SIEMENS

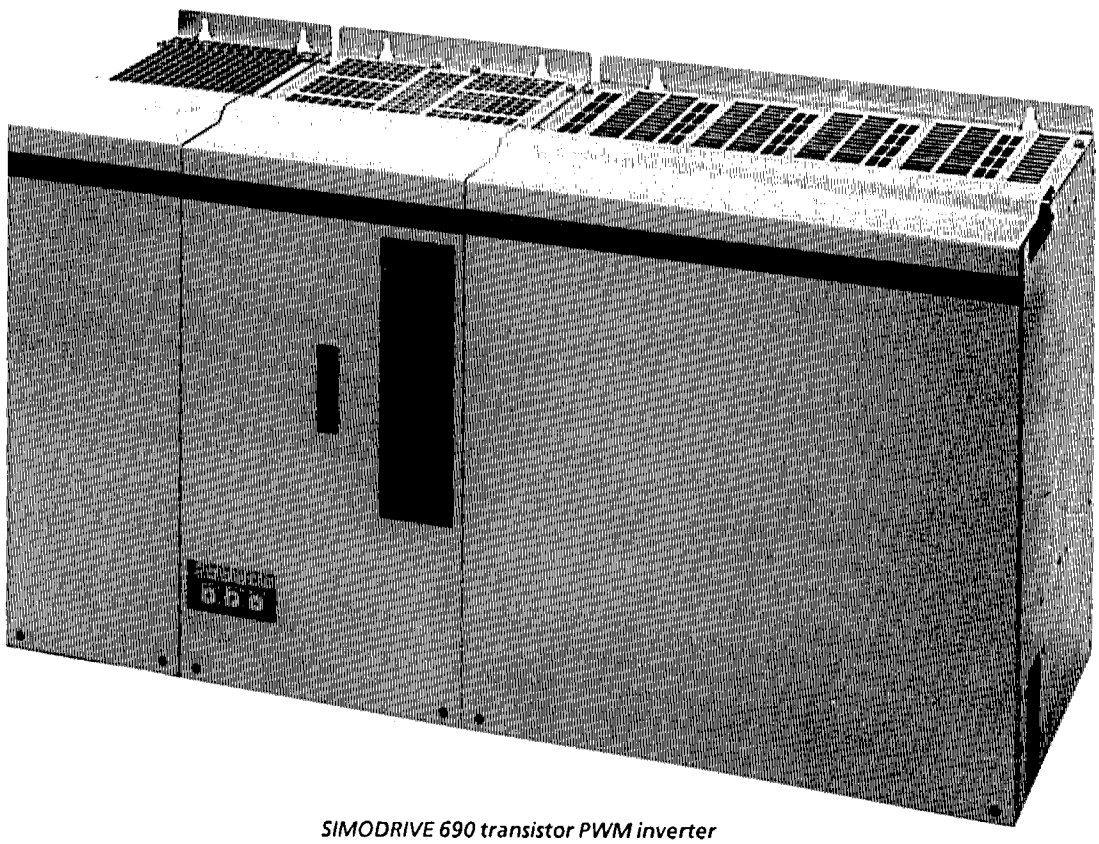
SIMODRIVE

Transistor PWM Inverter

Combination System for Three-Phase Main Spindle Drive and Feed Drives

SIMODRIVE 690

Instructions	Order No.	6SC6901-6AA76
	Internal Item No.	GWE 462 011.9000.76 Jf-101



SIMODRIVE 690 transistor PWM inverter

Editions

The following editions have been published so far. The sections changed since the previous edition are indicated in the "Changes" column.

Edition	Order No.	Changes
04880.1	GWE 462 011.9000.00 Ja-101	First edition
09880.1	GWE 462 011.9000.00 Jb-101	Revised edition
11880.1	GWE 462 011.9000.00 Jb-101	Unchanged reprint
05890.1	GWE 462 011.9000.00 Jd-101	Revised edition
08900.2	GWE 462 011.9000.76 Jf-101	Revised edition

NOTES

The SIMODRIVE unit may not be connected to a supply system with ELCBs (permitted under DIN VDE 0160, Section 6.5).

In compliance with DIN VDE 0160/05.88, all SIMODRIVE units are subjected to a high-voltage test at the time of routine testing. If the electrical equipment of machine tools undergoes high-voltage testing, all connectors must be separated or terminals opened (permissible under DIN VDE 0113, Part 1, Section 13.2). Damage to sensitive electronic components can thus be prevented.

In the operational state, protection against direct contact is afforded in a form to render the units suitable for installation in electrical operating areas (DIN VDE 0558, Part 1a, Section 5.4.3.2.2).

The parameter indications are based on software release 11.

Pertinent wiring manual 6SC6901-6BA00

This Instruction Manual is also available in the following other languages:

German	Order No.: 6SC6901-6AA00
French	6SC6901-6AA77

CAUTION

The modules of the unit include electrostatically sensitive devices (ESD).

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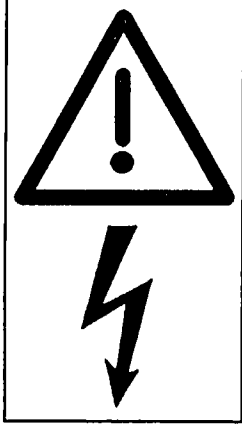
NOTE

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.
Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local Siemens Sales Office.
The contents of this instruction manual shall not become part or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

Safety instructions



WARNING

Hazardous voltages are present in this electrical equipment during operation.

Non-observance of the safety instructions can result in severe personal injury or property damage.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, and maintenance procedures contained herein.

The successful and safe operation of this equiment is dependent on proper handling, installation, operation and maintenance.

Definitions

• QUALIFIED PERSON

For the purpose of this instruction manual and product labels, a "qualified person" is one who is familiar with the installation, construction and operation of the equipment and the hazards involved.

In addition, he has the following qualifications:

1. Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
2. Is trained in the proper care and use of protective equipment in accordance with established safety practices.
3. Is trained in rendering first aid.

• DANGER

For the purpose of this instruction manual and product labels, "Danger" indicates death, severe personal injury or substantial property damage will result if proper precautions are not taken.

• WARNING

For the purpose of this instruction manual and product labels, "Warning" indicates death, severe personal injury or substantial property damage can result if proper precautions are not taken.

• CAUTION

For the purpose of this instruction manual and product labels, "Caution" indicates minor personal injury or property damage can result if proper precautions are not taken.

• NOTE

For the purpose of this instruction manual, "Note" indicates information about the product or the respective part of the instruction manual which is essential to highlight.

1 Description

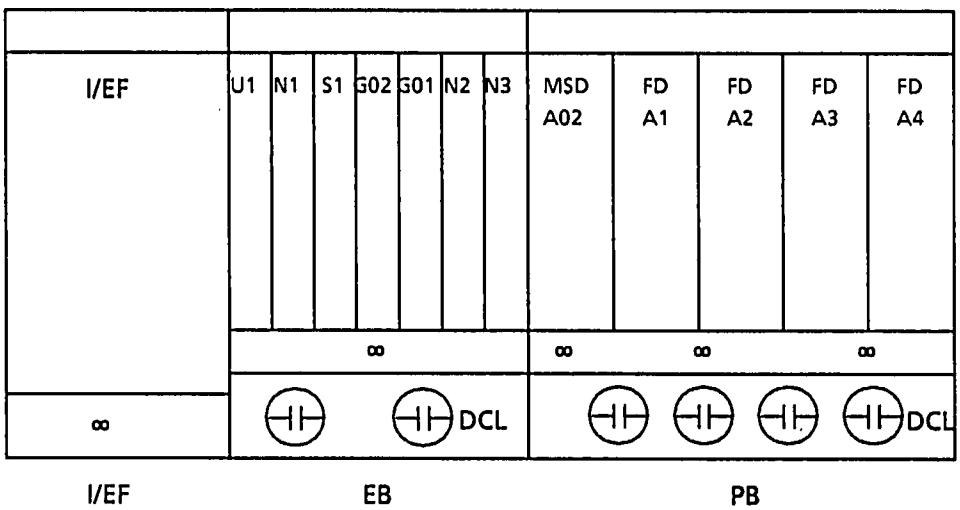
1.1 Application

SIMODRIVE 690 transistor pulse-width-modulated inverters are used together with brushless three-phase servomotors of the 1FT5 series (suitable for 575 V DC link voltage) for driving the feed axes of machine tools, and together with three-phase induction motors of the 1PH5/6 series for driving the main spindles of machine tools.

The inverters control the speed of the drive in four-quadrant operation and satisfy highest demands on the dynamic control response.

NOTE
If motors of a type other than 1PH5/6 are used, contact SIEMENS AUT E243 for coordination of the appropriate converter setting data.

1.2 Design



The combination unit combines the functions of the SIMODRIVE 650 main spindle drive inverter (MSD) and of the SIMODRIVE 610 feed drive inverter (FD). All inverters draw from a common DC link (DCL). The unit is subdivided into three function blocks. The input/energy feedback block (I/EF) contains the line-side converter and the step-up converter with the necessary driving circuits. The electronics block (EB) contains all necessary PCBs:

U1	I/O module	MSD
N1	Controller module	MSD
S1	Optional module	MSD
G02	Central module	
G01	Power supply	
N2	Controller module, axes 1 - 3	FD
N3	Controller module, axes 4 - 6	FD

The power block (PB) can take a maximum complement of 1 main spindle inverter and 6 feed axis inverters, depending on the design of the inverter modules used. The electrical connections between the component units are made with cable assemblies and ribbon cables according to the circuit diagram.

If necessary, the maximum capacity of the combination unit can be increased to 12 feed axes by adding an electronics extension block (EEB).

The component blocks of the combination units are delivered with all necessary connecting materials contained in a suitably marked cardboard box.

Also contained in this package are the stick-on labels required for the identification marking of the inverter modules and other power section components after installation.

1.3 Mode of operation of the main spindle drive

The three-phase main spindle drive is provided with digital closed-loop and open-loop control. The control system consists of the speed controller with ramp-function generator and stored field-weakening characteristic; it further includes a secondary torque control loop, the inverter driving circuit and the sequence controller.

The control system receives a torque-proportional signal and the actual-speed value and causes the inverter to give the motor voltage precisely the frequency, amplitude and phase angle which are needed to obtain the required torque and magnetic field, with due regard to the torque and field limitations (field-oriented operation). This makes the asynchronous machine controllable as if it were a DC machine with armature and weak-field control range (transvector control).

The output voltages of the inverter are pulse-width modulated for sinusoidal arithmetic mean values like a three-phase AC voltage and drive the main spindle motor.

The actual-speed value is derived from the signals of an encoder fitted on the motor shaft.

The inverter for the main spindle drive and the feed drive inverters are supplied with 575 V DC (voltage control with secondary current control). The supply comes from a 6-pulse thyristor converter and a transistorized step-up converter. In regenerative braking the thyristor converter is operated with a delay angle of 150° and the transistor circuit feeds pulse-width modulated energy back into the supply system, overcoming the inverter voltage of the thyristor bridge.

1.4 Mode of operation of the feed drive

The AC feed drive is controlled by a cascade configuration of a speed control circuit and a current control circuit. The output of the current controller is taken to a pulse-width modulator which converts the analog value to a binary signal whose pulse/pause ratio is proportional to the amplitude of the input signal. This pulse-width-modulated voltage setpoint drives the power transistors so as to produce a setpoint-proportional voltage with a mean value depending on the pulse/pause ratio.

In an AC feed drive the function of the electro-mechanical commutator is performed by an electronic commutator. This commutator is implemented by the transistor PWM inverter as controlled by the shaft encoder signals.

The actual-speed signal is provided by a brushless AC tachogenerator.

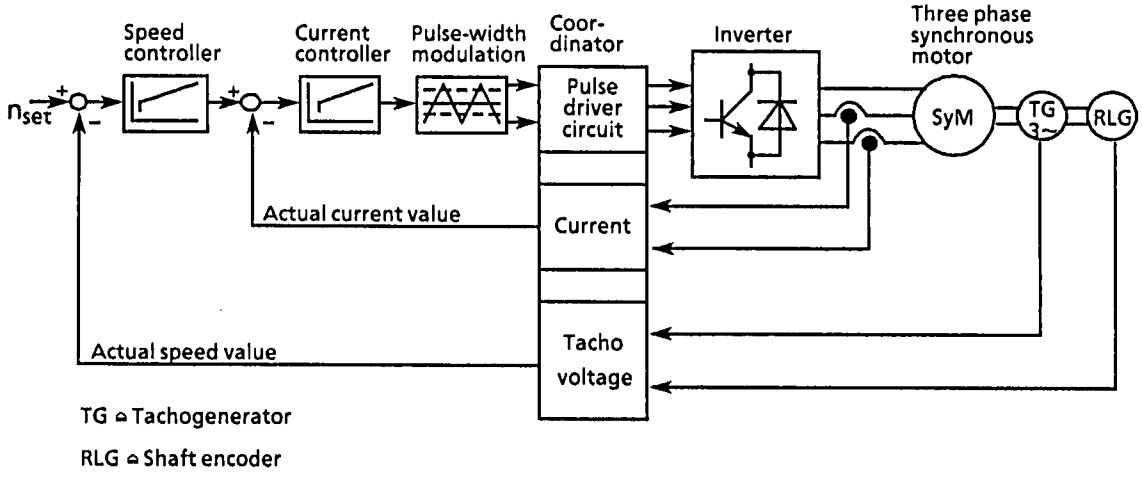
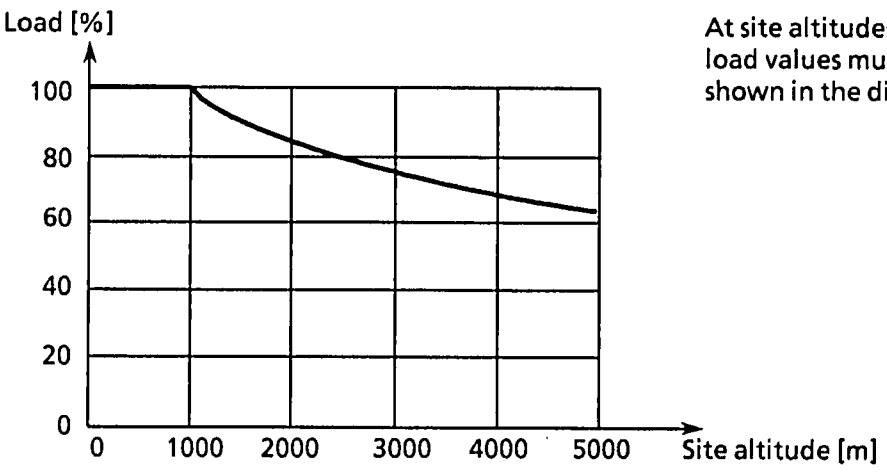


Fig. 1.1 Block diagram of an AC feed drive

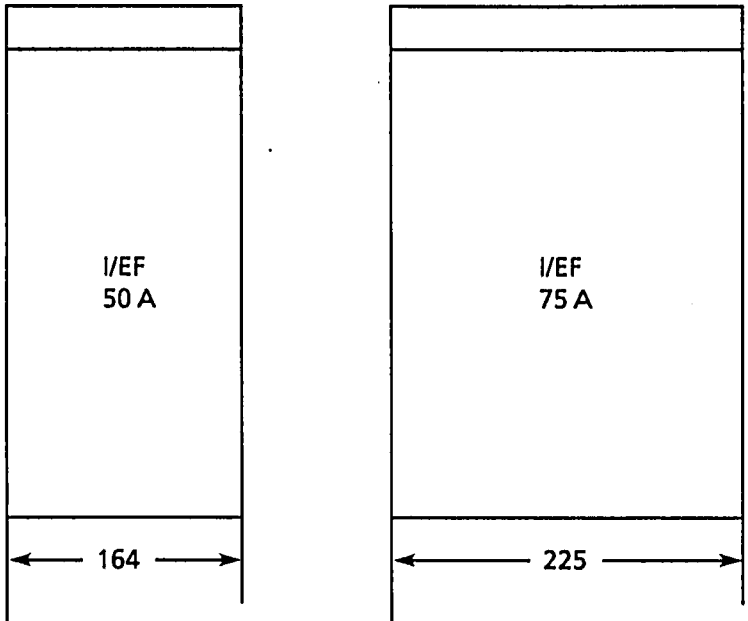
1.5 Technical data

Supply voltage	3AC 380 V, – 10 %*)/ + 15 %
Rated frequency	50 to 60 Hz
Current consumption at U_{rated} /during line undervoltage	36 A/40 A (6SC6901-0VR05) 55 A/61 A (6SC6901-0VR07)
Connected load, nominal	23 kW (6SC6901-0VR05) 35 kW (6SC6901-0VR07)
Input fuse	45 A high-speed (6SC6901-0VR05) 80 A high-speed (6SC6901-0VR07)
Output voltage, MSD inverter	3AC 430 V
Output voltage, FD inverter	3UC 575 V
Output current	Depending on inverter modules used
Output frequency, MSD	0 to 300 Hz
Efficiency in rated operation	Approx. 95 %
DC link voltage	575 V
Number of feed axes	1 to 12
Power loss	$P_V \approx P \cdot 0.05$ P ≙ Input power of combination unit with drives typically loaded
Permissible ambient temperature	0 °C to + 40 °C
Permissible storage temperature	– 25 °C to + 85 °C
Cooling method	AF
Site altitude	The specified load values refer to site altitudes of up to 1000 m a.s.l. At site altitudes over 1000 m, the load values must be reduced as shown in the diagram below.



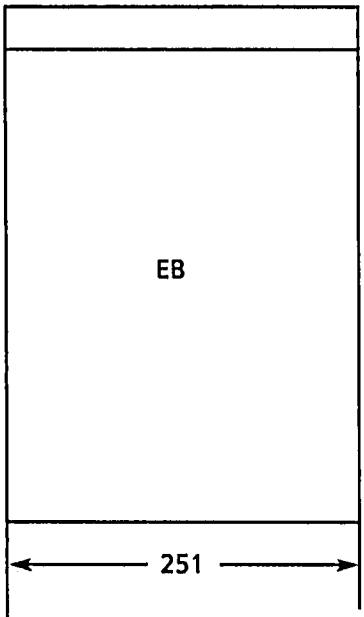
*) DIN VDE 0160 provides that the internal undervoltage monitoring device need not respond to periodic voltage notches with a magnitude of 20 % of the crest value and a duration of 1 ms occurring once every 3.3 ms while the system voltage is 90 % of the rated supply voltage.

1.6 Ordering data overview, options



Input/energy feedback block (35 kW) 6SC6901-0VR07

Input/energy feedback block (23 kW) 6SC6901-0VR05

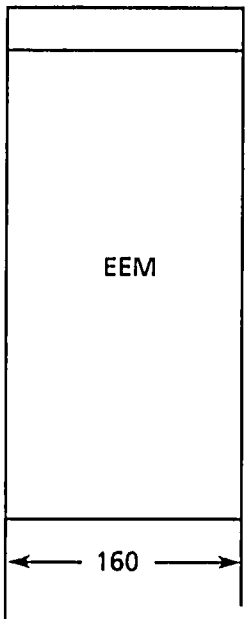


Feed axis controller complement to be specified by "Z" suffix to the machine-readable product designation, followed by the order codes of the desired controller modules.

Order code	Number of plug-in station	Number of controllers on one module
N21	2	1
N22	2	2
N23	2	3
N31	3	1
N32	3	2
N33	3	3

Electronics block 6SC6901-0E — 0 - Z

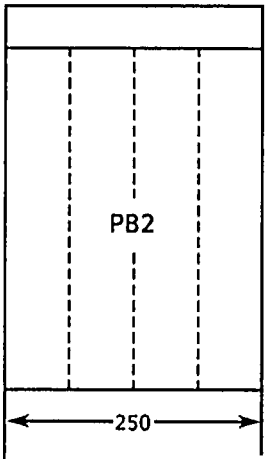
DC link control version
0 ≙ Standard
1 ≙ External DC link
2 ≙ Extension module
Feed axis controller version
A ≙ Analog
D ≙ Digital



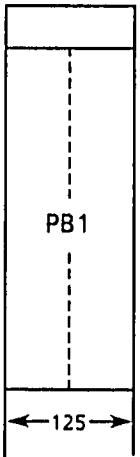
Electronics extension modul 6SC6901-0EA20 - Z

Feed axis controller complement to be specified by "Z" suffix to the machine-readable product designation, followed by the order codes of the desired controller modules.

Order code	Number of plug-in station	Number of controllers on one module
N41	4	1
N42	4	2
N43	4	3
N51	5	1
N52	5	2
N53	5	3



Power module block PB2 with 4 plug-in stations 6SC6901-2AA00-Z



Power module block PB1 with 2 plug-in stations 6SC6901-1AA00-Z

Power module complements to be specified by "Z" suffix to the machine-readable product designation, followed by the order codes.

Power circuit modules available:

Order code	Current	Number of plug-in stations required
H20	20 A	2
H30	30 A	2
H40	40 A	3
H60	60 A	3
A07	7/14 A	1
A15	15/30 A	1
A30	30/60 A	2
A40	40/80 A	3

Pulse cables	FD	0.5 m	6SC6101-0LA20 (for 3 axes)
		1.0 m	6SC6101-0LA21 (for 3 axes)
		1.5 m	6SC6101-0LA22 (for 3 axes)
	MSD	0.25 m	6SC6101-0LA30
		1.0 m	6SC6101-0LA31
Terminating connector	FD*		6SC6101-0XA00
	MSD**		6SC6101-0XA06

* This is required when using a feed axis controller which is not connected to a power module.

** This is required if the unit is to be operated without MSD power module.

Optional modules

A73 Feed control for C-axis mode (MSD)
(Instructions/Order No.: 6SC6501-0AC76)

A74 Spindle positioning control without NC (MSD)
(Instructions/Order No.: 6SC6501-0AD76

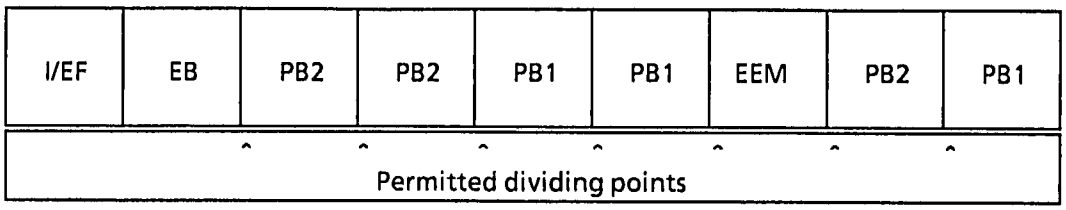
A75 Feed control for C-axis mode and oriented spindle stop (german only)
(Instructions/Order No. 6SC6501-0AE00)

2 Installation

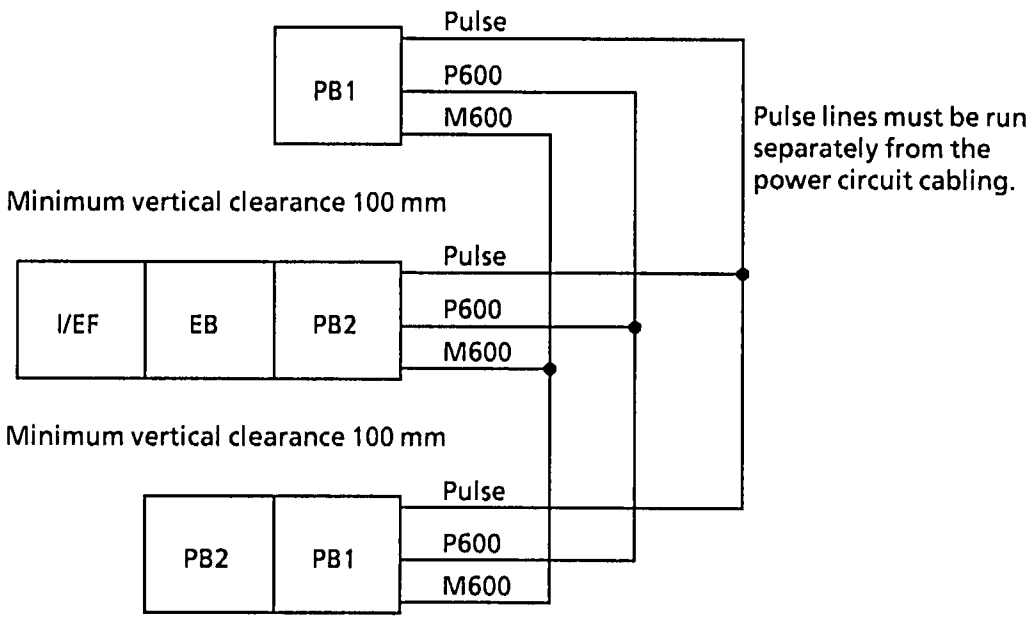
2.1 Mounting in cabinets or machine frames

The combination unit is intented for vertical mounting in cabinets or machine frames. All components must be mounted with the incoming supply and motor terminals pointing downwards.

For the mounting dimensions and fixing point geometry, see the dimension drawings.



The unit can be subdivided at the permitted points and mounted in up to 3 tiers. The minimum basic unit consisting of the input/energy feedback block and the electronics block must invariably be mounted in the middle tier. The DC link wiring should take the shortest possible routes and use 2 x 16 mm^2 twisted cable. All modules must be earthed in operation. Components mounted side-by-side can be interconnected with the links supplied with the equipment.



The MSD power module may only be fitted immediately adjacent to the electronics block or in the top tier.

To ensure unobstructed cooling air circulation, clear spaces of 100 mm must be provided above and below the component units. The units must be protected against electrically conducting dust deposits and vapours (degree of protection IP-00 to DIN 40050).

2.2 Connecting instructions

Connect the units according to the terminal connection diagram. Setpoint and actual-value lines must be screened and segregated from power cabling and contactor control lines. Screen leads must be direct-connected to the converter earth bars. The control lines for the I/O module U1 must be segregated from the conductor control lines.

The unit may only be connected to an earthed-neutral system. The infeed connections and the power connections between the converter and motor must be made with the correct phase relation for a clockwise rotating field. The motor supply leads must be twisted or a 3-core cable with additional earth conductor must be used (max. 16 mm^2). The earth conductors of the infeed cable and of the motor supply cables must be connected to the converter earth bars. Poor earthing of the motors may give rise to malfunctions of electrical components.

Galvanic isolation of the AC motor from the supply voltage or of the inverter from the supply system must be provided for safety reasons by a contactor connected between the motor and PWM inverter or between the supply system and inverter.

The control circuitry must ensure that this contactor can be operated only at zero current, i.e. when the inverter pulses are blocked (no signal at terminal 63). Terminal 63 must additionally be interlocked with an auxiliary contact of the isolating contactor.

A delayed-dropout contactor must be used to prevent a dropout, in the event of a supply interruption, before the buffer time of the PWM inverter has elapsed. The dropout delay must be longer than the maximum response time of pulse enabling terminal 63, which is 40 ms. In the case of a DC-actuated contactor (3TB4.17-OB) this can be achieved by connecting a free-wheeling diode (3TX6406-OH) in the coil circuit of the contactor.

The sensor line between the motor and the PWM inverter must be 16-core screened cable according to the cable schematics in Sections 2.3 and 2.4. The outer insulation of the sensor cable must be stripped at the earth bus in order to connect the screen to M (0 V reference potential). The screen of the sensor cable must not be connected to the housing of the motor-side connector to prevent formation of an earth loop. In the case of the main spindle drive the screen must be connected to pin H of the connector. This ensures that the internal screen of the sensor electronics is connected to the screen of the sensor cable and, hence, to M potential (screen terminal G01-X131). The chassis earth connection between the NC and the inverter unit should take the shortest possible route (conductor cross-section at least 10 mm^2).

Terminal G01-X131 must be connected to the earthing point of the NC or to earth if no NC is provided.

If the complete electric installation of a machine tool is subjected to high-voltage testing, it is absolutely essential to separate all connections from the SIMODRIVE unit. Otherwise there is the risk of damage to the electrical and electronic components.

To ensure reliable earthing, the fixing screws of the cover panels must be tightened before putting the unit in operation.

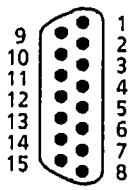
The 2 x 17-pole terminating connector which can be ordered separately must be inserted in socket X62 on jumpering module U2 if the unit is operated without MSD inverter.

A ready-made cable assembly can be ordered for the sensor line between the motor and the converter unit.

2.3 Connection of the main spindle drive

2.3.1 Sensor cable between the motor and PWM inverter

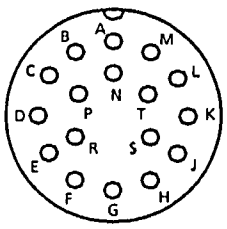
Connector on SIMODRIVE 690 unit U1-X131

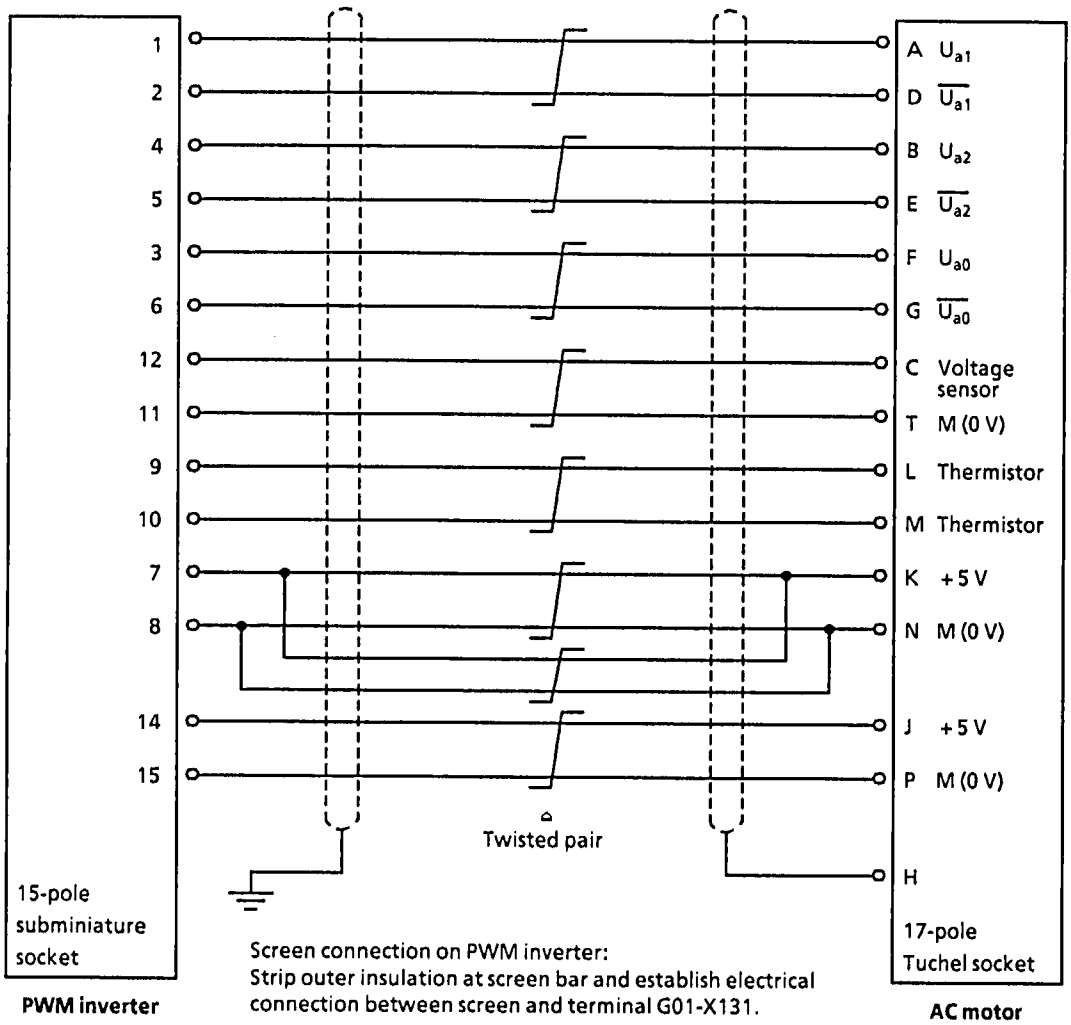


Order numbers:

Connector assy.	6ZY1075-0AA00
Cable support	6ZY1076-0AA00
Mounting plate	6SY9070
Latch	6SY9071

Connector on 1PH5/6 motor





Shaft encoder cable 8 x 2 x 0.18 mm², shielded twisted-pair cable

With connectors	Order No. 6FC9348-0A.
Sold by the meter, without connectors	Order No. 6FC9343-0AA

Fig. 2.1 Sensor cable connection

2.3.2 Terminals of the main spindle drive

Module-Connector. Pin	Terminal number	Signal level**)	Function	I or O	Description
U1- X111.1	56		$n_{set\,1}$ (+)	I	Speed setpoint 1
X111.2	14		$n_{set\,1}$ (−)	I	(+/− 10 volts)
X111.3	15			O	M (0 V reference)
X111.4	24		$n_{set\,2}$ (+)	I	Speed setpoint 2
X111.5	8		$n_{set\,2}$ (−)	I	(+/− 10 volts)
X111.6					
X111.7	75		n_{act} display	O	(DAC1)
X111.8	76		Reference pot.	O	Analog output (DAC1)
X111.9	16		P/P_{max} display	O	for connecting (DAC2)
X111.10	77		Reference pot.	O	a display (DAC2)
X111.11	18		Unass. output	O	instrument (DAC3)
X111.12	78		Reference pot.	O	(DAC3)
X111.13	47		P10	O	Reference voltages for the
X111.14	69		M	O	speed setpoint input
X111.15	46		N10	O	(max. 10 mA)
U1- X121.1	9		P24 Ex	O	Aux. voltage derived from DC link;
X121.2	19		M24 Ex	O/I	not available before DC link charging.
X121.3	63	H	Pulse enabling	I	L signal causes pulse blocking (drive coasts to standstill)
X121.4	64	H	Controller enabling	I	H signal enables power transistor driving pulses and controllers. L signal causes the drive to be ramped down at the rate set in P-17; controller blocking occurs at n_{min}.
X121.5	81	L	Quick stop	I	L signal sets n_{set} suddenly to 0.
X121.6	62	H	$T_{ramp} = 0$		H signal bypasses ramp generator
X121.7	111	H	Torque limiting	I	H signal activates an additional torque limit
X121.8	60	H	Oscillating	I	Injection of oscillating setpoint for gear changing
X121.9	117	H	Gear step preselection	I	Terminals for changeover of controller parameters etc.
X121.10	118	H			
X121.11	*) 119	H			
X121.12	*) 158	H	Torque control	I	H signal causes changeover from speed control to torque control
X121.13	*) R	H	Reset	I	Remote resetting

Table 2.1 Connector pin assignment of the I/O module U1 (connectable cross-sections: 0.25 - 1.5 mm²)

*) Multi-function inputs, see Section 3.3.14
**) H ≙ + 18 V to + 30 V, L ≙ 0 V to + 2 V

2.3.3 Relay functions

Module - Connector. Pin	Terminal number	Permissible switching voltage		Contact	Function
		AC	DC		
G02- X141.6	216	60 V	30 V	NC	$n_{act} \leq n_x$ relay, drops off if $n_{act} > n_x$, adjustable via P-23 to P-26 (gear step-dependent, in rev/min). This relay can be assigned other functions (see P-53 and P-185 to P-189).
X141.5	214	60 V	30 V	M	
X141.4	215	60 V	30 V	NO	
G02- X141.9	210	60 V	30 V	NC	Motor overtemperature alerting relay, drops off if temperature threshold is exceeded or sensor fails. Adjustable via P-63 (°C). Drive is tripped approximately 4 mins later.
X141.8	208	60 V	30 V	M	
X141.7	209	60 V	30 V	NO	
G02- X141.1	109	60 V	30 V	NO	$M_d \geq M_{dx}$ relay, drops off if $M_d > M_{dx}$. The % setting via P-47 is referred to the current torque limit and is ineffectuated when n_{set} changes are made.
X141.2	108	60 V	30 V	M	
X141.3	110	60 V	30 V	NC	
G02- X131.8	127	60 V	30 V	NO	$n_{set} = n_{act}$ relay, picks up if $n_{set} = n_{act}$ within the tolerance band selected via P-27. Load-induced speed fluctuations leave the relay unaffected.
X131.9	126	60 V	30 V	M	
X131.10	128	60 V	30 V	NC	
G02- X131.4	74	60 V	30 V	NC	Ready/Faulted relay, Selectable via P-53. For explanations, see Section 3.3.9.
X131.3	73.1*)	60 V	30 V	M	
X131.2	73.2*)	60 V	30 V	M	
X131.1	72	60 V	30 V	NO	
G02- X131.7	116	60 V	30 V	NC	$n < n_{min}$ relay, picks up if $n < n_{min}$. Adjustable via P-21.
X131.6	114	60 V	30 V	M	
X131.5	115	60 V	30 V	NO	

Table 2.2 Connector pin assignment of the central module G02 (conductor cross-sections : 0.25 - 1.5 mm²)

The relays are de-energized under fault conditions. This fact must be taken into account when planning the external adaptive control.

*) Terminals 73.1 and 73.2 are interconnected via a 0 Ω resistor.

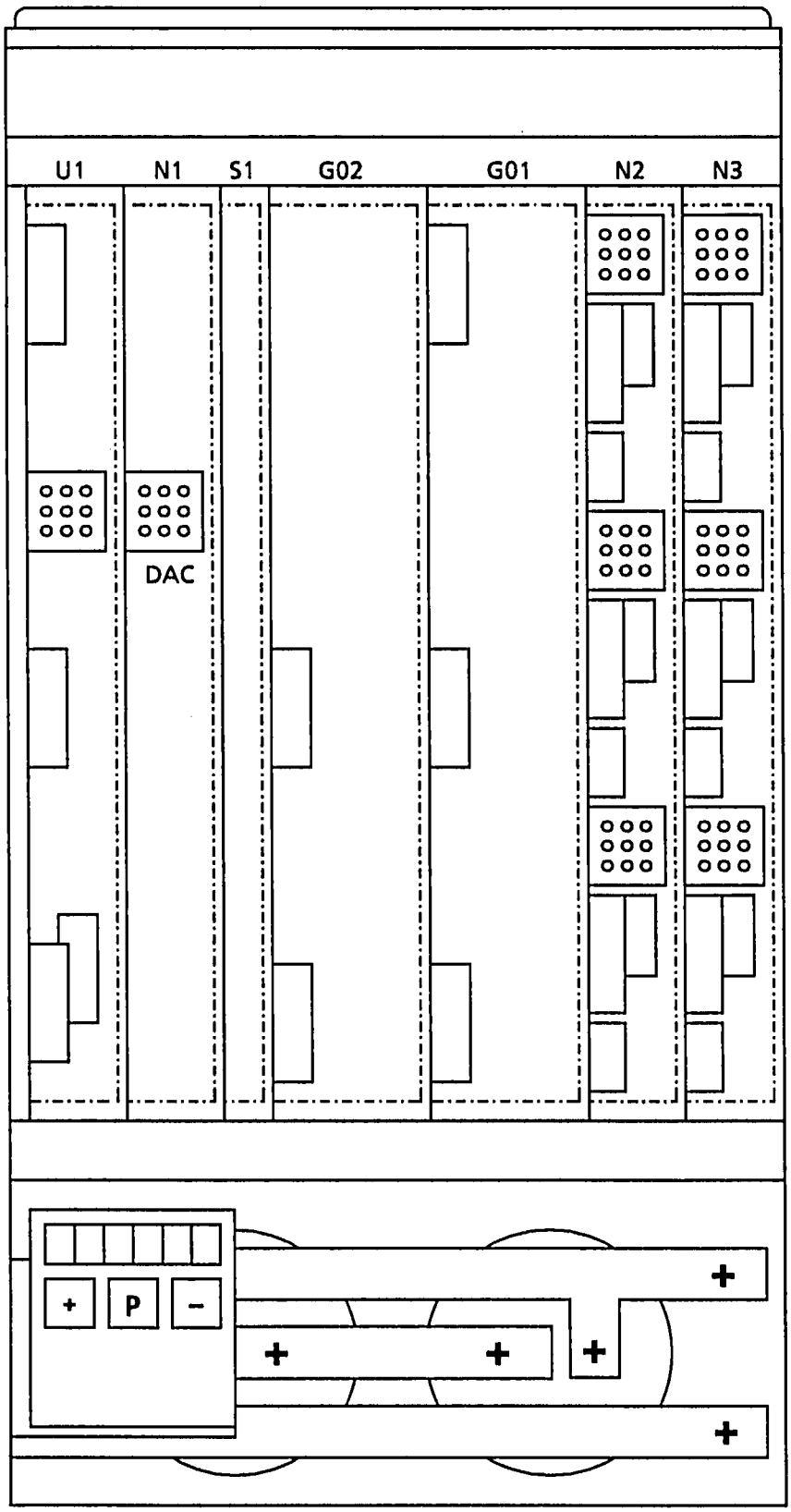


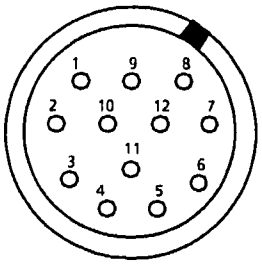
Fig. 2.2 Locations of terminals in SIMODRIVE 690 PWM inverter (electronics block)

2.4 Connection of the feed drive

Maximum cable length: about 50 m. Cable lengths of up to 100 m are possible, but may adversely affect the dynamic response and the smoothness of running at very low speeds.

2.4.1 Sensor cable between feed motor and PWM inverter

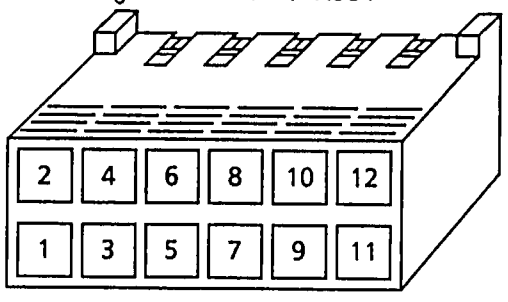
Connector on 1FT5 motor



Crimp connection side

Connector:
Siemens
Order No.: 6FC 9348-7AD

Connector on SIMODRIVE 690 inverter
+ N_o - X311/- X321/- X331



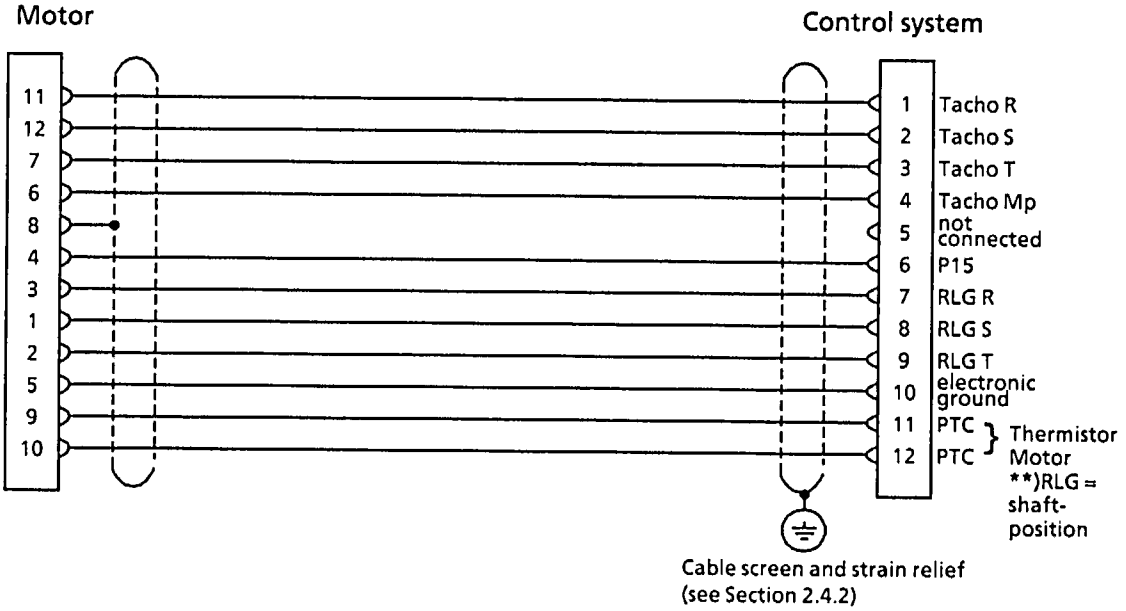
Crimp connection side

Connector casing:
DUBOX 65239-006 Messrs. Du Pont
Order No.: 6FC 9348-7AB (with 12 crimp contacts)

Crimp tools:
HT234 hand tool for contacts supplied loose
Messrs. Du Pont
Order No.: 6FC 9348-8AA
HT250/HT251 hand tool for contacts supplied on tape
Messrs. Du Pont
Order No.: 6FC 9348-8AB

Crimp contacts:
76357-401 (contacts supplied loose) Messrs. Du Pont
Order No.: 6ZY1074-0AA00
76347-403 (contacts supplied on tape) Messrs. Du Pont

76347-403 (contacts supplied on tape) can also be handled with the crimping pliers for HT234 contacts (supplied loose), once the crimp contacts have been taken off the tape.

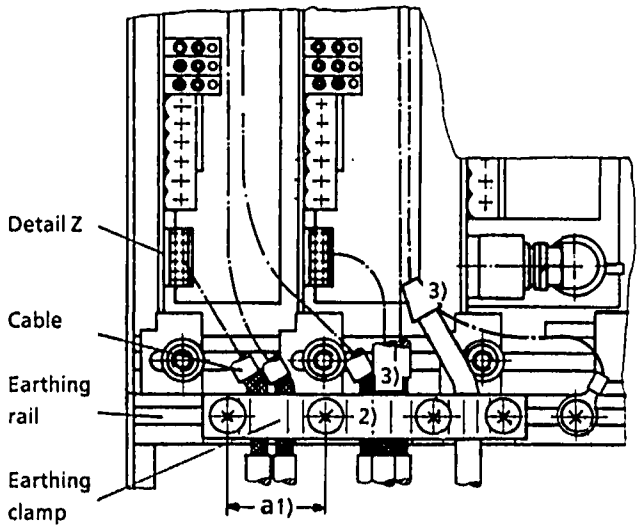


Cable screen and strain relief
(see Section 2.4.2)

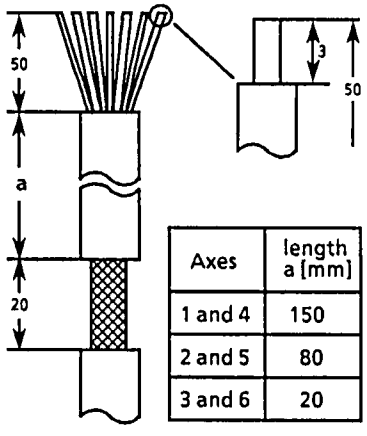
Shaft encoder cable, 12 x 0,23 mm², shielded with connectors
Sold by the meter without connectors

Order No. 6FC9348-5A.
Order No. 6FC9348-6AA

2.4.2 Shield connection and strain relief of cables



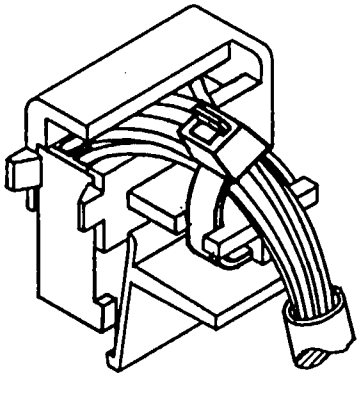
1) One to three cable shields can be connected, depending on distance a between screws
2) **Important!** Shield of setpoint cables from NC must not be connected to chassis earth
3) Alternative method of connecting the cable shields

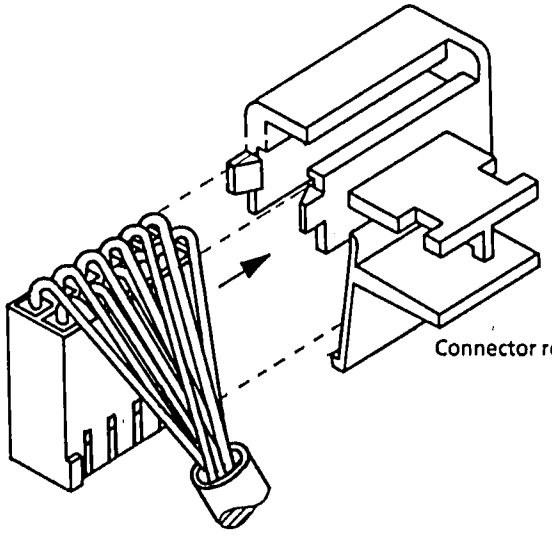


Axes	length a [mm]
1 and 4	150
2 and 5	80
3 and 6	20

Insulation stripped for earthing of cable shield and strain relief

Detail Z





Set of shield earthing parts, Order No.: 6SC6101-0SB01
The connector receptacle is included in the set of connection parts supplied with the control electronics for 1 axis.

2.4.3 Terminals of the feed drive control

Terminal No.	Location	Function	I or O *)	Typical voltage	Max. connectable cross-section
Supply voltages					
7	+G0-X111	Auxiliary voltage (18 - 30 V)	O	+24 V, 50 mA max.	1.5 mm²
10	+G01-X111	Auxiliary voltage (–18 to –30 V)	O	–24 V, 50 mA max.	1.5 mm²
45	+G01-X111	Electronics voltage	O	+15 V, 10 mA max.	1.5 mm²
44	+G01-X111	Electronics voltage	O	+15 V, 10 mA max.	1.5 mm²
9, 19	+G01-X121	Enabling voltage	I/O	+24 V, 0 V	1.5 mm²
11, 15	+G01-X111	External aux. voltage	I	+24 V, 1 A**)	1.5 mm2
15	+G01-X111 +G01-X131	Earth } internally 0 V ref. } connected	O /O	0 V 0 V	1.5 mm2 M6 terminal stud
Electronic signals					
R	+G01-X111	Fault memory resetting	I	0 V	1.5 mm²
56, 14	+N_o-X1_o1	Speed setpoint I	I	±10 V	1.5 mm²
24, 8	+N_o-X4_o1	Speed setpoint II	I	±10 V	1.5 mm²
6	+N_o-X1_o1	Integrator blocking	I	+15 V	1.5 mm²
96	+N_o-X1_o1	Current limit reducing	I	–15 V	1.5 mm²
63	+G01-X121	Pulse enabling	I	+12 V to +30 V	1.5 mm²
64	+G01-X121	Drive enabling	I	+12 V to +30 V	1.5 mm²
65	+N_o-X1_o1	Speed controller enabling	I	+12 V to +30 V	1.5 mm²
16	+N_o-X4_o1	Actual current value	O	±10 V (R_i = 2 kΩ)	1.5 mm²
58	+N_o-X4_o1	Current setpoint	I	±10 V	1.5 mm²
Messages					
5	+G0-X111	I^2t ⩾ and /or ϑ_{Motor}	A	0 V, 50 mA	1.5 mm²
74,73.1*) (NC) 72,73.2*) (NO)	+G0-X121	Relay contact, signallling drive fault/ready	A	250 V CA, 5 A 30 V CC, 5 A	1.5 mm²

Table 2.3

*) I ≙ Input O ≙ Output

**) Tolerance: + 19 V to 30 V (see Section 4.1.12)

N_o ≙ N2, N3

X1_o1 ≙ X111, X121, X131

X4_o1 ≙ X411, X421, X431

*) Terminals 73.1 and 73.2 are interconnected via a 0 Ω resistor.

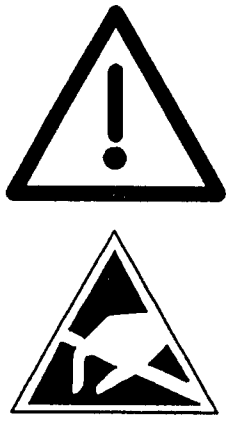
2.5 Enabling conditions for main spindle and feed axes

All axes of the SIMODRIVE 690 combination unit draw from a common DC link. This DC link is controlled exclusively by the electronics section of the main spindle drive. This fact must be considered in the higher-level control arrangement. Internal interlocks prevent the main spindle drive controller from being enabled before the DC link has been charged and the absence of fault signals ascertained. Only in this status is it permissible for the feed axis drives to be enabled (Terminal 64). This means that availability of the "Ready" signal for the main spindle (Terminal 64) is a prerequisite for the enabling of the feed axes.

With due regard to this interlock the feed axes can be operated in the motor mode. The energy feedback capability of the inverter, however, is contingent upon availability of the main spindle controller enable signals (at Terminals 63 and 64). Only thereafter will the DC link be controlled and will it be possible for braking energy from the feed drives to be fed back to the supply. Without these enable signals, an excessive feedback of braking energy from the feed axes causes the inverter to initially convert this energy to heat in the integral chopper resistor. This resistor, however, is rated for short-time power peaks only and is provided with overload protection. Operation of this overload protection trips the inverter on grounds of fault criterion F-41 (DC link overvoltage).

From software release 06 onwards it is possible to enable the DC link controller before the pulse enable signal appears at Terminal 63 of the MSD control electronics. To accomplish this, the contents of parameter P-53 must be increased by 8 0 H, thereby limiting the effect of the main spindle controller enable signal (Terminal 64) to the main spindle drive. This makes it possible for the DC link to be controlled and for braking energy from the feed axes to be recuperated while the main spindle drive controller is inhibited.

3 Commissioning the main spindle drive



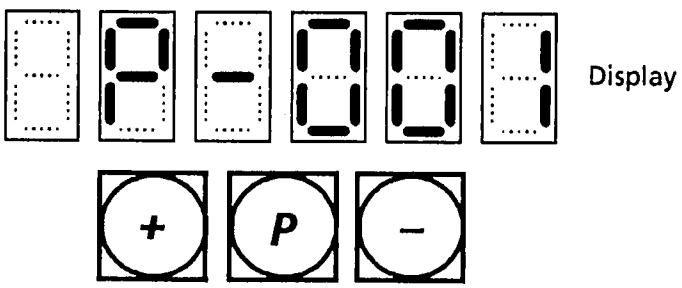
WARNING

Safe operation is dependent upon proper handling and installation by qualified personnel under observance of all warnings contained in this instruction manual.
Non-observance can result in death, severe personal injury or substantial property damage.

The modules of the unit include electrostatically sensitive devices. Before touching a PCB the person carrying out the work must himself be electrostatically discharged. The simplest way of accomplishing this is to touch an electrically conducting earthed object (e.g. a bare metal part of a switchboard or the protective-earth contact of a socket outlet).

3.1 Display and control elements

The control and display system consists of three keys and one six-position 7-segment display.



Display

Fig. 3.1 Display module H1

The display is used to indicate and change parameter settings and to indicate status and fault messages.

Key	Function
"P"	Change from parameter number to parameter value and vice versa
"+"	Go to higher parameter number or increase the parameter value
"–"	Go to lower parameter number or decrease the parameter value
"+" and "P"	Rapid changing of parameter number or value in positive direction
"–" and "P"	Rapid changing of parameter number or value in negative direction

Table 3.1 Function of keys in operator control mode

Key	Function
"P"	Fault resetting when controller has been blocked
"+"	Proceeding to next fault message, if any
"–"	Temporary changeover to operator control mode (for about 1 minute)

Table 3.2 Function of keys in fault display mode

3.2 Operator control and parameter indication

A parameter value cannot be changed until the write protection in parameter P-51 has been cancelled. This is done by setting parameter P-51 to 0 0 0 4 H. The value of a selected parameter can then be increased by pressing key S2 (" + "). The change is indicated on the display. Pressing of key S1 ("–") decreases the parameter number or the value of selected parameter.

Pressing of key S3 ("P") causes the display to change from the parameter number to the parameter value and vice versa.

Momentarily pressing the " + " key or " – " key causes the last digit to be increased or decreased by "1". The rate at which a parameter number or parameter value is changed can be increased by prolonged pressing of the appropriate key. The rate of change can be increased further by a factor of 16 by pressing the "P" key in addition to the " + " or " – " key.

Example: In order to decrease the value of parameter P-32 (speed controller reset time) from 512 ms to 70 ms, proceed as follows:

1) Actuate "P" to obtain parameter number display.

2) Actuate "–" or " + " key to select parameter P-51 " (write protection).

3) Actuate "P" to obtain parameter value display.

4) Actuate " + " to select hexadecimal value 0 0 0 4 H.

5) Actuate "P" to obtain parameter number display.

6) Actuate "–" to select parameter P-32.

7) Actuate "P" to obtain parameter value display
Display reads 512 (≙ 512 ms).

8) Actuate "-" to decrease this value to 70 (≙ 70 ms).
The change is immediately effective.

The example shows that the parameters are set in physical quantities. The setting range can be preselected per software. In the present example the reset time is adjustable from 1 ms to 6000 ms with a minimum increment of 1 ms (≙ 0.2 ‰). The values are displayed in either decimal or hexadecimal format. Hexadecimal values are identified by a letter "H" appearing in the last position of the display and by leading zeros not being suppressed.

If the hexadecimal format has been selected, the parameter number on the display is followed by a dot in the last position. Changes of parameter values in decimal format can only be carried out between preprogrammed maximum and minimum limits.

Parameter changes become immediately effective via the RAM with only few exceptions (P-110, P-115, P-116, P-119, P-141, P-195). If a changed parameter value is to be stored, parameter P-52 (writing into the EEPROM) must be set to 0 0 0 1 H. The display in parameter P-52 changes back to 0 0 0 0 H once the value has been written into the EEPROM. As a prerequisite, the write protection must previously have been cancelled also per hardware. This is done by opening the write protection jumper S1 on controller module N1.

3.3 Parameter groups

The parameters are divided into the following groups:

- Status indications (see Section 3.3.1)	(P-00)
- Measured value indications (see Section 3.3.2)	(P-01 to P-11)
- Standardization of analog outputs (see Section 3.3.3)	P-12 to P-13
- Speed settings (see Section 3.3.4)	P-14 to P-15
- Ramp-function generator settings (see Section 3.3.5)	P-16 to P-18
- Speed monitor settings (see Section 3.3.6)	P-20 to P-29
- Speed controller settings (see Section 3.3.7)	P-31 to P-38
- Torque limits (see Section 3.3.8)	P-39 to P-50
- Key words and control words (see Section 3.3.9)	P-51 to P-53
- Parameters for auxiliary NC function M19 (see Section 3.3.10)	P-54 to P-62
- Motor and supply cable data (see Section 3.3.11)	P-63 to P-65 P-81 to P-82
- Assignment and standardization of the DACs and test sockets (see Section 3.3.12)	P-66 to P-69 P-76 to P-80
- Forming of the DC link capacitors (see Section 3.3.13)	P-75
- Assigment of functions to terminals (see Section 3.3.14)	P-83 to P-85
- Matching to motor and converter data (see Section 3.3.15)	P-95 to P-98
- Software release (see Section 3.3.16)	(P-99)
- Status indications (expanded by optional functions) (see Section 3.3.17)	(P-100)
- C-axis settings (see Instructions GWE 462 500.9011.76 J)	P-103 to P-119 P-157, P-158, P-195
- Positioning settings (see Instructions GWE 462 500.9012.76 J)	P-120 to P-150
- Oscillation settings (see Section 3.3.19)	P-154 to P-156
- Motor data (see Section 3.3.20)	P-160 to P-177
- V/Hz controlled operation (see Section 3.3.21)	P-184
- Selectable relay functions (see Section 3.3.22)	P-185 to P-189
- Damping element (see Section 3.3.23)	P-196 to P-198

The parameters in parentheses are indications; all other parameters can be changed after entering the key word in P-51.

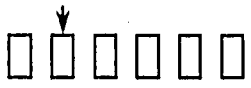
3.3.1 Status indications

In parameter P-00 the current operating state is indicated on the display.

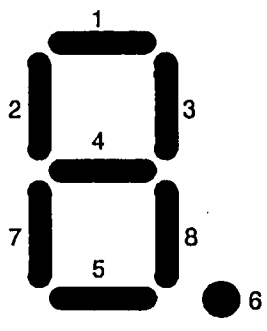
3.3.1.1 First position

This position of the display is not used in the status and fault indicating mode and remains dark.

3.3.1.2 Second position



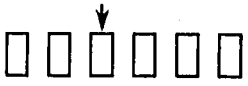
This position indicates the states of the relay functions after completion of DC-link charging. The assignment of segments to relay functions is as follows:



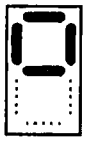
Segment	Meaning	Response threshold set in parameter
1	$n_{act} < n_x$	P-23, P-24, P-25, P-26
2	$M_d < M_{dx}$	P-47
3	$\overline{\text{Motor overtermperature alerting}}$	P-63
4	$n_{set} = n_{act}$	P-27
5	$n_{act} < n_{min}$	P-21
6	Ready/Fault	P-53
7	Limiting position 1 reached (Option A74)	P-144
8	Limiting position 2 reached (Option A74)	P-145

The segments light up when the corresponding relays are in the picked-up state.

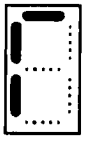
3.3.1.3 Third position

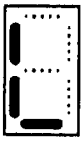


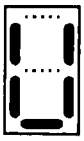
The symbols displayed in this position have the following meanings:

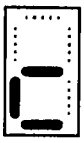
Symbol  : The unit is in a waiting state.
The condition still to be fulfilled is indicated in the next position.

 : All enabling signals are available;
speed control mode has been preselected.

 : All enabling signals are available;
torque control mode has been preselected.

 : All enabling signals are available;
auxiliary NC function M19 has been activated.

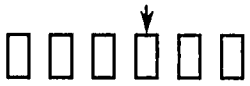
 : All enabling signals are available;
V/Hz-controlled operation

 : All enabling signals are available;
speed control in C-axis mode has been preselected.

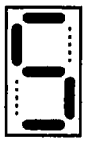
 : Holding brake in C-axis mode

 : All enabling signals are available;
position control mode has been selected.

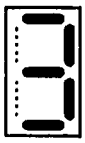
3.3.1.4 Fourth position



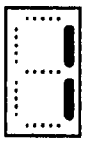
The conditions that must be fulfilled before the motor can be started are indicated in this position:

Symbol  : Enabling signal for line-side converter firing circuit not available

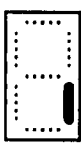
 : DC link not yet charged

 : Pulse enabling signal not present (terminal 63)

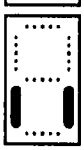
 : Controller enabling signal not present (terminal 64)

 : Ramp generator enabling signal not present (terminal 81)

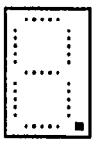
When all of these conditions are fulfilled, the fourth position from the left changes to indicating the torque direction called for by the control:

Symbol  : Motor operation

or

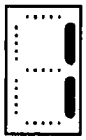
 : Generator operation

3.3.1.5 Fifth position

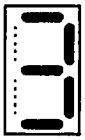
 : Damping element active (P-196, P-197, P-198)

3.3.1.6 Sixth position

This position indicates which gear step (GS) has been selected. A "1" is displayed if no gear step is provided or if none has been selected.

Symbol  : Terms. 117, 118 and 119 not activated (GS1)

 :Term. 117 activated (GS2)

 : Term. 118 activated (GS3)

 : Term. 119 activated (GS4, P-83 = 1)

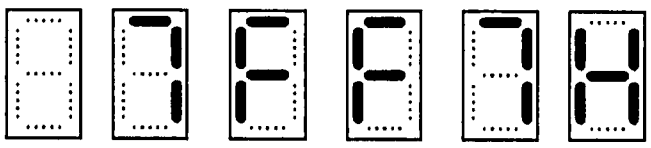
3.3.2 Measured value and status indications

Indications assigned to parameters P-01 to P-11:

P-01 to P-11

Parameter	Indication	Unit	Format
P-01	Speed setpoint	%	0 - 100.0
P-02	Actual speed value	min-1	0 -16000
P-03	Torque-generating current component	%	0 - 100.0
P-04	M_d/M_{dmax} or, when $n = n_{rated}$, P/P_{max} (P-39)	%	0 - 100.0
P-05	Motor frequency	Hz	0 - 300.0
P-06	DC link voltage	V	0 - 999
P-07	DC link current	A	0 - 300
P-08	DC link power	kW	0 - 160.0
P-09	Line frequency	Hz	0 - 100.0
P-10	Stator temperature	°C	-10 - +150
P-11	Status of binary inputs	Hex	

Example of P-11: All terminals are activated, control keys are not actuated

Display 

P-11

8		Term. 119	Term. 111	Term. 63	"−"	
0		Term. 158	Term. 60	Term. 64	"+"	
5		Term. R	Term. 117	Term. 81	"P"	
0			Term. 118	Term. 62		

3.3.3 Standardization of analog outputs

The analog output voltages at terminals 75 and 16 can be standardized by setting parameters P-12 and P-13. With the parameters set to 100.0 % (50.0 %) the analog output voltages representing the maximum values of the motor are 10 V (5 V).

P-12 Standardization of the DAC for the actual-speed value (Terms. 75/76) −200.0 % - +300.0 %

Standardization is valid only if: P-66 = 0272H
P-67 = 0000H

P-13 Standardization of the DAC for M_d/M_{dmax} or P/P_{max} (Terms. 16/77) −200.0 % - +300.0 %

Standardization is valid only if: P-68 = 0274H
P-69 = 0000H

3.3.4 Speed settings

P-14 Standardization of n_{set} (≙ tacho matching) – 250.0 % - + 250.0 %
Parameter P-14 is used to select the speed obtained with ± 10 V analog input voltage.
If n_{set} = 10 V and P-14 = 100 %, 4 times the rated speed (n_{rated}) is reached provided that P-29 ≥ 4 x n_{rated}.
The sign of parameter P-14 determines the direction of rotation of the motor:

+ ≙ CW rotation with positive speed setpoint
– ≙ CCW rotation with positive speed setpoint

P-15 Offset correction of the n_{set} input (≙ drift compensation) 0 0 0 0 H
e.g. positive correction value 0 0 2 F H,
negative correction value F F D 0 H
The hexadecimal format is used to permit finest possible grading of the offset correction.

P-113 Speed setpoint channel selection
The speed setpoint can be input via terminals 56/14 or 24/8 on the I/O module. These setpoint inputs can be switched by setting P-113.

P-113 setting	Terminal	
	56/14	28/4
0	off	off
1	on	off
2	off	on
3	on	on

3.3.5 Ramp function generator settings

Parameters P-16 and P-17 are used for separate adjustment of the ramp-up and ramp-down times.

P-16 Ramp-up time (from n = 0 to n_{max}) 0.00 - 32.00 s

P-17 Ramp-down time (from n_{max} to n = 0) 0.00 - 32.00 s

P-18 Degree of ramp rounding (0 ≙ no rounding) 0 - 10

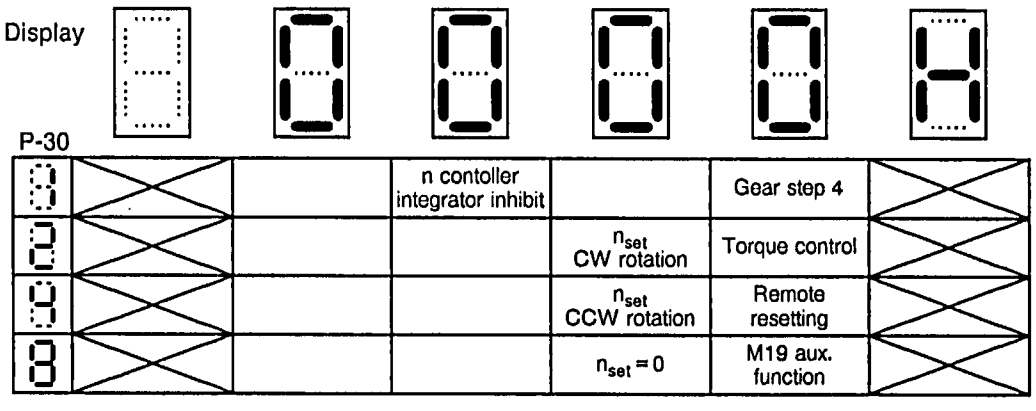
3.3.6 Speed monitor settings

P-21 Response threshold of the n_{min} relay 0 - 6300 min-1

P-22 Response threshold of the internal n_{min} detection system required for stopping the drive without any reverse rotation. At n_{min} the torque is cut off so that the drive coasts to a standstill. This n_{min} threshold is <u>not</u> identical to the response threshold of the n_{min} relay, but may be set to the same value. 0 - 1500 min-1

P-23	Response threshold of the $n<n_x$ relay	Gear step 1	0 - 16000 min-1
P-24	Response threshold of the $n<n_x$ relay	Gear step 2 (Term. 117)	0 - 16000 min-1
P-25	Response threshold of the $n<n_x$ relay	Gear step 3 (Term. 118)	0 - 16000 min-1
P-26	Response threshold of the $n<n_x$ relay	Gear step 4 (Term. 119)	0 - 16000 min-1
P-27	Tolerance band of the response threshold of the $n_{act} = n_{set}$ relay. This per cent value is referred to the rated speed.		0.1 % - 11.0 %
P-29	Maximum motor speed (speed limitation)	4-pole motors: 2-pole motors:	0 - 11500 min-1 0 - 20100 min-1

P-30 Indication of the functions assigned to terminals 119, 158 and R (via parameters P-83 to P-85).
The following codes are displayed only if the corresponding function has been set and the terminal is activated.



3.3.7 Speed controller settings

The speed controller has a PI characteristic which can be separately adjusted for four gear steps.

P-31	Speed controller gain	Gear step 1	0.0 - 120.0
P-32	Speed controller reset time	Gear step 1	0 - 6000 ms
P-33	Speed controller gain	Gear step 2 (Term. 117)	0.0 - 120.0
P-34	Speed controller reset time	Gear step 2 (Term. 117)	0 - 6000 ms
P-35	Speed controller gain	Gear step 3 (Term. 118)	0.0 - 120.0
P-36	Speed controller reset time	Gear step 3 (Term. 118)	0 - 6000 ms
P-37	Speed controller gain	Gear step 4 (Term. 119)	0.0 - 120.0
P-38	Speed controller reset time	Gear step 4 (Term. 119)	0 - 6000 ms

3.3.8 Torque limit settings

In the constant torque range the limit settings refer to the motor rated torque. At higher than rated speeds, i.e. in the constant output range, the torque limit settings refer to the current operating point. With a torque limit setting of 100 %, for example, the torque is limited to the rated torque at speeds up to rated speed. At higher speeds the torque limit drops in proportion to 1/n in such a way that the rated output is reached at any speed.

The lowest setting governs if several limits are active at the same time.

P-39	1st torque limit Absolute torque limit	0.0 - 180.0 %
P-40	Braking torque limit in % of the maximum attainable driving torque (motor torque not reduced by limit settings).	0 - 100 %
P-41	2nd torque limit This torque limit is activated via terminal 111 and (possibly) P-50.	0.0 - 180.0 %
P-42	Selection of the torque limit which temporarily limits the speed controller output after a changeover from motor operation to generator operation.	25 - 80 %
P-43	Duration of the torque limitation set in P-42.	40 - 200 ms
P-44	Torque limit for gear step 2 (Term. 117)	0.0 - 180.0 %
P-45	Torque limit for gear step 3 (Term. 118)	0.0 - 180.0 %
P-46	Torque limit for gear step 4 (Term. 119)	0.0 - 180.0 %
P-47	$M_d > M_{dx}$ relay This setting refers to the currently active torque limit.	0.0 - 100.0 %
P-48	Torque setpoint standardization M_{dset}	– 250.0 % - + 250.0 %
P-49	Torque setpoint offset correction M_{dset}	0 0 0 0 H
P-50	Speed at which changeover from 1st to 2nd torque limit takes place on condition that terminal 111 carries active signal. The second torque limit is activated if terminal 111 carries an active signal and the changeover speed in P-50 is exceeded.	0 - 11500 min^{-1}

*) Effective only in the torque control mode (term. 158) (see Section 3.5.2)

3.3.9 Key and control words

P-51 Key word for parameter variability. (Write protection is ineffectuated by writing it in parameter P-51.) Initializing on switch-on of the unit causes 0 0 0 0 H to appear on the display. — 0000H

Setting P-51 to 0 0 0 4 H cancels the write protection for parameters P-12 to P-79, P-83 to P-85 and P-95 to P-98.

P-52 Setting P-52 to 0 0 0 1 H causes the EEPROM to be overwritten with the contents of the EEPROM duplicate, which is stored in the RAM, provided that the hardware write protection has been cancelled by opening the write protection jumper S1 on controller module N1. LED3 lights up (see Section 3.3.12). — 0000H

P-53 Various control functions can be activated and changed by setting the appropriate bit patterns in command parameter P-53. Combination of such functions is possible.

With the least significant bit (bit 0) not set, the "Ready" relay remains in the picked-up state as long as there is no fault signal, provided that the pulse enabling and controller enabling signals are present and that the motor is in the magnetized state. — 0000H

With the least significant bit (bit 0) set, the "Ready" relay remains in the picked-up state as long as there is no fault signal. — 0001H

Setting of bit 3 enables the setpoint input via the assignable-function terminals (P-83 to P-85) (also see Section 3.3.14). — 0008H

With bit 5 set, a changeover from controller enabling to controller blocking while DC link voltage is available results in an additional fault resetting signal — 0020H

With bit 6 set, fault messages F-01 and F-02 are cancelled automatically on voltage recovery, provided that no controller enabling signal is present. — 0040H

Setting of bit 7 causes the DC link controller to be enabled when pulse enabling for the main spindle drive takes place. — 0080H

With bit 8 not set, a speed setpoint input of less than 6 min^{-1} is interpreted as meaning 0 min^{-1}. — 0000H

With bit 8 set, there is no lower limit to the speed setpoints that can be input. — 0100H

Setting of bit 9 causes the function of the n_x relay to be changed into a preselected other function (P-185 to P-189). — 0200H

If several bits are set, the corresponding combinations must be added in hexadecimal form, e.g.:
Setting of bit 0, bit 6, bit 7 and bit 8 ≙
0001H + 0040H + 0080H + 0100H = 01C1H

0	0	0	1
0	0	4	0
0	0	8	0
0	1	0	0
0	**1**	**C**	**1**

3.3.10 Parameters for auxiliary NC function M19 (oriented spindle stop)

This group of parameters is for the settings required for auxiliary NC function M19, which is in charge of optimization of the oriented spindle stop and controlled standstill functions (see Section 3.5.1).

The functions of these parameters are activated only on condition that the "M19 function" signal is present at the terminal assigned to this function by appropriate setting of parameters P-83 to P-85 (assignment of functions to terminals).

P-54	Speed setpoint standardizing factor for M19 operation. Switchover to this standardizing factor for the purpose of spindle positioning via NC takes place if the speed drops below the limit set in P-56. The set standardization value must have the same sign as P-14.	– 200.0 % - + 250.0 %
P-55	Offset correction of the speed setpoint channel in M19 operation. Outside M19 the offset correction selected in P-15 is active. Also see Section 3.3.4.	0 0 0 0 H
P-56	Speed below which the setpoint standardizing factor selected in P-54 becomes active.	0 - 8000 min^{-1}
P-57	Proportional gain of internal position controller. 0 1 0 0 H corresponds to unity proportional gain.	0 0 0 0 H
P-58	Intensification of actual-speed signal weighting in M19 operation	1 - 10
P-59	Positioning bandwidth of the speed setpoint channel in M19 operation. Setting of positioning "window" in increments (+ / –).	Hex
P-60	"In position" monitoring time elapsing before activation of internal position controller. Once the spindle orientation has steadied within the positioning window selected in P-59, the monitoring time set in P60 runs down. The internal position controller is activated thereafter.	0.0 - 16.0 s

3.3.11 Motor data and supply cable resistance

Setting of the motor code number (see Section 3.3.15) causes all control-relevant type-specific data of the motor to be activated automatically. In the present parameter group it is only possible (and only necessary) to set a lower maximum motor temperature and the resistance of the motor supply cable.

P-63 Maximum stator temperature — 0 - 150 °C
If the set temperature is exceeded, the relay signal is output after approx. 30 s and the F-14 fault message appears after 4 min.

P-64 Fixed temperature of the motor — 0 - 150 °C
If a temperature other than 0 °C is set under this parameter, then this temperature is entered in the thermal calculation instead of the measured temperature and the motor temperature monitoring feature is ineffective

P-65 Supply cable resistance — 0 - 9999 mΩ
The calculated resistance value of one lead of the supply cable between the motor and the inverter is input under this parameter.

P-82 Magnetization integration time

P-82	Integration time
6	200 ms
7	400 ms
8	800 ms
9	1600 ms
10	3200 ms

3.3.12 Assignment and standardization of the DACs and test sockets

The processor module is provided with test sockets to facilitate the diagnosis of faults. These test sockets are connected to DACs whose assignment to measurands can be parameterized as required.

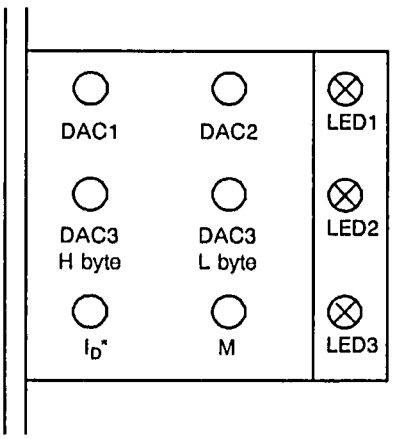


Fig. 3.2 Layout of test sockets and LEDs on the front of controller module N1

(Encoder, track A)

Assigning the DACs to the variables to be measured is carried out by entering the appropriate RAM addresses in parameters P-66, P-68 or P-76. The assignment of addresses can be seen from a "List of variables".

(Encoder, track B)

The assignment of test socket ID* to the DC link current setpoint is fixed and permanent.

(EEPROM write protection)

The contents of the associated addresses are standardized via parameters P-67, P-69 and P-77.

Standardization is carried out by shifting the bits of the selected data words to the left. Up to 15 left shifts can be carried out (setting the parameters in 0 0 0 F H format).

The DACs have a resolution of 8 bits. Only the high-order byte of a word is evaluated.
The DAC outputs corresponding to inputs 7 F H and 8 0 H are + 10 V and – 10 V respectively .
In the case of DAC3 the H byte is output via the left test socket and the L byte is output via the right test socket.

At terminals 18/78 of the I/O module the H byte and the L byte of the address entered in parameter P-76 are output at the same time.

NOTE

The analog outputs of the I/O module are connected in parallel to those of the CPU (DAC1 to DAC3). It must therefore be ensured that in normal operation the addresses of the variables to be indicated on external instruments have been stored in parameters P-66, P-68 and P-76.

P-66	Assignment of DAC1 (RAM address: 0 2 7 2 H ≙ n_{act} *))	0 0 0 0 H
P-67	Standardization of DAC1 (left shift)	0 0 0 0 H
P-68	Assignment of DAC2 (RAM address: 0 2 7 4 H ≙ M_d/M_{dmax} for $n < n_{rated}$ P/P_{max} for $n > n_{rated}$ *))	0 0 0 0 H
P-69	Standardization of DAC2 (left shift)	0 0 0 0 H
P-76	Assignment of DAC3 (RAM address: 0 3 1 E H ≙ P_{act} *))	0 0 0 0 H
P-77	Standardization of DAC3 (left shift)	0 0 0 0 H
P-78	Offset DAC1	0 0 0 0 H
P-79	Offset DAC2	0 0 0 0 H
P-80	Offset DAC3	0 0 0 0 H

Example: Measuring the actual speed value as an analog quantity

The address of the data word "Actual speed value" is entered in parameter P-66. The internal standardization of the actual speed value is 1500 min^{-1} ≙ 1 0 0 0 H.

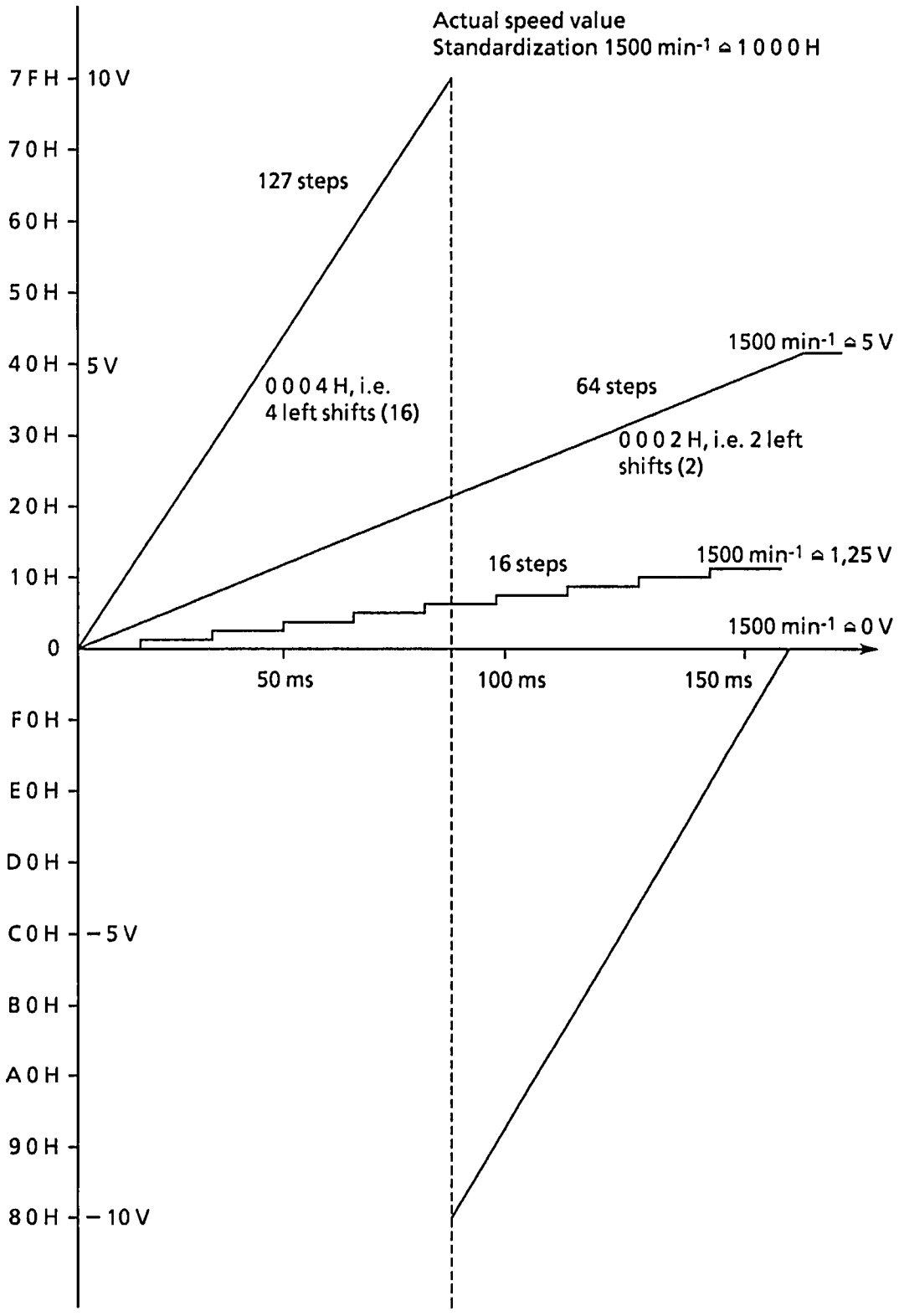
With a standardizing input of 0 0 0 1 H in parameter P-67 the data word to be output is shifted to the left by one position (multiplication by 2). The bit pattern then present at the input to the DAC at a speed of 1500 min^{-1} is 2 0 H (since 2 x 1 0 0 0 H = 2 0 0 0 H, of which only the higher-value byte, i.e. 2 0 H, is output).

This corresponds to an analog output voltage of

$$20\,H \cdot \frac{10\,V}{7F\,H} = 32 \cdot \frac{10\,V}{127} = 2.5\,V$$

*) Works setting
Protection against overdriving has been programmed for addresses 0 2 7 2 H (n_{act} value), 0 2 7 4 H (M_d or P) and 0 2 E A H (M_d*) from software release 05 onwards. However, this protection is only effective if no left shift has been entered in parameters P-67, P-69 and P-77 and no offset correction in parameters P-78, P-79 and P-80.

Analog output signals obtained from a DAC with different standardization settings, exemplified by the actual speed value (starting ramp 0 - 1500 min^{-1}).



Assignment list for the DACs (test sockets):
(values for speed controller optimization)

Value	Address Hex	Standardization Hex	Input value	Output value
n_{set} before RFG	034AH	0001H 0000H	4000H ≙ 10V 4000H ≙ 10V	10V 5V
n_{set} after RFG	0374H	0001H 0000H	4000H ≙ 10V 4000H ≙ 10V	10V 5V
$\lvert n_{act} \rvert$	0C52H	0001H 0000H	4000H ≙ 6000 min^{-1} 4000H ≙ 6000 min^{-1}	10V 5V
M_{dset} (Torque setpoint)	0402H	0001H 0000H	4000H ≙ 100 % 4000H ≙ 100 %	10V 5V

Further addresses of variables required for diagnostics purposes (variable list)

0314H Magnetizing current setpoint
0316H Active current setpoint (torque setpoint for C-axis mode)
0318H Stator current absolute value setpoint
031EH Power
0322H Current setpoint, phase R
0324H Current setpoint, phase S
0344H Slip frequency setpoint
0402H Torque setpoint
0440H Rotor flux setpoint
074EH Speed setpoint (C axis)
0940H Speed setpoint
0374H Speed setpoint after RFG
0352H Actual speed value
0D34H Actual speed value in V/Hz-controlled mode
0380H Angle formed between stator voltage vector and rotor flux axis
0382H Angle formed between stator voltage vector and stator electrical axis
038CH Angle formed between stator and rotor electrical axes
0750H Actual speed value (C axis)
080AH DC link voltage
083CH Delay angle, line-side converter firing circuit

034CH Synchronization controller output
0870H Driving/Regenerative braking
0C88H Positioning controller output (M19)

Writing of 0001H into parameter P-184 causes switchover from speed-controlled operation to U/f controlled operation of the converter. It is then possible to operate the drive on the programmed voltage/frequency characteristic even when actual-value channels are faulted.

3.3.13 Forming of the DC link capacitors

P-75 Forming 0000H

If fault message F-42 appears or if the line fuses blow when the inverter is switched on for the first time after prolonged storage, it indicates that forming of the DC link is necessary.

To accomplish this, parameter P-75 must be set to 0 0 0 1 H and the set value must be written into the EEPROM via parameter P-52.

The details of the capacitor forming process are given in Section 3.5.

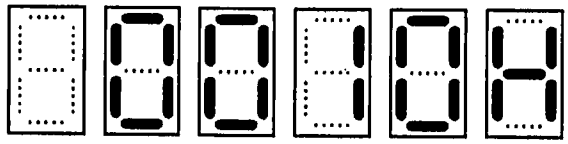
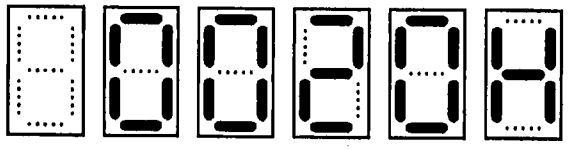
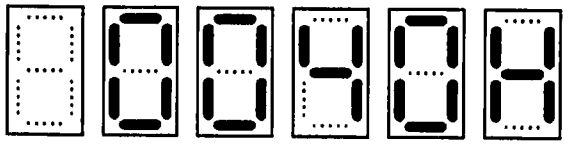
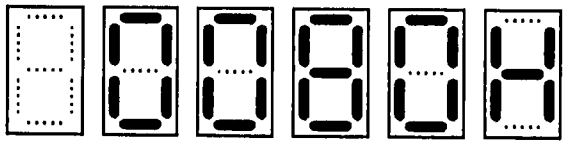
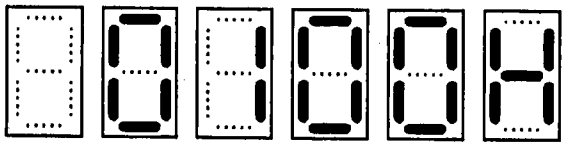
3.3.14 Assignment of functions to terminals

P-83 to P-85 Parameters P-83 to P-85 permit different functions to be assigned to three terminals by software. The function of a selected terminal is indicated via P-30 (see Section 3.3.6).

P-83 Terminal 119
P-84 Terminal 158
P-85 Terminal R

The following functions can be assigned to the terminals:

Display	
0004H	Gear step 4
0008H	Torque control
0010H	Remote resetting
0020H	Oriented spindle stop (M19)

Display	
	Unassigned
	Clockwise running only
	Counter-clockwise running only
	n_{set} = 0
	n-controller integrator inhibit

The settings "Clockwise running only", "Counter-clockwise running only" and "n_{set} = 0" can only be activated if this has been enabled in P-53 by setting bit 3 (0 0 0 8 H).

The following basic assignment has been set at the works:

P-83 0 0 0 1 H ≙ Gear step 4
P-84 0 0 0 2 H ≙ Torque control
P-85 0 0 0 4 H ≙ Remote "Reset"

Example: In order to be able to activate the M19 function via terminal 158, it is necessary to set parameter P-84 to the value of 0 0 0 8 H.

3.3.15 Matching to motor and inverter data

P-94 DC-link capacitance in µF 0 - 30000 µF

The DC link capacitance must be matched according to the converter power circuit module complement, i.e. total of EE and LE modules.

Electronics module EE	3000 µF
per power circuit module LE1 (125 mm)	1100 µF
per power circuit module LE2 (250 mm)	3000 µF
per power circuit module LE3 (250 mm)	6000 µF

Parameters P-95, P-96 and P-98 are used to select the appropriate converter and motor data for subsequent transfer from the EPROM into the RAM and EEPROM by way of setting parameter P-97 to 0 0 0 1 H (in the EEPROM).

P-95 Matching to inverter data 0 - 14

PWM inverter	MSD	I/R feedback unit	Code number for parameterization
6SC6901	20 A	50 A	7
6SC6901	30 A	50 A	5
6SC6901	40 A	75 A	9
6SC6901	60 A	75 A	10
6SC6901	20 A	75 A	11
6SC6901	30 A	75 A	12

Table 3.3 Code numbers for matching to inverter data

P-96 Matching to motor data For code numbers, see Table 3.4 100 - 130

Three-phase motor	Code No.	P_{rated} [kW]	n_{rated} [min^{-1}]	n_{max} [min^{-1}]	Inverter current rating required to achieve overload capability factor: 1.0	1.2	1.4	1.6
1PH5101-4CF4	101	3.0	1500	8000	20 A	20 A	20 A	20 A
1PH5101-4CG4	114	4.0	2000	8000	20 A	20 A	20 A	20 A
1PH5101-2CH4	124	4.0	3000	16000	20 A	20 A	20 A	20 A
1PH5104-4CF4	102	4.5	1500	8000	20 A	20 A	20 A	20 A
1PH5104-4CG4	115	6.0	2000	8000	20 A	20 A	20 A	30 A
1PH5104-2CH4	126	6.0	3000	16000	20 A	20 A	20 A	30 A
1PH5107-4CF4	103	6.5	1500	8000	20 A	30 A	30 A	30 A
1PH5107-4CG4	116	8.5	2000	8000	20 A	30 A	30 A	30 A
1PH5107-2CH4	121	8.0	3000	16000	20 A	30 A	30 A	30 A
1PH5131-4CF4	104	9.0	1500	6300	30 A	40 A	40 A	40 A
1PH5131-4CG4	117	12.0	2000	6300	30 A	30 A	40 A	40 A
1PH5131-2CH4	127	12.0	3000	14000	30 A	40 A	40 A	40 A
1PH5137-4CF0	130	15.0	1500	6300	40 A	—	—	—
1PH5137-4CF4	105	15.0	1500	6300	60 A	60 A	60 A	60 A
1PH5137-4CG4	111	20.0	2000	6300	60 A	60 A	60 A	—
1PH5137-2CH4	109	18.0	3000	14000	60 A	60 A	60 A	—
1PH5138-4CF4	110	18.0	1500	6300	60 A	60 A	60 A	—
1PH5138-4CG4	118	24.0	2000	6300	60 A	60 A	—	—
1PH5161-4CF0	131	20.0	1500	6300	60 A	60 A	—	—
1PH5161-4CF4	106	20.0	1500	6300	60 A	—	—	—
1PH5161-4CG4	119	26.0	2000	6300	60 A	—	—	—

Table 3.4 Code numbers required for matching to motor data

NOTE
The "bootstrapping" function (P-97) must be carried out after changing the code number set in P-95 and/or P-96 in order to ensure that the corresponding data sets are transferred.

P-97 Bootstrapping (also see Section 5.2) 0000H

P-98 Shaft encoder pulses per motor revolution 256 - 32000

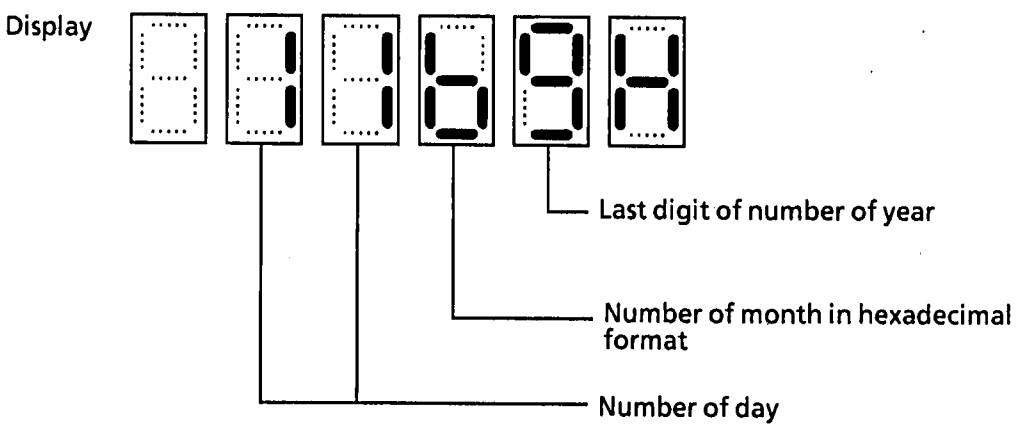
Example:

If the display reads P-95 after the unit has been switched on, it indicates that bootstrapping is necessary. This is done by inputting the inverter type code in parameter P-95, the motor type code in parameter P-96 and the number of encoder pulses per motor revolution in parameter P-98 (see Section 3.5).

Transfer of the selected type data from the EPROM into the RAM and EEPROM must then be initiated by writing 0 0 0 1 H in parameter P-97. The write protection jumper S1 on controller module N1 must be open for this operation (cancellation of hardware write protection).

3.3.16 Software release

The software version is indicated by the last two digits of the number shown on the EPROMs of the controller module (see also Section 5.2). The software release date can be displayed by selecting parameter P-99.



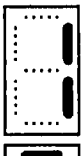
Overview of software versions:	Version	Display in P-99
	03	0AEB (04. 87)
	04	1987
	05	3158
	06	2788
	07	07A8
	08	0839
	09	0979
	10	1099
	11	11b9

Selection of parameter P-199 causes the release date of the inverter control software to appear on the display.

3.3.17 Status indications in P-100

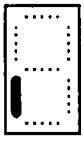
The status indications in P-100 are identical to those in P-00, except that the following symbols for the spindle positioning mode appear in the 5th position:

Position setpoint is input from external source (terminal 517 has L potential).



Position setpoint 1 is taken from internally stored values (P-121 to P-124) (terminal 512 → H and terminal 517 → H).

Position setpoint 2 is taken from internally stored value (P-125) (terminals 512, 517 and 516 → H).



Incremental advancing with the increment set in P-127 has been selected (terminals 512, 517 and 513 → H).

3.3.18 Parameters P-101 to P-150, P-157 to P-159 and P-195

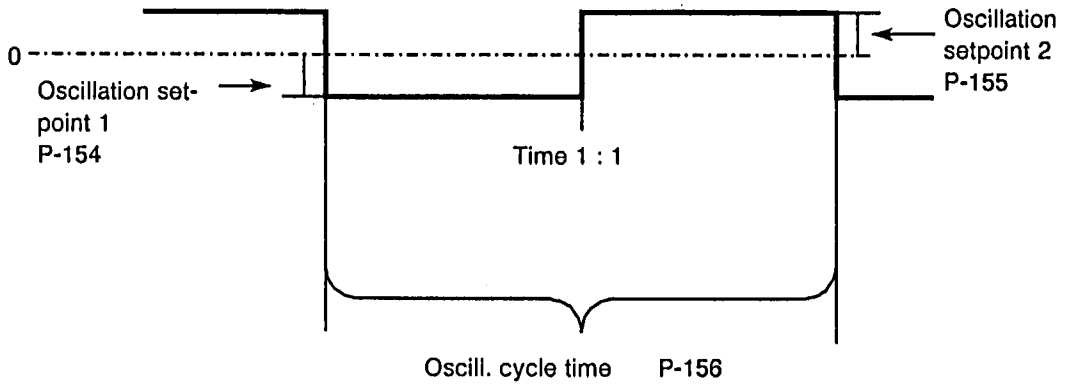
These parameters are used for the positioning and C-axis mode options and are described in the instruction manuals for the optional PCBs.

3.3.19 Oscillation setpoints

P-154 Oscillation setpoint 1 Hex

P-155 Oscillation setpoint 2 Hex
The settings are made in hexadecimal format.
Standardization: Rated speed ≙ 1 0 0 0 H

P-156 Oscillation cycle time 0.00 - 60.00 s



3.3.20 Motor data P-160 to P-177

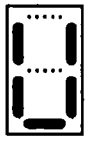
The data of motor types (including non-Siemens types) which are not stored in the memory can be input via parameters P-160 to P-175. If a motor is not listed in Section 3.3.15, it can be entered via parameters P-160 to P-175. If parameter P-177 is then set to 1, the motor data are calculated on the basis of parameters P-160 to P-175 and stored. Code number 99 is then indicated in P-96.

Important: The entries in parameters P-160 to P-175 must be complete before P-177 is set to 1.

P-176 Torque reduction
The speed at which the Md reduction function becomes operative - allowing for the motor stalling limit - is defined in P-176. Adjustments to the parameter setting are effective only after a system restart (mains power OFF-ON).
The parameter setting does not need to be changed if the motor type has been loaded via P-96.

3.3.21 Voltage-frequency (V/Hz) controlled operation

P-184 The control mode can be switched to V/Hz-controlled operation by setting this parameter to 0 0 0 1 H.
Indicated in P-00, 3rd digit

Symbol 

In this mode it is possible to check the speed feedback value (address 0 D 3 4 H as of SW 08) and current feedback value of the inverter.

Note:

1) Step changes in the setpoint speed with a short ramp-up time (P-16, P-17) lead to fault messages (F-41).
2) Terminal 62 (ramp-up time = 0) is ineffective.
3) The setpoint is increased along the set ramp (P-17) even when terminal 81 is activated.
4) With the same setpoint voltage, the speed reached in this mode is not equal to that reached in the speed control mode

3.3.22 Selectable relay function

The n_x relay function can be switched to a programmable relay function by setting bit 9 in P-53 (0 2 0 0 H).
The following settings can be made in P-185 to P-189:

P-185	Selection of address to be monitored	Hex
P-186	Response threshold of address to be monitored	Hex
P-187	Pick-up delay of the relay	0.0 - 10.0 s
P-188	Drop-out delay of the relay	0.0 - 10.0 s
P-189	Differential gap of the relay	Hex

3.3.23 Precontrol

P-190	A precontrol value is applied to the DC-link control as a function of the motor load. The precontrol value is defined in P-190. 0.1 = Minimum precontrol value 10.0 = Maximum precontrol value	0.1 - 10

3.3.24 Damping element

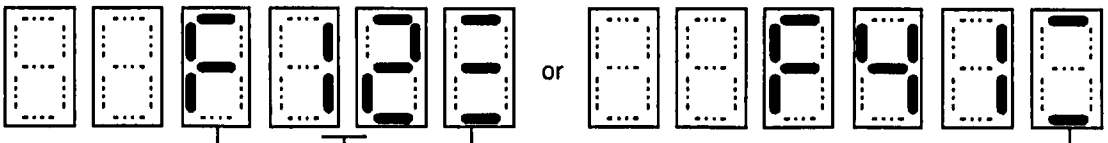
Parameters P-196 to P-198 can be used to insert a damping element in the frequency control channel of the inverter. If properly tuned, this damping element reduces or eliminates drive-related noise emission from the gearbox.

P-196	Control flag for the damping element Damping element ineffective Damping element effective in the frequency control channel	 0 0 0 0 H 0 0 0 4 H
P-197	Resonant frequency The frequency of the torsional vibration that has been measured must be input in this parameter	50.0 - 100.0 Hz
P-198	Damping constant The intensity of the damping effect is adjusted in this parameter	0.01 - 0.38

3.4 Faults

3.4.1 Fault indication

If a fault arises, it causes automatic changeover from the operator communication program to the fault program and a flashing indication with the following symbols:



This symbol indicates that one fault alone (in this case No. 41 meaning DC link overvoltage) has caused the trip.

This symbol indicates that two or more fault signals have arrived.
Pressing the " + " key causes the next fault code number to appear on the display.

Fault code number
(see Fault Code List, Section 3.4.3)

Fault message symbol

3.4.2 Faults after power-up

If all LEDs of the display remain dark after power-up, any one of the following fault conditions may be responsible:

- at least two phases dead
- at least two input fuses blown
- blown power supply fuses on firing circuit module A0 in the input/energy feedback section
- faulty connection between operator communication module H1 and controller module N1
- 5 V power supply faulted
- controller module N1 defective

If all LEDs on the display light up after power-up (8.8.8.8.8.8.), the following faults may have occurred:

- Defect on controller module N1
- EPROM on controller module N1 defective or incorrectly inserted
- No initializing pulse on the I/O module

3.4.3 Fault code list

For fault correction, check the components/equipment items in the sequence listed.

Fault code	Fault	Cause
F-01	Power supply disturbance	- Pulse cable U2-X117→G02-X117 not connected - Phase dead - Fuses F1, F2 or F3 blown - Fuses F4, F5 or F6 on A0 blown - A0 defective - U1 defective
F-02	Wrong rotating field	- Infeed phase sequence incorrect (mains connection)
F-11	Speed controller fully open; no actual speed value	- Motor sensor cable not connected - Encoder line interrupted - Shaft encoder defective - Motor not connected to inverter or one phase dead - Motor mechanically blocked - U1 defective - Firing circuit EPROMs defective - Power supply for driving stage or driving circuit module defective
F-12	Inverter overcurrent	- Motor/inverter incorrectly matched - Short-circuit/earth fault at inverter - A02 defective - U1 defective - N1 defective - Torque limit setting too high (e.g. P-39)
F-14	Motor overtemperature	- Motor overloaded - Excessive motor current, e.g. due to wrong motor data in P-96 - NTC thermistor defective (motor) - Motor fan defective - U1 defective - Interturn fault in motor
F-15	Converter overtemperature	- Converter overloaded (motor/inverter incorrectly matched) - High ambient temperature - Fan failure - PTC thermistor on A02 defective - Terminating plug not inserted (for operation without MSD inverter) (6SC6101– 0XA06)

Fault code	Fault	Cause
F-19	Temperature sensor malfunction	- NTC thermistor defective (motor) - Sensor connection open-circuited - Temperature below -20°C - U1 defective
F-40	Internal power supply disturbed	- P15 - P10 not available - N10REF or disturbed - P5 - P24 - G01 defective - G02 defective - U1 defective - Earth fault in motor phase (low resistance $<10\ k\Omega$)
F-41	DC link overvoltage	- Feed axis operation without MSD pulse enabling (see Section 2.5) - Temporary mains overvoltage - Voltage measuring system defective on A0, or G02, or U1 - V1 or V5 in step-up converter defective - Motor/inverter incorrectly matched - Mains failure during regenerative braking - Sporadic fault caused by shaft encoder or encoder line - Direct earth fault in motor phase
F-42	DC link overcurrent	- Converter overloaded - A0 defective - Current transformer U11 defective - Chopper transistors V1, V5 defective - Thyristor defective - Short-circuit in DC link - U1 defective - N1 defective
F-48*)		
F-51	DC link overvoltage	- U1 defective - N1 defective
F-52	DC link undervoltage	- Mains voltage dip - A0 defective - G02 defective - U1 defective

*) fault code is not used from software version 09 onwards

Fault message	Fault	Cause
F-53	DC link charging disturbance	- Thyristor gate pulse leads disconnected from A0-X13, -X14 - A0 defective - G02 defective - U1 defective - N1 defective
F-54	Mains disturbance	- 45 Hz > Mains frequency > 65 Hz - Severe frequency fluctuations - Mains synchronizing voltage missing - A0 defective - U1 defective - N1 defective
F-55	Faulty setpoint value calculation	- Values written into EEPROM exceed limit values (bootstrapping necessary)
F-56	System frequency timer failure	- N1 defective - U1 defective - G01 defective
F-57	Frequency sensor in PLL circuit faulty	- N1 defective
F-61	Maximum motor frequency exceeded	- Excessive machine frequency output from control processor - Inadmissible motor speed limit entered in parameter P-29
F-71	EPROM sum check error L byte, control processor	- EPROM D82 on N1 defective
F-72	EPROM sum check error H byte, control processor	- EPROM D80 on N1 defective
F-73	EPROM sum check error L byte, firing circuit processor	- EPROM D78 on N1 defective
F-74	EPROM sum check error H byte, firing circuit processor	- EPROM D76 on N1 defective
F-75	EEPROM sum check error	- Memory error in EEPROM (bootstrapping required) - EEPROM D74 defective
F-77	No initializing pulse	- N1 wrongly inserted - U1 wrongly inserted - U1 defective
F-78	I/O program execution time exceeded	- Fault in EEPROM D74 (bootstrapping or changing of EEPROM required)
F-81	High DC link voltage	- G02 defective

3.4.4 Fault resetting

Faults can be reset in the following way:

- **Resetting with parameter key**

For resetting with the parameter key, a controller blocking signal must be present. During resetting the two outer parts of the display turn dark. Resetting is followed by automatic re-activation of the operator communication program, provided that there is no further fault.

- **Remote reset 1**

This takes place when the signal at terminal 64 changes from controller enable to controller block while DC link voltage is available.

This possibility of fault resetting is available only if 0 0 2 0 H has been set in parameter P-53.

- **Remote reset 2**

This takes place when reset terminal "R" is activated in the presence of a controller blocking signal.

- **Automatic resetting of fault messages F-01 and F-02**

Appropriate setting of bit 6 in parameter P-53 (see Section 3.3.9) causes fault messages F-01 and F-02 in response to short-time voltage interruptions during which the electronics power supply is buffered from the DC link energy to be reset automatically, on condition that controller blocking signal is present at the same time.

- **Resetting by switch-off**

Fault resetting takes place if the unit is switched off and on again.

3.4.5 Changeover to the operator communication level

After fault resetting through the controller blocking function (Remote reset 1), which is indicated by the fault message on the display changing from flashing to steady, pressing of the parameter key causes the operator communication program to be restarted.

Pressing of the "–" key while a fault is present causes temporary changeover to the operator communication program for about one minute.

3.4.6 Diagnostics aids

3.4.6.1 Test sockets and LEDs

In addition to the fault messages appearing on the display, further diagnostics aids are provided in the form of test sockets and LEDs on the controller module and I/O module.

The functions of the LEDs and the way of using the test sockets on the controller module (Fig. 3.4) are described in Section 3.3.12.

The following values can be accessed via the test sockets on the I/O module:

I_R : Motor current in phase R
I_S : Motor current in phase S
I_T : Motor current in phase T
I_D : DC link current

Inverter module	I_R, I_S, I_T	I/EF block	I_D
H20	5 V ≙ 45 A	50 A	10 V ≙ 180 A
H30	5 V ≙ 70 A	75 A	10 V ≙ 310 A
H40	5 V ≙ 90 A		
H60	5 V ≙ 135 A		

I_{WR} : Absolute value of motor current
Rectified actual-value signals of the three phase currents I_R, I_S, I_T
M : Reference potential

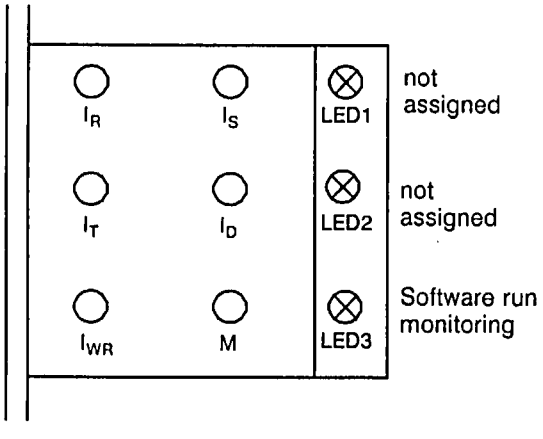


Fig. 3.3 Layout of test sockets in front plate of I/O module U1

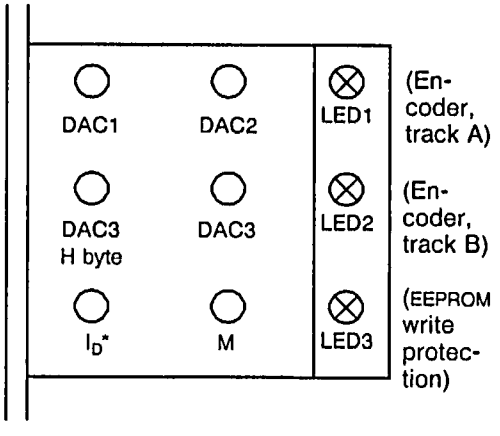


Fig. 3.4 Layout of test sockets in front plate of control module N1

3.4.6.2 Transistor diagnostic parameter

P-70 A further diagnostics aid is the transistor diagnosis parameter P-70. A parameter value other than 0 0 0 0 H may have the following causes:

Driving circuit module A0 defective
I/O module U1 defective
Power circuit module A02 defective
Chopper transistor T1 or T5 defective
Failure of power supply for A1

If a transistor monitoring device operates, the parameter value changes from 0 0 0 0 H to the value assigned to the transistor affected.

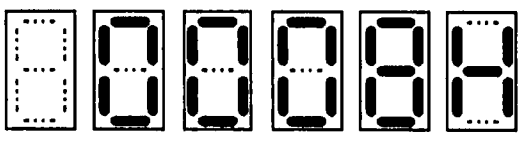
Phase U2	0 0 0 1 H	Transistor module V2 faulted
	0 0 0 2 H	Transistor module V2 faulted
Phase V2	0 0 0 4 H	Transistor module V3 faulted
	0 0 0 8 H	Transistor V3 module faulted
Phase W2	0 0 1 0 H	Transistor module V4 faulted
	0 0 2 0 H	Transistor module V4 faulted
Chopper	0 0 4 0 H	Transistor V1 faulted
	0 0 8 0 H	Transistor V5 faulted
	0 0 F F H	Failure of power supply for A1

Fault resetting or switching the combination unit off and on again causes the parameter value to go back to 0 0 0 0 H.

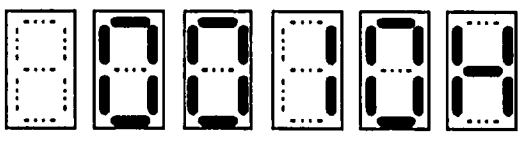
Parameter values other than the ones listed above may appear in P-70 if more than one transistor monitoring device has operated.

3.4.6.3 Error flag

P-28 Fault messages which do not cause the motor to stop (pulse inhibition) are stored in P-28.



Calibration error in sensing circuit for actual DC-link voltage value



External P-24 V power supply faulty

3.4.6.4 Actual speed value error counter

P-20 The value in P-20 is incremented by 1 every time a speed difference of approximately 100 rev/min is detected within the sampling time (3 ms).
Sporadic increases by a few increments can be ignored since these do not affect the speed controller.
A high disturbance level causes sharp and continuous increases in the P-20 value.
Possible causes:
- Encoder screen not earthed (see Section 2.2.1)
- Encoder defective
- M potential of power supply (electronics M) not connected to PE (frame) (see Section 2.2).

3.4.6.5 Minimum/maximum value memory

Parameters P-181, P-182 and P-183 are provided to facilitate monitoring of individual variables (RAM data locations).

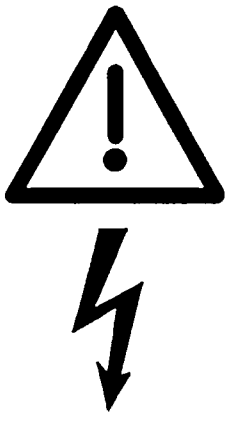
P-181 Address of variable to be monitored.
The parameter value can be stored in the EEPROM.

P-182 Minimum value

P-183 Maximum value

The storage function can be restarted by changing the address in P-181 and re-entering the original address.

3.5 Commissioning flowchart



WARNING

Safe operation is dependent upon proper handling and installation by qualified personnel under observance of all warnings contained in this instruction manual.

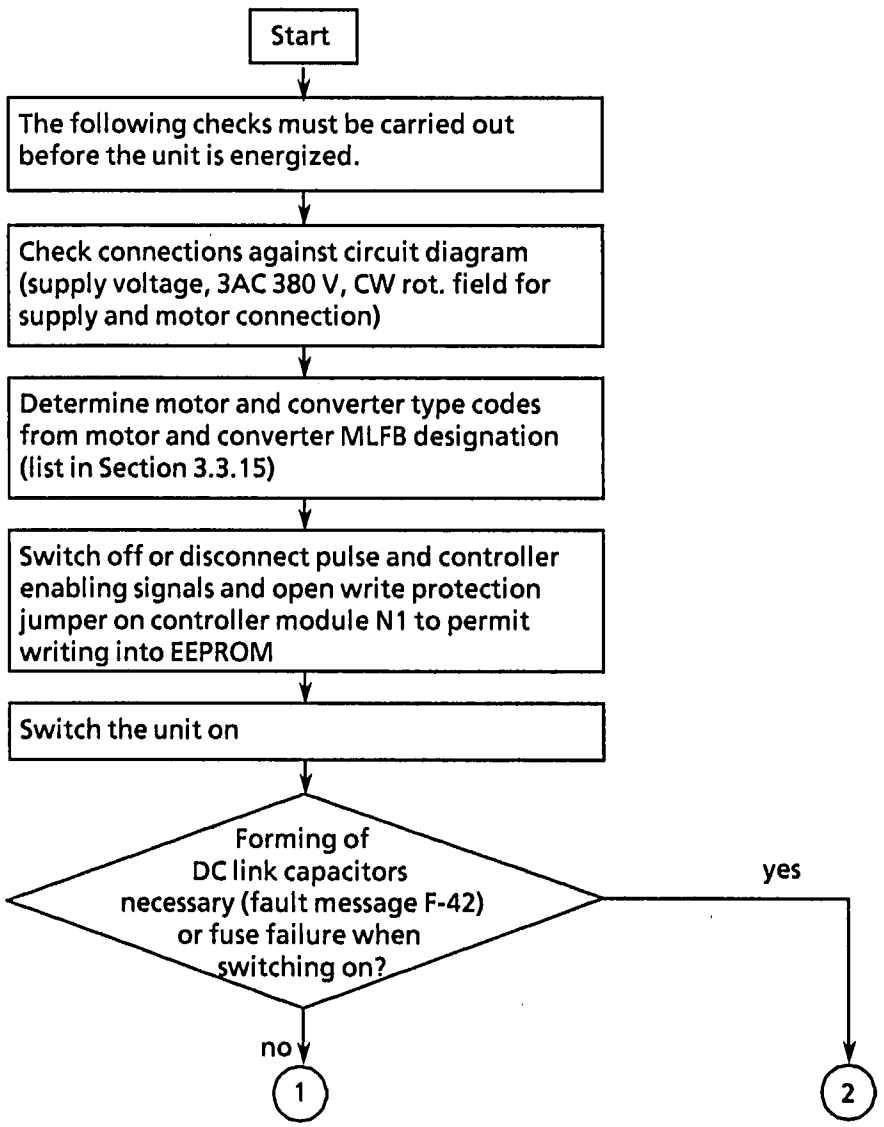
The DC link capacitors cause high voltage to persist for a short time (about 4 minutes) after disconnection from the supply.

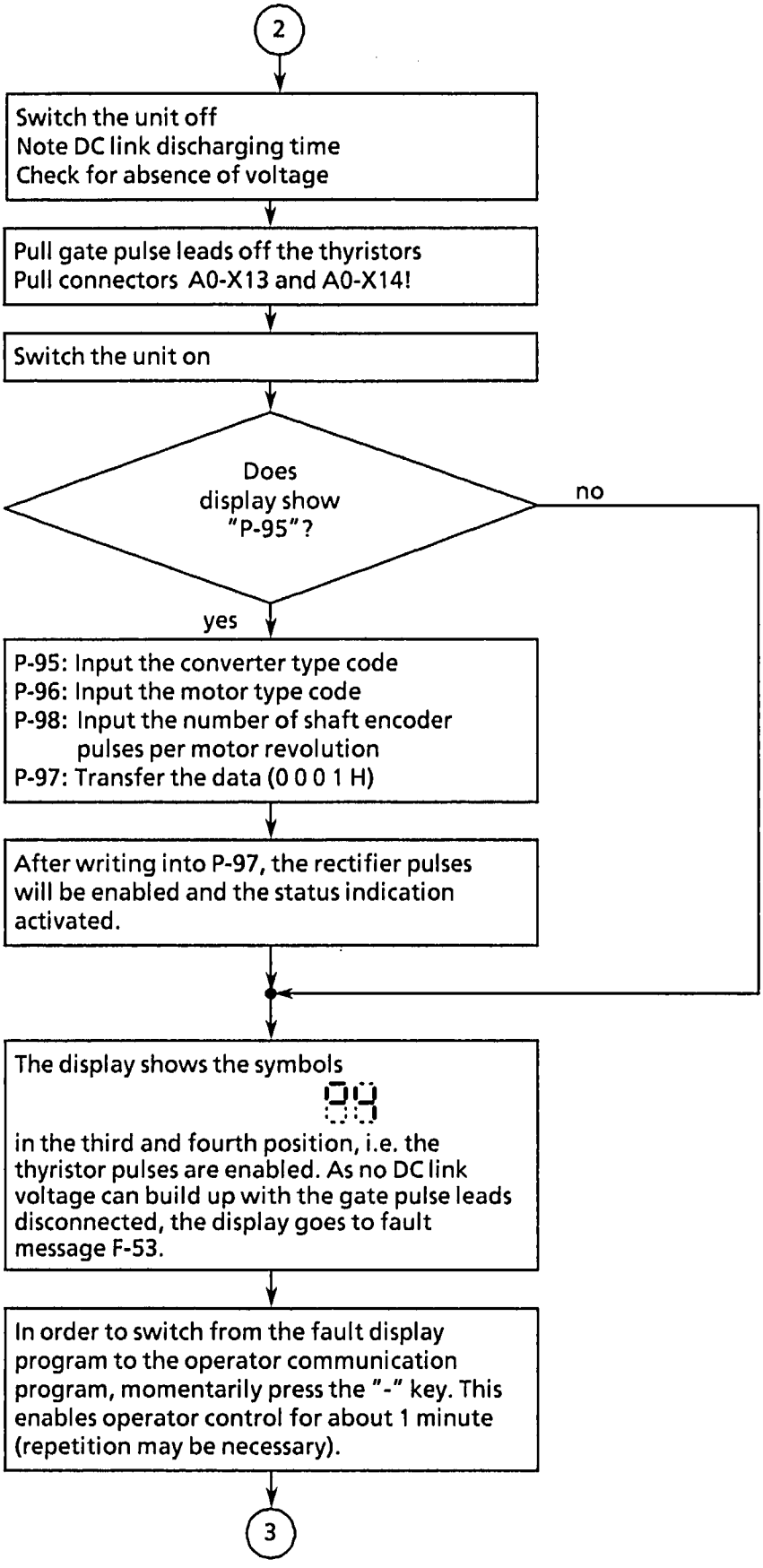
When working on the open unit, remember that live parts are exposed to contact.

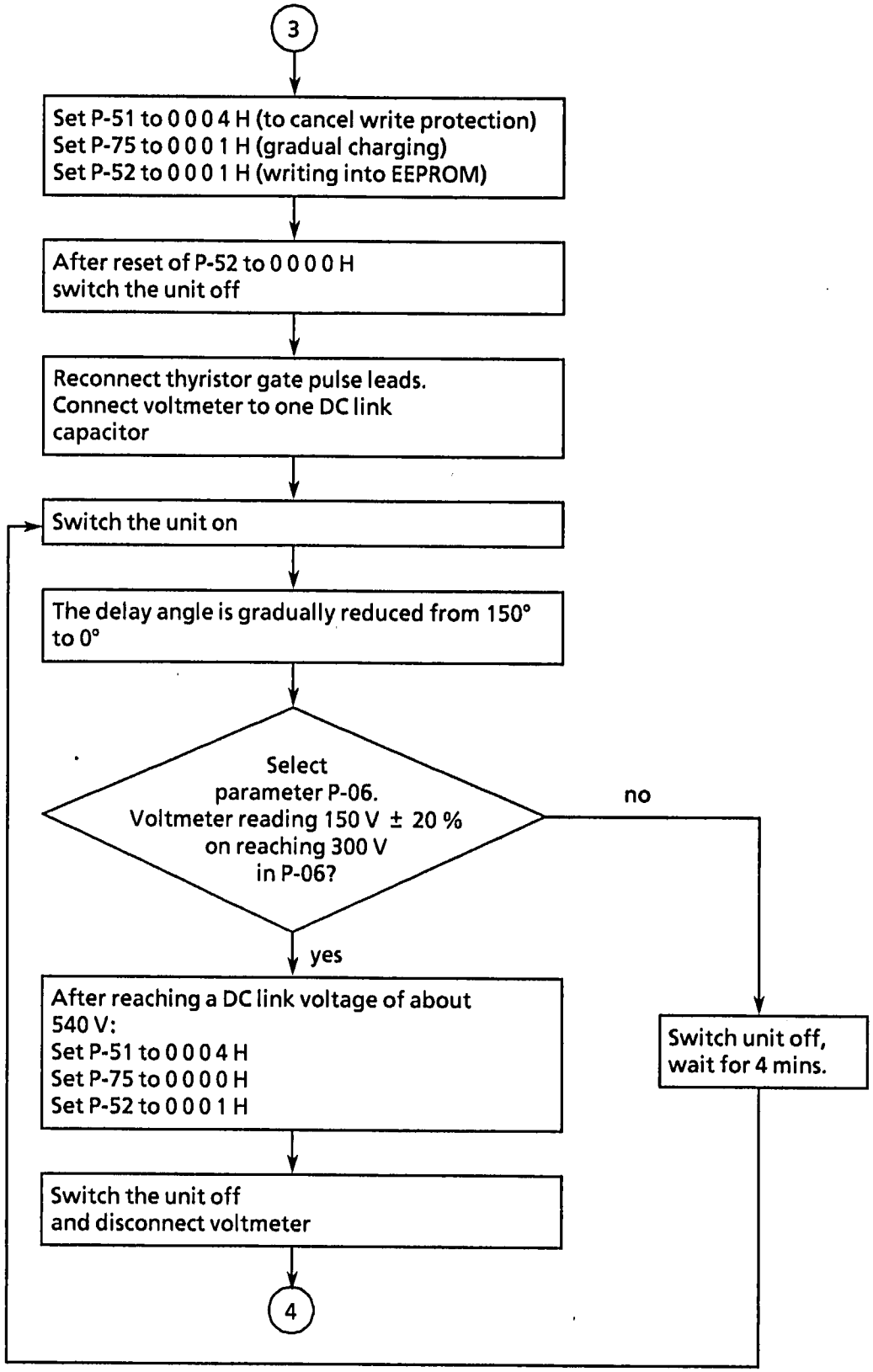
Parts of the equipment may be live even when the motor is stationary.

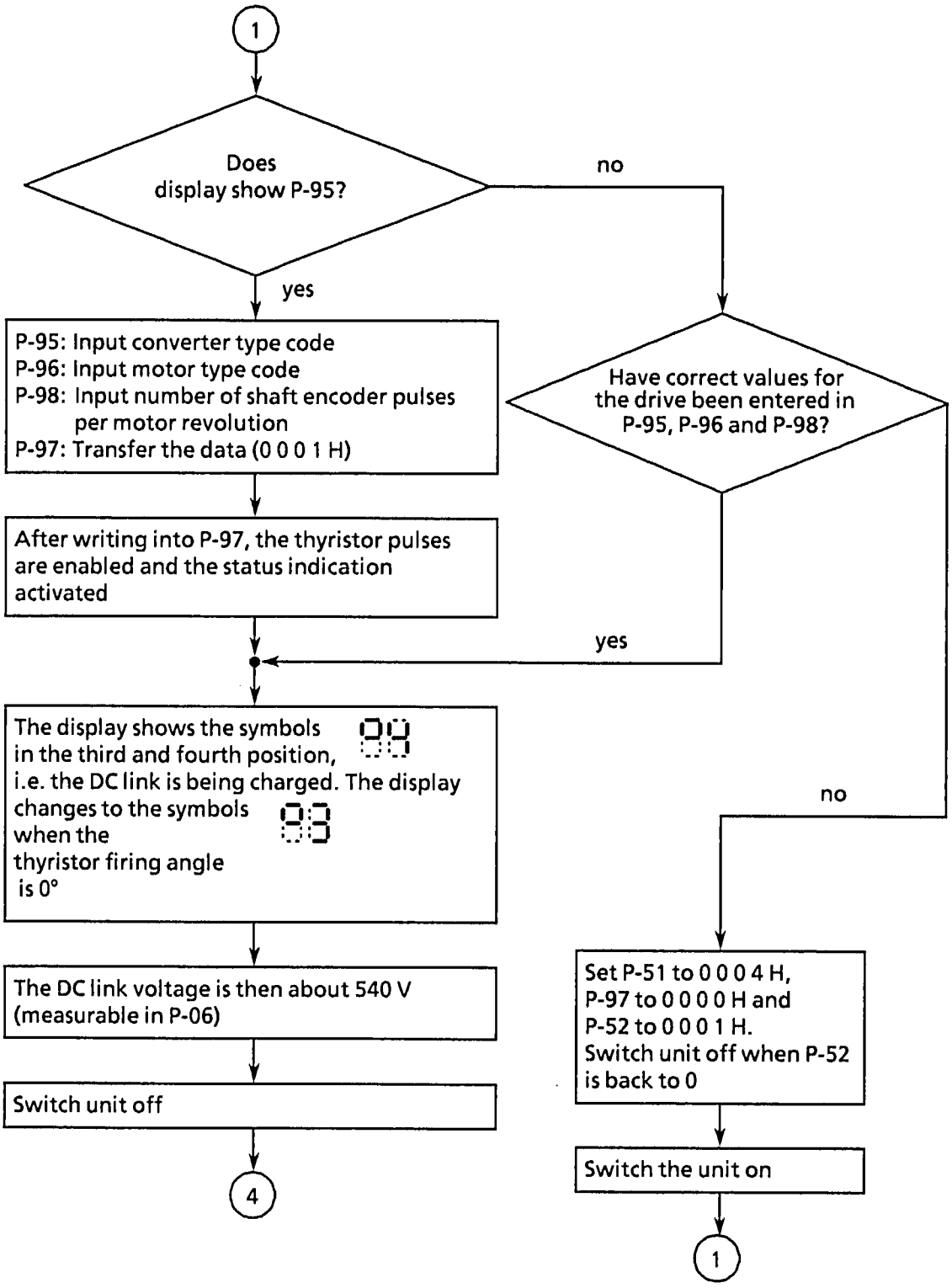
Only qualified personnel may work on the equipment.

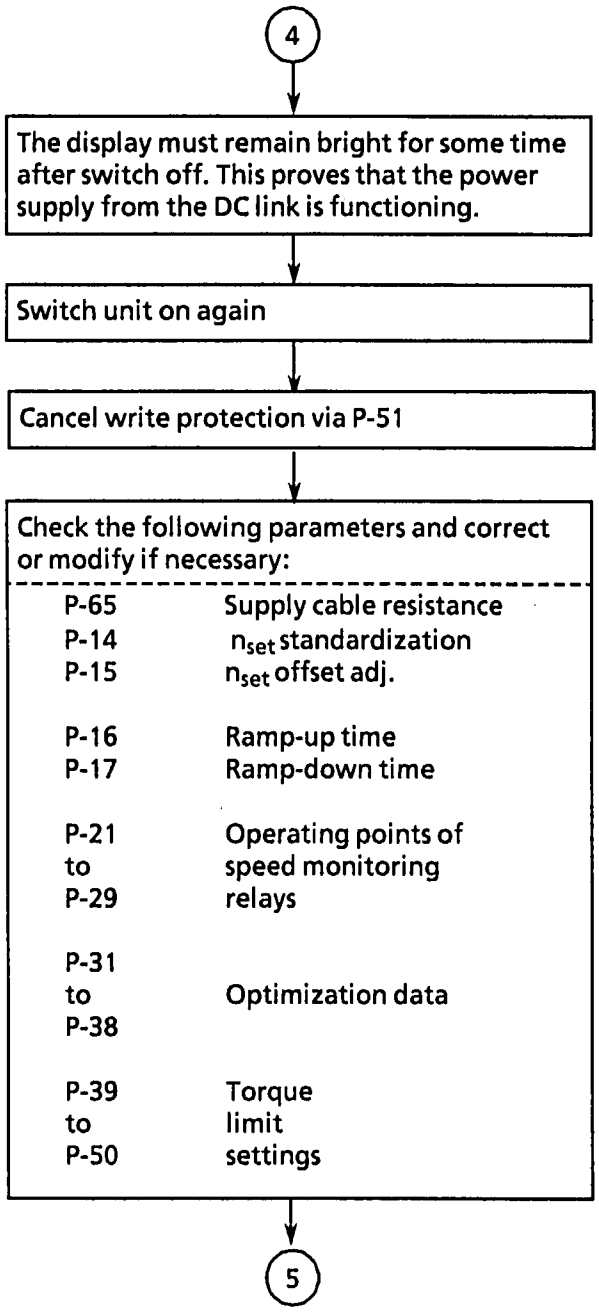
Non-observance can result in death, severe personal injury or substantial property damage.

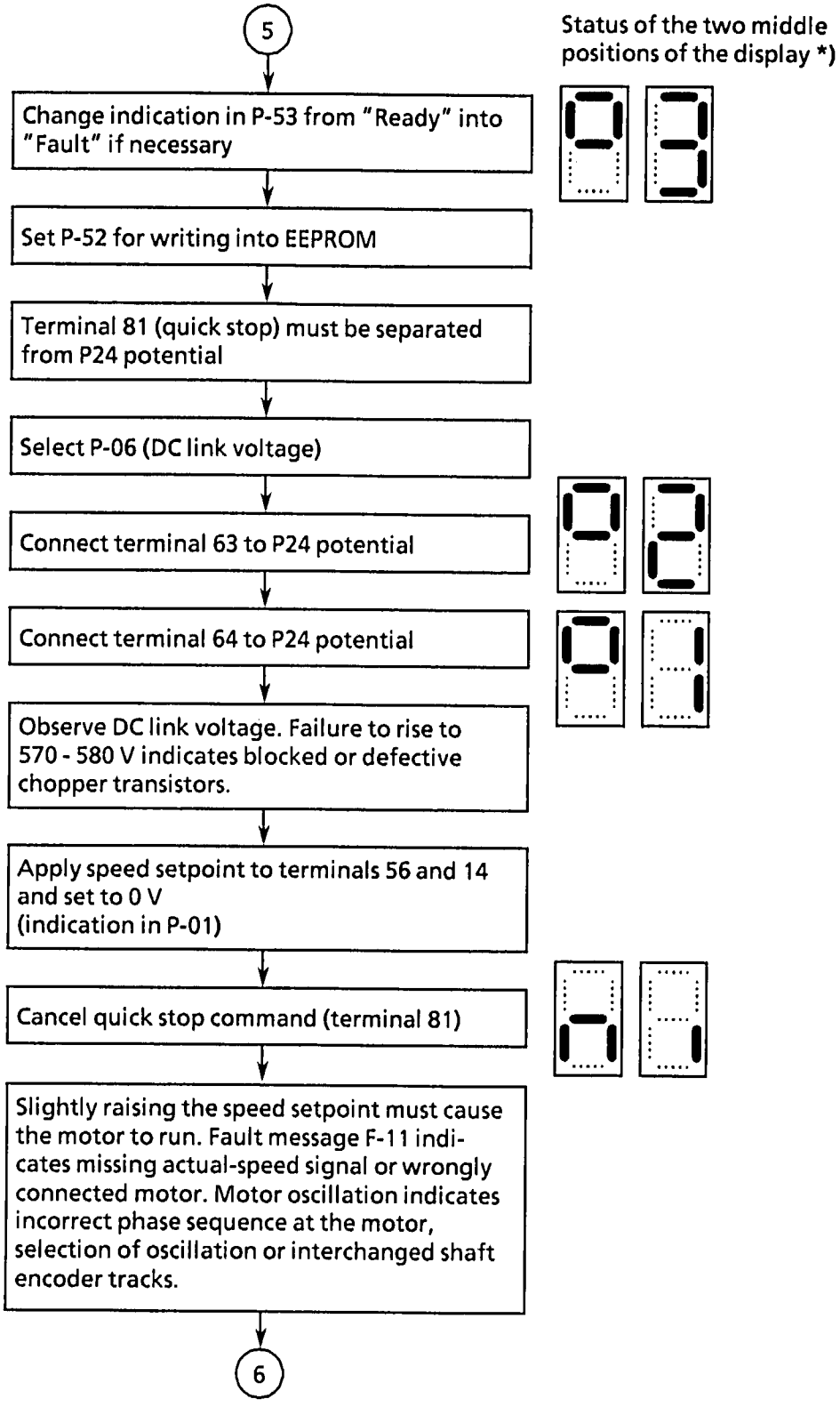



2
Switch the unit off
Note DC link discharging time
Check for absence of voltage
Pull gate pulse leads off the thyristors
Pull connectors A0-X13 and A0-X14!
Switch the unit on
Does display show "P-95"?
no
yes
P-95: Input the converter type code
P-96: Input the motor type code
P-98: Input the number of shaft encoder pulses per motor revolution
P-97: Transfer the data (0 0 0 1 H)
After writing into P-97, the rectifier pulses will be enabled and the status indication activated.
The display shows the symbols
in the third and fourth position, i.e. the thyristor pulses are enabled. As no DC link voltage can build up with the gate pulse leads disconnected, the display goes to fault message F-53.
In order to switch from the fault display program to the operator communication program, momentarily press the "-" key. This enables operator control for about 1 minute (repetition may be necessary).
3

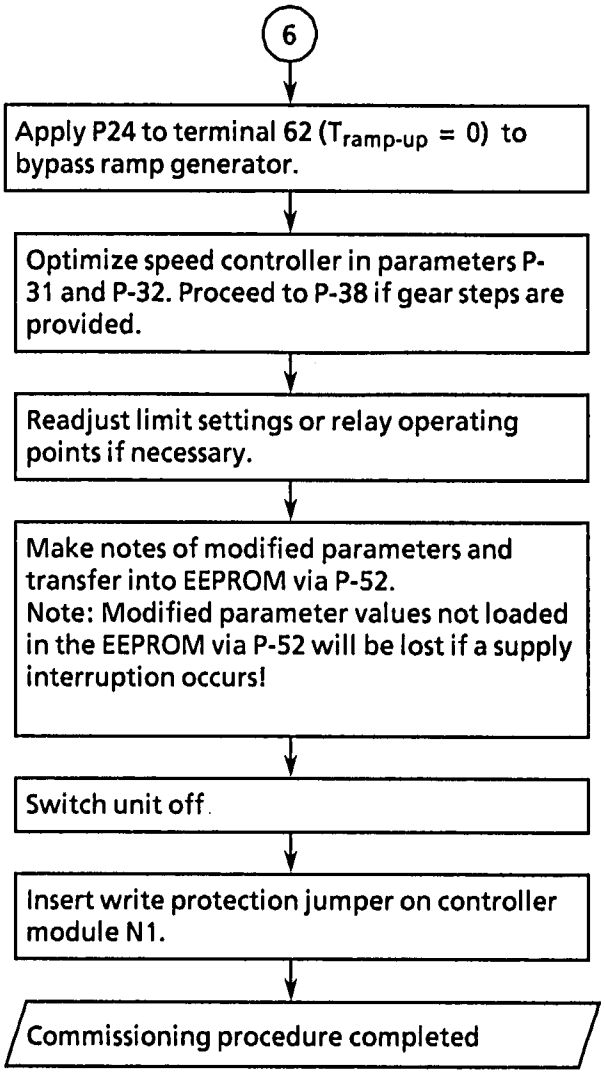

3
Set P-51 to 0 0 0 4 H (to cancel write protection)
Set P-75 to 0 0 0 1 H (gradual charging)
Set P-52 to 0 0 0 1 H (writing into EEPROM)
After reset of P-52 to 0 0 0 0 H
switch the unit off
Reconnect thyristor gate pulse leads.
Connect voltmeter to one DC link
capacitor
Switch the unit on
The delay angle is gradually reduced from 150°
to 0°
Select
parameter P-06.
Voltmeter reading 150 V ± 20 %
on reaching 300 V
in P-06?
no
yes
After reaching a DC link voltage of about
540 V:
Set P-51 to 0 0 0 4 H
Set P-75 to 0 0 0 0 H
Set P-52 to 0 0 0 1 H
Switch unit off,
wait for 4 mins.
Switch the unit off
and disconnect voltmeter
4


1
Does display show P-95?
no
yes
P-95: Input converter type code
P-96: Input motor type code
P-98: Input number of shaft encoder pulses per motor revolution
P-97: Transfer the data (0 0 0 1 H)
Have correct values for the drive been entered in P-95, P-96 and P-98?
After writing into P-97, the thyristor pulses are enabled and the status indication activated
yes
The display shows the symbols 04 in the third and fourth position, i.e. the DC link is being charged. The display changes to the symbols 03 when the thyristor firing angle is 0°
no
The DC link voltage is then about 540 V (measurable in P-06)
Switch unit off
4
Set P-51 to 0 0 0 4 H, P-97 to 0 0 0 0 H and P-52 to 0 0 0 1 H. Switch unit off when P-52 is back to 0
Switch the unit on
1

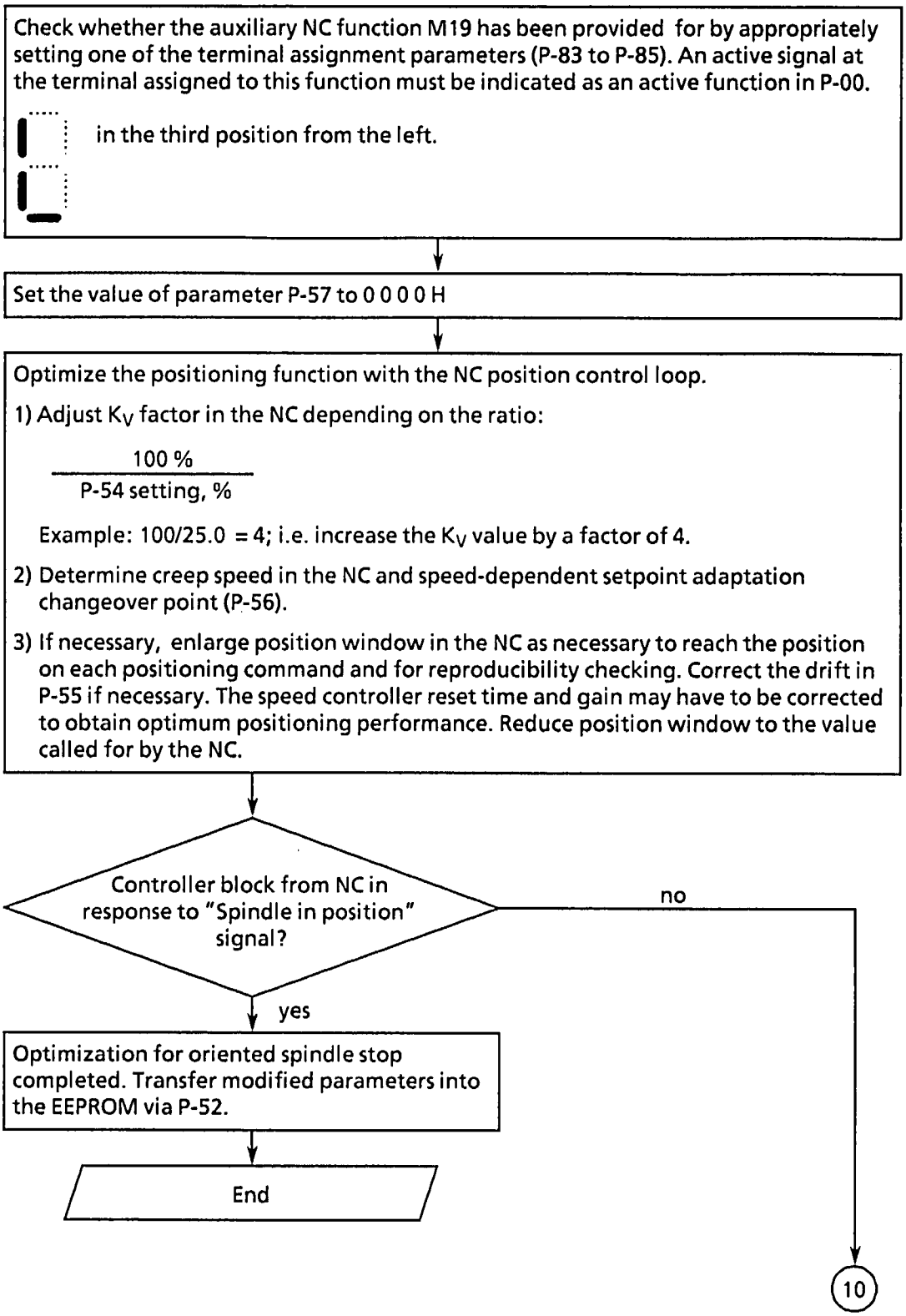

4
The display must remain bright for some time after switch off. This proves that the power supply from the DC link is functioning.
Switch unit on again
Cancel write protection via P-51
Check the following parameters and correct or modify if necessary:
P-65 Supply cable resistance
P-14 n_{set} standardization
P-15 n_{set} offset adj.
P-16 Ramp-up time
P-17 Ramp-down time
P-21 to P-29 Operating points of speed monitoring relays
P-31 to P-38 Optimization data
P-39 to P-50 Torque limit settings
5

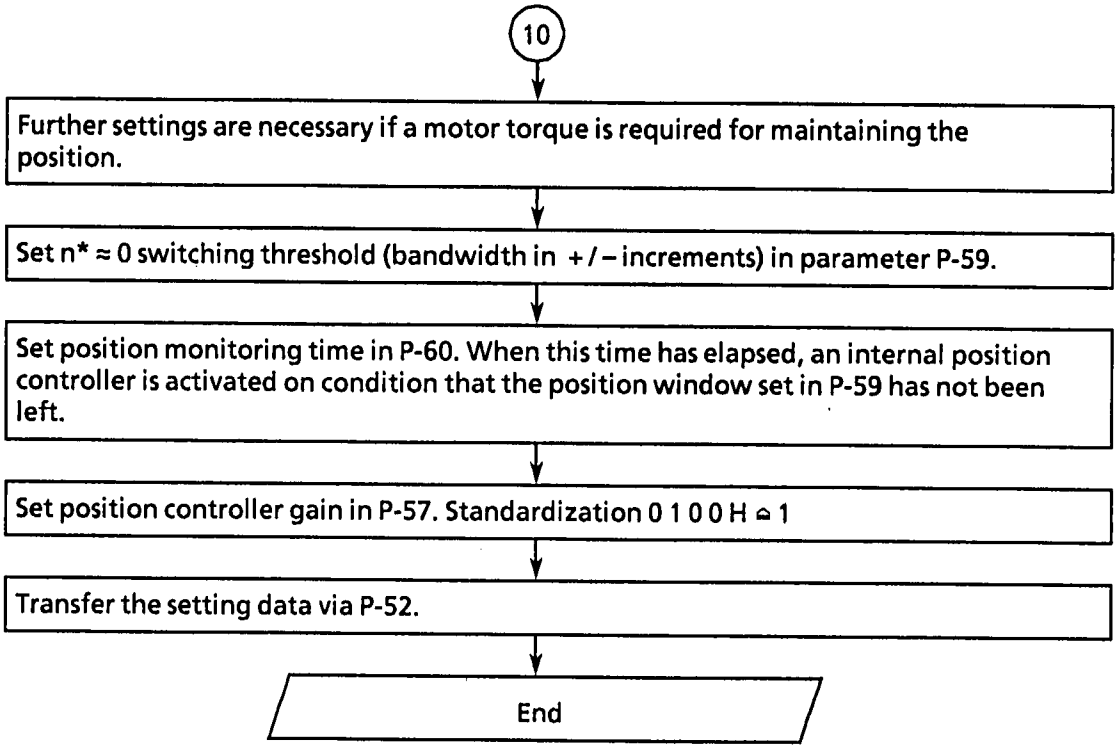


*) see symbols under 3.3.1


6
Apply P24 to terminal 62 ($T_{ramp-up}$ = 0) to bypass ramp generator.
Optimize speed controller in parameters P-31 and P-32. Proceed to P-38 if gear steps are provided.
Readjust limit settings or relay operating points if necessary.
Make notes of modified parameters and transfer into EEPROM via P-52.
Note: Modified parameter values not loaded in the EEPROM via P-52 will be lost if a supply interruption occurs!
Switch unit off.
Insert write protection jumper on controller module N1.
Commissioning procedure completed

3.5.1 Commissioning of auxiliary NC function M19




10
Further settings are necessary if a motor torque is required for maintaining the position.
Set n* ≈ 0 switching threshold (bandwidth in +/– increments) in parameter P-59.
Set position monitoring time in P-60. When this time has elapsed, an internal position controller is activated on condition that the position window set in P-59 has not been left.
Set position controller gain in P-57. Standardization 0 1 0 0 H ≙ 1
Transfer the setting data via P-52.
End

3.5.2 Two-motor three-phase main spindle drive

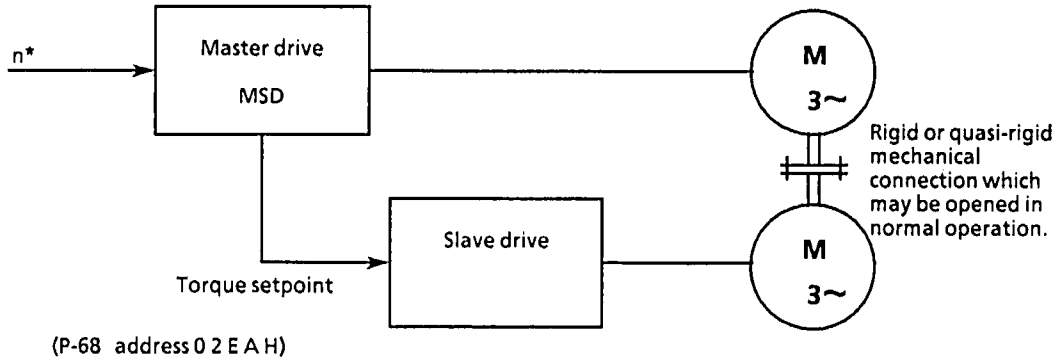


Fig. 3.4 Schematic of two-motor drive

- **Rigid mechancial coupling of the drives**

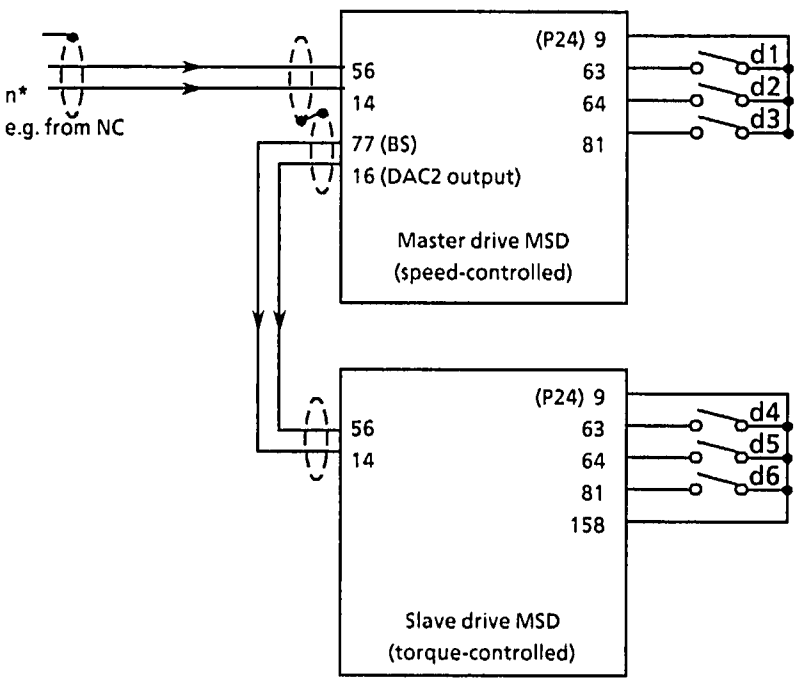


Fig. 3.5 Wiring of logic controls for rigid mechancial coupling of the two motors

Figure 3.5 shows the wiring connections required between the controller modules if the drives remain mechanically coupled at all times. The control system must ensure that the mechancial coupling element between the drives must not transmit torque under any static and dynamic loading conditions, i.e. the motors are not allowed to drive one another.

If the two motors are of different types or have different gear ratios, they should not be operated at the dynamic torque limit. Speed changes may only been made through the setpoint channel of the master drive.

Pulse blocking causes the drives to coast to a standstill. The slave drive controller may not be blocked (e.g. through the $n < n_{min}$ criterion) before the motor is at rest.

The ramp generator (parameters P-16 and P-17) must be so adjusted that the drives never reach the dynamic torque limit.

Separate control relays should be used for the master drive and the slave drive to keep the two 24 V power supplies galvanically isolated. (Example: Do <u>not</u> connect both terminals 63 to a common contact.)

- **Quasi-rigid coupling of the drives**

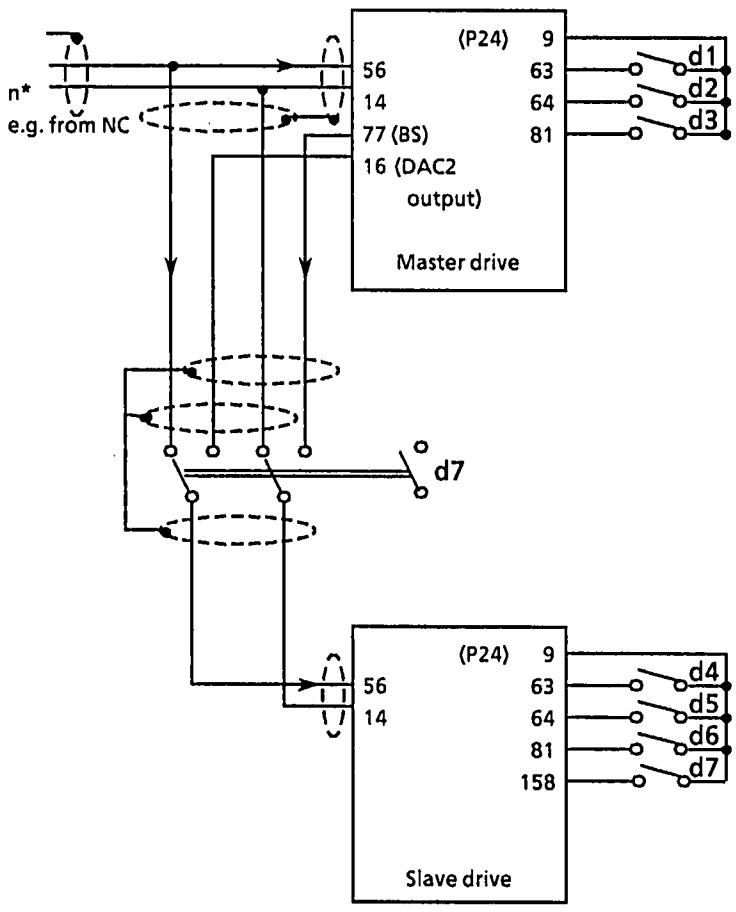


Fig. 3.6 Wiring of logic controls for quasi-rigid coupling of the two motors

Figure 3.6 shows how the controller modules must be interconnected for two motors which may be mechanically uncoupled, e.g. in the case of the motors being coupled through a workpiece. In this case, separate speed-controlled operation must be possible in addition to master-slave operation.

Relay d7 switches the slave drive from speed-controlled to torque-controlled operation. This changeover must be contingent upon rigid mechanical coupling of the two motors (check-back signals).

Separate speed-controlled operation must be possible only when the motors are not mechanically coupled. This mode must be activated via terminal 64, i.e. the speed setpoint must be applied to both drive controls. Selective controller enabling makes it possible to hold one of the two drives stationary.

With software releases 1987 and younger, terminals 78 and 18 on the master drives may be used instead of 77 and 16 for coupling the two drives. This improves the control performance in coupled running.

- **Parameter settings**

In order to ensure that the torque setpoint is available at terminals 16 and 77 of the I/O module of the master drive, the address 0 2 E A H must be written in parameter P-68. Shifting in parameter P-69 permits variation of the voltage corresponding to a given torque value. If parameter P-69 is set to 0, the voltage across terminals 16 and 76 at motor rated torque is + 5 V (provided that P-13 has been set to 100 %). Fine adjustment of this output value and sign inversion are possible in parameter P-13.

Parameters P-48 and P-49 are additionally effective when the slave drive is in the torque-controlled mode. In P-48 a torque-matching adjustment can be made (corresponding to the P-14 setting in speed-controlled operation) and in P-49 the torque drift can be compensated (corresponding to the P-15 setting in speed-controlled operation). Parameter P-49 is not suitable for compensating frictional forces. P-48 and P-49 are not effective in the speed-controlled mode.

When using terminals 78 and 18, it is necessary to set parameters P-76 and P-77 instead of P-68 and P-69.

4 Commissioning the feed drive

WARNING

The successful and safe operation of this equiment is dependent on proper handling, installation, operation and maintenance.
Non-observance can result in death, severe personal injury or substantial property damage.

The modules of the unit include electrostatically sensitive devices. Before touching a PCB the person carrying out the work must himself be electrostatically discharged. The simplest way of accomplishing this is to touch an electrically conducting earthed object (e.g. a bare metal part of a switchboard or the protective-earth contact of a socket outlet).

4.1 Adapting the control system

4.1.1 Tacho-generator voltage

The tacho input circuit of the unit is designed for a typical tacho voltage of between 30 and 40 V at rated motor speed. For motors with a lower tacho voltage (11 to 16.5 V), jumpers must be inserted on the controller module. The jumpers are supplied loose in the wiring accessories for the control system for 1 axis.

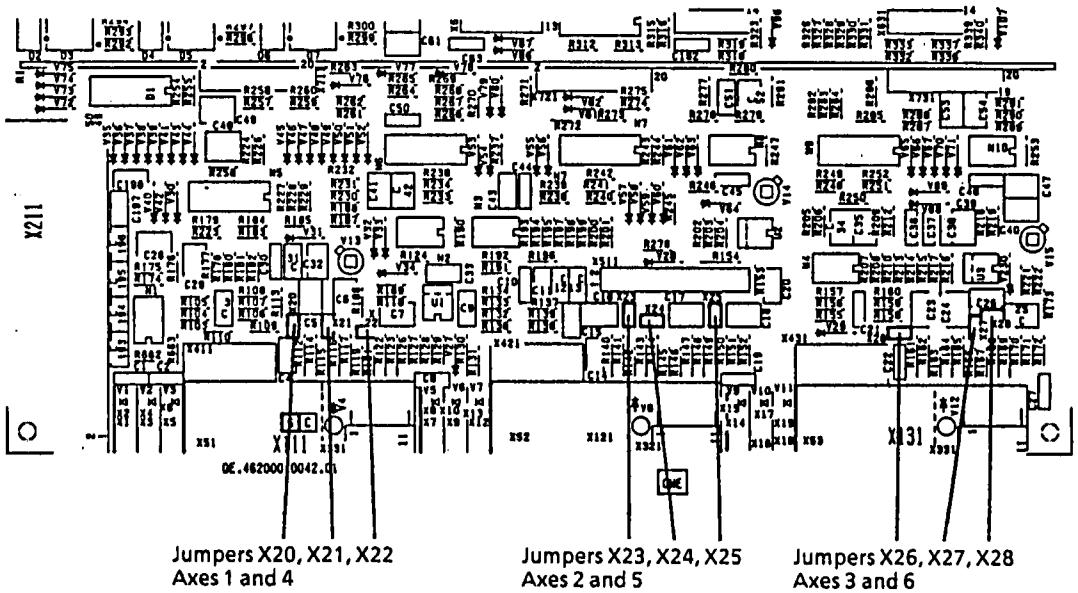
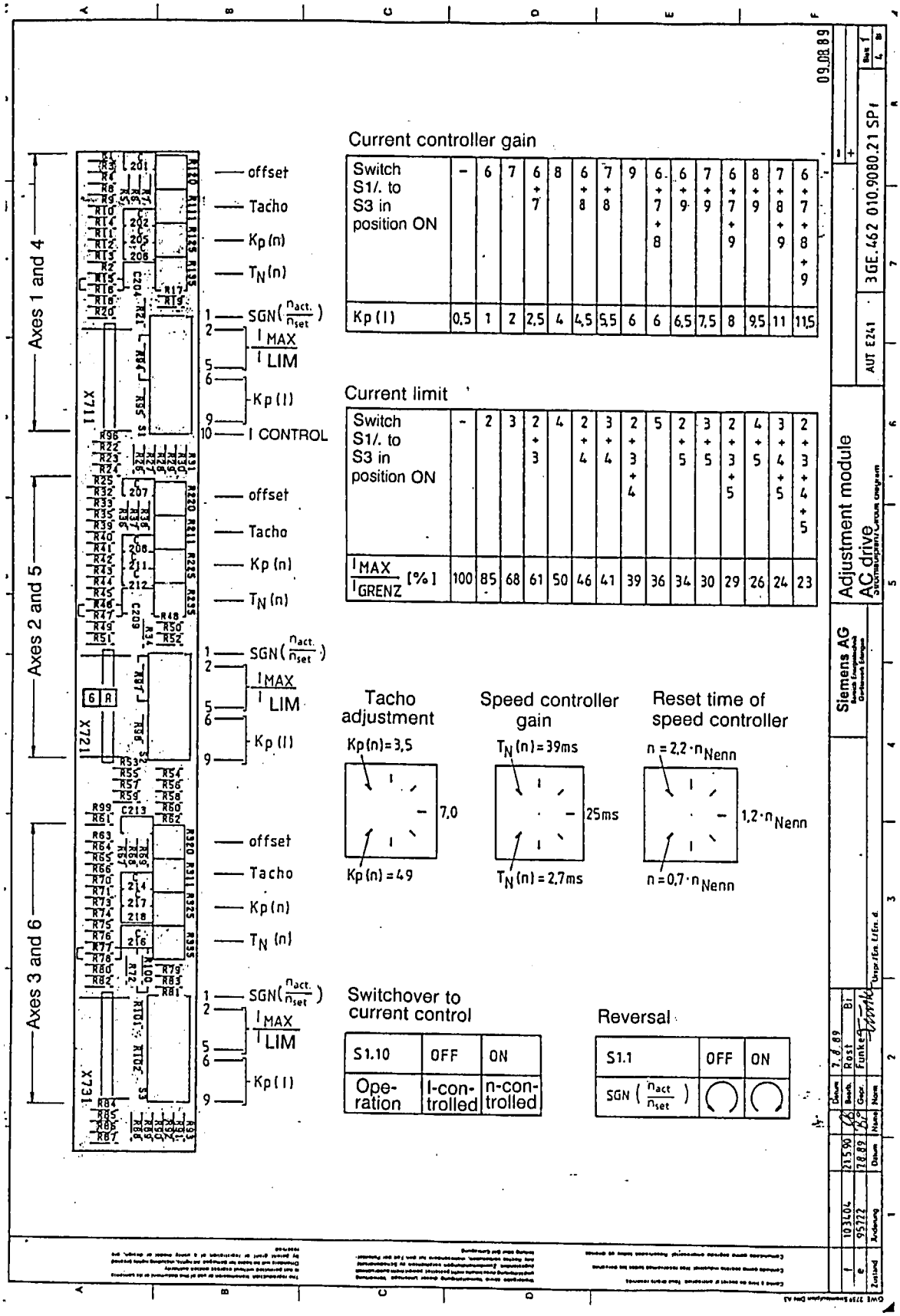


Fig. 4.1 Location of jumpers on the controller module

Motor type	Rated speed in min^{-1}	Tacho voltage at rated speed	Jumpers to be inserted			Actual-speed value at rated speed Test socket X
			Axes 1 and 4	Axes 2 and 5	Axes 3 and 6	
1FT506. -0AA71	1200	40 V	-	-	-	10 V
to -0AC71	2000	40 V	-	-	-	10 V
1FT513. -0AF71	3000	40 V	-	-	-	10 V

Table 4.1

4.1.2 Setting elements (controller modules N2, N3)



Switch S1/. to S3 in position ON	–	6	7	6 + 7	8	6 + 8	7 + 8	9	6 + 7 + 8	6 + 9	7 + 9	6 + 7 + 9	8 + 9	7 + 8 + 9	6 + 7 + 8 + 9
Kp (I)	0,5	1	2	2,5	4	4,5	5,5	6	6	6,5	7,5	8	9,5	11	11,5

Switch S1/. to S3 in position ON	–	2	3	2 + 3	4	2 + 4	3 + 4	2 + 3 + 4	5	2 + 5	3 + 5	2 + 3 + 5	4 + 5	3 + 4 + 5	2 + 3 + 4 + 5
$\frac{I_{MAX}}{I_{GRENZ}}$ [%]	100	85	68	61	50	46	41	39	36	34	30	29	26	24	23

4.1.3 Motor/PWM inverter matching tables

Matching table for SIMODRIVE inverter modules **A07 (7/14 A)**
Setting of the contacts of switches S1, S2 and S3 on the adjustment module.

Servo-motor				Current limit					Current controller gain				
1FT	M_o [Nm]	I_o [A]	n_{rated} in min^{-1}	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp (I)
5062-0AC71	2.2	1.4	2000	x	o	x	o	6.4	x	x	x	x	11.5
5062-0AF71	2.2	2.1	3000	o	x	o	o	9.5	x	x	o	x	8.0
5064-0AC71	4.5	2.9	2000	o	o	o	o	14.0	x	x	x	x	11.5
5064-0AF71	4.5	4.3	3000	o	o	o	o	14.0	x	x	x	o	6.0
5064-0AG71	4.5	7.1	4000	o	o	o	o	14.0	x	o	x	o	4.5
5066-0AC71	6.5	4.2	2000	o	o	o	o	14.0	x	x	o	x	8.0
5066-0AF71	6.5	6.2	3000	o	o	o	o	14.0	o	o	x	o	4.0
5070-0AC71	3.0	1.9	2000	o	o	x	o	7.0	x	x	x	x	11.5
5070-0AF71	3.0	2.8	3000	x	o	o	o	11.9	o	x	x	x	11.0
5071-0AC71	4.5	2.9	2000	x	o	o	o	11.9	x	x	x	x	11.5
5071-0AF71	4.5	4.2	3000	o	o	o	o	14.0	x	x	x	o	6.0
5072-0AC71	10.0	6.3	2000	o	o	o	o	14.0	x	x	o	x	8.0
5073-0AC71	7.0	4.4	2000	o	o	o	o	14.0	x	x	o	x	8.0
5073-0AF71	7.0	6.5	3000	o	o	o	o	14.0	o	o	x	o	4.0
5100-0AC71	10.0	6.2	2000	o	o	o	o	14.0	o	x	x	o	5.5

Table 4.2

o ≙ Contact in initial (OFF) position
x ≙ Contact in ON position
Contacts S1.1, S2.1, S3.1: Reversal
Contact S1.10/resistor R200: For current-controlled operation of all 3 axes, set contact S1.10 to ON/fit jumper in the position of R200.

Matching table for SIMODRIVE inverter modules **A15 (15/30 A)**
Settings of the contacts of switches S1, S2 and S3 on the adjustment module.

Servo-motor				Current limit					Current controller gain				
1FT	M_o [Nm]	I_o [A]	n_{rated} in min^{-1}	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp (I)
5062-0AC71	2.2	1.4	2000	x	x	x	x	6.9	x	x	x	x	11.5
5062-0AF71	2.2	2.1	3000	o	x	o	x	9.0	x	x	o	x	8.0
5064-0AC71	4.5	2.9	2000	x	o	x	o	13.8	x	x	x	x	11.5
5064-0AF71	4.5	4.3	3000	o	x	o	o	20.4	x	x	o	x	8.0
5064-0AG71	4.5	7.1	4000	o	o	o	o	30.0	o	x	o	x	7.5
5066-0AC71	6.5	4.2	2000	o	x	o	o	20.4	x	x	x	x	11.5
5066-0AF71	6.5	6.2	3000	o	o	o	o	30.0	x	x	o	x	8.0
5066-0AG71	6.5	10.3	4000	o	o	o	o	30.0	x	o	x	o	4.5
5070-0AC71	3.0	1.9	2000	o	o	x	x	7.8	x	x	x	x	11.5
5070-0AF71	3.0	2.8	3000	o	o	o	x	10.8	o	o	x	x	9.5
5071-0AC71	4.5	2.9	2000	x	x	x	o	11.7	x	x	x	x	11.5
5071-0AF71	4.5	4.2	3000	o	x	o	o	20.4	x	x	o	x	8.0
5072-0AC71	10.0	6.3	2000	x	o	o	o	25.5	x	x	x	x	11.5
5072-0AF71	10.0	9.3	3000	o	o	o	o	30.0	o	x	o	x	7.5
5072-0AG71	10.0	15.5	4000	o	o	o	o	30.0	o	o	x	o	4
5073-0AC71	7.0	4.4	2000	o	x	o	o	20.4	x	x	x	x	11.5
5073-0AF71	7.0	6.5	3000	o	o	o	o	30.0	x	x	o	x	8.0
5074-0AC71	14.0	8.8	2000	o	o	o	o	30.0	o	o	x	x	9.5
5074-0AF71	14.0	13.0	3000	o	o	o	o	30.0	o	o	x	o	4.0
5076-0AC71	18.0	11.5	2000	o	o	o	o	30.0	x	x	x	o	6.0
5076-0AF71	18.0	17.0	3000	o	o	o	o	30.0	x	x	o	o	2.5
5100-0AC71	10.0	6.2	2000	o	o	o	o	30.0	x	x	x	x	11.5
5100-0AF71	10.0	9.1	3000	o	o	o	o	30.0	x	o	x	o	4.5
5101-0AC71	15.0	9.3	2000	o	o	o	o	30.0	x	o	o	x	6.5
5101-0AF71	15.0	14.0	3000	o	o	o	o	30.0	x	x	o	o	2.5
5102-0AA71	27.0	10.0	1200	o	o	o	o	30.0	o	o	x	x	9.5
5102-0AC71	27.0	15.5	2000	o	o	o	o	30.0	x	x	o	o	2.5
5103-0AC71	19.0	12.0	2000	o	o	o	o	30.0	x	o	x	o	4.5
5103-0AF71	19.0	17.5	3000	o	o	o	o	30.0	o	x	o	o	2.0
5104-0AA71	37.0	14.0	1200	o	o	o	o	30.0	x	o	o	x	6.5
5106-0AA71	45.0	17.0	1200	o	o	o	o	30.0	o	x	x	o	5.5
5108-0AA71	55.0	20.5	1200	o	o	o	o	30.0	o	o	x	o	4.0

Table 4.3

o ≙ Contact in initial (OFF) position
x ≙ Contact in ON position
Contacts S1.1, S2.1, S3.1: Reversal
Contact S1.10/resistor R200: For current-controlled operation of all 3 axes, set contact S1.10 to ON/fit jumper in the position of R200.

Matching table for SIMODRIVE inverter modules **A30 (30/60 A)**
Settings of the contacts of switches of S1, S2 and S3 on the adjustment module.

Servo-motor				Current limit					Current controller gain				
1FT	M_0 [Nm]	I_0 [A]	n_{rated} in min^{-1}	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp (I)
5064-0AC71	4.5	2.9	2000	x	x	x	x	13.8	x	x	x	x	11.5
5064-0AF71	4.5	4.3	3000	x	o	o	x	20.4	x	x	o	x	8.0
5064-0AG71	4.5	7.1	4000	o	o	x	o	30.0	o	x	o	x	7.5
5066-0AC71	6.5	4.2	2000	x	o	o	x	20.4	x	x	x	x	11.5
5066-0AF71	6.5	6.2	3000	o	o	x	o	30.0	x	x	o	x	8.0
5066-0AG71	6.5	10.3	4000	o	x	o	o	40.8	x	o	o	x	6.5
5071-0AF71	4.5	4.2	3000	x	o	o	x	20.4	o	o	x	x	9.5
5072-0AC71	10.0	6.3	2000	o	o	x	o	30.0	x	x	x	x	11.5
5072-0AF71	10.0	9.3	3000	o	x	o	o	40.8	o	o	x	x	9.5
5072-0AG71	10.0	15.5	4000	o	o	o	o	60.0	x	x	o	x	8
5073-0AC71	7.0	4.4	2000	x	o	o	x	20.4	x	x	x	x	11.5
5073-0AF71	7.0	6.5	3000	o	o	x	o	30.0	x	x	o	x	8.0
5074-0AC71	14.0	8.8	2000	o	x	o	o	40.8	x	x	x	x	11.5
5074-0AF71	14.0	13.0	3000	o	o	o	o	60.0	x	x	o	x	8.0
5074-0AG71	14.0	22.5	4000	o	o	o	o	60.0	o	o	x	o	4.0
5076-0AC71	18.0	11.5	2000	x	o	o	o	51.0	o	x	x	x	11.0
5076-0AF71	18.0	17.0	3000	o	o	o	o	60.0	x	x	x	o	6.0
5076-0AG71	18.0	27.0	4000	o	o	o	o	60.0	o	o	x	o	4.0
5100-0AC71	10.0	6.2	2000	o	o	x	o	30.0	o	x	x	x	11.0
5100-0AF71	10.0	9.1	3000	o	x	o	o	40.8	x	o	o	x	6.5
5101-0AC71	15.0	9.3	2000	o	x	o	o	40.8	o	o	x	x	9.5
5101-0AF71	15.0	14.0	3000	o	o	o	o	60.0	x	x	x	o	6.0
5102-0AA71	27.0	10.5	1200	o	x	o	o	40.8	x	x	x	x	11.5
5102-0AC71	27.0	15.5	2000	o	o	o	o	60.0	o	x	o	x	7.5
5102-0AF71	27.0	25.0	3000	o	o	o	o	60.0	x	x	o	o	2.5
5103-0AC71	19.0	12.0	2000	o	o	o	o	60.0	o	o	x	x	9.5
5103-0AF71	19.0	17.5	3000	o	o	o	o	60.0	o	o	x	o	4.0
5104-0AA71	37.0	14.0	1200	o	o	o	o	60.0	x	x	x	x	11.5
5104-0AC71	37.0	23.0	2000	o	o	o	o	60.0	x	o	x	o	4.5
5106-0AA71	45.0	17.0	1200	o	o	o	o	60.0	o	x	x	x	11.0
5106-0AC71	45.0	28.0	2000	o	o	o	o	60.0	x	o	x	o	4.5
5108-0AA71	55.0	20.5	1200	o	o	o	o	60.0	x	x	o	x	8.0

Table 4.4

o ≙ Contact in initial (OFF) position
x ≙ Contact in ON position
Contacts S1.1, S2.1, S3.1: Reversal
Contact S1.10/resistor R200: For current-controlled operation of all 3 axes, set contact S1.10 to ON/fit jumper in the position of R200.

Matching table for SIMODRIVE inverter modules **A40 (40/80 A)**
Settings of the contacts of switches S1, S2 and S3 on the adjustment module.

Servo-motor				Current limit					Current controller gain				
1FT	M_o [Nm]	I_o [A]	n_{rated} in min^{-1}	Contacts				I_{max} [A]	Contacts				Kp (I)
				2	3	4	5		6	7	8	9	
5064-0AF71	4.5	4.3	3000	o	x	x	x	19.2	x	x	o	x	8.0
5064-0AG71	4.5	7.1	4000	o	o	x	x	28.8	x	o	o	x	6.5
5066-0AC71	6.5	4.2	2000	o	x	x	x	19.2	x	x	x	x	11.5
5066-0AF71	6.5	6.2	3000	o	o	o	x	28.8	x	x	o	x	8.0
5066-0AG71	6.5	10.3	4000	o	o	x	o	40.0	x	o	o	x	6.5
5071-0AF71	4.5	4.2	3000	o	o	x	x	20.8	o	o	x	x	9.5
5072-0AC71	10.0	6.3	2000	o	o	o	x	28.8	x	x	x	x	11.5
5072-0AF71	10.0	9.3	3000	o	o	x	o	40.0	o	o	x	x	9.5
5072-0AG71	10.0	15.5	4000	o	x	o	o	54.4	o	x	o	x	7.5
5073-0AC71	7.0	4.4	2000	o	o	x	x	20.8	x	x	x	x	11.5
5073-0AF71	7.0	6.5	3000	x	x	x	o	31.2	x	x	o	x	8.0
5074-0AC71	14.0	8.8	2000	o	o	x	o	40.0	x	x	x	x	11.5
5074-0AF71	14.0	13.0	3000	x	o	o	o	68.0	o	o	x	x	9.5
5074-0AG71	14.0	22.5	4000	o	o	o	o	80.0	x	o	o	x	4.5
5076-0AC71	18.0	11.5	2000	x	x	o	o	48.8	o	x	x	x	11.0
5076-0AF71	18.0	17.0	3000	o	o	o	o	80.0	x	x	o	x	8.0
5076-0AG71	18.0	27.0	4000	o	o	o	o	80.0	x	o	x	o	4.5
5100-0AC71	10.0	6.2	2000	x	x	x	o	31.2	x	x	x	x	11.5
5100-0AF71	10.0	9.1	3000	o	o	x	o	40.0	x	o	o	x	6.5
5101-0AC71	15.0	9.3	2000	o	o	x	o	40.0	o	o	x	x	9.5
5101-0AF71	15.0	14.0	3000	x	o	o	o	68.0	o	x	o	x	7.5
5102-0AA71	27.0	10.5	1200	x	x	o	o	48.8	x	x	x	x	11.5
5102-0AC71	27.0	15.5	2000	o	o	o	o	80.0	o	o	x	x	9.5
5102-0AF71	27.0	25.0	3000	o	o	o	o	80.0	x	o	x	o	4.5
5103-0AC71	19.0	12.0	2000	x	o	o	o	68.0	o	o	x	x	9.5
5103-0AF71	19.0	17.5	3000	o	o	o	o	80.0	x	o	x	o	4.5
5104-0AA71	37.0	14.0	1200	x	o	o	o	68.0	x	x	x	x	11.5
5104-0AC71	37.0	23.0	2000	o	o	o	o	80.0	x	o	o	x	6.5
5106-0AA71	45.0	17.0	1200	o	o	o	o	80.0	x	x	x	x	11.5
5106-0AC71	45.0	28.0	2000	o	o	o	o	80.0	o	x	x	o	5.5
5108-0AA71	55.0	20.5	1200	o	o	o	o	80.0	x	x	x	x	11.5

Table 4.5

o ≙ Contact in initial (OFF) position
x ≙ Contact in ON position
Contacts S1.1, S2.1, S3.1: Reversal
Contact S1.10/resistor R200: For current-controlled operation of all 3 axes, set contact S1.10 to ON/fit jumper in the position of R200.

4.1.4 Nominal data

Short-time limit current	2 x I_N (200 ms) (I_N ≙ rated current)
Efficiency	approx. 95 %
Number of feed axes	1 to 6

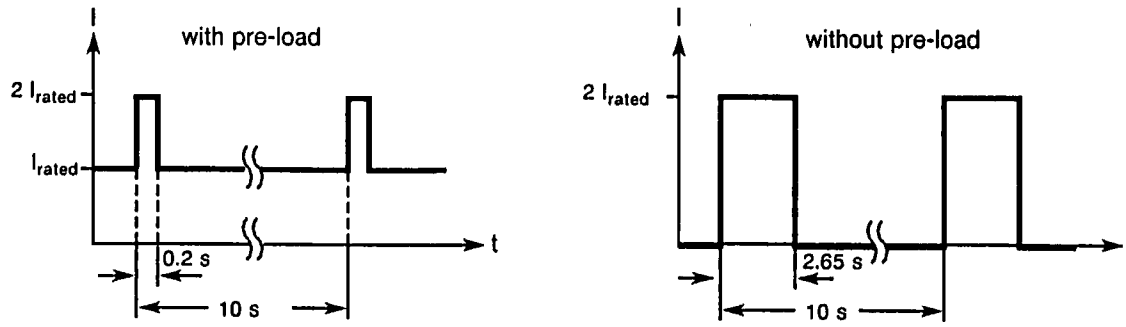


Fig. 4.2 Rated load cycles for power module in operation with short-time limit current

In operation without short-time limit current, a continuous current of 1.1 times the rated current is permissible (see also Section 4.1.5).

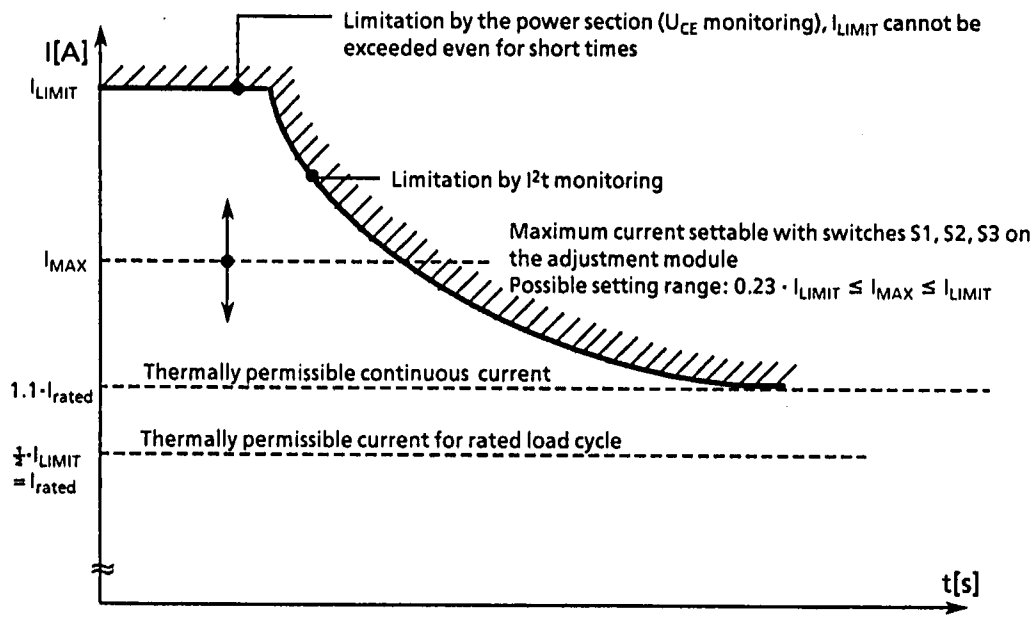


Fig. 4.3 Effective current limits

4.1.5 Testing the load cycle

The I^2t curve (Fig. 4.4) describes the following monitoring function:

The actual current value is approximately squared and the result subsequently integrated. If the actual current value is larger than 1.1 times the rated current, the voltage excursion of the integrator is negative, otherwise it is positive.
If the integrator, starting from rest (start-up of the unit or reset command), has a negative total voltage excursion of about – 15 V, the current setpoint limitation takes effect.

To calculate the given load cycle of the total voltage excursion, proceed as follows:

1) Divide the load cycle into time sections Δt_i (i = 1, ..., n) with constant current I.

2) Use the following formula to calculate the part voltage excursion ΔU_i (i = 1, ..., n) for each time section depending on the sign:

$$\frac{\Delta U_i}{V} \equiv \frac{\Delta t_i}{s} \cdot \left[2{,}2 - 2 \cdot \left(\frac{I}{I_{rated}}\right)^2\right]$$

3) Add the part voltage excursions according to sign.

4) Total voltage excursion ≤ -15 V → Load cycle impermissible
   > -15 V → Load cycle permissible

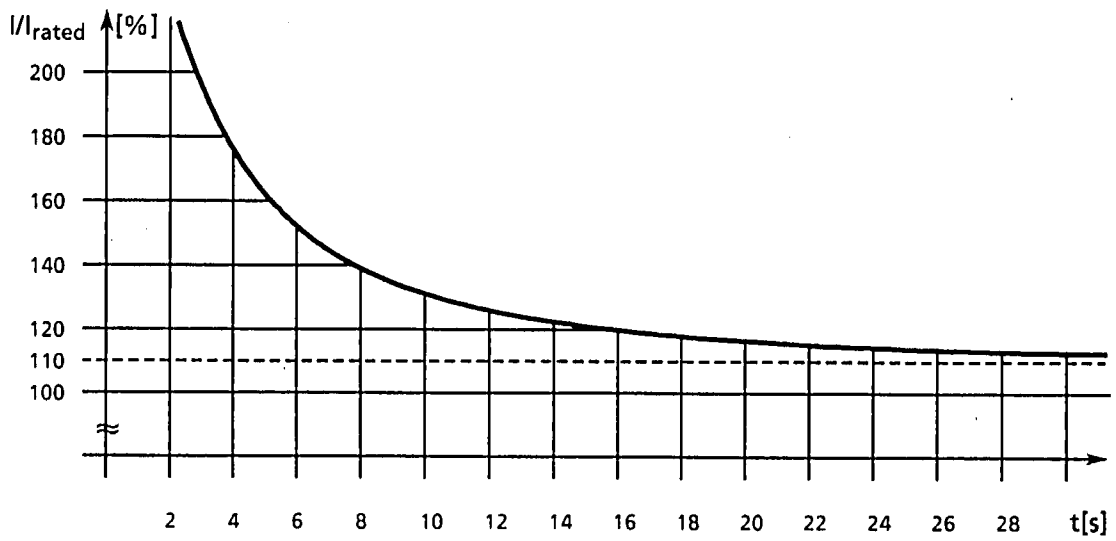


Fig. 4.4 I^2t-curve ≙ thermally permissible time duration of overcurrent

4.1.6 Current setpoint limitation; holding against a hard stop

When voltage is applied to terminal 96 according to Figures 4.5 and 4.6, the "Speed controller fully open" monitoring feature is made ineffective.
The permissible standstill current of the power circuit modules is 0.5 x I_{rated} ≙ 25 % $\frac{I_{set}}{I_{rated}}$

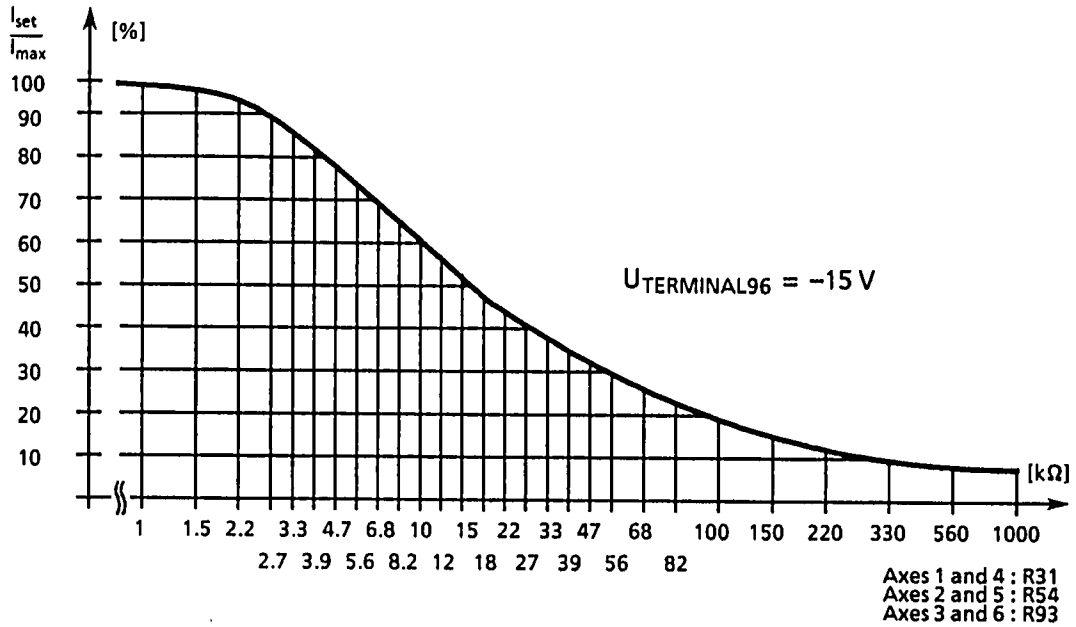


Fig. 4.5 Current setpoint limit as a function of R31, R54, R93 on the adjustment module

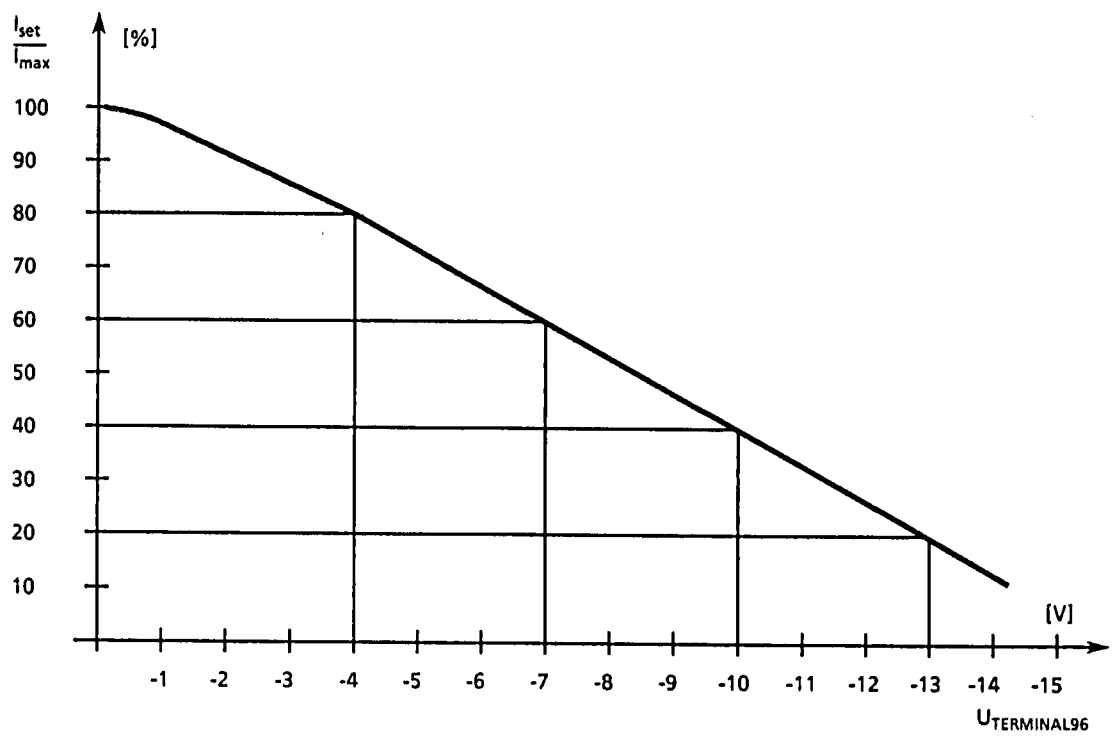


Fig. 4.6 Current setpoint limit as a function of the voltage at terminal 96 (input resistance of terminal 96 is 12 kΩ)

4.1.7 Speed controller adaptation

The speed controller reset time $T_{Nnominal}$ can be adjusted with potentiometers R135 (axes 1 and 4), R235 (axes 2 and 5) and R335 (axes 3 and 6). In order to adaptively reduce the reset time T_N of the speed controller at very low speeds, the adjustment module must be fitted with resistors R15 (for axes 1 and 4) R46 (for axes 2 and 5) and R77 (for axes 3 and 6). The reset time can be reduced to the following T_{Nadapt} values with the following resistance values:

With 0.1 kΩ to 5 % of $T_{Nnominal}$
With 1.2 kΩ to 25 % of $T_{Nnominal}$
With 1.8 kΩ to 33 % of $T_{Nnominal}$
With 3.9 kΩ to 50 % of $T_{Nnominal}$
With 10 kΩ to 72 % of $T_{Nnominal}$
With 20 kΩ to 84 % of $T_{Nnominal}$
With 39 kΩ to 91 % of $T_{Nnominal}$

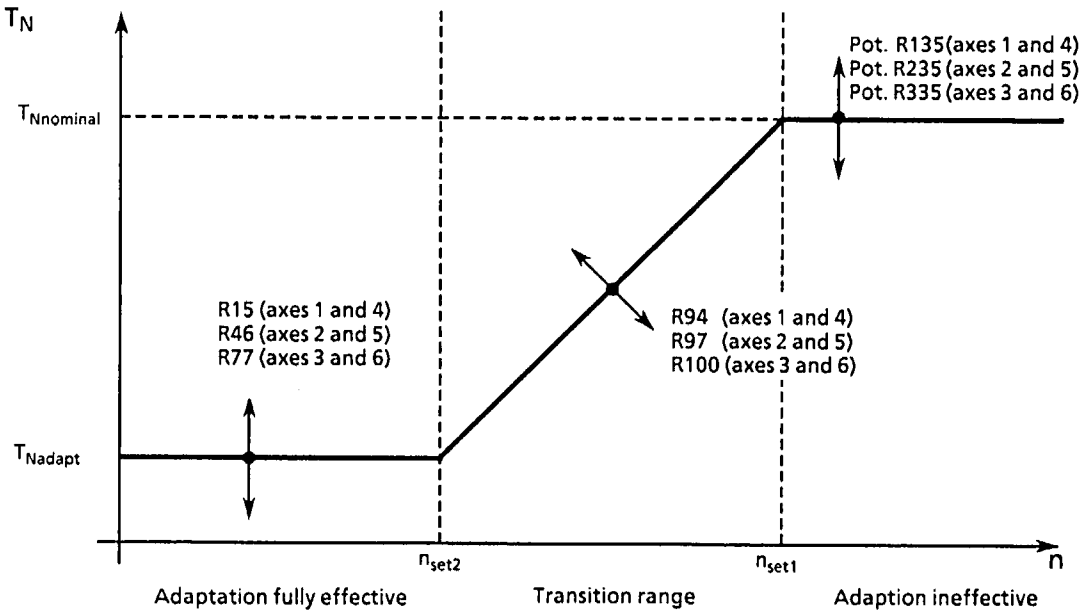


Fig. 4.7 Adaptive reduction of reset time at low speeds

With the speed controller module as supplied, i.e. no resistors fitted in positions R94 (axes 1 and 4), R97 (axes 2 and 5) and R100 (axes 3 and 6), the reduction of the reset time begins at $n_{set\,1}$ ≙ approx. 200 mV and the preset minimum is reached at $n_{set\,2}$ ≙ approx. 33 mV.

The point at which the reset time adaptation becomes effective can be adjusted with resistors R94, R97 and R100 as indicated in the following table (values apply to versions from K onwards).

R in kΩ	n_{set1} in mV	n_{set2} in mV
0.1	20	4
1.0	50	10
1.5	60	12
2.2	80	15
4.7	110	20
10.0	140	30
open	200	33

Table 4.6

4.1.8 Reversal

The direction of rotation of the motor can be reversed by contact 1 of DIL switches S1 (axes 1 and 4), S2 (axes 2 and 5) and S3 (axes 3 and 6) on the adjustment module.

4.1.9 Electrical weight compensation

The weight on mechanically preloaded axes can be compensated by fitting resistors R3, R5 (axes 1 and 4), R32, R36 (axes 2 and 5) and R63, R67 (axes 3 and 6). When setting the resistance values, note that $I_{weight\ compensation}$ must not be allowed to exceed I_{rated}. The internal current limit (I_{max}/I_{limit}) must also be reduced by the same percentage on switch S2 (contacts 2 to 5).

Example: Assume that I_{max}/I_{limit} = 100 % (S2.2 to S2.5 set to OFF)
Requirement: $I_{weight\ compensation}/I_{max}$ = 30 %
Correction: I_{max}/I_{limit} = 100 % - 30 % ≈ 68 % (S2.3 to ON)

Monitoring circuits in the power section may respond if this rule is not observed.

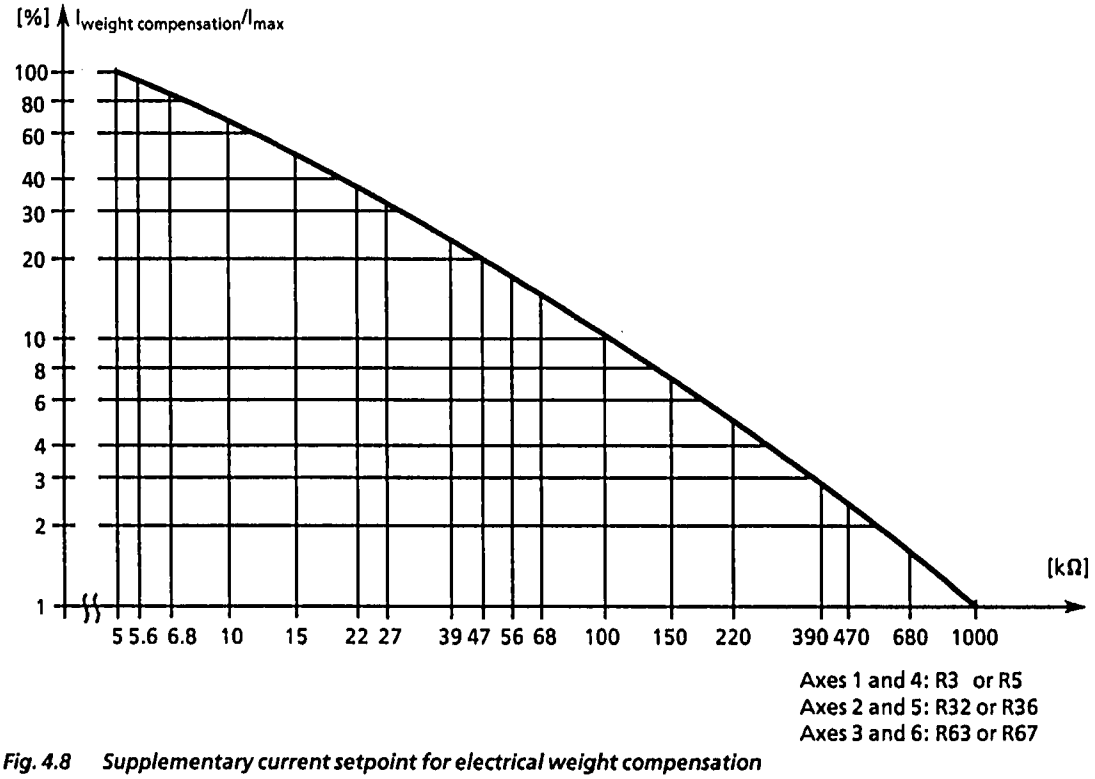


Fig. 4.8 Supplementary current setpoint for electrical weight compensation

A positive current setpoint at test sockets T1 (axes 1 and 4), T2 (axes 2 and 5), T3 (axes 3 and 6) is obtained by fitting resistors R5, R36, R67 on the adjustment module. A negative current setpoint is obtained by fitting resistors R3, R32 and R63 on the adjustment module.

4.1.10 Current-controlled operation

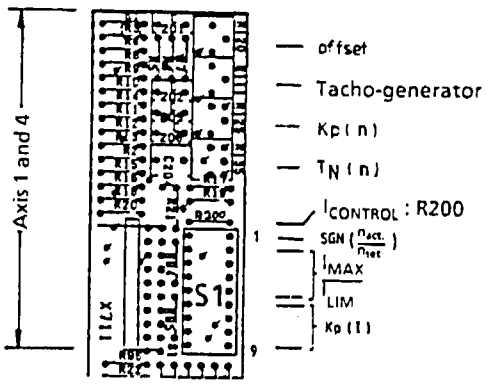
Apply the current setpoint (I_{set}) to the following terminals:

X411:58 and X411:8 (axes 1 and 4)
X421:58 and X421:8 (axes 2 and 5)
X431:58 and X431:8 (axes 3 and 6)

Then apply the central pulse and controller enabling signals (by connecting terminals X121:63 and X121:64 to terminal X121:9 on the power supply).
The further procedure depends on the version of adjustment module and on whether the current of the 3 (6) axes is to be controlled in common or individually.

<u>In order to operate all 3 (6) axes with current control (with P-action component only)</u>

a) 9-pole switch S1

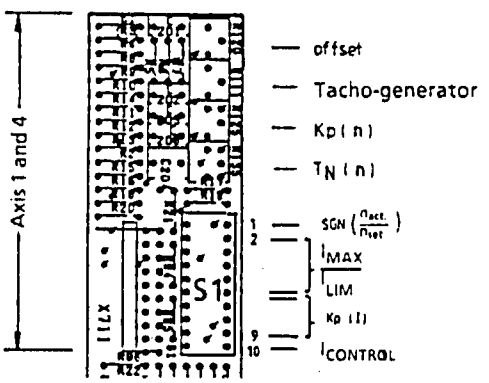


- Fit jumper R200 on the adjustment module
- Set for axis-specific controller enabling:

Connect X111:65 to X111:9 (axes 1 and 4)
Connect X121:65 to X121:9 (axes 2 and 5)
Connect X131:65 to X131:9 (axes 3 and 6)

Fig. 4.9a

b) 10-pole switch S1



- Set switch S1.10 on adjustment module to ON
- Set for axis-specific controller enabling:

Connect X111:65 to X111:9 (axes 1 and 4)
Connect X121:65 to X121:9 (axes 2 and 5)
Connect X131:65 to X131:9 (axes 3 and 6)

Fig. 4.9b

In order to operate individual axes with current control (with P-action component only)

a) 9-pole switch S1

- No jumper in position R200

b) 10-pole switch S1

- Set switch S1.10 on the adjustment module to OFF

- Remove the following resistors from the controller module:

R263 (axes 1 and 4)
R369 (axes 2 and 5)
R327 (axes 3 and 6)

- Set for axis-specific controller blocking

Disconnect X111:65 – X111:9 (axes 1 and 4)
Disconnect X121:65 – X121:9 (axes 2 and 5)
Disconnect X131:65 – X131:9 (axes 3 and 6)

Current-controlled operation with PI current controller

A purely P-action controller is not a sufficiently accurate current controller for special applications which employ pure torque control and do not permit a steady-state deviation. Furthermore, the feeback of the actual speed value to the current setpoint across the short-circuited speed controller (0.5 kΩ in feedback circuit) with max. 600 mV causes an additional control error.

Torque-controlled operation with PI current controller not affected by the actual speed value can be implemented as follows;

- Activate terminal 6 on the controller module with + 15 V, thus disabling the integral-action component of the speed controller.
- Remove (using pincers) resistor R9 (1st axis) on the adjustment module. The actual speed value is now decoupled.
  To eliminate the effect of the speed controller offset, the potentiometers for K_p and T_N should be turned as far as possible to the left (minimum gain). The drift should also be compensated (I* = 0 V, test socket T = 0 V).
- The current setpoint is input via terminal 58-8.
  Terminal 56 must be connected to terminal 14.

All other terminals and switches must be set as for speed-controlled operation, i.e. terminals 63, 64. 65 enabled and switch S1.10 to OFF.

The current limits remain effective in current-controlled operation.

4.1.11 Current setpoint for parallel operation

Speed-controlled axis 1 and/or 4 of the controller module can act as master and feed its current setpoint to current-controlled slave axis 2 and/or 3 (or 5 and/or 6). The following modifications are required on the control module for this purpose:

- Axis 2 and/or 5 to operate as slave:

  Remove jumper R431
  Fit jumper R430
  Apply - 15 V to X121:96 ("Speed controller fully open" monitoring deactivated)

- Axis 3 and/or 6 to operate as slave:

  Remove jumper R449
  Fit jumper R448
  Apply - 15 V to X131:96 ("Speed controller fully open" monitoring deactivated)

4.1.12 External power supply for controller enabling

The internal power supply for controller enabling can be deactivated by removing resistors R20 and R21 from module G01. An external potential-free power supply (+24 V) can be connected via terminal X121:19 (reference potential) and terminal X121:9 of the power supply.

4.1.13 Circuit modifications in the speed setpoint channel

The smoothing time constant in the speed setpoint channel can be increased by the addition of capacitors C301 (axes 1 and 4), C302 (axes 2 and 5) and C303 (axes 3 and 6) on the controller module (see Fig. 4.10).

The input resistance of the speed setpoint channel can be adjusted by the addition of R450 (axes 1 and 4), R461 (axes 2 and 5) and R471 (axes 3 and 6).

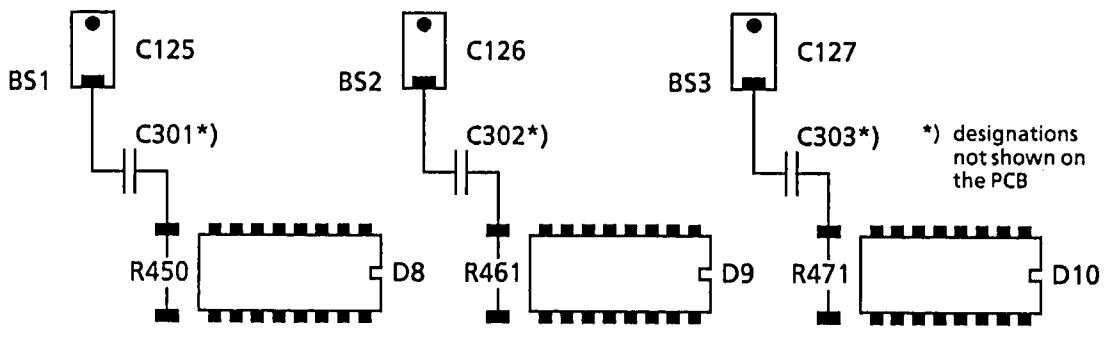


Fig. 4.10 ■ ≙ *Soldering pins (provided on controller modules in versions from N onwards)*

4.1.14 Monitoring for speed controller integration limit

If the speed controller is fully open for more than approx. 200 ms, pulse blocking and controller inhibition will be initiated.

If necessary, this monitoring time can be extended by increasing the resistance value of R605 (axes 1 and 4), R646 (axes 2 and 5) and R656 (axes 3 and 6) on the controller module (from version N on soldering pins).

Monitoring time for axis 1 (example):

$$\frac{t}{s} \approx \frac{R605}{M\Omega} \cdot 0.55$$

4.1.15 Operation of control axes without power circuit module

If no motor is connected to an axis, pins 11 and 12 of connector X311 (for axes 1 and 4), X321 (for axes 2 and 5) or X331 (for axes 3 and 6) on the controller module (DUBOX connectors) must be short-circuited (see Fig. 4.11)

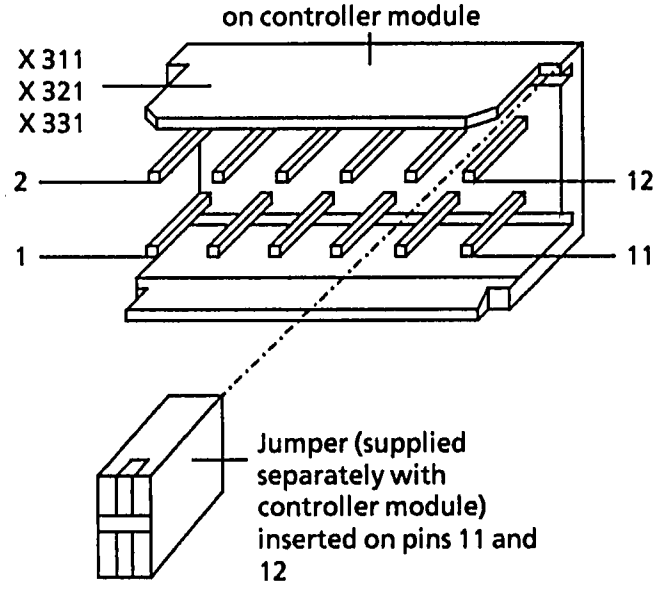


Fig. 4.11 Terminating connector

The pulse cables must be provided with a terminating connector in order to prevent disturbances during operation without power circuit module.

For all control modules:

Order No.: 6SC6101-0XB10 (16-way)
6SC6101-0XB12 (34-way)

Adapter 1 x 34-way to 2 x 16-way
Order No.: 6SC6101-0LA12

4.2 Signals

No fault indication will appear until approximately 1 s after power-up.

4.2.1 Ready/Fault signal

The ready signal can be converted into a fault signal by removing diode V13 on power supply module G01.

A fault signal will not appear until the unit has been connected to the supply for approximately 1 s.

A fault indication occurs if the ± 15 V monitoring device, the DC link voltage monitoring device ($U_{DC\,link}$ ≫) or the monitoring device for the speed controller integration limit operate.

The ready indication occurs if none of the aforementioned fault conditions applies and if the enable signal is present at terminals 63 and 64.

4.2.2 Reset fault memories

The fault memories in the unit can be reset by applying an M signal to terminal R of connector X111 on the power supply module or by switching the unit off and then on again.

NOTE
The DC-link voltage must have dropped to at least 25 V before the unit is switched on again to ensure that an internal reset signal is generated. The link voltage takes approximately 10 s (depending on unit version) to drop to the correct value.

4.2.3 I^2t and motor overtemperature signals

For this signal, terminal 5 with location code +G01-X111 provides an open collector output which is common to all axes. A relay can be connected to this output and to terminal 7 or some other power supply (connect freewheeling diode in parallel!) (Fig. 4.12). The relay is picked up when the signal is active.

Relay data: U_N = 12 V or 15 V, $I_N \leq$ 50 mA when using the internal voltage at terminal 7.
When using an external voltage of 24 V, a 24 V relay can be used
(U_N = 24 V, $I_N \leq$ 50 mA).

If terminal 5 is direct-connected to the programmable logic controller (PLC), a pull-up resistor of 1.0 kΩ (1.0 W) must be connected to terminals 5 and 7 or some other power supply (indication active ≙ L signal) (Fig. 4.13).

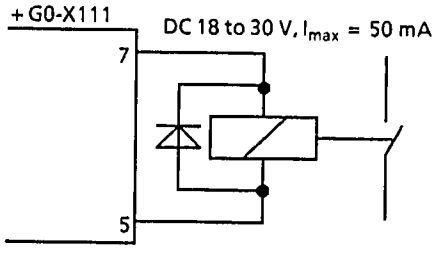


Fig. 4.12 Connection of a relay

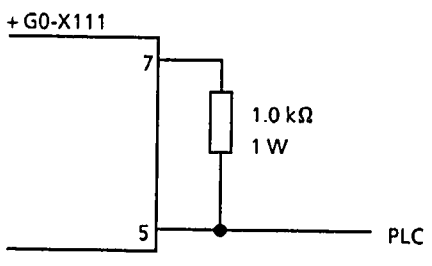


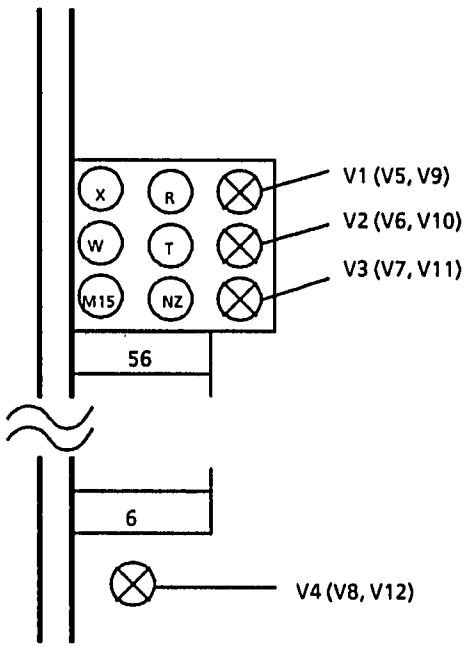
Fig. 4.13 Connection to the PLC

NOTE

The motor overtemperature indication has no effects in the unit.

The I^2t indication is followed with a delay by a current reduction to the thermally permissible continuous current of the power section.
The unit is not tripped. To clear the fault indication, the unit must either be switched off or reset.

4.3 Test sockets, display elements



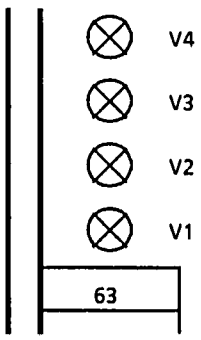
X	Actual speed value	± 10V
R	Speed setpoint	± 10V
W	Actual current value	± 10V ≙ selected current limit
T	Current setpoint	± 10V

All the values are standardized to 10 V DC.

NZ	Input for injecting a supplementary setpoint (e.g. by battery box)
M15	Electronic ground

V1	Tacho monitoring (not provided)
V2	Speed controller fully open
V3	I^2t monitoring
V4	Motor overtemperature

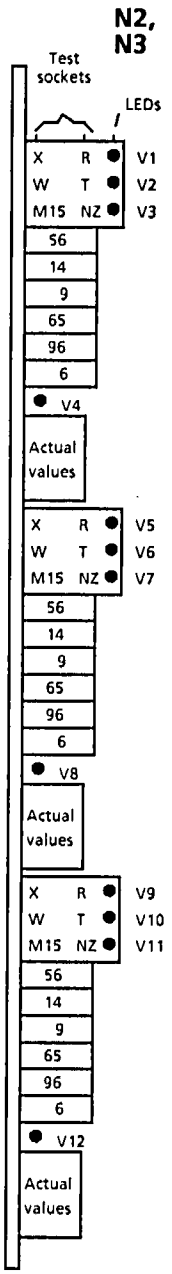
Fig. 4.14 Test sockets and display elements on controller modules N2 and N3



V1	Group fault
V2	± 15 V monitoring
V3	$U_{DC\text{-}link}$ ⩾
V4	Enabling signals

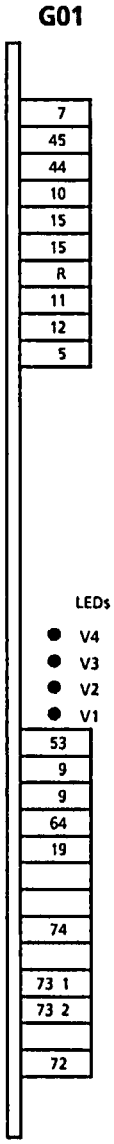
Fig. 4.15 Display elements on power supply module G01

4.4 Faults



Type of fault	Indications	Meaning	Possible causes
Axis does not move even though the reference value is applied to terminal 56	Green LED + G01-V4 lights up, red LEDs do not light up	No enabling signal at terminals 63 and/or 64	Customer's interlocking circuit activated, R20, R21 disconnected
	No LED lights up		External main fuse blown or not inserted or power supply defective
	Red LED + G01-V1 lights up, red LEDs (N_o) do not light up + G01-V2 lights up	± 15 V out of tolerance or not available	
	+ G01-V3 lights up	Voltage of DC link circuit too high	Supply voltage too high, load inertia too high, current limit mismatched
	Red LED + G01-V1 lights up Red LED + N_o-V1* lights up	Tacho monitoring circuit responded	Tacho or tacho cable defective
	Red LED + G0-V1 lights up Red LED + N_o-V2* lights up	Controller monitoring circuit responded (speed controller amplifier driven to maximum)	Sensor cable interrupted, mechanical system blocked, cable between motor and inverter defective, power section (A1 to A6) defective, ribbon cable between control and power section defective, motor winding connected in the wrong order

Table 4.7a



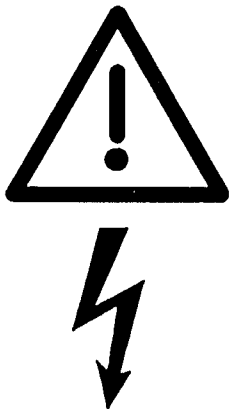
Type of fault	Indications	Meaning	Possible causes
Axis moves, but unit trips repeatedly	Red LED + G01-V1 lights up Red LED + G01-V3 lights up	Overvoltage in DC link circuit during braking	Load inertia too high, current limit not matched to motor, motor speed exceeds rated speed, resistor for voltage limitation overloaded, no loading by frictional forces, vertical axis without weight compensation
	Red LED + G01-V1 lights up Red LED + N_o-V2* lights up	Acceleration or reversing time exceeds limit value (more than 200 ms)	Current limitation set too low or load inertia too high
	Red LED + N_o-V3* lights up or red LED + N_o-V4* lights up	I^2t-monitoring circuit responded Motor overtemperature circuit responded	Effective torque too high, too many starts and stops, machining forces too high, motor defective
Surface finish is poor or inaccurate positioning			Motor defective (e.g. does not run smoothly with low setpoints), P gain of speed controller set too low (potentiometers R125, R225, R325); mutual interference of axes (due to wrong shielding or wrong installation of earth wire)
Fuses blow	F10,F110 or F310 blow		Fault in power section Remedial action: Replace module
	F247 blows		Fault in power supply and monitoring system or in the DC link voltage monitoring circuit 0.3/30 kW (G10) Remedial action: Replace both modules

Table 4.7b

N_o ≙ N2, N3
+ N_o-V1* ≙ + N_o-V1/-V5/-V9 ≙ Tacho monitoring
+ N_o-V2* ≙ + N_o-V2/-V6/-V10 ≙ Speed controller amplifier at maximum
+ N_o-V3* ≙ + N_o-V3/-V7/-V11 ≙ I^2t monitoring
+ N_o-V4* ≙ + N_o-V4/-V8/-V12 ≙ Motor overtemperature

+ G01 - V1 ≙ Group fault
+ G01 - V2 ≙ ± 15 V
+ G01 - V3 ≙ $U_{DC\,link}$ ⩾
+ G01 - V4 ≙ Enabling signals

4.5 Commissioning flowchart



WARNING

Safe operation is dependent upon proper handling and installation by qualified personnel under observance of all warnings contained in this instruction manual.

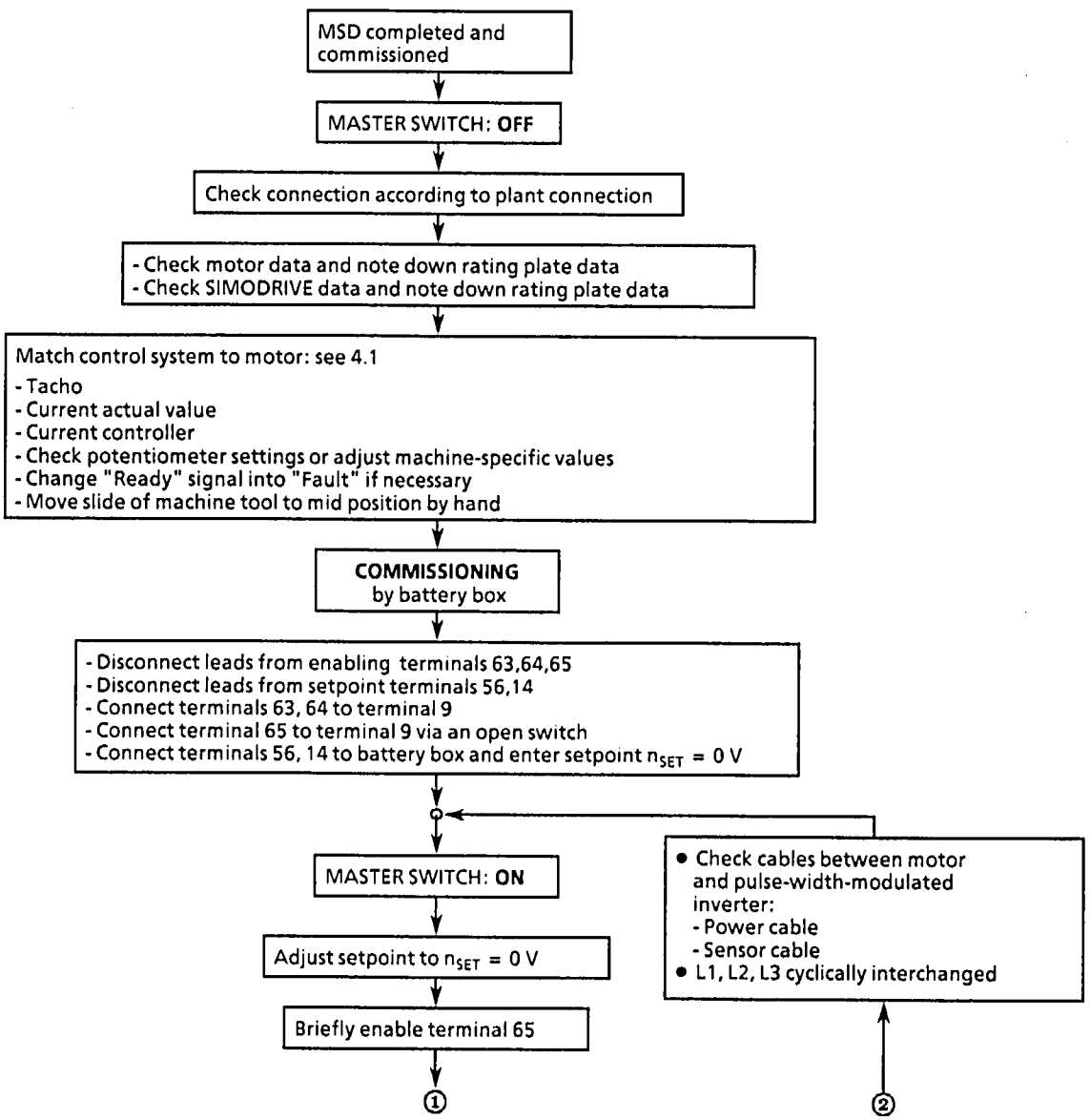
The DC link capacitors cause high voltage to persist for a short time (about 4 minutes) after disconnection from the supply.

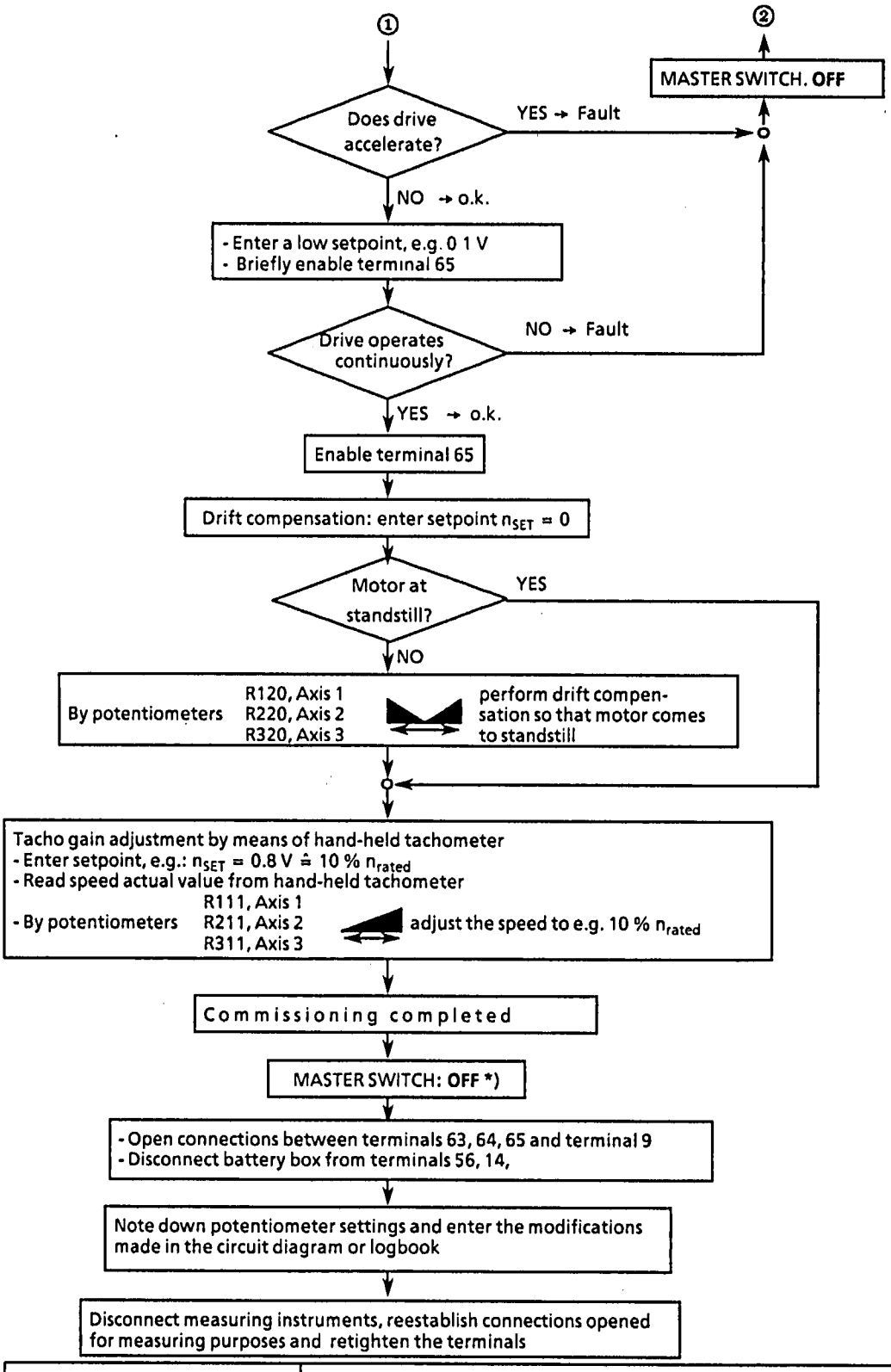
When working on the open unit, remember that live parts are exposed to contact.

Parts of the equipment may be live even when the motor is stationary.

Only qualified personnel may work on the equipment.

Non-observance can result in death, severe personal injury or substantial property damage.

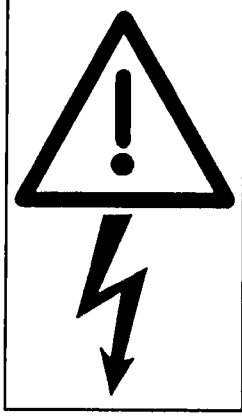




*)CAUTION

In the event of faults, the DC link circuit will remain at dangerous potential for approx. 4 minutes after disconnection of the unit. Before carrying out any manual work on the unit with the cover removed, the master switch must be opened and the DC link circuit discharged.

5 Maintenance



WARNING

Hazardous voltages are present in this electrical equipment during operation.

Non-observance of the safety instructions can result in severe personal injury or property damage.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, and maintenance procedures contained herein.

The successful and safe operation of this equiment is dependent on proper handling, installation, operation and maintenance.

5.1 Inspection and servicing

Provided that the instructions given in Section 2.1 (Mounting) have been observed, the unit does not require any maintenance.

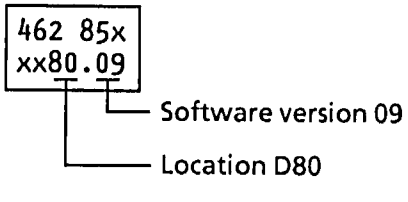
If the unit is found to be heavily polluted with dust and dirt, it should be cleaned with dry and oil-free compressed air in order to exclude the risk of flashovers and inadequate cooling.

5.2 Changing the software and bootstrapping

NOTE

The modules of the unit include electrostatically sensitive devices. Before touching a PCB the person carrying out the work must himself be electrostatically discharged. The simplest way of accomplishing this is to touch an electrically conducting earthed object (e.g. a bare metal part of a switchboard or the protective-earth contact of a socket outlet).
Observe module handling instructions listed in Appendix.

The numbers shown on the EPROMs of the controller module contain code numbers for the locations of the EPROMs and the software version.



When replacing EPROMs of earlier software releases and for bootstrapping, proceed as follows:

1. Open write protection jumper S1 on controller module N1 (LED3 lights up).

2. Take notes of all settings that have been changed after delivery (P-12 to P-98); also note the settings of P-105 to P-150, P-157, P-158, P-195 when using the C-axis or oriented spindle stop options.

3.*) Set parameter P-51 to 0 0 0 4 H
P-97 to 0 0 0 0 H
P-52 to 0 0 0 1 H.

4.*) Switch the unit off when P-52 has automatically changed to 0 0 0 0 H.

5. Change EPROMs (2 for driving circuit processor and 2 for control processor).
(This is only necessary when the software needs to be changed)

6. Switch the unit on after inserting the controller module N1. This must cause P-95 to appear on the display.

7. Perform bootstrapping operation while pulse blocking and controller blocking signals are present:
   - P-95 Enter inverter code number
   - P-96 Enter motor code number
   - P-98 If special shaft encoder with other than 1024 pulses per revolution is used, set to deviating number of pulses per revolution
   - P-97 Set to 0 0 0 1 H. (The unit then changes to the status display mode.)

8. Set P-51 to 0 0 0 4 H. Re-enter the values that have been noted in step 2 above and write into memory by setting P-52 to 0 0 0 1 H.

9. Re-insert write protection jumper S1. This renders the converter ready for operation.

*) Can be omitted for software changes as of software release 10 (controller software)

5.3 Spare parts

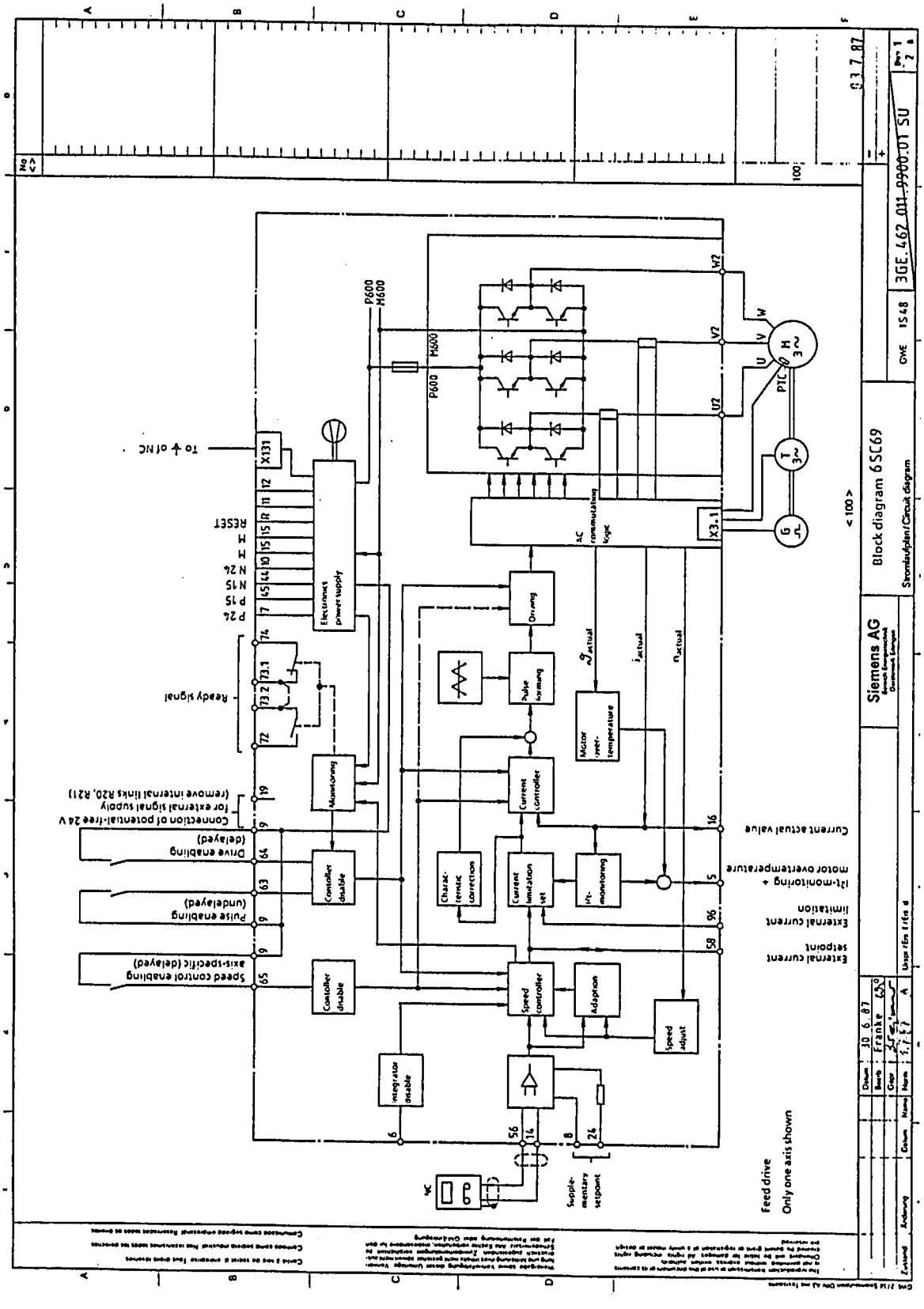
Spare parts can be ordered from the Spare Parts Service ANL 434-ED.

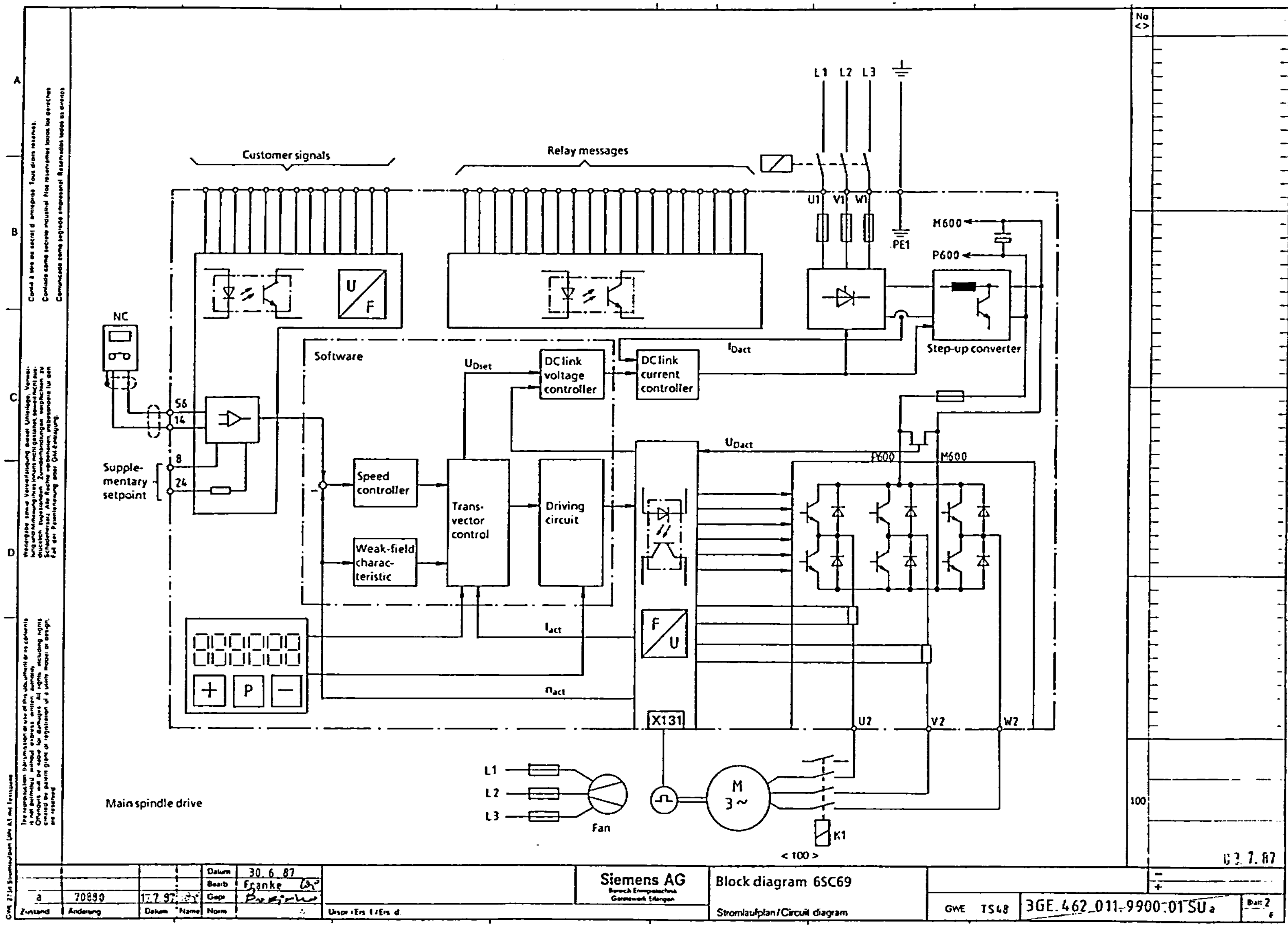
Function		Designation or location	Order No.
Contoller module MSD *)		N1	6SC6500-0NA02
I/O module		U1	6SC6500-0UC01
Display module		H1	6SC6500-0UB02
Feed control for C-axis (option A73)		S1	6SC6500-0BB01
Oriented spindle stop (option A74)		S1	6SC6500-0BC01
Options A74 + A73 (option A75)		S1	6SC6500-0BA01
Power supply including voltage limitation G10		G01	6SC6100-0GC12
Central module		G02	6SC6100-0GE01
Controller FD with adjustment module	1 axis 2 axes 3 axes	N2, N3	6SC6100-0NA01 6SC6100-0NA11 6SC6100-0NA21
Adjustment module (separate)	1 axis 2 axes 3 axes	N2, N3	6SC6100-0SA01 6SC6100-0SA11 6SC6100-0SA21
Power modules		H20 H30 H40 H60 A07 A15 A30 A40	6SC6502-0AA81 6SC6503-0AA81 6SC6504-0AA81 6SC6506-0AA81 6SC6501-0AB81 6SC6502-0AB81 6SC6503-0AB81 6SC6504-0AB81
Driving module, I/RF module 50 A Driving module, I/RF module 75 A		A0 A0	6SC6505-0AD03 6SC6507-0AD03
Wiring accessory Control for 1 axis			6SC6101-0SA03
Set of screen earthing parts			6SC6101-0SB01
Terminating connector (Weidmüller)	10pole 13pole 10pole 9pole 15pole 13pole 7pole 9pole	G01-X111 G01-X121 G02-X131 G02-X141 U1-X111 U1-X121 S1-X111 S1-X112	6SC6101-0XC06 6SC6101-0XC01 6SC6101-0XC13 6SC6101-0XC14 6SY9063 6SY9062 6SY9060 6SY9061
Subminiature connector Cable support Subminiature connector Cable support Mounting plate Latch	15 pole 15 pole 25 pole 25 pole	U1-X131 S1-X113	6ZY1075-0AA00 6ZY1076-0AA00 V42254-A1115-B225 6SY9072 6SY9070 6SY9071
Fuse	45 A 80 A 30 A/700 V 80 A/660 V NH 63 A	VR05 VR07 LT-ZK VR05, VR07 from version A onwards	6ZY1008-0AA00 6ZY1010-0AA00 6ZY1011-0AA00 6SY9447 6SY9465

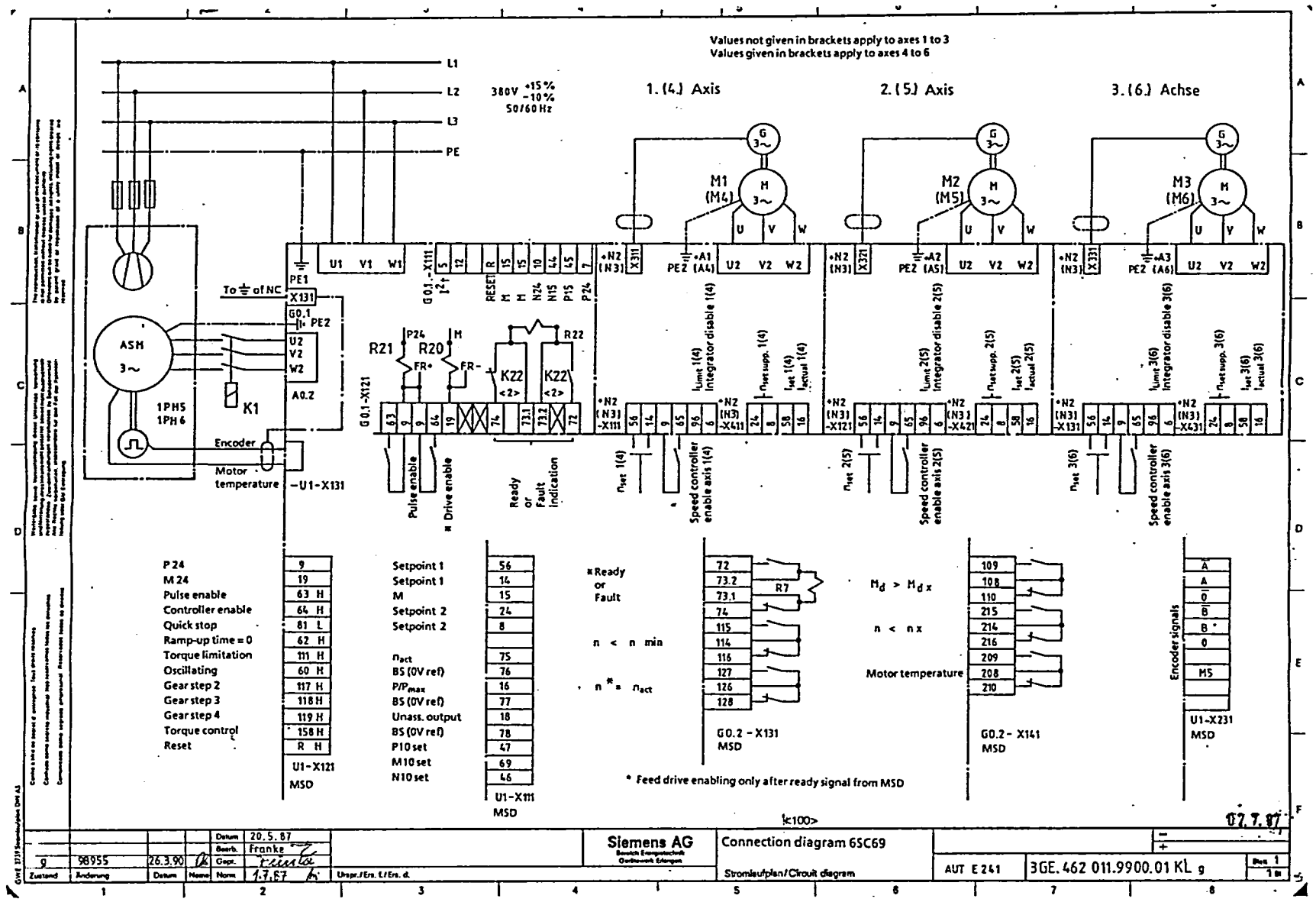
*) Note! N1 controller modules as spare parts are supplied without software. This must be ordered separately if required.

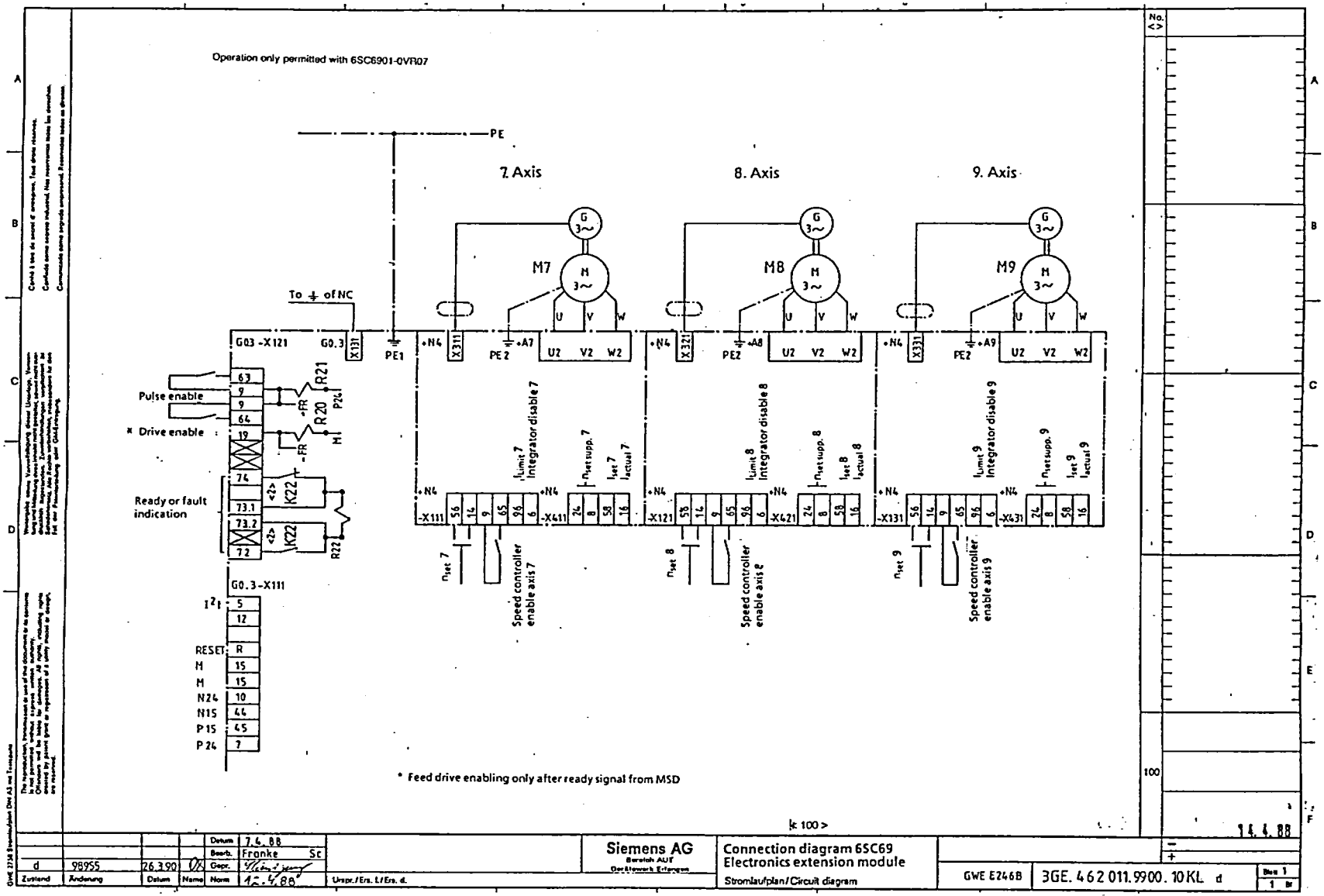
6 Appendix

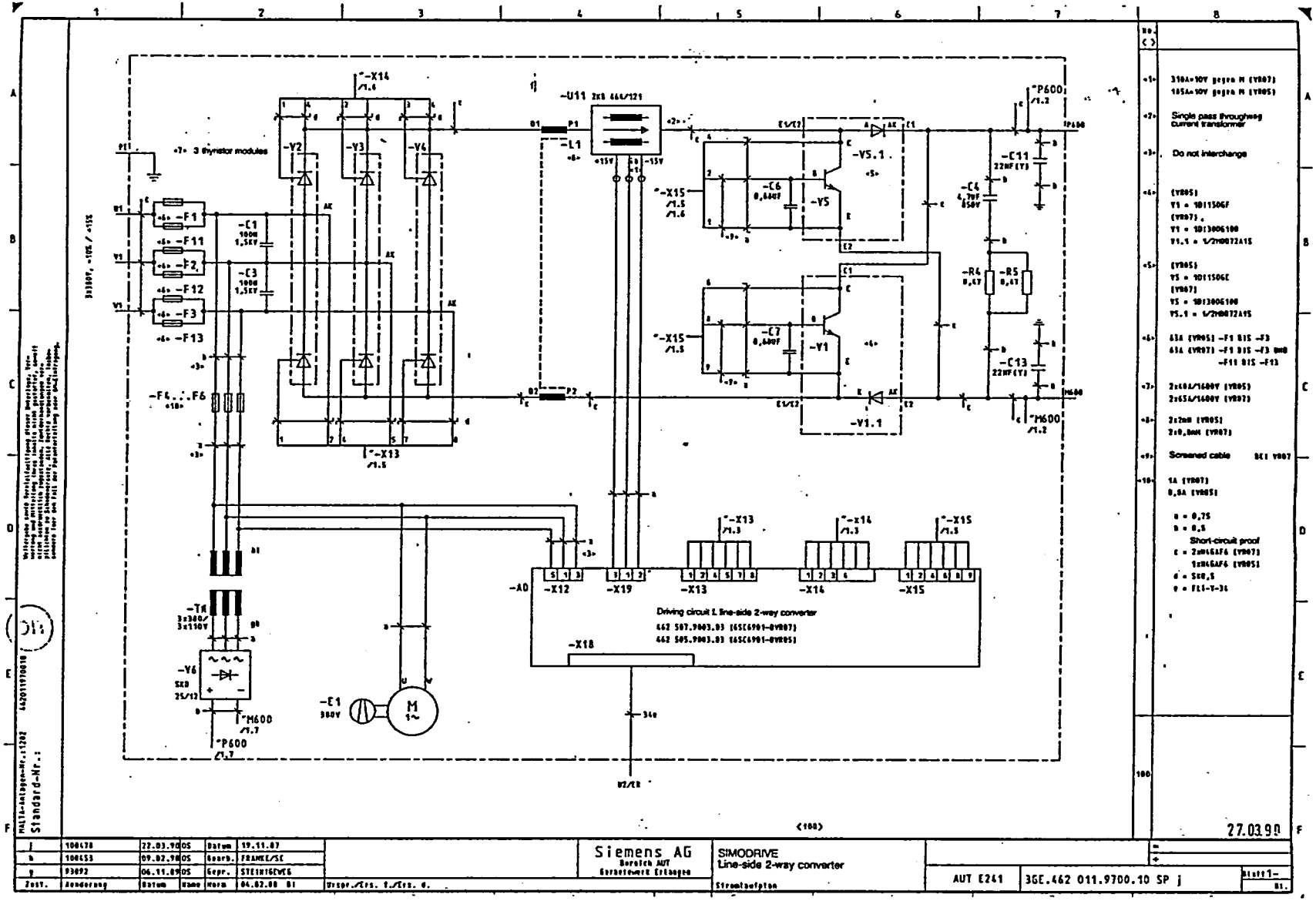
6.1 Block diagram

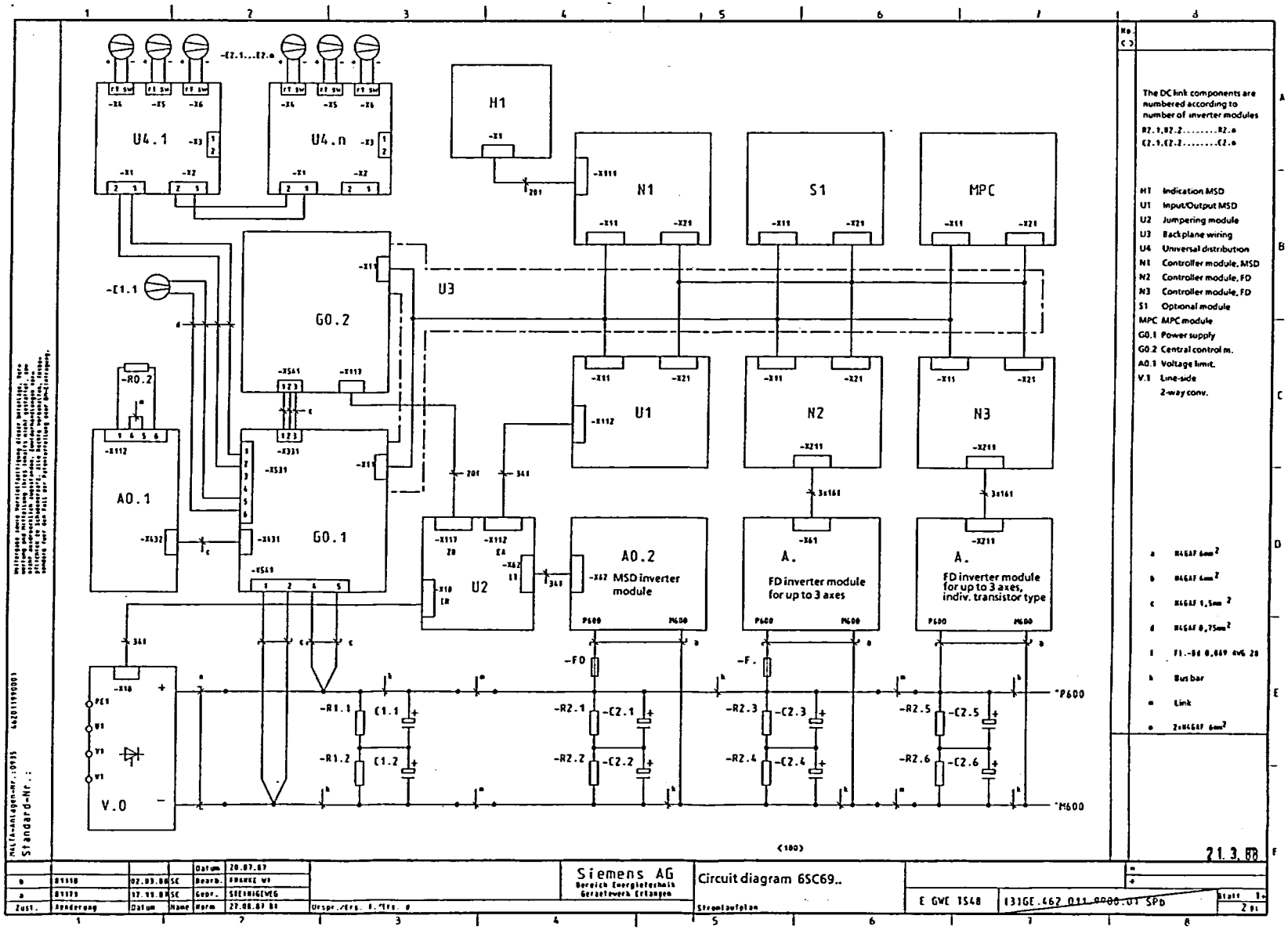


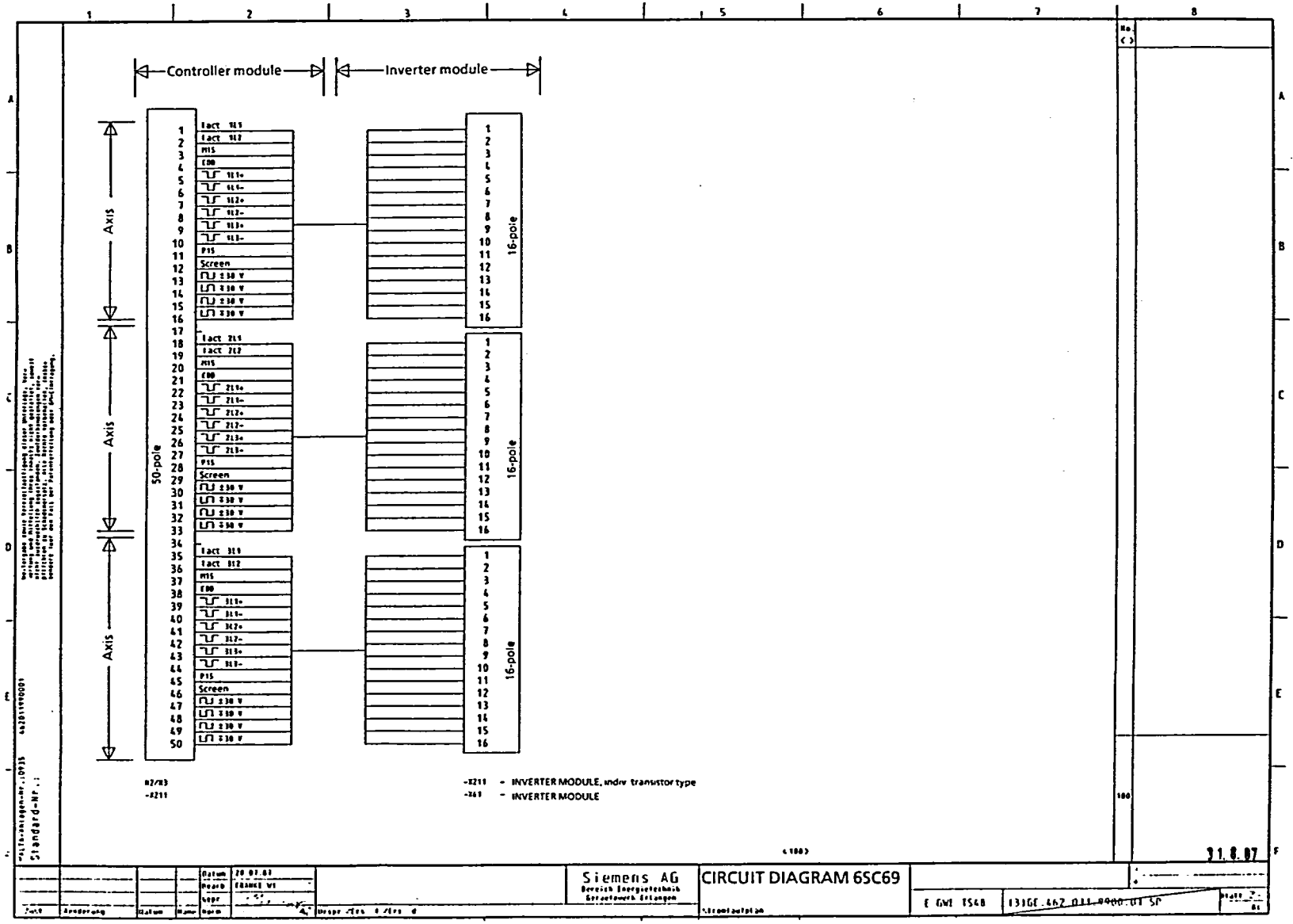

Customer signals
Relay messages
L1 L2 L3
U1 V1 W1
PE1
M600
P600
Step-up converter
NC
Software
U_Dset
DC link voltage controller
DC link current controller
I_Dact
U_Dact
56
14
8
24
Supple-mentary setpoint
Speed controller
Weak-field charac-teristic
Trans-vector control
Driving circuit
P600
M600
I_act
n_act
X131
U2
V2
W2
L1
L2
L3
Fan
M 3~
K1
< 100 >
Main spindle drive
Siemens AG
Block diagram 6SC69
Stromlaufplan/Circuit diagram
Datum 30. 6. 87
Bearb Franke
a 70880
Zustand Änderung Datum Name Norm
GWE TS48 3GE. 462. 011. 9900. 01 SU a
100

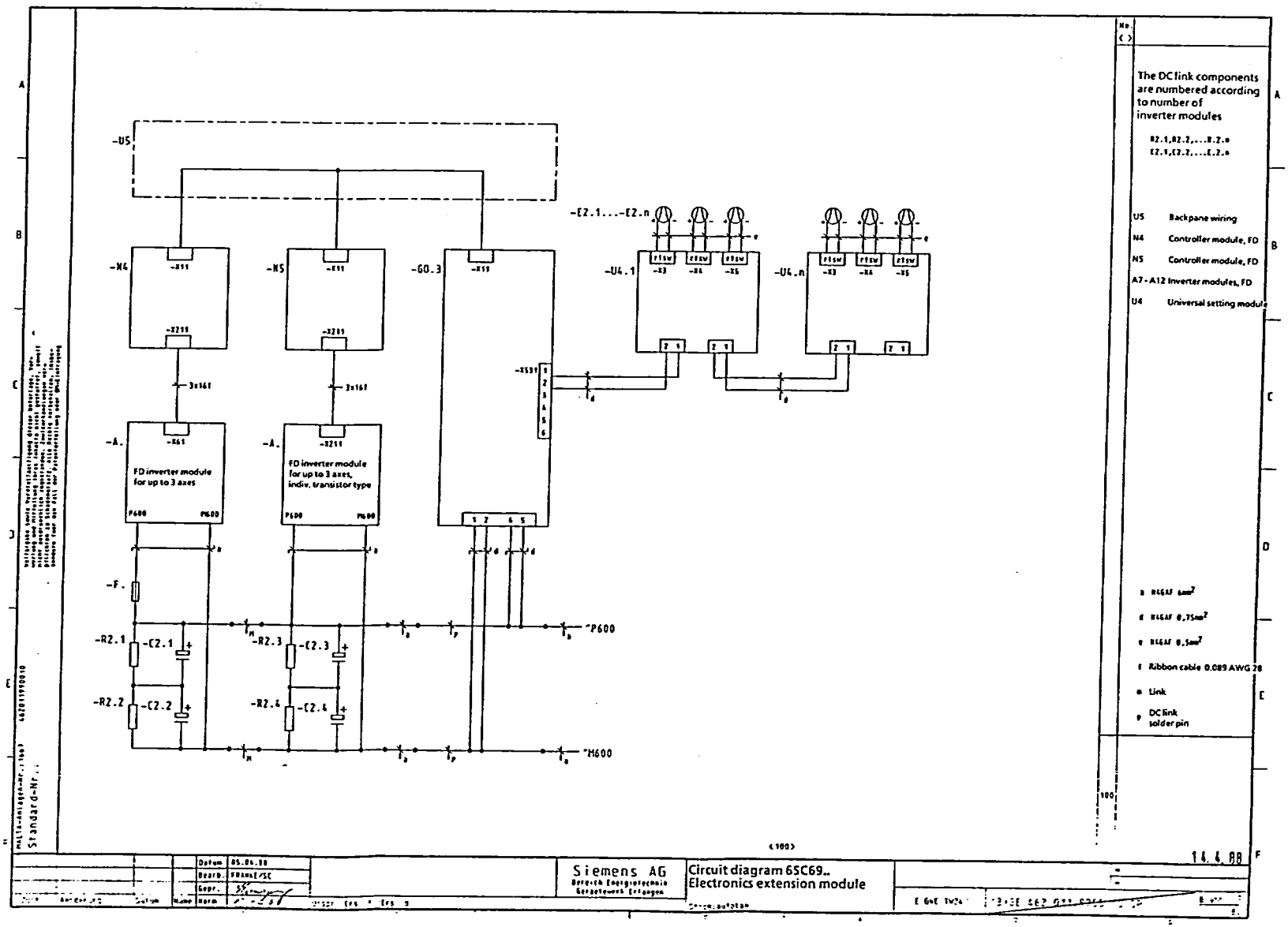

Values not given in brackets apply to axes 1 to 3
Values given in brackets apply to axes 4 to 6
L1
L2
L3
PE
380V +15% -10%
50/60 Hz
1. (4.) Axis
2. (5.) Axis
3. (6.) Achse
M1 (M4)
M2 (M5)
M3 (M6)
ASM
1PH5
1PH6
K1
Encoder
Motor temperature
-U1-X131
R21
R20
R22
K22
Pulse enable
Drive enable
Ready or Fault indication
Speed controller enable axis 1(4)
Speed controller enable axis 2(5)
Speed controller enable axis 3(6)
P24
M24
Pulse enable
Controller enable
Quick stop
Ramp-up time = 0
Torque limitation
Oscillating
Gear step 2
Gear step 3
Gear step 4
Torque control
Reset
U1-X121 MSD
Setpoint 1
Setpoint 1
M
Setpoint 2
Setpoint 2
BS (0V ref)
BS (0V ref)
Unass. output
BS (0V ref)
P10 set
M10 set
N10 set
U1-X111 MSD
*Ready or Fault
n < n min
n* = nact
R7
G0.2 - X131 MSD
Md > Mdx
n < nx
Motor temperature
G0.2 - X141 MSD
Encoder signals
U1-X231 MSD
* Feed drive enabling only after ready signal from MSD
07.7.87
Siemens AG
Connection diagram 6SC69
Stromlaufplan/Circuit diagram
AUT E 241
3GE.462 011.9900.01 KL g
20.5.87
Franke
1.7.87
98955
26.3.90


Operation only permitted with 6SC6901-0VR07
PE
7. Axis
8. Axis
9. Axis
M7
M8
M9
To ⏚ of NC
G03 -X121
G0.3
X131
PE1
PE2
+A7
+A8
+A9
U2 V2 W2
Pulse enable
* Drive enable
Ready or fault indication
R21
R20
R22
K22
G0.3-X111
RESET
M
N24
N15
P15
P24
Integrator disable 7
Integrator disable 8
Integrator disable 9
Speed controller enable axis 7
Speed controller enable axis 8
Speed controller enable axis 9
* Feed drive enabling only after ready signal from MSD
Siemens AG
Connection diagram 6SC69
Electronics extension module
Stromlaufplan/Circuit diagram
GWE E246B
3GE. 462 011.9900. 10KL d
14.4.88

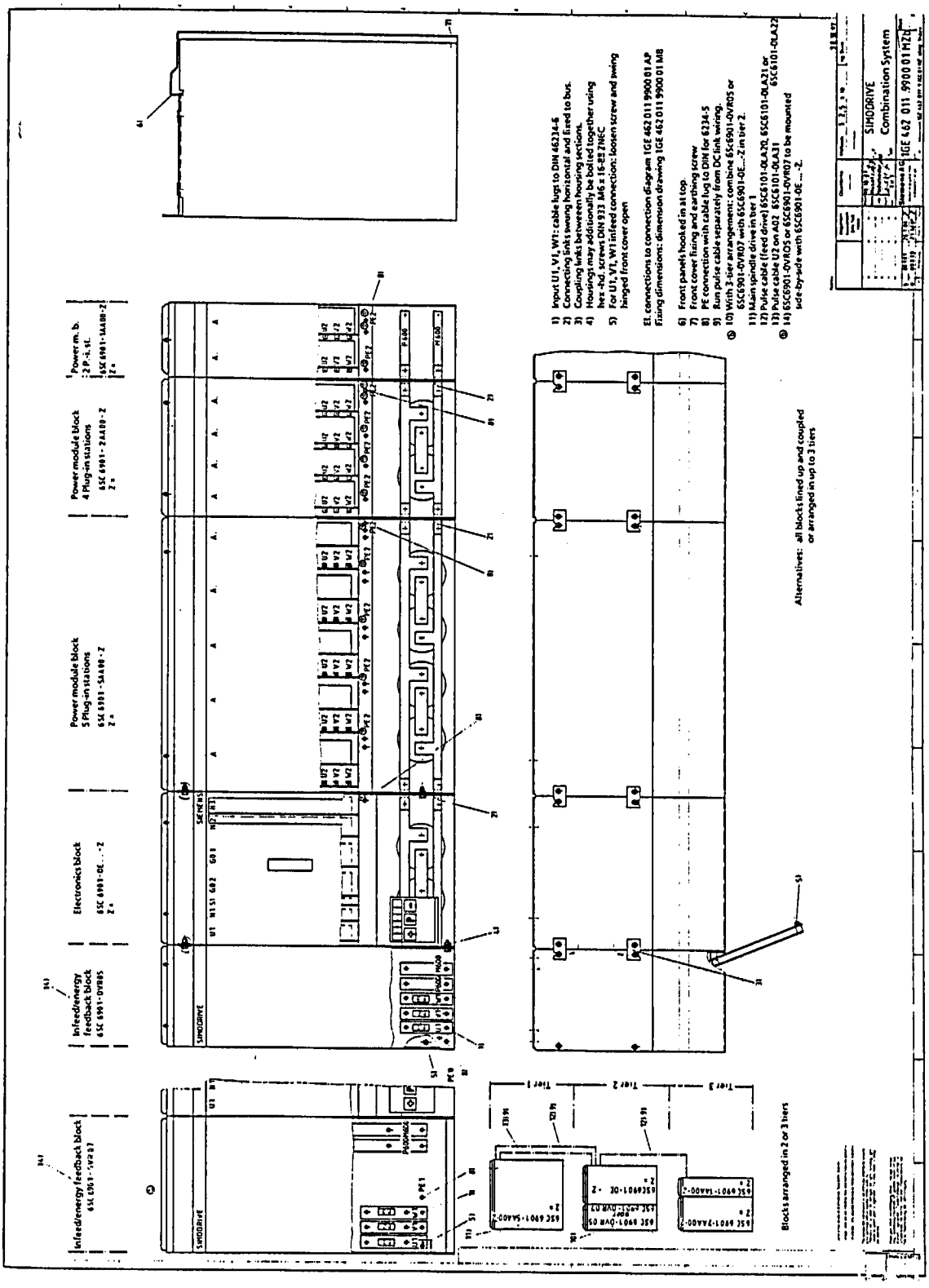

Driving circuit L line-side 2-way converter
462 507.9003.03 (6SC6901-0VB07)
462 505.9003.03 (6SC6901-0VB05)
Siemens AG
Bereich AUT
Geschäftsgebiet Erlangen
SIMODRIVE
Line-side 2-way converter
AUT E241
3GE.462 011.9700.10 SP j
27.03.90

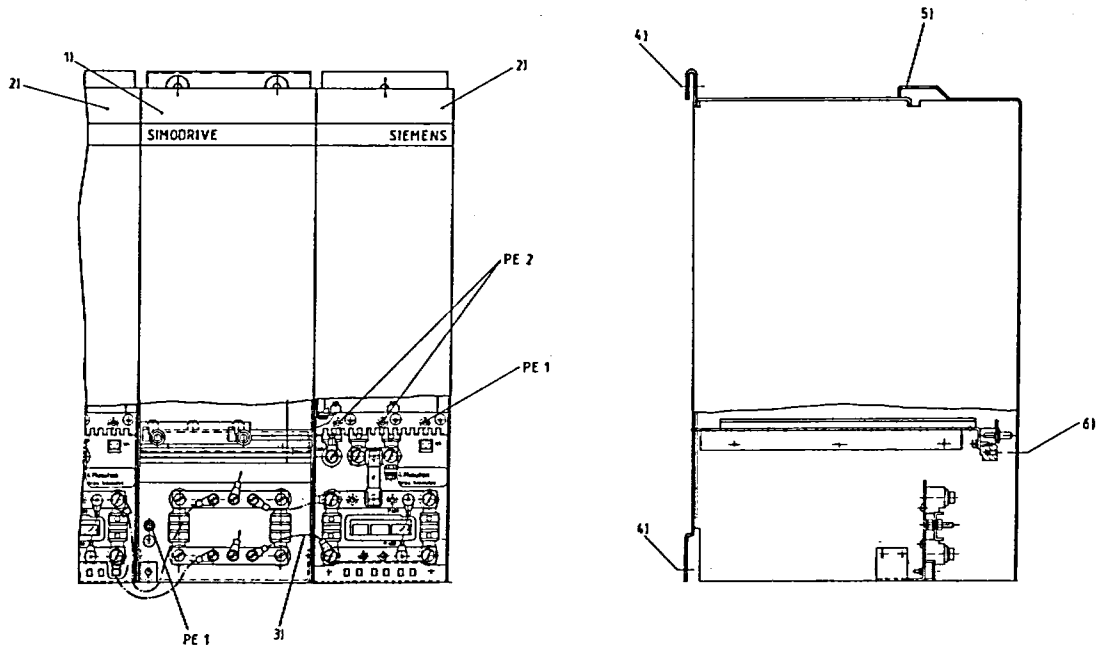

H1
N1
S1
MPC
U4.1
U4.n
G0.2
G0.1
U3
U1
U2
N2
N3
A0.1
A0.2
MSD inverter module
FD inverter module for up to 3 axes
FD inverter module for up to 3 axes, indiv. transistor type
V.0
P600
M600
The DC link components are numbered according to number of inverter modules
H1 Indication MSD
U1 Input/Output MSD
U2 Jumpering module
U3 Backplane wiring
U4 Universal distribution
N1 Controller module, MSD
N2 Controller module, FD
N3 Controller module, FD
S1 Optional module
MPC MPC module
G0.1 Power supply
G0.2 Central control m.
A0.1 Voltage limit.
V.1 Line-side 2-way conv.
Siemens AG
Circuit diagram 6SC69..
E GWE 1548


Controller module
Inverter module
Axis
Axis
Axis
50-pole
16-pole
16-pole
16-pole
-A211 - INVERTER MODULE, indiv. transistor type
-A61 - INVERTER MODULE
Siemens AG
CIRCUIT DIAGRAM 6SC69
31.8.87


-U5
-N4
-N5
-G0.3
-E2.1...-E2.n
-U4.1
-U4.n
3x16f
-A.
FD inverter module for up to 3 axes
FD inverter module for up to 3 axes, indiv. transistor type
-F.
-R2.1
-C2.1
-R2.3
-C2.3
-R2.2
-C2.2
-R2.4
-C2.4
P600
M600
The DC link components are numbered according to number of inverter modules
U5 Backpane wiring
N4 Controller module, FD
N5 Controller module, FD
A7 - A12 Inverter modules, FD
U4 Universal setting module
Ribbon cable 0.089 AWG 28
Link
DC link solder pin
Siemens AG
Circuit diagram 6SC69..
Electronics extension module
14.4.88

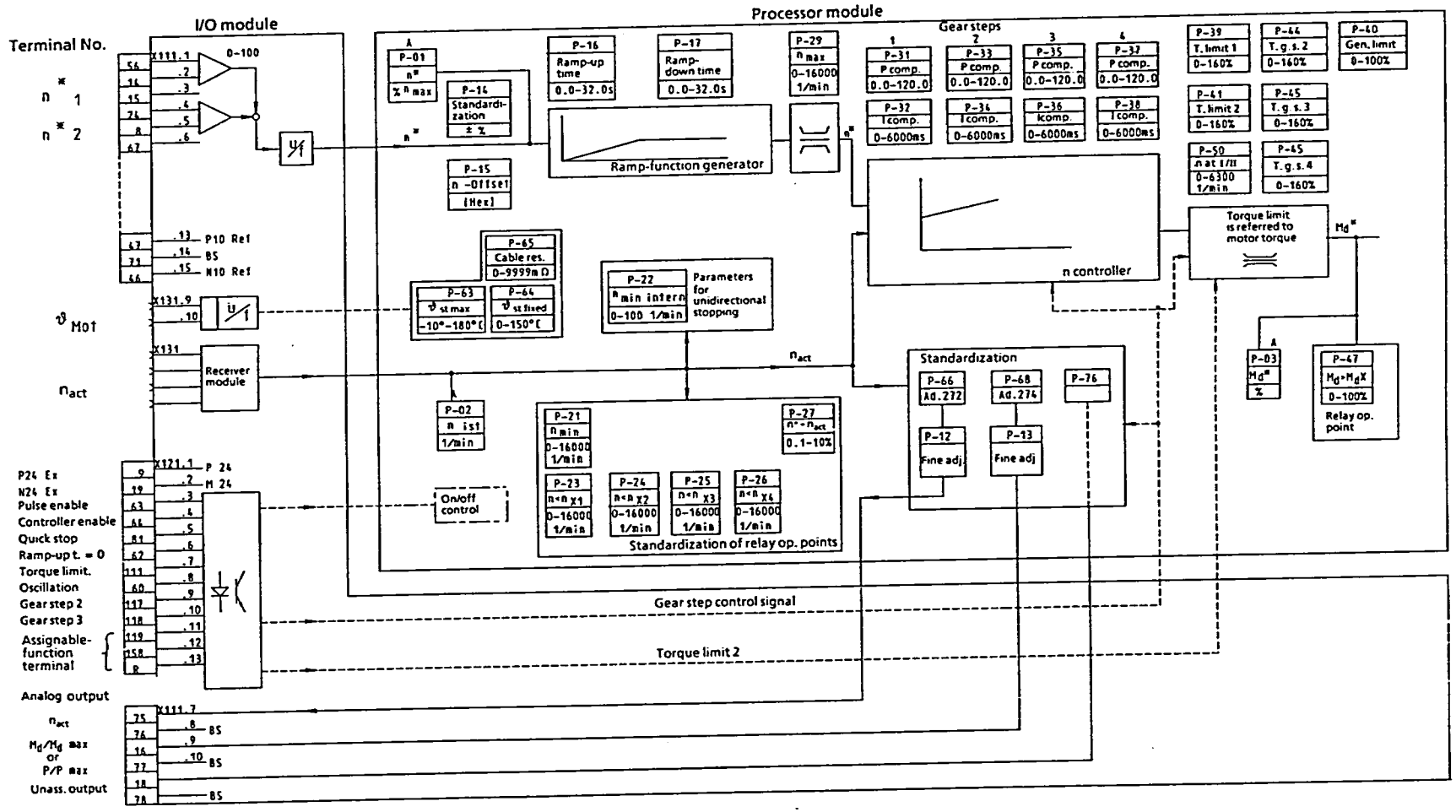
6.4 Installation drawing





1) Housing
2) Power module block
3) Ensure correct polarity when connecting the DC link jumpers to the basic housing
4) Fixing dimensions: Dimension drawing 2GE 462 011.9740.00 MB
5) Front cover must be fitted
6) PE connection to front cover must be established

Electronics extension module
Combination system
Gehäuse 160
2GE.462 011.9740.00MZ



A = Display

Schematic of setting and optimization parameters (main spindle drive)

6.6 Parameter list

Parameters shown in brackets are indicating parameters only.

		The parameters in the form listed are valid from these software versions onwards
(P-00)	Status display	03
(P-01)	Speed setpoint (%)	03
(P-02)	Actual speed value (min^{-1})	05
(P-03)	Torque setpoint (%)	05
(P-04)	Torque ratio $M_d/M_{d\ rated}$ or P/P_{rated} (%)	03
(P-05)	Motor frequency (Hz)	03
(P-06)	DC link voltage (V)	03
(P-07)	DC link current (A)	03
(P-08)	DC link power (kW)	03
(P-09)	Line frequency (Hz)	03
(P-10)	Stator temperature (°C)	03
(P-11)	Input word (Hex)	
P-12	Standardization of DAC for n_{act} display (%)	05
P-13	Standardization of DAC for P/P_{max} display (%)	05
P-14	Speed setpoint standardization (%)	03
P-15	Speed setpoint offset correction (Hex)	03
P-16	Ramp-up time (s)	08
P-17	Ramp-down time (s)	08
P-18	Degree of ramp rounding	08
(P-20)	Actual speed value error counter	08
P-21	n_{min} relay 1 (min^{-1})	03
P-22	n_{min} internal (min^{-1})	03
P-23	$n < n_x$ relay, gear step 1 (min^{-1})	03
P-24	$n < n_x$ relay, gear step 2 (min^{-1})	03
P-25	$n < n_x$ relay, gear step 3 (min^{-1})	03
P-26	$n < n_x$ relay, gear step 4 (min^{-1})	03
P-27	$n_{set} = n_{act}$ relay (%)	03
(P-28)	Error flag	09
P-29	Limiting speed (min^{-1})	03
(P-30)	Indication of active functions P-83 to P-85	04
P-31	n controller P-action component, gear step 1 (1)	03
P-32	n controller I-action component, gear step 1 (ms)	03
P-33	n controller P-action component, gear step 2 (1)	03
P-34	n controller I-action component, gear step 2 (ms)	03
P-35	n controller P-action component, gear step 3 (1)	03
P-36	n controller I-action component, gear step 3 (ms)	03
P-37	n controller P-action component, gear step 4 (1)	03
P-38	n controller I-action component, gear step 4 (ms)	03

P-39	1st torque limit (%)	03
P-40	Regenerative braking limit (%)	03
P-41	2nd torque limit (%)	03
P-42	Torque limit for changeover from motor to generator operation	05
P-43	Duration of torque limitation in P-42	05
P-44	Torque limit, gear step 2 (%)	03
P-45	Torque limit, gear step 3 (%)	03
P-46	Torque limit, gear step 4 (%)	03
P-47	Md > Mdx relay (%)	03
P-48	Standardization of torque setpoint (%)	04
P-49	Torque setpoint offset correction (Hex)	04
P-50	1st/2nd torque limit changeover speed (min-1)	03
P-51	Key word (Hex)	03
P-52	Transfer into EEPROM (Hex)	03
P-53	Ready/Fault message control word (Hex)	08
P-54	M19 - Speed setpoint standardization (%)	03
P-55	M19 - Speed setpoint offset correction (Hex)	03
P-56	M19 - Changeover speed (min-1)	03
P-57	M19 - Position controller gain (1)	03
P-58	M19 - Actual speed signal amplification	06
P-59	M19 - Position window (1)	03
P-60	M19 - Monitoring time (s)	03
(P-61)	M19 - Position controller output	05
P-63	Maximum motor temperature (°C)	03
P-64	Fixed temperature (°C)	03
P-65	Cable resistance (mΩ)	03
P-66	Assignment of DAC1 (Hex)	03
P-67	Standardization of DAC1 (Hex)	03
P-68	Assignment of DAC2 (Hex)	03
P-69	Standardization of DAC2 (Hex)	03
(P-70)	Transistor diagnosis	05
P-75	Forming of DC link capacitors	03
P-76	Assignment of DAC3 (Hex)	09
P-77	Standardization of DAC3 (Hex)	09
P-78	Offset DAC1	04
P-79	Offset DAC2	04
P-80	Offset DAC3	04
P-81	Rotor resistance correction	03
P-82	Magnetization time	05
P-83	Terminal function assignment, terminal 119 (Hex)	04
P-84	Terminal function assignment, terminal 158 (Hex)	04
P-85	Terminal function assignment, terminal R (Hex)	04
P-90	Control flag	09
P-94	Dc link capacitance(µF) (for combination unit)	09
P-95	Inverter code number (1)	03
P-96	Motor code number (1)	03
P-98	Shaft encoder pulses/revolution (1)	03
(P-99)	Release date of control software D80/D82 (DD/M/J)	03

(P-100)	Status indication	07
(P-101)	nset (‰)	04
(P-102)	nact (min-1)	04
P-103	Digital filter	04
P-104	Q factor of filter	04
P-105	P gain of n controller for C-axis mode (1)	03
P-106	Reset time TN of n controller for C-axis mode (ms)	03
P-107	Speed at which changeover to C-axis mode is permitted (min-1)	03
P-108	Speed at which changeover to normal nact value occurs in C-axis mode (min-1)	03
P-109	C-axis switching parameter (Hex)	08
P-110	C-axis encoder matching factor, sin/cos (Hex)	04
P-111	P gain of n controller for normal nact value (1)	03
P-112	Reset time TN of n controller for normal nact value (ms)	03
P-113	nset channel selection (Dec)	04
P-114	Standardization of nset for C-axis mode, gear step 1 (%)	03
P-115	Current controller P gain (inverter)	04
P-116	Current controller reset time (inverter)	04
P-117	Activation of nact-filter	04
P-118	Sensor adaptation factor (Hex)	04
P-119	Flux adaptation factor (%)	04
P-121	Internal position setpoint 1 (Dec)	04
P-122	Internal position setpoint 1 (Dec)	04
P-123	Internal position setpoint 1 (Dec)	04
P-124	Internal position setpoint 1 (Dec)	04
P-125	Internal position setpoint 2 (Dec)	04
P-126	Speed controller I-action component reactivation point (degrees)	11
P-127	Internal incremental position setpoint (Dec)	04
(P-128)	Current position setpoint	06
P-129	Position flag = internal zero mark (Hex)	04
P-130	Internal zero mark (Dec)	04
P-131	Max. number of pulses between two zero marks (Dec)	04
P-132	Max. number of pulses between two zero marks (Dec)	04
P-133	Max. number of pulses between two zero marks (Dec)	04
P-134	Max. number of pulses between two zero marks (Dec)	04
P-135	Activation point KV factor 1 (degrees)	03
P-136	Activation point KV factor 2 (degrees)	03
P-137	KV factor 1 (Hex)	03
P-138	KV factor 1 (Hex)	03
P-139	Multiplier for braking parabola (1 0 0 H ≙ 1)	03
(P-140)	Position counter reading (Dec)	04
P-141	Switching parameter (Hex)	03
P-142	Flag for speed rise (Hex)	03
P-143	Zero mark band width (degrees)	03
P-144	Response margin, relay 1 (degrees)	03
P-145	Response margin, relay 2 (degrees)	03
P-146	Search speed 1 (min-1)	03
P-147	Search speed 2 (min-1)	03
P-148	Search speed 3 (min-1)	03
P-149	Start-up parameter (Hex)	03
P-150	Search speed 4 (min-1)	03
P-151	Key word (Hex)	03
P-152	Transfer into EEPROM (Hex)	03
P-153	Ready/Fault message control word (Hex)	08

P-154	Oscillation setpoint 1 (Hex)	05
P-155	Oscillation setpoint 2 (Hex)	05
P-156	Oscillation interval (s)	05
P-157	Standardization of nset for C-axis mode, gear step 2 (%)	06
P-158	Standardization of nset for C-axis mode, gear step 3 (%)	06
P-159	KV factor "Holding brake" (C-axis mode)	08
P-160	Motor rated output (kW)	04*)
P-161	Rated current (A)	04*)
P-162	Rated voltage (V)	04*)
P-163	Rated speed (min-1)	04*)
P-164	Rated frequency (Hz)	04*)
P-165	No-load voltage (V)	04*)
P-166	No-load current (dA)	04*)
P-167	Stator resistance, cold (mΩ)	04*)
P-168	Rotor resistance, cold (mΩ)	04*)
P-169	Stator leakage reactance (mΩ)	04*)
P-170	Rotor leakage reactance (mΩ)	04*)
P-171	Magnetizing reactance (mΩ)	04*)
P-172	First transition frequency (Hz)	04*)
P-173	Second transition frequency (Hz)	04*)
P-174	Maximum speed (min-1)	04*)
P-175	Maximum motor temperature (oC)	04*)
P-176	Threshold speed for torque reduction (to retain stability)	08
P-177	Setting to 1 causes the data to be calculated and stored	04
P-181	Address of monitored variable	09
(P-182)	Minimum value display	09
(P-183)	Maximum value display	09
P-184	V/Hz-controlled operation (Hex)	06
P-185	Memory address selection (Hex) — Selectable relay function	08
P-186	Response threshold (Hex) — Selectable relay function	08
P-187	Pick-up delay (s) — Selectable relay function	08
P-188	Drop-out delay (s) — Selectable relay function	08
P-189	Differential gap (Hex) — Selectable relay function	08
P-190	Precontrol for DC-link control	09
P-191	Offset correction of DC link current setpoint (Hex)	05
(P-192)	Position counter reading (square-pulse encoder with 90 000 pulses/rev) (Hex)	08
(P-193)	Position counter reading (sine-cosine encoder) (Hex) — C-axis mode	08
(P-194)	Position controller output, "Holding brake" function (Hex) — C-axis mode	08
P-195	Computing time change (filter function, C-axis mode) — C-axis mode	06
P196	Control flag for damping element	09
P197	Resonant frequency	09
P198	Damping constant	09
(P-199)	Release date of inverter control software D76/D78	08

*) The values of parameters P-160 to P-176 can be stored from software version 08 onwards

6.7 Setting and checking data

6.7.1 Main spindle drive settings

Serial No.:

Parameter	Meaning	Setting range	Unit	Works setting	Setting
DAC settings (see Section 3.3.3)					
P-12	Standardization of DAC for n_{act} indication	– 200.0 - +300.0	%	100.0	
P-13	Standardization of DAC for P/P_{max} indication	– 200.0 - +300.0	%	100.0	
Speed settings (see Section 3.3.4)					
P-113	Speed-setpoint channel selection	0 - 3	Dec	3	
P-14	n_{set} standardization	– 250.0 - +250.0	%	100.0	
P-15	n_{set} offset correction	0 0 0 0 - F F F F	Hex	0 0 0 0	
Ramp-function generator settings (see Section 3.3.5)					
P-16	Ramp-up time	0.00 - 32.00	s	4.0	
P-17	Ramp-down time	0.00 - 32.00	s	4.0	
P-18	Degree of ramp rounding	0 - 10	1	0	
Speed monitoring settings (see Section 3.3.6)					
P-21	n_{min} relay	0 - 6300	min^{-1}	7	
P-22	n_{min} internal	0 - 1500	min^{-1}	11	
P-23	n_x for $n < n_{x1}$ relay	0 - 16000	min^{-1}	1500	
P-24	n_x for $n < n_{x2}$ relay	0 - 16000	min^{-1}	1500	
P-25	n_x for $n < n_{x3}$ relay	0 - 16000	min^{-1}	1500	
P-26	n_x for $n < n_{x4}$ relay	0 - 16000	min^{-1}	1500	
P-27	$n_{set} = n_{act}$	0.1 - 11.0	%	3.9	
P-29	n_{max} setting	0 - 20100	min^{-1}	*)	
Speed controller settings (see Section 3.3.7)					
P-31	P-action component f. gear step 1	0.0 - 120.0	1	32.0	
P-32	I-action component f. gear step 1	5 - 6000	ms	512	
P-33	P-action component f. gear step 2	0.0 - 120.0	1	32.0	
P-34	I-action component f. gear step 2	5 - 6000	ms	512	
P-35	P-action component f. gear step 3	0.0 - 120.0	1	32.0	
P-36	I-action component f. gear step 3	5 - 6000	ms	512	
P-37	P-action component f. gear step 4	0.0 - 120.0	1	32.0	
P-38	I-action component f. gear step 4	5 - 6000	ms	512	

*) Depends on motor type

Parameter	Meaning	Setting range	Unit	Works setting	Setting
Torque limits (see Section 3.3.8)					
P-39	1st torque limit	0.0 - 180.0	%	100.0	
P-40	Regenerative braking limit	0 - 100	%	80	
P-41	2nd torque limit	0.0 - 180.0	%	100.0	
P-42	Torque limit, mot→gen	30 - 80	%	50	
P-43	Duration of torque limit in P-42	40 - 200	ms	80	
P-44	Torque limit, gear step 2	0.0 - 180.0	%	100.0	
P-45	Torque limit, gear step 3	0.0 - 180.0	%	100.0	
P-46	Torque limit, gear step 4	0.0 - 180.0	%	100.0	
P-47	$M_d > M_{dx}$ relay	0.0 - 100.0	%	90.0	
P-48	Torque setpoint standardization	- 250.0 - + 250.0	%	100.0	
P-49	Torque setpoint offset correction	0 0 0 0 - F F F F	Hex	0 0 0 0	
P-50	1st/2nd torque limit changeover speed	0 - 11500	min^{-1}	6000	
Control word (see Section 3.3.9)					
P-53	Ready/Fault indication	0 0 0 0 - F F F F	Hex	0 1 0 1	
Settings for auxiliary NC function M19 (see Section 3.3.10)					
P-54	n_{set} standardization	- 250.0 - + 250.0	%	25.0	
P-55	n_{set} offset correction	0 0 0 0 - F F F F	Hex	0 0 0 0	
P-56	Changeover speed	0 - 8000	min^{-1}	750	
P-57	Position controller amplification	0 0 0 0 - F F F F	1	0 0 0 0	
P-58	n_{act} amplification	1 - 10	1	2	
P-59	Position window	0 0 0 0 - F F F F	Hex	0 0 0 1	
P-60	Monitoring time	0.0 - 16.0	s	0.85	
Settings for motor data and cable resistance (see Section 3.3.11)					
P-63	Max. motor temperature	0 - 150	°C	150	
P-64	Fixed temperature	0 - 150	°C	0	
P-65	Cable resistance	0 - 9999	mΩ	0	
P-81 *)	Rotor resistance correction	50 - 200	%	100	
P-82 *)	Magnetization time	6 - 10	1	8	

*) These settings can be changed only if P-51 has been set to 0 0 1 0 H

Parameter	Meaning	Setting range	Unit	Works setting	Setting
DAC function assignment and standardization (see Section 3.3.12)					
P-66	Assignment of DAC 1	0000 - FFFF	Hex	0272	
P-67	Standardization	0000 - FFFF	Hex	0000	
P-68	Assignment of DAC 2	0000 - FFFF	Hex	0274	
P-69	Standardization	0000 - FFFF	Hex	0000	
P-76	Assignment of DAC 3	0000 - FFFF	Hex	031E	
P-77	Standardization	0000 - FFFF	Hex	0004	
P-78	Offset DAC1	0000 - FFFF	Hex	0000	
P-79	Offset DAC2	0000 - FFFF	Hex	0000	
P-80	Offset DAC3	0000 - FFFF	Hex	0000	
Assignment of terminal function (see Section 3.3.14)					
P-83	Terminal 119	0000 - 0100	Hex	0001	
P-84	Terminal 158	0000 - 0100	Hex	0002	
P-85	Terminal R	0000 - 0100	Hex	0004	
Inverter and motor data (see Section 3.3.15)					
P-94	DC link capacitance (for combination unit)	0 - 30000	µF	*)	
P-95	Converter code number	1 - 10	1	1	
P-96	Motor code number	101 - 135	1	101	
P-98	Encoder pulses/revolution	256 - 32000	1	1024	
(P-99)	Release date of control software version	-	1	**)	

*) Depends on inverter type
**) Depends on software version

Parameter	Meaning	Setting range	Unit	Works setting	Setting
C-axis controller settings (see Instructions 6SC6501-0AC00)					
P-103	Centre frequency, (n_{act} filter)	30 - 100	Hz	50	
P-104	Q factor of filter	0 - 6	1	3	
P-105	P comp. (C-axis act. val.)	0 - 120	1	64	
P-106	I comp. (C-axis act. val.)	0 - 6000	ms	32	
P-107	C-axis changeover speed	0 - 400	min^{-1}	93	
P-108	Act.-val. changeover speed	0 - 50	min^{-1}	46	
P-109	C-axis switching parameter	0 0 0 0 - F F F F	Hex	0	
P-110 *)	C-axis encoder matching factor, sin/cos	0 0 0 0 - F F F F	Hex	0 8 E 3	
P-111	P comp. (normal act. val.)	0 - 120	1	32	
P-112	I comp. (normal act. val.)	0 - 6000	ms	128	
P-114	n_{set} standardization (gear step 1)	– 200.0 - +250.0	%	100.0	
P-115 *)	Current controller P comp.	0.01 - 1.00	1	0.36	
P-116 *)	Current controller I comp.	0 0 0 0 - F F F F	Hex	1 0 0 0	
P-117	Activation of n_{act} filter	0 0 0 0 - F F F F	Hex	0	
P-118 *)	Sensor matching factor	0 0 0 0 - F F F F	Hex	0 8 5 8	
P-119 *)	Flux matching factor	10 - 100	%	100	
P-157	n_{Set} standardization (gear step 2)	– 200.0 - +250.0	%	100.0	
P-158	n_{set} standardization (gear step 3)	– 200.0 - +250.0	%	100.0	
P-159	K_V factor "Holding brake"	0 0 0 0 - F F F F	Hex	0 0 0 A H	
P-195	Computing time, C-axis mode	0 0 0 0 - F F F F	Hex	0 7 6 8	

*) After the settings have been made and transferred to the EEPROM (P-52): Switch the unit off, wait for the 7-segment display to go out and switch on again. Otherwise the changes will not become effective.

Parameter	Meaning	Setting range	Unit	Works setting	Setting
Positioning function settings (see Instructions 6SC6501-0AD00)					
P-121	Setpoint 1 for gear step 1	0 - 32767	1	0	
P-122	Setpoint 1 for gear step 2	0 - 32767	1	0	
P-123	Setpoint 1 for gear step 3	0 - 32767	1	0	
P-124	Setpoint 1 for gear step 4	0 - 32767	1	0	
P-125	Setpoint 2	0 - 32767	1	0	
P-127	Setpoint in increments	0 - 9900	1	256	
P-130	Indication of the internal zero mark	0 - 32767	1	0	
P-131	Maximum number of pulses between zero marks, gear step 1	0 - 32767	1	4096	
P-132	Maximum number of pulses between zero marks, gear step 2	0 - 32767	1	4096	
P-133	Maximum number of pulses between zero marks, gear step 3	0 - 32767	1	4096	
P-134	Maximum number of pulses between zero marks, gear step 4	0 - 32767	1	4096	
P-135	Activation point K_V factor 1	0 - 360.0	$\measuredangle^{\circ}$	10.0	
P-136	Activation point K_V factor 2	0 - 360.0	$\measuredangle^{\circ}$	2.0	
P-137	K_V factor 1	0 0 0 0 - F F F F	Hex	1 0 0 0	
P-138	K_V factor 2	0 0 0 0 - F F F F	Hex	1 0 0 0	
P-139	Multiplier for braking parabola	0 0 0 0 - F F F F	Hex	0 1 0 0	
P-141 *)	Switching parameter	0 0 0 0 - F F F F	Hex	0 0 0 1	
P-142	Flag for speed rise	0 0 0 0 - F F F F	Hex	0 0 0 0	
P-143	Zero mark band width	180.0 - 350.0	$\measuredangle^{\circ}$	337.5	
P-144	Response margin, relay 1	0 - 18.00	Grad	1.00	
P-145	Response margin, relay 2	0 - 18.00	Grad	5.00	
P-146	Search speed 1	– 4000 - + 4000	min^{-1}	375	
P-147	Search speed 2	– 4000 - + 4000	min^{-1}	375	
P-148	Search speed 3	– 4000 - + 4000	min^{-1}	375	
P-149	Start-up parameter	0 0 0 0 - F F F F	Hex	0 0 0 0	
P-150	Search speed 4	– 4000 - + 4000	min^{-1}	375	

*) After the settings have been made and transferred to the EEPROM (P-52):
Switch the unit off, wait for the 7-segment display to go out and switch on again.
Otherwise the changes will not become effective.

Parameter	Meaning	Setting range	Unit	Works setting	Setting
Oscillation settings (see Section 3.3.19)					
P-154	Oscillation setpoint 1	0 0 0 0 - F F F F	Hex	0 0 1 4	
P-155	Oscillation setpoint 2	0 0 0 0 - F F F F	Hex	F F E C	
P-156	Oscillation interval	0.1 - 60	s	0.20	
Motor data (see Section 3.3.20)					
P-160 *)	Rated output	0 - 70	kW	**)	
P-161 *)	Rated current	0 - 200.0	A	63.3	
P-162 *)	Rated voltage	0 - 500	V	277	
P-163 *)	Rated speed	0 - 6000	min^{-1}	1500	
P-164 *)	Rated frequency	0 - 400.0	Hz	50,0	
P-165 *)	No-load voltage	0 - 500	V	268	
P-166 *)	No-load current	0 - 100.0	A	36.2	
P-167 *)	Cold stator resistance	0 - 32767	mΩ	54	
P-168 *)	Cold rotor resistance	0 - 32767	mΩ	28	
P-169 *)	Stator leakage reactance	0 - 32767	mΩ	320	
P-170 *)	Rotor leakage reactance	0 - 32767	mΩ	79	
P-171 *)	Magnetizing reactance	0 - 32767	mΩ	3660	
P-172 *)	First transition frequency	0 - 125	Hz	50	
P-173 *)	Second transition frequency	0 - 125	Hz	100	
P-174 *)	Maximum speed	0 - 20000	min^{-1}	6100	
P-175 *)	Maximum motor temperature	0 - 200	°C	150	
P-176 *) *)**	Threshold speed for torque reduction (to retain stability)	0 0 0 0 - F F F F	Hex	**)	
V/Hz-controlled operation (see Section 3.3.21)					
P-184 *)	V/Hz-controlled operation	0 0 0 0 - F F F F	Hex	0	
Selectable relay function (see Section 3.3.22)					
P-185	Selection of memory address	0 0 0 0 - F F F F	Hex	0 5 F E	
P-186	Response threshold	0 0 0 0 - F F F F	Hex	0 2 0 0	
P-187	Pick-up delay	0.00 - 10.00	s	0.40	
P-188	Drop-out delay	0.00 - 10.00	s	0.40	
P-189	Differential gap	0 0 0 0 - F F F F	Hex	0 0 1 0	

*) Setting can be changed only when P-51 has been set to 0 0 1 0 H

**) Depends on motor type

***) After the settings have been made and transferred to the EEPROM (P-52): Switch the unit off, wait for the 7-segment display to go out and switch on again. Otherwise the changes will not become effective.

Parameter	Meaning	Setting range	Unit	Works setting	Setting
Precontrol (see Section 3.3.23)					
P-190	Precontrol for DC-link control	0.0 - 10.0	Dec	5.0	
Damping element (see Section 3.3.24)					
P-196	Control flag for damping element	0 0 0 0 - 0 1 0 0	Hex	0	
P-197	Resonant frequency	50.0 - 100.0	Hz	96.0	
P-198	Damping constant	0.1 - 0.38	1	0.37	

6.7.2 Feed drive settings

Serial No.:

Reversal

Power module	Servo motor						Current limit						Current controller				
	Axis	1FT	M_o in Nm	I_o in A	$n_{nom.}$ in min^{-1}	Contacts of DIL-switches S1, S2, S3					I_{max} in A	Contacts of DIL-switches S1, S2, S3				Kp (I)
						1	2	3	4	5		6	7	8	9	

Setting of potentiometers:

	Tacho	Kp(n)	T_N(n)			Tacho	Kp(n)	T_N(n)			Tacho	Kp(n)	T_N(n)
Axis 1					Axis 2					Axis 3			
Axis 4					Axis 5					Axis 6			

Jumpers for matching the tacho voltage

	X20	X21	X22			X23	X24	X25			X26	X27	X28
Axis 1					Axis 2					Axis 3			
Axis 4					Axis 5					Axis 6			

Speed controller adaptation

	R15	R94			R46	R97			R77	R100
Axis 1				Axis 2				Axis 3		
Axis 4				Axis 5				Axis 6		

Electrical weight compensation

	R3	R5			R32	R36			R63	R67
Axis 1				Axis 2				Axis 3		
Axis 4				Axis 5				Axis 6		

Speed setpoint channel

	C301	R450			C302	R461			C303	R471
Axis 1				Axis 2				Axis 3		
Axis 4				Axis 5				Axis 6		

"Speed controller at integration limit" monitoring circuit

	R605			R646			R656
Axis 1			Axis 2			Axis 3	
Axis 4			Axis 5			Axis 6	

Machine-dependent values

		Axis 1 (X)	Axis 2 (Y)	Axis 3 (Z)	Axis 4 (U)	Axis 5 (V)	Axis 6 (W)
Setpoint	at $V_{max.}$						
Tacho voltage	at $V_{max.}$						
Motor speed	at $V_{max.}$						

Miscellaneous:

Date: Commissioning engineer:

6.8 Electrostatically sensitive devices (ESD)

Electrostatically sensitive devices (ESD)

Generally, PCBs should not be touched unless work has to be carried out on them.

Before touching a PCB, the person carrying out the work must himself be electrostatically discharged. The simplest way of doing this is to touch an electrically conducting earthed object (e.g. a bare metal part of a switchboard or the protective earth contact of a socket outlet).

PCBs must not be allowed to come in contact with electrically insulating materials such as plastic foil, insulating table tops or clothing made of synthetic fibres.

PCBs may only be set down or stored on electrically conducting surfaces.

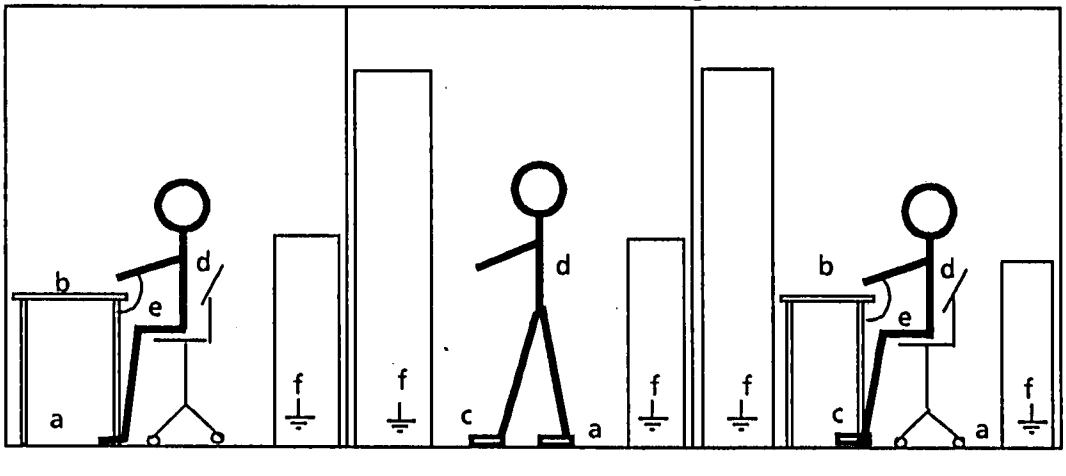
When carrying out soldering jobs on PCBs, make sure that the soldering tip has been earthed.

PCBs and electronic components should generally be packed in electrically conducting containers (such as metallized-plastic boxes or metal cans) before being stored or shipped.

If the use of non-conducting packing containers cannot be avoided, PCBs must be wrapped in a conducting material before being put in them. Examples of such materials include electrically conducting foam rubber or household aluminium foil.

For easy reference, the protective measures necessary when dealing with sensitive electronic components are illustrated in the sketches below.

a = Conductive flooring
b = Anti-static table
c = Anti-static footwear
d = Anti-static overall
e = Anti-static chain
f = Earthing connections of cabinets



Seated work station **Standing work station** **Standing / seated work station**

Addresses

Firma Euchner
Kohlhammerstr. 16

D-7022 Leinfelden-Echterdingen 1

Du Pont de Nemours GmbH
Max-Planck-Str. 11

D-6057 Dietzenbach

Firma Kabelmetall Electro
Postfach 25 51

D-8500 Nürnberg 1

Standards and specifications

DIN 40050	IP Degrees of protection
DIN VDE 0100	Specifications for the installation of power-current systems with operating voltages of up to 1000 V
DIN VDE 0106	Protection against electric shock
DIN VDE 0113	Electrical equipment of industrial machines
DIN VDE 0160	Electronic equipment to be used in electrical power installations
DIN VDE 0558	VDE specifications for semiconductor converters

Available from:	DIN Standards	DIN VDE Specifications
	Beuth-Verlag GmbH Postfach 1145 D-1000 Berlin 30	VDE-Auslieferungsstelle Merianstraße 29 D-6050 Offenbach

Please fill in and remit to the following address after commissioning:

Siemens Aktiengesellschaft
GWE TQS
Frauenauracher Str. 80
D-8520 Erlangen

Converter data:
Serial No.: .....
Type: .....
MLFB *): .....
Software release: .....
Module version indices::

Module	A0	U1	N1	G02	G01	N2	N3
Index							

Machine tool manufacturer:

Commissioning carried out by:

Customer ☐ ZN ☐ MA ☐

Commissioning was found to be

problem-free ☐

difficult ☐ Reasons: .....
.....

Faults ☐ Failed components/modules: .....
.....

Improvements ☐ .....

Experience gained ☐ .....

Customer suggestions ☐ .....
(Use back of sheet if appropriate)

Date ..... Commissioning engineer .....

*) Machine-readable product code

To

Siemens Aktiengesellschaft
GWE TGE 21

Postfach 3269

D – 8520 Erlangen

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Corrections

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