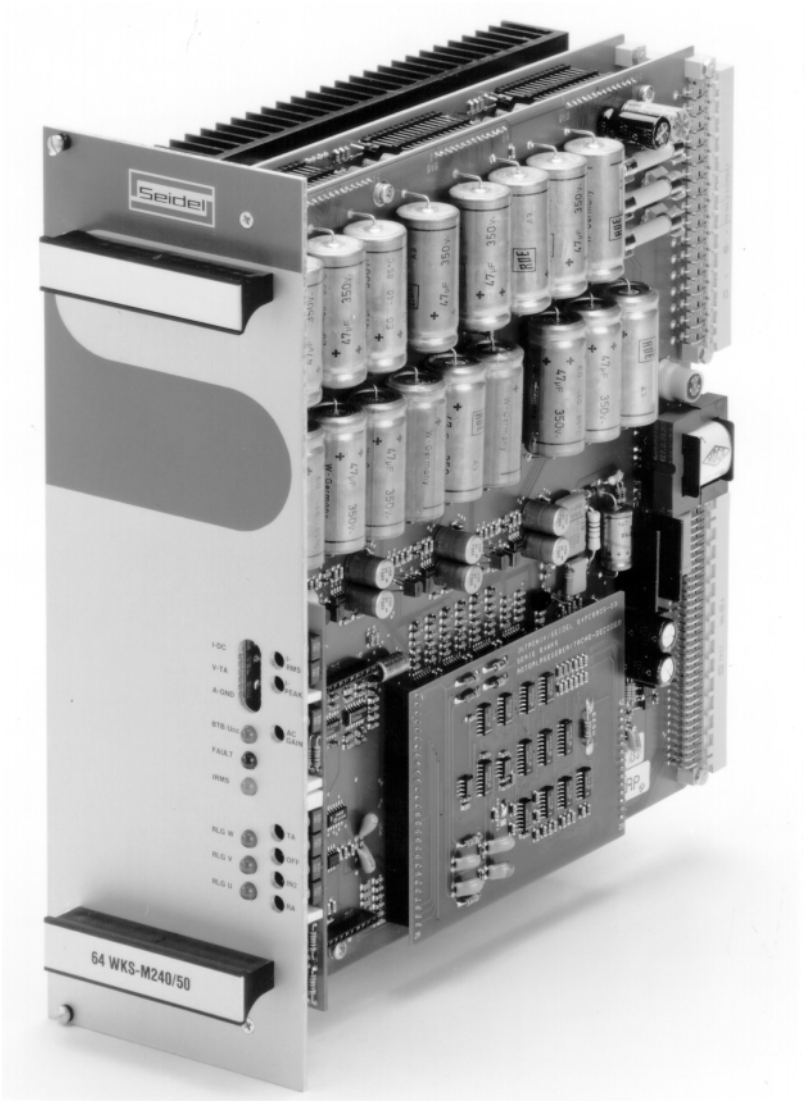
KOLLMORGEN
Seidel

Transistor — Inverter
Series : 64WKS



Installation manual
Edition 10/00

Technical changes improving performance and specifications,
may be made without prior notice !

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I General Information

I.1 Introduction

This manual explains how to install, put into operation, set and adjust the 64WKS transistor inverter.

The manual is divided into 6 sections:

Section 1: General information, specifications, power supply unit

Section 2: Installation instructions

Section 3: Commissioning

Section 4: Functions and options

Section 5: Drawings and wiring diagrams

Section 6: Annex with ordering informations

In particular, please refer to the safety instructions given at the beginning of each section. Only in this way you will avoid damage and hazards.

Only qualified personnel with basic electrotechnical knowledge may be authorized to install the controller and its associated equipment.

Only qualified personnel with extensive knowledge in the sectors of electrical engineering/drive engineering may commission the controller.

On request, we offer instruction and training courses.

Seidel only provides a functional warranty for the inverter with synchronous motor if SM series motors are used.

I.2 Equipment concept

Using state-of-the-art components and SMD technology, a four-quadrant controller in double-sized Eurocard format was developed for brushless DC servomotors (AC servomotors) based on the synchronism principle.

The output stage is designed as a pulse-width-modulated transistor stage. The trapezoidal output currents and motor speed are controlled by PI controllers. The phase reversal of the motor and tachometer windings is controlled by the electronic rotor position sensor (RLG) of the motor.

If necessary, up to three devices can be connected in parallel to **boost performance**, with one master taking over control and synchronization.

This device enables the generation of a highly dynamic speed or torque/current control circuit. The actual speed is measured **either** by the electronic rectification of the three-phase (brushless) tachometer signal **or** by the feedback of a DC tachometer signal.

All the variable adjustment parameters and adaptations are accommodated on a plug-in **customer print**, and are accessible from the front panel.

The standard potentiometers can be replaced by adapted fixed resistors for standard use.

A maximum of four 64WKS series equipment as well as a 56WK-P Series power supply unit can be housed in **one single** 19" 6U standard rack.

The appliance is connected at the rear via plug-in terminals or stud bolts for the power terminals. In the case of the optional compact housing, the equipment is connected via plug-in terminals (accessible from the front) for the control signals or stud bolts for the power terminals.

This equipment requires ventilation in any case.

The compact housings are supplied with integrated fans as standard. The total width of the compact housing is 170mm, so 3 housings will comfortably fit side by side in a 600mm control cabinet.

I.3 Functional groups

On a 220 x 233.4 x 18 TE double-sized Eurocard format in SMD technology, also available in a compact housing with a width of 30TE with front connection, the following functional groups are located:

- Intermediate circuit smoothing capacitors
- Fuses for intermediate circuit, auxiliary power supply unit
- 4-quadrant output stage, three-phase
- Auxiliary power stage, internal or external supply (**24V** option)
- 2 rated value differential inputs
- Rated current input and output
- Input for **three-phase, brushless or DC tachometer**
- Input for rotor position sensor (RLG)
- Enable input
- Control input for controllers connected in parallel
- It monitoring of actual current value with signal output
- PI current and speed controller
- Balancing potentiometer and fixed components for all key adjustments on a plug-in customer print
- Solder straps for optional extras
- Socket for option board -01- with the following additional functions:
  — limit switch inputs, ramp alternator, 1:1 control effective at rated value input 2
- 24V logic with optocouplers for control signals
- Ready-to-operate relay (BTB) with isolated contact
- LED displays for ready to use, fault, It, ballast circuit and RLG signals
- Front panel

I.4 Technical specifications

			64WKS - M240 /	
Rated specifications		**Unit**	**50**	**70**
Rated supply voltage		V~	3 x 60...172	
Rated connected load (for 50/70 A rated current)		kVA	9	12
Rated DC voltage in intermediate circuit		V=	240	
Rated output current		A	50	70
Peak output current (available for max. 5 s)		A	100	140
Max. fuse protection of 56WK-P power supply unit		AM	3 x 63	
Switch-off threshold at overvoltage		V	325	
Form factor of the output current (at rated specifications and minimum motor load inductance of 0.6/0.4 mH)		—	1,01	
Bandwidth of secondary current control circuit		kHz	1	
Clock rate of output stage		kHz	(2 *) 8,5	
Residual voltage drop at rated current		V	4	
Quiescent power loss, output stage disable		W	20	
Power loss at rated current (including power loss of power supply unit without ballast power loss)		W	280	400
Auxiliary voltage outputs		V	±15	
		mA	±20	
Auxiliary voltage outputs for RLG/tachometer		V	±15	
		mA	±30	
Inputs				
Nominal value 1, permanently set		V	±10	
Nominal value 2, adjustable between 0 and 100%		V	±10	
Max. common-mode voltage (both rated value inputs)		V	±10	
Input resistance (both rated value inputs)		kΩ	20	
Max. input drift (both rated value input)		µV/K	±15	
24 V auxiliary voltage supply (option)		V	24 (18...30)	
		A	1,2	
Connections				
Controller:	Control signals	DIN 41612 - C64 (connector)		
	Power signals	DIN 41612 - E48 (connector)		
Rear-panel board:	RLG	Sub D - 9-pol. (socket)		
	Control signals	Combicon 5,08 , 20 (or 2 x 12) pin		
	Power signals	M6 studs		
Mechanical specifications				
Weight	Board	2,5 kg		
	Compact housing with board	5,1 kg		
Dimensions	double-sized Eurocard (18M)	220 x 233,4 x 91 mm		
	Compact housing (dxhxw)	296 x 390 x 165 mm		

I.5 Permissible ambient conditions

Tolerance for supply voltage	±10%
Installation position in 19" rack	vertical
Ventilation type: force-ventilated	**also for unloaded equipment** (ventilator permanently installed in compact housing; supplied externally by 220 V AC power supply unit)
Ambient temperature (at rated values)	0 to +45°C
Power reduction (2,5% / °C) in range	+45 to +55°C
Storage temperature (rel. humidity max. 95%, non-condensing)	-25 to +85°C
Protective system (in connection area)	IP 00

I.6 Connectable motor types

We recommend the following torque ranges from our range of **AC servomotors**:

— SM Series, torque range 7 to 100 Nm

I.7 Protective functions

The 64WKS transistor inverter features the following protective functions:

— Short-circuit-proof and ground-fault-proof at the motor connection terminals
— Operating voltage monitoring
— Overvoltage protection
— Fuse protection of the DC intermediate circuit
— Temperature monitoring of the output stage
— I^2t monitoring to protect the amplifier and motor
— Monitoring of RLG signals

I.8 Parallel controller operation

To double or treble the output currents, two or three identical 64WKS modules can be easily connected in parallel. Interconnect power outputs U2, V2 and W2 via L0.6-70/140 double chokes to reduce cross currents. **One controller**, known as the **master**, synchronously controls all the slave controllers, to ensure even distribution of current. All the monitoring functions remain active; the controllers need not be adjusted.
For slave controllers, the master/slave plug-in jumper must be removed from the backplane. In addition, connect the master via a 10-conductor ribbon cable (controller accessory) between the XST405 terminal posts. The master and slave remain interchangeable.
For commissioning, the master can be operated without the slave.
The master is connected and controlled as usual; the slave requires only the enable signal (terminal 16, looped from the master). Also connect one RLG signal (e.g. pin 7) in the slave RLG connector (XST401) with the GND (pin 6) by means of a jumper plug, otherwise the integrated RLG monitor will be activated.
The speed controller, the inputs for rated value, tachometer and limit switch as well as the slave tachometer and current monitors are deactivated.
I_{RMS} and I_{PEAK} must be adjusted as usual.
See also pages 30 and 31 in the drawing section of this manual.

I.9 Isolating transformers

Isolating transformers are required to operate the power supply unit. To ensure that the system runs properly and the terms of warranty are met, the isolating transformers must conform to the specifications below.

Type Three phase isolating transformers with shielding winding according to VDE 0550 in circuit Y/y or Y/d.

Connected voltage 400 (380) V with ± 5% tap for adaptation to fluctuating power supply.

Secondary voltage For 240 V DC intermediate circuit, 172 V (phase to phase). **Do not ground secondary star point.**

No-load voltage (secondary) The permitted no-load voltage overshoot is approx. 4%.

Short circuit voltage The referred short-circuit voltage u_k must be 4% + 1% to protect the rectifier diodes according to VDE 0160 against starting and overvoltage. For transformer voltages greater than **8 kVA**, a soft start is required.

Power factor The load of the transformer and three-phase AC bridge rectifier results in a power factor of $\lambda = 0.9$.

Overload response The momentary overload typical of servo operation should not produce voltage drops in excess of u_k or damage the transformer.

Attention !
The use of a transformer which fails to comply with the above specifications will impair operating reliability and can lead to controller damage. We only assume functional warranty of the controller if SEIDEL isolating transformers are used (see below).

Seidel transformers (3-phase, rated phase to phase voltage 400 [380] V)

Our isolating transformers comply with the above specification.

Type	Output/kW	Secondary voltage/V	Order No.
3T3.0K-240	3.0	172	56898
3T5.0K-240	5.0	172	55027
3T8.0K-240	8.0	172	57006
3T10K-240	10	172	56958

I.10 Power supply unit 56WK-P240/80-B

I.10.1 Equipment description

The high-performance **power supply unit of the 56WK-P Series** with an integrated ballast circuit **-B-** and external ballast resistor **BAR375** is ideally suited for supplying the 64WKS-M240/xx transistorized inverter.
The 56WK-P240/80-B power supply unit is a standard 19" rackmounting equipment designed for powering several transistorized inverters.
The rated current for convection cooling is 30A and 90 A for forced cooling. Peak current load capability is 60 A for convection cooling and 180 A for forced cooling.
The operator is responsible for providing mains fuse protection.
The power supply unit provides up to **90 A in the DC intermediate circuit**, while the motors are supplied with a **lower average active voltage** via the controller. A power supply unit is thus capable of supplying several controllers in a 19" system. At an axis simultaneity factor of <1, the power supply of **3- and 4-axis systems** is possible with only one power supply unit from this series.
The permissible **peak current of the ballast circuit is 90 A**, so the smallest permissible resistance value of the external ballast resistor is **3.3** Ω.
The rated load is determined throughout by the ballast resistor. With the BAR375, for instance, it is **375 W**. By interconnecting several resistors, ballast output - with regard to the minimum resistance value - can be increased without difficulty. Ensure that the **R616** resistor is rated for the maximum permissible **rated load** of the ballast resistor. In the event of **overload or undervoltage**, the isolated ready-to-operate contact (terminals 1/2) opens.

The expected ballast output must be roughly calculated by the operator to avoid ballast circuit overload.
In a rough estimate, the sum of the **peak power** of all the connected controllers should be no more than **three times the ballast peak load**. The **rated load** of the ballast circuit should be higher than **3% of the sum rated load** of all the connected motors.
To avoid ballast resistor overload due to brake operations after switching off the controllers or in the event of mains overvoltage or an equipment fault, **protect the ballast resistor by a 10 AT fuse**.

If there is a lack of fuse protection or severe tolerance deviations in the fuse, an overload in the ballast circuit (see technical specifications) can damage the electronics. It is therefore important to observe the maximum permissible peak load of the ballast circuit.

To prevent overvoltage, suppressor diodes are integrated in the appliance.

I.10.2 Specifications of 56WK-P240/80-B

Rated specifications	Unit	56WK-P240/80-B
Rated supply voltage	V~	3 x 172
Rated connected load	kVA	22
Rated DC voltage in intermediate circuit	V—	240
Peak DC output current, free convection	A	30
Peak DC output current, forced-ventilated	A	90
Peak output current (available for max. 5s), free convection	A	60
Peak output current (available for max. 5s), forced ventilation	A	180
Max. external fuse protection of rectifier	AM	3 x 63
Max. external fuse protection of ballast circuit	AT	10
Rated capacity of smoothing electrolytic capacitors	µF	1900
Power loss at rated current (without ballast power loss)	W	200
Undervoltage limit (READY-TO-OPERATE)	V	40
Ballast circuit		
Min. starting threshold	V	285
Rated voltage	V	300
Continuous output (self-ventilated)	W	3000#
Continuous output (forced-ventilated)	W	5000#
Minimum permissible ballast resistance	Ω	3,3
Peak power for 1s	kW	27
Peak power for 2s	kW	27
Peak power for 5s	kW	20#
External ballast resistance		
Continuous output (self-ventilated)	W	375
Continuous output (forced-ventilated)	W	500
Minimum resistance	Ω	3,3
Displays and monitoring		
Green LED for ready to operate		
Yellow LED for ballast circuit		
Monitoring of ballast circuit/READY-TO-OPERATE (BTB) relay		
Connections		
Plug-in module	DIN 41612 multiple contact strip, type E48	
Type N56WKMB backplane	M6 stud bolt	
for type BAR375 external ballast resistor	M5 stud bolt	
Control signals (undervoltage signal)	MSTB 1.5 plug-in terminal	
BAR 375 ballast resistor	6.3 mm Faston	
Mechanical specifications		
Weight	1,2kg	
Dimensions	double-size Eurocard format, width 12M Insertion depth 220mm, 220x233.4x60mm	
Weight of BAR 375	1kg	
Dimensions of BAR375	310 x 75 x 35 mm	

Note:

= normally limited due to the permissible power loss of the ballast resistors

II Installation instructions

II.1 Safety instructions

- Check the rating plate of the controller. Compare the rated voltage and rated current with the transformer specifications and motor specifications.
- Never switch on the operating voltage until you have read Section III of this manual (Commissioning).
- Make sure that the maximum permitted rated voltage of 240 V DC is not exceeded at the terminals Ucc, 0 V/GND of the controller. An excessively high voltage at these terminals can destroy the ballast circuit in the controller.
- Make sure that the controller is sufficiently ventilated (see also chapter I.5). **An incorrectly installed ventilator or lack of ventilator can destroy the controller**.
- The front of the module is only protected against accidental contact when the module is mounted in the 19" rack and fastened with the screws provided.
- Use twisted pairs for rated value, rotor position sensor, tachometer and motor cables. The tachometer, rotor position sensor (RLG) and rated value cables must be installed shielded. Make sure that the wire cross-sections are sufficient to avoid excessively high power losses and to prevent the cables from overheating. Refer to Section II.2.1.
- Ground the intermediate circuit (0 V/GND). A non-grounded intermediate circuit is a hazard to the system operator if there is a ground fault in the motor or fault currents on the GND conductor. The electronic system may also be destroyed in the event of a fault if the intermediate circuit is not grounded. A ground fault in the motor is no longer detected if there is no grounding.
- All ground connections must start at the same star point to prevent ground loops and potential differences on the ground cable. Connect all ground cables to a PE rail, e.g. in the control cabinet. Refer to Section IV.4.2.
- Check that the screens are correctly connected:
  rotor position sensor ,tachometer screen at the controller (GND/PE or 0V/GND)
  rated value screen on the control system at NC-GND
  Screens may only be connected to one side
- Loop the ready to operate contact (terminals 21, 22) into the protective circuit of the system. The controller function can only be monitored in this way.
- The ±15 V auxiliary voltages must not be routed out of the control cabinet. This will avoid capacitative and/or inductive interference.
- After inserting the modules, secure the front panels using the fastening screws provided. This is the only way of ensuring that the connectors have a reliable contact. Insufficient contact will erode the plug-in contacts.
- **Never plug in or remove the controller when live**. Even 5 seconds after power off, the capacitors can still have dangerous levels of residual charge. Measure the voltage in the intermediate circuit and wait until the voltage has dropped below 40V.

II.2 Connection and wiring

The **motor cables** must be stranded with sufficient cross-sections (for single conductors) or installed in cables (oilflex cables, etc.). It is important to ensure that the GND/PE rail (studs) is connected correctly at the central PE point on the control cabinet. Install suppressors, such as annular cores or chokes, as close as possible to the controller. Rotor position sensor, tachometer and rated value conductors **must be** twisted in pairs and installed shielded. The rotor position sensor and tachometer shields are best connected to the GND at the controller and the rated value shield to the rated value source (CNC). The controller and the control system **must have the same PE/GND reference point** (e.g. the PE rail in the control cabinet). You can connect the control system to the GND reference point for improved interference suppression at medium impedance (e.g. more than 100Ω). This is permitted by the common-mode rejection of the rated value inputs. The logic inputs should be driven by the control system at 24 V (15 to 30 V). The use of the 15 V auxiliary power pack should be reserved for commissioning and simple applications.

II.2.1 Wire cross-sections

When wiring, consult the minimum wire cross-sections specified below. You will then prevent high cable losses and cable overtemperature.

Unit	Designation	Cross-section	Remarks
64WKS-M240/50	DC intermediate circuit	3 x 10 mm^2	Ucc, 0 V, PE
64WKS-M240/70	DC intermediate circuit	3 x 16 mm^2	Ucc, 0 V, PE
64WKS-M240/50	Motor conductors	3 x 16 mm^2	U2, V2, W2, PE
64WKS-M240/70	Motor conductors	4 x 25 mm^2	U2, V2, W2, PE
64WKS/all types	Tachometer, RLG	6 x 2 x 0.14mm^2	twisted pairs, shielded
64WKS/all types	Rated value	2 x 0.14 mm^2	twisted, shielded
64WKS/all types	Control signals, BTB	0.5 mm^2	
64WKS/all types	Brake	2 x 1.0 mm^2	
64WKS/all types	Thermal safety contact	2 x 0.5 mm^2	
64WKS/all types	+24 V/GND	1.0 mm^2	Optional

II.2.2 Fuse protection

Fuse protection of the 56WK-P AC power supply unit (cable protection) is performed by the user, either using fuses (secondary side) or motor safety switches with phase failure monitoring on the primary side.
You can use pointed pliers to replace the fuses without dismounting the controller.

Component designation	Module description	Position	Appliance rated curr.		Size
			50 A	70 A	
—	AC power supply	External	max. 3 x 63 AM		
S1, S2, S3	DC interm. circuit	Motherb.	20 AM	30 AM	6.3 x 32
S4	Auxiliary voltage	Motherb.	1 AM	1 AM	Microfuse
	Option 24 V	Motherb	2 AM	2 AM	Microfuse
—	Ventilator	External	1 AM	1 AM	5 x 20

II.2.3 Connector pin assignment for 64WKS

XST404, 20 pin F64WKSMB Combicon block (terminal no.)	XST404,2x12 pin R64WKSMB Combicon block (terminal no.)		Signal description	Direction	Abbreviation
1	1	(upper)	Rated value 1+ ,±10 V	**Input**	SW 1+
2	2	(upper)	Rated value 1- ,±10 V	**Input**	SW 1-
3	3	(upper)	Rated value 2+ ,±10 V	**Input**	SW 2+
4	4	(upper)	Rated value 2- ,±10 V	**Input**	SW 2-
7	7	(lower)	Curr. rated val. OFF ±8 V	**Output**	ISA
8	8	(lower)	Curr. rated val. ON ±8 V	**Input**	ISE
10	10	(lower)	Limit switch positive	**Input**	PSTOP
11	11	(lower)	Limit switch negative	**Input**	NSTOP
12	12	(lower)	Digital GND (DGND)	**Input**	DGND
13	13	(upper)	+ 15 V auxiliary voltage	**Output**	+15
14	14	(upper)	- 15 V auxiliary voltage	**Output**	-15
15	15	(upper)	Integral off / 1:1	**Input**	1:1
16	16	(upper)	Enable	**Input**	E
17	17	(upper)	Analogue GND (AGND) connected to 0 V	**Input**	AGND
18	18	(lower)	I^2t signal	**Output**	I2T
19	19	(lower)	IDC monitor ±10V / I_{PEAK}	**Output**	IDC
21	21	(lower)	BTB contact	**Input**	BTB
22	22	(lower)	BTB contact	**Output**	BTB
23	23	(upper)	Tacho monitor ±3,2V/1000min^{-1}	**Output**	TA
24	24	(lower)	+24V aux. voltage (option) referred to 0 V terminal	**Input**	+ 24
—-	25	(lower)	GND for +24V (option)	**Input**	0V
—-	26	(upper)	Shield		Schirm

All analogue inputs ±10 V refers to analogue GND (terminal 17). All digital inputs H-active 24 V/10 mA refers to digital GND (terminal 12), floating to analogue GND (if solder strap LB2 is open). For commissioning, all digital inputs may be fed by +15V auxiliary voltage (terminal 13). Solder strap LB2 (closed when delivered) provides the ground connection between AGND and DGND.

XST401, 9 pin Sub D (pin no.:)	Signal description with AC tachometer	Signal description with DC tachometer	Abbreviation
1	+ 15 V for RLG	+ 15 V for RLG and tacho	+ 15 V
2	Tacho centre	GND for tacho	Ta-Mp
3	Tacho phase W	Tacho - (0V)	Ta-W
4	Tacho phase V	- 15 V for tacho	Ta-V
5	Tacho phase U	Tacho +	Ta - U
6	GND for RLG	GND for RLG	GND
7	RLG phase W	RLG phase W (X)	RLG-W
8	RLG phase V	RLG phase V (Z)	RLG-V
9	RLG phase U	RLG phase U (Y)	RLG-U

When using a DC tachometer, the solder straps LB 20 and 21 must be soldered to the “DC” position. The tachometer signal is inverted by LB501.

II.3 Checklist

- — Check rating plates
- — Select applicable wiring diagram
- — Select conductors as described in Section II.2.1.
- — Define common ground point.
- — Ground transformer (core and shielding winding)
- — Ground motor housing.
- — Ground NC-GND of control system.
- — Ground intermediate circuit (terminal 0 V/GND) of the controller.
- — Loop ready to operate contact into the safety circuit.
- — Connect digital control inputs of the controller.
- — Connect rated value inputs.
- — Connect rated value conductor shield to NC-GND of the control system.
- — Connect the tachometer conductor shield to the GND/PE terminal.
- — Connect the tachometer and the rotor position sensor (RLG).
- — Connect the motor conductors.
- — Check the ventilation (see Section I.5).
- — Make sure that the ±15 V auxiliary voltages do not exit the control cabinet.
- — Connect the operating voltage (observe maximum permissible voltages)

III Commissioning

III.1 Safety instructions

- Check that the safety instructions in Section II.1 have been observed.
- Observe the instructions for commissioning in Section III.2. The correct sequence of steps for commissioning helps you prevent damage. Please contact us if you require any further information.
- First consult Section IV about the functions and options featured in the 64WKS controller if you have to make changes to the controller.
  You are permitted to perform controller adjustment and optimization as well as use circuit elements by means of solder straps.
  Any other tampering invalidates the warranty.
- Match the rms current and the peak current of the controller to the motor. The necessary steps are explained in Sections IV.2.3.6 and IV.2.3.7.

Never remove or plug in the controller when it is switched ON. Observe the operating LED.

This is the only way that you can prevent erosion of the plug-in contacts, the destruction of entire modules of the controller and any personal danger due to fully charged capacitors. Even 5 seconds after switching off the power supply, the capacitors can have dangerous levels of residual charge. Measure the voltage in the intermediate circuit until it has dropped below 40 V.

Only **plug** in the controller when the operating voltage is switched off.

Only **remove** the controller when the undervoltage limit is undershot. Observe the LEDs of the controller after switching off the operating voltage. After a short time, the green LED goes off and the red LED briefly comes on. You can now remove the controller.

- The front of the module is only protected against shock if the module is inserted in the 19" rack and secured with the screws provided.

III.2 Instructions for Commissioning

Commissioning is only summarized here. We can provide you with further information at our **training courses** (on request).

1. Check the wiring using the wiring diagram (transformer and rotor position sensor terminal, grounding, motor terminal, control signals).
2. Check the equipment rating plates (rated voltage, rated current, special adjustment, if necessary).
3. Check the emergency OFF circuit before switching on the controller for the first time.
4. Reduce the gain (turn AC GAIN potentiometer to the left-hand stop) and the peak current (I_{PEAK} potentiometer almost to the left-hand stop) as a precautionary measure.
5. Switch on the transformer after the controllers are removed; test the AC power pack (60 to 172 V AC); switch off the transformer.
6. Plug in the power supply unit. Check the DC intermediate circuit voltage (240 V DC to 0 V/GND). Switch off the transformer.
7. Wait until the intermediate circuit is virtually discharged. Measure the intermediate circuit voltage with a voltmeter. The voltage should drop below 40 V DC.
8. Plug in a controller. Inhibit the enable signal and check the emergency OFF function. Switch on if there is no risk of damage or injury to machinery or persons, even if the drive system is unintentionally moved.
9. Move the axle by switching the enable signal with an applied (small) rated value.
10. Adapt the axle (AC GAIN, I_{PEAK}, OFFSET, TACHO, I_{RMS} - if not already preset).
11. Switch off and plug in other controllers if not connected to the power pack.

Further steps for commissioning are described from item 7 onwards.

III.3 Interference suppression

If there is interference in the CNC or in the analogue or digital positiontransfer, there are the following additional measures:

— additional ferrites in the motor feeders
— shielding the motor cable
— RF filter at the nominal value output of the CNC (RC from 1 kΩ/10 nF)
— integration of armature circuit chokes (please use only models supplied by us)

Check in each case which measures are sufficient to eliminate the interference.

IV Functions and Options

IV.1 Safety instructions

- First read Chapter IV before you make any modifications to the controller.

- The controller can only be modified by **trained qualified personnel**.
  You are permitted to perform controller adjustment and optimization as well as use circuit elements by means of solder straps.
  Any other tampering will invalidate the warranty.

- The controller must be restarted after each modification. Follow the putting into operation and safety instructions. See Chapter III.

IV.2 Functional description

IV.2.1 Input functions

IV.2.1.1 Rated value inputs In1, In2

The controller is fitted with two non-reactive differential inputs for the rated values (or DC tachometer).

Input 1 is permanently set for differential input voltages of ±10 V.
Input 2 is fitted with an adjustable attenuator (P 602).

— Clockwise rotation increases the speed (efficiency is increased).
— Positive voltage at terminals 1 to 2 or terminals 3 to 4 produces clockwise shaft rotation (top view of shaft).

The common-mode voltage range (important for preventing ground loops) is additionally ±10 V for both inputs; the input resistance is 20 kΩ.

IV.2.1.2 Tachometer input Ta

P 604 is used to fine-tune the tachometer. The control range is ±30%. The fixed resistors R601 to 604 (tolerance 0.5%) determine tachometer normalization.

The standard equipment is designed for tachometer voltages of 10.8 V or 16.2 V at rated speeds of 2000 or 3000 rpm (SM Series motors) and approx. right- or left-hand stop of P604.

If motors are used with a **DC tachometer output**, remove solder straps LB20 and LB21 from the backplane and solder them in position DC. The sensitivity of the tachometer input can be adjusted between 4 V and 8 V for rated speed at the tachometer potentiometer. R533 (= 10 kΩ) on the rotor position sensor board determines the basic setting. By resoldering LB501, the input can be inverted.

IV.2.1.3 Digital control inputs

All inputs are coupled **floating** via optocouplers. The ground reference is **digital GND** (DGND, terminal 12). The logic system is designed for +24 V/10 mA (PLC-compatible). The H level is +15 to 30 V.

If required, the controller can be driven at +15 V (terminal 13). Digital GND (terminal 12) and analogue GND (terminal 17) must then be connected.
In the as-delivered state, the LB2 solder strap connects AGND and DGND on the controller board.

Input enable E (terminal 16)

The controller output stage is enabled by the enable signal (24 V input, H-active, 15 V to 30 V/10 mA logic level to digital GND, terminal 12, floating).
The connected motor is torque-free when disabled. The integral components of the speed and current controller are also disabled.

The following control inputs are also available when using the option board -01- (refer to Section IV.3.1):

- **1:1/integral off** (1:1, terminal 15), **H-level** for switching over the speed controller to **current control**.

  This signal acts on both rated value inputs.

- **Limit switch** positive/negative (**PSTOP/NSTOP**, terminals 10/11)**, H-level in the normal operating mode** (open-circuit-proof). If an input signal is lost (limit switch OFF), its direction of rotation is disabled.

  These two signals act on rated value input only.

The digital input circuits 1:1/integral off and PSTOP/NSTOP are mounted on the option board -01- and **can only be used if there is an option board**.

You can also use the controller as a 1:1 current control **without** the option board -01-. The customer board must then be modified:
— replace R607 (100kΩ) by 3kΩ
— short C604
— disable the tachometer by removing R610
— potentiometer AC-GAIN P605 at ccw-stop

IV.2.2 Output functions

IV.2.2.1 Armature rated current monitor output IDC

The output supplies ±10 V for ± **peak current** referred to AGND (output resistance 1 kΩ). The DC average value of all three phases, which is approximately **proportional to the supplied motor torque**, is emitted.

Measuring accuracy is ± 5% of measured value ±1 A.

This signal can also be used as a **current rated** value signal for a second 1:1 wired (slave) controller of a tandem drive.

IV.2.2.2 Tachometer monitor output VTA

The output supplies ±3.2 V/1000 rpm referred to AGND (output resistance 1kΩ) at standard normalization for tachometer motors (tachometer voltage 5.4 V/1000 rpm). Normalization is **not** affected by the tachometer potentiometer P 604.

IV.2.2.3 Ready-to-operate (BTB) contact

Ready-to-operate (BTB, terminals 21, 22, **100 VDC/0.1 A**) is signalled via a **floating** relay contact.

The contact is **closed** when the controller is ready to operate. The signal is **not** affected by the enable signal and by the I^2t limiter.

IV.2.2.4 Test points

- **Armature rated current monitor (IDC)**, ±10 V normalization for ± appliance **peak current**, 1 kΩ output impedance, analogue GND is reference point. In case of connecting several controllers in parallel, the output supplies ±10V for the **summed** ±peak current of all amplifiers.
- **Tachometer monitor (VTA)**, voltage corresponding to the tachometer voltage, analogue GND is reference point.
  The test point emits the same signal as described in section IV.2.2.2.
  The output impedance is 1kΩ to AGND.
  If motors with a DC tachometer (tachometer voltage 2.5 V/1000 rpm) are connected at standard normalization on the rotor position sensor board when R533 = 10 kΩ, the output provides 2.5 V/1000 rpm.

IV.2.3 Possible adjustments

IV.2.3.1 Ramp potentiometer P601

When the option board -01- is plugged in, you can set the required rise time on the potentiometer P601 for a rated value step (**only active at rated value 2**).
With standard equipment (C606 = 10 nF), the left-hand stop of the potentiometer corresponds to a rise time of 100 ms.
Clockwise rotation reduces the time to 10 ms at the right-hand stop. If necessary, you can reduce C606 down to 1 nF.
(adjustment range 1:10)

IV.2.3.2 Rated value potentiometer P602

You can attenuate the rated value input IN2 using potentiometer 602. Clockwise rotation increases the speed.
(adjustment range 0 to 100%)

IV.2.3.3 Offset potentiometer P603

The offset potentiometer P603 is used to compensate fault voltages in the operational amplifier or the rated value voltage source (control) which are present at a rated value of 0 V.

Adjust to motor standstill when the amplifier is active (enabled) and the rated value voltage is 0 V.
(adjustment range ±10 mV)

IV.2.3.4 Tachometer potentiometer P604

The potentiometer P604 is used to fine-tune the tachometer. The control range is ±30%.

The standard equipment is designed for tachometer voltages of 10.8 V or 16.2 V at rated speeds of 2000 or 3000 rpm and right- or left-hand stops of the potentiometer.

When using motors with a **DC tachometer** output, remove solder straps LB20 and LB22 from their backplane and solder them in position DC. The sensitivity of the tachometer input can be adjusted to between 4 V and 8 V for rated speed at the tachometer potentiometer. R533 =10 kΩ governs the basic setting. The input can be inverted by resoldering LB501.

IV.2.3.5 AC GAIN potentiometer P605

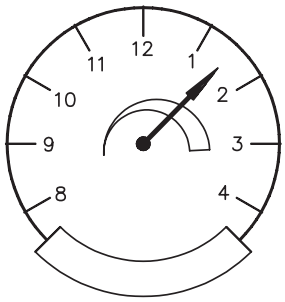
You can **increase** the proportional gain of the PI speed controller by rotating the potentiometer P605 clockwise (control becomes stiffer). When the potentiometer reaches the left-hand stop, R607 (100 kΩ) sets the basic gain to approx. 10.
The integral component is set by C604 to 100 kΩ x 0.33 μF = 33 ms. The control circuit becomes slower (softer) by increasing C604.
Reducing C604 improves the response sensitivity of the controller but increases the tendency to resonate. The standard equipment only needs to be modified in exceptional cases.
Set P605 when the amplifier is ON and the motor is stationary (rated value voltage = 0V) by rotating clockwise until oscillation starts (very easily observed using the oscilloscope on the current monitor) and then by turning back until just before the oscillation limit.

R605 restricts the gain of the I - components to approx. 2000 at very low frequencies.

IV.2.3.6 Peak current I_{PEAK} P606

You can reduce the peak current I_{PEAK} by turning P606 **anti-clockwise**. The control range (linear) is 0 to 100%. Alternatively, the final value can be reduced by a fixed resistor. The following table gives details of the **basic setting** of I_{PEAK} and I_{RMS} for putting into operation. **Precision adjustment** - especially for small currents - is possible using the method described in **section IV.2.3.7**.

Front view of potentiometers at built in amplifier



Potentiometers
P606 and P607
I_{peak} and I_{rms}

As delivery state
cw (half past 4)

64WKS–M240/50(70)

P606			P607		
	IPEAK/A			IRMS/A	
Position	Typ50A	Typ70A	Position	Typ50A	Typ70A
cw	100	140	cw	50	70
4	96	137	4	47	65
3	84	120	3	43	59
2	72	104	2	39	53
1	60	87	1	34	47
12	48	70	12	30	42
11	36	53	11	26	36
10	24	36	10	21	31
9	12	20	9	17	25
8	(4)	(7)	8	(8)	(10)
ccw	0	0	ccw	0	0

IV.2.3.7 RMS current I_{RMS}, I^2t limit P607

The controller is capable of supplying the peak current I_{PEAK} (100 A or 140 A depending on the type of equipment) for a maximum period of 5 s. This is then limited to the set rated current I_{RMS}.

I_{RMS} is reduced by turning P607 **anti-clockwise**. The control range (quadratic) is 0 to 100%. Its centre position corresponds to approx. 70% of the rated current.

The time t, during which the pulse current can be tapped, changes according to the selected settings of I_{RMS} and I_{PEAK}:

$$t = \frac{(I_{RMS})^2 \times 20\ s}{I_{PEAK}^2}$$

Alternatively, I_{RMS} can also be adjusted by a fixed resistor.

Two motor phases can be exchanged to set the current easily. The motor is then set to a preference position after switching the enable signal, even without a rated value. The amplifier current initially increases to the set **peak current** and then drops to the I_{RMS} values after reaching the I^2t limit. Use an oscilloscope to measure test point to AGND at the IDC (current monitor).
Start adjustment with a low I_{RMS} current (P607 near the left-hand stop). Set the required current by rotating P607 clockwise step by step.

IV.2.4 Other functions

IV.2.4.1 Frequency response of the controller

If required in **exceptional cases**, the frequency response of the current controller can be altered. The basic setting is designed for a bandwidth of 1 kHz which means that the delay time is negligibly short.

IV.2.4.2 I^2t monitoring

When the set rms current limit value (I_{RMS}, I^2t limit, see Section IV.2.3.7) is reached, the pulse current is limited until the rms value load drops.
The ready-to-operate signal is **not** affected.
A yellow LED indicates that the I^2t limiter has responded. This is actively signalled at the I^2t signal output (terminal 18) by a floating optocoupler output. A minimum pull-up impedance of 2.2 kΩ to +15 to 30 (24) V can be provided externally, if necessary.

IV.2.4.3 Displays

Green/red LEDs for intermediate circuit voltage]and sum error

The **green** LED lights up when the intermediate circuit voltage is applied and the auxiliary voltage power pack (±15 V) operates correctly.
The controller is ready-to-operate when the green LED lights up **and** the red LED does not light up.
The ready-to-operate contact (**100 VDC / 0.1 A** floating NO contact, terminals 21, 22) is closed when the controller is ready to operate.
The **red** LED lights up under the following conditions:

- overcurrent (short-circuit), ground fault
- overvoltage
- undervoltage of the auxiliary power pack
- overtemperature of the heat sink (output stage)
- response of rotor position sensor monitor

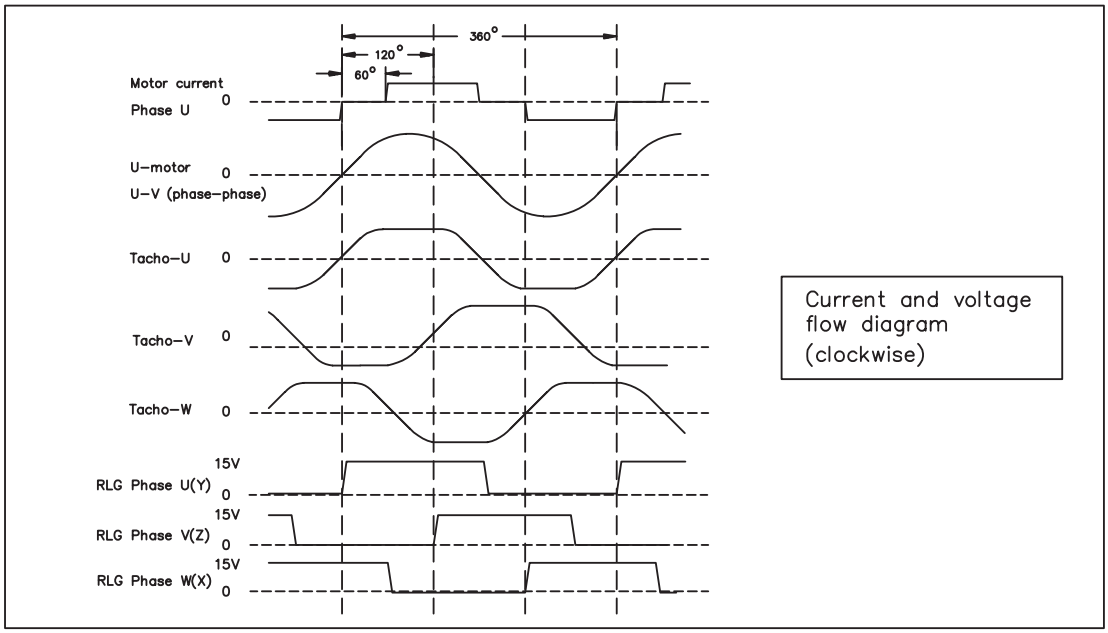
The ready-to-operate contact **opens** at the same time.
The fault memory is only reset by **switching off the supply voltage**.

Yellow LED for I^2t monitoring

The upper **yellow** LED I_{RMS} D13 with a simultaneous signal (terminal 18) lights up when the set rms current limit value is reached. The ready-to-operate contact is **not** affected.

Green LEDs for rotor position sensors

Three **green** LEDs D2, D3 and D4 indicate the rotor position sensor signals. If the controller is properly connected, the LEDs light up alternately for a period of 180° el. with a phase displacement of 120° el. This means that one or two LEDs always light up, but under no circumstances none or all three. A monitoring circuit checks that the input signals meet the above requirements. In the event of a fault, the ready-to-operate contact is opened immediately and the red LED comes on.



Current and voltage flow diagram (clockwise)

IV.3 Options

IV.3.1 Option board -01-

In order to activate the option board -01-, you **must open** the solder strap LB1 on the controller motherboard before plugging in the option board (accessible from above if the customer board is removed).
You must also wire the limit switch inputs, even if you only use the ramp generator.

IV.3.1.1 Ramp generator RAMP

When the option board -01- is plugged in, you can set the required rise time at the potentiometer P601 for a rated value step.

Effective only at rated value input 2

At the **left-hand stop** of the potentiometer, C606 can be used to select the maximum rise time of approx. 10 ms per nF for a rated value step of 10 V.
If set correctly (i.e. the rise time is **shorter** than the mechanical time constant of the control circuit), this option can considerably improve the stability of the control circuit without noticeably reducing the control speed.

The basic equipment for C606 is 10 nF, corresponding to 100 ms when P601 is set to the left-hand stop.

IV.3.1.2 1:1 control

You can switch over the speed controller to **current control** by applying the 1:1 signal (input 24 V, H-active, terminal 15). The **P** gain is then set to **1**, the **I** component of the controller is **shorted** and the **tachometer signal** is also **switched off** internally.

The 1:1 signal acts on both rated value inputs

See page 16 if you want to use 1:1 control without the option board -01-.

IV.3.1.3 Limit switch PSTOP, NSTOP

The loss of a signal (24 V inputs, H-active) **blocks** its direction of rotation and brakes at the same time. The I component of the controller is then shorted in order to limit the motor current when it is run to a fixed stop.
PSTOP (terminal 10) blocks its anti-clockwise rotation and NSTOP (terminal 11) its clockwise rotation.
If **both** signals are lost, the drive system from any direction and speed brakes until it stops (e.g. can be used as an emergency OFF function).

The limit switch inputs only act on rated value input 2

IV.3.2 External 24 V auxiliary voltage

In the as-delivered state, the auxiliary voltage power pack is powered from the DC intermediate circuit (80 to 240 V).
If you wish to ensure that the error signals are stored even after switching off the intermediate circuit voltage, you can power the auxiliary power pack from an external 24 V DC source (18 to 48 V DC).

If the 24 V option is used, the intermediate circuit can be powered by any low voltage (e.g. 48 V battery). This offers advantages, e.g. in the set-up mode.

Caution:
If you wish to power the controller subsequently using an external 24 V DC voltage, you must carry out several modifications.
(See section IV.4.1) Please contact us !

IV.4 Solder straps

IV.4.1 External 24 V DC auxiliary voltage

If you wish to power the controller **subsequently** using an external 24 V DC voltage, you must carry out several modifications. Please contact us.
Power is supplied via terminal 24 to **OV/GND** and **not** to terminals 12/17.
If you order the controller with the 24 V option, the modifications have already been performed by the manufacturer.

IV.4.2 Digital GND, analogue GND

In the as-delivered state, LB2 is closed, i.e. DGND and AGND are bridged (terminals 12 and 17).

The **digital** control signals (enable, PSTOP, NSTOP, 1:1) refer to **terminal 12** (DGND). If the strap LB2 remains closed, the **common GND/ground point** is also used by the controller and control system as a GND reference point for the control signals. The additional connection between terminal 12 and the control system should then be disconnected to prevent ground loops.

If potential isolation is used, open LB2 and connect terminal 12 to GND of the control system/NC.

Terminal 17 (AGND) is only used as a reference point for (non-grounded) **rated value voltages** and **monitor** signals.

IV.4.3 Option board -01-

The option board -01- (ramp generator, limit switch, 1:1) is only active if the solder strap LB1 is **open**.

In the as-delivered state, LB1 is closed unless option -01- has been ordered. The solder strap is accessible from the top after removing the option board.

Erroneously connecting the option board -01- in case of closed LB1 or absent option board -01- with open LB1 may effect incorrect reactions of the drive.

IV.4.4 DC - tachometer

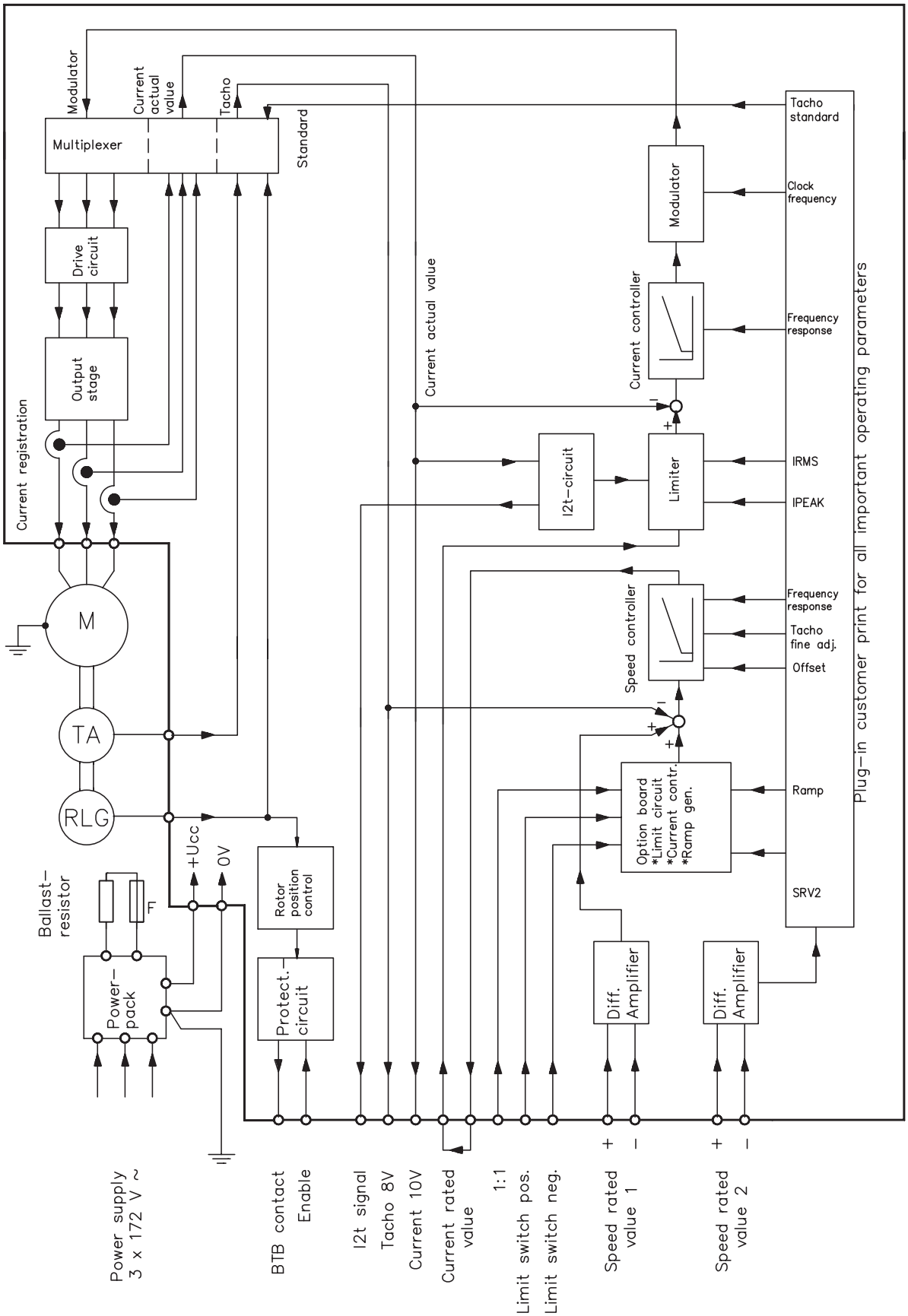
For the power supply of a motor with a DC tachometer output using connector XST401 (9-pin sub-D), the following solder straps must be modified:

— **open LB20 and LB21 and solder in position “DC” (F/R64WKSMB)**

The tachometer input can be inverted by resoldering **LB501**.

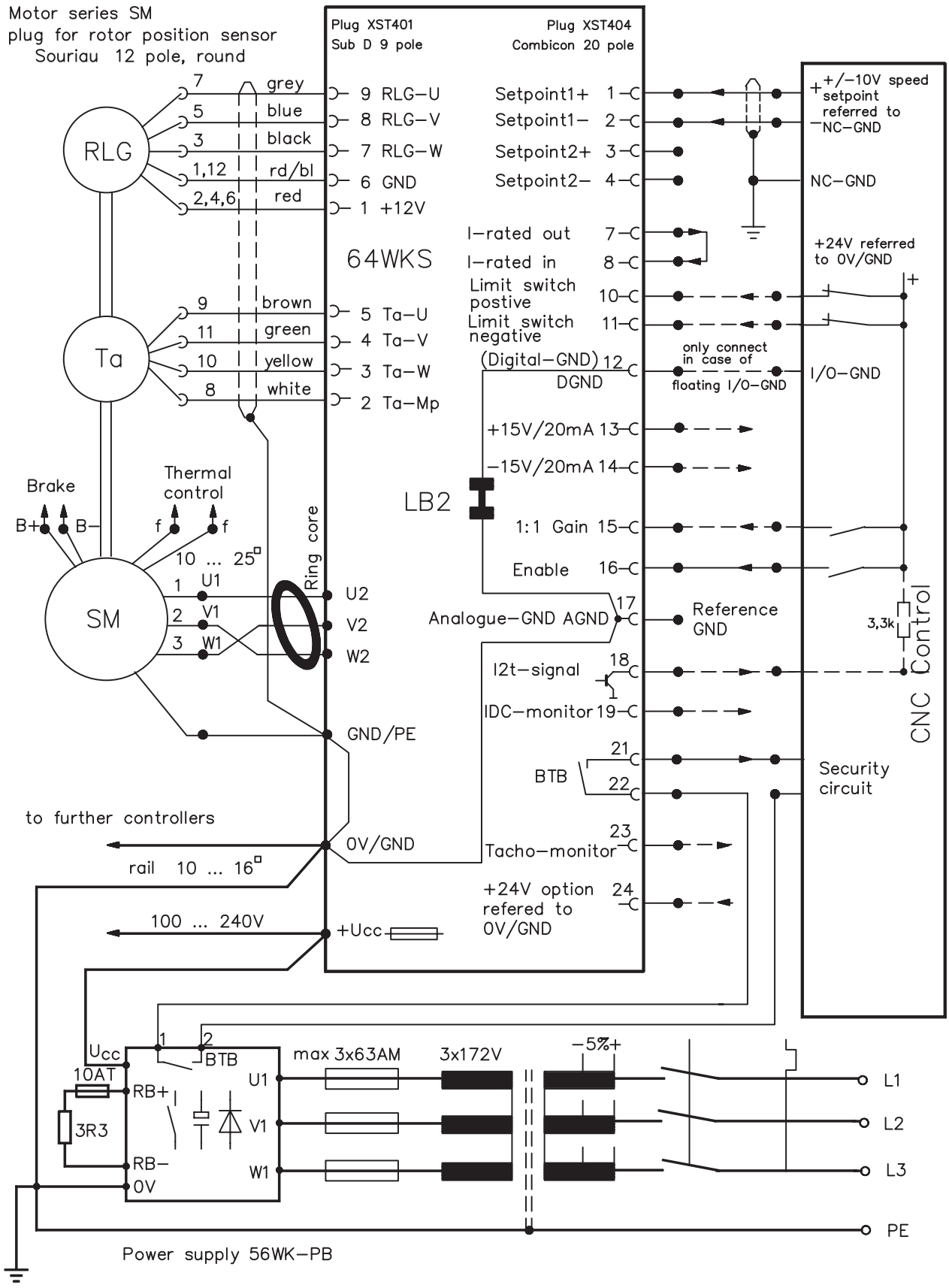
V Drawings

V.1 Block diagram 64WKS



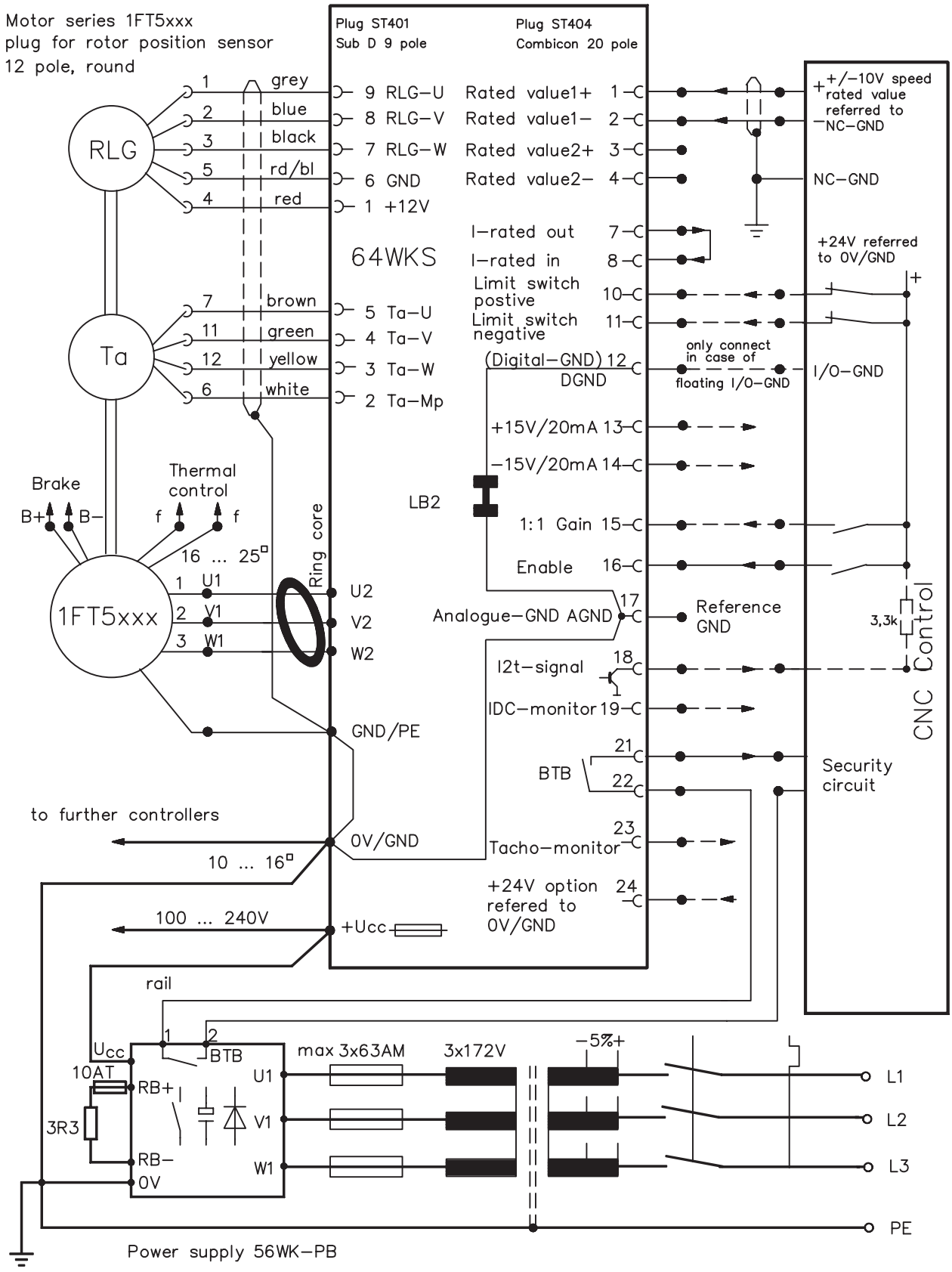
V.2 Wiring diagram 64WKS for SM motors

Caution ! Never remove or plug–in the controller when it is alive !

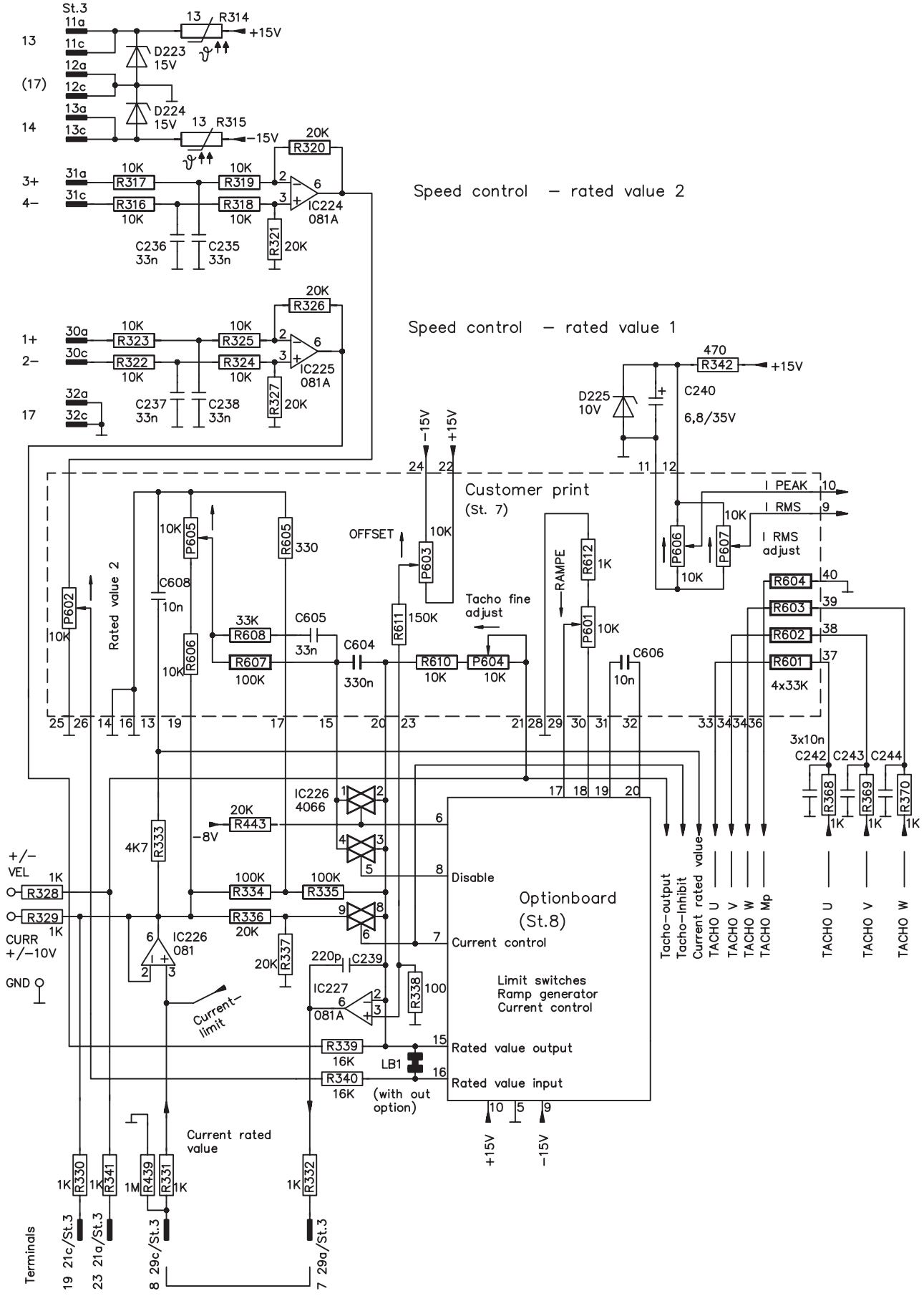


V.3 Wiring diagram 64WKS for 1FT5xxx motors

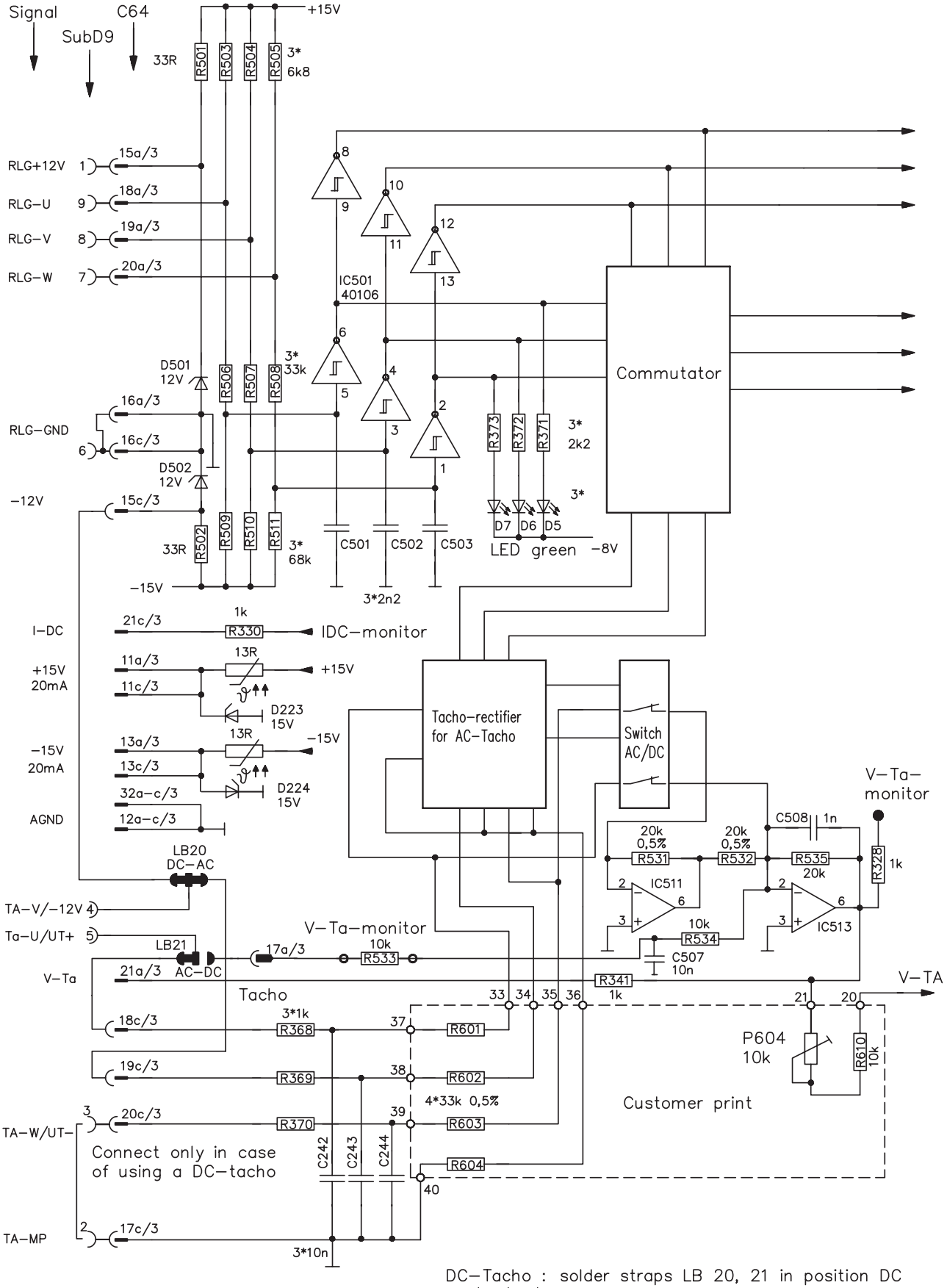
Caution ! Never remove or plug–in the controller when it is alive !



V.4 Speed control circuit 64WKS

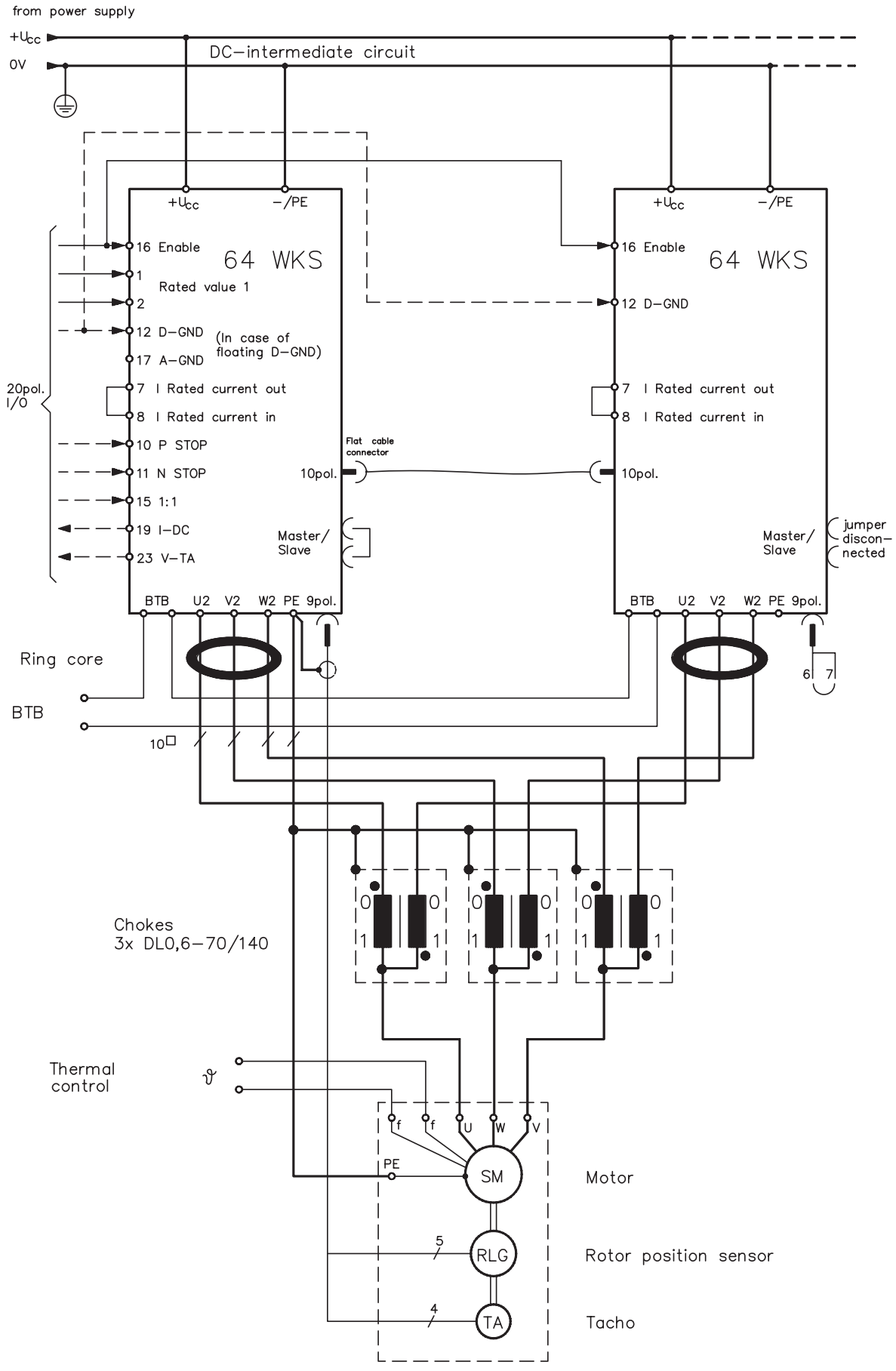


V.5 RLG/TA input circuits 64WKS

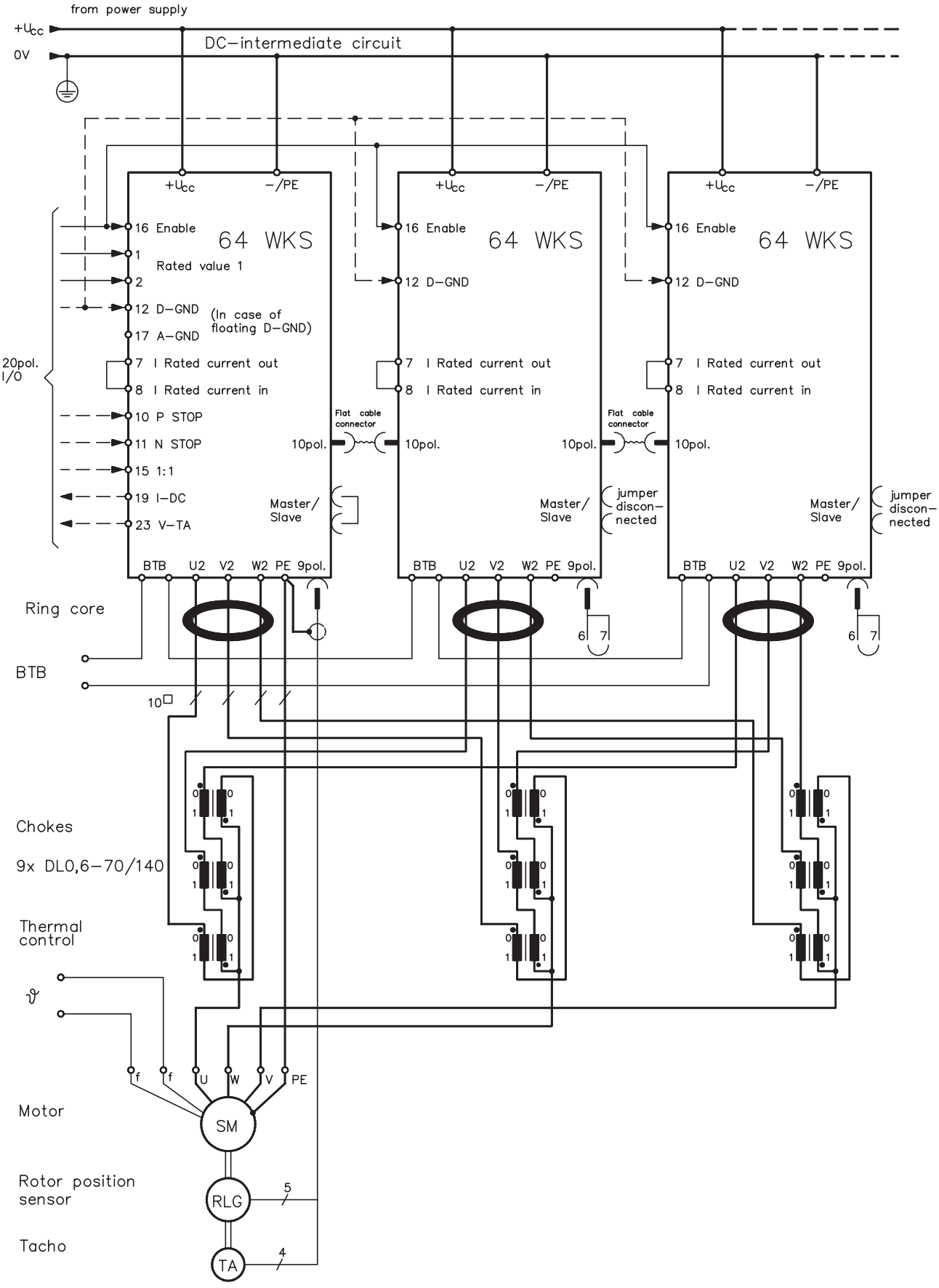


DC–Tacho : solder straps LB 20, 21 in position DC on back plane.
Close LB 501 if neccessary

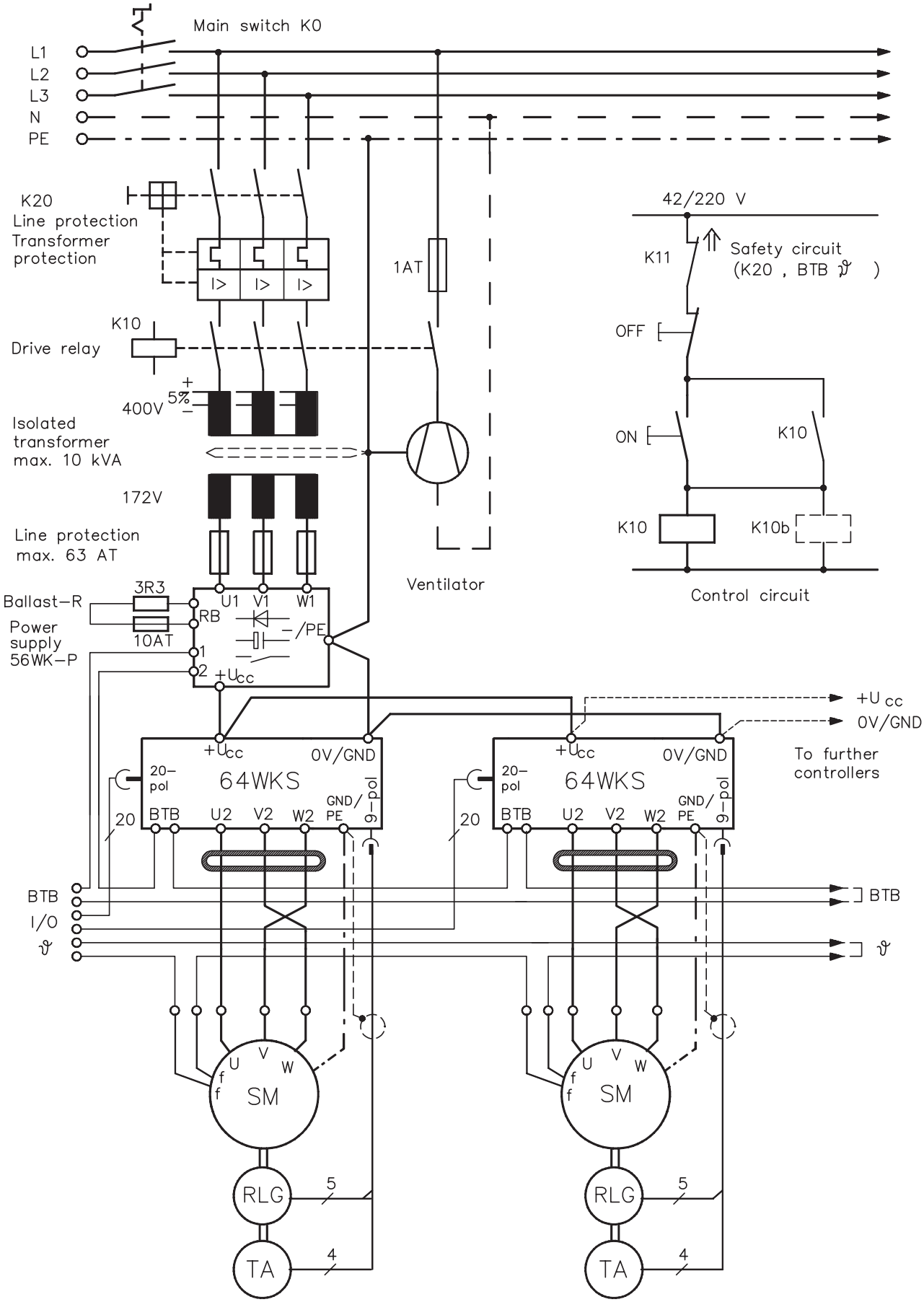
V.6 Suggestion for connecting diagram 2 x 64WKS in parallel



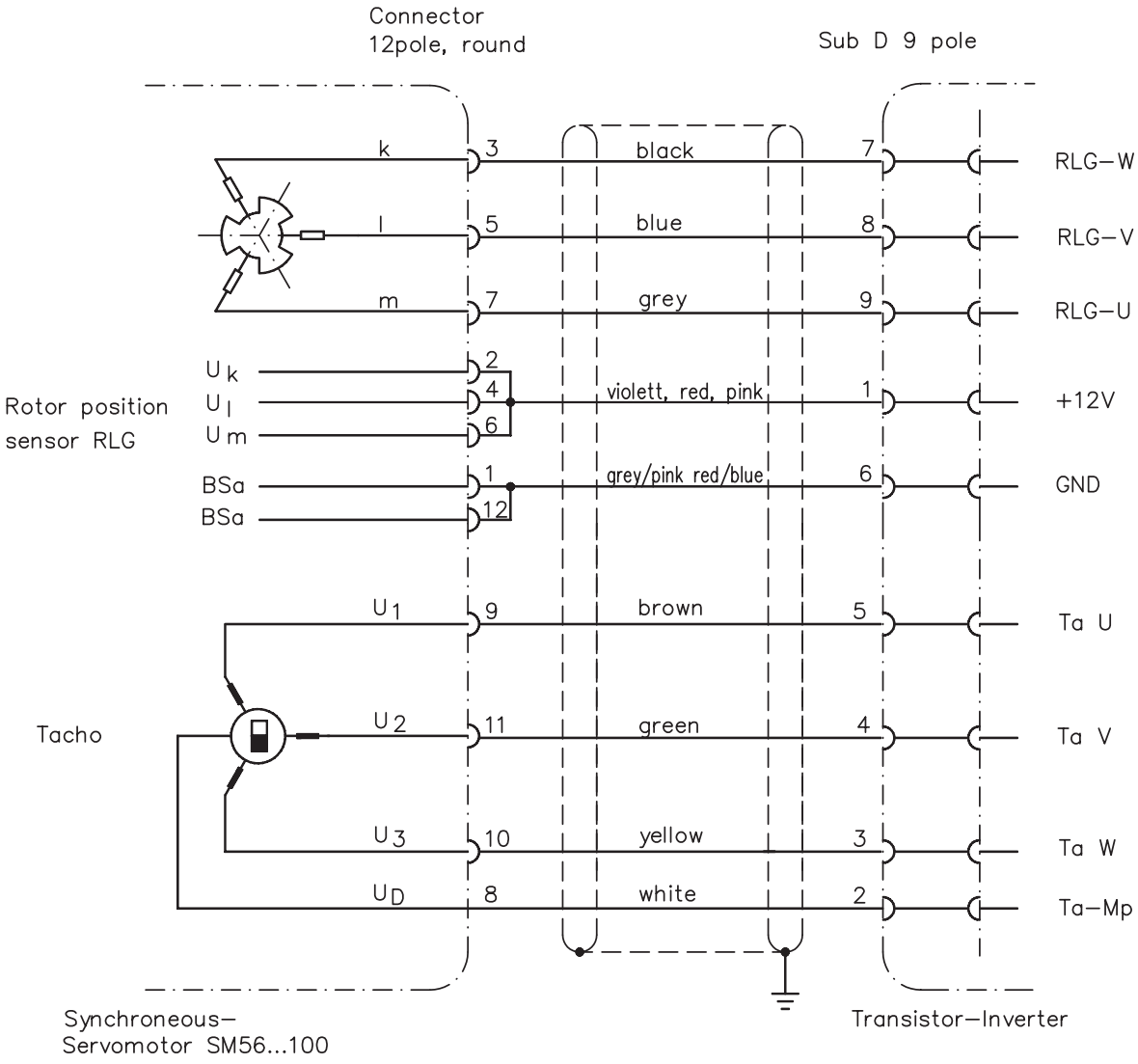
V.7 Suggestion for connecting diagram 3 x 64WKS in parallel

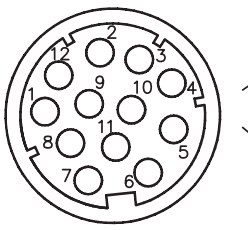


V.8 Proposed wiring diagram 64WKS with 56WK-P



V.9 Connecting RLG and tachometer for SM motors





1	red, blue
2	violett
3	black
4	red
5	blue
6	pink
7	grey
8	white
9	brown
10	yellow
11	green
12	grey / pink

Connector: Souriau, round

	Mat.No.:
angle 90°:	62828
12 Crimpcontacts:	63367

Type: Paarflex CY
6 x 2 x 0,14
12–pole, shielded,
twisted pairs

Shield not connected

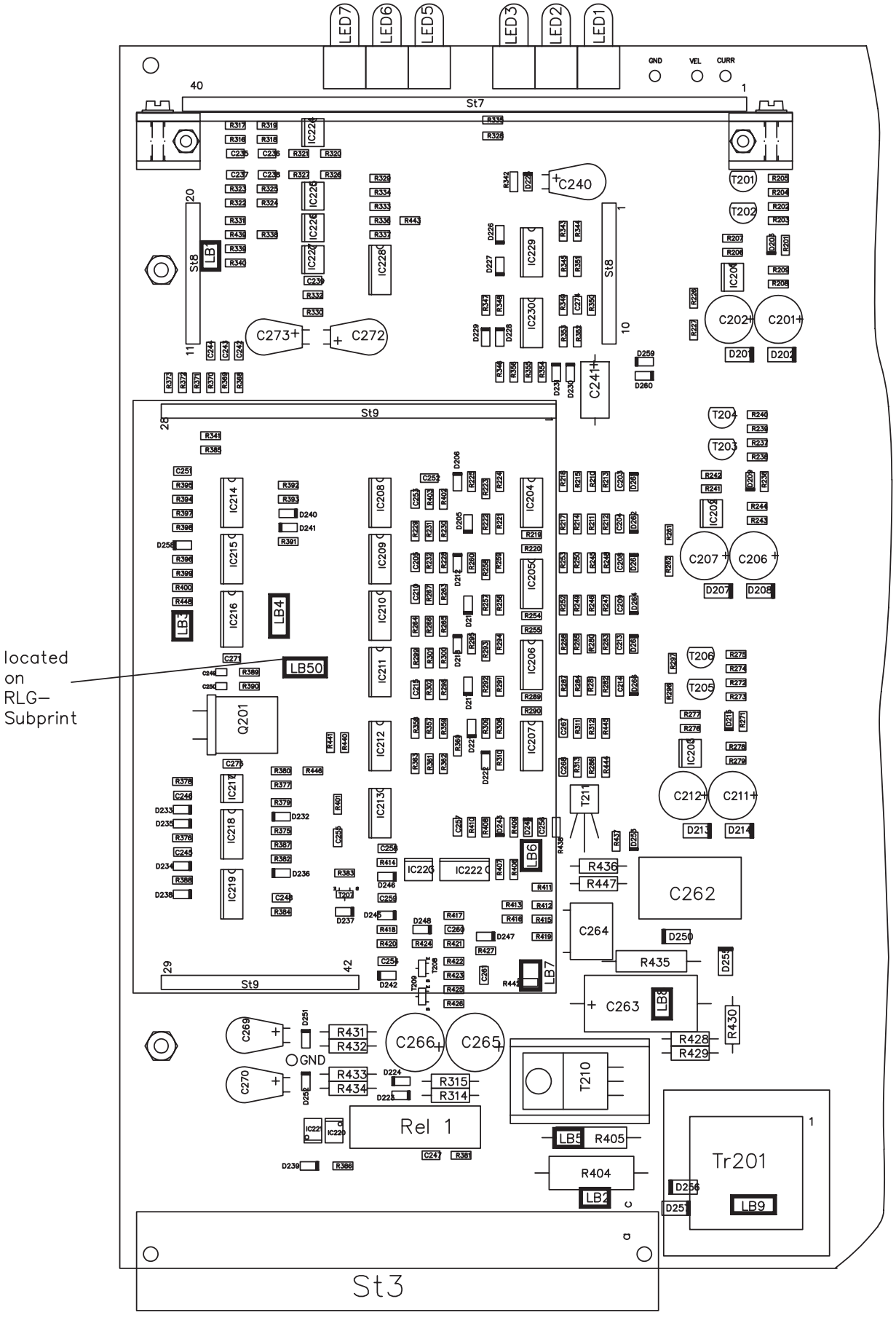
Shield enlarged and connected to PE – terminal

Rubber hose isolated

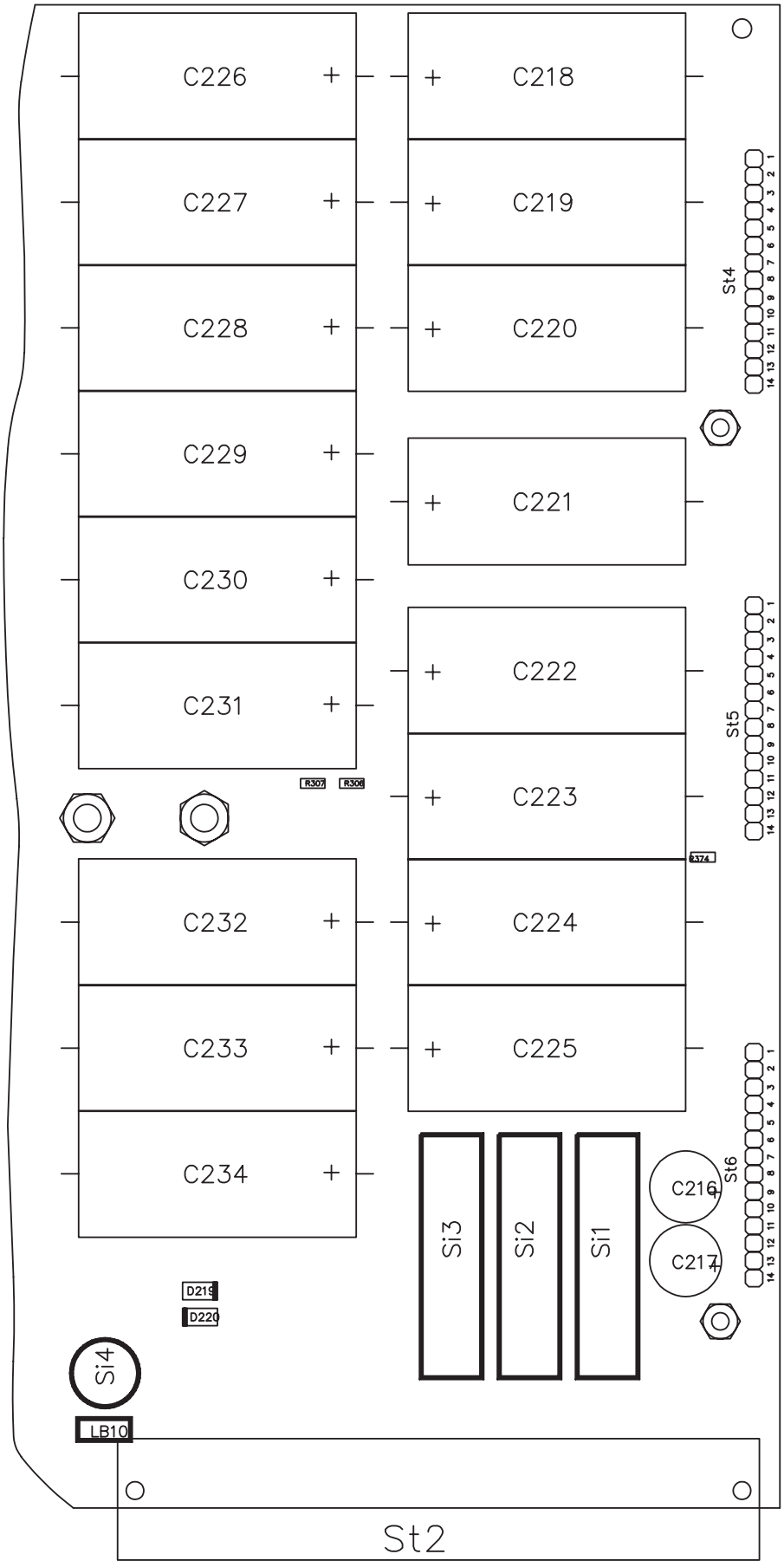
Sub D–Connector, 9pole, male
XST401

1	red	+12V
6	red / blue	GND
2	white	TA–Mp
7	black	RLG W
3	yellow	TA–W
8	blue	RLG V
4	green	TA–V
9	grey	RLG U
5	brown	TA–U

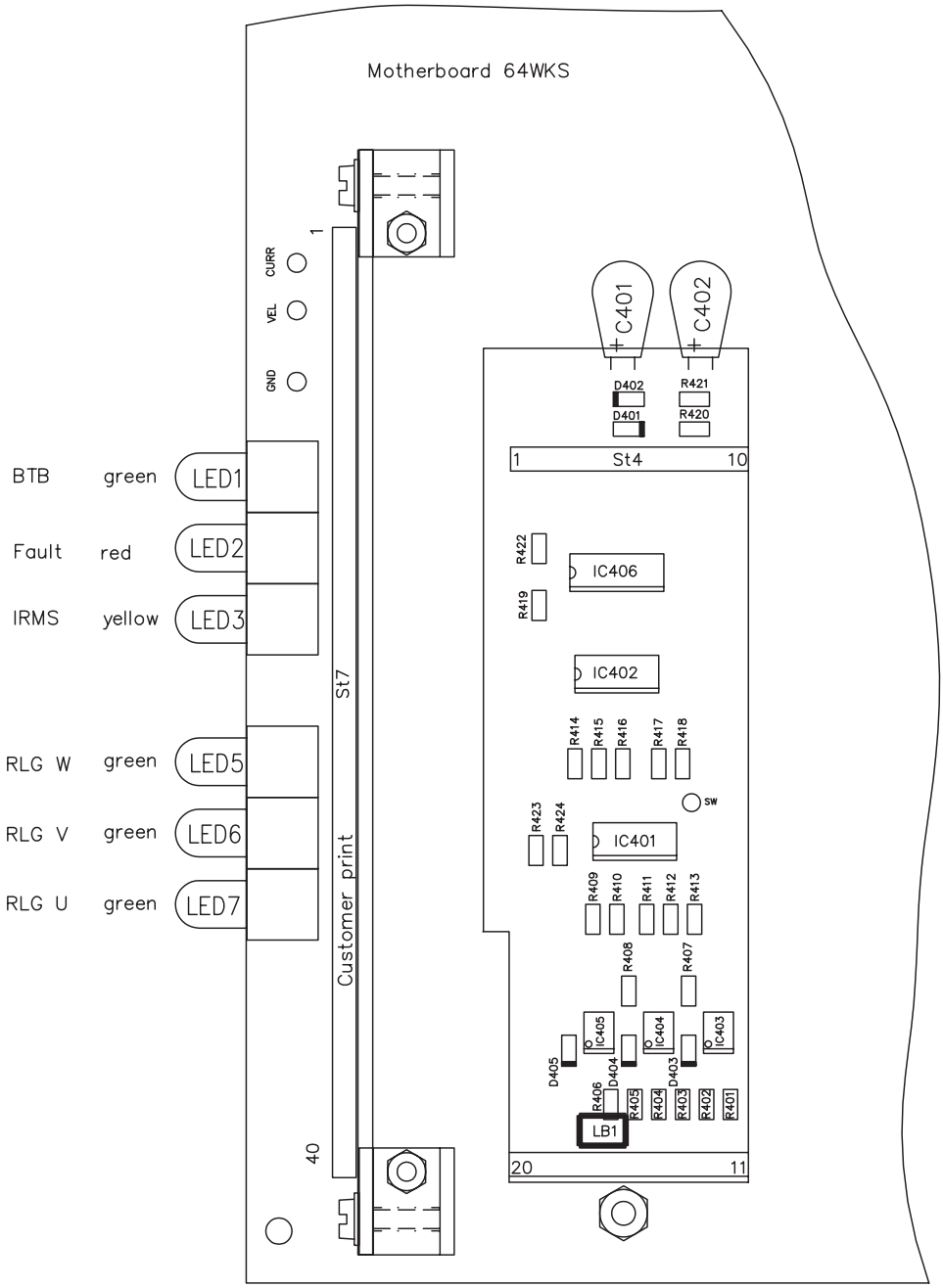
V.10 Component layout diagram 64WKS, Part 1



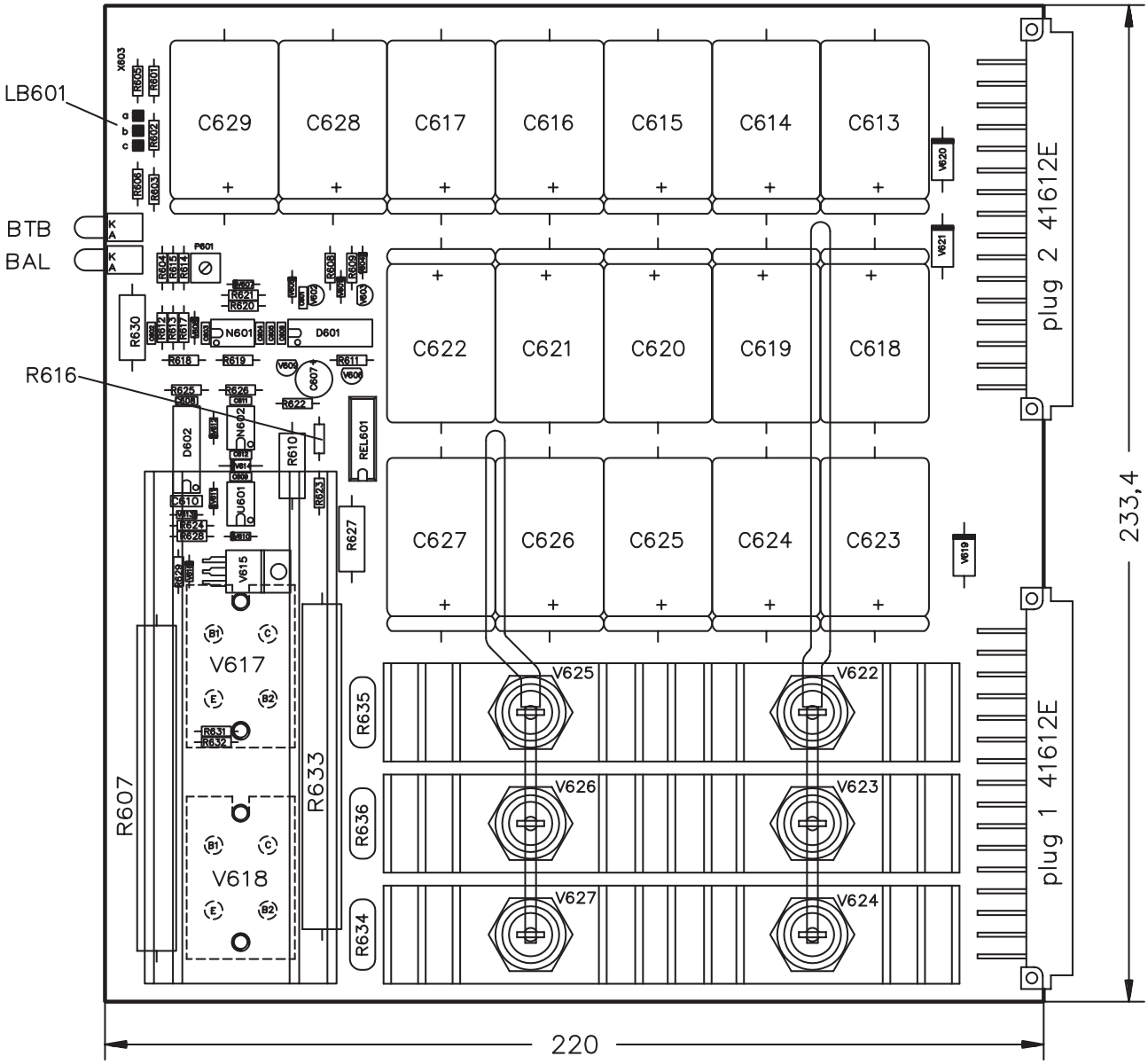
V.11 Component layout diagram 64WKS, Part 2



V.12 Component layout diagram option -01-



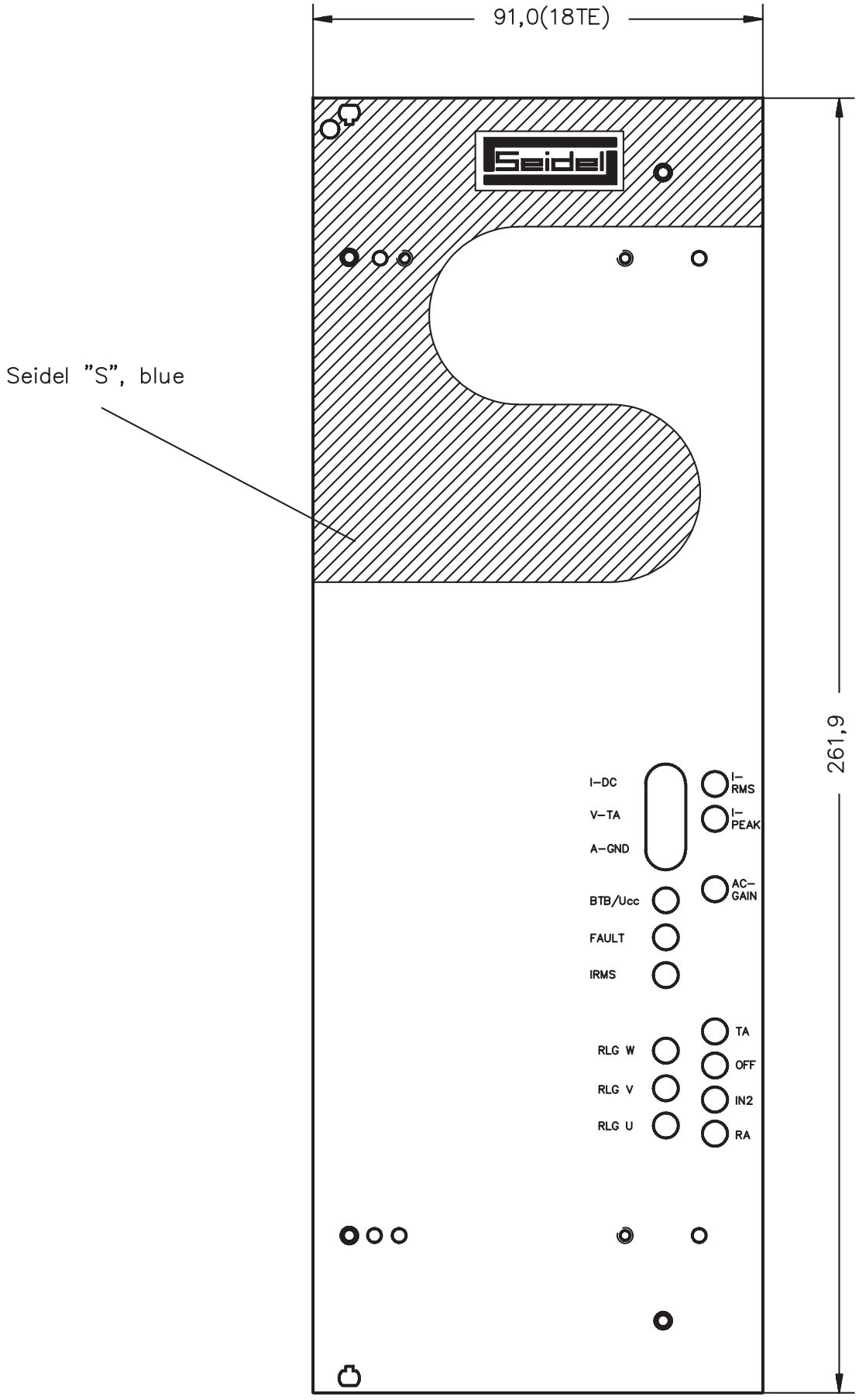
V.13 Component layout diagram 56WK-P



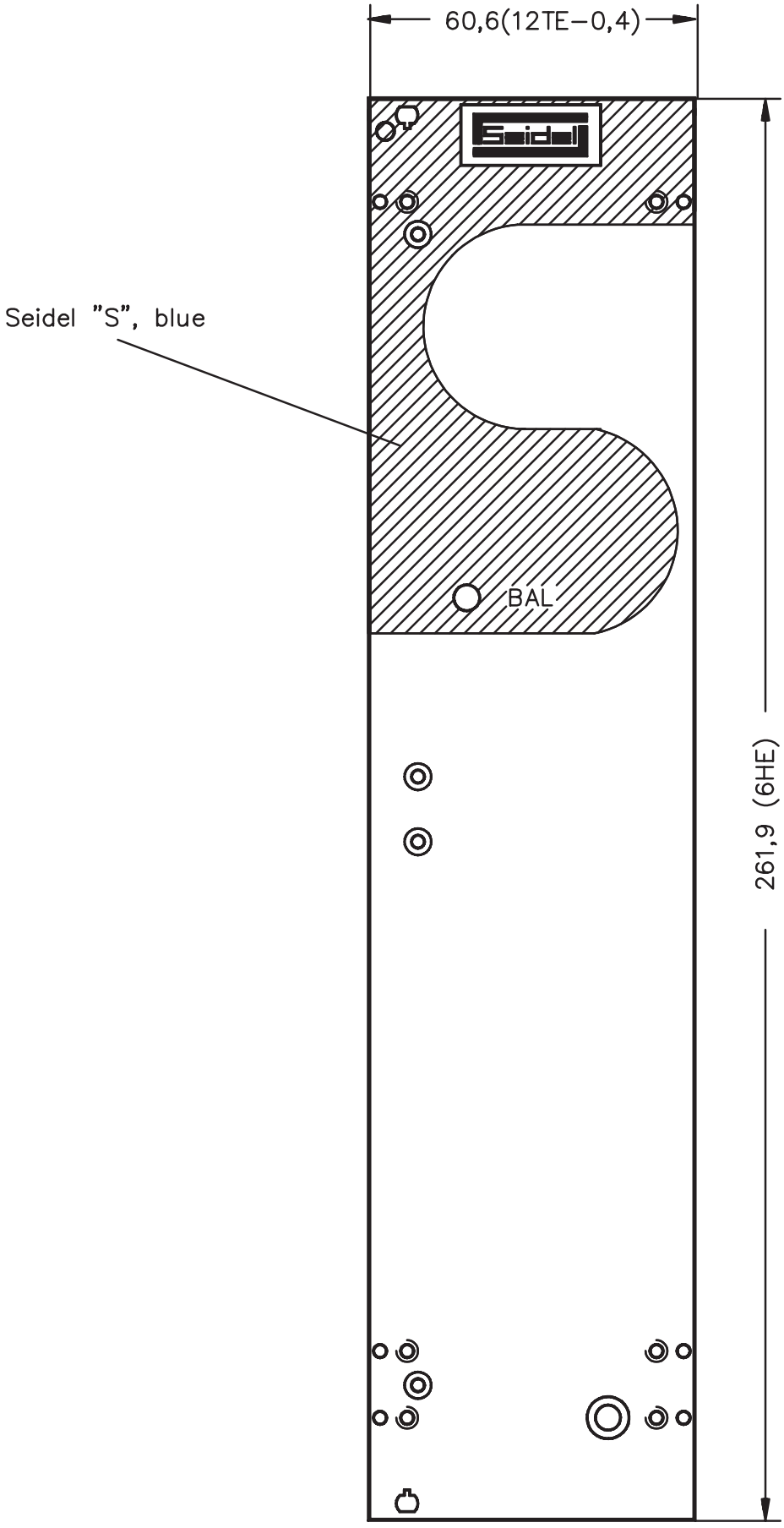
LB601	Ucc	R_{Bmin}
a–b	240 V	3,3 Ω
b–c	150 V	2,2 Ω

P_{BAL}	BAR 375	R616
400 W	1 x R_{Bmin}	470 kΩ
1500 W	4 x R_{Bmin}	2,2 MΩ

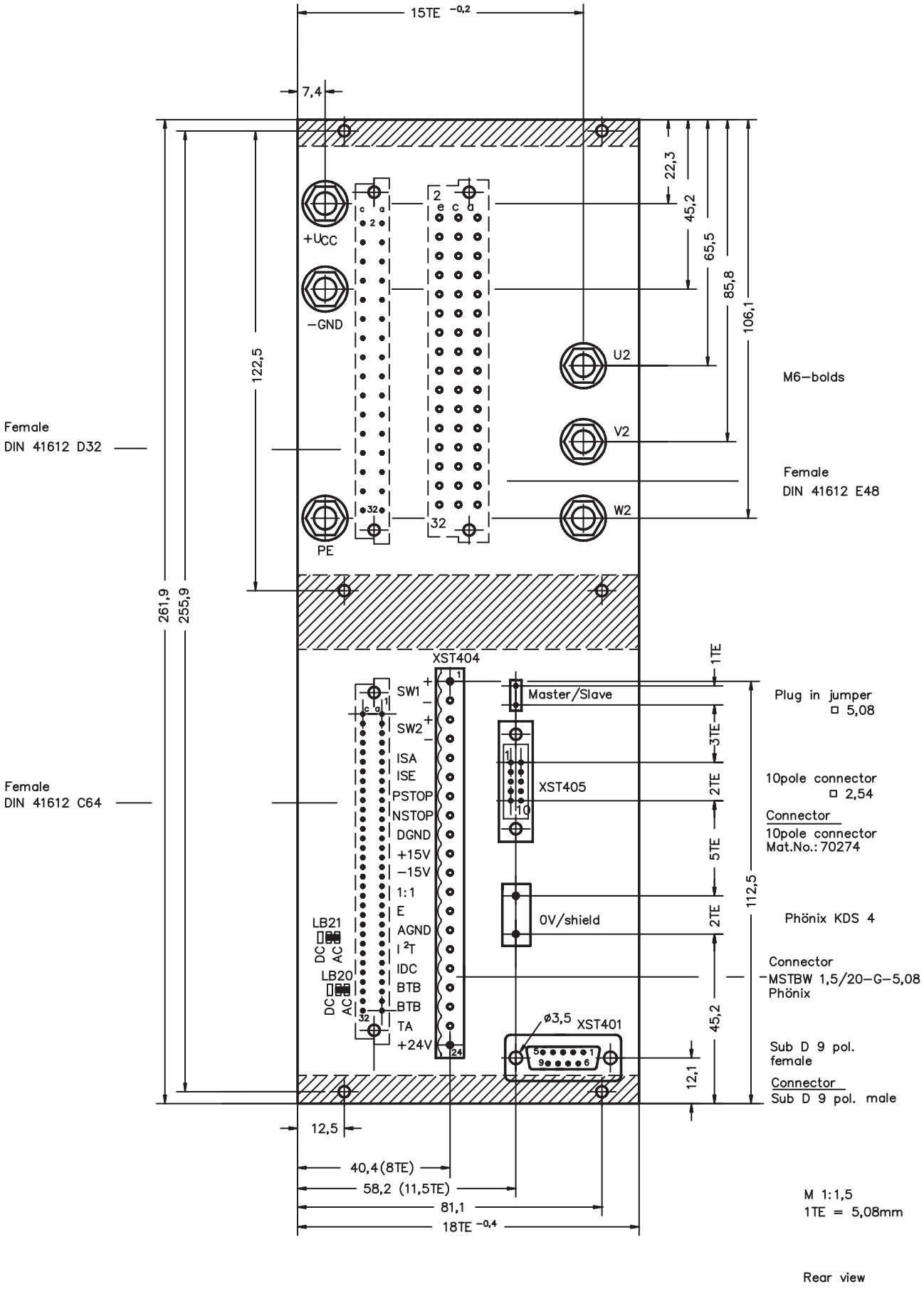
V.14 Front panel 64WKS



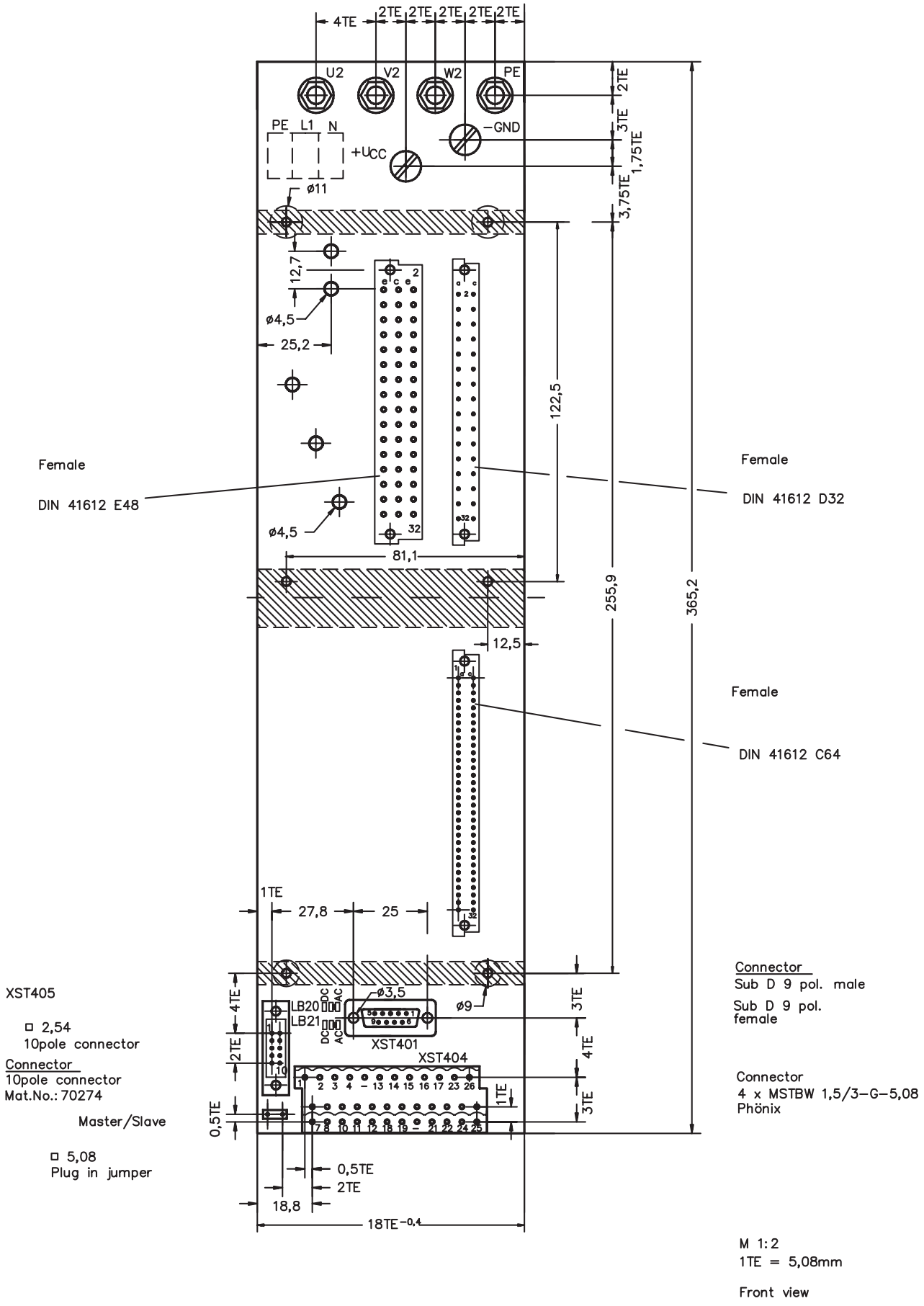
V.15 Front panel 56WK-P



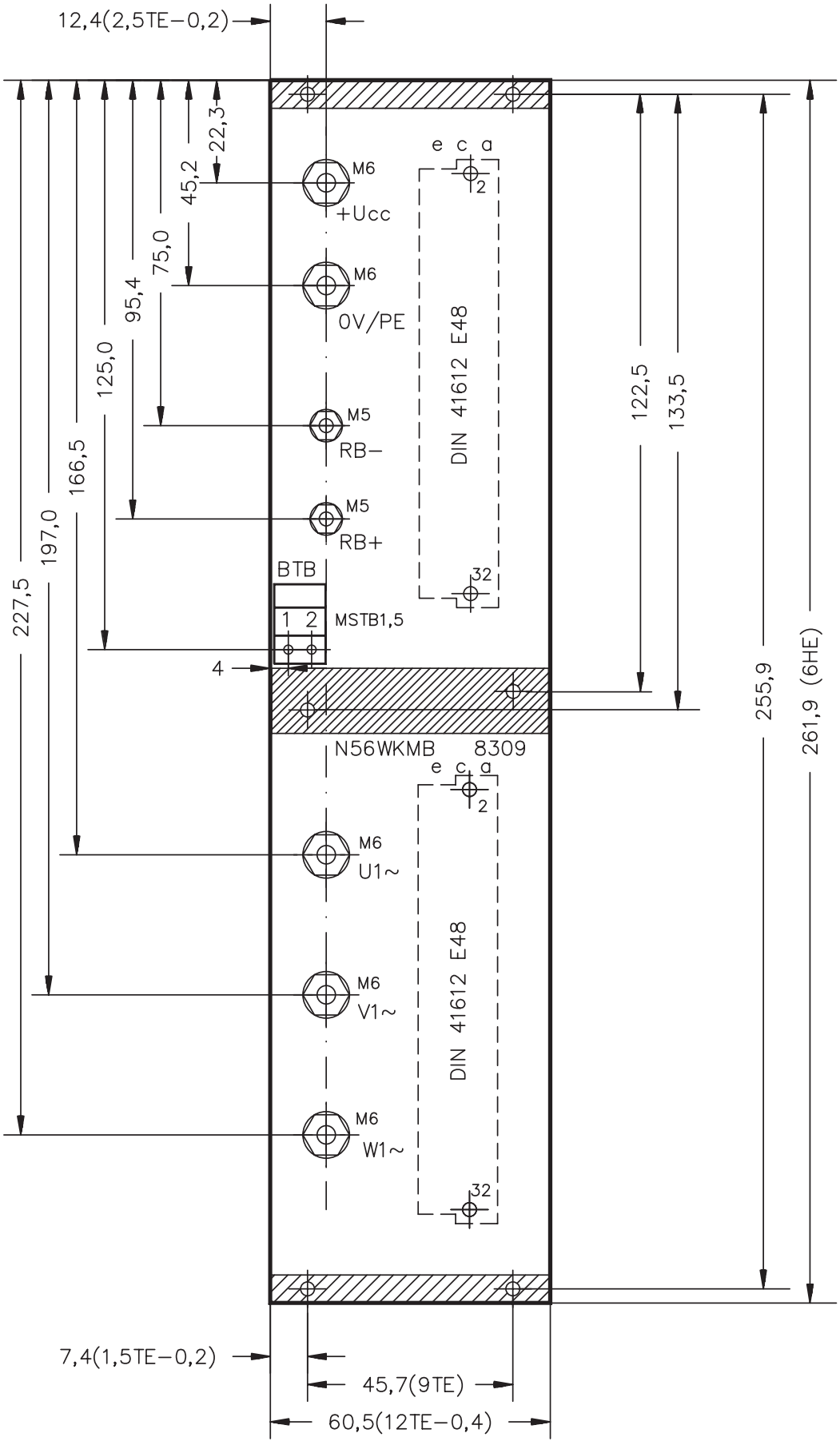
V.16 Backplane F64WKSMB



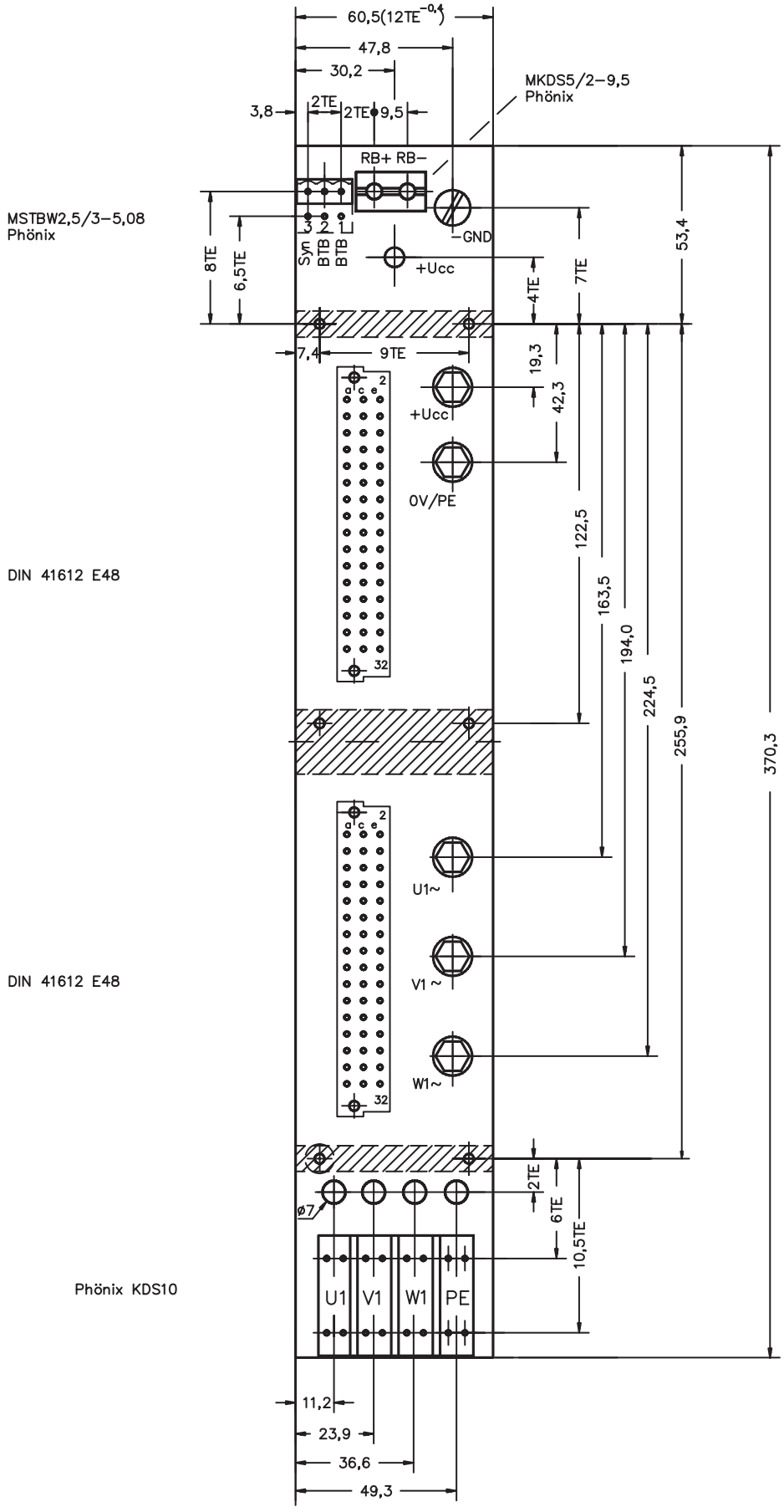
V.17 Backplane R64WKSMB



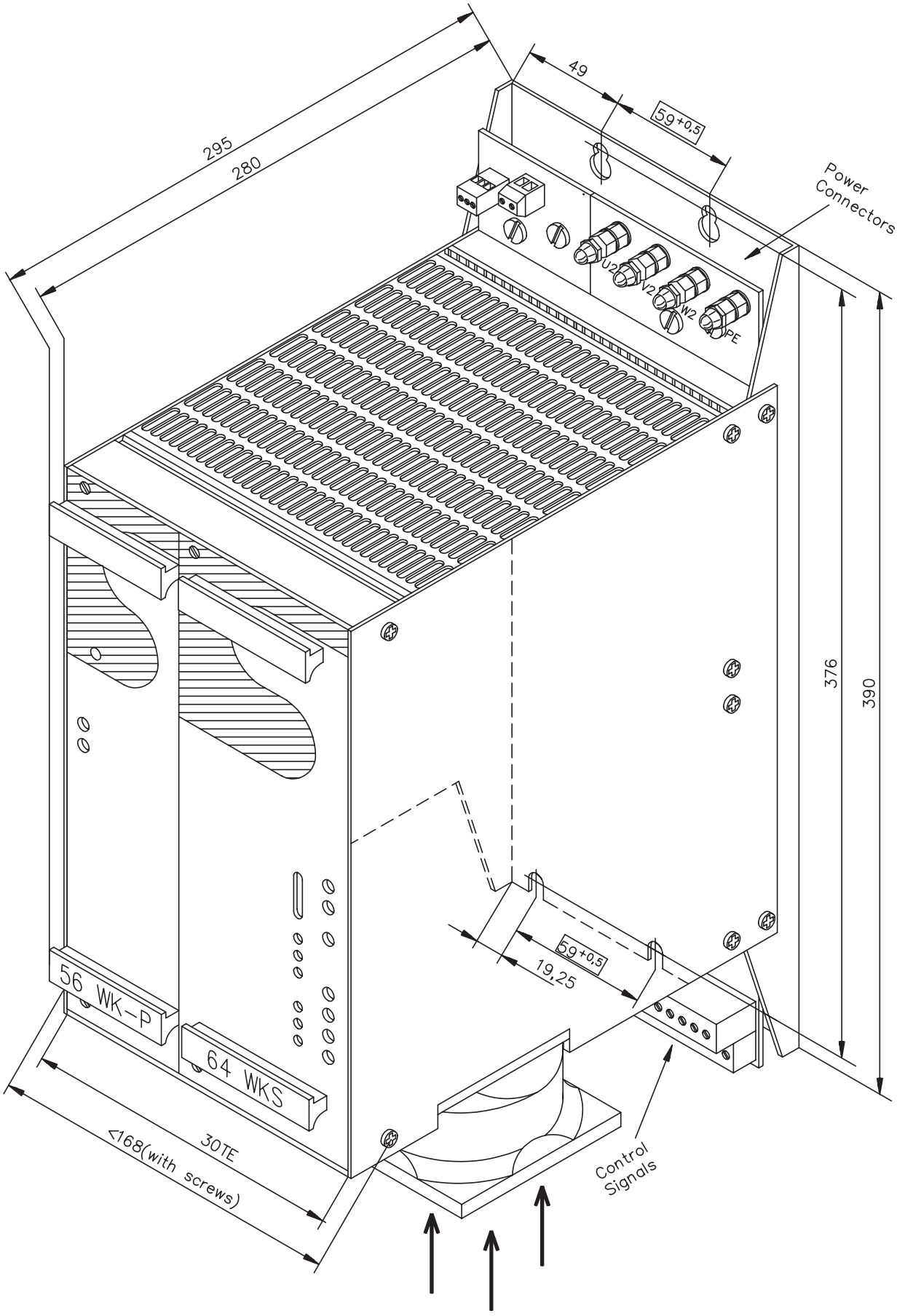
V.18 Backplane N56WKSMB



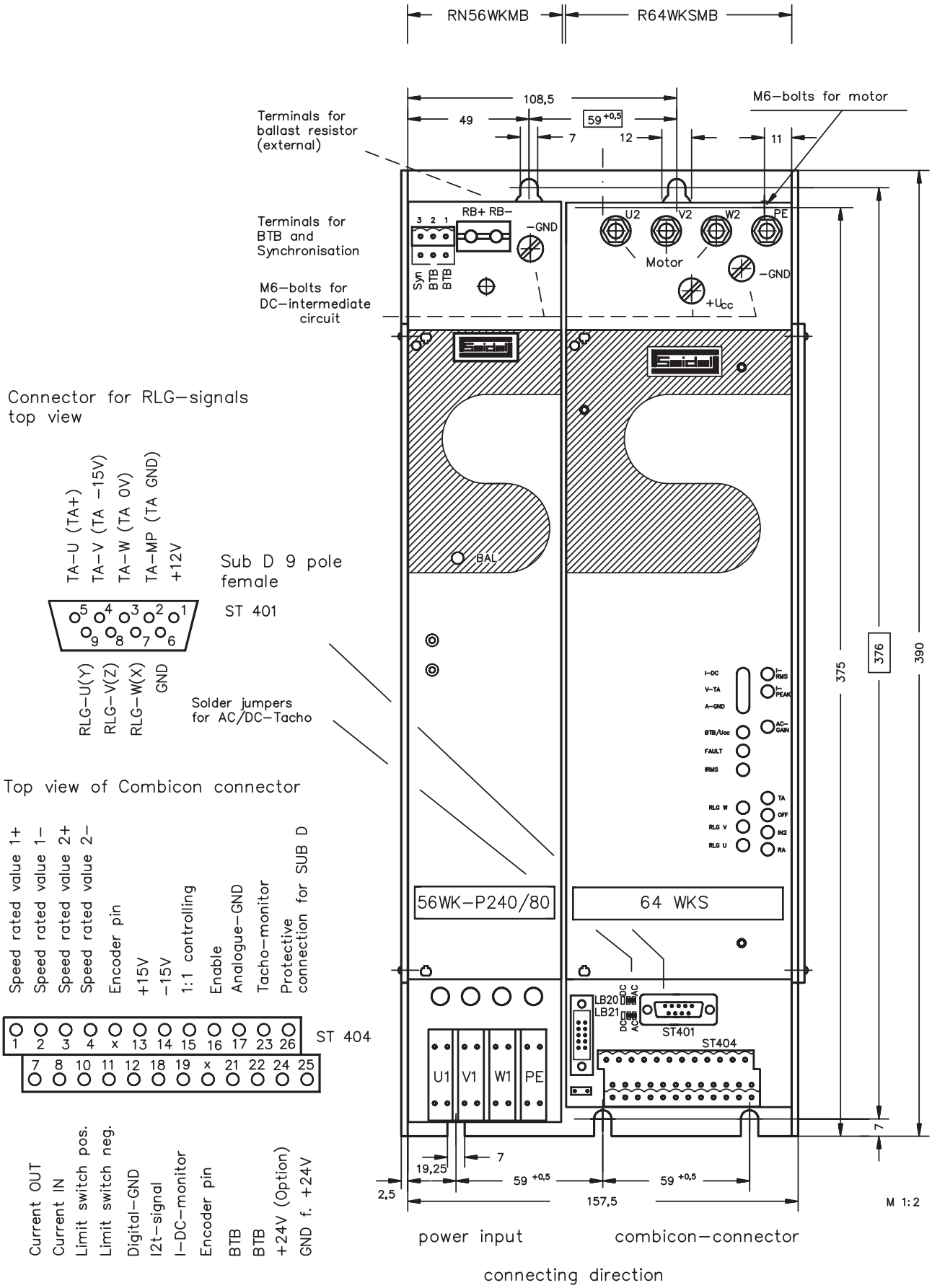
V.19 Backplane RN56WKSMB



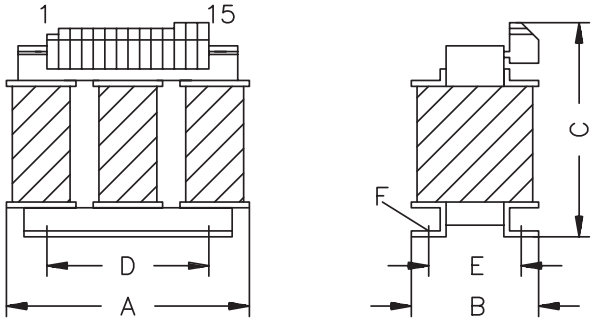
V.20 Compact housing K2-L with 56WK-P and 64WKS



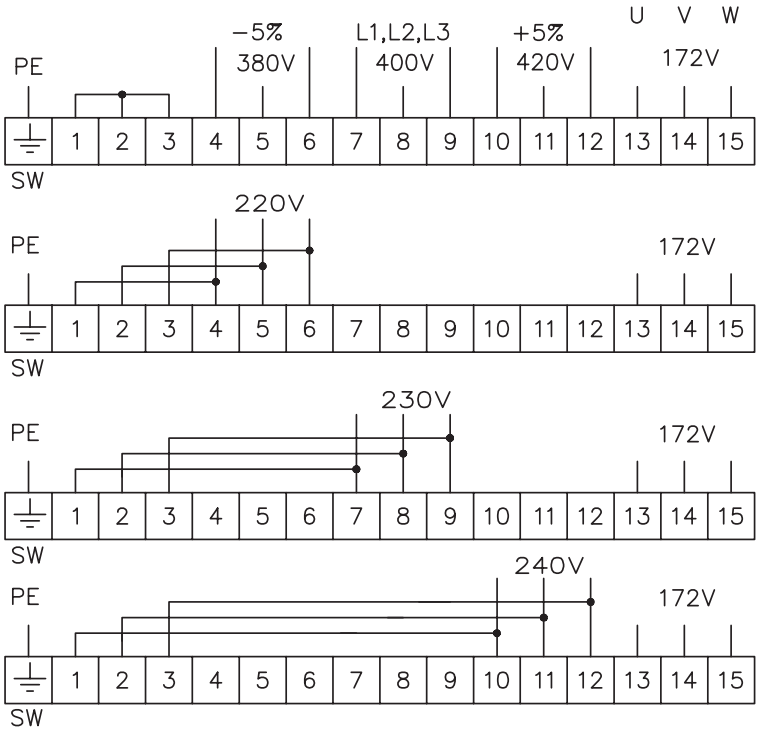
V.21 Mounting/connecting compact housing K2-L



V.22 Isolating transformers



Type		Dimensions in mm						Weight
	Phase	A	B	C	D	E	F	kp
3T2,0K-240	3	240	145	260	143	110	8x12	22,0
3T3,0K-240	3	300	155	310	200	92	10x15	35,0
3T5,0K-240	3	360	175	385	240	135	10x15	62,0
3T8,0K-240	3	450	220	440	280	165	10x15	98,0
3T10K-240	3	450	220	440	280	165	10x15	109,0



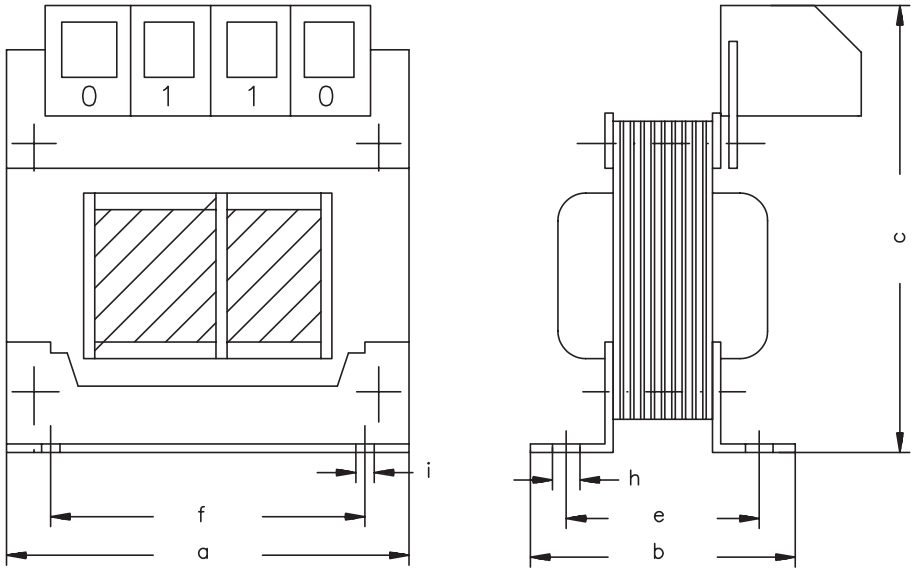
Other primary voltages available on special order

Ordering informations

3T 3,0K-240

- Isolated transformer with shielding Uk=4%
- Power in kVA
- DC-voltage in intermediate circuit 240 means 172V secondary voltage

V.23 Chokes



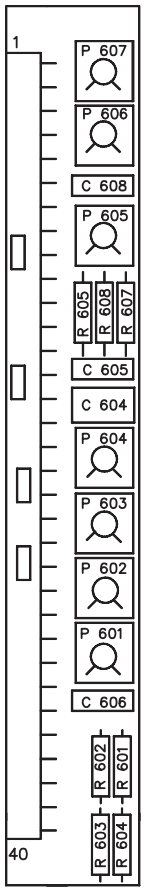
Type chokes	a	b	c	e	f	h	i	terminals
DL 0,6 – 70/140	150	105	160	72	122	13	7	TRK10

Dimensions in mm

V.24 Form for customer print

Customer	Commission	Name	Material–No.

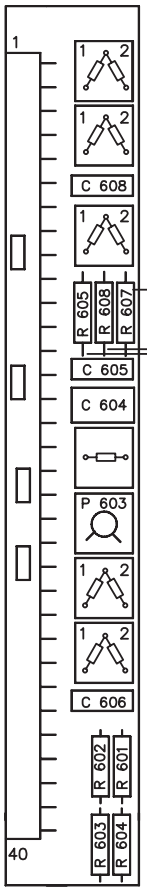
Position of Potentiometers



Adjustment

I RMS (0...In)	= _____	A
I PEAK (0...In)	= _____	A
AC – GAIN	= _____	%
VP	= _____	x
	= _____	x
TI	= _____	ms
TACHO (+/–30%)	= _____	%
OFFSET		
INPUT 2	= _____	V
RAMP (OPTION)	= _____	ms
T RAMP		
VTA (Tacho)		

Fixed components



1 =	_____	kΩ
2 =	_____	kΩ
1 =	_____	kΩ
2 =	_____	kΩ
=	_____	nF
1 =	_____	kΩ
2 =	_____	kΩ
=	_____	kΩ
=	_____	kΩ
=	_____	kΩ
=	_____	nF
=	_____	nF
=	_____	kΩ
1 =	_____	kΩ
2 =	_____	kΩ
1 =	_____	kΩ
2 =	_____	kΩ
=	_____	nF
=	_____	kΩ

Standard components

Component / Motor ser.	R601...R604(0,5%)	R605	R607	R608	C604	C605	C606
SM	33k	0,33k	100k	33k	330n	33n	10n
1FT5xxx	82k	0,33k	100k	33k	330n	33n	10n

Remars:

Date	Components	Reason

VI Annex

VI.1 Ordering informations

Name, part	Order No., Material No.	Equipment, description
Transistor-Inverter		
64WKS-M240/50-RLG	64619	I_{RMS} = 50A
64WKS-M240/70-RLG	64263	I_{RMS} = 70A
### Please quote the motor type used when ordering the equipment.		
Power supply		
56WK-P240/80-B	59143	with ballast circuit
Options		
Optionboard -01-	67848	ramp generator, limit switches, 1:1 control
Backplanes		
F64WKSMB	65455	short backplane, rear terminals
R64WKSMB	65765	long backplane, front terminals
N56WKMB	59636	short backplane, rear terminals
RN56WKMB	69345	long backplane, front terminals
### Combicon connector (XST404) part of supply		
Compact housing		
K2-L	70778	with ventilator fan, without backplanes
K2-L-R64WKSMB-RN56WKMB	71930	with ventilator fan, with backplanes
Cables		
RLG-cable for SM-motors	62504	Length 5m, terminated
RLG-cable for SM-motors	62508	Length 10m, terminated
### other lengths on request		
Connectors		
SubD-9pins (XST401)	63626	Mating connector (male), with cover and solder contacts
RLG-Connector for SM-motors	62828	type Souriau, with solder contacts

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