDEandTÜVregulationsandTradebodyguidelines
- CEandEMCadvice



Connection

Connecting Conductors					
Continuous Current A		15	25	40	60
Power connection cross section, minimum	mm ²	1.5	1.5	2.5	4
Motor connection cross section, minimum	mm ²	1.5	1.5	4	10
Control voltage connection cross section, minimum	mm ²	0.5	0.5	0.5	0.5

Free



3 Electrical Installation

The devices adhere to the EU guidelines 89/336/EWG and the technical standards EN61000-2 and 61000-4 provided that the following conditions are observed:

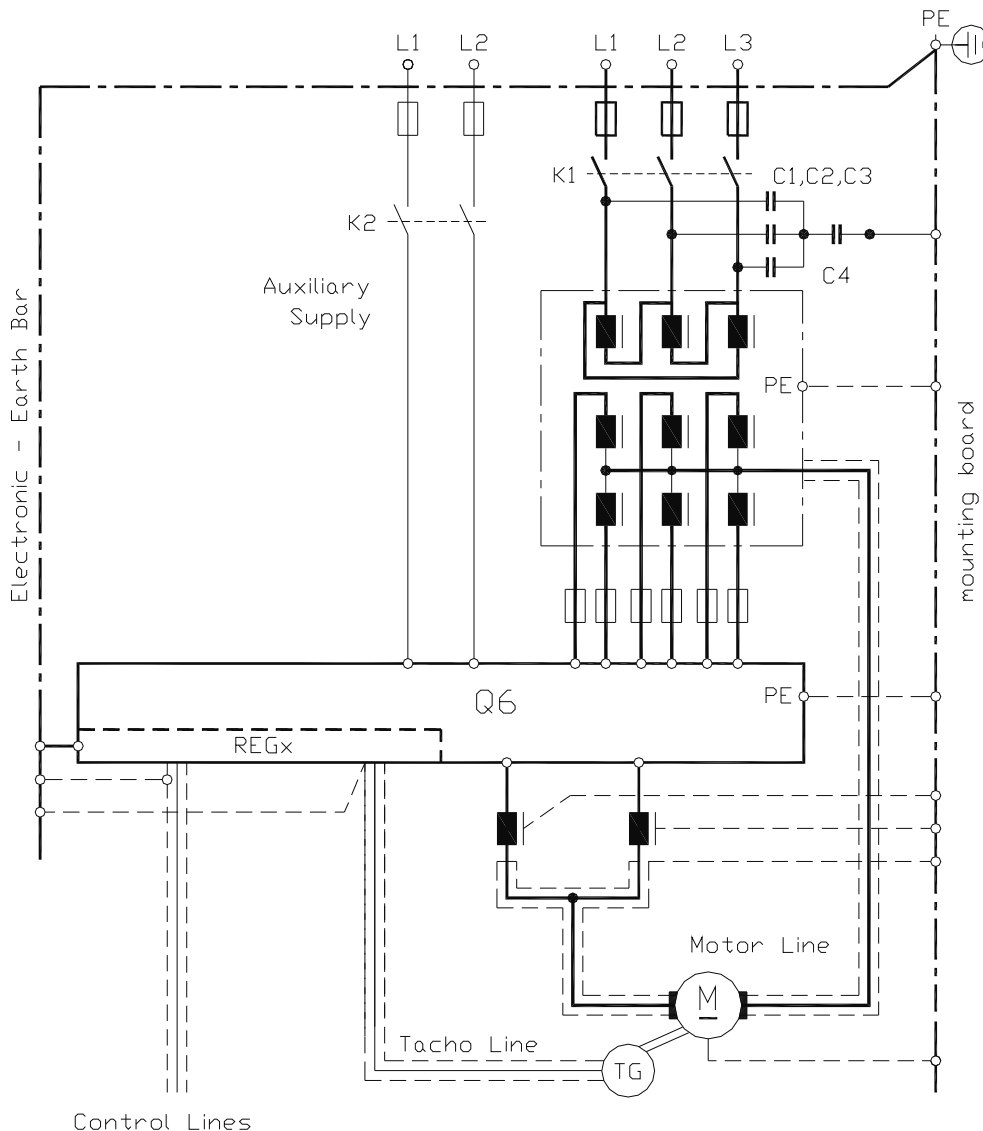
- The device, the transformer, and filter capacitors are mounted on a 500x500x2 mm mounting plate.
- The mounting plate must be connected to ground using a 10mm² wire.
- The motor housing must be connected to ground using a 10mm² wire.
- The device ground X1:8 must be connected to the mounting plate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

Three-phase connection:

Transformer type: see technical details
 Filter capacitors: 3x1 nF(x)+0.5x1 nF(y)
 Conductor length between the device and the power choke <250mm

Motor connection:

Motor conductors I = 1.5m, shielded
 Tacho and all control lines I = 1.5m, shielded
 Shielding connected to PE



The connection advice is a general information and it is non-obligatory.

Adhere to:

- connection and operating instructions
- local regulations
- EU guideline 89/392/EEG
- 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 .

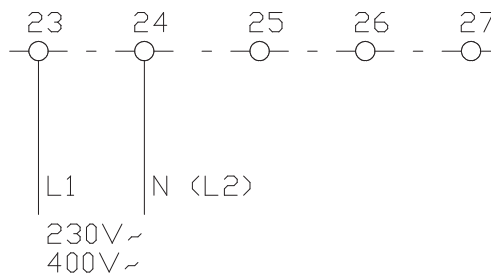
Input filter

see CE advice, page 11

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

Auxiliary voltage connection

Connection	terminal X5:23, X5:24
Power supply	230V~ or 400V~ (observe the type plate)
Input current	0.1A'
Phase position	regardless
Internal fuses	0.8AT



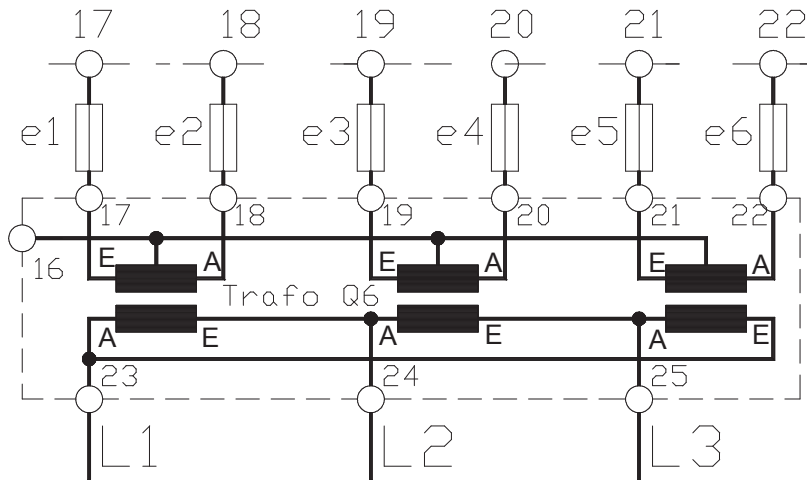
60Hz main supply

In order to operate the thyristor drive via a 60Hz mains supply, the contacts 1 and 2 of the switch S3 must be in position ON.

3 Electrical Installation

Transformer power connection

A special Q6 transformer is used. The primary side uses a Delta connection, the secondary side is arranged as a 6-phase centre-tap circuit.



L1, L2, L3 □ clockwise rotating field

A= beginning of the winding

E= winding end

Transformer rating

$$PT_r = \text{secondary voltage} \times \text{continuous current (I)} \times 1.4$$

To allow for the dc current loading, the transformer must be over-dimensioned by a factor 1.4.

Transformer fuse

Slow acting

Input fuses

Super fast acting (e1... e6)

These fuses are internally monitored for drop out.



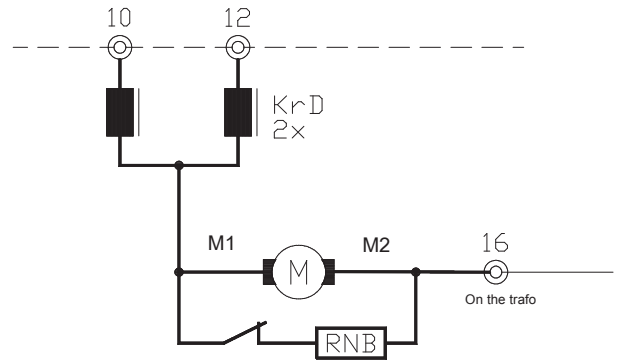
Attention:

If the secondary voltages produced by the transformer are inferior to those specified in the technical data, please indicate these voltages on order, as 6 internal resistors must then be adapted.

Motorconnection

Connection

Motor -	terminal X5:10
Motor +	terminal X5:12
Motor	terminal 16 (across the transformer)



Armaturechoke

Inductance L [mH] = $(U_A / I_A) \times 0.8$

When the command value is positive, M1 is positive and M2 (16) is negative.

Switchinginthearmaturecircuit

- dc circuit current-free
- disable inactive



Warning:

Switchingoffundercurrentwillcreatearcingacrosstheswitchcontacts.

Switchingonwhilethedriveisenabledwillcausethefuseto fail.

Powersupplyfailure-brakeresistors

Break contact of the mains contactor K1
The resistors are to be connected in parallel directly to the motor armature without isolating the motor from the control unit.



Attention:

The power lines are to be shielded and routed separately from control lines!

For electro-magnetic interferences please refer to the advice, page 11.

3 Electrical Installation

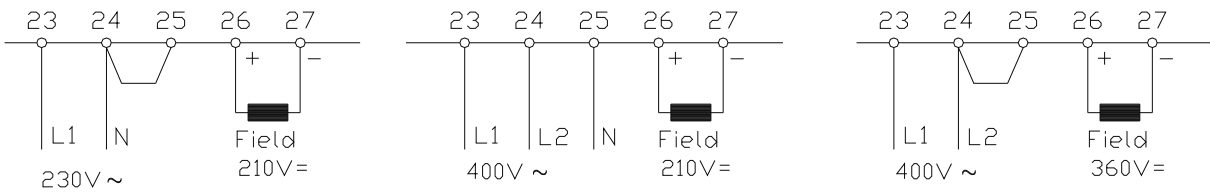
Fieldconnection(option)

Connection

Input		X5:23,X5:25
Field	negative	X5:27
Field	positive	X5:26

Terminalconnector

Fieldvoltage



Powersupply

230V ~
400V ~
400V ~ withN

Fieldsupply

210V=
360V=
210V=

Fieldcurrent

Fuses max. 1.5A
Watchdog 2.5Af
if the fuse fails, the device switches off

Actual value Connection

Tacho

Feedback device options

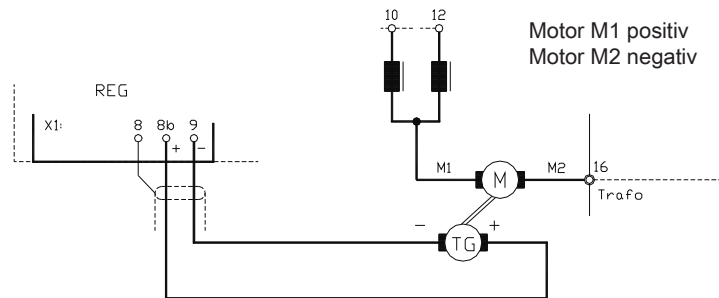
- dc- Tacho generator (standard)
- ac- Tacho generator with shaft angle detection (optional extra)
- incremental encoder with direction dependant (optional extra)

Connection

Regulation section (see the REG manual)

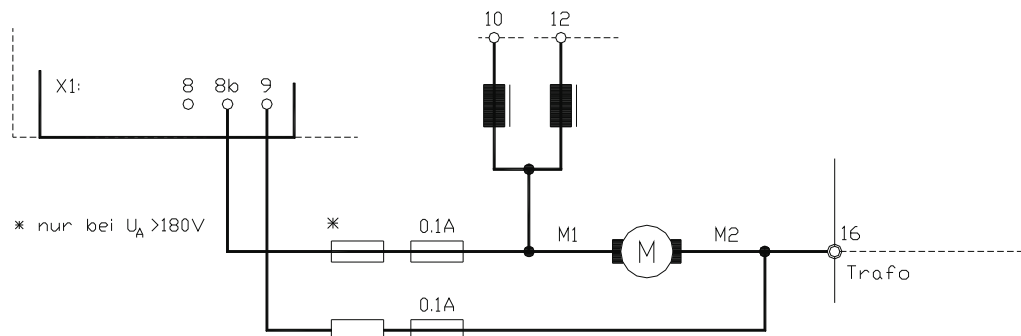
In the case of a positive command value

- Tacho plus X 1:8b
- Tacho minus X 1:9
- Shield X 1:8



ArmatureVoltage

The armature Voltage may be used as the actual value. In this case the control resolution will be greatly reduced (1:50).



Limitingtheactualvaluevoltage

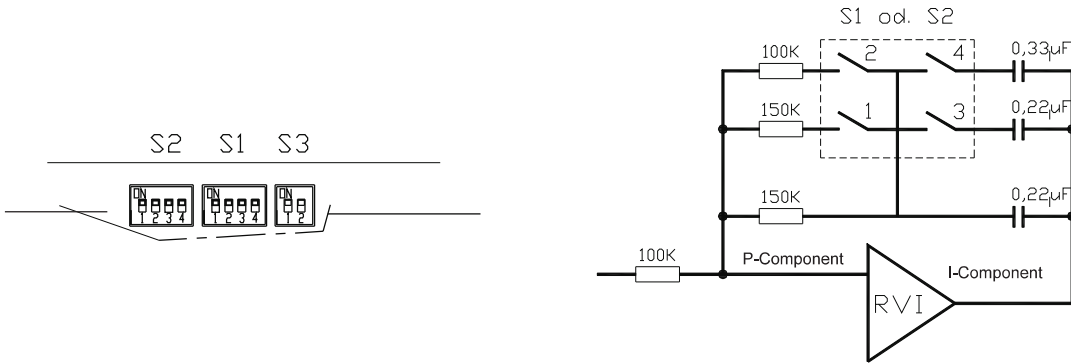
- Fusing 2x 0.1A/500V directly in the armature circuit!
- For armature voltage >180V= additional resistors are required

4 Adjustments

Currentcontroller

The PI characteristics of the controller are adjusted by means of DIP switches.

Switch		Controller
S1	>>>	RVI-1
S2	>>>	RVI-2



Circularcurrent

The circular current is adjusted by means of P1. It is increased by turning the potentiometer anti-clockwise.

Measurement:

The circular current can be measured across the choke circuit when the motor is stationary.

Please observe:

The device circular current corresponds to the circular current plus motor current. Thus, the motor current is reduced if the adjusted circular current value is too high.



Optimization of the current controller

- Connect an oscilloscope across the current actual value X3:21
- Current command value step-change 1V X3:16
- Increase the current command value by 1V steps to 10V
- Alter the P-amplification by means of the DIP switches S2:1 and S1:1, S1:2 and S2:2
- Optimal adjustment see fig. 1
- Not permissible adjustment see fig. 2
- Alter the integral part by means of the DIP switches S2:3 and S1:3, S2:4 and S12:4

Oscilloscope-Current adjustment

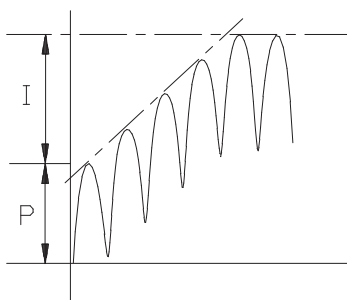


Fig. 1

Optimal adjustment

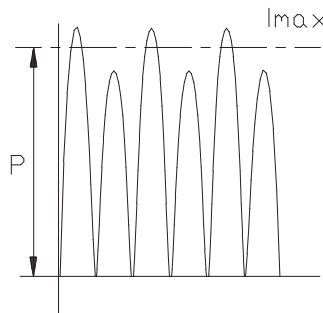


Fig. 2

P-amplification too high

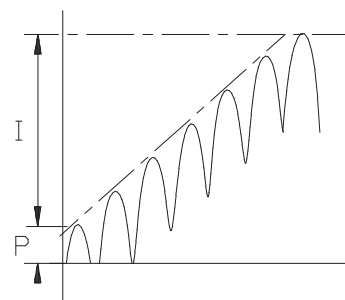


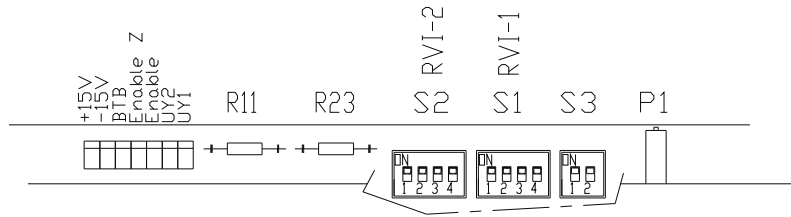
Fig. 3

P-amplification too low

Displays

Some important functions are indicated by LEDs:
green LEDs indicate the active state

Display	LED designation
ready for operation	BTB
Auxiliary voltage watchdog	+15V, -15V
Enable current controller	enable
Enable triggering	enable triggering
Current command value direction	RVI-1 or RVI-2



BTBsignal-Driveready

BTB signal	X3:25	>+10V
Error	X3:25	<+2V

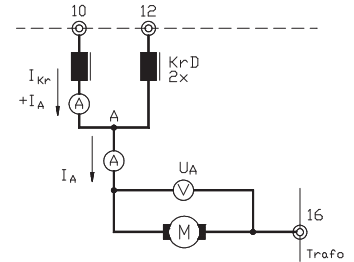
Errors:

- auxiliary voltage supply: +24V, +15V, -15V
- power supply connection: fuse failure, under-voltage

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

Measurementadvice

Measuring instruments:	multimeters for current and voltage
Measuring faults:	mean value > actual value acc. to the form factor approx. 1 to 5%



Measuredvalues

with a positive command value

Voltage: positive between the choke centre point (A) and the transformer (16), max 1.15 x power supply

Current: ammeter in the motor circuit

MeasuredvaluesREG

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

5 Commissioning

1. Connection advice

Connect the drive in accordance with the Q6 manual and the control electronics manual (e.g. REG).

Please observe in particular:

- Check the power supply voltage with that specified on the type plate.
- Insert the fuses according to the technical data (page 6).
- Check the field voltage connection and the motor and tacho connections!

2. Commissioning

Basic connections:

Mains supply, field, tacho, or armature feedback, drive enable, command value.
For armature voltage control the tacho watchdog must be switched off.

2.1 Drive enable switch open or drive enable voltage 0V

Command value		0V
Switch S9		adjust to tacho voltage
for armature voltage control		adjust to 0
Switch S4		position 2
Switch S5		position 6
Potentiometer I_{max1} , I_{max2}		adjust to approx. 10% of full scale
Potentiometer	XP	adjust to 50%
Potentiometer	ID	= 100%
Potentiometer	IxR	= left full scale
Potentiometer	n_{max}	= left full scale
Potentiometer	INT	= left full scale
Switch tacho control	ON:	DS1 K:1, DS2 K:3 and 4
	OFF:	DS3 K:4, DS4 K:2
		Bridges R13 and R14 soldered-in
Switch armature voltage control	ON:	DS1 K:1, DS2 K:3 and 4, DS3 K:4, DS4 K:2 and 4
		Bridges R13 and R14 open!

2.2 Apply the voltage

The LEDs L3 (BTB) and L7 (stationary) must light.
All other LEDs are off.

2.3 Close the switch 'drive enable' or apply drive enable voltage of 10V

The LEDs L1 and L2 must also light

The drive must be at a standstill or turn slowly (offset).

If the drive accelerates in the correct direction, the polarity of the tacho voltage and the armature voltage feedback must be changed.

If the drive accelerates in the wrong direction, the polarity of the armature or the field must be changed.

2.4 Increase the command value voltage to approx. 10%

The drive must accelerate to approx. 10% of the speed.

If the rotation direction is wrong, change the polarity of the tacho and the field **or** the polarity of the tacho and the armature.

2.5 Current controller amplification

(Switch S1, S2 on the power section)

The current amplification is adjusted to a low armature circuit inductance

(High switch settings can lead to motor oscillation which cannot be influenced by means of the speed controller. In this case, first set switch S1-2 then switch S2-2 to „Off“.

If the drive still does not run smoothly, set the switches S1-1 and S2-1 to „Off“.

The current response can be measured by means of an oscilloscope across the test point X4:20 (see page 17).

2.6 Speed controller amplification

Adjust on the REG board.

Adjust the P-term to the lowest possible setting from 1 to 5 (switch S4).

Adjust the I-term to match the axis momentum (switch S5):

large axis momentum - high adjusted value

small axis momentum - low adjusted value

With the command value set to 10% speed, increase the amplification by turning the potentiometer Xp clockwise. When the drive begins to oscillate, reduce the amplification by turning the potentiometer anti-clockwise by approximately 10%.

For the fine adjustment of the amplification the control response should be measured by means of an oscilloscope across the test point X4:15 (see page 17).

2.7 Further adjustments

such as speed, peak current, continuous current, etc.

(rf. to the manual REG and Q6)

2.8 Switching Off

If the switch `drive enable` is opened, or the drive enable voltage is switched to 0V, the LED L1 will extinguish and the drive will brake until standstill. After approx. 2s the LED L2 will extinguish and the drive is disabled. After approx. 5 more seconds, the thyristor triggering circuit is disabled.

2.9 Commissioning adjustments

The adjustments should be documented in the protocol and the adjustment potentiometers should be sealed with a suitable lacquer.

Guarantee

We guarantee 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. WE undertakes no guarantee for devices which have been modified for special applications.

During the warranty period, we will, at its option, either repair or replace products that prove to be defective, this includes guaranteed functional attributes. We specifically disclaim 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 us.

For products returned to us for warranty service, the Buyer shall prepay shipping charges to us and we 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 us 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 our 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).

We reserve 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. We do 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.

Protocol

Customer **MachineNo.**
Device **SerialNo**
Controlvoltage [V~]
Powersupplyvoltage [V~)
Fieldvoltage [V=]

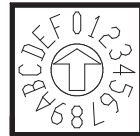
Inputs

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=]

Speedcontroller settings

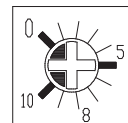
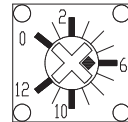
Switches

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
 IxR compensation P2 Position



DSwitches

ON no.
 OFF no.

7 Protocol

Current controller settings

Switches

Switches S1, S2 open (off)

 closed (on)

Switch S3

	OFF (50Hz)	ON (60Hz)
K1:		
K2:		

Measureddata

Armature voltage max . [V=]

Armature current peak [A=]

Armature current continuous [A=]

DC tacho voltage max. [V=]

Tacho voltage max. [V=]

Acceleration X4: [V/ms]

Integrator X4: [V/ms]

Motordata

Typeplatedata

Manufacturer

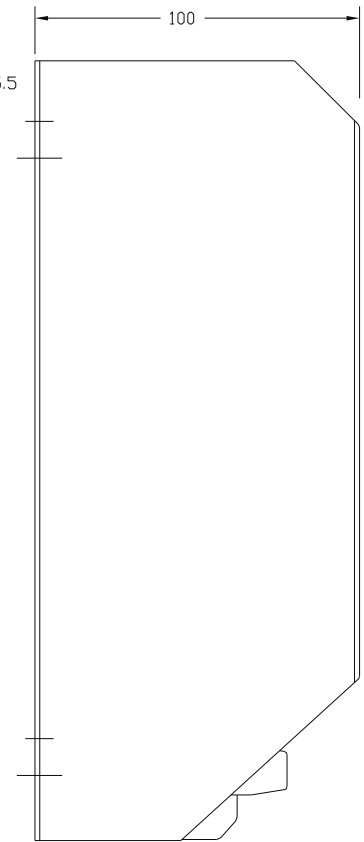
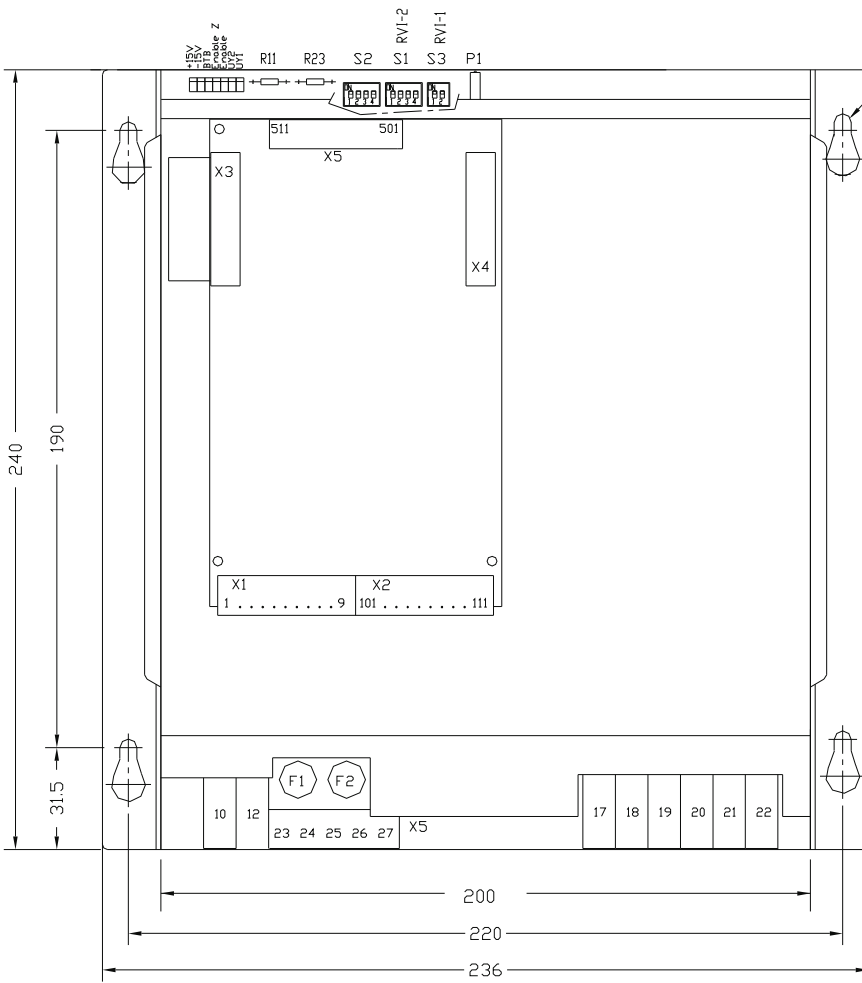
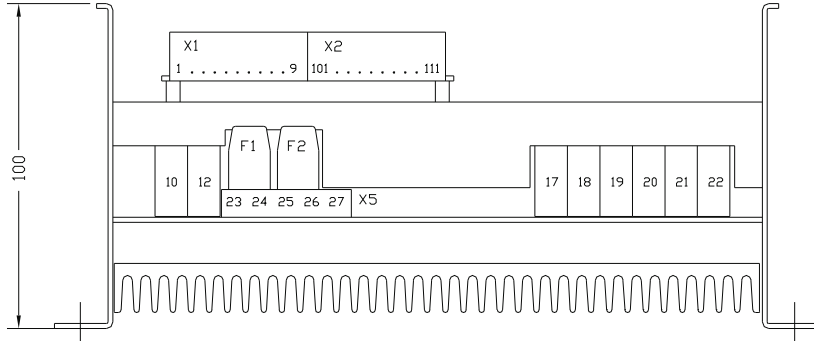
Type Serial number

Motor voltage [V=] Motor current [A=]

Brake [V] Fan [V]



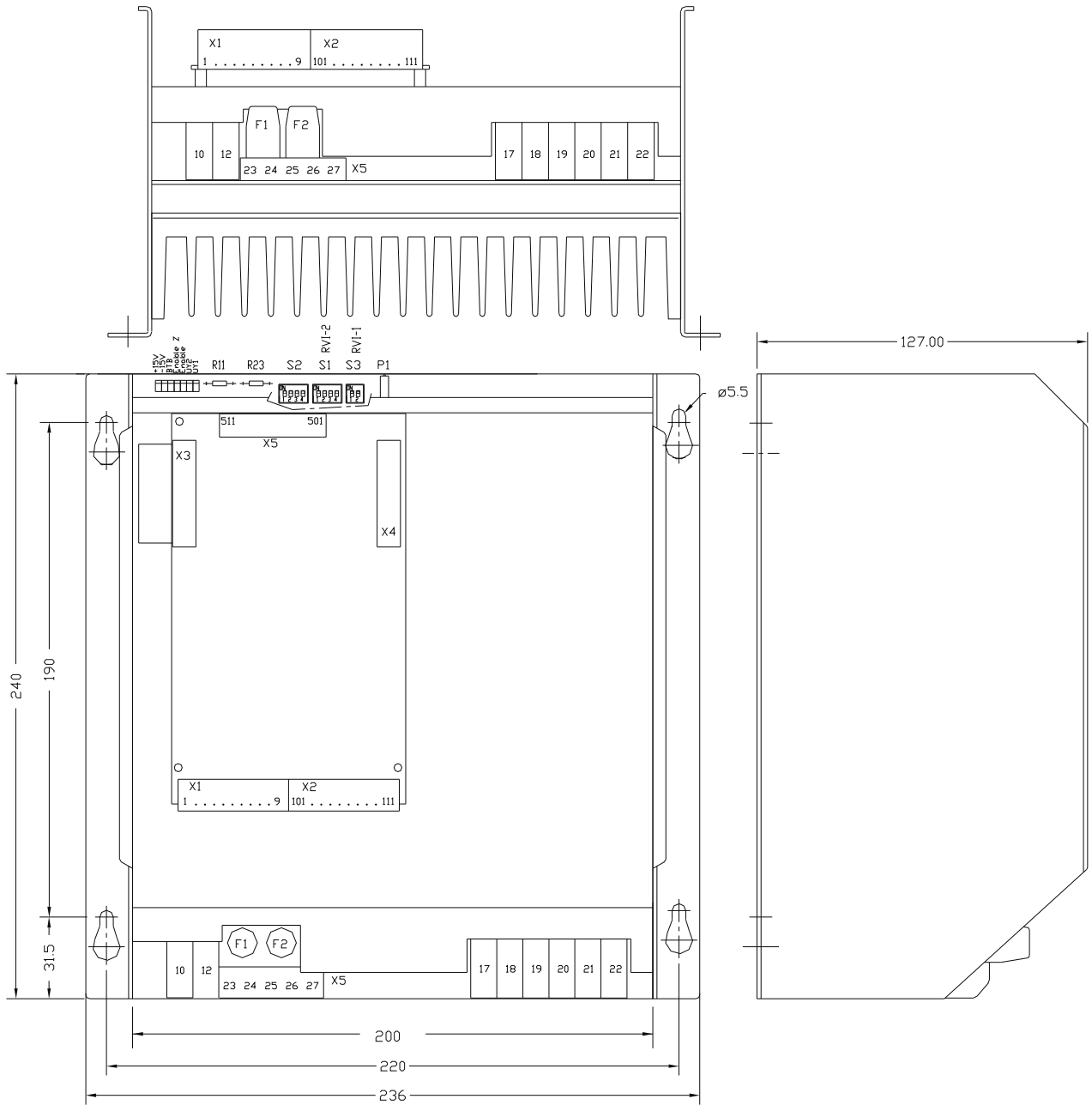
8 Drawings



Q6-M012-15A

Classic Q6 x/x-x

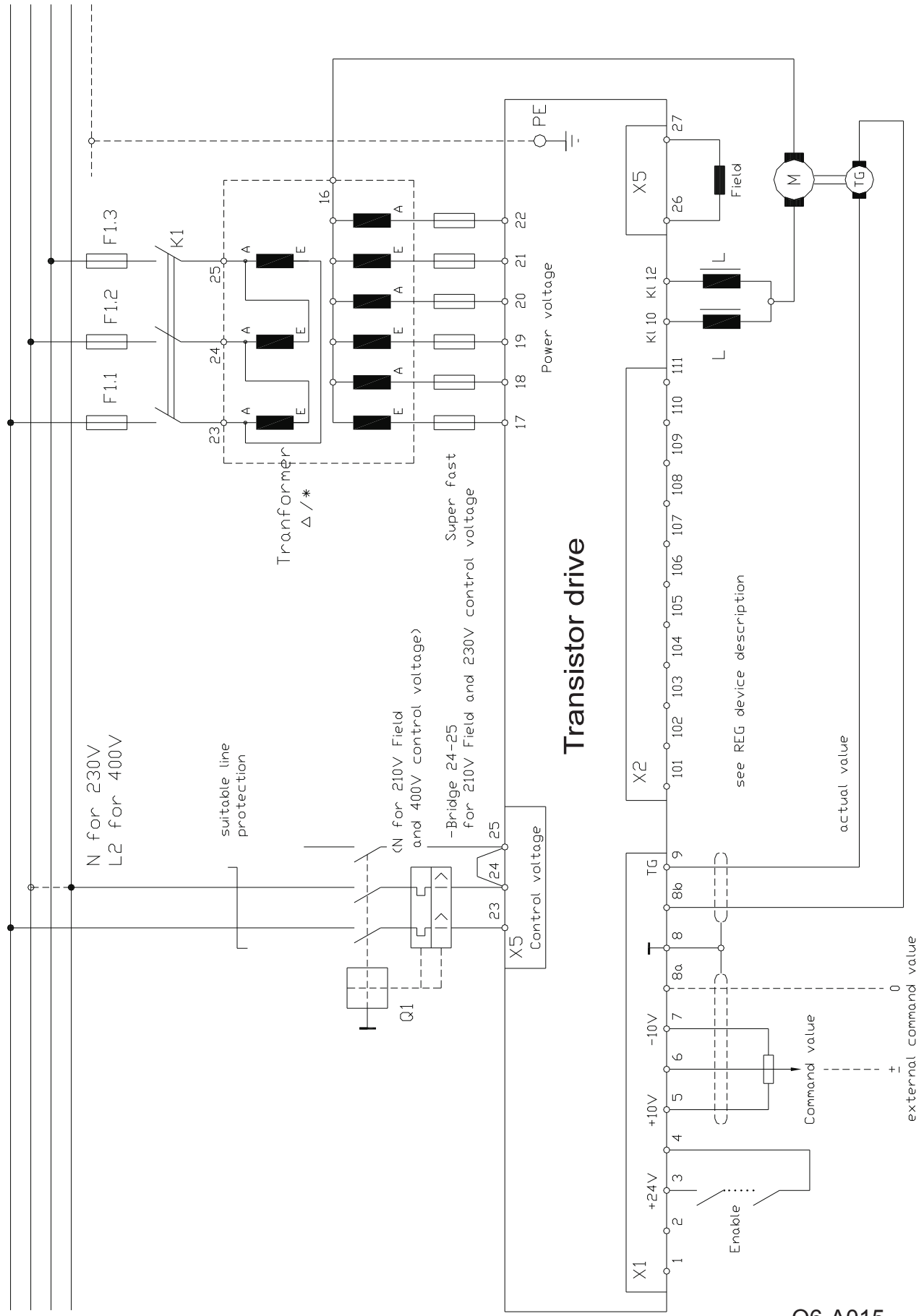
Dimensions Classic Q6 40-60A



Q6-M012-40A

8 Drawings

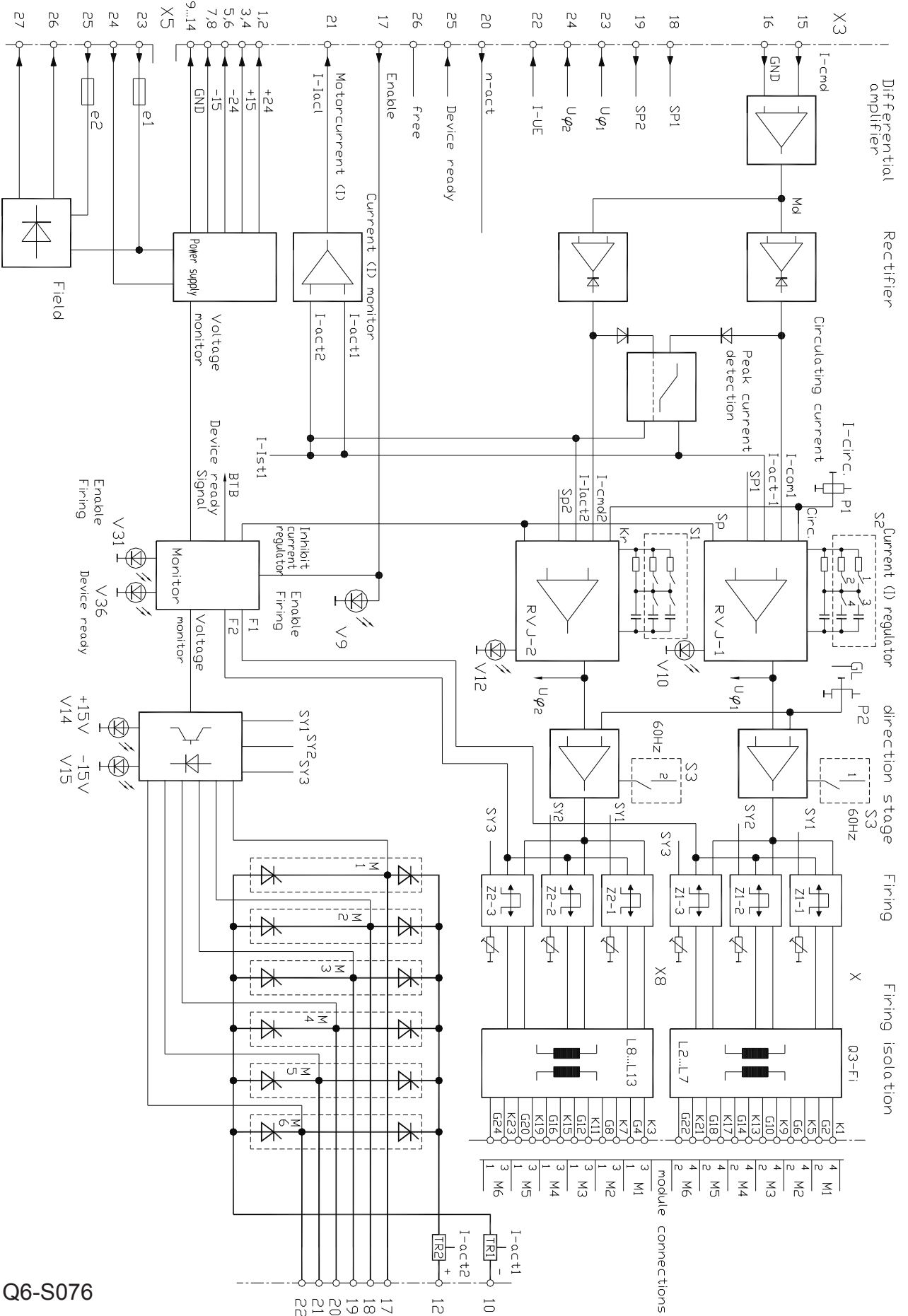
L1
L2
L3
N
PE



Transistor drive

Q6-A015

Circuit Diagram Q6



Q6-S076