1 Power module (PM6--600)

1.1 Description PM6--600

All function blocks of the power module are arranged on a common heat sink, the cooling fins of which are located in the directly cooled outside area of the control cabinet when installed. This means that the power loss of the device is led directly to the outside and does not reach the interior of the cabinet.

G power supply

G ballast circuit

G low voltage power supply

G servo amplifier for 6 robot axes

G Brake switch (common for all 6 robot axes)

G Monitoring of motor currents and short-circuit protection

G Monitoring the temperatures of the heat sink, air, ballast resistor and fans

G Interface to DSEAT

Special features:

G 600V technology, at 400V -- 415V mains voltage there is no longer a transformer needed.

G All 6 servo drives in one device.

G All connections are pluggable.

G Connections to the PC (DSEAT) via a 40-pin. Ribbon cable.

G power amplifiers are equipped with IGBTs (isolated gate bipolar transistor); modern, safe technology.

G Plug & Play technology: no settings on the device required.

G Uniform for all IR standard types

1.1.1 Blockschaltbild Powermodul

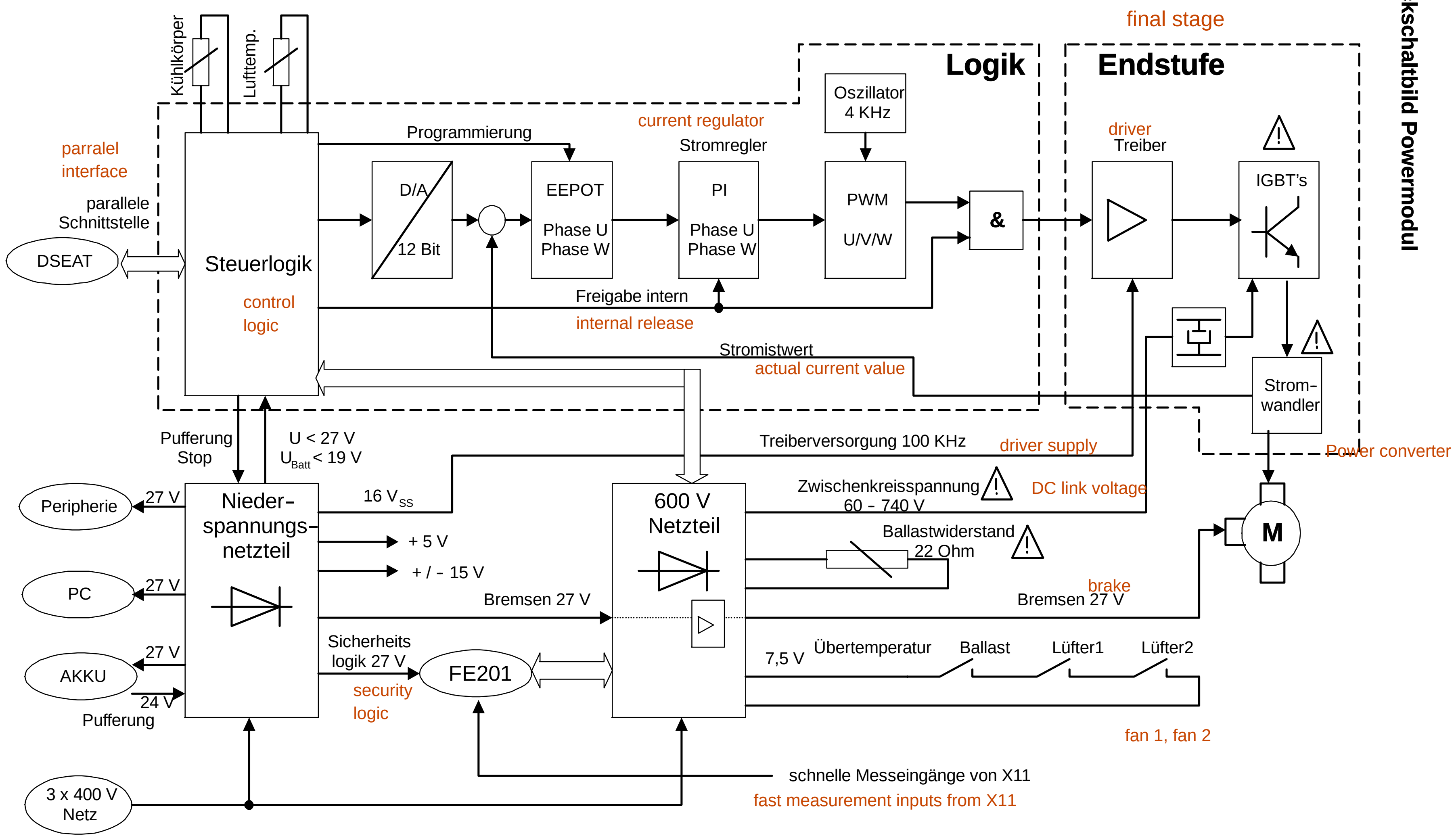


Abb. 1 Blockschaltbild Powermodul

1.1.2 How the power module works

Fig. 1 shows the block diagram of the power module. The PM6 has no built-in intelligence (processor). Data is simply supplied and queried by the processor on the DSEAT.

This data exchange is carried out via a parallel interface (12 bit data, 6 bit address) realized. The DSEAT can therefore write 12 bits to different addresses per access read from different addresses. The so-called control logic is required on the PM6 side.

The DSEAT writes the following information into the power module. read by the power module:

write:	**read:**
Current setpoint axis n phase U	Overcurrent axis n
Current setpoint axis n phase W	Current saturation axis n
Release axis n	Brake error
Brake axis n	Ballast circuit
Values for EEPot axis n	U> DC link
Buffering stop	U<27V
	U< battery
	Voltage monitoring
	Temperature heat sink
	Temperature ballast resistance
	Temperature cabinet
	Sum error
	Status K1 (drives ON)
	BTB
	Ballast switch ON
	Fast measuring input 1..4
	Motor connector position axis n 50%
	Motor connector position axis n100%
	Enable additional axis n
	Level of the DC link voltage (8 bits)
	Transmission error

The DSEAT specifies the current setpoints for each axis in the commutation cycle (125ÿs). This 12 bit information is routed via logic to the corresponding D/A converter. After Current control, the analog signal is converted into pulse widths in the PWM unit, then fed to the driver stage and finally to the power stage. After the final stage is over The actual current value is recorded by the current transformer and fed back to the current controller.

The mains voltage is supplied to the 600V power module and the 27V power supply.

The power module is used for rectification and contains the ballast circuit and the brake control.

The 27V power supply converts the mains voltage into a regulated 26.7V. This voltage supplies:

G all contactors/relays in the cabinet

G the periphery

G the PC

G the battery with charging voltage (therefore exactly 26.7V)

G the brakes

1.1.3 Blockschaltbild Netzteil 27 V

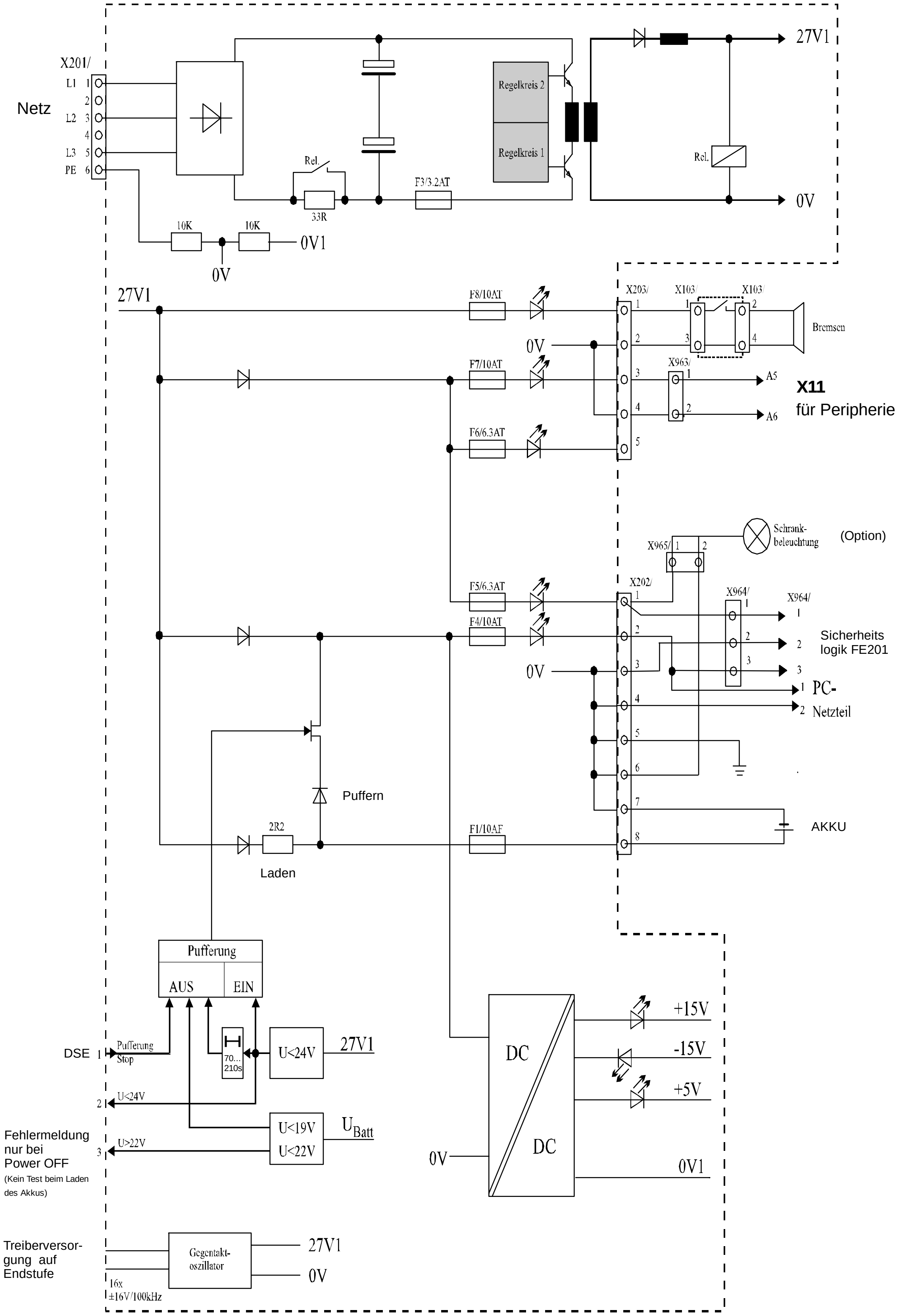


Abb. 2 Blockschaltbild Netzteil 27 V

1.1.4 How the power supply works

Fig. 2 shows the block diagram of the power supply. The mains voltage at the X201 is rectified in order to charge the electrolytic capacitors via a current limiting resistor. The current limiting resistor is only necessary during the switch-on process; this is bridged when the electrolytic capacitors are charged so as not to overload it thermally.

By controlling the switching transistor with a regulated pulse width modulated control voltage, the switching power supply delivers a constant output voltage of 27 V.

If the first control circuit fails, the output voltage of the switching power supply would rise to an unacceptably high level. To avoid this, there is a second control loop that limits the output voltage.

The brakes, the peripherals, the safety logic card A1 and the PC power supply are supplied with the constant voltage of 27 V (fused and provided with LEDs).

With an additional DC/DC converter, the power supply also converts the internal ones

Voltages +/-- 15V and 5V are generated for the power module.

The power supply is also used to charge the backup battery. If the output voltage of the Power supply below 24V (e.g. power failure, POWER OFF....), after switching on one Switching transistor of the PC is supplied via the buffer battery. This buffer operation can be carried out the signal from the computer “buffering stop” due to the battery voltage falling below 19V or automatically interrupted by the hardware after 70s...210s.

A push-pull oscillator supplies the drivers of the power amplifiers with the required voltage. 100 kHz is generated for this.

1.1.5 Blockschaltbild Netzmodul 600V

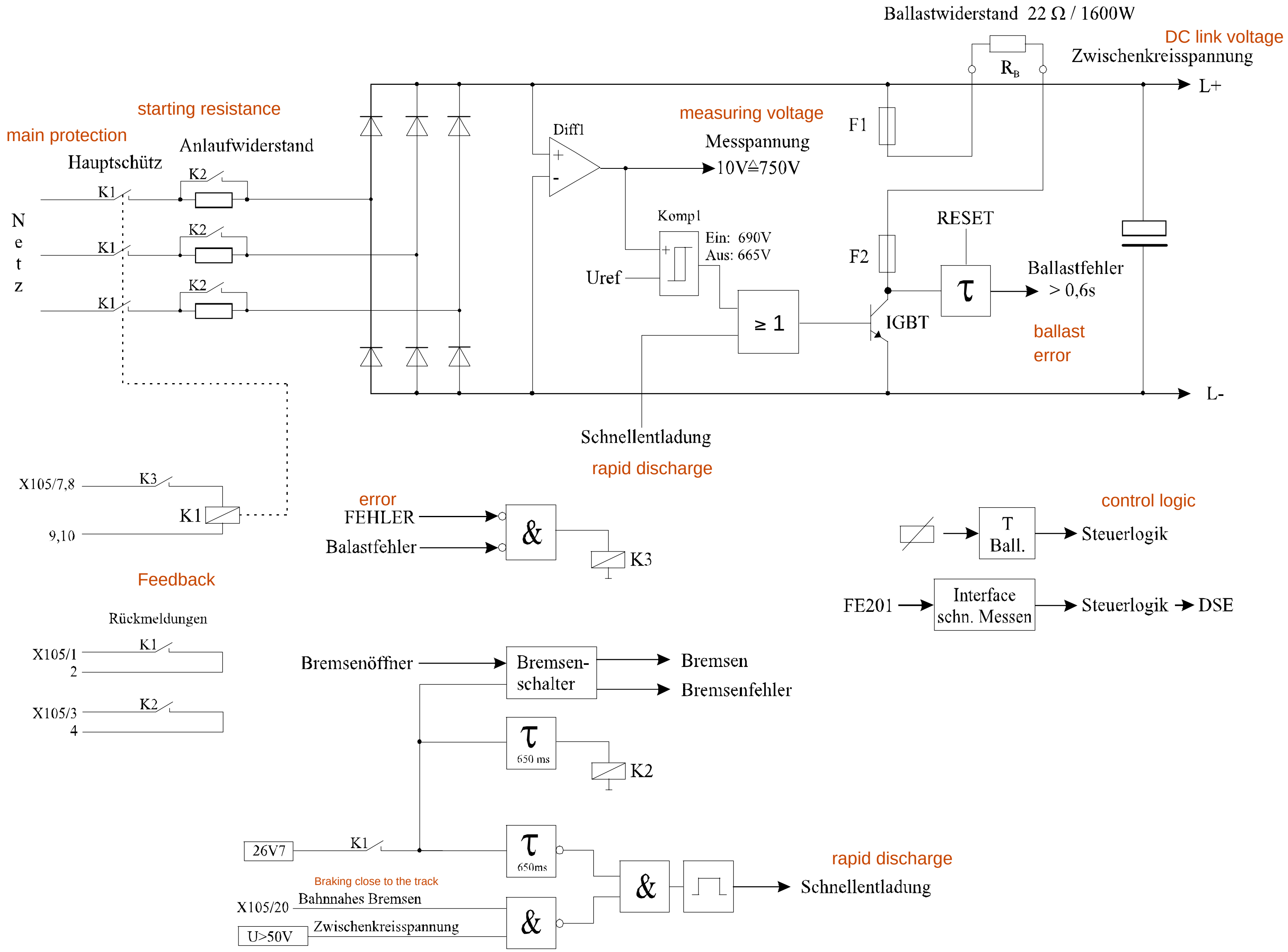


Abb. 3 Blockschaltbild Netzmodul 600 V

1.1.6 How the network module works

Figure 3 shows the block diagram of the power module. The mains voltage reaches the 3-phase bridge rectifier via the drives ON contacts K1 and via the starting resistors.

The starting resistors are necessary so that the current for charging the electrolytic capacitors remains limited. These starting resistances are activated by the K2 contacts, approx. 0.6s after K1 has pulled. bridged.

The differential amplifier Diff1 provides a voltage proportional to the intermediate circuit voltage at the output.

Evaluation of this voltage:

G Measuring the DC link voltage and sending the value to the computer;

G Triggering the error “overvoltage” (U>750V) or “undervoltage” (U < 60V)

G Triggering the ballast circuit;

Ballast circuit:

When the motors brake, they act as a generator and return voltage. This can cause the intermediate circuit voltage to rise to an unacceptably high level. To prevent this, serves the ballast circuit.

At UZ>690V the comparator (Comp1) and thus the IGBT switches on. This will make the The intermediate circuit voltage is short-circuited via the fuses F1, F2 and the ballast resistor RB and an impermissible voltage increase is avoided. After the voltage drops to U < 665V, the comparator switches off its output and the IGBT blocks again.

The duty cycle of the ballast circuit is monitored via a timer. If a preset time (approx. 0.6 s) is exceeded, a ballast error is triggered and saved. This ballast error leads to the opening of K3 and the opening of the main contactor K1.

Quick discharge:

After the drives are OFF, the electrolytic capacitors would store the high intermediate circuit voltage for a very long time.

To prevent this danger, rapid discharge is carried out using a hardware circuit triggered. For this purpose, the ballast circuit is addressed via a pulse (preset duration).

The rapid discharge occurs when the main contactor K1 has dropped out and the input for When braking close to the path, there is no voltage or the intermediate circuit voltage has fallen below 50V.

Signal forwarding:

The safety logic provides the inputs for quick measurements via the control logic DSE forwarded.

The temperature of the ballast resistor is also communicated to the control logic.

1.1.7 Block diagram of an output stage

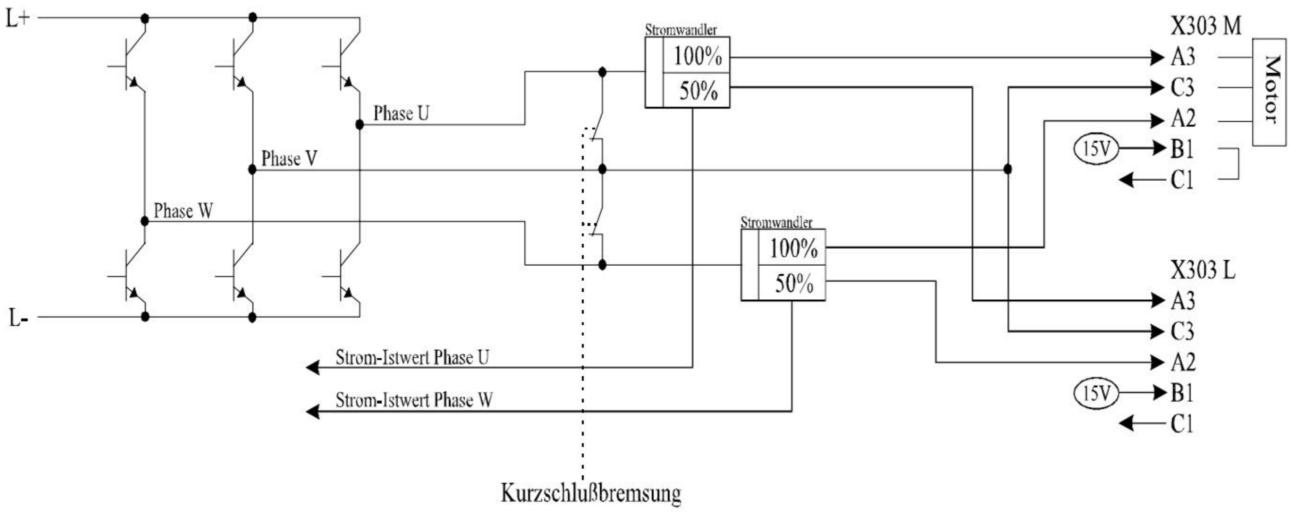


Fig. 4 Block diagram of an output stage

1.1.8 How an output stage works

Fig. 4 shows the block diagram of the output stage axis 3. The transistor pairs are controlled by the PWM logic in such a way that a sinusoidal voltage is created on the phase U, phase V and phase W lines to control the motors.

The phases U and W are passed through current transformers, whereby the actual current values are recorded.

Depending on whether the motor is connected to the X303 "Medium power" socket or to the X303 "L" low power socket, for example, 100% or 50% of the maximum current is available to the motor.

The computer can read pin C1 of any socket. Because there is a bridge from B1 to C1 on the motor plug, the computer can recognize which plug the motor is plugged into.

The computer can now check the configuration by comparing it with its machine data.

R1/machine.dat: e.g. $CURR_CAL [1] = 2.0 ! This means that the plug for axis 1 must be plugged into "L" (1.0 must be entered for "M").

1.2 Blockschaltbild Überwachungen

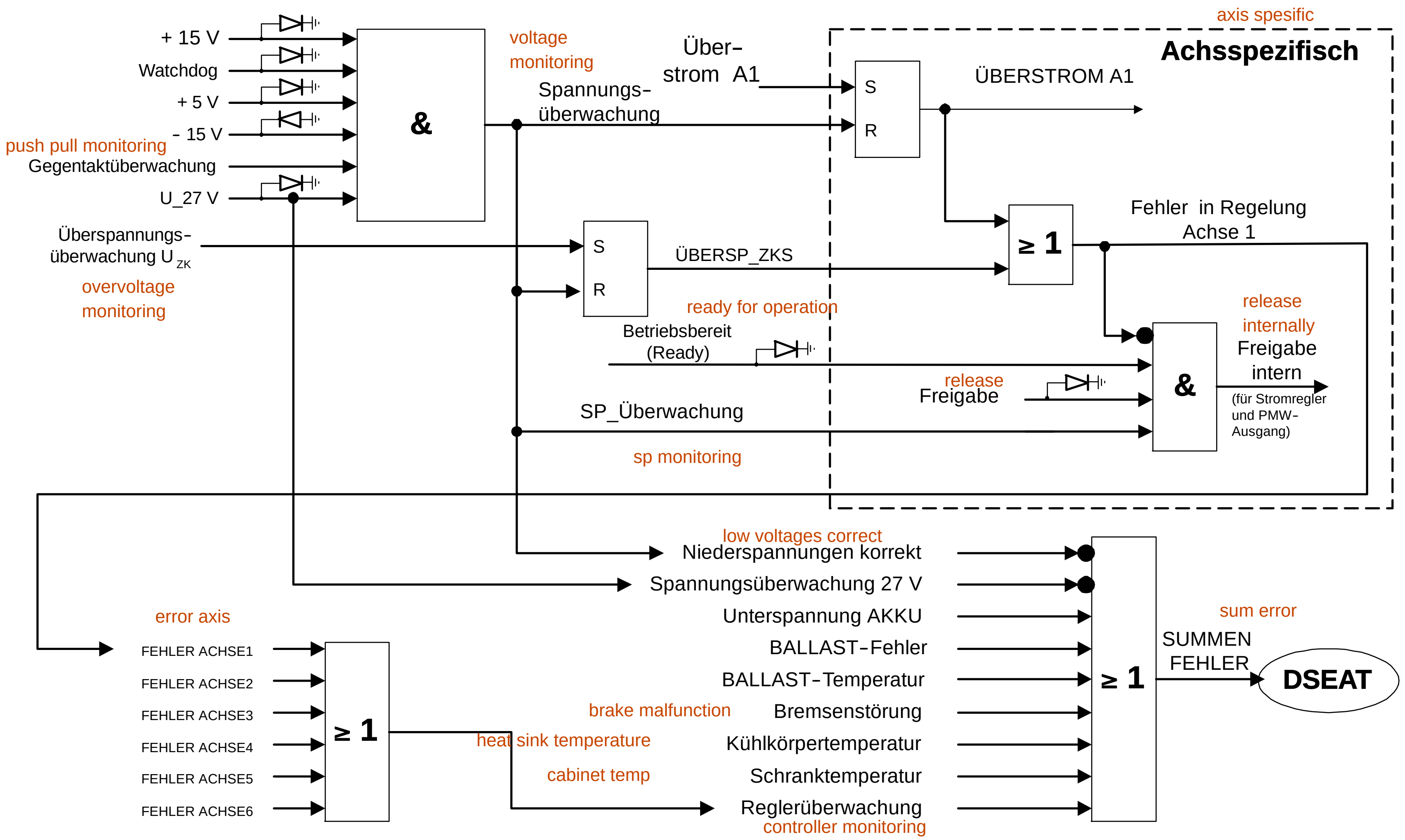


Abb. 5 Blockschaltbild Überwachungen

1.2.1 Description of monitoring

Figure 5 above shows how the error signals arise and how they are connected.

1.2.1.1 Monitoring of the 27 V power supply

G **+15V:** (!Message number: 123)

Monitoring the +15V for internal logic

G **Error watchdog:** (!Message number: 267)

The DSEAT accesses the PM6 cyclically (writing and reading). Every time it is accessed a monoflop is retriggered so that its output never drops. If cyclic access longer than 0.5 ms, the output of the monoflop also drops and thus produces this Error signal “error watchdog”. The signal is displayed via an LED.

G5V :

Monitoring the +5V for internal logic

G **--15V:**

Monitoring the --15V for internal logic

G **push-pull monitoring:**

The push-pull (16 Vpp, 100 kHz) for the driver stages is available.

G **U_27V:**

Voltage monitoring of 27V. Voltage drops below 24V or rises above 30V.

G **Undervoltage BATTERY:** (!Message number: 1201)

The voltage of the buffer battery has dropped to below 22V (only 1 buffering process left á 1 minute possible);

1.2.1.2 Monitoring of the 600 V power module

G **Voltage monitoring UZK:** (!Message number: 124)

Monitoring of the intermediate circuit voltage at U>750V.

G **Ballast error:** (!Message number: 218)

The ballast resistor is constantly switched on for longer than approx. 0.6 s.

G **Ballast temperature:** (!Message number: 266)

The temperature sensor on the ballast resistor reports overtemperature.

G **Brake fault:** (!Message number: 122)

If the brake is short-circuited or the brake output is open (cable break).

1.2.1.3 Monitoring the logic part

G **Cabinet temperature:** (!Message number: 219)

The ambient temperature in the cabinet is greater than 60ºC+/--2K.

G **Heatsink temperature:** The (!Message number: 118)

temperature at the heatsink of the final transistors is greater than 80ºC+/-5K.

G **Overcurrent:** (!Message number: 121)

The maximum current limit of the power output stage has been exceeded

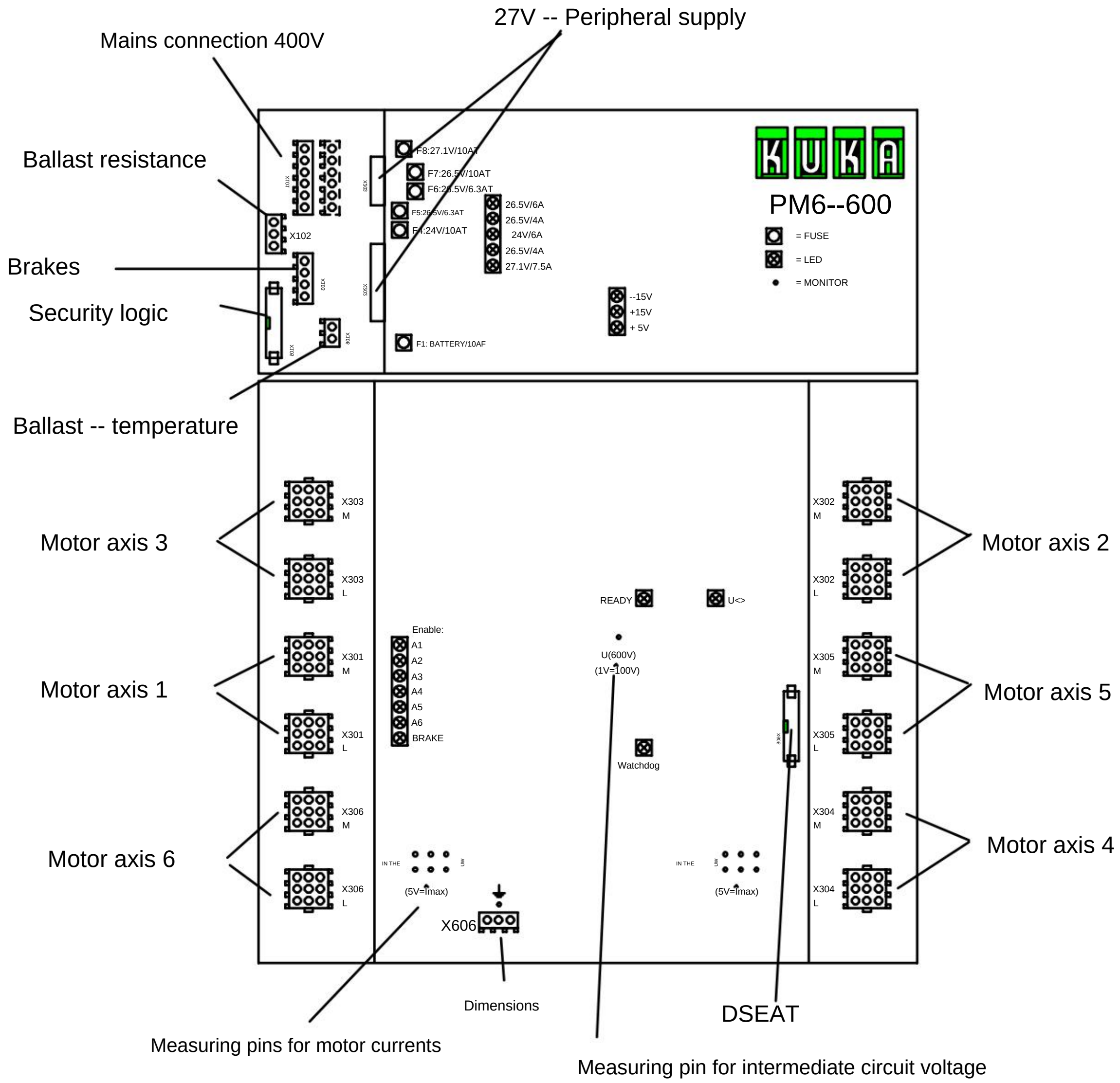
G **Error control A1 ... A6:**

An overcurrent or too high a DC link voltage (UZKS > 750 V) was detected.
provides.

G **sum error:**

If the DSEAT receives a total error message, it can then query the exact cause of the error. This is then communicated to the controller, which issues a corresponding error message (see numbers in brackets).

1.3 Front view PM6--600



1.3.1 Routing the motor connectors

The motor plugs are inserted depending on the type of robot connected.

Upper plug position (M): medium power

Lower plug position (L): low power

The control records the plug position and reports an incorrectly plugged motor cable.

Mixing up the motor cables with each other is not detected.
Please pay attention to the axis assignment!

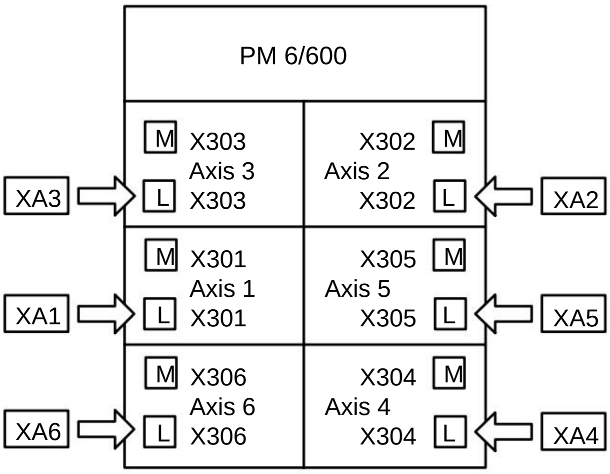
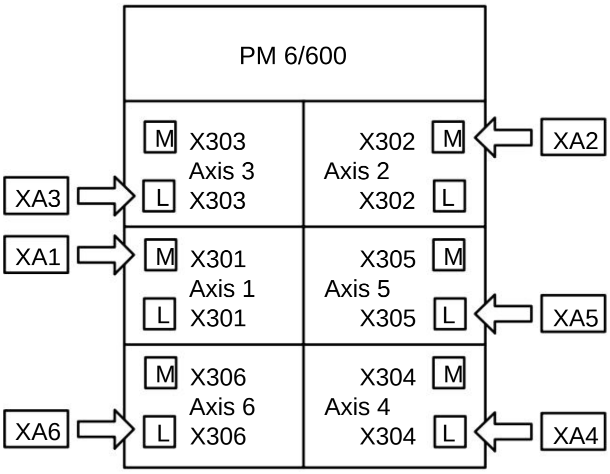
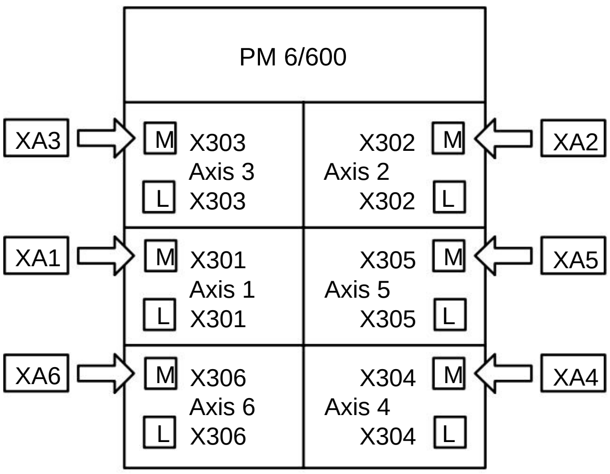
<table>
<tr><th>Connector assignment</th><th>Robot type</th></tr>
<tr><td>
</td><td>KR 6
KR 15</td></tr>
<tr><td>
</td><td>KR 30
KR 30 L 15
KR 45</td></tr>
<tr><td>
</td><td>KR 125
KR 125 p
KR 150
KR200</td></tr>
</table>

Fig. 6 Connector assignment

1.3.2 Description of fuses/LEDs

G Description of fuses

F8: 27.1V10AT for brake control

F7: 26.5V10AT for the peripherals

F6: 26.5V/6.3AT (not used)

F5: 26.5V/6.3AT cabinet lighting (option), supply for VFE201

F4: 24V/10AT supply for PC

F1: Battery/10AF (sits in the + supply line of the battery)

G Description of the LEDs

26.5V/6A: F7 for the peripherals

26.5V/4A: F6 (not used)

24V/6A: F4 supply for PC

26.5V/4A: F5 cabinet lighting (option), supply for VFE201

27.1V/7.5A: F8 for brake control

READY:	Lights up as long as the power module is ready for operation.
U < >:	Lights up as long as the 27 V voltage is greater than 24 V and is less than 30 V.
WATCHDOG:	Lights up as long as communication with the DSEAT is OK.
ENABLE A1 -- A6:	Lights up as long as the axes are enabled.
BRAKE:	Lights up when the brakes receive the 27 V to open.

1.4 Installing/removing the power module

Removing from the robot cabinet: Before starting the removal work, unplug the power cable and ensure that it cannot be plugged back in unintentionally (warning sign on the plug!)

Removal from the component test stand: Before starting the removal work, switch off the main switch and secure it against being switched on again. (Green signal lamp lights up!)

Voltages over 600V can be present in the PM6-600 for up to 5 minutes after switching off!

1.4.1 Expansion of the PM6-600

G Switch off the system and wait until buffering is complete

G Disconnect all plugs from the PM6--600

G 6 Unlock the sliding latch (turn latch in the cabinet!)

G Remove PM6--600

When removing the PM6--600, be sure to pay attention to the weight of 29 kg!

1.4.2 Installation of the PM6-600

G Check PM6--600 for production status and mechanical damage

G Check the seals on the heat sink for completeness

G Place PM6--600 on the rail in the component test bench

G 6 Lock the sliding latch (turn latch in the cabinet!)

G Reconnect all plugs on the PM6-600

When installing the PM6-600, make sure that all plugs (especially the motor plugs) are in the correct positions when plugged back in!

1.4.3 Current controller programming after replacing the power module

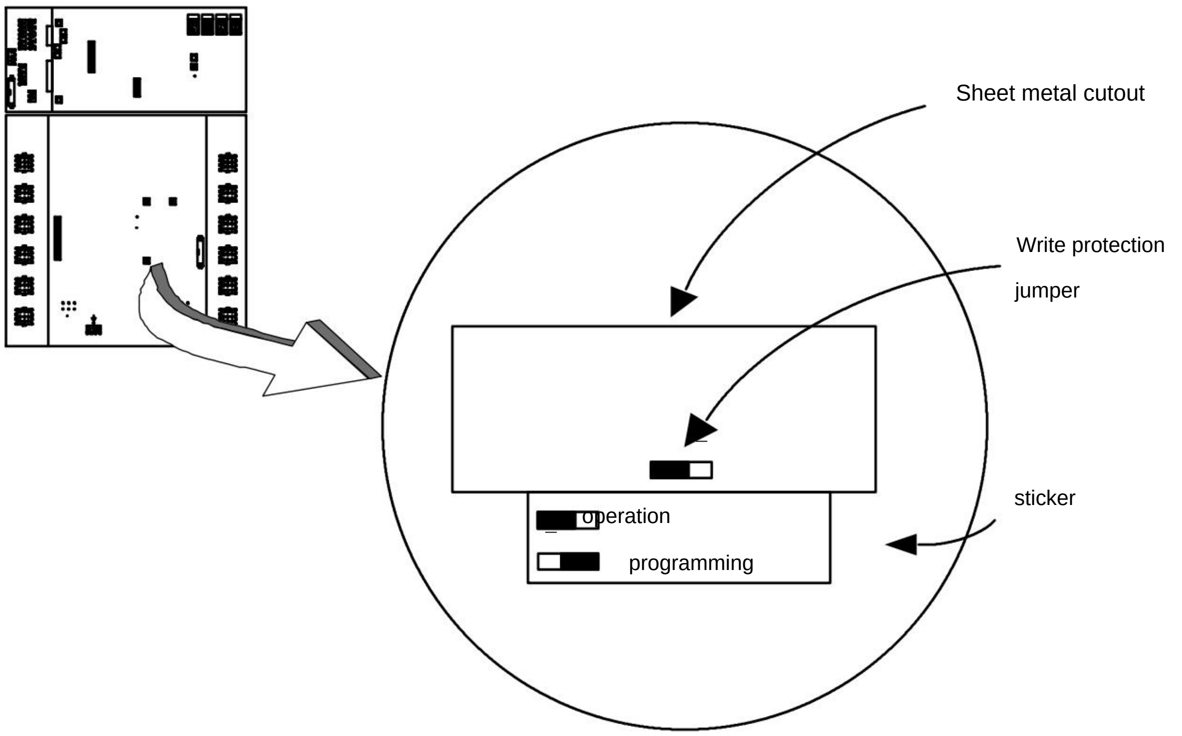
The power modules contain a programmable potentiometer (EEPot) with which the current controller can be optimized to the corresponding KR type. The optimal value for this setting is stored in the machine data.

After replacing the power module and after replacing a KRC1 control cabinet with a standby control cabinet, the correct current controller setting should be transferred to the new power module and saved.

The following procedure applies after replacing the power module or cabinet: (1) Switch on the KR C1 control and let it start up.

(2) Put the write protection jumper in the “programming” position.

Only required for power modules with write protection JUMPER!



(3) On the KCP under the user interface, call up the menu items HELP --> VERSION.
Compare whether the IR type display matches the actual machine type. If not, the correct machine data must be loaded.

(4) Call up the menu items DISPLAY --> VARIABLE --> CORRECT.
A window for entering variables appears.
Enter the following in the “NAME” field: $PROG_EEPOT

(5) Press “NEW VALUE” on the lower menu bar or click with a mouse in the “NEW VALUE” input field.

Enter “1” for the new value (for axis 1).

By then pressing the Enter key, the current controller of axis 1 is programmed with the value that is stored in the machine data.

By entering “2” in the “NEW VALUE” field and pressing “Enter” axis 2 is programmed, etc.

Program all axes operated on the KRC1 controller in this way.

(6) Put the write protection jumper in the “Operation” position (only for power modules with write protection jumpers).

1.5 Functional test of the PM6-600

G Switch on system

G after booting up, check the following LEDs on the PM6--600 (must be lit-
ten!):

"LED series": 26.5V/6A; 26.5V/4A; 24V/6A; 26.5V/4A; 27.1V/7.5A

"LED row": --15V; +15V; +5V

and the watchdog LED (connection to DSE OK)

Ready LED (power module ready for operation)

U < >--LED (in the voltage range 24V < U < 30 V)

G If adjustment is necessary, carry out this (clock adjustment)

G load the "DUMMY" test program

G SAK--carry out trip; Make sure that the following row of LEDs lights up:

"LED row": A1 to A6 (enable the axes) and BRAKE

LED (brake release)

G start the test program and let it run for approx. 15 minutes; While the program is running, check error messages from the control and the running noises of the motors

G stop the program with the "Stop" key

G Press the "Drives off" button (drives are switched off)

G "EMERGENCY OFF" -- Press the switch and change the operating mode selector switch to manual mode. switch

-- Press all three enabling buttons one after the other: drives must not switch on (only the relays K5 and K6 on FE201 are switched)

G "EMERGENCY OFF" -- Unlock switch

-- Relays K1 and K2 close (two-channel). When the consent buttons are pressed, the drives are switched on (relays K5 and K6 on FE201, relays L23 and L24 on FE202 (VW only) and several contactors in the power module close.
The contactors in the power module are difficult to see (due to ventilation slots), but they are clearly audible!

G move and check all six axes individually (both in "plus" and in "min-"
nus" direction)

G Make sure that the backup battery is connected. G Switch off the

system and ensure that buffering takes place. Check: PC remains switched on, four LEDs on PM6--600 (24V, 15V, +15V, +5V) and LED on RDW light up, LED on DSEAT flashes. After approx. 45 s, buffering is completed, the LEDs go out and the PC is automatically switched off

G after a short time (30 seconds) restart the system G after

booting, check whether buffering has taken place properly (no
to adjust axes)

G Load the DUMMY test program and let it run again for approx. 30 minutes to remove any heat.
to exclude measurement errors.