SIEMENS

SIMODRIVE 611 Analog System
Transistor PWM Inverters for
AC Feed Drives and
AC Main Spindle Drives

Installation and Start–up Guide 04.97 Edition

Service Documentation

SIEMENS

SIMODRIVE 611 Analog System Transistor PWM Inverters for AC Feed Drives and AC Main Spindle Drives

Start–Up Guide

Service Documentation

Valid for

Equipment series 6SN11–

04.97 Edition

Overview of SINUMERIK 840D/810D/FM–NC Documentation (08.97)

General Documentation

- *SINUMERIK* 840D/810D/FM–NC — Brochure
- *SINUMERIK* 840D/810D/FM–NC/611 — Catalog Ordering Info. NC 60.1, Technical Info. NC 60.2
- *SINUMERIK SIROTEC SIMODRIVE* Accessories — Catalog Accessories NC–Z

User Documentation

- *SINUMERIK* 840D/810D/FM–NC — AUTOTURN
  - Short Guide
  - Programming (Part 1)
  - Setup (Part 2)
- *SINUMERIK* 840D/810D/FM–NC — Operator's Guide
  - Unit Operator Panel
  - HPU
- *SINUMERIK* 840D/810D/FM–NC — Diagnostics Guide

User Documentation

- *SINUMERIK* 840D/810D/FM–NC — **Operator's Guide**
  - Short Guide
  - Operator's Guide
- *SINUMERIK* 840D/810D/FM–NC — **Programming Guide**
  - Short Guide
  - Fundamentals
  - Advanced
  - Cycles
  - Measuring Cycles
- *SINUMERIK* 810D — Operator's Guide
  - MANUALTURN
  - SHOPMILL

Manufacturer / Service Documentation

- *SINUMERIK* 810D — Description of Functions
  - MANUALTURN
  - SHOPMILL
- *SINUMERIK* 840D/810D/FM–NC — Description of Functions **Synchronous actions** Wood, Glass, Ceramics
- *SINUMERIK* 840D/810D — Description of Functions **Computer LInk**

Manufacturer / Service Documentation

- *SINUMERIK* — **Manual Configuring (HW)**
  - FM–NC
  - 810D
  - 840D
- *SINUMERIK* 840D/810D/FM–NC — **Manual Operator Components** (HW)
- *SIMODRIVE SINUMERIK* 611D 840D/810D — Description of Functions **Drive Functions**
- *SINUMERIK* 840D/810D/FM–NC — **Description of Functions**
  - Basic Machine
  - Extended Functions
  - Special Functions
- *SINUMERIK* 840D/810D/FM–NC — **Configuring KIt** MMC100/101
  - Configuring Syntax
  - Development Kit
- *SINUMERIK* 840D/810D/FM–NC — **Screen Kit** MMC100/101 SW Update and Configuration

Manufacturer / Service Documentation

- *SINUMERIK* 840D/810D — Description of Functions **Tool Management**
- *SINUMERIK* 840D/810D/FM–NC — Description of Functions Operator Interface **OP 030**
- *SINUMERIK* 840D/810D — Description of Functions Operator Interface **HPU**
- *SIMODRIVE SINUMERIK* — Description of Functions SINUMERIK **Safety Integrated**
- *SINUMERIK* 840D — Description of Functions **Digitizing**
- *SIMODRIVE SINUMERIK* — **Installation & Start-up Guide**
  - FM–NC
  - 810D
  - 840D/611D
- *SIMODRIVE SINUMERIK* 840D/810D FM–NC 611D — Lists

Electronic Documentation

- *SINUMERIK SIMODRIVE* 840D/810D/FM–NC 611, Motors — **DOC ON CD** The SINUMERIK System

SIMODRIVE® documentation

Edition coding

Brief details of this edition and previous editions are listed below

The status of each edition is shown by the code in the ”Remarks” column.

Status code in the ”Remarks” column:

A . . . . New documentation.
B . . . . Unrevised reprint with new Order No.
C . . . . Revised edition with new status
If factual changes have been made on the page since the last edition, this is indicated by a new edition coding in the header on that page.

07.94	6SN1197–0AA60–0BP0	**A**
10.94	6SN1197–0AA60–0BP1	**C**
12.94	6SN1197–0AA60–0BP2	**C**
03.96	6SN1197–0AA60–0BP3	**C**
04.97	6SN1197–0AA60–0BP4	**C**

Dieses Buch ist Bestandteil der Dokumentation auf CD–ROM (**DOCONCD**)

09.97	6FC5 198–6CA00–0AG0 (**840C** Read)	**C**
09.97	6FC5 198–6CB00–0AG0 (**840C** Print)	**C**
09.97	6FC5 198–6CC00–0AG0 (**840C** Net)	**C**
09.97	6FC5 298–4CA00–0AG0 (**840D** Read)	**C**
09.97	6FC5 298–4CB00–0AG0 (**840D** Print)	**C**
09.97	6FC5 298–4CC00–0AG0 (**840D** Net)	**C**

This publication was produced on Interleaf V 5.4

Functions may be executable in the control but are not described in this documentation. No claims can be made on these functions if included with a new shipment or when involved with service.

We have checked the contents of this document to ensure that they coincide with the described hardware and software. The information in this document is regularly checked and necessary corrections are included in reprints. We are thankful for any recommendations for improvement.

Subject to change without prior notice.

Order No. 6SN1197–0AA60–0BP4
Printed in the Federal Republic of Germany

Siemens–Aktiengesellschaft

Definitions

Qualified personal

For the purpose of these Instructions and product labels, a ”qualified person” is someone who is familiar with the installation, mounting, start–up and operation of the equipment and the hazards involved. He or she must have the following qualifications:

- Trained and authorized to energize, de–energize, clear, ground and tag circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- Trained in rendering first aid.

Danger

This symbol in the document indicates death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

This symbol appears in the document, if death, severe personal injury or property damage **can** result if proper precautions are not taken.

Caution

This symbol appears in the document indicating that minor personal injury or material damage **can** result if proper precautions are not taken.

!

Wichtig

This symbol appears in the documentation if a particular issue is significant.

Note

For the purposes of these Instructions, ”Note” indicates information about the product or the respective part of the Instruction Manual which is essential to highlight.

Warning

Operational electrical equipment has parts and components which are at hazardous voltage levels.

Incorrect handling of these units, i. e. not observing the warning information, can therefore lead to death, severe bodily injury or significant material damage.

Only appropriately qualified personal may commission/start–up this equipment.

This personal must have in–depth knowledge regarding all of the warning information and service measures according to this Manual.

Perfect, save and reliable operation of this equipment assumes that it has been professionally transported, stored, mounted and installed as well as careful operator control and service.

Hazardous axis motion can occur when working with the equipment.

Note

When handling cables observe the following

- they must not be damaged
- they must not be strained and
- they must not come into contact with rotating components**.**

Note

It is not permissible to connect SIMODRIVE equipment to a supply system with ELCBs (this restriction is permitted according to DIN VDE 0160, Section 6.5). When operational, protection against direct contact is provided in a form to allow the unit to be used in enclosed electrical equipment rooms (DIN VDE 0558 Part 1 / 07.87, Section 5.4.3.2.4).

In compliance with DIN VDE 0160 / 05.88, all SIMODRIVE units are subject to a high–voltage test at the time of routine testing. If the electrical equipment of industrial tools is subject to a high–voltage test, all connections must be disconnected so that sensitive electronic components in the SIMODRIVE converter are not damage (permissible according to DIN VDE 0113 / 06.93, Part 1, Section 20.4).

Warning

Start–up/commissioning is absolutely prohibited until it has been ensured that the machine in which the components described here are to be installed, fulfills the regulations/specifications of the Directive 89/392/EWG.

Warning

The information and instructions in all of the documentation supplied and any other instructions must always be observed to eliminate hazardous situations and damage.

- For special versions of the machines and equipment, the information in the associated catalogs and quotations applies.
- Further, all of the relevant national, local and plant/system–specific regulations and specifications must be taken into account.
- All work should be undertaken with the system in a no–voltage condition!

Warning

Before commissioning 611D, it should be checked that the encoder cable does not have a ground fault.
If ground faults occur, for loads which exert a force on the drive, uncontrolled movement could occur.
This no longer occurs for 6SN1118–0D□2□–0AA0, Version B.

ESD information

Electro– **S**tatic **D**evices

Components which can be destroyed by electrostatic discharge are individual components, integrated circuits, or boards, which when handled, tested, or transported, could be destroyed by electrostatic fields or electrostatic discharge. These components are designated as **ESDS** (**E**lectro**S**tatic **D**ischarge **S**ensitive Devices).

Handling ESDS boards:

- The human body, working area and packing should be well grounded when handling ESDS components!
- Electronic boards should only be touched when absolutely necessary.
- Components may only be touched, if
  - you are continuously grounded through an ESDS wristlet,
  - you are wearing ESDS shoes or ESDS shoe grounding strips in conjunction with an ESDS floor surface.
- Boards may only be placed on conductive surfaces
  (desk with ESDS surface, conductive ESDS foam rubber, ESDS packing bag, ESDS transport containers).
- Boards may not be brought close to data terminals, monitors or television sets (a minimum of 10 cm should be kept between the board and the screen).
- Boards may not be brought into contact with materials which can be charged–up and which are highly insulating, e. g. plastic foils, insulating desktops, articles of clothing manufactured from man–made fibers.
- Measuring work may only be carried out on the boards if
  - the measuring equipment is grounded (e. g. via the protective conductor) or
  - for floating measuring equipment, the probe is briefly discharged before making measurements (e. g. a bare control housing is touched).
- Only hold the control modules at the front panel

Note

Start–up software is available for starting–up/commissioning the main spindle– and induction motor modules.

Start–up software Order No.: 6SN1153–2AX10–□AB□

Documentation Order No.: 6SN1197–0AA30–0□P□

SINUMERIK and SIMODRIVE

Enhanced productivity as a result of fast, reliable commissioning

Handling

Sophisticated industrial electronics, as are involved here, have to be handled especially carefully. We regularly evaluate and investigate equipment which is returned and in so doing we have identified some of the main fault causes, which in some cases results from incorrect handling during commissioning and troubleshooting.

Check list

The following check list should help you to simply commission the components we have supplied and guarantee a high availability when used in conjunction with your product or equipment.

- Observe all of the ESD measures when handling components.
- Tighten–up all bolts and screws to the specified torque. Pay special attention to the DC link bolt connections (1.8 Nm tightening torque).
- Correctly insert all connectors and lock/screw into place.
- Screw the control components into the power module.
- Observe the power–on sequence in the Planning Guide.

  If the unit is frequently powered–down and up, the DC link charge circuit is locked–out. The DC link can only be charged again after it has cooled down for several minutes with the supply off.
- Are there line supply/motor contactors connected to the drive converter? These are only switched in a no–current condition.
- Ground all components and connect all of the shields. Connection X131 is grounded.
- Observe the load capability of the central power supply.
- Only discharge the unit at the DC link buses through a minimum of 10 Ω.
- In operation, units with hard disks may only be stressed with a of max. 1 g (read/write error; defective).
- Use the correct software for the particular unit.
- Are OEM components (ISA–/PCMCIA card) used? Their current drain must lie within the specified values.
- CRT monitors may not be subject to magnetic fields (e.g. power supply unit coils).
- When commissioning and fault finding, always proceed in a modular step–by–step fashion.This means: First commission the central controller and line supply module, then connect–up and commission the components one after another.

- The units are designed for the specified mechanical, climatic and electrical ambient conditions. None of the limit values may be exceeded, neither in operation nor during transport. Please pay specific attention to the following:
  - line supply conditions
  - pollutants
  - damaging gases
  - climatic ambient conditions
  - storage/transport
  - shock stressing
  - vibration stressing
  - ambient temperature

Further information

Further detailed information is provided in the Planning Guides and Installation Start–up Guides associated with our products.

■

General information (AL)

AL

Permissible combinations of inverter modules and control cards

1

Table 1-1 Selection table to set the current controller referred to the resulting inverter currents

SIMODRIVE 611 components	Feed/main spindle controls with analog setpoint interface											
	Feed drive control, analog 1–axis, user–friendly interface 6SN1118–0AA11–0AA0	Feed drive control, analog 1–axis, standard interface 6SN1118–0AD11–0AA0	Feed drive control, analog 2–axis, standard interface 6SN1118–0AE11–0AA0	Feed drive resolver contr.,anal. 1–axis, standard interface 6SN1118–0BJ11–0AA0	Feed drive resolver contr.,anal. 2–axis, standard interface 6SN1118–0BK11–0AA0	Main spindle drive control, ana no direct meas. system 6SN1121–0BA11–0AA0	Main spindle drive control, ana dir. meas. system, TTL signals 6SN1121–0BA12–0AA0y	Main spindle drive contr., anal. external position output 6SN1121–0BA13–0AA0	Induction motor control, anal. Fixed setpoints, mot. pot. 6SN1122–0BA11–0AA0	Induction motor control, anal– anal. speed, fixed setp., mot.pc 6SN1122–0BA12–0AA	Main spindle drive control, anal 6SN1121–0BA11–0AA1	Induction motor control, analog 6SN1122–0BA11–0AA1
Parameter board, feed drive, analog user–friendly 6SN1114–0AA01–0AA0	necessary	—	—	—	—	—	—	—	—	—	—	—
Main spindle option, feed drive, analog, user–friendly 6SN1114–0AA02–0AA□	possible	—	—	—	—	—	—	—	—	—	—	—
8A inverter module 6SN112□–1AA0□–0HA□	FD: 4/8A	FD: 4/8A	—	FD–R: 3/6A	—	—	—	—	IM: 3/3/3 A	IM: 3/3/3 A	—	IM: 3/3/3 A
15A inverter module 6SN112□–1AA0□–0AA□	FD: 7.5/15A	FD: 7.5/15A	—	FD–R: 5/10A	—	—	—	—	IM: 5/5/8 A	IM: 5/5/8 A	—	IM: 5/5/8 A
25A inverter module 6SN112□–1AA0□–0BA□	FD: 12.5/25A	FD: 12.5/25A	—	FD–R: 9/18A	—	—	—	—	IM: 8/10/16A	IM: 8/10/16A	—	IM: 8/10/16A
50A inverter module 6SN112□–1AA0□–0CA□	FD: 25/50A	FD: 25/50A	—	FD–R: 18/36A	—	MSD: 24/32/32A	MSD: 24/32/32A	MSD: 24/32/32A	IM: 24/32/32A	IM: 24/32/32A	MSD: 24/32/32A	IM: 24/32/32A
80A inverter module 6SN112□–1AA0□–0DA□	FD: 40/80A	FD: 40/80A	—	FD–R: 28/56A	—	MSD: 30/40/51A	MSD: 30/40/51A	MSD: 30/40/51A	IM: 30/40/51A	IM: 30/40/51A	MSD: 30/40/51A	IM: 30/40/51A
120A inverter module 6SN112□–1AA0□–0GA□	—	—	—	—	—	MSD: 45/60/76A	MSD: 45/60/76A	MSD: 45/60/76A	IM: 45/60/76A	IM: 45/60/76A	MSD: 45/60/76A	IM: 45/60/76A
108A inverter module 6SN112□–1AA0□–0LA□	—	—	—	—	—	MSD: 45/60/76A	MSD: 45/60/76A	MSD: 45/60/76A	IM: 45/60/76A	IM: 45/60/76A	MSD: 45/60/76A	IM: 45/60/76A
160A inverter module 6SN112□–1AA0□–0EA□	FD: 80/160A	FD: 80/160A	—	—	—	MSD: 60/80/102A	MSD: 60/80/102A	MSD: 60/80/102A	IM: 60/80/102A	IM: 60/80/102A	MSD: 60/80/102A	IM: 60/80/102A
200A inverter module 6SN112□–1AA0□–0FA□	FD: 100/200A	FD: 100/200A	—	—	—	MSD: 85/111/127A	MSD: 85/111/127A	MSD: 85/111/127A	IM: 85/111/127A	IM: 85/111/127A	MSD: 85/111/127A	IM: 85/111/127A

Table 1-1 Selection table to set the current controller referred to the resulting inverter currents

SIMODRIVE 611 components	Vorschub–/Hauptspindelregelungen mit analoger Sollwertschnittstelle											
	Feed drive control, analog 1–axis, user–friendly interface 6SN1118–0AA11–0AA0	Feed drive control, analog 1–axis, standard interface 6SN1118–0AD11–0AA0	Feed drive control, analog 2–axis, standard interface 6SN1118–0AE11–0AA0	Feed drive resolver contr.,anal. 1–axis, standard interface 6SN1118–0BJ11–0AA0	Feed drive resolver contr.,anal. 2–axis, standard interface 6SN1118–0BK11–0AA0	Main spindle drive control, anal no direct meas. system 6SN1121–0BA11–0AA0	Main spindle drive control, anal dir. meas. system, TTL signals 6SN1121–0BA12–0AA0	Main spindle drive contr., anal. external position output 6SN1121–0BA13–0AA0	Induction motor control, anal. Fixed setpoints, mot. pot. 6SN1122–0BA11–0AA0	Induction motor control, anal– anal. speed, fixed setp., mot.pot. 6SN1122–0BA12–0AA	Main spindle drive control, anal 6SN1121–0BA11–0AA1	Induction motor control, analog 6SN1122–0BA11–0AA1
200A inverter module pipe connection 6SN112□–1AA0□–0FA□	FD: 100/200A	FD: 100/200A	——	——	——	MSD: 85/110/127A	MSD: 85/110/127A	MSD: 85/110/127A	IM: 85/110/127A	IM: 85/110/127A	IM: 85/110/127A	IM: 85/110/127A
300A inverter module 6SN112□–1AA0□–0JA□	——	——	——	——	——	MSD: 120/150/193A	MSD: 120/150/193A	MSD: 120/150/193A	IM: 120/150/193A	IM: 120/150/193A	IM: 120/150/193A	IM: 120/150/193A
400A inverter module 6SN112□–1AA0□–0KA0	——	——	——	——	——	MSD: 200/250/257A	MSD: 200/250/257A	MSD: 200/250/257A	IM: 200/250/257A	IM: 200/250/257A	IM: 200/250/257A	IM: 200/250/257A
2x8A inverter module 6SN112□–1AB0□–0HA0	——	——	FD: 2x4/8A	——	FD–R: 2x3/6A	——	——	——	——	——	——	——
2x15A inverter module 6SN112□–1AB0□–0AA0	——	——	FD: 2x7.5/15A	——	FD–R: 2x5/10A	——	——	——	——	——	——	——
2x25A inverter module 6SN112□–1AB0□–0BA□	——	——	FD: 2x12.5/25A	——	FD–R: 2x9/18A	——	——	——	——	——	——	——
2x50A inverter module 6SN112□–1AB0□–0CA□	——	——	FD: 2x25/50A	——	FD–R: 2x18/36A	——	——	——	——	——	——	——

This Start–Up Guide is valid for the following drive modules:

6SN1130–1AA11–0□A0	1–axis feed drive module, user–friendly interface
6SN1130–1AA12–0□A0	1–axis feed drive module, user–friendly interface with main spindle drive option
6SN1130–1AD11–0□A0	1–axis feed drive module, standard interface
6SN1130–1AE11–0□A0	2–axis feed drive module, standard interface
6SN1135–1BA1□–0□A0	MSD module
6SN1140–1BA1□–0□A0	IM module

Note

The document describes all of the steps necessary to commission an installed SIMODRIVE drive group. Please refer to the associated Planning Guides for additional technical information, e.g. regarding

- ambient conditions
- recommended circuits
- connecting diagrams
- dimension sheets/dimension drawings

Please refer to the associate Planning Guide:

SIMODRIVE 611
Transistor PWM Inverters for AC Feed Drives and AC Main Spindle Drives
Order No.: 6SN1197–0AA00–0□P□

SIMODRIVE
AC Motors for Feed– and Main Spindle Drives
Order No.: 6SN1197–0AA20–0□P□

■

Supply infeed (NE)

NE

Standard settings, NE modules (UE and I/R modules), monitoring and pulsed resistor modules 1

!

Wichtig

Observe the information for sinusoidal current control for I/R modules!

A switch S1 is provided on the upper side of the NE and monitoring module to set the following functions:

ON:	S1	OFF:
V_{supply}=415V$^{\pm 10\%}$ V_{DClink}=625 V[1]	1	V_{supply}=415V$^{\pm 10\%}$ $V_{DC\ link}$=600 V[1]
Fault message	2	Ready signal
Regen. feedback off[1]	3	Regenerative feedback on
V_{Supply}=480V$^{+6\%-10\%}$	4	Standard, refer to S1.1
Controlled infeed off	5	Control infeed
Sinusoidal current control ∼	6	**Square–wave current control** ⊓

Standard setting

Fig. 1-1 DIL switch S1

!

Wichtig

For I/R modules Order No. 6SN114☐–1☐☐0☐–0☐☐**1** the basic setting is for sinusoidal control (closed–loop). Observe the information/instructions, Page NE1–3!

!

Wichtig

Before the equipment is powered–up or down using the main switch or a line contactor, terminal 63 (pulse enable) and/or terminal 48 (start terminal, contactor control) should be de–energized or disconnected!

[1] Only possible for I/R modules, monitoring thresholds are increased for all NE modules

Switch S 1.1 :

OFF: I/R module V_{supply} =400V ± 10%; $V_{DC\ link}$=600V
UE module V_{supply} =400V ± 10%; $V_{DC\ link}$=1.35*V_{supply}
monitoring thresholds: (I/R, UE–, monitoring modules)
pulsed resistor on =644V; pulsed resistor off =618V
$V_{DC\ link}$>> =710V;

ON: I/R module V_{supply} =415V ± 10%; $V_{DC\ link}$=625V
UE module V_{supply} =415V ± 10%; $V_{DC\ link}$=1.35*V_{supply}
Monitoring thresholds: (I/R–, UE–, monitoring modules)
pulsed resistor on =670V; pulsed resistor off =640V
$V_{DC\ link}$>> =740V;

Switch S 1.2 :

OFF: Ready signal (X111 ready relay)
For S1.2=OFF, the relay switches if the following conditions are fulfilled:
– internal main contactor CLOSED (terminals NS1–NS2 connected,
terminal 48 enabled)
– terminal 63,64=ENERGIZED
– no fault present (also not on feed drive 611A Standard, or 611D drives)
– feed drive with standard interface or resolver for setting ”Ready” is enabled (terminals 663,65)

ON: Fault message (X111 ready relay)
For S1.2=ON, the relay switches if the following conditions are fulfilled:
– internal main contactor CLOSED (terminals NS1–NS2 connected,
terminal 48 enabled)
– no fault present (also not on feed drive 611A Standard, or 611D drives)
– feed drive with standard interface or resolver for setting ”ready” is enabled (terminals 663,65);

Switch S 1.3 :

OFF: Standard setting, regenerative feedback active
I/R modules are capable of regenerative feedback
UE modules: The pulsed resistor in the module is effective

ON: Regenerative feedback switched–out (disabled)
I/R module: Regenerative feedback operation is inhibited
UE modules: The pulsed resistor in the module is not effective

Comment: This function is only effective for UE 10 kW from MLFB (Order No.): 6SN1146–1AC00–0AA1 (however, not for UE
28kW)

Switch S 1.4 :

OFF: Standard setting for all NE modules, refer to S1.1

ON: V_{supply} =**480V+6%–10%**; $V_{DC\ link}$=1.35*V_{supply} in the infeed direction
Monitoring thresholds: (I/R, UE, monitoring modules)
pulsed resistor on =744V; pulsed resistor off =718V
$V_{DC\ link}$>> =795V.

Comment: Uncontrolled operation in the infeed direction.
(only valid for Order No. 6SN114□–1□□0□–0□□**1**

Note

Only in conjunction with power modules, Order No. (6SN114☐–1☐☐0☐–0☐☐**1**).
For motors with shaft height <100: Utilization max. up to 60 k values. Please observe the Planning Guide, Motors.
S1.4 ON overwrites the functions of S1.5 and S1.1 .

Switch S 1.5 :

This function is only available in conjunction with I/R modules
Order No. :6SN114☐–1☐☐0☐–0☐☐**1**

OFF: Standard setting, controlled infeed active.

ON: Uncontrolled operation in the infeed direction $V_{DC\ link}$=1.35*V_{supply} .
Regenerative feedback operation is initiated at V DC link=600 or 625V, depending on the setting of S1.1 .

Switch S 1.6 :

OFF: Square–wave current control (square–wave current is drawn from the line supply)

ON: This function is only available in conjunction with I/R modules
6SN114☐–1☐☐0☐–0☐☐**1**
Sinusoidal current control (sinusoidal current is drawn from the line supply)

Sinusoidal current is only permissible if the following secondary conditions are fulfilled :

I/R 16 kW	I/R 36 kW	I/R 55 kW	I/R 80 kW	I/R 120 kW
6SN114☐–1B☐01–0BA**1**	6SN114☐–1B☐02–0CA**1**	6SN114☐–1B☐0☐–0DA**1**	6SN114☐–1BB00–0EA**1**	6SN114☐–1BB01–0FA**1**
HF reactor 16 kW	HF reactor 36 kW	HF reactor 55 kW	HF reactor 80kW	HF reactor 120kW
6SN1111–0AA00–0BA0	6SN1111–0AA00–0CA0	6SN1111–0AA00–0DA0	6SN1111–0AA00–1EA0	6SN1111–0AA00–1FA0
Line filter for sinusoidal current [1)] 16 kW	Line filter for sinusoidal current [1)] 36 kW	Line filter for sinusoidal current [1)] 55 kW	Line filter for sinusoidal current [1)] 80 kW	Line filter for sinusoidal current [1)] 120 kW
6SN1111–0AA01–2BA0	6SN1111–0AA01–2CA0	6SN1111–0AA01–2DA0	6SN1111–0AA01–2EA0	6SN1111–0AA01–2FA0

!

Wichtig

For all of the combinations not listed here, only square–wave current control is permissible.

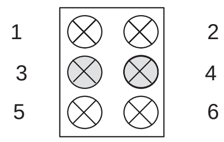
1) In the sinusoidal line supply filters, contrary to the square–wave current filter modules, there is no HF commutating reactor. The HF commutating reactor must be separately mounted.

■

Service and diagnostics 2

NE

Display elements of the monitoring– and NE modules



1 LED, red	– ±15 V electronics power supply faulted
2 LED, red	– 5 V voltage level faulted
3 LED green	– external enable signals not available (terminal 63 and/or terminal 64 missing)
4 LED yellow	– DC link charged
5 LED, red	– line supply fault (single– or multi–phase supply failure at the terminals U1, V1, W1) 1) – commutating reactor either not available or incorrectly selected, – fault level of the line supply or transformer too low
6 LED red	– DC link overvoltage possible causes: Regenerative feedback off, setting–up operation, line supply fault, for UE pulsed–resistor not operational, line supply voltage too high, dynamic overload condition

Effects:

1	red LED bright:	Pulses for the complete drive group are canceled
2	red LED bright:	Pulses for the complete drive group are canceled
4	yellow LED dark:	xxxx
5	red LED bright:	1) Only the I/R module pulses are canceled (regenerative feedback no longer possible. Axes first continue to run. Ready relay drops–out
6	red LED bright:	Pulses for the complete drive group are canceled

1) Line supply fault identification time approx. 30ms
Line supply fault is identified for a three–phase voltage < 280V.
For 1–phase supply failure, the drive axes pulses are canceled after approx. 1 min.
(latched signal) valid for Order No. 6SN1114☐–1☐☐0☐–0☐☐**1**

2.1 Terminals and relay functions

- X111: **READY RELAY:**
  – terminals 72 – 73.1: NO contact in the quiescent state
  – terminals 73.2 – 74: NC contact in the quiescent state

  For S1.2=OFF, the relay switches if the following conditions are fulfilled:
  – internal main contactor CLOSED (terminals NS1–NS2 connected, terminal 48 enabled)
  – terminals 63, 64 =ENERGIZED
  – no fault present (also not on feed drive 611A Standard, or 611D drives)
  – feed drive with Standard interface or resolver is enabled for the ”ready” setting (terminals 663, 65)
  For S1.2=ON, the relay switches if the following conditions are fulfilled:
  – internal main contactor CLOSED (terminal NS1–NS2 connected, terminal 48 enabled)
  – no fault present (also not on feed drive 611A Standard, and 611D drives)
  – feed drive with Standard interface or resolver enabled for this ”ready” setting (terminals 663, 65).

- X121: **I^2t_alarm and motor overtemperature:**
  terminal 5.1 – 5.2: NO contact in the quiescent state
  terminal 5.1 – 5.3: NC contact in the quiescent state
  This relay switches, if:
  – the > heatsink temperature monitoring responds at the I/R
  – the > motor temperature monitoring responds at the 611D feed drive
  > heatsink temperature monitoring responds
  – at the feed drive 611A user–friendly
  > motor temperature monitoring responds
  > heatsink temperature monitoring responds
  > I^2t–temperature monitoring responds (non–latching)
  – at 611A Standard
  > Motor temperature monitoring responds
  > heatsink temperature monitoring responds

- X171: Terminal **NS1–NS2** (coil circuit of the internal line supply– and pre–charging contactor):
  – is used to electrically isolate from the line supply (signal contact, terminals 111–213 must be interrogated)
  – may only be switched if terminal 48 is open–circuit (without any restriction from Order No. 6SN114□–1□□0**1**–0□□□ for 10, 16 and 55kW, from Order No. 6SN114□–1□□0**2**–0□□□ for 36kW, all 80 and 120kW)

- terminal 48: **Start**
  – has the highest priority
  – Sequence: Pre–charging ON interrogation $V_{DC\ link} \geq 310V$ and $V_{DC\ link} \geq \sqrt{2}*V_{supply}–50V$
  – > 500ms pre–charging contactor OUT, interrogation whether OUT, main contactor IN
  >1s internal enable signals (for I/R and module group)
  – saved during pre–charging

- terminal 63: **Pulse enable**
  – has the highest priority for pulse enable of all the modules
  – acts instantaneously (without delay)

- Terminal 64: **Drive enable**
  – acts instantaneously on all modules
  – when the signal is withdrawn, n_{set} is set to 0 for all drives, and
  > for main spindle drive / induction motor module 611 A, the pulses are canceled after a speed, which can be set, is fallen below. The drive is braked along the ramp.

> for feed drives 611 A, after the selected timer stages have expired (as supplied: 240ms) all of the controllers and pulses are inhibited. The drive brakes along the current limit.
> for 611D drives, the pulses are deleted after a selectable speed has been fallen below and/or a time which can be set, has expired. The drive brakes along the set limits. (For spindles, a ramp can be achieved via regenerative limiting [kW])

NE

- terminal 112: **Setting–up operation** (V_{min} 3–ph. 24V AC or 34 V DC)
  – the $V_{DC\ link}$ – closed–loop control is inhibited
  – regenerative feedback is not possible, i.e. when braking, $V_{DC\ link}$ can be >600V!
  – this function is interrogated with the start inhibit signal, terminal AS1–AS2.

Caution

For induction motors, even for low $V_{DC\ link,}$ high speeds can be reached!

- terminals AS1–AS2: **start inhibit signal**
  – terminals AS1–AS2 closed means ”start inhibit is effective” (setting–up operation)
- terminals 111, 113, 213: signal contact, internal line contactor
  – terminals 111 – 113: NO contact
  – terminals 111 – 213: NC contact (for I/R 16kW and UE 10kW only from Order No. 6SN114□–1□□0**1**–0□□□)
- terminal 19: **FR–:**
  – reference ground, enable voltage
  – floating (connected to the general reference ground, terminal 15 via 10kΩ)
  – it is not permissible to connect terminal 19 with terminal 15 (connect to PE rail or X131)
- terminal 9: **FR+:**
  – 24V enable voltage
  – max. load capability of the power supply:500mA (corresponds to 8 slots;1 optocoupler input requires 12mA)
- X 141: **electronic voltages:**

– terminal 7:	P24	+20.4 to 28.8V / 50mA
– terminal 45:	P15	+15V / 10mA
– terminal 44:	N15	–15V / 10mA
– terminal 10:	N24	–20.4 to 28.8V / 50mA
– terminal 15:	M	0V

  – it is not permissible to connect terminal 15 to PE (ground loop)
  – it is not permissible to connect terminal 15 with terminal 19 (short–circuit via reactor, which internally connects terminal 15 with X131)

- terminal **L1–L2 for 80kW and 120kW – I/R**
  – is used to supply the coil of the internal line contactor
  – is supplied directly at the line supply with 2–ph. 400V AC (not between I/R and reactor)
  – fuse: $I_N \geq$ 4 A, type gL
- **Fan connection for 80 and 120kW I/R**
  – 3–ph. 360 to 510V AC , 45–65 Hz directly at the line supply (not between the I/R and reactor)
  – observe the rotating field (phase sequence)!
  – fuse: $I_N \geq$ 1.5 A (motor protection circuit–breaker)

- **6 – conductor connection with additional connection of the power supply at the DC link:**
  – for this operating mode, terminals 2U1, 2V1 and 2W1 of the power supply **must be supplied** with the line supply voltage **between** the series reactor and I/R, otherwise the power supply will be destroyed! This is also valid for the monitoring modules!

- **Monitoring module** with line supply connection **and** additional connection of the power supply to the DC link:
  – for this operating mode, terminals 2U1, 2V1 and 2W1 of the power supply **must be supplied** with the line supply voltage between the series reactor and I/R, as otherwise the power supply will be destroyed.
  – terminal 63 must be switched via the ready relay of the I/R in order to prevent the module, to the right of the monitoring module, starting during pre–charging.

Diagnostic instructions

If a line supply fault is displayed or if the yellow LED is dark, the overvoltage limiting module must be checked.
Procedure:

1. Power–down the drive converter (into a no–voltage condition)
2. Remove the overvoltage limiting module and insert connector X181 on the NE module. If the NE module functions, then the overvoltage limiting module is defect and must be replaced.
   Otherwise, check the line supply and if required, also the NE module/drive group.

Note

In this way, operation can be continued, but **without overvoltage protection.**

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3. Insert the overvoltage limiting module 566018.9415.00 up to its end stop, and insert connector X181 on the overvoltage limiting module.

■

Appendix 3

Note

When using non–PELV circuits at terminals AS1, AS2, terminal 111, terminal 113, terminal 213, connector coding must be used to prevent the connector being interchanged (refer to EN 60204–1 Section 6.4) refer to Catalog NC 60.1 for the Order No. of the coding connector. Only PELV circuits may be connected at terminal 19.

3.1 Connecting terminals NE, monitoring and pulsed resistor modules

Table 3-1 Terminal functions

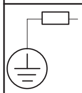
Term. No.	Designation	Function	Type 1)	Typ. voltage/limit values	Max. cross–section	Terminals available in 3)
U1 V1 W1		Supply	I	3–ph. 400 V AC	Refer to the Planning Guide	I/R, UE
L1 L2		Supply connection for contactor	I I	2–ph. 400 V AC dir. at supply L1, L2, L3, refer to Sec. 9.2	16mm^2/10mm^2 4) 16mm^2/10mm^2 4)	I/R 80/104 kW, 120/156 kW
PE P600 M600		Protective conductor DC link DC link	I I/O I/O	0 V +300 V –300 V	Bolt Busbar Busbar	I/R, UE, MM, PR
		Grounding bar 5)	I/O	–300 V	Busbar	I/R, UE
P600 M600		DC link DC link	I I	+300 V –300 V	16mm^2/10mm^2 4) 16mm^2/10mm^2 4)	MM
1R, 2R, 3R		Internal resistor connection	I/O	± 300 V	16mm^2/10mm^2 4)	PR
	X131	Electronics M	I/O	0 V	16mm^2/10mm^2 4)	I/R, UE, MM
	X351	Equipment bus	I/O	Various	Ribbon cable	I/R, UE, MM, PR
M500 P500 1U1 2U1 1V1 2V1 1W1 2W1	X181 X181 X181 X181 X181 X181 X181 X181	DC link power supply DC link power supply Output L1 Input L1 Output L2 Input L2 Output L3 Input L3	I I O I O I O I	600 V DC 600 V DC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2	I/R, UE, MM
7 45 44 10 15 R	X141 X141 X141 X141 X141 X141	P24 P15 N15 N24 M RESET 6)	O O O O O I	+20.4...28.8 V/50 mA +15 V/10 mA –15 V/10 mA –20.4...28.8 V/50 mA 0 V Term.15/R_E = 10 kΩ	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2	I/R, UE, MM
5.3 5.2 5.1 63 9 9 64 19	X121 X121 X121 X121 X121 X121 X121	Relay contacts Group message I^2t/motor temp. Pulse enable 2) Enable voltage 2)8) Enable voltage 2)8) Drive enable 2) Enable voltage, reference potential	NC NO I I A A I	50 V DC/0.5 A/12 VA max 5 V DC/3 mA min +13 V...30 V/R_E = 1.5 kΩ +24 V +24 V +13 V...30 V/R_E = 1.5 kΩ 0 V	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2	I/R, UE, MM

Table 3-1 Terminal functions

Term. No.	Desi-gna-tion	Function	Type 1)	Typ. voltage/limit values	Max. cross–section	Terminals available in 3)
74 nc 73.2 73.1 nc 72	X111 X111 X111 X111 X111 X111	Relay contact Ready signal	NC I I NO	1–ph. 250V AC/50V DC /2A max 5V DC/3mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2	I/R, UE, MM
9 112	X161 X161	Enable voltage 2)8) Setting–up operation/ Standard operation 2)	O I	+24 V +21 V...30 V/R_E = 1.5 kΩ	1.5 mm^2 1.5 mm^2	I/R, UE, MM
48 111 213 113	X161 X161 X161 X161	Contactor control 2) Signaling contacts Line contactor	I I NC 7) NO	+13 V...30 V/R_E = 1.5 kΩ +30 V/1 A (111–113) 1–ph. 250 V AC/50 V DC/ 2 A max 17 V DC/3 mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2	I/R, UE
AS1 AS2	X172 X172	Signaling contact Start inhibit (terminal112)	I NC	250V AC/1A/50V DC/2A max 5 V DC/10 mA min	1.5 mm^2 1.5 mm^2	I/R
NS1 NS2	X171 X171	Coil contact for line–, pre–charging contactor	O I	+24 V	1.5 mm^2 1.5 mm^2	I/R, UE
19 50	X221 X221	Enable voltage Reference potential Control contact for fast discharge	O I	0 V 0 V	1.5 mm^2 1.5 mm^2	PR

Notes:
1) I = Input, O = Output, NC = NC contact, NO = NO contact (for signal: Closed= high/open= low)
2) Terminal 19 is the reference ground (is connected inside the module with 10 kΩ to the general reference ground X131/terminal 15). It is **not** permissible to connect terminal 15 to PE or to terminal 19. Do **not** connect external voltage sources to terminal 15! Terminal 19 can be connected with X131.
3) I/R = infeed/regenerative feedback module;
UE = uncontrolled infeed;
monitoring module;
PW = pulsed–resistor module
4) The 1st number is valid for cable lugs. The second number is valid for finely–stranded conductors without connector sleeves.
5) The grounding bar is used to ground the DC link M bus via 100 kΩ (it should preferably always be inserted for non–grounded supply networks).
6) RESET = resets the fault memory, edge triggered for the complete drive group (terminal R→ terminal 15 = RESET)
7) terminal 111–213 positively–driven NC contact (for I/R 16 kW and UE 10kW, only from MLFB (Order No. 6SN114□–1□□0**1**–0□□□).
Terminal 111–113, NO contact, not positively driven
8) max. current load of terminals 9–19: 0.5A

3.2 Connecting terminals, UE module 5/10 kW

Table 3-2 Terminal functions

Term. No.	Desi-gnation	Function	Type[1]	Typ. voltage/limit values	Max. cross–section
U1 V1 W1	X1	Supply	I	3–ph. 400 V AC	4 mm^2 finely stranded without connector sleeves 6 mm^2 with cable lug
PE1 PE2	–	Protective conductor	I	0 V	M5 thread
	X131 X351	Electronics M Equipment bus Grounding bar[3]	I I/O I/O	0 V Various –300 V	M4 thread 34–pin ribbon cable Busbar
P600 M600		DC link DC link	I/O I/O	+300 V –300 V	Busbar Busbar
M500 P500 1U1 2U1 1V1 2V1 1W1 2W1	X181 X181 X181 X181 X181 X181 X181 X181	DC link power supply DC link power supply Output L1 Input L1 Output L2 Input L2 Output L3 Input L3	I I O I O I O I	–300 V +300 V 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
5.3 5.2 5.1 nc	X121A X121A X121A X121A	Relay contact Group signal I^2t/motor temperature	NC NO I	50 V DC/0.5 A/12 VA max 5 V DC/3 mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
74 73.2 73.1 72	X121B X121B X121B X121B	Relay signal Ready/ fault	NC I I NO	1–ph. 250 V AC/50 V DC/2 A max 5 V DC/3 mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
63 9 9 64 R 19	X141A X141A X141A X141A X141A X141A	Pulse enable[2] FR+[2][4] FR+[2][4] Drive enable[2] RESET[2] FR–, reference ground, enable voltage	I O O I I O	+13 V...30 V/R_E = 1.5 kΩ +24 V +24 V +13 V...30 V/R_E = 1.5 kΩ 0/+24 V 0 V	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
111 213	X161 X161	Signaling contact Line contactor	I NC	1–ph. 250 V AC/50 V DC/2 A 17 V DC/3 mA min	1.5 mm^2 1.5 mm^2
9 112 48 NS1 NS2 15	X141B X141B X141B X141B X141B X141B	FR+[2][4] Setting–up/standard operation[2] Contactor control[2] Coil contact for the line supply pre–charging contactor M	O I I O I O	+24 V +13 V...30 V/R_E = 1.5 kΩ +13 V...30 V/R_E = 1.5 kΩ +24 V 0/+24 V 0 V	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2

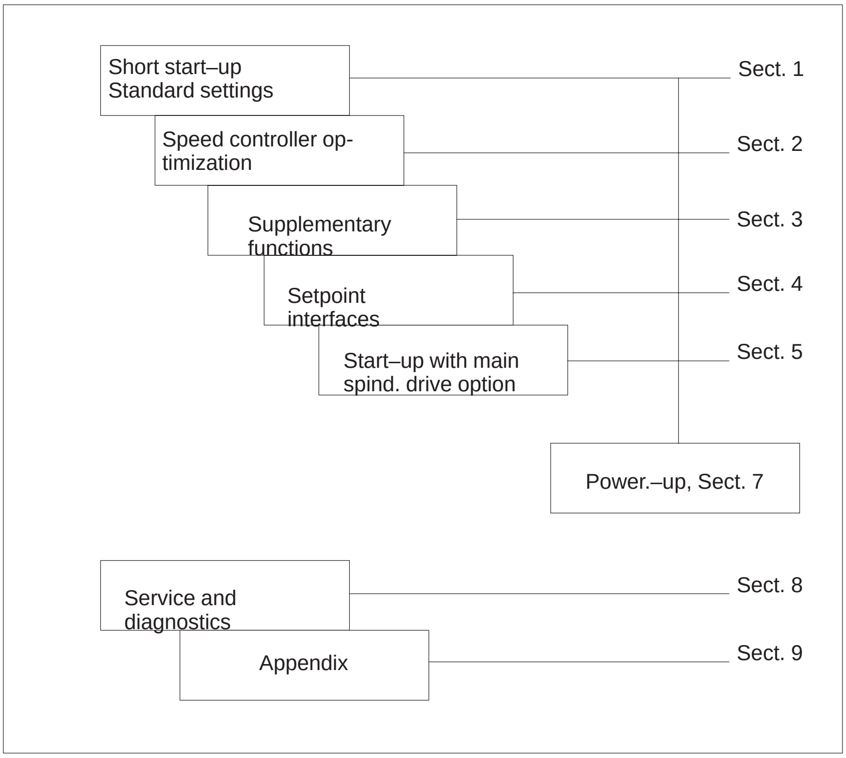
Notes:
1) I = Input, O = Output, NC = NC contact, NO = NO contact (for signal: Closed= high/open= low)
2) Terminal 19 is the reference terminal (connected in the module to general reference ground X131 with 10 kΩ).
3) The grounding bar is used to ground the DC link M bar via 100 kΩ (this should always be inserted for non–grounded supply networks).
4) max. current loading of terminals 9 – 19: A1

■

Feed modules (VS)

Start–up steps of the feed drive modules with user–friendly– and standard interface

Start–up is sub–divided into steps; after the standard setting, this can be followed by an additional start–up step or the drive converter powered–up.



Short start–up, standard settings 1

The setting elements for the user–friendly interface are located on the parameter board, for the standard interface, on the control (refer to Section 9 Appendix). The tachometer adaptation, current normalization and current controller gain parameters should be set for a standard start–up.

VS

1.1 Tachometer adaptation for motors with tachometer voltages ≤ 16.5 V at rated speed

Only for 1FT503□–□A**F**71 and 1FT504□–□A**F**71 motors

User–friendly– and standard interface

All three contacts, switch S1 (S4 for the 2nd axis standard interface) = ON
Further, an adjustment can be made using discrete resistors, refer to Section 3.1 - 3.2.

1.2 Current controller settings

The settings for the current limit and current controller gain Kp(I) can be taken from the adaptation tables, Table 1-3 up to Table 1-9. If the required feed module/motor combination cannot be found, the values can be determined using the associated formulas.

User–friendly interface

Parameter board, switch S2

Standard interface

Control board, switch S2 **(S5 for 2nd axis)**

Note

The following setting values are valid for both control versions, as long as, in individual cases, specific reference is not made to differences.

Current actual value normalization

$$\text{Current limit} = \frac{I_{max}\ \text{(adjusted maximum current)}}{I_{limit}\ \text{(peak current of the power module)}}\ [\%]$$

Table 1-1 Current limit

S2.x or S5.x to 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
(%)	100	85	68	61	50	46	41	39	36	34	30	29	26	24	23

The current limit must be reduced at least to the peak value permitted for the motor. It may be necessary to reduce it still further depending on the mechanical system which is driven.

Current controller gain Kp(I)

$$\text{Kp(I) t} \quad \frac{I_{max} \cdot L_A}{40}$$

I_{max} =maximum axis current set in A
L_A =motor winding inductance in mH (refer to the configuringguide, AC motors for feed– and main spindledrives)

Table 1-2 Current controller gain

S2.x and S5.x to ON	–	6	7	6 7	8	6 8	7 8	9	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	6.5	7.5	8	9.5	11	11.5

User–friendly interface

The setting range of the current controller gain can be additionally increased using R15 on the parameter board.

The following formula is valid for S2.6 to S2.9 closed (ON):

$$\text{Kp(I)} = 11,5 + \frac{1230\ \Omega}{\text{R15}}$$

Adaptation tables

Definition: o = Contact in the basic OFF setting
x = Contact in the ON setting

Table 1-3 **Adaptation table for feed module 4/8 A**

Servomotor				**Current limit** [1)]					**Current controller gain**				
1FT...	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
5034–□AK71	0.5	0.93	6000	x	o	x	o	3.68	o	x	o	o	2.0
5036–□AK71	0.75	1.4	6000	o	x	o	o	5.44	o	x	o	o	2.0
5042–□AF71	0.66	0.75	3000	x	o	o	x	2.72	x	x	o	o	2.5
5042–□AK71	0.66	1.2	6000	x	x	o	o	4.88	x	x	o	o	2.5
5044–□AF71	1.3	1.5	3000	o	x	o	o	5.44	x	x	o	o	2.5
5044–□AK71	1.3	2.3	6000	o	o	o	o	8.0	x	o	o	o	1.0
5046–□AF71	2.6	3.0	3000	o	o	o	o	8.0	o	x	o	o	2.0
5062–□AC71	2.2	1.3	2000	o	x	o	o	5.44	x	x	x	x	11.5
5062–□AF71	2.2	2.0	3000	o	o	o	o	8.0	o	x	o	x	7.5
5062–□AG71	2.2	2.7	4000	o	o	o	o	8.0	o	o	x	o	4.0
5062–□AK71	2.2	3.9	6000	o	o	o	o	8.0	x	o	o	o	1.0
5064–□AC71	4.5	2.7	2000	o	o	o	o	8.0	o	x	o	x	7.5
5066–□AC71	6.5	3.9	2000	o	o	o	o	8.0	x	o	x	o	4.5
5070–□AC71	3.0	1.8	2000	o	o	o	o	8.0	x	x	x	x	11.5
5070–□AF71	3.0	2.6	3000	o	o	o	o	8.0	o	x	o	x	7.5
5070–□AG71	3.0	3.6	4000	o	o	o	o	8.0	x	o	x	o	4.5
5071–□AC71	4.5	2.9	2000	o	o	o	o	8.0	x	x	o	x	8.0

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-4 **Adaptation table for feed module 7.5/15 A**

Servomotor				**Current limit** 1)					**Current controller gain**				
1FT...	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
5034–□AK71	0.5	0.93	6000	o	x	x	x	3.68	o	x	o	o	2.0
5036–□AK71	0.75	1.4	6000	o	o	o	x	5.44	o	x	o	o	2.0
5042–□AF71	0.66	0.75	3000	x	x	x	x	3.45	o	o	x	o	4.0
5042–□AK71	0.66	1.2	6000	x	x	o	x	4.5	o	x	o	o	2.0
5044–□AF71	1.3	1.5	3000	x	x	x	o	5.85	o	o	x	o	4.0
5044–□AK71	1.3	2.3	6000	x	x	o	o	9.15	o	x	o	o	2.0
5046–□AF71	2.6	3.0	3000	x	o	o	o	12.7	o	o	x	o	4.0
5046–□AK71	2.6	4.7	6000	o	o	o	o	15.0	x	o	o	o	1.0
5062–□AC71	2.2	1.3	2000	x	o	o	x	5.1	o	x	x	x	11.0
5062–□AF71	2.2	2.0	3000	o	o	x	o	7.5	x	o	o	x	6.5
5062–□AG71	2.2	2.7	4000	o	x	o	o	10.2	o	x	x	o	5.5
5062–□AK71	2.2	3.9	6000	o	o	o	o	15.0	x	x	o	o	2.5
5064–□AC71	4.5	2.7	2000	o	x	o	o	10.2	o	o	x	x	9.5
5064–□AF71	4.5	4.1	3000	o	o	o	o	15.0	x	o	o	x	6.5
5064–□AG71	4.5	5.5	4000	o	o	o	o	15.0	x	x	o	o	2.5
5066–□AC71	6.5	3.9	2000	o	o	o	o	15.0	o	o	x	x	9.5
5066–□AF71	6.5	6.0	3000	o	o	o	o	15.0	o	o	x	o	4.0
5070–□AC71	3.0	1.8	2000	o	o	x	o	7.5	x	x	x	x	11.5
5070–□AF71	3.0	2.6	3000	o	x	o	o	10.2	o	o	x	x	9.5
5070–□AG71	3.0	3.6	4000	o	o	o	o	15.0	x	x	o	x	8.0
5070–□AK71	3.0	5.3	6000	o	o	o	o	15.0	o	o	x	o	4.0
5071–□AC71	4.5	2.9	2000	x	o	o	o	12.7	x	x	x	x	11.5
5071–□AF71	4.5	4.3	3000	o	o	o	o	15.0	x	o	o	x	6.5
5071–□AG71	4.5	5.2	4000	o	o	o	o	15.0	x	o	x	o	4.5
5072–□AC71	10.0	6.1	2000	o	o	o	o	15.0	x	x	o	x	8.0
5073–□AC71	7.0	4.3	2000	o	o	o	o	15.0	o	o	x	x	9.5
5073–□AF71	7.0	6.4	3000	o	o	o	o	15.0	o	o	x	o	4.0
5100–□AC71	10.0	6.2	2000	o	o	o	o	15.0	o	x	x	o	5.5

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-5 **Adaptation table for feed module 12.5/25 A**

Servomotor				**Current limit** [1)]					**Current controller gain**				
1FT...	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
5036–□AK71	0.75	1.4	6000	x	x	x	x	5.75	o	x	o	o	2.0
5044–□AF71	1.3	1.5	3000	o	x	x	x	6.0	o	o	x	o	4.0
5044–□AK71	1.3	2.3	6000	o	o	o	x	9.0	o	x	o	o	2.0
5046–□AF71	2.6	3.0	3000	o	o	x	o	12.5	o	o	x	o	4.0
5046–□AK71	2.6	4.7	6000	o	x	o	o	17.0	o	x	o	o	2.0
5062–□AC71	2.2	1.3	2000	x	x	x	x	5.75	x	x	x	x	11.5
5062–□AF71	2.2	2.0	3000	x	o	o	x	8.5	x	x	o	x	8.0
5062–□AG71	2.2	2.7	4000	x	o	x	o	10.25	o	x	x	o	5.5
5062–□AK71	2.2	3.9	6000	x	x	o	o	15.75	x	x	o	o	2.5
5064–□AC71	4.5	2.7	2000	x	o	x	o	10.25	x	x	x	x	11.5
5064–□AF71	4.5	4.1	3000	o	x	o	o	17.0	x	o	o	x	6.5
5064–□AG71	4.5	5.5	4000	o	o	o	o	25.0	o	x	x	o	5.5
5064–□AK71	4.5	8.0	6000	o	o	o	o	25.0	x	x	o	o	2.5
5066–□AC71	6.5	3.9	2000	o	x	o	o	17.0	o	o	x	x	9.5
5066–□AF71	6.5	6.0	3000	o	o	o	o	25.0	x	o	o	x	6.5
5066–□AG71	6.5	7.9	4000	o	o	o	o	25.0	x	x	o	o	2.5
5066–□AK71	6.5	11.6	6000	o	o	o	o	25.0	o	x	o	o	2.0
5070–□AC71	3.0	1.8	2000	o	x	o	x	7.5	x	x	x	x	11.5
5070–□AF71	3.0	2.6	3000	x	o	x	o	11.5	o	x	x	x	11.0
5070–□AG71	3.0	3.6	4000	o	x	o	o	17.0	o	o	x	x	9.5
5070–□AK71	3.0	5.3	6000	o	o	o	o	25.0	x	o	o	x	6.5
5071–□AC71	4.5	2.9	2000	o	o	x	o	12.5	x	x	x	x	11.5
5071–□AF71	4.5	4.3	3000	o	x	o	o	17.0	x	x	o	x	8.0
5071–□AG71	4.5	5.2	4000	o	o	o	o	25.0	x	x	o	x	8.0
5071–□AK71	4.5	7.9	6000	o	o	o	o	25.0	x	x	o	o	2.5
5072–□AC71	10.0	6.1	2000	o	o	o	o	25.0	x	x	x	x	11.5
5072–□AF71	10.0	9.1	3000	o	o	o	o	25.0	o	o	o	x	6.0
5072–□AG71	10.0	12.0	4000	o	o	o	o	25.0	x	x	o	o	2.5
5073–□AC71	7.0	4.3	2000	o	x	o	o	17.0	o	o	x	x	9.5
5073–□AF71	7.0	6.4	3000	o	o	o	o	25.0	x	o	o	x	6.5
5073–□AG71	7.0	8.1	4000	o	o	o	o	25.0	x	o	x	o	4.5
5073–□AK71	7.0	12.5	6000	o	o	o	o	25.0	x	o	o	o	1.0
5074–□AC71	14.0	8.5	2000	o	o	o	o	25.0	x	x	o	x	8.0
5076–□AC71	18.0	11.5	2000	o	o	o	o	25.0	o	x	x	o	5.5
5100–□AC71	10.0	6.2	2000	o	o	o	o	25.0	o	o	x	x	9.5
5100–□AF71	10.0	9.2	3000	o	o	o	o	25.0	o	o	x	o	4.0
5100–□AG71	10.0	12.5	4000	o	o	o	o	25.0	x	x	o	o	2.5
5101–□AC71	15.0	9.4	2000	o	o	o	o	25.0	o	x	x	o	5.5
5102–□AA71	27.0	9.9	1200	o	o	o	o	25.0	x	x	o	x	8.0
5103–□AC71	19.0	12.0	2000	o	o	o	o	25.0	o	o	x	o	4.0

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-6 **Adaptation table for feed module 25/50 A**

Servomotor				**Current limit** [1)]					**Current controller gain**				
1FT...	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp(I)
5044–□AK71	1.3	2.3	6000	o	o	x	x	13.0	x	x	o	o	2.5
5046–□AF71	2.6	3.0	3000	o	x	o	x	15.0	o	o	x	o	4.0
5046–□AK71	2.6	4.7	6000	o	o	x	o	25.0	x	x	o	o	2.5
5062–□AG71	2.2	2.7	4000	x	o	x	x	13.0	x	o	o	x	6.5
5062–□AK71	2.2	3.9	6000	o	x	x	o	19.5	x	o	x	o	4.5
5064–□AC71	4.5	2.7	2000	o	o	x	x	13.0	x	x	x	x	11.5
5064–□AF71	4.5	4.1	3000	x	x	x	o	19.5	x	x	o	x	8.0
5064–□AG71	4.5	5.5	4000	o	o	x	o	25.0	o	x	x	o	5.5
5064–□AK71	4.5	8.0	6000	o	x	o	o	34.0	x	x	o	o	2.5
5066–□AC71	6.5	3.9	2000	x	x	x	o	19.5	x	x	x	x	11.5
5066–□AF71	6.5	6.0	3000	x	x	o	o	30.5	x	x	o	x	8.0
5066–□AG71	6.5	7.9	4000	o	x	o	o	34.0	x	o	x	o	4.5
5066–□AK71	6.5	11.6	6000	o	o	o	o	50.0	o	o	x	o	4.0
5070–□AF71	3.0	2.6	3000	o	x	x	x	12.0	x	x	x	x	11.5
5070–□AG71	3.0	3.6	4000	x	o	o	x	17.0	o	o	x	x	9.5
5070–□AK71	3.0	5.3	6000	o	o	x	o	25.0	x	o	o	x	6.5
5071–□AC71	4.5	2.9	2000	o	o	x	x	13.0	x	x	x	x	11.5
5071–□AF71	4.5	4.3	3000	o	x	x	o	20.5	o	o	x	x	9.5
5071–□AG71	4.5	5.2	4000	o	o	x	o	25.0	x	x	o	x	8.0
5071–□AK71	4.5	7.9	6000	o	x	o	o	34.0	o	o	x	o	4.0
5072–□AC71	10.0	6.1	2000	o	o	x	o	25.0	x	x	x	x	11.5
5072–□AF71	10.0	9.1	3000	x	o	o	o	42.5	o	o	x	x	9.5
5072–□AG71	10.0	12.0	4000	o	o	o	o	50.0	x	o	o	x	6.5
5072–□AK71	10.0	17.5	6000	o	o	o	o	50.0	x	x	o	o	2.5
5073–□AC71	7.0	4.3	2000	o	x	x	o	20.5	x	x	x	x	11.5
5073–□AF71	7.0	6.4	3000	x	x	o	o	30.5	x	x	o	x	8.0
5073–□AG71	7.0	8.1	4000	x	o	o	o	42.5	o	x	o	x	7.5
5073–□AK71	7.0	12.5	6000	o	o	o	o	50.0	x	x	o	o	2.5
5074–□AC71	14.0	8.5	2000	x	o	o	o	42.5	x	x	x	x	11.5
5074–□AF71	14.0	13.0	3000	o	o	o	o	50.0	x	o	o	x	6.5
5074–□AG71	14.0	16.5	4000	o	o	o	o	50.0	x	o	x	o	4.5
5074–□AK71	14.0	25.0	6000	o	o	o	o	50.0	x	o	o	o	1.0
5076–□AC71	18.0	11.5	2000	o	o	o	o	50.0	o	x	x	x	11.0
5076–□AF71	18.0	16.5	3000	o	o	o	o	50.0	x	o	x	o	4.5
5076–□AG71	18.0	21.5	4000	o	o	o	o	50.0	x	x	o	o	2.5
5100–□AC71	10.0	6.2	2000	x	x	o	o	30.5	x	x	x	x	11.5
5100–□AF71	10.0	9.2	3000	x	o	o	o	42.5	x	o	o	x	6.5
5100–□AG71	10.0	12.5	4000	o	o	o	o	50.0	x	o	x	o	4.5
5100–□AK71	10.0	18.0	6000	o	o	o	o	50.0	x	x	o	o	2.5
5101–□AC71	15.0	9.4	2000	x	o	o	o	42.5	o	o	x	x	9.5
5101–□AF71	15.0	14.5	3000	o	o	o	o	50.0	x	o	x	o	4.5
5101–□AG71	15.0	17.5	4000	o	o	o	o	50.0	x	x	o	o	2.5
5102–□AA71	27.0	9.9	1200	x	o	o	o	42.5	x	x	x	x	11.5
5102–□AC71	27.0	16.5	2000	o	o	o	o	50.0	x	o	o	x	6.5
5102–□AF71	27.0	25.0	3000	o	o	o	o	50.0	x	x	o	o	2.5

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-6 **adaptation table for feed module 25/50 A**

Servomotor				**Current limit** [1]					**Current controller gain**				
1FT...	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
5103–□AC71	19.0	12.0	2000	o	o	o	o	50.0	x	x	o	o	8.0
5103–□AF71	19.0	17.5	3000	o	o	o	o	50.0	x	x	o	o	2.5
5103–□AG71	19.0	23.0	4000	o	o	o	o	50.0	o	x	o	x	2.0
5104–□AA71	37.0	14.0	1200	o	o	o	o	50.0	x	x	x	x	11.5
5104–□AC71	37.0	22.5	2000	o	o	o	o	50.0	o	o	x	o	4.0
5106–□AA71	45.0	17.0	1200	o	o	o	o	50.0	x	x	o	x	8.0
5108–□AA71	55.0	20.5	1200	o	o	o	o	50.0	x	o	o	x	6.5
5132–□AA71	60.0	22.5	1200	o	o	o	o	50.0	o	x	o	x	7.5

VS

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-7 **Adaptation table for feed module 40/80 A**

Servomotor				**Current limit** 1)					**Current controller gain**				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
4101–□SK71	20.0	33.0	6000	o	o	o	o	80.0	o	x	o	o	2.0
4101–□SN71	20.0	39.0	8000	o	o	o	o	80.0	x	o	o	o	1.0
4102–□SG71	33.0	35.0	4000	o	o	o	o	80.0	o	o	x	o	4.0
5046–□AK71	2.6	4.7	6000	o	x	o	x	24.0	x	x	o	o	2.5
5062–□AK71	2.2	3.9	6000	o	x	x	x	19.2	o	o	x	o	4.0
5064–□AF71	4.5	4.1	3000	o	x	x	x	19.2	x	x	o	x	8.0
5064–□AG71	4.5	5.5	4000	o	o	o	x	28.8	x	o	o	x	6.5
5064–□AK71	4.5	8.0	6000	o	o	x	o	40.0	o	o	x	o	4.0
5066–□AC71	6.5	3.9	2000	o	x	x	x	19.2	x	x	x	x	11.5
5066–□AF71	6.5	6.0	3000	o	o	o	x	28.2	x	x	o	x	8.0
5066–□AG71	6.5	7.9	4000	o	o	x	o	40.0	o	o	o	x	6.0
5066–□AK71	6.5	11.6	6000	o	x	o	o	54.4	x	o	x	o	4.5
5070–□AK71	3.0	5.3	6000	o	x	o	x	24.0	x	o	o	x	6.5
5071–□AF71	4.5	4.3	3000	o	o	x	x	20.8	o	o	x	x	9.5
5071–□AG71	4.5	5.2	4000	x	o	o	x	27.2	x	x	o	x	8.0
5071–□AK71	4.5	7.9	6000	o	o	x	o	40.0	x	o	x	o	4.5
5072–□AC71	10.0	6.1	2000	o	o	o	x	28.8	x	x	x	x	11.5
5072–□AF71	10.0	9.1	3000	o	o	x	o	40.0	o	o	x	x	9.5
5072–□AG71	10.0	12.0	4000	o	x	o	o	54.4	o	x	o	x	7.5
5072–□AK71	10.0	17.5	6000	o	o	o	o	80.0	o	x	x	o	5.5
5073–□AC71	7.0	4.3	2000	o	o	x	x	20.8	x	x	x	x	11.5
5073–□AF71	7.0	6.4	3000	x	x	x	o	31.2	x	x	o	x	8.0
5073–□AG71	7.0	8.1	4000	o	o	x	o	40.0	x	o	o	x	6.5
5073–□AK71	7.0	12.5	6000	o	x	o	o	54.4	x	x	o	o	2.5
5074–□AC71	14.0	8.5	2000	o	o	x	o	40.0	x	x	x	x	11.5
5074–□AF71	14.0	13.0	3000	o	x	o	o	54.4	o	x	o	x	7.5
5074–□AG71	14.0	16.5	4000	o	o	o	o	80.0	x	o	o	x	6.5
5074–□AK71	14.0	25.0	6000	o	o	o	o	80.0	x	x	o	o	2.5
5074–□SG71	16.0	19.0	4000	o	o	o	o	80.0	o	o	o	x	6.0
5074–□SK71	16.0	28.0	6000	o	o	o	o	80.0	x	x	o	o	2.5
5076–□AC71	18.0	11.5	2000	x	x	o	o	48.8	o	x	x	x	11.0
5076–□AF71	18.0	16.5	3000	x	o	o	o	68.0	x	o	o	x	6.5
5076–□AG71	18.0	21.5	4000	o	o	o	o	80.0	x	o	x	o	4.5
5076–□AK71	18.0	32.0	6000	o	o	o	o	80.0	o	x	o	o	2.0
5076–□SG71	20.5	24.5	4000	o	o	o	o	80.0	o	o	x	o	4.0
5100–□AC71	10.0	6.2	2000	x	x	x	o	31.2	x	x	x	x	11.5
5100–□AF71	10.0	9.2	3000	o	o	x	o	40.0	x	o	o	x	6.5
5100–□AG71	10.0	12.5	4000	o	x	o	o	54.4	o	x	x	o	5.5
5100–□AK71	10.0	18.0	6000	o	o	o	o	80.0	o	o	x	o	4.0
5101–□AC71	15.0	9.4	2000	o	o	x	o	40.0	x	x	o	x	8.0
5101–□AF71	15.0	14.5	3000	o	x	o	o	54.4	o	x	x	o	5.5
5101–□AG71	15.0	17.5	4000	o	o	o	o	80.0	x	o	x	o	4.5
5101–□AK71	15.0	26.5	6000	o	o	o	o	80.0	o	x	o	o	2.0

1) The specified value is the maximum permisisble current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-7 **Adaptation table for feed module 40/80 A**

Servomotor				**Current limit** [1]					**Current controller gain**				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
5102–□AA71	27.0	9.9	1200	o	o	x	o	40.0	x	x	x	x	11.5
5102–□AC71	27.0	16.5	2000	o	o	o	o	80.0	o	o	x	x	9.5
5102–□AF71	27.0	25.0	3000	o	o	o	o	80.0	o	o	x	o	4.0
5102–□AG71	27.0	31.5	4000	o	o	o	o	80.0	x	x	o	o	2.5
5103–□AC71	19.0	12.0	2000	o	x	o	o	54.4	x	x	o	x	8.0
5103–□AF71	19.0	17.5	3000	o	o	o	o	80.0	o	o	o	x	6.0
5103–□AG71	19.0	23.0	4000	o	o	o	o	80.0	x	x	o	o	2.5
5104–□AA71	37.0	14.0	1200	o	x	o	o	54.4	x	x	x	x	11.5
5104–□AC71	37.0	22.5	2000	o	o	o	o	80.0	x	o	o	x	6.5
5104–□AF71	37.0	34.0	3000	o	o	o	o	80.0	x	x	o	o	2.5
5106–□AA71	45.0	17.0	1200	o	o	o	o	80.0	x	x	x	x	11.5
5106–□AC71	45.0	26.8	2000	o	o	o	o	80.0	o	x	x	o	5.5
5108–□AA71	55.0	20.5	1200	o	o	o	o	80.0	x	x	x	x	11.5
5108–□AC71	55.0	32.5	2000	o	o	o	o	80.0	x	o	x	o	4.5
5132–□AA71	60.0	22.5	1200	o	o	o	o	80.0	x	x	x	x	11.5
5132–□AC71	60.0	35.5	2000	o	o	o	o	80.0	x	o	x	o	4.5
5132–□SA71	70.0	26.0	1200	o	o	o	o	80.0	x	x	x	x	11.5
5134–□AA71	75.0	28.0	1200	o	o	o	o	80.0	o	o	x	x	9.5
5134–□SA71	90.0	34.0	1200	o	o	o	o	80.0	o	o	x	x	9.5
5136–□AA71	85.0	31.5	1200	o	o	o	o	80.0	o	x	o	x	7.5
5138–□AA71	105.0	39.0	1200	o	o	o	o	80.0	o	o	o	x	6.0

1) The specified value is the maximum permisisble current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-8 **Adaptation table for feed module 80/160 A**

Servomotor				**Current limit** 1)					**Current controller gain**				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
4101–□SK71	20.0	33.0	6000	o	o	o	o	160.0	x	o	x	o	4.5
4101–□SN71	20.0	39.0	8000	o	o	o	o	160.0	x	x	o	o	2.5
4102–□SG71	33.0	35.0	4000	o	o	o	o	160.0	x	x	o	x	8.0
4102–□SK71	33.0	47.0	6000	o	o	o	o	160.0	x	o	x	o	4.5
4104–□SG71	45.0	46.0	4000	o	o	o	o	160.0	o	x	x	o	5.5
4104–□SK71	45.0	60.0	6000	o	o	o	o	160.0	x	x	o	o	2.5
4106–□SG71	59.0	56.0	4000	o	o	o	o	160.0	x	o	x	o	4.5
5064–□AK71	4.5	8.0	6000	o	o	x	x	41.6	x	o	x	o	4.5
5066–□AG71	6.5	7.9	4000	o	x	x	x	38.4	o	o	o	x	6.0
5066–□AK71	6.5	11.6	6000	o	o	o	x	57.6	x	o	x	o	4.5
5071–□AK71	4.5	7.9	6000	o	x	x	x	38.4	x	o	x	o	4.5
5072–□AF71	10.0	9.1	3000	o	o	x	x	41.6	o	o	x	x	9.5
5072–□AG71	10.0	12.0	4000	o	o	o	x	57.6	x	x	o	x	8.0
5072–□AK71	10.0	17.5	6000	o	o	x	o	80.0	o	x	x	o	5.5
5073–□AG71	7.0	8.1	4000	o	o	x	x	41.6	x	o	o	x	6.5
5073–□AK71	7.0	12.5	6000	o	x	x	o	65.5	o	o	x	o	4.0
5074–□AC71	14.0	8.5	2000	o	o	x	x	41.6	x	x	x	x	11.5
5074–□AF71	14.0	13.0	3000	o	x	x	o	65.6	x	x	o	x	8.0
5074–□AG71	14.0	16.5	4000	o	o	x	o	80.0	x	o	o	x	6.5
5074–□AK71	14.0	25.0	6000	x	x	o	o	97.6	x	x	o	o	2.5
5074–□SG71	16.0	19.0	4000	o	o	x	o	80.0	o	x	x	o	5.5
5074–□SK71	16.0	28.0	6000	x	x	o	o	97.0	x	x	o	o	2.5
5076–□AC71	18.0	11.5	2000	o	x	o	x	48.0	o	o	x	x	9.5
5076–□AF71	18.0	16.5	3000	x	o	x	o	73.6	o	x	o	x	7.5
5076–□AG71	18.0	21.5	4000	o	x	o	o	108.8	x	o	o	x	6.5
5076–□AK71	18.0	32.0	6000	o	o	o	o	160.0	o	o	x	o	4.0
5076–□SG71	20.5	24.5	4000	o	x	o	o	108.8	o	x	x	o	5.5
5076–□SK71	20.5	36.0	6000	o	o	o	o	160.0	o	o	x	o	4.0
5100–□AF71	10.0	9.2	3000	x	x	o	x	46.4	x	x	o	x	8.0
5100–□AG71	10.0	12.5	4000	x	x	x	o	62.4	x	o	o	x	6.5
5100–□AK71	10.0	18.0	6000	o	o	x	o	80.0	o	o	x	o	4.0
5101–□AC71	15.0	9.4	2000	o	o	x	x	41.6	o	o	x	x	9.5
5101–□AF71	15.0	14.5	3000	o	x	x	o	65.6	x	o	o	x	6.5
5101–□AG71	15.0	17.5	4000	o	o	x	o	80.0	x	o	x	o	4.5
5101–□AK71	15.0	26.5	6000	x	o	o	o	136.0	o	o	x	o	4.0
5102–□AA71	27.0	9.9	1200	x	x	o	x	46.4	x	x	x	x	11.5
5102–□AC71	27.0	16.5	2000	o	o	x	o	80.0	o	o	x	x	9.5
5102–□AF71	27.0	25.0	3000	o	x	o	o	108.8	o	x	x	o	5.5
5102–□AG71	27.0	31.5	4000	o	o	o	o	160.0	o	x	x	o	5.5
5102–□SF71	34.0	31.5	3000	o	x	o	o	108.8	x	o	x	o	4.5
5102–□SG71	34.0	39.5	4000	o	o	o	o	160.0	x	o	x	o	4.5
5103–□AC71	19.0	12.0	2000	o	o	o	x	57.6	x	x	o	x	8.0
5103–□AF71	19.0	17.5	3000	o	o	x	o	80.0	o	o	o	x	6.0
5103–□AG71	19.0	23.0	4000	o	x	o	o	108.8	x	o	x	o	4.5

1) The specified value is the maximum permisisble current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

VS

Table 1-8 **Adaptation table for feed module 80/160 A**

Servomotor				**Current limit** [1]					**Current controller gain**				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp(I)
5104–□AA71	37.0	14.0	1200	x	x	x	o	62.4	x	x	x	x	11.5
5104–□AC71	37.0	22.5	2000	o	x	o	o	108.8	o	o	x	x	9.5
5104–□AF71	37.0	34.0	3000	o	o	o	o	160.0	x	o	o	x	6.5
5104–□SF71	48.0	44.0	3000	o	o	o	o	160.0	o	x	x	o	5.5
5106–□AA71	45.0	17.0	1200	o	o	x	o	80.0	x	x	x	x	11.5
5106–□AC71	45.0	26.8	2000	o	x	o	o	108.0	o	x	o	x	7.5
5106–□AF71	45.0	42.5	3000	o	o	o	o	160.0	x	o	x	o	4.5
5106–□SF71	57.0	54.0	3000	o	o	o	o	160.0	o	o	x	o	4.0
5108–□AA71	55.0	20.5	1200	o	o	x	o	80.0	x	x	x	x	11.5
5108–□AC71	55.0	32.5	2000	o	o	o	o	160.0	o	o	x	x	9.5
5108–□AF71	55.0	50.5	3000	o	o	o	o	160.0	o	o	x	o	4.0
5132–□AA71	60.0	22.5	1200	o	x	o	o	108.8	x	x	x	x	11.5
5132–□AC71	60.0	35.5	2000	o	o	o	o	160.0	x	x	o	x	8.0
5132–□AF71	60.0	47.5	3000	o	o	o	o	160.0	o	x	x	o	5.5
5132–□SA71	70.0	26.0	1200	o	x	o	o	108.8	x	x	x	x	11.5
5132–□SC71	70.0	41.0	2000	o	o	o	o	160.0	x	x	o	x	8.0
5132–□SF71	70.0	55.5	3000	o	o	o	o	160.0	x	x	x	o	5.5
5134–□AA71	75.0	28.0	1200	o	x	o	o	108.8	x	x	x	x	11.5
5134–□AC71	75.0	47.0	2000	o	o	o	o	160.0	x	o	o	o	6.5
5134–□SA71	90.0	34.0	1200	o	x	o	o	108.8	x	x	x	x	11.5
5134–□SC71	90.0	56.0	2000	o	o	o	o	160.0	x	o	o	x	6.5
5136–□AA71	85.0	31.5	1200	x	o	o	o	136.0	x	x	x	x	11.5
5136–□AC71	85.0	47.5	2000	o	o	o	o	160.0	x	o	o	x	6.5
5136–□SA71	110.0	41.0	1200	x	o	o	o	136.0	x	x	x	x	11.5
5136–□SC71	110.0	61.5	2000	o	o	o	o	160.0	x	o	o	o	6.5
5138–□AA71	105.0	39.0	1200	o	o	o	o	160.0	x	x	x	x	11.5
5138–□SA71	140.0	52.0	1200	o	o	o	o	160.0	x	x	x	x	11.5

1) The specified value is the maximum permisisble current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-9 **Adaptation table for feed module 100/200 A**

Servomotor				Current limit 1)					Current controller gain				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts				I_{max} [A]	Contacts				Kp(I)
				2	3	4	5		6	7	8	9	
4101–☐SK71	20.0	33.0	6000	o	x	o	o	136.0	x	x	o	o	2.5
4101–☐SN71	20.0	39.0	8000	x	o	o	o	170.0	x	x	o	o	2.0
4102–☐SG71	33.0	35.0	4000	x	o	o	o	170.0	o	o	x	x	9.5
4102–☐SK71	33.0	47.0	6000	o	o	o	o	200.0	o	x	x	o	5.5
4104–☐SG71	45.0	46.0	4000	o	o	o	o	200.0	x	o	o	x	6.5
4104–☐SK71	45.0	60.0	6000	o	o	o	o	200.0	x	x	o	o	2.5
4106–☐SG71	59.0	56.0	4000	o	o	o	o	200.0	o	x	x	o	5.5
5066–☐AK71	6.5	11.6	6000	o	x	o	x	60.0	x	o	x	o	4.5
5072–☐AG71	10.0	12.0	4000	o	x	o	x	60.0	x	x	o	x	8.0
5072–☐AK71	10.0	17.5	6000	o	x	x	o	82.0	o	x	x	o	5.5
5073–☐AK71	7.0	12.5	6000	o	x	o	x	60.0	o	o	x	o	4.0
5074–☐AF71	14.0	13.0	3000	o	x	o	x	60.0	x	x	o	x	8.0
5074–☐AG71	14.0	16.5	4000	o	x	x	o	82.0	x	o	o	x	6.5
5074–☐AK71	14.0	25.0	6000	o	o	x	o	100.0	x	x	o	o	2.5
5074–☐SG71	16.0	19.0	4000	o	x	x	o	82.0	o	o	o	x	6.0
5074–☐SK71	16.0	28.0	6000	o	o	x	o	100.0	x	x	o	o	2.5
5076–☐AC71	18.0	11.5	2000	o	o	x	x	52.0	x	x	x	x	11.5
5076–☐AF71	18.0	16.5	3000	x	x	x	o	78.0	x	x	o	x	8.0
5076–☐AG71	18.0	21.5	4000	o	o	x	o	100.0	o	x	x	o	5.5
5076–☐AK71	18.0	32.0	6000	o	x	o	o	136.0	x	x	o	o	2.5
5076–☐SG71	20.5	24.5	4000	o	o	x	o	100.0	x	o	x	o	4.5
5076–☐SK71	20.5	36.0	6000	o	x	o	o	136.0	x	x	o	o	2.5
5100–☐AF71	10.0	9.2	3000	x	x	x	x	46.0	x	x	o	x	8.0
5100–☐AG71	10.0	12.5	4000	o	x	o	x	60.0	o	o	o	x	6.0
5100–☐AK71	10.0	18.0	6000	x	o	x	o	92.0	x	o	x	o	4.5
5101–☐AC71	15.0	9.4	2000	x	x	x	x	46.0	o	o	x	x	9.5
5101–☐AF71	15.0	14.5	3000	o	x	o	x	60.0	o	o	o	x	6.0
5101–☐AG71	15.0	17.5	4000	x	o	x	o	92.0	o	o	o	x	6.0
5101–☐AK71	15.0	26.5	6000	o	x	o	o	136.0	o	o	x	o	4.0
5102–☐AA71	27.0	9.9	1200	x	x	x	x	46.0	x	x	x	x	11.5
5102–☐AC71	27.0	16.5	2000	x	x	x	o	78.0	o	o	x	x	9.5
5102–☐AF71	27.0	25.0	3000	o	o	x	o	100.0	x	o	x	o	4.5
5102–☐AG71	27.0	31.5	4000	o	x	o	o	136.0	x	o	x	o	4.5
5102–☐SF71	34.0	31.5	3000	x	x	o	o	122.0	o	x	x	o	5.5
5102–☐SG71	34.0	39.5	4000	o	x	o	o	136.0	o	o	x	o	4.0
5103–☐AC71	19.0	12.0	2000	o	x	o	x	60.0	o	o	x	x	9.5
5103–☐AF71	19.0	17.5	3000	x	o	x	o	92.0	x	o	o	x	6.5
5103–☐AG71	19.0	23.0	4000	x	x	o	o	122.0	o	x	x	o	5.5
5104–☐AA71	37.0	14.0	1200	o	x	o	x	60.0	x	x	x	x	11.5
5104–☐AC71	37.0	22.5	2000	o	o	x	o	100.0	x	x	o	x	8.0
5104–☐AF71	37.0	34.0	3000	o	x	o	o	136.0	o	x	x	o	5.5
5104–☐SF71	48.0	44.0	3000	o	x	o	o	136.0	x	o	x	o	4.5
5106–☐AA71	45.0	17.0	1200	x	x	x	o	78.0	x	x	x	x	11.5
5106–☐AC71	45.0	26.8	2000	x	x	o	o	122.0	x	x	o	x	8.0
5106–☐AF71	45.0	42.5	3000	o	o	o	o	200.0	o	x	x	o	5.5
5106–☐SF71	57.0	54.0	3000	o	o	o	o	200.0	x	o	x	o	4.5

1) The specified value is the maximum permisisble current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

Table 1-9 **Adaptation table for feed module 100/200 A**

Servomotor				Current limit 1)					Current controller gain				
1FT	M_o [Nm]	I_o [A]	n_{rated} [RPM]	Contacts 2	3	4	5	I_{max} [A]	Contacts 6	7	8	9	Kp(I)
5108–☐AA71	55.0	20.5	1200	x	o	x	o	92.0	x	x	x	x	11.5
5108–☐AC71	55.0	32.5	2000	o	x	o	o	136.0	x	x	o	x	8.0
5108–☐AF71	55.0	50.5	3000	o	o	o	o	200.0	x	o	x	o	4.5
5132–☐AA71	60.0	22.5	1200	o	o	x	o	100.0	x	x	x	x	11.5
5132–☐AC71	60.0	35.5	2000	x	o	o	o	170.0	o	o	x	x	9.5
5132–☐AF71	60.0	47.5	3000	o	o	o	o	200.0	x	o	o	x	6.5
5132–☐SA71	70.0	26.0	1200	o	o	x	o	100.0	x	x	x	x	11.5
5132–☐SC71	70.0	41.0	2000	x	o	o	o	170.0	o	o	x	x	9.5
5132–☐SF71	70.0	55.5	3000	o	o	o	o	200.0	x	o	o	x	6.5
5134–☐AA71	75.0	28.0	1200	x	x	o	o	122.0	x	x	x	x	11.5
5134–☐AC71	75.0	47.0	2000	o	o	o	o	200.0	x	x	o	x	8.0
5134–☐SA71	90.0	34.0	1200	x	x	o	o	122.0	x	x	x	x	11.5
5134–☐SC71	90.0	56.0	2000	o	o	o	o	200.0	x	x	o	x	8.0
5136–☐AA71	85.0	31.5	1200	o	x	o	o	136.0	x	x	x	x	11.5
5136–☐AC71	85.0	47.5	2000	o	o	o	o	200.0	x	x	o	x	8.0
5136–☐SA71	110.0	41.0	1200	o	x	o	o	136.0	x	x	x	x	11.5
5136–☐SC71	110.0	61.5	2000	o	o	o	o	200.0	x	x	o	x	8.0
5138–☐AA71	105.0	39.0	1200	x	o	o	o	170.0	x	x	x	x	11.5
5138–☐SA71	140.0	52.0	1200	x	o	o	o	170.0	x	x	x	x	11.5

VS

1) The specified value is the maximum permissible current of the particular power module – motor combination. It may be necessary to reduce the specified value depending on the driven mechanical system.

■

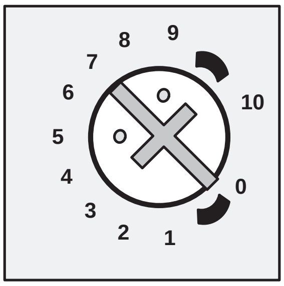
Speed controller optimization 2

The additional smoothing functions in the speed controller loop (damping mechanical resonance effects) are described in Section 3. Proceed as follows when optimizing the speed controller:

4. Tachometer adjustment
5. Gain Kp
6. Integral action time T_N
7. Adaptation T_N (if required)
8. I–component limiting (if required)
9. Drift compensation (offset)

The unit must be powered–up to optimize the speed controller Sections 2.1, 2.2, 2.3 and 2.8. Therefore please refer to Section 7 ”Powering–up”.

The potentiometer scale divisions (in the setting tables) are defined as follows:



The setting shown in the diagram corresponds to 7 scale divisions.

2.1 Tachometer adjustment

For motors with tachometer voltages ≤ 16.5 V, it is necessary to also proceed according to Section 1.1.

Potentiometer	Setting range
T	$0.7\ n_{rated} \leq 2.2\ n_{act\ N} \leq 2.2\ n_{rated}$

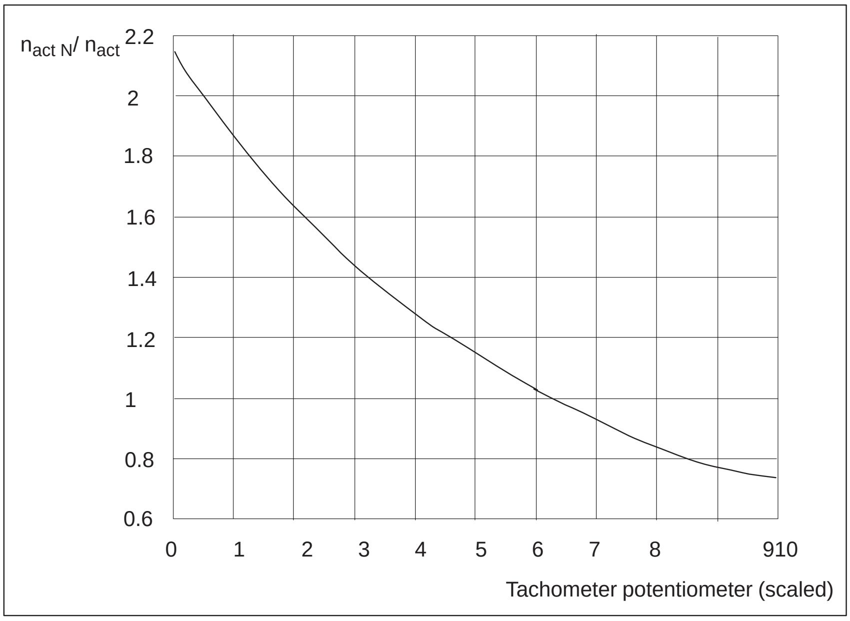


Fig. 2-1 Tachometer adjustment

Extending the setting range using R3 and R10 (only for the user–friendly interface).

Function	Component	Mounted
$n_{act\ N} > 0.7\ n_{rated}$	Increase R3	0 Ω (as supplied)
$n_{act\ N} < 2.2\ n_{rated}$	Mount R10	Open (as supplied)

2.2 Setting the proportional gain Kp without adaptation

The proportional gain Kp of the speed controller can be set using potentiometer Kp. The range can be extended if required using the fixed resistor R50 (only for the user–friendly interface ; R50 = 68 kΩ (as supplied)).
The gain, set using the Kp potentiometer is additionally influenced by the setting of potentiometer T_N.

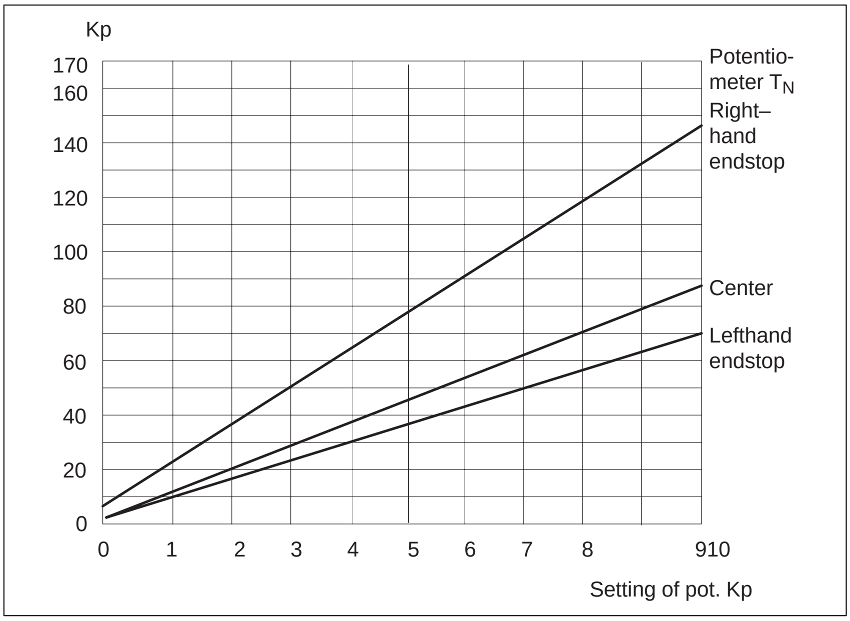


Fig. 2-2 Proportional gain Kp as a function of the Kp and T_N potentiometers

2.3 Setting the integral action time T_N without adaptation

The speed controller integral action time is set using potentiometer T_N; the range can be, if required, extended using C2 (only for the user–friendly interface).

Fig. 2-3 Integral action time T_N as a function of potentiometer T_N

2.4 Integral action time with adaptation (if required)

Adaptation is activated and preset via R34 (only the user–friendly interface), and S3.5 (S6.5 for a 2nd axis) for the standard interface.

R34 = open R34 = mounted	Adaptation inactive (as supplied) Adaptation operates acc. to the following diagrams

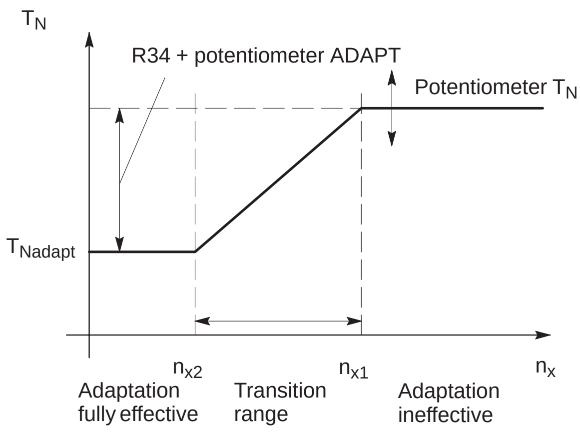


Fig. 2-4 Integral action time dependency

$n_x = |n_{setp.} + n_{act.}|$

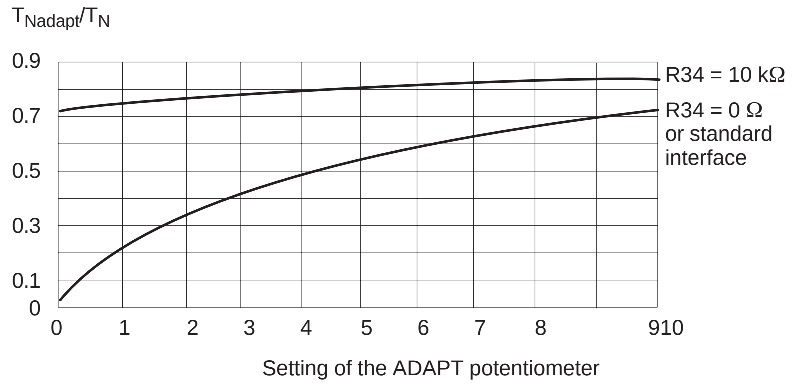


Fig. 2-5 Dependency of adaptation T_N

2.5 Proportional gain with adaptation (only user–friendly interface)

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Offsets can occur in the transition range.

Adaptation is activated and preset using R38 (if required):

R38 = open R38 = mounted	Adaptation inactive (as supplied) Adaptation operates acc. to the following diagrams

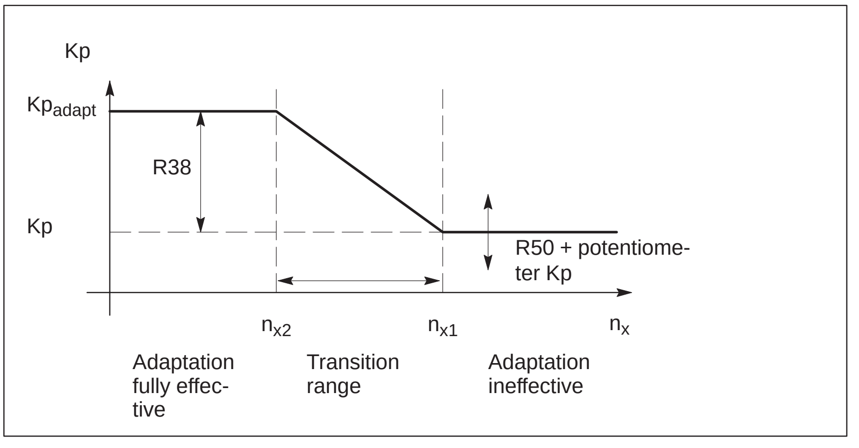


Fig. 2-6 Proportional gain Kp as a function of the speed

$n_x = |n_{setp.} + n_{act.}|$

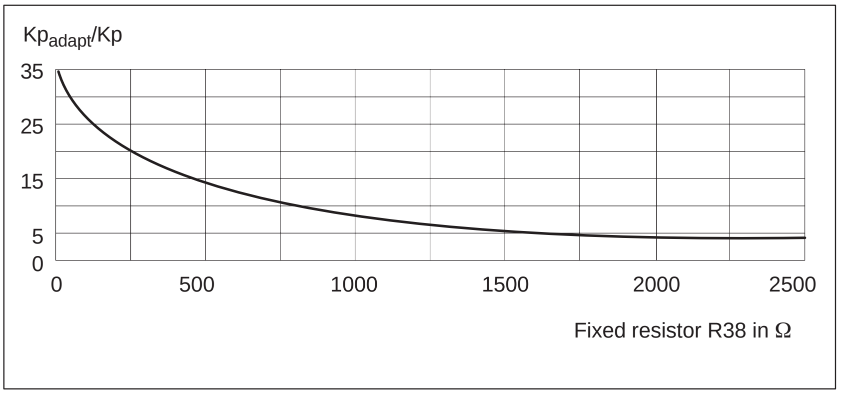


Fig. 2-7 Adaptation Kp as a function of R38 in the ”adaptation fully effective” range

2.6 Setting the adaptation range (generally not required)

The adaptation range can be set using the following resistors:

R40 User–friendly interface
R543 Standard interface 1st axis (from Order No. 6SN1118–0AD11–0AA1)
R544 Standard interface 2nd axis (from Order No. 6SN1118–0AE11–0AA1)

R☐ = open — — — — R☐ = inserted ————	Maximum adaptation range (as supplied) Adapt. reduced acc. to the following diagram

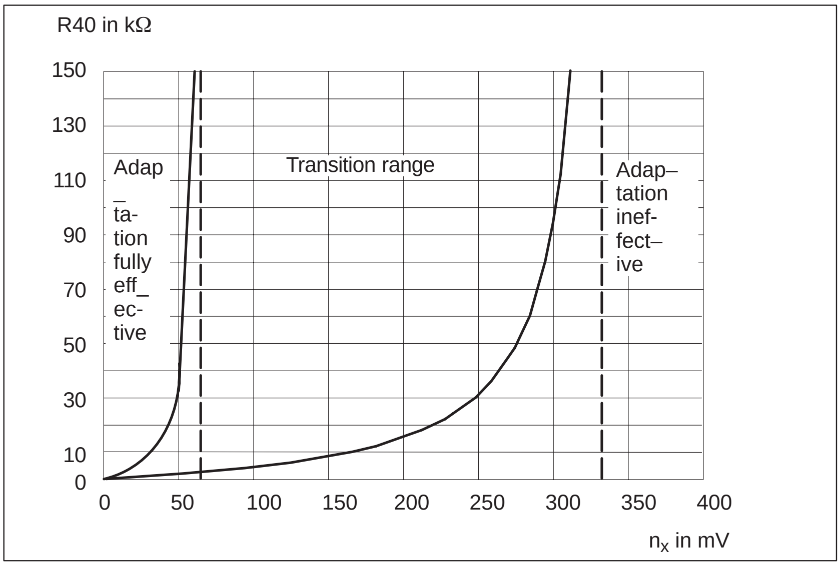


Fig. 2-8 Adaptation range

$n_x = |n_{setp.1} + n_{act.}|$

2.7 I component limiting of the speed controller

R52 User–friendly interface
R547 Standard interface 1st axis (from Order No. 6SN1118–0AD11–0AA1)
R550 Standard interface 2nd axis (from Order No. 6SN1118–0AE11–0AA1)

R52 = open R52 = 0 Ω	I component fully effective (as supplied) I component ineffective

R52 can be between 100 kΩ and 2 MΩ to limit the speed controller I component, e. g. for slipstick effects.

2.8 Drift offset

Adjusted using potentiometer for $n_{set} = 0$ (terminals 56 and 14 connected)

Potentiometer drift	Control range ±30 mV

■

3 Start–up, supplementary functions

3.1 Setting elements with standard interface

VS

Setting elements, switch S2 and S3 or S5 and S6 for the 2nd axis

S2/S5 contacts 10 x DIL	OFF	ON
1	Motor **clockwise** direction of rotation for a positive speed setpoint (motor shaft, drive end) at terminal 56/14	Motor **counter–clockwise** direction of rotation for a positive speed setpoint (motor shaft, drive end)1) at terminal 56/14
2...5	Curr. normal. (I_{max}=100 %)1)	Curr. normal. (I_{max} = 23 %)
6...9	Current controller gain (0.5)1)	Current controller gain (11.5)
10	Speed–controlled operation1)	Current–controlled operation

S3/S6 contacts 8 x DIL	Function	OFF	ON
1	Speed setpoint smoothing	No smoothing1)	With τ = 2.2 ms
2	Speed actual value smoothing	No smoothing1)	With τ = 280 μs
3	Speed controller smoothing	No smoothing1)	With τ = 370 μs
4	Current setpoint smoothing	No smoothing1)	With τ = 110 μs
5	Speed contr. adaptation	OFF1)	ON
6	Ready/fault2)	Ready to run signal1)	Fault signal
7	Master/slave3)4)	Master1)	Slave4)
8	Current–controlled operation	With I component	Without I component1)

1) As supplied
2) Acts on the BB relay of the NE/monitoring module. If the user–friendly and standard interface are used together, or just the standard interface alone, then the BB relay on the NE module drops–out if there is no enable signal or a fault is present.
3) Function only for 2–axis version
4) The slave axis must be operated in the current–controlled mode with enabled I component.

The following supplementary functions can be set by mounting wired components onto the basic board. (from Order No. 6SN1118–0AD11–0AA**1** (1 axis) and from Order No. 6SN1118–0AE11–0AA**1** (2 axis) .

Function	BKZ axis 1	BKZ axis 2	Value range
Smoothing, speed controller	C231	C235	0 ... 100nF
Smoothing n_{set}	C232	C236	0 ... 2.2 μF
Smoothing n_{act}	C233	C237	0 ... 100nF
Smoothing n_{set}	C234	C238	0 ... 100nF
Timer ”speed controller at its endstop”	C239	C240	0 ... 2.2 μF
Tachometer adaptation	539R, 540R, 541R	R536, R537. R538	0 ... ∞ kΩ, 0.1%, 25ppm/k
Clock frequency PBM	R542	R542	62 kΩ ... ∞
Adaptation range	R543	R544	0 ... ∞ kΩ
Speed setpoint adaptation	R545	R546	0 ... ∞ kΩ
Limiting, speed controller I component	R547	R550	~ 100 kΩ ... 2 MΩ
Electronic weight equalization, pos./neg.	R548/R549	R551/R552	20 kΩ ... ∞
Response threshold I^2t monitoring	R553	R554	0 ... ∞ kΩ

Axial metal film resistors, type of construction 0204 (RM 7.62 mm) and radial MKT capacitors (RM 5.08 mm) must be located at the positions provided. When adapting the tachometer, it should be observed that the resistors have a relative accuracy of 0.1% to one another and a Tk of < 25 ppm/k.

Note The board could be damaged if the incorrect material is used

Important Only suitably qualified personnel may carry–out soldering work on the board (maintaining the ESD Guidelines).

3.1.1 Dimensioning the setting elements (standard interface)

a) Smoothing functions

Speed controller: T=C231(C235)•78 kΩ

n_{set}: T=C232(C236)•10 kΩ

n_{act}: T=C233(C236)•~ 10 kΩ (dependent on the tachometer potentiometer setting)

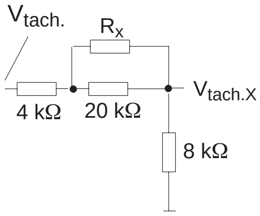
I_{set}: T=C234(C238)•5 kΩ

b) timer, ”speed controller at its endstop”

The monitoring time is 230 ms as standard, and can be increased, when required, by mounting C239 (C240). The following simple relationship is valid:

$$T_{Zst}= \left(+1.15 \, \frac{C239\ (C240)}{\mu F} \right) \bullet 200\ \text{ms}$$

c) Tachometer adaptation
The following equivalent circuit diagram is valid for the individual tachometer voltages:



The tachometer voltage V_{tach} is normally 40 V at rated speed, which results in a voltage$_{tachoX}$ of 10 V. For a rated speed which significantly deviates from the rated motor speed, it is possible to re–dimension corresponding to this criterium.
The following formula is valid:

$$R_x = \frac{\left[5 \cdot k\Omega \bullet \left(V_{tach.} / V_{tach.X}\right) - 7.5 \cdot k\Omega\right]}{-1\ \frac{1}{4} \bullet \left(V_{tach.} / V_{tach.X}\right)}$$

d) clock frequency PBM
If noise problems occur (the motor makes a whistling sound), then the PWM inverter clock frequency can be changed for both axes together.(Fig. 3–1)
In this case, it must be observed that the available current (I_n, I_{max}) is reduced when the clock frequency is increased (refer to Pj, Section 4.1).

The I^2t limiting is set in the factory to a pulse frequency of 3.3 kHz and a maximum ambient temperature of 40°C. If these values are exceeded (pulse frequency and/or ambient temperature), the response threshold must be adapted (refer to Fig. 3-2).

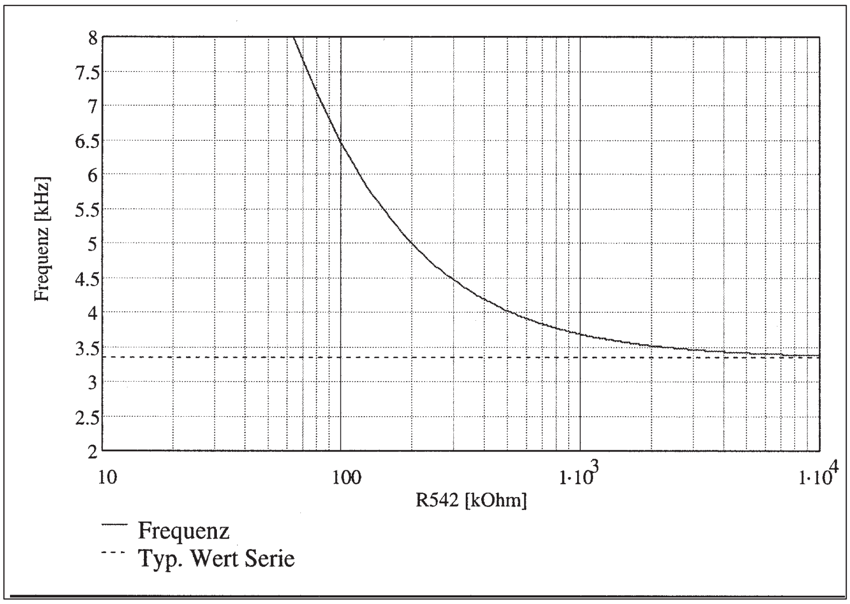
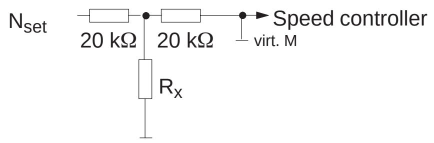


Fig. 3-1

e) Speed setpoint adaptation
If the adjustment range of the tachometer potentiometer is not sufficient (for lower speed range), then the speed setpoint can be adapted via a setpoint voltage divider circuit. The following circuit diagram is valid:



The following relationship is obtained for R545 (R546):

$$R_x = 10 \cdot k\Omega \bullet \frac{n_{required}}{n_{rated} - n_{required}}$$

f) Limiting, speed controller I component (refer to2.7)
The maximum speed controller I component can be limited by mounting R547 (R550).

g) Electronic weight equalization
The value to be set for the electronic weight equalization is obtained from the current setpoint I_{setGwa} which can be measured at the test socket T for the axis to be enabled, at standstill (N_{set}=0).

$R = \frac{10 \cdot V}{I_{SetGwa}} \bullet 10 \cdot k\Omega$ Caution: $I_{SetGwa} \leq 5V \Rightarrow R \geq 20\ k\Omega$!

After mounting, the value at test socket T must be able to be measured with the same polarity, with the axis inhibited.

h) Response threshold I^2t-monitoring
The I^2t monitoring limits the current setpoint to a thermally permissible value. The response threshold is 55% of the power module peak current, and, when required, can be reduced corresponding to the following characteristic, by mounting R553 (R554):

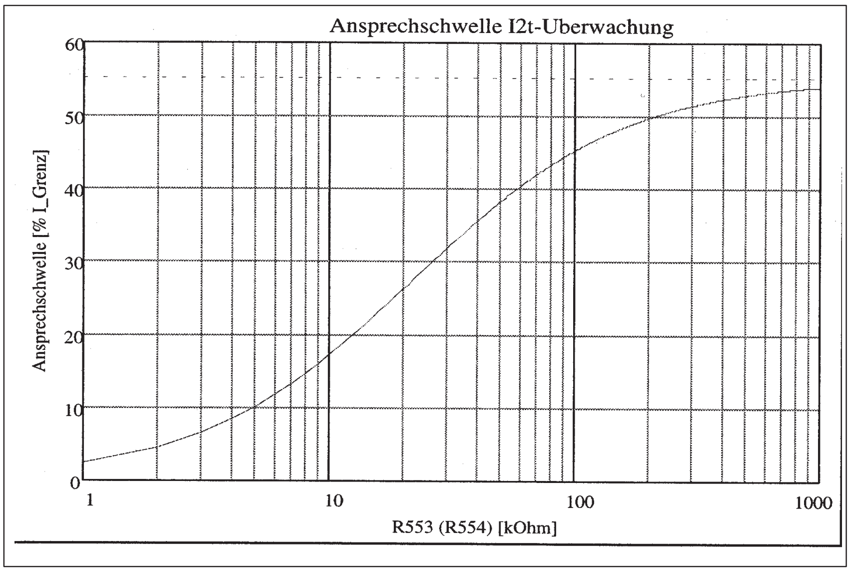


Fig. 3-2

VS

3.2 Setting elements with user–friendly interface

Setting elements on the parameter board; terminal = H → jumpered with terminal 9, terminal = L → open.

Function	Component(s)	Effect
Ready/fault Relay terminal 672/673/674	R33 = 0 Ω (as supplied) R33 = open	Ready signal fault signal
Speed/current controlled (permanently selected via switch)	S2: 10 = OFF (as supplied) S2: 10 = ON	Closed–loop speed control closed–loop current control
Speed/current controlled (selected via terminal)	R14 = 0 Ω1); terminal 22 = L R14 = 0 Ω; terminal 22 = H	Closed–loop speed control closed–loop current control
Supplementary setpoint 1 via terminal 22 = H	R16 (as supplied = open)2) R17 (as supplied = open) R18 (as supplied = open)	Voltage divider at 10 V Voltage divider at –10 V Voltage divider at the ref. point
Supplementary setpoint 2 via terminal 23 = H	R21 (as supplied = open)2) R19 (as supplied = open) R22 (as supplied = open)	Voltage divider at 10 V Voltage divider at –10 V Voltage divider at the ref. point
Current–controlled operation with/ without I component	R1 = 0 Ω (as supplied) R1 = open	I component inhibited P I component active PI
Controller– and pulse inhibit via terminal 65	R13 = open (as supplied) R13 = 0 Ω	Delayed Instantaneous
Master-/slave operation: Master operation	R42 + R44 = 0 Ω, S2: 10 = OFF	Master operation, terminal 258 = output
Slave operation	R44 = 0 Ω, R1 + R42 = open, S2: 10 = ON	Slave operation, terminal 258 = input
Timer, speed controller at its endstop	R54 = 360 kΩ (as supplied) R54 as selected	t = 230 ms $R54\,[k\Omega] = \frac{t\,[ms]}{0.56} - 47$
Monitoring, n controller at n stop	R32 = 0 Ω (as supplied) R32 = open	Monitoring active Monitoring inactive
Direction of rotation reversal (direction of rotation for a positive setpoint at terminal 56/14)	S2: 1 = ON (as supplied) S2: 1 = OFF	Motor ccw, drive shaft end Motor cw, drive shaft end
Speed controller smoothing	C3 (as supplied = open)	$\tau = C3 \cdot 68\,k\Omega$
Speed setpoint smoothing	C4 (as supplied = open)	$\tau = C4 \cdot 10\,k\Omega$
Speed actual value smoothing	C5 (as supplied = open)	$\tau = C5 \cdot 5\,k\Omega$
Current setpoint smoothing	C6 (as supplied = open)	$\tau = C6 \cdot 1\,k\Omega$
Speed setpoint adaptation2) (only terminal 56/14)	R5 = 20 kΩ (as supplied)	$\lvert 100\% \cdot n_{ACTN} \rvert$=11 ... 5V
Current setpoint adaptation	R42 (as supplied = 0 Ω)2)	$I_{set} < 10$ V
Travel to endstop (set using R12)	R12 according to Fig. 3–3 Condition: Terminal 96 connected to terminal 44	Limiting according to Fig. 3–3 Speed controller monitoring inactive

1) As supplied: R14 = open

2) $R = \frac{N_{set}}{10V} \bullet \left(\frac{N_{rated}}{N_{max}} - 0.5 \right) \bullet 40 \cdot k\Omega$

Function	Component(s)	Effect
Travel to end stop (variable via terminal 96)	R12 = open (as supplied) voltage at terminal 96 according to Fig. 3-4	Limiting acc. to Fig. 3-4, n–contr. monitoring inactive
Setting–up operation (central, via terminal 112 on the NE module)	R12 according to Fig.KEIN MERKER terminal 112 = open (when supplied, terminal 112 to terminal 9)	Limiting according to Fig.KEIN MERKER, Speed controller monitoring inactive
Current reduced after timer, n controller at end stop, has expired	R2 according to Fig. 3-5 R32 = open	Reduction acc. to Fig. 3-5 n–contr. monit. disabled
Current reduced after the I^2t timer has expired	R2 = open (as supplied) R32 = open	S1–duty = 1.1 I_{rated}
Response threshold I^2t	R9 = 30 kΩ (as supplied) R9 according to Fig. 3-6	S1–duty = 1.1 I_{rated} Limiting acc. to Fig. 3-6
Electronic weight equalization[1)]	R46 + R48 = open (as supplied) R46 for neg. I set at socket T R48 for pos. I set at socket T	no weight equalization Suppl. I set acc. to Fig. 3-7 Suppl. I set acc. to Fig. 3-7
Tachometer adaptation[2)]	R6, R7, R8 tolerance ≤ 0.1%	$R_x = \dfrac{\left[5 \cdot k\Omega \bullet \left(V_{tach.} / V_{tach.X}\right) - 7.5 \cdot k\Omega\right]}{-1\ 1/4 \bullet \left(V_{tach.} / V_{tach.X}\right)}$
Clock frequency	R542	Refer to Fig.3-1

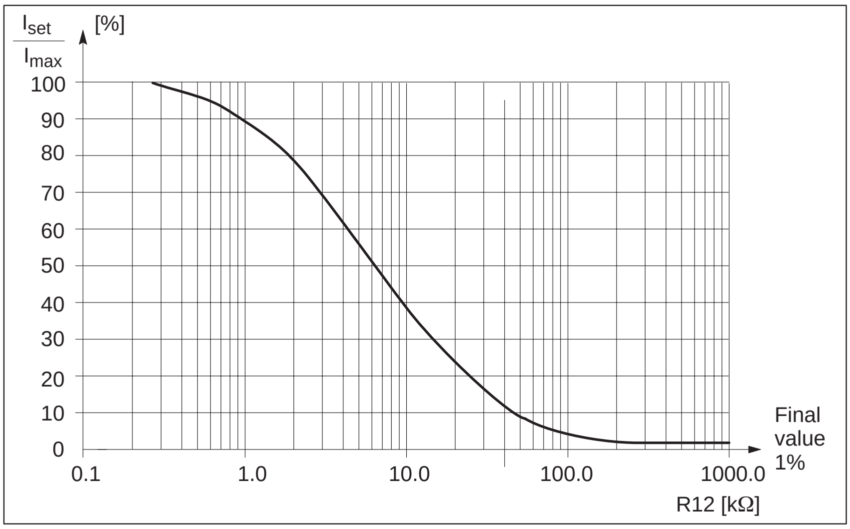


Fig. 3-3 Current setpoint limiting as a function R12, |30 V| ≥ terminal 96 ≥ |12 V|

1)

Warning

For version 4620087701.00 of the control board, for weight compensation, the internal current setpoint must be reduced via R42!

$$R42\ [k\Omega] = \frac{20 \cdot I\ \text{weight equalization}/I_{max}}{1 - I\ \text{weight compensation}/I_{max}}$$

For control boards, from version 4620087701.01 onwards, zero offset cannot be measured after R46 and R48 have been mounted and an axis enabled. If R46 and R48 have been correctly mounted according to Fig. 3-7, the offset must be able to be measured when the axis is inhibited.

2) Refer to Section 3.1.1

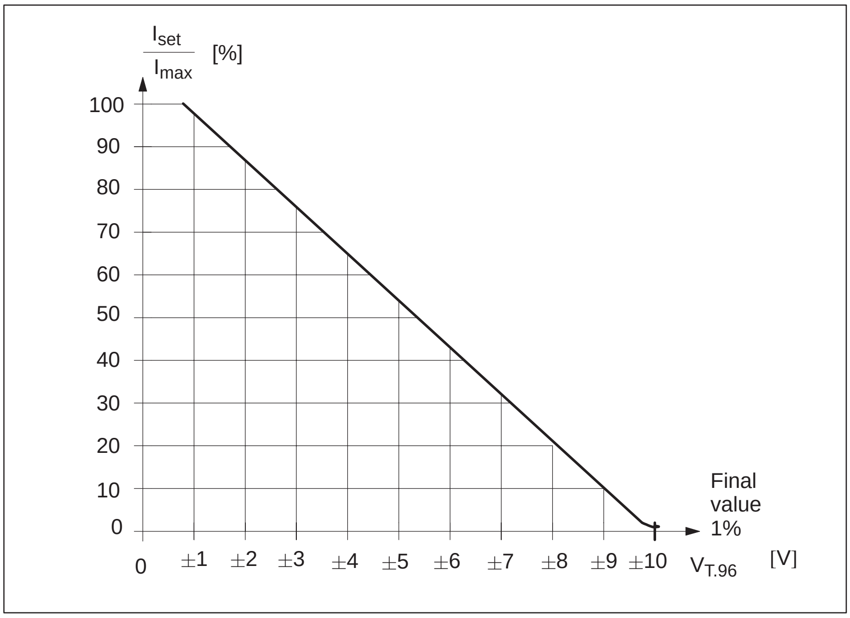


Fig. 3-4 Current setpoint limiting as a function of the voltage at terminal 96 (R12=open)

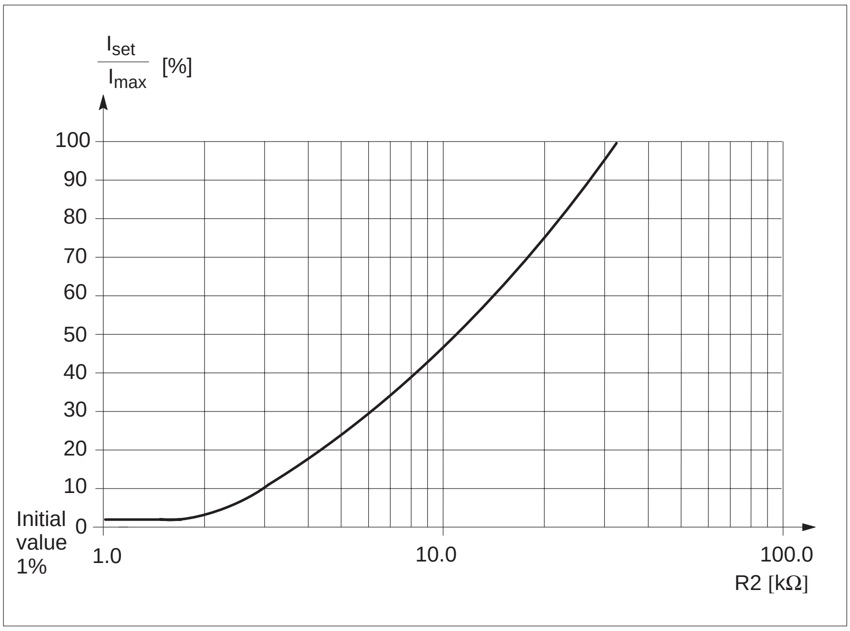


Fig. 3-5 Current setpoint limiting as a function of R2

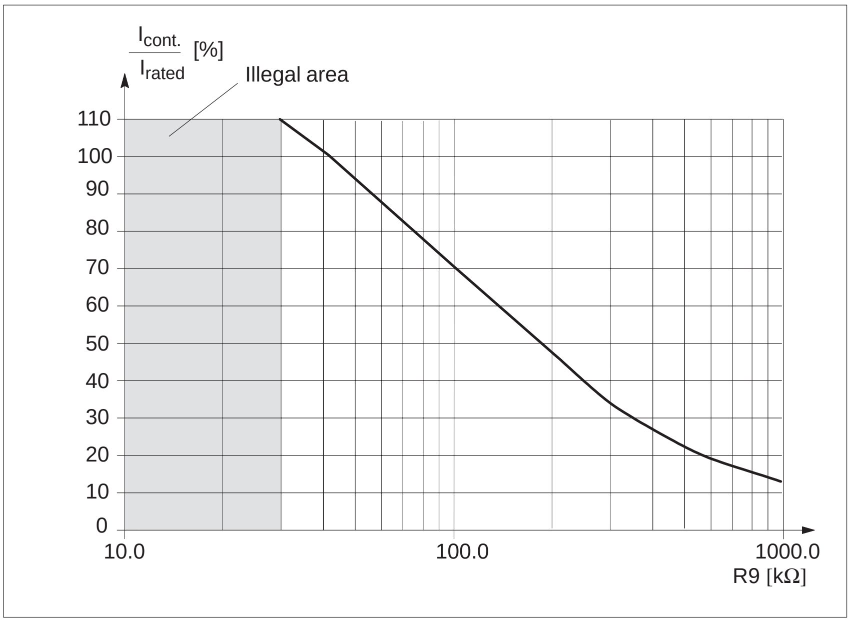


Fig. 3-6 Response threshold I^2t monitoring as a function R9

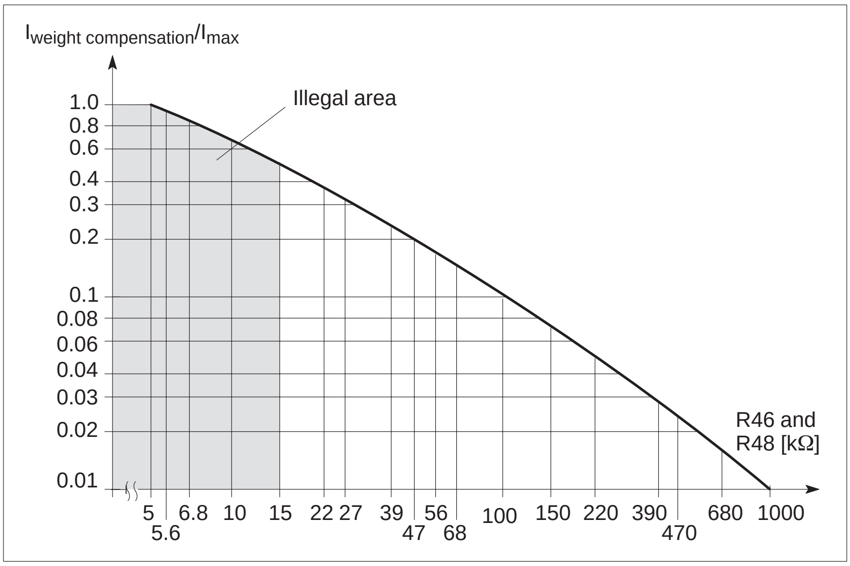


Fig. 3-7 Supplementary current setpoint for electronic weight equalization

Inverter clock frequency PBM

If noise problems occur (the motor makes a whistling sound), the PWM inverter clock frequency can be adapted by mounting R369 on the basic board.
In this case, it must be observed that the available current (I_n, I_{max}) is reduced when the clock frequency is increased. (refer to Pj Section 4.1)
The I2t limiting is designed for a pulse frequency set in the factory to 3.3 kHz and a max. ambient temperature of 40 °C. When this value is exceeded (pulse frequency and/or ambient temperature), the response threshold must be adapted (refer to Fig. 3-2).
The characteristic is valid according to Fig. 3-1.

■

4 Setpoint interfaces

VS

Definitions:

- X — Optimal, taking into account the setpoint input characteristics
- (empty box) Possible
- (grey box) Not permissible, and to some extent also not possible

Table 4-1 Main setpoint–supplementary setpoints

Mode	Setpoint	Term.56/14	Term.24/20	Int. setpoint term.22	Int. setpoint term.23	Socket NZ	Term.258
Speed controlled	Main setpoint	X					
	Supplementary setpoint		X	X	X	X	
Current controlled	Main setpoint		X				
	Supplementary setpoint			X			
Slave, I controlled Current setpoint input	Main setpoint						X
	Supplementary setpoint						
Main spindle drive option Main spindle drive operation	Main setpoint	X					
	Supplementary setpoint						
Main spindle drive option C axis	Main setpoint		X				
	Supplementary setpoint			X	X		

Table 4-2 Motor direction of rotation for a positive setpoint and S2.1 = ON

Mode	Term.56/14	Term.24/20	Term.22	Term.23	Socket NZ	Master/slave term.258
Speed controlled	ccw	cw	R16/18 cw	R19/22 cw	ccw	
			R17/18 ccw	R21/22 ccw		
Current controlled		cw	R16/18 cw	R19/22 cw		cw (slave)
			R17/18 ccw	R21/22 ccw		

When viewing the motor shaft, drive end

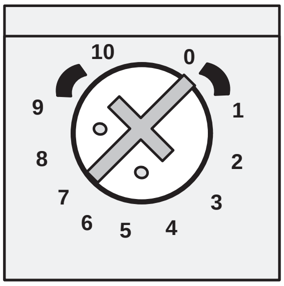
■

Start–up with main spindle drive option 5

The settings for the control parameters for C–axis operation on the parameter board, control parameters for main spindle drive operation, on the option board.

The main spindle drive option components which have to be modified, are mounted on solder pins (layout, refer to Section 9).

The potentiometer scale divisions (in the setting tables) are defined as follows:



The setting shown in the diagram corresponds to 7 scale divisions.

5.1 Pre–settings

Warning

Parameter board changes: Remove R4, R5 and R54 and, if necessary, C4 (when supplied this is not mounted).
If this is not observed, it could result in undesirable axis motion!

5.1.1 Settings with the control board removed

Ramp–up time

Table 5-1 Ramp–up time from 0 V to 10 V in s via terminal 56/14, set using potentiometer R20 and terminal 102

	0	1	2	3	4	5	6	7	8	9	10
Term.102 open	0.01	0.11	0.21	0.31	0.4	0.5	0.6	0.7	0.8	0.9	1.11
Term.102 to term. 9	0.1	1.08	2.07	3.06	4.04	5.03	6.02	7.01	8.01	9.04	11.05

The ramp–up time range via R20 can be changed by modifying R27/R60.

Torque limiting

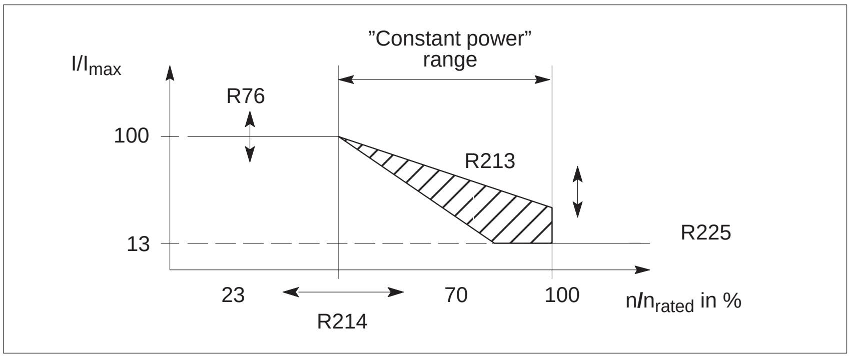


Fig. 5-1 Torque limiting

Table 5-2 Adjustable start of the ”constant power” range referred to $n_{max} = \pm 10$ V in % via R214

Pot. R214	0	1	2	3	4	5	6	7	8	9	10
Start of the range in %	70	65	60	55	50	45	40	35	30	26	22

Table 5-3 Deviations of the selected power to constant power at the point n_{max} in % via R213

Pot. R213	0	1	2	3	4	5	6	7	8	9	10
Deviation in %	+20					0					–20

Table 5-4 Constant torque limiting I_{set}/I_{max} in % via R76 (solder pins), R76 is open when supplied

R76 in kΩ	3	4.3	6.2	8.2	11	15	18	22	27	≥36
I_{set}/I_{max} in %	10	20	30	40	50	60	70	80	90	100

Intermediate values can be determined by interpolating

Table 5-5 Speed–dependent torque limiting I_{set}/I_{max} in % via R225 (solder pins) for R226 = 20 kΩ

R225 in kΩ	2.4	4.7	7.5	11	16	22	30	47	70	100
I_{set}/I_{max} in %	1	10	20	30	40	50	60	70	80	85

12 % I_{set}/I_{max} are set as standard. Intermediate values are obtained by interpolating.

VS

Normalization of- |M/P| display

Table 5-6 Normalization via potentiometer R903 (when supplied, factor = 1)

Pot. R903	0	1	2	3	4	5	6	7	8	9	10
Normalization Factor	3	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1

Relay function, limit value stage output

Terminal selected using 0 Ω resistors

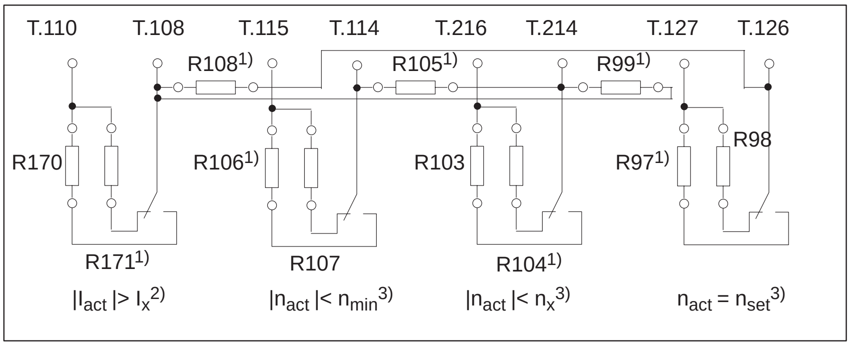


Fig. 5-2 Relay functions

1) As supplied
2) Relay drops out
3) Relay pulls–in if the function is fulfilled.

Table 5-7 Limit value functions

Limit value stage	Range					Settings via fixed values					
$\lvert I_{act}\rvert > I_x$ pot. R211	4.5 %...100 %					Smoothing for relay contact bounce = C87 Suppressed: n_{set} step > 31 mV, R180 = 0 Ω hysteresis = 10 mV, R179 = 2 kΩ					
Pot. R211	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
I_x =in %	100	90	81	71	62	52	43	33	24	14	4.5
$\lvert n_{act}\rvert < n_{min}$ pot. R10	0.3 %...1.7 % n_{max}					Smoothing for relay contact bounce = C68, 400 mV hysteresis (as supplied), inactive for C axis: R100 = 0 Ω (as supplied) R274 = 300 kΩ, corresponds to 20 mV hysteresis					
Pot. R10	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
n_{min}=in %	0.3	0.44	0.58	0.73	0.87	1.02	1.16	1.31	1.45	1.59	1.74
$\lvert n_{act}\rvert < n_x$ pot. R43	3 %...100 % n_{max}					Relay contact bounce smoothing = C68					
Pot. R43	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
n_x=in %	3.4	13	23	34	44	54	64	74	84	94	104
$n_{set} = n_{set}$*	Only in main spindle operation					Monitoring threshold: n_{set} – diff < 20 mV, R179 = 2 kΩ hysteresis = 10 mV, R180 = 0 Ω extension = 32 ms, C20 = 1 μF					

Functions via fixed values

Table 5-8 Settings via fixed values

Function	Component(s)	Effect
Ramp–function generator tracking	R270 = 0 Ω (as supplied) R270 = open	Tracking active Tracking inactive
Speed setpoint smoothing	C40	τ [ms] = 10 · C40 [μF]
Correction setpoint for main spindle operation (term.65 brakes to setpoint, term.24)[2)]	R900 + R901 = open (as supplied) R900 + 901 = 40 kΩ	No correction setpoint Correction setpoint via T.24/20
Current actual value/power display	R160 = open, R207 = 1 kΩ (as supplied) R160 = 1 kΩ, R207 = open	|M/P|–display $\lvert I_{act}\rvert$–display
C–axis/main spindle drive op. setpoint, MSD: term.56/14 setpoint, C axis: term.24/20 or fixed setpoint via term.22 or term.23	Terminal 61 = open Terminal 61 at term.9	Main spindle drive operation C–axis operation Changeover, refer to Fig. 5–3
Changeover speed, term.61	R77/78	1)

1) Changeover speed = $\dfrac{R77 \cdot (47000 - R78 \cdot 15)}{R77 \cdot 47\,k\Omega + R78 \cdot (R77 + 47\,k\Omega)}$ [%]

2) **Warning:** The pulses are only canceled when the n_{off} threshold is fallen below!

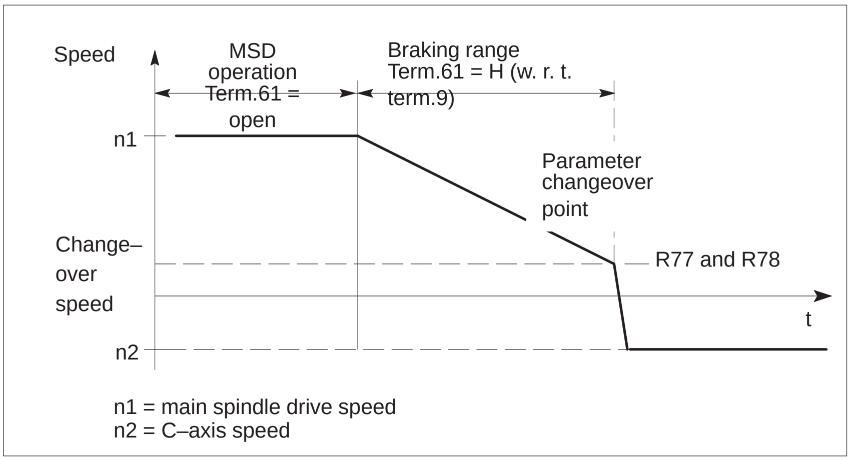


Fig. 5-3 Changeover function, terminal 61

Parameter changeover for C–axis operation

- Closed–loop control parameters, drift setting, setpoint input
- Adaptation enable
- 200 ms timer switched–in
- Several relay functions inhibited
- n_{off} shutdown inhibited

5.1.2 Settings in operation

Setting rule

1. Set the C–axis parameters via the parameter board (tachometer, T_N, K_P, drift).

   C–axis parameters, refer to the speed controller optimization, Section 2

2. Set the main spindle drive parameters via potentiometers on the option board front panel:

Pot. R44	0	1	2	3	4	5	6	7	8	9	10
Pot. R35=ccw	2										1
Pot. R35=cw	15										1

Fig. 5-4 Extending the integral action time using pot. R44 and the influence of pot. R35 on the parameter board, extending T_N by a specific factor

Table 5-9 Reducing the proportional gain with pot. R45 and the influence of pot. R25 on the parameter board, reduction of Kp in %

Pot. R45		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Potentio-meter R25	**left**	33.1	29.5	26.3	23.3	20.4	17.5	14.6	11.5	8.2	4.5	0.1
	center	90.9	89.4	87.8	85.9	83.7	81	77.5	72.4	64.4	48.7	1.5
	right	95.1	94.3	93.3	92.3	90.9	89.3	87	83.7	77.9	65	2.8

Table 5-10 Lowest speed before controller and pulse inhibit (braking to n_{off} for terminal 64/65 $\rightarrow$ pulse cancellation) via potentiometer R1

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
n_{off} as a % of n_{max}	0.34	0.47	0.61	0.74	0.88	1.02	1.15	1.29	1.42	1.56	1.69

Table 5-11 Drift compensation via potentiometer R96 for n_{set} = 0

Potentiometer R96	Control range $\pm$30 mV

5.2 Analog outputs

Function	**Terminal**	**Boundary condition**
Speed actual value	Term.75	Non–normalized speed actual value as for test socket ”X”
Power display (utilization)	Term.162	|M/P| display (as supplied) Fig. 5–5, display-|M/P| , Table 5–6, Normalization
Current actual value	Term.162	$\lvert I_{act}\rvert$ display by changing–over components (Table 5–8, settings via fixed values)

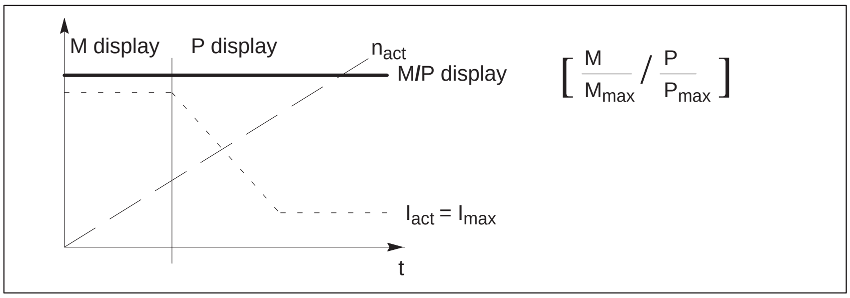


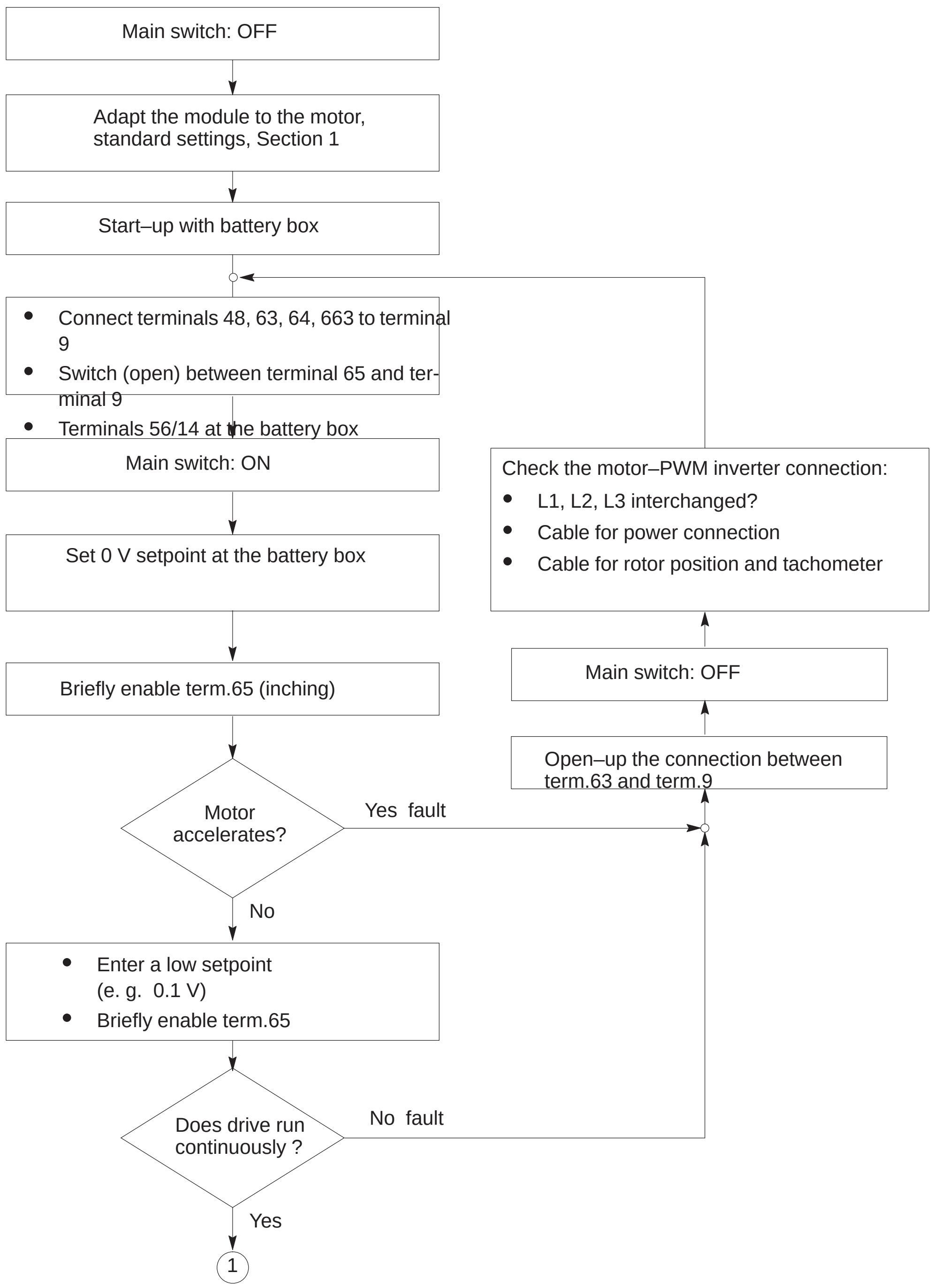
Fig. 5-5 M/P|display

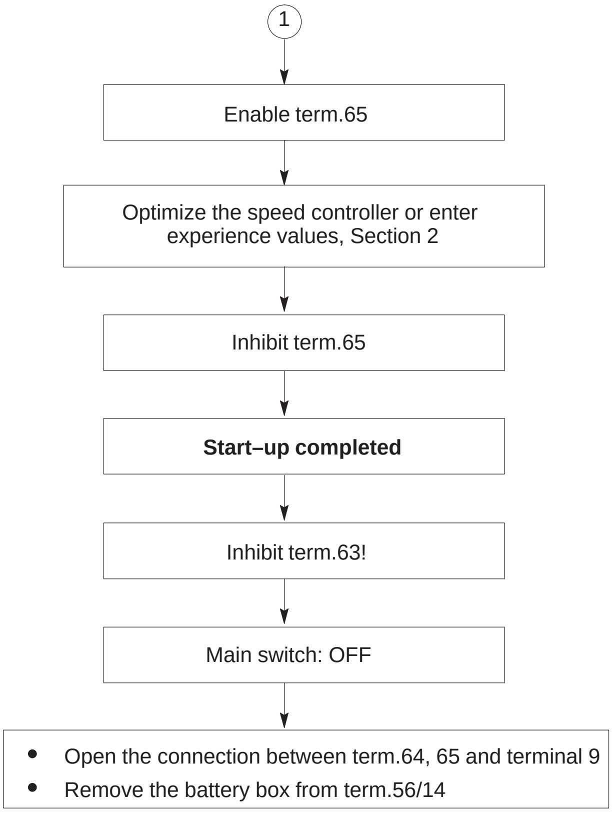
■

6 Free for supplementary texts

■

7 Power–on


Main switch: OFF
Adapt the module to the motor, standard settings, Section 1
Start–up with battery box
Connect terminals 48, 63, 64, 663 to terminal 9
Switch (open) between terminal 65 and terminal 9
Terminals 56/14 at the battery box
Main switch: ON
Set 0 V setpoint at the battery box
Briefly enable term.65 (inching)
Motor accelerates?
Yes fault
No
Enter a low setpoint (e. g. 0.1 V)
Briefly enable term.65
Does drive run continuously ?
No fault
Yes
1
Check the motor–PWM inverter connection:
L1, L2, L3 interchanged?
Cable for power connection
Cable for rotor position and tachometer
Main switch: OFF
Open–up the connection between term.63 and term.9


1
Enable term.65
Optimize the speed controller or enter experience values, Section 2
Inhibit term.65
Start–up completed
Inhibit term.63!
Main switch: OFF
Open the connection between term.64, 65 and terminal 9
Remove the battery box from term.56/14

Maintenance and diagnostics 8

8.1 Test sockets and display elements of the feed modules

VS

8.1.1 User–friendly interface

Test sockets

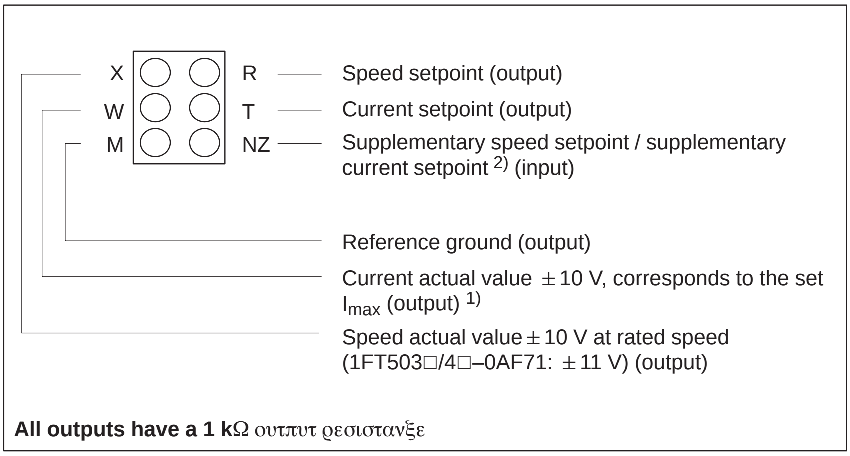


Fig. 8-1

Operating display

Par. board inserted	No	Yes	Yes	Yes	Yes	Yes
Pulse enable 663	–	No	No	Yes	Yes	Yes
Controller enable 65	–	No	Yes	No	Yes	Yes
Current–controlled	No	No	No	No	No	Yes

Speed–controlled operation (standard operation)

[1] Setting value I_{max} refer to Section 1.2
[2] Depending on the operating mode, speed–/current controlled

Fault display

Fault	1	2	3	4	5	6	7	F
I^2t monitoring or heatsink tempera-ture overtemp.	X				X			
Rot. pos. encoder		X						
Speed controller at its limit					X	X	X	
Tachometer monitoring				X				
$I_{act} = 0$							X	
Motor overtemp.			X					
5 V undervoltage (5 V faulted)								X
Effect:	Current limiting	Pulse cancel.		Pulse cancel.	Pulse cancel.	Pulse cancel.	Pulse cancel.	Pulse cancellation
Signal, NE:	Term. 5.x	–	Term. 5.x	–	–	–	–	–
Message FD:	T.291	T.297+ T.672/ T.674	T.5.x T.294	T.297+ T.672/ T.674	T.672/ T.674	T.288+ T.672/ T.674	T.288+ T.672/ T.674	T.672/ T.674[1)]

Sequence when the temperature– or I^2t monitoring responds

- **I^2t monitoring:**
  - an alarm is issued at terminal 5.x of the NE module (non–latching) a minimum of 250 ms before limiting is activated
  - when limiting is activated, fault 1 is displayed and a signal is output at terminal 291 (latching)
- **Heatsink temperature rise monitoring:**
  - an alarm is issued at terminal 5.x of the NE module when the heatsink shutdown temperature is reached (non–latching)
  - the pulses are inhibited, fault 1 is displayed and a signal is output at terminal 291 + terminal 672/terminal 674 after typically 4 s (latching)

Motor overtemperature

SIMODRIVE 611 feed modules with closed–loop control for 1FT5 servomotors are equipped with an evaluation circuit for the PTC thermistors integrated in the motor windings.

The motors are protected from inadmissible high winding temperatures with the monitoring combination (tripping temperature 150 °C).

As the drive shouldn't unpredictably intervene in the machining process, the trip is only signaled to the SIMODRIVE 611 via individual fault signal terminal 289/294/296 (latching) or centrally via terminals 5.1, 5.2 and 5.3 of the infeed module (latching) when the response temperature is reached (the drive is not shutdown).

There is no internal system response to protect the motor. The user must ensure that the motor can thermally recover after the signal has been issued, by appropriately configuring the adaptation control. In this case, it may be required to immediately shutdown the motor.

1) Depending on the mode (ready/fault signal)

Continued: Motor overtemperature

A delay time is not permissible.

If the motor is not thermally monitored, when an overload situation occurs or if the drive converter was over dimensioned, the complete drive could be destroyed.

8.1.2 Standard interface

Test sockets and fault displays

VS

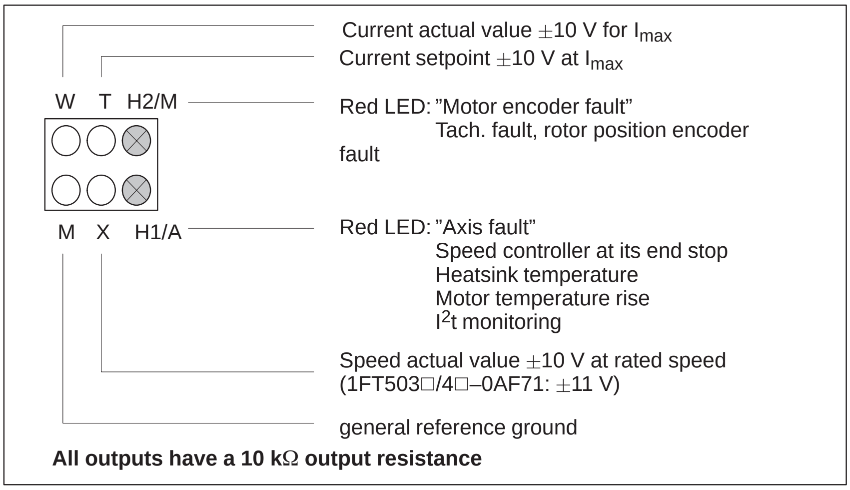


Fig. 8-2

Sequence when the temperature– or I^2t monitoring responds

- **I^2t–monitoring**
  - min. 250 ms before limiting starts, an alarm is issued at terminal 5.x of the NE module (non–latching)
  - fault display H1 is output when limiting starts.
- **Heatsink temperature monitoring:**
  - an alarm is issued at terminal 5.x of the NE module when the heatsink shutdown temperature is reached (non–latching)
  - the pulses are inhibited, fault H1 is displayed and a signal is issued at terminal 72/terminal 73/terminal 74 of the NE module after typically 4 s (latching)

Motor overtemperature

SIMODRIVE 611 feed modules with closed–loop control for 1FT5 servomotors are equipped with an evaluation circuit for the PTC thermistors integrated in the motor windings.

The motors are protected from inadmissible high winding temperatures with the monitoring combination (tripping temperature 150 °C).

As the drive shouldn’t unpredictably intervene in the machining process, the trip is only signaled to the SIMODRIVE 611 or centrally via terminals 5.1, 5.2 and 5.3 of the infeed module (latching) as signal when the response temperature is reached (the drive is not shutdown).

There is no internal system response to protect the motor. The user must ensure that the motor can thermally recover after the signal has been issued, by appropriately configuring the adaptation control. In this case, it may be required to immediately shutdown the motor.

A delay time is not permissible.

If the motor is not thermally monitored, when an overload situation occurs or if the drive converter was over dimensioned, the complete drive could be destroyed.

8.2 Troubleshooting

Table 8-1 Troubleshooting

Fault, user–friendly interface	Fault, standard interface	Possible fault cause
1	H1	RMS torque too high? ambient temp. > 40 °C?
2	H2	Actual value cable and shield correctly connected? Motor encoder defective?
3	H1	Motor overloaded, RMS torque too high?
4	H2	Refer to F2
5	H1	Axis mechanically locked? RMS torque too high?
6	H1	Motor incorrectly connected? External moment of inertia too high? RMS to high (mechanically locked)?
7	–	Motor feeder interrupted, motor feeder, short–circuit/ground fault (Vce monitoring stored up to POWER–ON)? Fault cannot be removed → replace module
F	–	5V level faulted → replace module

■

Appendix 9

VS

9.1 Connecting terminals

Table 9-1 **User–friendly interface**

Term. No.	Desig.	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
U2 V2 W2		Motor connection	O	3–ph. 0...450 V AC	According to the Planning Guide
PE1 PE2		Protective conductor Protective conductor	I I	0 V 0 V	Bolt Bolt
P600 M600	 X151/351	DC link DC link Equipment bus	I/O I/O I/O	+300 V –300 V	Busbar Busbar Ribbon cable
56 2) 14 2)	X321 X321	Speed setpoint 1 Differential input	I I	0V... ± 10V 7)	1.5 mm^2 1.5 mm^2
AS1 AS2	X331 X331	Checkback contact Relay, start inhibit	NC	max. 250V_{AC}/1A, 30 V_{DC}/2A	1.5 mm^2
663 9 65 9 22 23	X331 X331 X331 X331 X331 X331	Pulse enable 3) Enable voltage 3)5) Controller enable 3) Enable voltage 3)5) Select int. fixed setpoint 1 3)/ current–controlled operation Select int. fixed setpoint 2 3)	I O I O I E	+21...30 V +24 V +13...30 V +24 V +13...30 V +13...30 V	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
20 2) 24 2)	X331 X331	Speed setpoint 2/current setpoint, different input	I I	0V...±10 V (340 µs smoothing) 7)	1.5 mm^2 1.5 mm^2
96 6) 44 6) 6 6) 258 6) 16 6)	X331 X331 X331 X331 X331	Current setpoint limiting Electronics voltage Integrator inhibit, n controller Current setpoint (master/slave) Norm. current actual value	I O I I/O O	0...±30 V –15 V/10 mA +13...30 V 0 V...±10 V 0 V...±10 V/R_i=1 kΩ	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
289 288 290 291 293 294 296 297 299	X341 X341 X341 X341 X341 X341 X341 X341 X341	Relay signals, center contact Speed controller at its limit I^2t monitoring Motor temperature rise Tachometer/rotor position encoder fault	I NO NC NO NC NO NC NO NC	4) max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A max. 30 V/1 A	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2

1) I = input, O = output, NC = NC contact, NO = NO contact (for signal: Closed=high, open=low)
2) Reference point of the differential input
3) Reference ground terminal 19 (not connected with general reference ground terminal 15)
4) Voltage referred to PE potential
5) Refer to NE Section 3.1 ... 3.2
6) Terminal T.15 on the NE module is the reference ground.
7) The common–mode range of the differential input is ±24V with respect to the PE potential and may never be exceeded.

Table 9-1 **User–friendly interface**

Term. No.	Desig.	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
672 673 674	X341 X341 X341	Ready fault signal	NO I NC	30 V/1 A 4) 30 V/1 A 30 V/1 A	1.5 mm^2 1.5 mm^2 1.5 mm^2
	X311	Motor encoder			

1) I = input, O = output, NC = NC contact, NO = NO contact (for signal: Closed=high, open=low)
2) Reference point of the differential input
3) Reference ground terminal 19 (not connected with general reference ground terminal 15)
4) Voltage referred to PE potential

Table 9-2 **Main spindle drive option (only possible for user–friendly interface)**

Term. No.	Desig.	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
102 2)	X312	T_H = 1 : 10	I	+13 V...30 V/R_E = 1.5 kΩ	1.5 mm^2
61 2)	X312	C–axis operation	I	+13 V...30 V/R_E = 1.5 kΩ	1.5 mm^2
75 3)	X312	n_{act}	O	0 V...±10 V	1.5 mm^2
162 3)	X312	P_{act}/I_{act} 5)	O	0 V...±10 V	1.5 mm^2
110	X322	$\lvert I_{act}\rvert > I_x$	NO/NC 4)	30 V/1.0 A max	1.5 mm^2
108	X322		I	30 V/1.0 A max	1.5 mm^2
115	X322	$\lvert n_{act}\rvert < n_{min}$	NO/NC 4)	30 V/1.0 A max	1.5 mm^2
114	X322		I	30 V/1.0 A max	1.5 mm^2
216	X322	$\lvert n_{act}\rvert < n_x$	NO/NC 4)	30 V/1.0 A max	1.5 mm^2
214	X322		I	30 V/1.0 A max	1.5 mm^2
127	X322	$n_{set=}\ n_{set*}$	NO/NC 4)	30 V/1.0 A max	1.5 mm^2
126	X322		I	30 V/1.0 A max	1.5 mm^2

VS

Table 9-3 **Standard interface**

Term. No.	Desig.	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
U2 V2 W2		Motor connection	O	3–ph. 0...450 V AC	According to the Planning Guide
PE1		Protective conductor	I	0 V	Bolt
PE2		Protective conductor	I	0 V	Bolt
P600		DC link	I/O	+300 V	Busbar
M600		DC link	I/O	–300 V	Busbar
	X151/351	Equipment bus	I/O		Ribbon cable
AS1 AS2	X321 X321	Checkback signal contact Relay, start inhibit	NC	250 V AC/1 A, 30 V DC/2A	1.5 mm^2
663	X321	Pulse enable 2)	I	+21 V...30 V	1.5 mm^2
9 6)	X321	Enable voltage 2)	O	+24 V	1.5 mm^2
56.1	X331	Speed setpoint/current setpoint	I	0 V...±10 V 7)	1.5 mm^2
14.1	X331	(differential input)	I		1.5 mm^2
65.1	X331	Controller enable 2)	I	+13 V...30 V	1.5 mm^2
9 6)	X331	Enable voltage 2)	O	+24 V	1.5 mm^2
22.1	X331	Select I controller 2)	I	+13 V...30 V	1.5 mm^2
9 6)	X331	Enable voltage 2)	O	+24 V	1.5 mm^2
56.2	X332	Speed setpoint/current setpoint	I	0 V...±10 V 7)	1.5 mm^2
14.2	X332	(differential input)	I		1.5 mm^2
65.2	X332	Controller enable 2)	I	+13 V...30 V	1.5 mm^2
9 6)	X332	Enable voltage 2)	O	+24 V	1.5 mm^2
22.2	X332	Select I controller 2)	I	+13 V...30 V	1.5 mm^2
9 6)	X332	Enable voltage 2)	O	+24 V	1.5 mm^2

1) I = input, O = output, NC = NC contact, NO = NO contact (for signal: Closed=high, open=low)
2) Reference ground terminal 19 (not connected with general reference ground terminal 15)
3) Terminal 15 on the NE module is the reference ground.
4) Can be optionally changed–over using jumpers
5) The power display is set as standard
6) refer to NE Section 3.1 ... 3.2
7) The common mode range of the differential input is ±24V with respect to the PE potential and may never be exceeded.

9.2 Block diagram, MSD option board

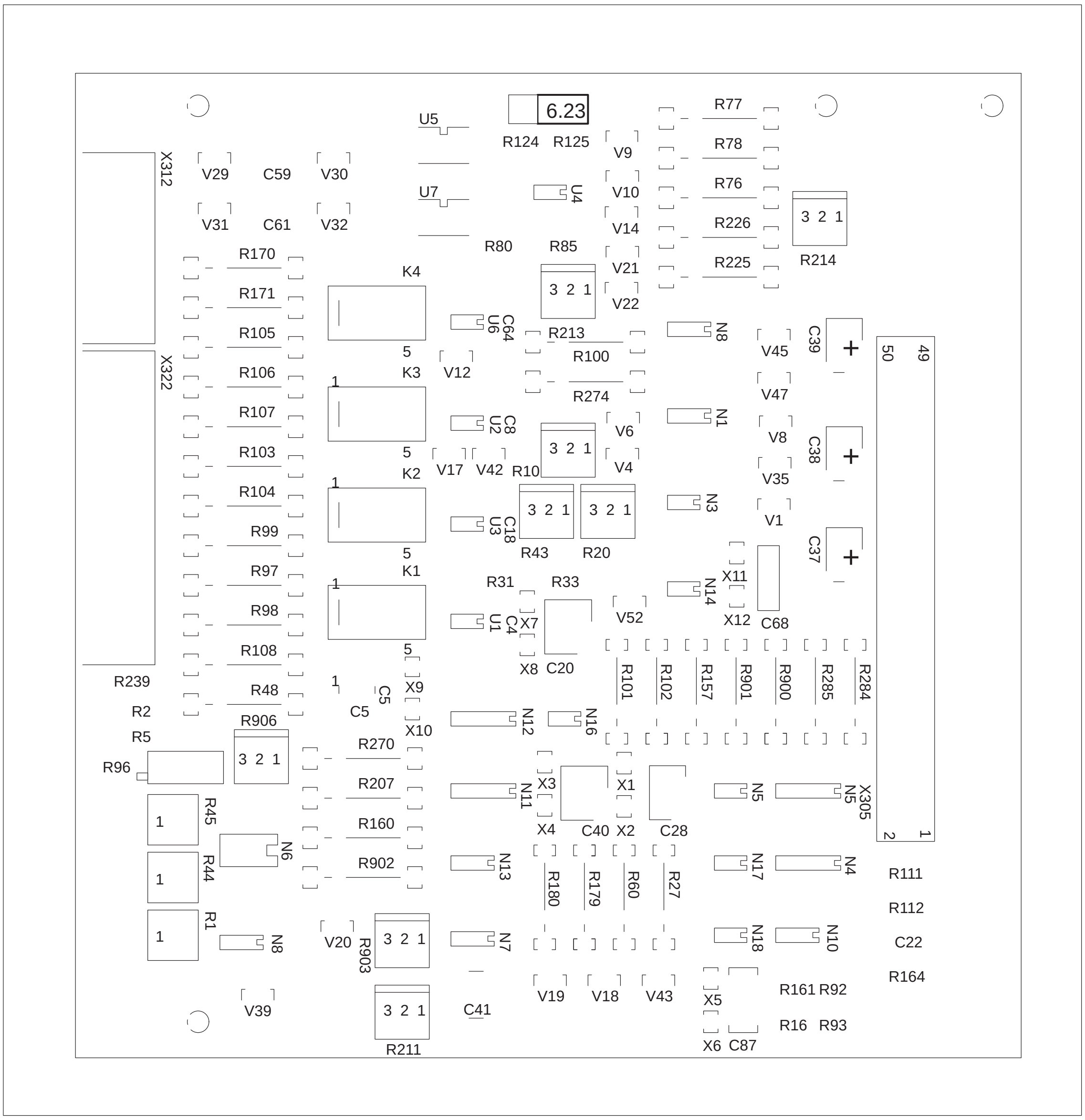


Fig. 9-1 Block diagram MSD option board

The capacitors are assigned to the adjacent solder pins.

VS

9.3 Block diagram, parameter board

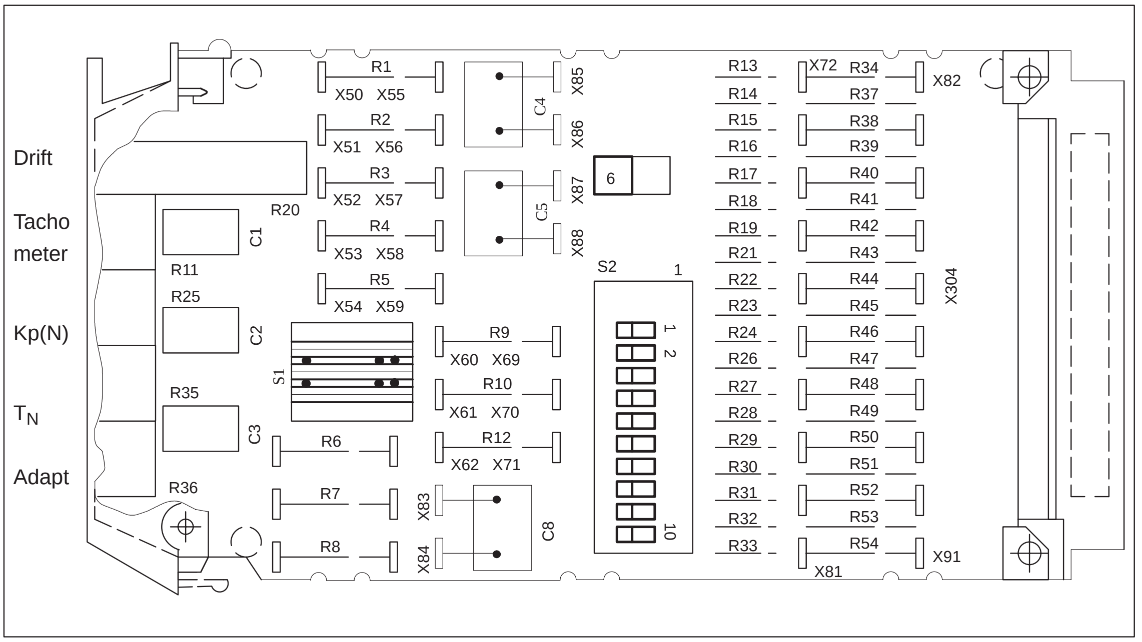


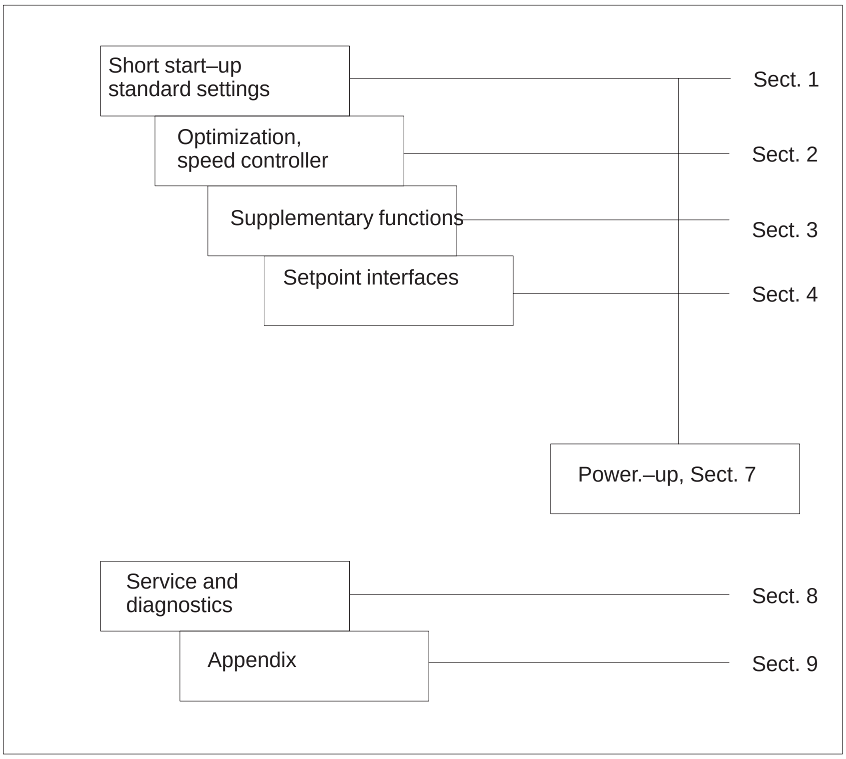
Fig. 9-2 Block diagram, parameter board

9.4 Block diagram, standard interface

Feed modules, resolver control (VR)

Start–up steps for feed drive modules, resolver control

Start–up is sub–divided into steps, after the standard setting, other start–up steps can follow, or the equipment can be powered–up.



Short start–up, standard settings 1

The setting elements (switches) are located on the board, and must be set before the control card is installed in the inverter module.

1.1 Pole numbers

!

Wichtig

The pole (pair) numbers for the motor and resolver must be set before start–up. Otherwise, the drive will be locked.

Axis 1: DIL switch S1, contacts 1–4
Axis 2: DIL switch S2, contacts 1–4

Table 1-1 Pole numbers

	2p motor	**2**	**4**	**6**	**8**	**2p resolver**	**2**	**4**	**6**	**8**
Axis 1	S1.x ON	–	1	2	1+2	S1.x ON	–	3	4	3+4
Axis 2	S2.x ON	–	1	2	1+2	S2.x ON	–	3	4	3+4

The pole pair numbers of the motors are dependent on the shaft height.

Table 1-2 Pole numbers of 1FT6 motors

Shaft height	36	48	63	80	100	132
Pole No. 2P	4	4	6	8	8	6

Table 1-3 Pole numbers of 1FK6 motors

Shaft height	36	48	63	80	100
Pole No. 2P	6	6	6	6	8

The pole (pair) number of the standard resolver is 2p=2.
The pole (pair) number of the resolver is specified on the motor rating plate.

1.2 Speed actual value normalization [RPM]

These normalizations are valid for standard resolver pole numbers, 2p=2.

- Normalization for special pole numbers, 2p=4, 6, 8, on request

It is recommended that normalization is set up for the motor rated speed. For motors with rated speeds 4500 RPM it is recommended that the normalization is set, which is closest to the required rated system speed.

For motors with rated speed 1500 RPM, the 2000 RPM normalization should be set.

Axis 1: DIL switch S4, contacts 1–4
Axis 2: DIL switch S4 contacts 5–8

Table 1-4 Speed normalization

	n_{rated}	2000	3000	3000	6000
Axis 1	S4.x ON	–	1+3	2+4	1+2+3+4
Axis 2	S4.x ON	–	5+7	6+8	5+6+7+8

Optionally possible

Refer to Section 2.1 for more detailed information regarding the speed ranges which can be set.

1.3 Current controller settings

DIL switch

Axis 1: DIL switch S3
Axis 2: DIL switch S6

Current actual value normalization

$$\text{Current limit} = \frac{I_{max}\ \text{(set value)}}{I_{Limit\ \text{(power module)}}} \quad [\%]$$

Imax must be reduced down to at least the peak current permitted for the motor.

Table 1-5 Current actual value normalization [%]

	I_{MAX}/I_{LIMIT} [%]	100	70
Axis 1	S3.x ON	–	1+2
Axis 2	S6.x ON	–	1+2

Current controller gain

$$Kp(I) < \frac{I_{max} * \quad L_A}{25} = \frac{I_{Limit} * \text{Current limit} * L_A}{25}$$

Imax = set maximum current (RMS value) of the axis in A
LA = rotating field inductance of the motor in mH (RMS value) (refer to the Planning Guide, AC Motors for Feed– and Main Spindle Drives).
Round–off the calculated values to values which can be set!

Table 1-6 Current controller gain Kp (I)

	Kp(I)	1	2	3	4	5	6	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	16
Axis 1	S3.x ON	–	3+7	4+8	3+4 + 7+8	5+9	3+5 + 7+9	4+5 + 8+9	3+4+ 5+7+ 8+9	3+6 + 7+10	4+6 + 8+10	3+4+ 6+7+ 8+10	5+6 + 9+10	3+5+ 6+7+ 9+10	4+5+ 6+8+ 9+10	3+4+ 5+6+ 7+8+ 9+10
Axis 2	S6.x ON	–	3+7	4+8	3+4 + 7+8	5+9	3+5 + 7+9	4+5 + 8+9	3+4+ 5+7+ 8+9	3+6 + 7+10	4+6 + 8+10	3+4+ 6+7+ 8+10	5+6 + 9+10	3+5+ 6+7+ 9+10	4+5+ 6+8+ 9+10	3+4+ 5+6+ 7+8+ 9+10

Adaptation tables

Definition: o = Contact in the basic OFF setting
x = Contact in the ON setting

Table 1-7 Adaptation tables for feed modules, resolver control 3/6A

Servomotor				**Current act. val. normaliz. Axis 1: S3 Axis 2: S6**		**Current controller gain Kp(I) Axis 1: S3 Axis 2: S6**				
1FT	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6031–4AK	0.83	1.2	6000	x	70	o	o	x	o	5.0
6034–4AK	1.65	2.15	6000	o	100	x	x	o	o	4.0
6041–4AF	2.15	1.55	3000	o	100	o	x	o	x	10.5
6041–4AK	2.15	2.55	6000	o	100	x	x	o	o	4.0
6044–4AF	4.15	2.50	3000	o	100	o	x	x	o	7.5
6061–6AC	3.30	1.60	2000	o	100	x	x	x	x	16.0
6061–6AF	3.30	2.25	3000	o	100	x	x	x	o	8.5
6062–6AC	5.00	2.30	2000	o	100	x	x	o	x	11.5

1FK	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6032–6AK	0.90	1.40	6000	o	100	x	x	o	o	4.0
6040–6AF	1.30	1.10	3000	x	70	x	o	x	o	6.0
6040–6AK	1.3	2.2	6000	0	100	x	0	0	0	2.0
6042–6AF	2.65	2.20	3000	o	100	x	x	o	o	4.0

Table 1-8 Adaptation table for feed modules, resolver control 5/10 A

Servomotor				Current act. val. normaliz. Axis 1: S3 Axis 2: S6		Current controller gain Kp(I) Axis 1: S3 Axis 2: S6				
1FT	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6034–4AK	1.65	2.15	6000	x	70	o	o	x	o	5.0
6041–4AF	2.15	1.55	3000	x	70	o	x	x	x	14.5
6041–4AK	2.15	2.55	6000	o	100	o	x	x	o	7.5
6044–4AF	4.15	2.50	3000	o	100	x	o	x	x	13.5
6044–4AK	4.15	4.85	6000	o	100	x	x	o	o	4.0
6061–6AF	3.30	2.25	3000	o	100	x	x	x	x	16.0
6061–6AH	3.30	3.35	4500	o	100	o	x	x	o	7.5
6061–6AK	3.30	4.10	6000	o	100	x	x	o	o	4.0
6062–6AC	5.00	2.30	2000	x	70	x	x	x	x	16.0
6062–6AF	5.00	3.40	3000	o	100	o	x	o	x	10.5
6062–6AH	5.00	4.80	4500	o	100	o	o	x	o	5.0
6062–6AK	5.00	6.40	6000	o	100	o	x	o	o	3.0
6064–6AC	7.90	3.50	2000	o	100	o	x	x	x	14.5
6064–6AF	7.90	5.00	3000	o	100	o	x	x	o	7.5
6081–8AC	6.60	3.40	2000	o	100	x	o	x	x	13.5

1FK	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6040–6AK	1.30	2.20	6000	x	70	o	x	o	o	3.0
6042–6AF	2.65	2.20	3000	o	100	o	x	x	o	7.5
6060–6AF	5.00	3.60	3000	o	100	o	x	x	o	7.5
6080–6AF	6.60	4.50	3000	o	100	o	x	x	o	7.5

Table 1-9 Adaptation table for feed modules, resolver control 9/18 A

Servomotor				Current act. val. normaliz. Axis 1: S3 Axis 2: S6		Current controller gain Kp(I) Axis 1: S3 Axis 2: S6				
1FT	M_0 [Nm] 60K	I_0 [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6044–4AK	4.15	4.85	6000	o	100	x	o	x	o	6.0
6061–6AF	3.30	2.25	3000	x	70	x	x	x	x	16.0
6061–6AH	3.30	3.25	4500	o	100	x	x	o	x	11.5
6061–6AK	3.30	4.10	6000	o	100	o	x	x	o	7.5
6062–6AF	5.00	3.40	3000	o	100	x	x	x	x	16.0
6062–6AH	5.00	4.80	4500	o	100	x	x	x	o	8.5
6062–6AK	5.00	6.40	6000	o	100	o	o	x	o	5.0
6064–6AC	7.90	3.50	2000	x	70	x	x	x	x	16.0
6064–6AF	7.90	5.00	3000	o	100	o	o	x	x	12.5
6064–6AH	7.90	7.60	4500	o	100	o	o	x	o	5.0
6064–6AK	7.90	9.90	6000	o	100	o	x	o	o	3.0
6081–8AC	6.60	3.40	2000	x	70	x	x	x	x	16.0
6081–8AF	6.60	4.90	3000	o	100	o	x	o	x	10.5
6081–8AH	6.60	7.40	4500	o	100	o	o	x	o	5.0
6081–8AK	6.60	9.40	6000	o	100	o	x	o	o	3.0
6082–8AC	10.40	5.50	2000	o	100	o	x	x	x	14.5
6082–8AF	10.40	8.20	3000	o	100	x	o	x	o	6.0
6084–8AC	16.20	7.55	2000	o	100	o	x	o	x	10.5
6084–8AK	16.20	20.50	6000	o	100	o	o	o	o	1.0
6102–8AB	22.40	7.40	1500	o	100	o	o	x	x	12.5

1FK	M_0 [Nm] 60K	I_0 [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6060–6AF	5.00	3.60	3000	x	70	x	o	o	x	9.5
6063–6AF	9.10	6.60	3000	o	100	x	o	x	o	6.0
6080–6AF	6.60	4.50	3000	o	100	o	o	x	x	12.5
6083–6AF	13.30	8.50	3000	o	100	o	x	x	o	7.5
6100–8AF	15.00	10.20	3000	o	100	o	x	o	o	3.0

Table 1-10 Adaptation table for feed modules, resolver control 18/36 A

Servomotor				Current act. val. normaliz. Axis 1: S3 Axis 2: S6		Current controller gain Kp(I) Axis 1: S3 Axis 2: S6				
1FT	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact 3+7	4+8	5+9	6+10	Kp(I)
6062–6AH	5.00	4.80	4500	x	70	x	x	o	x	11.5
6062–6AK	5.00	6.40	6000	o	100	x	o	o	x	9.5
6064–6AF	7.90	5.00	3000	x	70	x	x	x	x	16.0
6064–6AH	7.90	7.60	4500	o	100	o	x	o	x	10.5
6064–6AK	7.90	9.90	6000	o	100	x	o	x	o	6.0
6081–8AH	6.60	7.40	4500	o	100	o	x	o	x	10.5
6081–8AK	6.60	9.40	6000	o	100	x	o	x	o	6.0
6082–8AF	10.40	8.20	3000	o	100	x	o	x	x	13.5
6082–8AH	10.40	12.20	4500	o	100	x	o	x	o	6.0
6082–8AK	10.40	14.65	6000	o	100	x	x	o	o	4.0
6084–8AC	16.20	7.55	2000	x	70	o	x	x	x	14.5
6084–8AF	16.20	11.30	3000	o	100	x	o	o	x	9.5
6084–8AH	16.20	16.70	4500	o	100	x	x	o	o	4.0
6084–8AK	16.20	20.50	6000	o	100	o	x	o	o	3.0
6086–8AC	22.40	10.00	2000	o	100	x	x	x	x	16.0
6086–8AF	22.40	14.40	3000	o	100	x	x	x	o	8.5
6086–8AH	22.40	20.40	4500	o	100	x	x	o	o	4.0
6102–8AB	22.40	7.40	1500	x	70	x	x	x	x	16.0
6102–8AC	22.40	10.20	2000	o	100	x	o	x	x	13.5
6102–8AF	22.40	14.20	3000	o	100	o	x	x	o	7.5
6102–8AH	22.40	20.60	4500	o	100	o	x	o	o	3.0
6105–8AB	41.50	13.80	1500	o	100	o	x	x	x	14.5
6105–8AC	41.50	18.40	2000	o	100	x	x	x	o	8.5
6084–8SF	22.00	16.30	3000	o	100	x	x	x	o	8.5

1FK	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact 3+7	4+8	5+9	6+10	Kp(I)
6063–6AF	9.10	6.60	3000	x	70	o	x	x	o	7.5
6083–6AF	13.30	8.50	3000	o	100	x	o	x	x	13.5
6100–8AF	15.00	10.20	3000	o	100	x	o	x	o	6.0
6101–8AF	22.40	14.40	3000	o	100	o	o	x	o	5.0
6103–8AF	30.00	19.00	3000	o	100	o	x	o	o	3.0

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Table 1-11 Adaptation table for feed modules, resolver control 28/56 A

Servomotor				**Current act. val. normaliz. Axis 1: S3 Axis 2: S6**		**Current controller gain Kp(I) Axis 1: S3 Axis 2: S6**				
1FT	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact 3+7	Contact 4+8	Contact 5+9	Contact 6+10	Kp(I)
6062–6AK	5.00	6.40	6000	x	70	x	x	o	x	11.5
6064–6AH	7.90	7.60	4500	x	70	x	x	o	x	11.5
6064–6AK	7.90	9.90	6000	o	100	x	o	o	x	9.5
6081–8AK	6.60	9.40	6000	x	70	x	o	x	o	6.0
6082–8AF	10.40	8.20	3000	x	70	o	x	x	x	14.5
6082–8AH	10.40	12.20	4500	o	100	x	x	o	x	11.5
6082–8AK	10.40	14.65	6000	o	100	x	o	x	o	6.0
6084–8AF	16.20	11.30	3000	o	100	x	x	x	x	16.0
6084–8AH	16.20	16.70	4500	o	100	x	o	x	o	6.0
6084–8AK	16.20	20.50	6000	o	100	o	o	x	o	5.0
6086–8AC	22.40	10.00	2000	x	70	x	x	x	x	16.0
6086–8AF	22.40	14.40	3000	o	100	x	o	o	x	9.5
6086–8AH	22.40	20.40	4500	o	100	x	o	x	o	6.0
6102–8AC	22.40	10.20	2000	x	70	x	x	x	x	16.0
6102–8AF	22.40	14.20	3000	o	100	x	x	o	x	11.5
6102–8AH	22.40	20.60	4500	o	100	o	o	x	o	5.0
6105–8AB	41.50	13.80	1500	x	70	x	x	x	x	16.0
6105–8AC	41.50	18.40	2000	o	100	x	o	x	x	13.5
6105–8AF	41.50	27.70	3000	o	100	x	o	x	o	6.0
6108–8AB	58.00	18.50	1500	o	100	x	x	x	x	16.0
6108–8AC	58.00	24.00	2000	o	100	x	o	o	x	9.5
6132–6AB	62.00	18.50	1500	x	70	x	x	x	x	16.0
6132–6AC	62.00	25.00	2000	o	100	o	o	x	x	12.5
6132–6AF	62.00	37.00	3000	o	100	x	o	x	o	6.0
6134–6AB	79.00	24.00	1500	o	100	x	x	x	x	16.0
6134–6AC	79.00	31.50	2000	o	100	o	x	x	x	14.5
6136–6AB	95.00	28.00	1500	o	100	o	x	x	x	14.5
6084–8SF	22.00	16.30	3000	o	100	o	x	x	x	14.5
6084–8SH	22.00	22.90	4500	o	100	x	o	x	o	6.0
6084–8SK	22.00	31.00	6000	o	100	x	x	o	o	4.0
6086–8SF	29.50	22.30	3000	o	100	x	o	o	x	9.5
6105–8SC	50.00	25.00	2000	o	100	x	x	o	x	11.5

1FK	M_o [Nm] 60K	I_o [A] 60K	n_{rated} [RPM]	Contact 1+2	I_{max} [%]	Contact				Kp(I)
						3+7	4+8	5+9	6+10	
6083–6AF	13.30	8.50	3000	x	70	o	x	x	x	14.5
6100–8AF	15.00	10.20	3000	x	70	o	x	x	o	7.5
6101–8AF	22.40	14.40	3000	o	100	o	x	x	o	7.5
6103–8AF	30.00	19.00	3000	o	100	o	o	x	o	5.0

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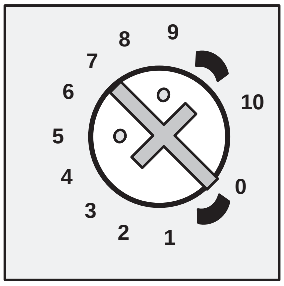
Optimization, speed controller 2

The additional smoothing functions in the speed controller loop (to dampen mechanical resonance effects) are described in Section 3. Proceed as follows when optimizing the speed controller:

1. Tachometer adjustment
2. Gain Kp
3. Integral action time T_N
4. Drift compensation (offset)

The unit must be powered–up to optimize the speed controller. Therefore, please observe Section 7 ”Powering–up”.

The potentiometer scale divisions (in the setting tables) are defined as follows:



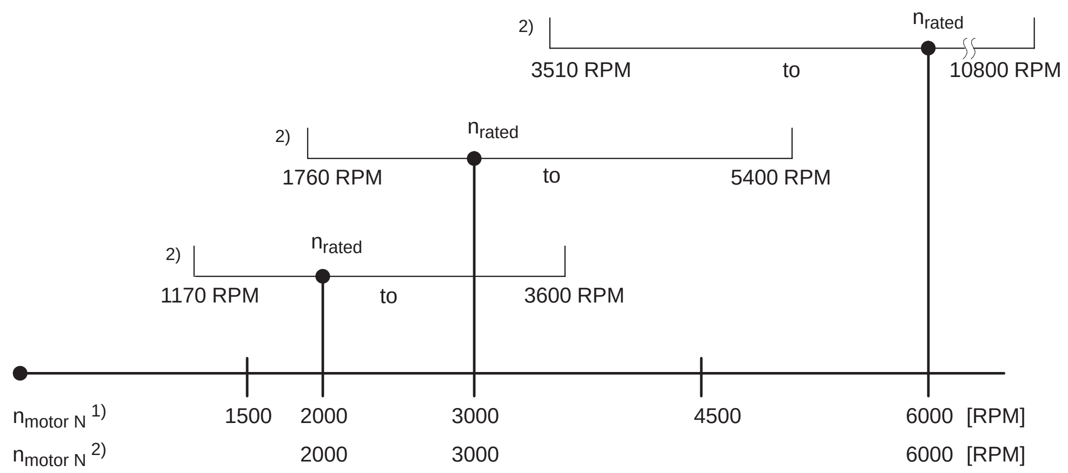
The setting shown in the diagram corresponds to 7 scale divisions.

2.1 Tachometer adjustment

The actual drive speed can, for a ±10 V speed setpoint, be varied within the following range around the rated speed set as described under Section 1.2:

Potentiometer	Setting range
T	$0.6\ n_{rated} \le n_{act\ N} \le 1.8\ n_{rated}$

The rated speeds, set according to Section 1.2 result in the following setting ranges for a ±10 V speed setpoint:



1) Rated motor speed
2) Rated speeds which can be set using the resolver control

Fig. 2-1

When reducing the speed setpoint, the setting range is also appropriately reduced. It is recommended, that motors with a 6000 RPM rated speed are operated with a ±8 V speed setpoint, in order to limit the selectable maximum speed.

Warning

Only the specified setting ranges are possible!
The setting range and maximum speed setpoint must be defined, so that the maximum permissible speed of the motor is never exceeded. The maximum permissible motor speeds are specified in the Planning Guide.

2.2 Setting the proportional gain Kp

The proportional gain Kp of the speed controller can be set using potentiometer Kp. The gain, set with the Kp potentiometer is only insignificantly influenced by the setting of the T_N potentiometers.

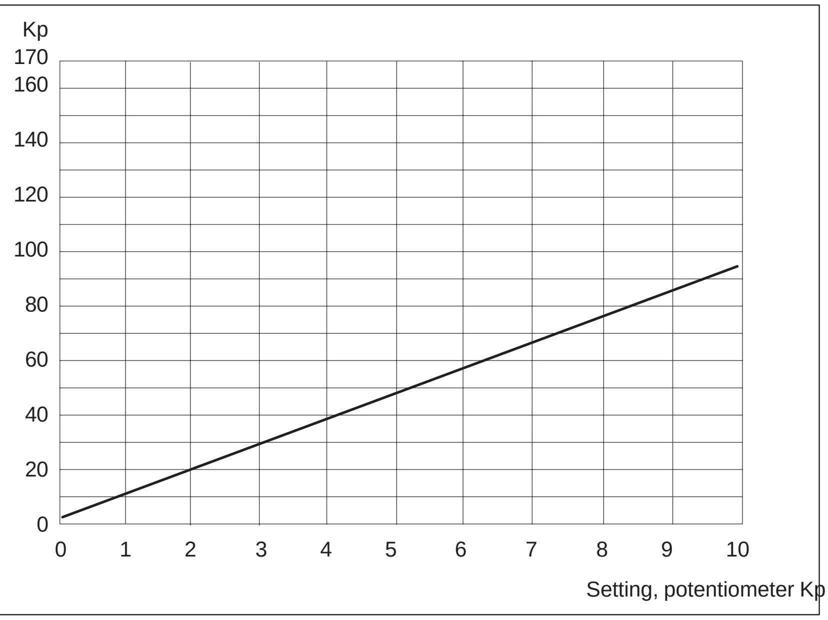


Fig. 2-2 Proportional gain Kp as a function of the Kp potentiometer

If the electronic weight equalization is active (refer to Section 3.3) this proportional gain is increased by the following factor:

$$\frac{\text{Kp (with weight equalization)}}{\text{Kp}} = 1 + \frac{I_{\text{weight equalization}}}{I_{\text{Max}}}$$

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2.3 Setting the integral action time T_N

The speed controller integral action time is set using potentiometer T_N.

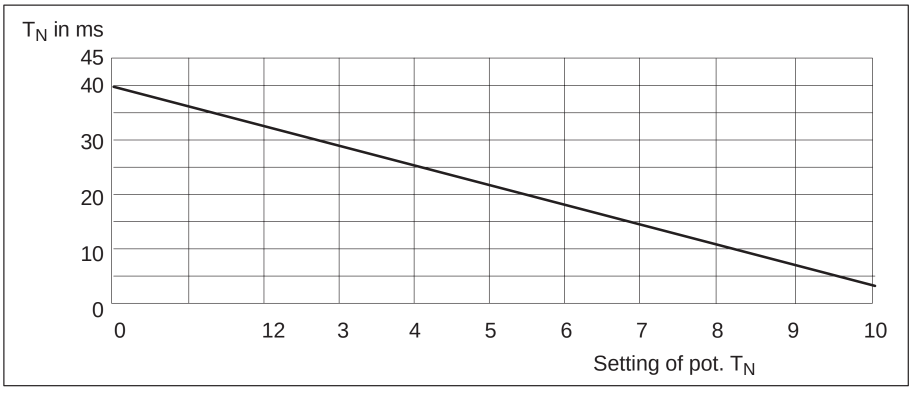

Fig. 2-3 Integral action time T_N as a function of T_N potentiometer

2.4 Drift offset

Compensation for $n_{set} = 0$ using a potentiometer

Potentiometer drift	Control range ±45 mV

■

Start–up, supplementary functions 3

3.1 Position processing

The WSG interface is not influenced by the controller inhibits (terminals 63, 64, 65, 663) and from the central reset (terminal R). The output signals are switched into a high–ohmic condition if encoder faults develop and for a power–on reset.

	Switch for axis 1	Switch for axis 2	Effect
Motor pole pair No. [1] Resolver pole pair No. [1) 4)]	S1.x S1.x	S2.x S2.x	2p=2, 4, 6, 8 corr. to p=1, 2, 3, 4 2p=2, 4, 6, 8 corr. to p=1, 2, 3, 4
Phase sequence of tracks A, B (WSG)	S1.6=OFF S1.6=ON	S2.6=OFF S2.6=ON	A before B, clockwise dir. of rotation [2] B before A, clockwise dir. of rotation [2]
Pulse number of the WSG interface	S1.7=OFF S1.7=ON	S2.7=OFF S2.7=ON	512 pulses/revolution 1024 pulses/revolution
Zero mark offset[3]	S1.8+S11.x=OFF S1.8=ON S11.1=ON S11.2=ON S11.3=ON S11.4=ON S11.5=ON	S2.8+S11.x=OFF S2.8=ON S11.6=ON S11.7=ON S11.8=ON S11.9=ON S11.10=ON	Offset by 0° mechanical Offset by 5.625° mechanical Offset by 11.25° mechanical Offset by 22.5° mechanical Offset by 45° mechanical Offset by 90° mechanical Offset by 180° mechanical

3.2 Current setpoint limiting

Function	Switch for axis 1	Switch for axis 2	Effect
Current setpoint limiting when selected using terminal 96 or for setting–up operation **Caution!** **The same limiting is effective for both functions**	S12.x=OFF S12.4=ON S12.3=ON S12.3+4=ON S12.2=ON S12.2+3=ON S12.1=ON	S12.x=OFF S12.8=ON S12.7=ON S12.7+8=ON S12.6=ON S12.6+7=ON S12.5=ON	Limiting to 100% Limiting to 75% Limiting to 55% Limiting to 45% Limiting to 25% Limiting to 20% Limiting to 5%

1) The pole pair numbers must be set before start–up (refer to Section 1)
2) When viewing the drive shaft end
3) The resulting zero mark offset is the sum of all set offsets
4) The number of zero marks per mechanical revolution is the same as the pole pair number p of the resolver

3.3 Other functions

Function	Switch for axis 1	Switch for axis 2	Effect
Integrator inhibit, speed controller Integrator inhibit, I controller [1] Fault message Master/slave Timer stage [2]	S5.1=OFF/ON S5.2=OFF/ON S5.5=OFF/ON S5.7=OFF/ON	S5.3=OFF/ON S5.4=OFF/ON S5.5=OFF/ON S5.6=OFF/ON S5.8=OFF/ON	Enable/inhibit Enable/inhibit Changeover, fault/ready signal 2nd axis as slave [3] 1 s / 300 ms
Function [4]	Components for axis 1	Components for axis 2	**As supplied**
Smoothing: Speed setpoint Speed actual value Speed controller T_N limits in the speed controller Weight equalization pos. I_{SET} Weight equalization neg. I_{SET}	 C135 [5] C143 [5] C134 [5] R448 [6] R349 [6] R348 [6]	 C148 [5] C149 [5] C147 [5] R454 [6] R356 [6] R355 [6]	 33 nF corresponds to 220 µs —— 1 nF corresponds to 160 µs —— —— ——

Calculating the smoothing time constants

Speed setpoint t_{set} = C135(C148) • 6.67 kΩ
Speed actual value t_{act} = C143(C144) • 6.67 kΩ
Speed actual value t_{nReg} = C134(C147) • 160 kΩ

The following components are on the component side (”Page 2”):C135, C143, C134, R348, R349, R454

The following components are located on the solder side (”Page 1”):C148, C149, C147, R355, R356, R448

External dimensioning, speed setpoint smoothing

Refer to Chapter 4.2.

Parameterization of the electronic weight equalization

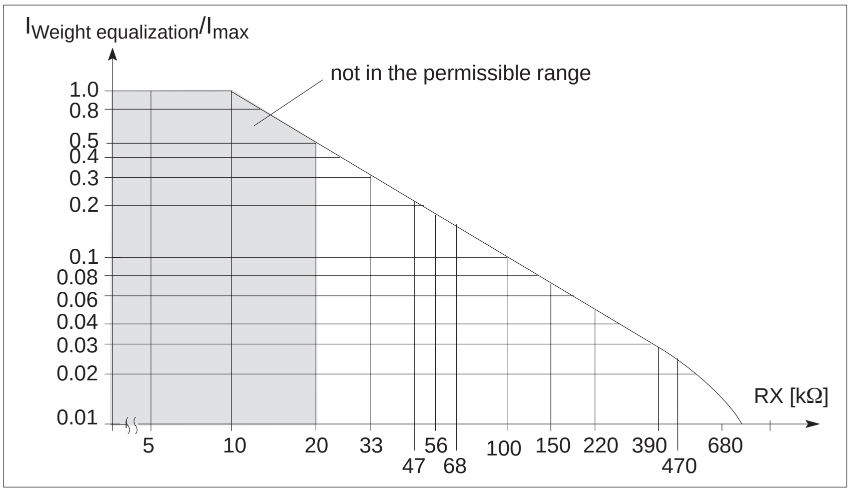

Fig. 3-1 Supplementary current setpoint for electronic weight equalization

Master slave operation

Current–controlled operation must always be selected for the slave axis using terminal 22. For the 2–axis control, master and slave can only be operated with opposing directions of rotation.

When using a one–axis control as master, the directions of rotation for the master and slave can be selected to either be opposing or the same. The selection is realized by connecting the current setpoint output (terminal 258, terminal 15) to the current setpoint differential input (terminal 24, terminal 20).

1) This function is only effective in the closed–loop current controlled mode; in the closed–loop speed controlled mode, the current controller integrator is always enabled

2) For terminal 65 and monitoring "speed controller at its limit"

3) Caution: Master and slave directions of rotation **oppose each other**

4) Adaptation, only for difficult operating conditions.
Adaptation is realized, if required, by soldering–in SMD components

5) SMD component, type of construction 0805

6) SMD component, type of construction 0204/Mini–Melf; equivalent, type of construction 0805

3.4 Operating feed modules without connected motor

Two–axis modules can be operated as single–axis module using the measures subsequently described.
To permit correct operation of the drive group, the ”motor temperature” and ”encoder fault” monitoring signals must be suppressed at the axis with is not connected.
To realize this, the following signals at the encoder interface (X311/X312) of the axis which is not connected, must be connected using short–circuit jumpers.

Measure	Signal	Pin	Jumper	Pin	Signal
1	TEMP_PLUS	13	———	25	TEMP_MINUS
2	SIN_PLUS	3	———	9	RES_POS
3	SIN_MINUS	4	———	11	RES_NEG

Warning

If measure 1 is not made, the group signal ”I2t motor temperature” of the I/R– or URE module is set to fault (overtemperature).
If measure 2,3 is not made, the ready relay of the I/R– and UE module signals ”fault”/”not ready”.

■

4 Setpoint interfaces

4.1 Overview

Definitions:

X	Optimal, taking into account the characteristics of the setpoint input
	Possible
	Not permitted, also, to some extent, not possible

Table 4-1 Main setpoint–supplementary setpoints

Operating mode	Setpoint	T.56/14	T.24/20	T.258/15[1)]
Speed–controlled	Main setpoint	X		
	Supplementary setpoint		X	
Current–controlled	Main setpoint		X	
	Supplementary setpoint			
Slave, I–controlled Current setpoint input	Main setpoint		X	
	Supplementary setpoint			
Master, speed–controlled Current setpoint output	Main setpoint			X
	Supplementary setpoint			

1) Only for 1–axis version,
For 2–axis version, the connection is realized on the board

4.2 External speed setpoint smoothing

Mounting locations C135 and C148 are provided on the board (refer to Section 3.3) for the internal speed setpoint smoothing. These mounting locations are provided for SMD capacitors.Time constants of approx. 1 ms can be achieved. Higher time constants must be realized by connecting–up the appropriate circuitry to the speed setpoint input, outside the board.
The following external circuit is recommended:

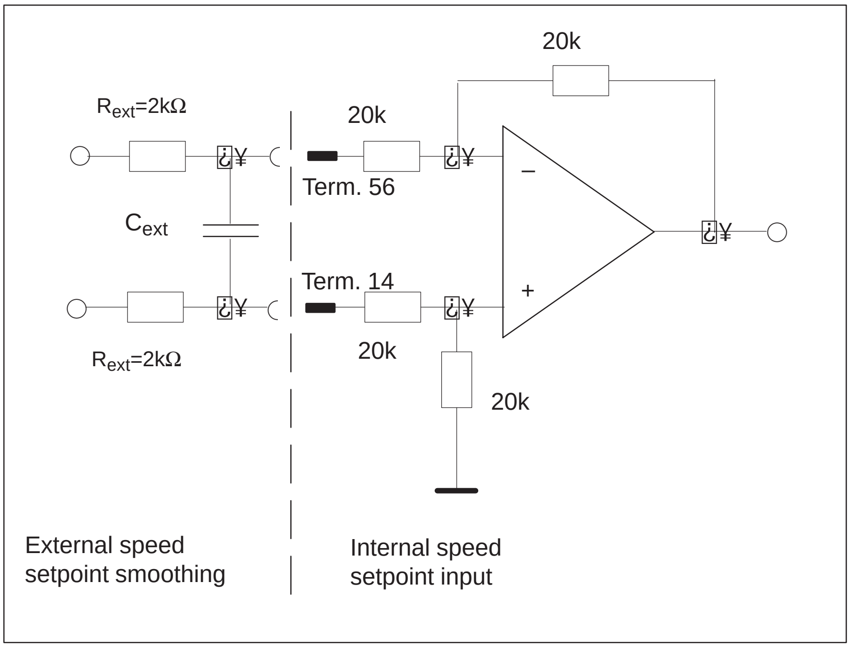

Fig. 4-1

The following is valid for the smoothing time constant of the speed setpoint:

$$t_{set,\ total} = t_{set} + t_{set,\ external}$$

t_{set} = internal speed setpoint smoothing (refer to Section 3.3)

$t_{set,\ external}$ = $C_{ext.} * 2 * R_{ext.} = C_{ext.} * 4k\Omega$

■

Free for expansions

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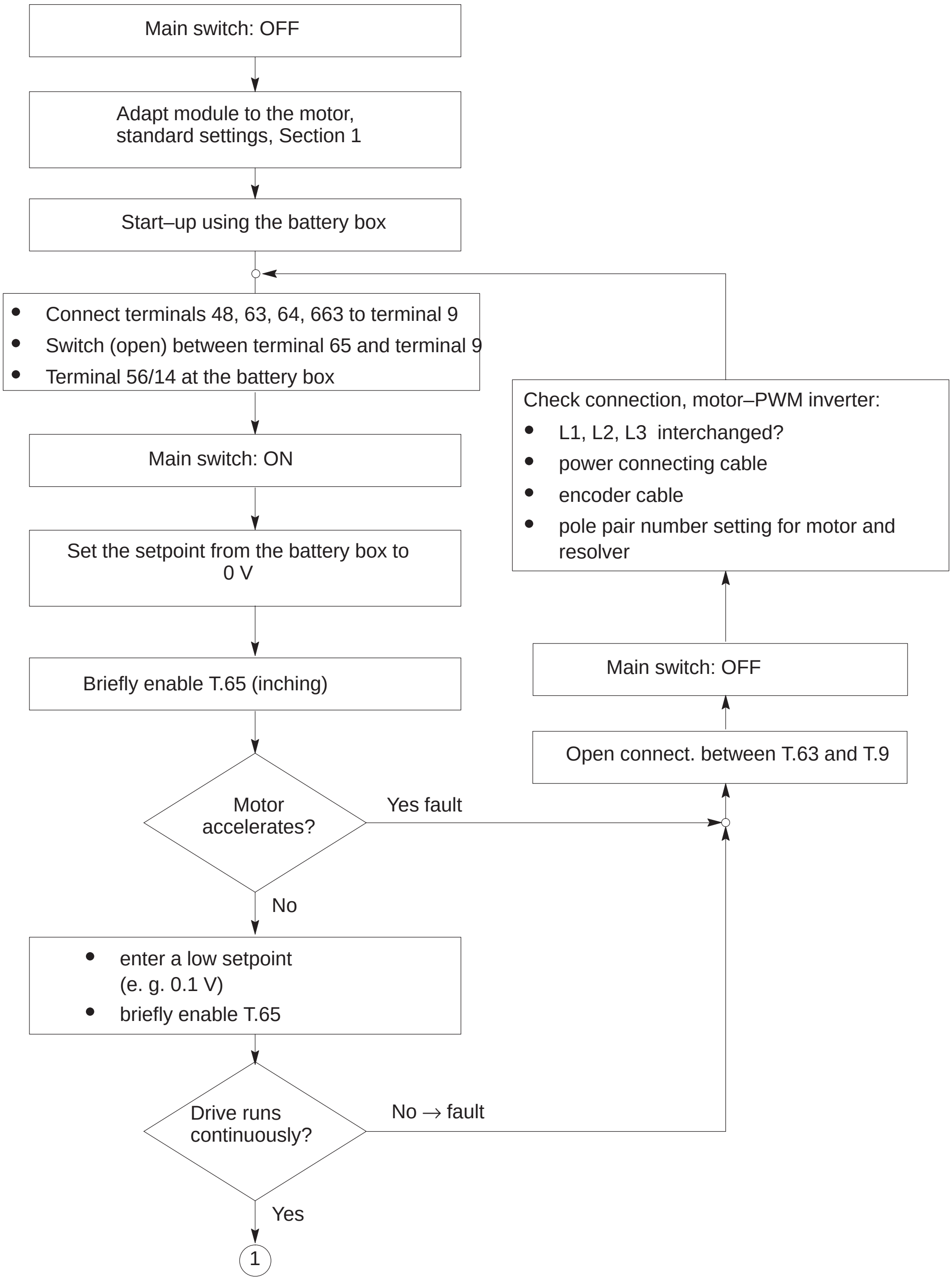
VR

6 Free for expansions

■

7

Power–up


Main switch: OFF
Adapt module to the motor, standard settings, Section 1
Start–up using the battery box
• Connect terminals 48, 63, 64, 663 to terminal 9
• Switch (open) between terminal 65 and terminal 9
• Terminal 56/14 at the battery box
Main switch: ON
Set the setpoint from the battery box to 0 V
Briefly enable T.65 (inching)
Motor accelerates?
Yes fault
No
• enter a low setpoint (e. g. 0.1 V)
• briefly enable T.65
Drive runs continuously?
No → fault
Yes
1
Open connect. between T.63 and T.9
Main switch: OFF
Check connection, motor–PWM inverter:
• L1, L2, L3 interchanged?
• power connecting cable
• encoder cable
• pole pair number setting for motor and resolver

1

Enable terminal 65

↓

Optimize the speed controller or set known values, Section 2

↓

Inhibit terminal 65

↓

If required, commission supplementary functions: Section 3

↓

Start–up completed

↓

Inhibit terminal 63!

↓

Main switch: OFF

↓

- open the connection between T.64, 65 and T.9
- disconnect the battery box from T.56/14

8 Maintenance and diagnostics

Test sockets

Terminal 16 = I_{act} and terminal 75 =n_{act} are available for measurement purposes.

Normalization: Terminal 16 10 V corresponds to I_{max}
Terminal 75 10 V corresponds to n_{rated} (refer to Sect. 2.1)

LED display

VR

An LED is available on the front panel for fault diagnostics.
Depending on the operating mode selection, either ready or fault is displayed.

Table 8-1 LED display

	LED dark	LED bright
Effect in the "ready" mode	Both axes of a two–axis board are enabled	At least one axis is inhibited via a terminal or as the result of an fault signal.
Effect in the "fault" mode	Both of the axes of a two–axis board are not inhibited as a result of a fault signal.	At least one axis is inhibited as the result of an fault signal.

Table 8-2 Fault signals, causes

Fault	Effect
Speed controller at its endstop	Stored [1)]
Encoder fault	Stored [1)]
Heatsink overtemperature	Pre–alarm to the NE module, stored after 4 s [1)]
Motor overtemperature	Pre–alarm to the NE module, not stored

1) Stored = pulse inhibit

X391/X392

To support fault diagnostics, the following signals are available at the connector of the WSG interface. 2)

Signal level : HCMOS / 5V

Table 8-3 Signals for fault analysis

Signal	Name	Pin	Status L=Low	Status H=High
READY	Hardware reset	1	Power supply voltage o.k.	Power supply voltage not o.k.: –Run–up after power–on –P5 defective
ER_IL	I^2t monitoring	9	No fault	Fault: Heatsink temperature too high
ER_TNR	Speed controller end stop	10	No fault	Fault: The speed controller has been at its limit for 1s/300ms
EN_WSG	Enable WSG signals	11	WSG interface inhibited A, B, R signals in a high–ohmic condition –hardware reset active –encoder fault	WSG interface enable A, B, R signals valid

Warning

2) Internal signals on the board for fault analysis!
Not intended for use in external boards!

■

Appendix 9

VR

9.1 Terminals

Table 9-1 Terminals

T. No.	Location 2)	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
56	X321/322	Speed setpoint	I	0V...±10V	1.5 mm^2
14	X321/322	Differential input	I		1.5 mm^2
24	X321/322	Speed/current setpoint	I	0V...±10V	1.5 mm^2
20	X321/322	Differential input	I		1.5 mm^2
75	X321/322	Speed actual value	O	0V...±10V	1.5 mm^2
15	X321/322	Reference potential	O	0V	1.5 mm^2
16	X321/322	Active current actual value	O	0V...±10V	1.5 mm^2
96	X321/322	Switch–in I_{set} limiting	I	+13V...30V	1.5 mm^2
9	X321/322	Enable potential	O	+24V	1.5 mm^2
22	X321/322	Changeover, n/I–controlled	I	+13V...30V	1.5 mm^2
9	X331	Enable potential	O	24V	1.5 mm^2
663	X331	Pulse enable	I	+21V...30V	1.5 mm^2
AS1	X331	Relay, start inhibit	NC	max. 250V_{AC}/1A	1.5 mm^2
AS2	X331	floating contact	NC		1.5 mm^2
9	X332	Enable potential	O	30V_{DC}/1A	1.5 mm^2
65.1	X332	Controller enable, axis 1	I	+13V...30V	1.5 mm^2
9	X332	Enable potential 3)	O	24V	1.5 mm^2
65.2	X332	Controller enable, axis 2 3)	I	+13V...30V	1.5 mm^2

For the 1–axis version, X332 has the following assignment:

Table 9–2 Terminals

T. No.	Location	Function	Type 1)	Typ. voltage/limit values	Max. cross–section
9	X332	Enable potential	O	+24V	1.5 mm^2
65.1	X332	Controller enable	I	+13V...30V	1.5 mm^2
15	X332	Reference potential	O	0V	1.5 mm^2
258	X332	Current setpoint	O	0V...±10V	1.5 mm^2

1) I = input, O = output, NC = NC contact NO = NO contact (for signal: Closed= high/open= low)
2) X321=1st axis, X322=2nd axis
3) Only for 2–axis version

9.2 Block diagrams

9.2.1 Block diagram, resolver control

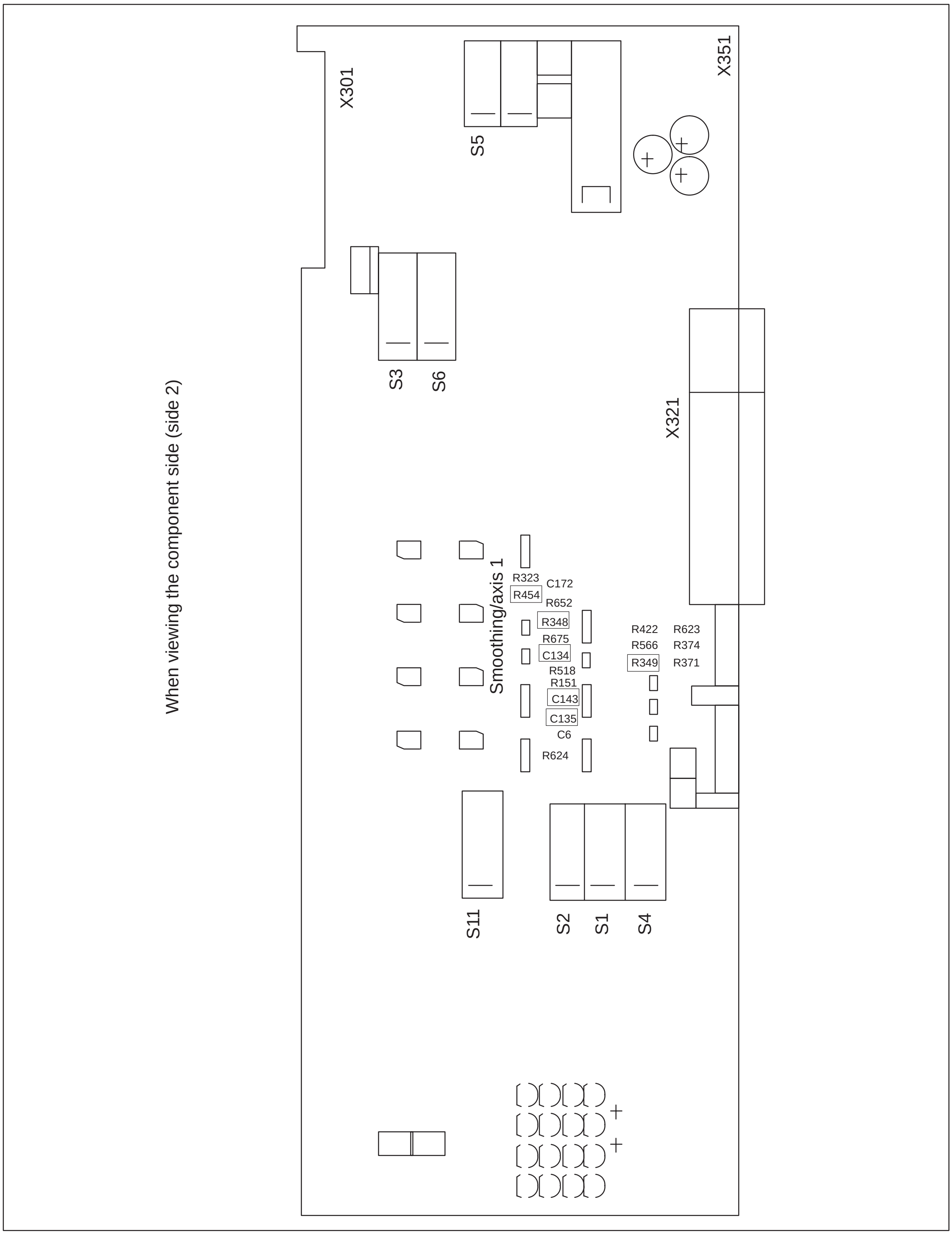


Fig. 9-1 Component side

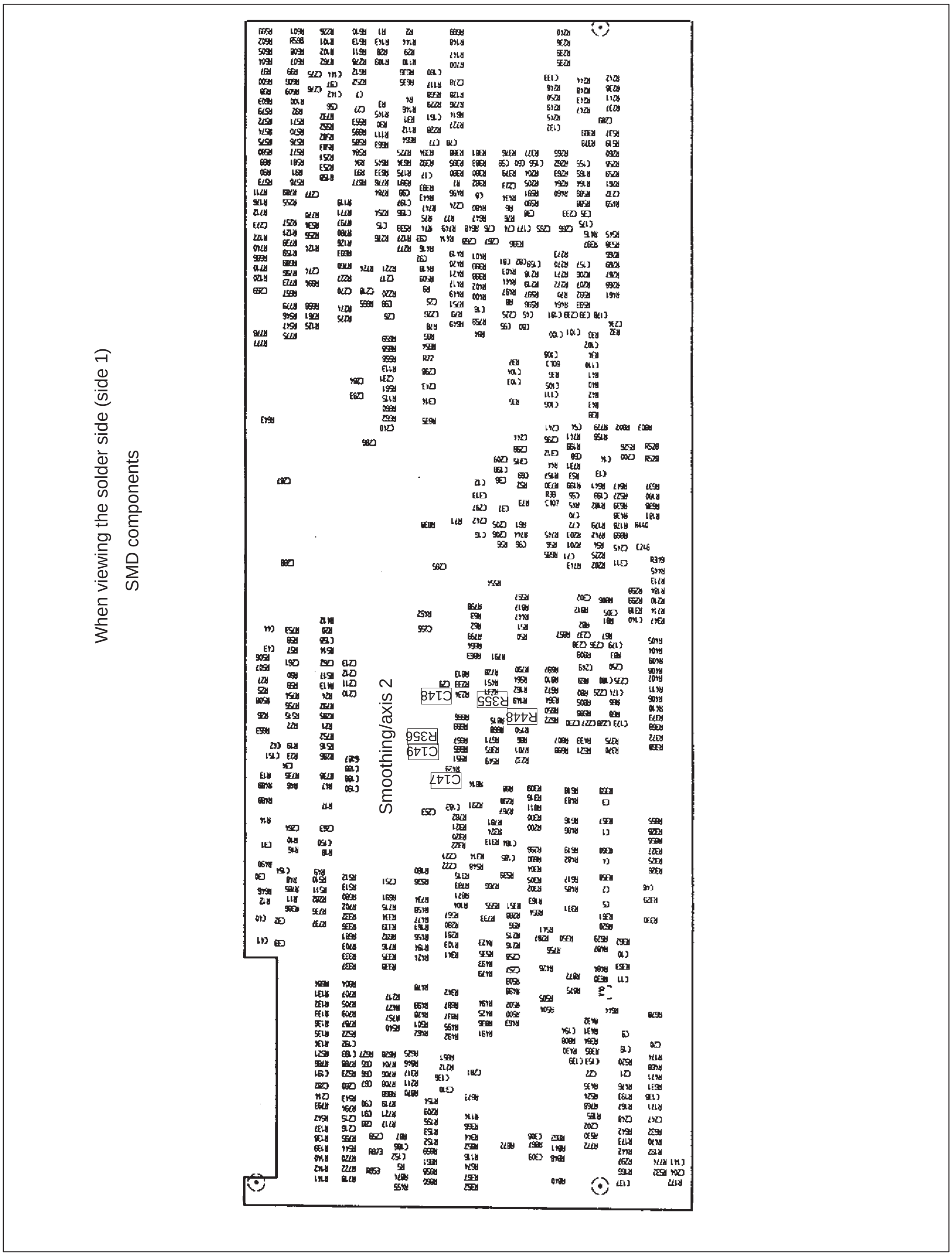


Fig. 9-2 Solder side

9.2.2 Block diagram, DIL switch

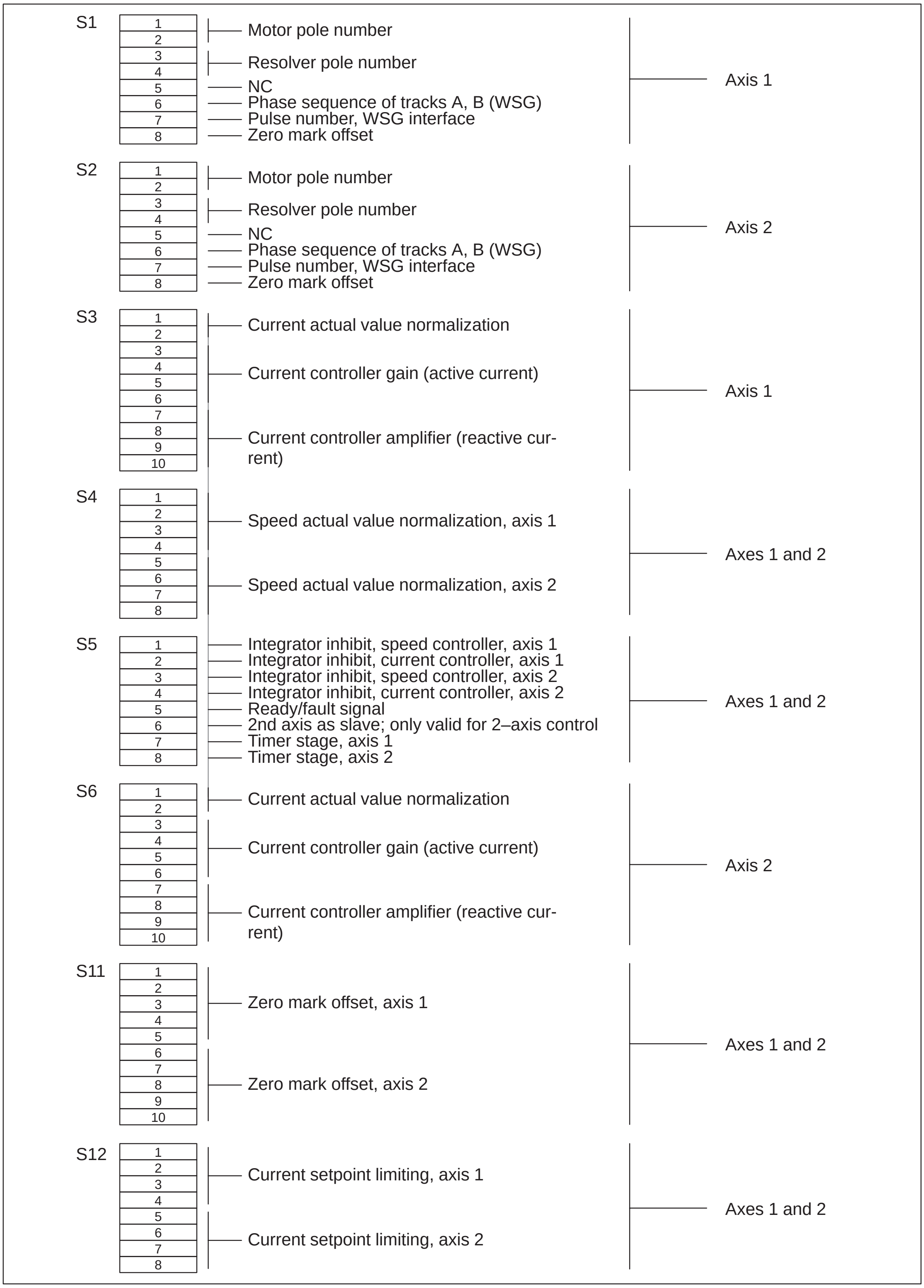


Fig. 9-3 DIL switches

9.3 Connector assignment

9.3.1 X311/X312, encoder interface, axis 1/axis 2

Resolver–control

25–pin subminiature–D plug connector, UNC4–40 screw locking, connected using pre–assembled cable

Table 9-2

Signal	Resolver control	Motor
SIN_PLUS	3	1
SIN_MINUS	4	2
M	5, 8, 24	–
COS_PLUS	6	11
COS_MINUS	7	12
RES_POS	9	10
RES_NEG	11	7
TEMP_PLUS	13	8
TEMP_MINUS	25	9

Refer to Section 3.4 for axis which is not used

VR

9.3.2 X391/X392, WSG interface, axis 1/axis 2

Resolver–control

25–pin subminiature–D plug connector, UNC4–40 screw locking, connected using pre–assembled cable

Table 9-3   1) Standard WSG interface type: RS422A / driver: 75ALS192

Signal	Remarks	Type	Resolver control	Numerik	FM–NC
M	WSG 1)	Reference pole	2	11	–9
O	WSG 1)	RS422A	3	1	–15
A_INV	WSG 1)	RS422A	4	9	–14
B	WSG 1)	RS422A	6	10	–13
B_INV	WSG 1)	RS422A	7	3	–12
R	WSG 1)	RS422A	12	4	–10
R_INV	WSG 1)	RS422A	13	12	–11
READY	only X392 2)	HCMOS !	1	NC	– NC
ER_IKL	Diagnostics 2)	HCMOS !	9	NC	– NC
ER_TNL	Diagnostics 2)	HCMOS !	10	NC	– NC
EN_WSG	Diagnostics 2)	HCMOS !	11	NC	– NC

Warning

2) Internal signals on the board for fault analysis!
Not intended for use in external boards!

■

Main spindle modules (HS)

First steps 1

Warning

This unit must be professionally transported stored, installed and mounted as well as careful operator control and service to guarantee perfect, safe and reliable operation.

Severe bodily injuries or material damage can result if this warning information is not observed.

The boards have components which can be destroyed by electrostatic discharge.
Please observe the ESDS information in the foreword.

Note

The board MLFB (Order No.) 6SN1121–0BA11–0AA1 can only be operated with firmware from 3.00.

The boards, MLFB (Order Nos.):
6SN1121–0BA11–0AA0
6SN1121–0BA12–0AA0
6SN1121–0BA13–0AA0
may only be operated with Firmware 2.xx.

1.1 Start–Up Guidelines

Structure of the Start–up Guide

The Start–up Guide is structured according to the sequence of the various start–up steps.

To start–up standard applications, where the preset drive converter interfaces (Section 1.5) and controller optimization when shipped are adequate, then only the highlighted start–up steps are of significance.

1 First steps

- **Start–up guidelines**
- **Start–up instructions**
- **Operator control and display elements, control parameters**
- **Overview, setting data**
- **Connections**

2 System configuration

- **Motor– and converter data sets**
  - **standard motors**
  - special motors
  - star/delta motors, 2 motors
- **Standard applications**
- Additional applications
  - auxiliary function M19
  - C–Axis
  - Spindle positioning
  - torque–controlled operation
  - monitor function
  - HPC axis

3 Converter interfaces

- Analog speed setpoint interface
- Input terminals
- Output terminals

4 Contr. optimization

- Speed controller
- current controller

5 Diagnostics, fault analysis

- Diagnostic resources
- Fault analysis

6 Appendix

- Flow diagram for short start–up
- Code numbers for power sections and standard motors
- Connection overviews
- Connector assignment
- Addresses, RAM variables
- Setting– and monitoring data

Fig. 1-1 Start–up steps

Parameter list

Warning

Parameter settings, which are not listed in the parameter list (refer to Section 6.6) may not be changed.

The parameter descriptions are in the form of tables.

The sequence in which they are listed is the actual parameterizing sequence.

Table 1-1 Example of the parameter display

Parameter attributes				setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–040.1	**P–270.1**	online, RESET, after initializa-tion, after con-version	4 10	Value range Dimensions	Parameter designation Brief description of the parameter FW x.xx

HS

Parameter attributes

- **Number**
  - Mot. 1

    Generally valid parameters, parameters for motor 1 (star) when using star/delta motors or 2 motors
  - Mot. 2

    Parameters for motor 2 (delta) when using star/delta motors or 2 motors
  - **(**P–001**)**

    Display parameter
  - P–040**.1**

    Gearbox stage–dependent parameters

- **Change effective**
  - Online

    Change is immediately effective
  - RESET

    The unit must be powered–down and up again
  - After conversion

    A conversion program is initiated by setting to 1H, after which the parameter is automatically reset to 0H (P–143, P–177, P–237, P–239).
  - After initialization

    Initialization is started by setting P–097 to 1H.
- **P–051**

  Write protection parameters
  Remove write protection by entering 4H and 10H

Setting range

For several control words, the functions are activated by setting bits.

Example:	Bit 8	0<u>1</u>00H	or	Bit 6	00<u>4</u>0H
	Bit 9	0<u>2</u>00H	or	Bit 7	00<u>8</u>0H

A combination of several functions is entered by hexadecimal addition.

Example:	Bit 8 + bit 9	0<u>3</u>00H	or	Bit 6 + bit 7	00<u>C</u>0H

Description

- **FW x.xx**

  Firmware–release dependent coding of the function– and parameter extensions. The extension is available from the specified firmware–release.

1.2 Start–up instructions

Start–up possibilities

using

- operator control and display elements (refer to Section 1.3)
- RS232C interface with an IBM AT–compatible computer and start–up software (refer to foreword)

Re–initialize drive converter (if required)

If an already initialized drive–converter is to be re–initialized, then proceed as follows:

- if required, back–up the setting data (parameters)
- remove write protection: Set **P–051** to 4H
- start initialization: Set **P–097** to 0H
- overwrite the parameters in the drive–machine data memory:
  Set **P–052** to 1H, and wait until **P–052** resets itself to 0H.
- power–on reset:
  Power–down the unit and power–up approximately 2 s after the display has disappeared:
  P–095 must then appear in the display.
- initialize (Section 2.1)

HS

Firmware replacement (if required)

The firmware can be replaced using the user–prompted start–up software for main spindle– and induction motor modules, from version V2.00.

Firmware release	Board
before FW 3.00	6SN1121–0BA1□–0AA0
from FW3.00	6SN1121–0BA11–0AA1

Procedure:

- back–up setting data (parameters)
- replace the firmware using the start–up program
- initialize with the pulses and controller inhibited (Section 2.1)
- re–load the backed–up settings
- back–up the setting data in the drive–machine data memory (Section 1.3)

Start–up of series machines, module replacement, component replacement

The drive converter setting data (parameters) can be saved on floppy disk using the start–up software. Proceed as follows to start–up additional drive converters (start–up of series machines):

1. Initialize with the pulses and controllers inhibited:
   Enter P–095 power module code number according to Table 6–1. [1)]
   – Motor code number and motor encoder pulse number are saved on the floppy disk, and therefore do not have to be entered.
   – Start initialization.
2. Load and save the setting data from the floppy disk.

[1)] Power module with MLFB (Order No.) 6SN112□–1A□0□–□□A1 are automatically identified from FW 3.00. It is then no longer possible/necessary to enter P–095.

1.3 Operator control and display elements, control parameters

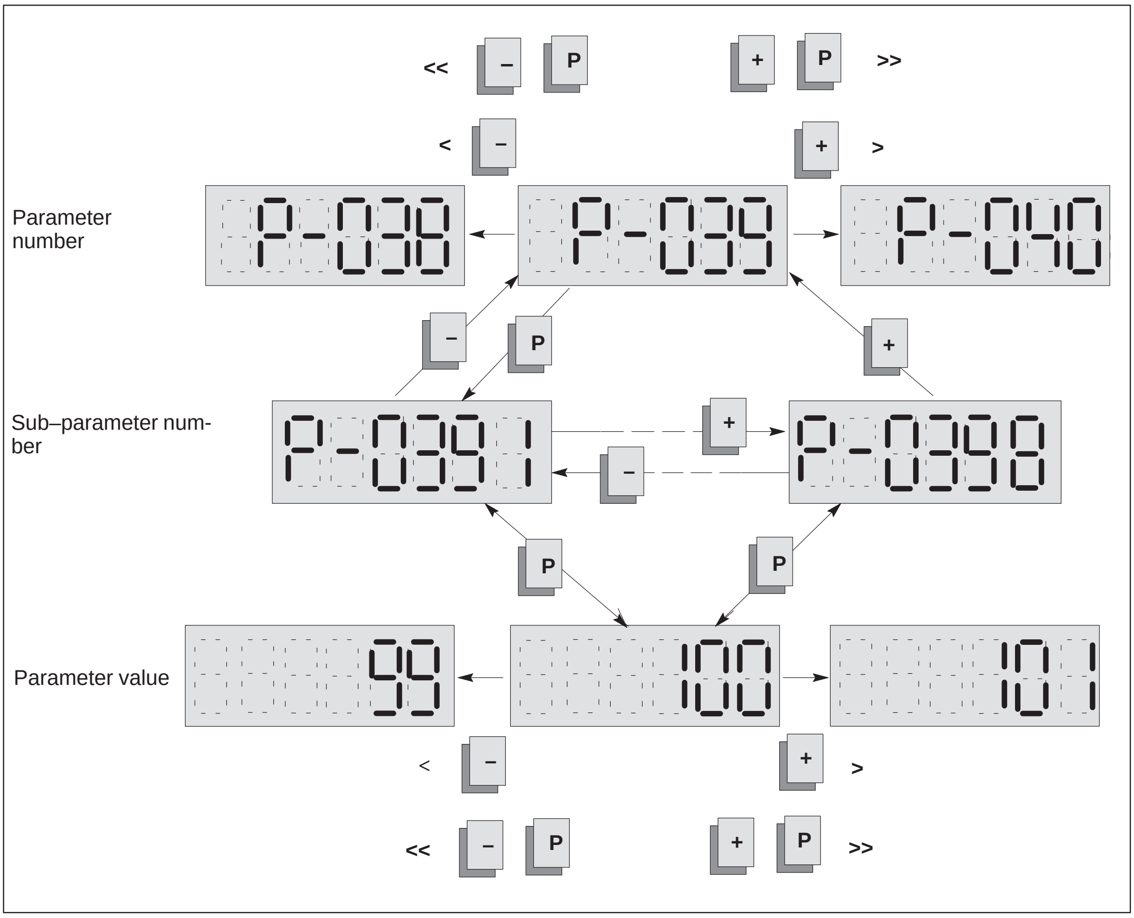
Operator control– and display elements

The following operator control– and display elements are available on the front panel to start–up and parameterize the SIMODRIVE 611 analog system, main spindle drive module:

- 3 op. contr. keys + , P and – key)
- 6–character LCD

The functions of the operator control elements are illustrated using parameter P–039 as example.

Gearbox–stage dependent parameters are listed with sub–parameter numbers (e.g. **P–039.1** to**P–039.8**).



Control parameters

Note

If data storage (**P–052**) is interrupted due to power failure or the power being disconnected, then the modified/changed values are lost, and when the power returns, the converter displays fault message ”F–07”. The parameter values can be reset after fault message ”F–07” is acknowledged (refer to Sec. 5.2.2).

Table 1-2 Control parameters

<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Setting range</th><th rowspan="3" colspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Change effective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td>P–051
P–151</td><td>–</td><td>Online</td><td>–</td><td>0...7FFF hex</td><td colspan="3">Write protection
Remove the write protection by entering 4H or 10H.</td></tr>
<tr><td>P–052
P–152</td><td>–</td><td>Online</td><td>4</td><td>0...1 hex</td><td colspan="3">Transfer parameters into FEPROM
Transfer into the drive–machine data memory is initiated by setting to 1H.
The parameter is reset to 0H after successful transfer.</td></tr>
<tr><td rowspan="7">P–053</td><td rowspan="7">–</td><td rowspan="7">Online</td><td rowspan="7">4</td><td rowspan="7">0...FFFF hex</td><td colspan="3">Control word</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>0</td><td>0000H
0001H</td><td>The ready relay pulls–in if there is no fault and the pulses and controller are enabled.
The ready relay pulls–in if there is no fault.</td></tr>
<tr><td>1</td><td>0000H
0002H</td><td>For a ramp–function generator fast stop, the speed setpoint is digitally set to zero but the motor remains magnetized.
The drive pulses are canceled when the drive comes to a stop.</td></tr>
<tr><td>4</td><td>0000H
0010H</td><td>Speed setpoint smoothing, inactive
Speed setpoint smoothing, active</td></tr>
<tr><td>5</td><td>0000H
0020H</td><td>Speed actual value smoothing inactive
Speed actual value smoothing active if simultaneously
P090 bit 3=0 FW 3.0</td></tr>
<tr><td>8
9
10</td><td></td><td><table><tr><th>Bit 10/bit 9/bit 8</th><th>Inverter clock frequency [kHz]</th></tr><tr><td>0000H</td><td>3.2</td></tr><tr><td>0100H</td><td>2.8 FW 3.0</td></tr><tr><td>0200H</td><td>6.3</td></tr><tr><td>0300H</td><td>5.0 FW 3.0</td></tr><tr><td>0400H</td><td>4.7</td></tr><tr><td>0500H</td><td>3.9 FW 3.0</td></tr><tr><td>0600H</td><td>7.8</td></tr><tr><td>0700H</td><td>5.9 FW 3.0</td></tr></table>Note:
A pulse frequency > 3.2 kHz is only possible if the drive is de–rated (refer to Fig. 1–3).</td></tr>
</table>

HS

Table 1-2 Control parameters

Parameter attributes: Number Mot. 1	Number Mot. 2	Change effective	P–051	Setting range	Description: Bit	Value	
					11	0000H 0800H	Fault message F–79 not suppressed, Fault message F–79 suppressed
					12	0000H 1000H	Ramp–function generator tracking, active Ramp–function generator tracking, inactive
					13	0000H 2000H	Bipolar speed setpoint evaluation Unipolar speed setpoint evaluation FW 2.00
					15	0000H 8000H	Cyclic display of parameter number active Cyclic display of parameter number inactive FW 3.0
P–090	–	Online	10	0...FFFF hex	**Control word**		
					Bit	Value	
					0	0000H 0001H	Parameter format, hex display Parameter format, dec display **Caution!** **Parameter settings in the hex format are ineffective!**
					1	0000H 0002H	Fault message F–09 activated Fault message F–09 suppressed FW 2.00
					2	0000H 0004H	Extended monitoring for F09 inactive Extended monitoring for F-09 active (short–circuit M/P5) FW 3.00
		RESET			3	0000H 0008H	Speed controller clock [μs] Standard operation 1000 HPC axis without filter 500 with filter 600 possible from FW 3.0 Standard operation 525 HPC axis without filter 300 with filter 350 If bit 3 is changed, it only becomes effective after saving in the FEPROM and powering–down and on again
		Online			4	0000H 0010H	Speed controller without integration inhibit Speed controller with integrator inhibit (for M19)
					5	0000H 0020H	Fault message F-18 suppressed Fault message F-18 active (FW 3.00)
					6	0000H 0040H	Speed controller integrator, when limited, is set to the difference between a torque limit and P component Speed controller integrator is held when limited FW 2.00

Various inverter clock frequencies can be parameterized, please observe current de–rating.

Table 1-3 Currents as a function of the inverter clock frequency, MSD analog f_T

Power module type	Order Nos. 6SN1123–1AA0□– 6SN1124–1AA0□– 6SN1135–1BA1□–	Code No.	In/Is6/Imax in A f_T=3.20 kHz	In/Is6/Imax in A f_T=4.70 kHz	In/Is6/Imax in A f_T=6.30 kHz	In/Is6/Imax in A f_T=7.80 kHz
50 A	–0CA□	6	24/32/32	20/26/26	15/20/20	10/14/14
80 A	–0DA□	7	30/40/51	26/34/44	21/28/36/	17/23/29
108 A	–0LA□	13	45/60/76	39/52/65	32/43/54	26/34/43
120 A	–0GA□	8	45/60/76	39/52/65	32/43/54	26/34/43
160 A	–0EA□	9	60/80/102	51/68/86	41/54/69	31/42/53
200 A	–0FA□	10	85/110/127	73/95/109/	60/78/90	48/63/72
300 A	–0JA□	11	120/150/193	101/127/163	81/102/131/	62/78/101
400 A	–0KA□	12	200/250/257	169/211/217	135/169/174	104/130/134

Power module type	Order Nos. 6SN1123–1AA0□– 6SN1124–1AA0□– 6SN1135–1BA1□–	Code No.	In/Is6/Imax in A f_T=2.80 kHz	In/Is6/Imax in A f_T=3.90 kHz from FW3.00	In/Is6/Imax in A f_T=5.00 kHz from FW3.00	In/Is6/Imax in A f_T=5.90 kHz from FW3.00
50 A	–0CA□	6	24/32/32	22/29/29	19/25/25	16/21/21
80 A	–0DA□	7	30/40/51	28/37/48	25/33/42	22/30/38
108 A	–0LA□	13	45/60/76	42/56/71	37/50/63	34/45/57
120 A	–0GA□	8	45/60/76	42/56/71	37/50/63	34/45/57
160 A	–0EA□	9	60/80/102	56/74/95	49/65/83	43/58/73
200 A	–0FA□	10	85/110/127	79/103/119	71/91/106	63/82/95
300 A	–0JA□	11	120/150/193	111/139/179	98/122/157	86/108/139
400 A	–0KA□	12	200/250/257	185/232/238	163/203/209	144/180/185

HS

1.4 Overview, setting data

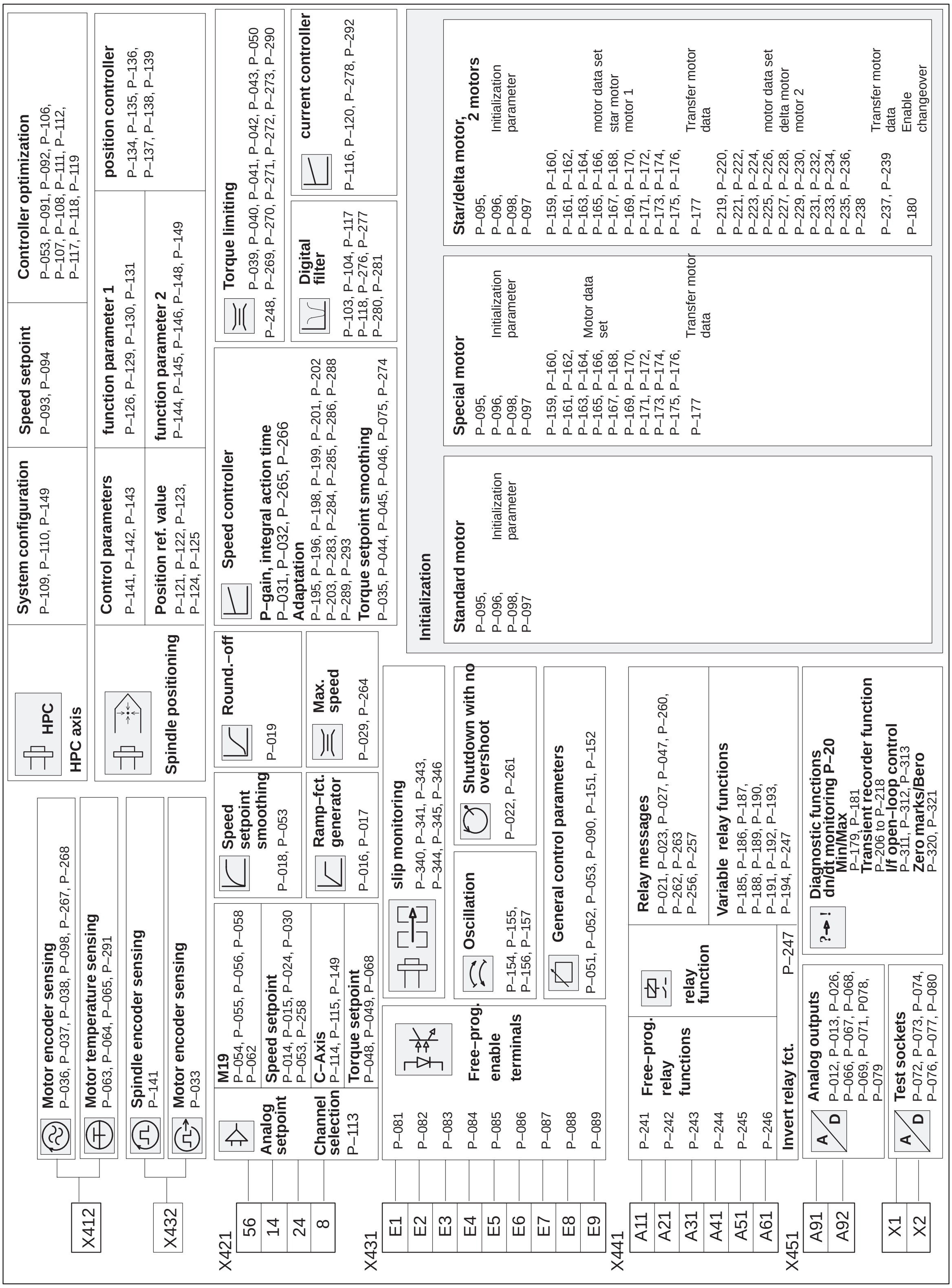


Fig. 1-2 Setting data

1.5 Connections

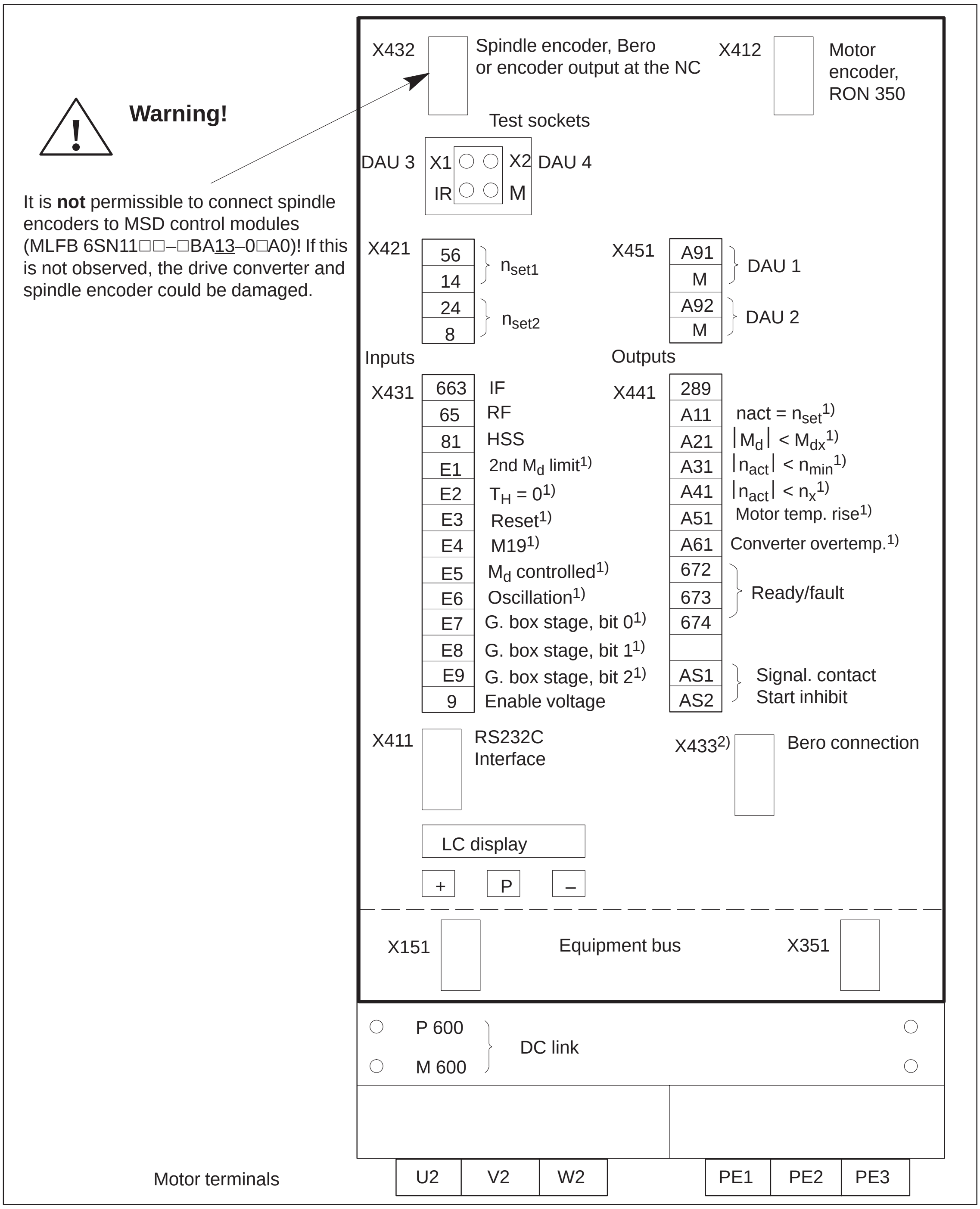


Fig. 1-3 Connections

1) Freely–programmable terminals and relay functions as supplied

2) only for MLFB (Order No.) 6SN1121–0BA11–0AA1

■

Determining and setting the system configuration

2

Warning

The motor could accelerate to inadmissibly high speeds and terminal 64 (NE) and terminal 65 (controller inhibit) could become ineffective if incorrect values are set in **P–098**. Only terminal 663 (axis–specific pulse cancellation) ”open” is effective.

2.1 Motor– and converter data sets

HS

2.1.1 Initializing the system configuration with standard motors

Initializing

Table 2-1 Initialization

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–095	–	After initial–ization	–	6...13 dec	**Power module code number** Pre–setting: 7 (Section 6.2) from FW 3.00 Pre–setting: 3 1)
P–096	–	After initial–ization	–	101...425 dec	**Motor code number** Pre–setting: 101 (Section 6.2)
P–098	–	After initial–ization	–	128...4096 dec	**Encoder pulse number, motor measuring system** Pre–setting: 2048 for 1PH4, 1PH6 Adapt for 1PH2 and toothed–wheel encoder.
P–097	–	–	–	0...1 hex	**Initialization** ”SEtUP” message is displayed. The selected motor/power module combination is loaded into the drive–machine data memory. The ”P–000” operating display is displayed after successful initialization.

1) Power modules with MLFB (Order No.) 6SN12□–1A□0□–□□A**1** are automatically identified from FW 3.00. It is then no longer possible to change P–095.

Operation from an uncontrolled infeed

Table 2-2 Operation from uncontrolled line supply infeed (UE)

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–173	–	After conversion	10	100...6000 RPM	**Speed at start of field weakening** Multiply init. by the fact. $V_{supply} \bullet 0.002 \bullet \frac{1}{V}$ (corresponds to 0.8 for V_{supply}=400V)
P–176	–	After conversion	10	1...150 %	**Stall torque reduction factor** Multiply init. value by the factor $(V_{supply} \bullet 0.002 \frac{1}{V})^2$ (corresponds to 0.64 for V_{supply}=400V)
P–177	–	online	10	0...1 hex	**Start calculation, motor** The calculations for the entered motor are started. ”99” is entered in P–096.
P–052	–	online	4	0...1 hex	**Parameter transfer into the FEPROM**

2.1.2 System configuration with special motors

Note

When special motors are used, the motor data must be discussed with the responsible SIEMENS office.

Overview

- Initializing special motors
- Motor data set
- Characteristics for the flux setpoint– and magnetizing inductance.

Initializing special motors

Table 2-3 Initializing special motors

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–095	–	After initial–ization	–	6...13 dec	**Power module code number** Pre–setting: 7 (Section6.2) from FW 3.00 Pre–setting: 3 [1)]
P–096	–	After initial–ization	–	101...425 dec	**Motor code number** Pre–setting: 101 (Section 6.2) Motor code number of a standard motor is entered, whose motor data approximately correspond to those of the special motor.
P–098	–	After initial–ization	–	128...4096 dec	**Encoder pulse number, motor measuring system** Pre–setting: 2048
P–097	–	–	–	0...1 hex	**Initialization** ”SEtUP” message is displayed. The selected motor/power module combinations are loaded into the drive–machine data memory. The operating display ”P–000” is displayed after successful initialization.

1) Power modules with MLFB (Order No.) 6SN112□–1A□0□–□□A**1** are identified automatically from FW 3.00. It is then not possible to change P–095.

HS

Motor data set

For special motors, the motor data must be entered. The motor data list (**P–159** to **P–176**) is provided in Section 6.6.

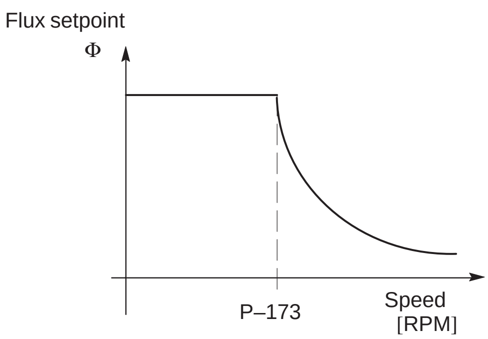
Table 2-4 Motor data set

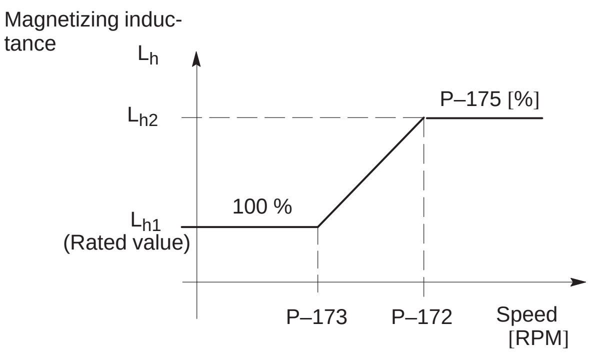
Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–158	–	online	4	0.000 mH...65.535 mH	from FW 3.00 Low–leakage motors require a series reactor to smooth the phase currents. The series reactor acts on the drive converter just like an increased stator leakage reactance P169/229. Previously, P169/P229 had to be manually adapted. P158 and P294 influence the stall limiting and the pre–assignment (pre–setting) of the current controller.
P–159 to P–176	–	After conversion	10	Refer to Section 6.6	**Motor data for motor 1** Motor data is entered for the special motor
P–177	–	online	10	0...1 hex	**Start calculation, motor 1 (P–096)** The calculations for the entered special motor are started. ”99” is entered in P–096.
P–052	–	online	4	0...1 hex	**Parameter transfer into the FEPROM**

Flux setpoint– and magnetizing inductance characteristic

Table 2-5 Flux setpoint– and magnetizing inductance characteristic

Parameter attributes: Number Mot. 1	Number Mot. 2	Chance effective	P–051	Setting range	Description
P–172	–	After conversion	10	10...10000 RPM	**Upper speed L_h characteristic** (magnetizing inductance characteristic)
P–173	–	After conversion	10	100...6000 RPM	**Speed at the start of field weakening** Speed at the start of field weakening for the flux setpoint characteristic and the lower speed for L_h characteristic. When an uncontr. infeed is used, the calc. value must be multiplied by the factor $V_{supply} \bullet 0.002 \frac{1}{V}$ (corresponds to 0.8 for V_{supply}= 400V)
P–175	–	After conversion	10	100...300 %	**Gain factor, L_h characteristic** $P\text{–}175 = \frac{L_{h2} \text{ (at n=P–172)}}{L_{h1} \text{ (at n=P–173)}} \cdot 100\,\%$ 100 % = constant L_h over the complete speed range
P–176	–	After conversion	10	1...150 %	**Stall torque reduction factor** Stall torque limit: P–176 > 100 %: Stall torque limit increased P–176 < 100 %: Stall torque limit decreased For operation from an uncontr. infeed, the calc. value must be mult. by the fact.$(V_{supply} \bullet 0.002 \frac{1}{V})^2$ (corresponds to 0.64 for V_{supply}= 400V)





HS

2.1.3 System configuration with star/delta motors, 2 motors

Note

When special motors are used, the motor data must be discussed with the responsible SIEMENS office.

Overview

- Initializing star/delta motors, 2 motors
- Motor data sets
- flux setpoint– and magnetizing reactance characteristic
- Motor changeover

Initializing star/delta motors, 2 motors

Table 2-6 Initializing star/delta motors, 2 motors

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–095	–	After initial–ization	–	6...13 dec	**Power module code number** Pre–setting: 7 (Section 6.2) from FW 3.00 Pre–setting: 3 [1)]
P–096	–	After initial–ization	–	101...425 dec	**Motor code number** Pre–setting: 101 (Section 6.2) The following motor code number should be entered, depending on the system configuration: Star/delta standard motor Enter the even (star motor) Motor code number Star/delta special motor Enter an even motor code number of a standard motor (star), whose motor data approximately correspond to those of the special motor. 2 standard motors Enter the motor code number of the first standard motor 1. stand. motor is entered 2 special motors Enter a motor code number of standard motor whose motor data approximately correspond to the first special motor.
P–098	–	After initial–ization	–	128...4096 dec	**Encoder pulse number, motor measuring system** Pre–setting: 2048

1) Power modules with MLFB (Order No.) 6SN12□–1A□0□–□□A**1** are automatically identified from FW 3.00. It is then not possible to change P–095.

Table 2-6 Initializing star/delta motors, 2 motors

Parameter attributes				Setting range	Description
Number		Chance ef-fective	P–051		
Mot. 1	Mot. 2				
P–097	–	–	–	0...1 hex	**Initialization** The ”SEtUP” message is displayed. The selected motor/power module combination is loaded into the drive–machine data memory. The operating display ”P–000” is displayed after successful initialization.
–	**P–238**	After con-version	10	101...338 dec	**Motor code number** Pre–setting: 101 (Section 6.2) The motor code number is entered for the 2nd mo-tor (delta) depending on the system configuration. Procedure as for P–096.
–	**P–239**	online	10	0...1 hex	**Start the calculation for motor 2 (P–238)**
P–052	–	online	4	0...1 hex	**Parameter transfer into the FEPROM**

Motor data sets, special motors

For special motors, the motor data must be entered. The list of motor data sets is provided in the Appendix (refer to Section 6.6).

- **P–158** to **P–176**, star motor data, or data set, motor 1
- **P–294, P–219** to **P–236** delta motor data or data set, motor 2

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Table 2-7 Motor data sets

Parameter attributes				Setting range	Description
Number		Chance ef-fective	P–051		
Mot. 1	Mot. 2				
P–159 to P–176	**P–219 to** P–236	After con-version	10	Refer to Section 6.6	**Motor data for motor 1/motor 2** Motor data is entered depending on the system configuration: Star/delta standard motor no input required Star/delta–special motor, enter the motor data for star (P–159 to P–176) and delta (P–219 to P–236) 2 standard motors no input required 2 special motors Enter the motor data for the 1st special motor (P–159 to P–176) and 2nd motor (P–219 to P–236) input
P–158	P294	online	4	0.000 mH...65.535 mH	from FW 3.00 Low–leakage motors require a series reactor to smooth the phase currents. The series reactor acts on the drive converter just like an increased stator leakage reactance P169/229. Previously, P169/P229 had to be manually adap-ted. P158 and P294 influence the stall limiting and the pre–assignment (pre–setting) of the current controller

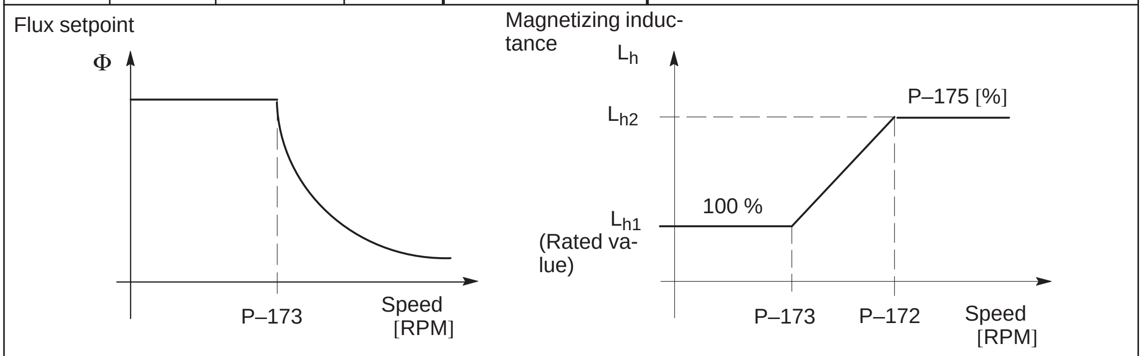
Table 2-7 Motor data sets

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–177	**P–237**	online	10	0...1 hex	**Start calculation, motor 1(P–096)/motor 2 (P–238)** The calculations for the entered motor data are started if P–180=0.
P–052	–	online	4	0...1 hex	**Parameter transfer into the FEPROM**

Flux setpoint– and magnetizing inductance characteristic

Table 2-8 Flux setpoint– and magnetizing inductance characteristic

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–172	**P–232**	After conversion	10	10...10000 RPM	**Upper speed L_h characteristic** (magnetizing inductance characteristic)
P–173	**P–233**	After conversion	10	100...6000 RPM	**Speed at the start of field weakening** Speed at the start of field weakening for the flux setpoint characteristic and the lower speed for L_h characteristic When an uncontr. infeed is used, the calc. value must be multiplied by the factor $V_{supply} \bullet 0.002 \frac{1}{V}$ (corresponds to 0.8 for V_{supply}= 400V)
P–175	**P–235**	After conversion	10	100...300 %	**Gain factor L_h characteristic** $P\text{–}175 = \frac{L_{h2}\ (\text{at } n=P\text{–}172)}{L_{h1}\ (\text{at } n=P\text{–}173)} \cdot 100\ \%$ 100 % = constant L_h over the complete speed range
P–176	**P–236**	After conversion	10	1...150 %	**Stall torque reduction factor** Stall torque limit: P–176 > 100 %: Stall torque limit increased P–176 < 100 %: Stall torque limit decreased For oper. from an uncontr. infeed, the calc. value must be mult. by the factor $(V_{supply} \bullet 0.002 \frac{1}{V})^2$ (corresponds to 0.64 for V_{supply}= 400V)



Motor changeover

Table 2-9 Motor changeover

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–180	–	online	10	0...1 hex	**Enable motor changeover (star/delta)** 0H: Motor changeover not possible 1H: Enable motor changeover **Note:** For the changeover request, a freely–programmable input terminal (E1 to E9) must be assigned function number 5 (parameterization, Section 3.2.2)

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2.2 Standard applications

2.2.1 Operating display

The actual converter operating status is displayed in parameters **P–000** and **P–100**.

Table 2-10 Operating display

Display					
Function group					
	Relay function	**Operating mode**	**Equipment status**	**Operating mode**	**Gearbox stage**
inactive	freely–progr. relay function 1 terminal A11 P–241 $n_{act} = n_{set}$ [1)] freely–progr. relay function 2 terminal A21 P–242 $\|M_d\| < M_{dx}$ [1)] freely–progr. relay function 3 terminal A31 P–243 $\|n_{act}\| < n_{min}$ [1)] freely–progr. relay function 4 terminal A41 P–244 $\|n_{act}\| < n_x$ [1)] freely–progr. relay function 5 terminal A51 P–245 mot–temp [1)] freely–progr. relay function 6 terminal A61 P–246 var. relay function (P–186) [1)] ready/fault terminal 672/674 P–053 ready **The segment is driven if the appropriate relay has pulled–in.**	drive not enabled:progress condition refer to column ”equipment status” speed controlled operation torque controlled operation torque– controlled operation with slip monitoring Operating mode M19 spindle positioning mode Operating mode C–axis Operating mode HPC axis 0.5 ms or 0.3ms Operating mode HPC axis 0.6 ms or 0.35ms diag. functions, I/f controlled operation Oscillation function has been selected (from fct. 3.00)	pulse enable at the NE module missing (T.63/T.48) axis–specific pulse enable missing (T663) controller enable missing at the NE module (T.64 and/ or controller enable missing at the main spindle module (T65) RFG enable missing (T.81) setpoint enable missing (select terminal function No. 16) Torque direction display for enabled motor: motor operation generator operation Speed controller clock fast, clock is active	**Display in P–000:** (only for star/delta mode) star circuit selected delta circuit selected digital filter is active **Display in P–100:** (only for spindle positioning mode) position 1 selected position 2 selected position 3 selected position 4 selected incremental positioning selected	Gearbox stage 1 is selected Gearbox stage 2 is selected Gearbox stage 3 is selected Gearbox stage 4 is selected Gearbox stage 5 is selected Gearbox stage 6 is selected Gearbox stage 7 is selected Gearbox stage 8 is selected Gearbox stage 1...8 Selected via freely–programmable terminal function P–081...P–089 =9, 10, 11

1) as supplied

2.2.2 Firmware version and module versions

Table 2-11 Firmware– and module version

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
(P–099)	–	–	–	0.00...99.00	**Firmware release**
(P–150)	–	–	–	–	**Board code**  **Function of connector X432:** F00H No function 200H with additional input for spindle encoder 300H Output, pulse encoder signal for external use

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2.2.3 Setting parameters for standard applications

Overview

- Speed settings
- torque limits
- Motor temperature monitoring
- Oscillation

Speed setting values

Table 2-12 Speed settings

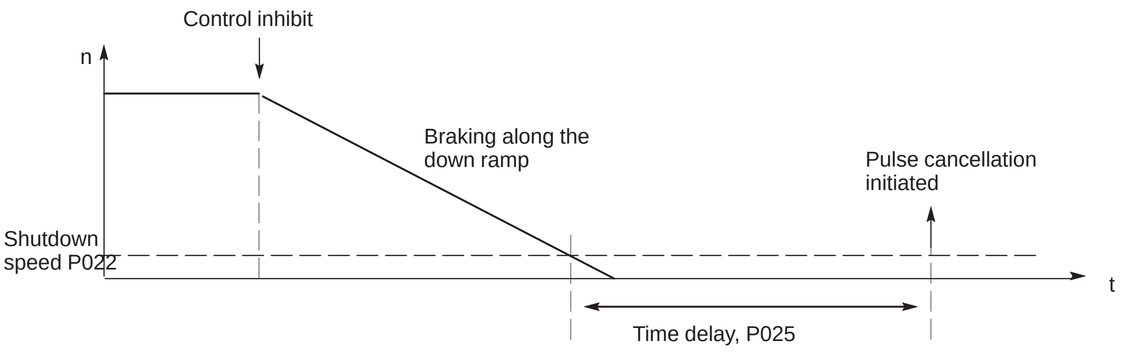
<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Setting range</th><th rowspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Chance ef-fective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td>P–022</td><td>P–261</td><td>online</td><td>4</td><td>1...n_{rated} RPM</td><td>Shutdown speed, pulse cancellation
When the controller is inhibited and the shutdown speed has been fallen below, the drive is switched into a no–current condition (shutdown without overshoot).</td></tr>
<tr><td>P–025</td><td></td><td>online</td><td>4</td><td>0...15000 ms</td><td>Pulses are canceled with a delay after the controller is inhibited FW 3.00
Pulse cancellation can be delayed after controller inhibit after braking along the down ramp via P025.</td></tr>
<tr><td colspan="6">
</td></tr>
<tr><td>P–029</td><td>P–264</td><td>online</td><td>4</td><td>0...n_{maxMot} RPM</td><td>Speed limiting
Max. motor speed setting</td></tr>
<tr><td>P–036</td><td>–</td><td>online</td><td>4</td><td>– 400...400 dec</td><td>Encoder phase error correction
If the two encoder tracks are not precisely shifted through 90°, then this results in torque ripple.
Setting resolution 1 corresponds to 0.18°∡
max. value 400 corresponds to 72°∡</td></tr>
</table>

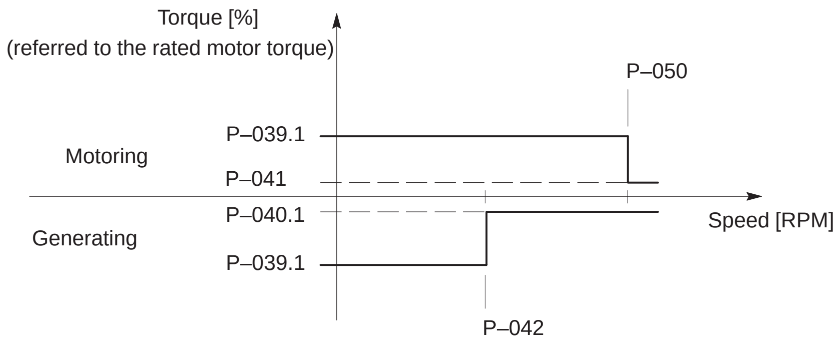
Table 2-12 Speed settings

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–037	**P–267**	online	4	1...32000 RPM	**Changeover speed, motor encoder evaluation** Above this speed, the fine evaluation of the speed actual value generation is disabled. (from firmware V2.00, no longer relevant)
P–038	**P–268**	online	4	1...500 RPM	**Hysteresis, P–037/P–267** (from firmware V2.00, no longer relevant)

Torque limit values

Table 2-13 Torque limits

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–039.1	**P–269.1**	online	4	5...300 %	**1st torque limit** (referred to the rated motor torque)
P–041	**P–271**	online	4	5...100 %	**2nd torque limit** Is activated by terminal 111 and when the speed, set in P–050/P–290 is exceeded.
P–050	**P–290**	online	4	0...n_{maxMot} RPM	**Changeover speed from Md1 to Md2**
P–040.1	**P–270.1**	online	4	5...100 %	**Regenerative limiting** (referred to P–039/P–269 or P–041/P–271)
P–042	**P–272**	online	4	1...n_{maxMot} RPM	**Changeover speed for P–040/P–270**
P–043	**P–273**	online	4	0...n_{maxMot} RPM	**Hysteresis, P–042/P–272**



Max. selectable torque limit: $\sqrt{\dfrac{I^2_{maxconv} - I_0^2{}_{Mot}}{I^2_{ratedmot} - I_0^2{}_{Mot}}} \cdot 100\ \%$ (referred to 10 s overload)

$I_{maxconv.}$ – maximum converter current
$I_{0\ mot}$ – no–load motor current
$I_{ratedmot}$ – rated motor current

Motor temperature monitoring

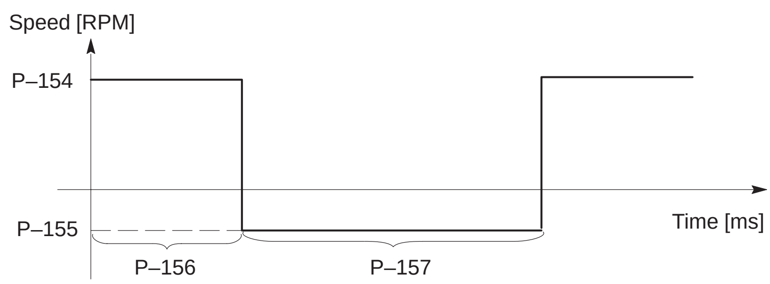
Table 2-14 Motor temperature monitoring

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–063	**P–291**	online	4	0...170 °C	**Maximum motor temperature** when exceeded, after approx. 1 s: "Alarm motor overtemperature" relay Time in P–065: Pulse cancellation and fault message F–14
P–064	–	online	4	0...170 °C	**Fixed temperature** The motor parameter is calculated using this fixed temperature if a value ≠ 0. **Caution!** The motor temperature monitoring is inactivated.
P–065	–	online	4	0...600 s	**Timer, motor temperature monitoring**

Oscillation

Table 2-15 Oscillation

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–154	–	online	4	$-n_{maxMot}$... n_{maxMot} RPM	**Oscillation setpoint 1**
P–155	–	online	4	$-n_{maxMot}$... n_{maxMot} RPM	**Oscillation setpoint 2**
P–156	–	online	4	10...10000 ms	**Oscillation pause time 1**
P–157	–	online	4	10...10000 ms 0...10000 ms from FW 3.00	**Oscillation interval time 2** **When a 0 is entered, only the value in P154 is effective, from FW 3.00**



2.3 Other applications

2.3.1 Oriented spindle stop (via NC auxiliary function M19)

Function M19 can be selected using a select terminal (E1 to E9) (refer to Section 3.2.2).

Table 2-16 Oriented spindle stop (via NC auxiliary function M19)

Parameter attributes				Setting range	Description
Number		Chance effective	P–051		
Mot. 1	Mot. 2				
P–054	–	online	4	$-n_{maxMot}$... n_{maxMot} RPM	**M19, speed setpoint normalization** Speed, which is reached for the analog input voltage in P–024. + = clockwise rotation for a positive speed setpoint – = counter–clockwise rotation for a negative speed setpoint
P–055	–	online	4	C000...4000 hex	**M19, offset correction** e. g. positive correction 2FH negative correction FF00H
P–056	–	online	4	0...n_{maxMot} RPM	**M19, changeover speed** Speed changeover point of the setpoint normalization factor. When the selected speed is fallen below, the values, entered in parameters P–054 and> P–055 become effective.
P–058	–	online	4	0...n_{maxMot} RPM	**Shutdown threshold, rounding–off M19** If the selected speed is fallen below, the speed setpoint smoothing and rounding–off are disabled. Restart is realized after canceling M19 operation. FW 2.00
P–062	–	online	4	0...n_{maxMot} RPM	**M19, switching threshold, I component speed controller** Speed actual value threshold for switching–in the integral action time from the speed controller. The integral action time is re–enabled if the absolute value of the speed, entered in P–062, is fallen below.
P–090	–	online	10	0...FFFF hex	**Control word** P–062 is activated by setting bit 4 = 1 (corresponds to 10H) in P–090.w

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2.3.2 C axis

C–axis operation can be switched–in using a select terminal (E1 to E9) (Section 3.2.2). The setpoint can only be entered via terminals 24 and 8.

Table 2-17 C–axis

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–114.1	–	online	4	$-n_{rated}-1 \ldots n_{rated}-1$ RPM	**Normalization, speed setpoint C axis** Speed, which is reached for the analog input voltage in P–024. + = clockwise rotation for positive speed setpoint – = counter–clockwise rotation for negative speed setpoint
P–115.1	–	online	4	C000...4000 hex	**Offset correction for P–114** Max. correction value 2000 or E000 corresponds approx. to 1/8 of P–114, if P–024 = 10.0

2.3.3 Spindle positioning

Overview

- function description
- Position reference values
- Function parameter 1
- Position controller
- Open–loop control parameters
- Function parameter 2
- diagnostics parameter
- short start–up

Function description

Without a higher–level closed–loop position control loop of a numerical control, the main spindle is positioned from the same direction of rotation or with a direction of rotation reversal.

There are various ways of sensing the position:

- with motor encoder (sin/cos tracks) without gearbox (all parameters are pre–initialized for this case)
- with motor encoder (sin/cos tracks) and external zero marks (BERO) at the spindle when the gearbox stage is changed–over
- with incremental spindle encoder (max. 8192 pulses per revolution), only for versions with spindle encoder input (6SN11□□–□BA12–0□A0)

  Spindle encoder signals are always evaluated as square–wave including pulse quadrupling.

Warning

It is ⌐£™ possible to connect spindle encoders to main spindle drive control cards with pulse encoder signal outputs for external use (MLFB 6SN11□□–VBA$_{13}$–0VA0)! If this is not observed, the equipment and spindle encoder could be damaged.

The hardware configuration must be entered via **P–141**.

The select terminal function ”Positioning on” (Funct.–No. 28) must be connected

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via parameters **P–081** to **P–089** to one of the freely–programmable terminals E1 to E9 (refer to Section 3.2.2). Positioning is initiated by connecting the enable voltage to the selected terminal.

Positioning is executed in several phases:

- **Drive braking**

  Starting from any speed, the drive brakes down to the search speed along the ramp specified by the ramp–up/ramp–down generator. The speed setpoint is entered from the positioning control and if a speed setpoint is injected at terminal 56, this is suppressed.

  The search speed, is the highest speed from which the drive can brake at the reference position in one revolution without overshoot. The upper search speed limit is defined by the deceleration capability of the drive, and thus by the external moment of inertia.

- **Position identification**

  The closed–loop position controller is switched–in after the search speed has been reached and the zero mark identified.

- **Travel to reference position**

  The final rotation before the target is sub–divided into three phases, dependent on the distance from the target.

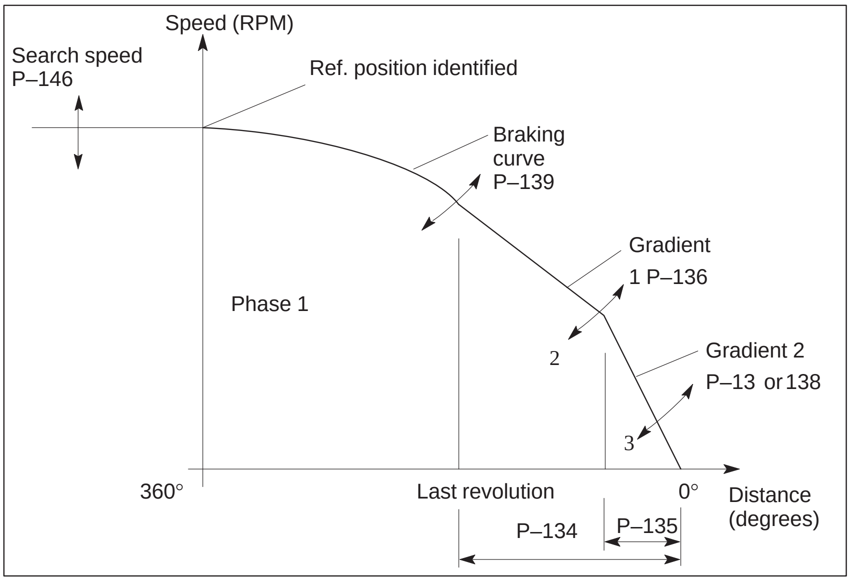

Fig. 2-1 Travel into position

The initiation points and gradients of the individual sections can be set. Thus, the approach characteristics can be adapted to the widest range of requirements **(P–134 to P–139).**

If the drive is rotating at a lower speed than the search speed, it can accelerate up to the search speed to reduce the positioning time. **(P–142)**.

In most cases, it is sufficient to adapt the search speed **P–146** and adapt parameters **P–137 or P–138 for optimization purposes.**

- **Reference format**

  The position reference value may only have values from 0 to max. +32767; from firmware release V2.00 max. 64000 I/rev. (corresponds to max. encoder pulse number between two zero pulses). The direction of rotation is obtained from the polarity of the search speed. Position reference values are entered in encoder pulses.

  When positioning with the motor encoder, **P–141** allows a multiplication factor to be entered to improve the reference value resolution. This multiplication factor can be 1, 2, 4, 8, 16 and 32. The multiplication factor can be selected so high that an arithmetic pulse number of up to 32768 is obtained.

  Example:

  RON350 standard encoder (2048 pulses). When using multiplication factor 16 this results in a calculated pulse number of 32768. This value must be entered into **P–131**. Setpoint inputs from 0 to 32768, from firmware release V2.00, max. 64000 pulses/revolution are possible. If higher values are entered, fault message FP–01 is output when positioning.

- **Enter the position reference value**

  Positioning can be realized with four internal position reference values per gearbox stage **(P–121 to P–122** and **P–124 to P–125)**.

Select terminal function 23	Select terminal function 27	Position reference value	Parameter for position reference value
0	0	1	P–121
1	0	2	P–122
0	1	3	P–124
1	1	4	P–125

  Another reference value can be selected, using select terminal functions 23 and 27 after the reference position has been reached. In this case, the signal at both terminals must be changed within 20 ms so that it can be considered to be simultaneous.

  When selecting a new position via a gearbox stage terminal, the ”in position” status is only executed, if the signal at the terminal, with function 28 (positioning ”on”) again changes from low to high. Contrary to select terminal functions 23 and 27, in this case, the zero mark is always passed–over again.

- **Incremental position reference value**

  An incremental position reference value per gearbox stage can be entered via parameter **P–123**. If the spindle is in position, and a positive edge appears at the freely–programmable terminal, assigned the select function 22, then the incremental position reference value is added to the current position reference value, and the drive travels to this calculated new position. This procedure can be re–started after the new position has been reached.

  For parameter **P–123**, contrary to **P–121, P–122, P–124** and **P–125**, negative values are also permissible.

- **Zero mark offset**

  A zero mark shift can be entered via parameters **P–129**/**P–130**.

  Setting possibility:

  Select positioning control (**P–149 = 1H**)
  Inhibit controllers and pulses.
  Rotate the spindle through a complete revolution and then set it into the required position (check via **P–140** corresponds to the position actual value).Set **P–129** to 1H, and wait until the parameter is automatically set again to 0H. The current position is now transferred as the new zero mark. The difference to the actual zero mark is displayed in **P–130**. If the spindle is now positioned to 0H, then the spindle moves to the position, which was stored in **P–130**.

- **Relay signals**

  Select relay functions 9 and 10 (refer to Section 3.3.2) are available for the ”position reached” relay signals. The associated tolerances are entered via parameters **P–144** and **P–145**.

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- **Spindle re–synchronization (zero mark)**

  When using a BERO zero mark, the position counter status of the spindle is re–synchronized after each gearbox stage change. This re–synchronization can be inhibited, or can be selected specifically via select terminals.

  Setting possibility:

  Spindle re–synchronization can be suppressed after a gearbox stage change, by setting bit 1 in parameter **P–149**. In this case, a signal change at one of the freely–programmable terminals, assigned the select terminal function ”gearbox stage, bit 0 to bit 2”, is then interpreted as parameter changeover from the position controller. Actual mechanical gearbox stage changeovers, when positioning to a motor encoder with external zero mark must be signaled to the position controller via select terminal function 29.

  Select terminal function 29 latches–in. The high signal level must be available for at least 20 ms.

Position reference values

Table 2-18 Position reference values

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–121	–	online	4	0...64000 dec	**Position reference value 1** Value is entered in encoder pulse number (max. input is increments per revolution)
P–122	–	online	4	0...64000 dec	**Position reference value 2**
P–123	–	online	4	–32768...32767 dec	**Position reference value, incremental** Value is entered in encoder pulse number (max. input is increments per revolution)
P–124	–	online	4	0...64000 dec	**Position reference value 3**
P–125	–	online	4	0...64000 dec	**Position reference value 4**

Function parameter 1

Table 2-19 Function parameter 1

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–126	–	online	4	0.0...180 degrees	**Bandwidth integrator enable, speed controller** In order to improve the approach characteristics when positioning, it is sometimes advantageous, if the speed controller integrator is disabled. The integrator inhibit (I component = 0) is canceled in the target range. The target range bandwidth can be set via this parameter.
P–149	–	online	4	0...FFFF hex	**Start–up parameter, C axis/position.** The integrator inhibit function is enabled by setting bit 5 (20H) via P–149.
P–129	–	online	4	0...1 hex	**Setting the internal zero mark** When bit 0 (1H) is set, the zero mark offset to the hardware zero mark is entered in P–130 (actual position counter status).
P–130	–	online	4	0...64000 dec	**Zero mark shift** Enters the difference to the hardware zero mark
P–131	–	online	4	128...64000 dec	**Max. pulse number between 2 zero marks** The pulse number for one spindle revolution is entered. If a spindle encoder (square–wave signals) is used, then quadrupling must be taken into account. If positioning is realized with gearbox and BERO, the difference between two consecutive BERO zero marks can be read–out via P–133. P–133 indicates the most accurate results in the speed range 100 to 500 RPM. Data read–out at standstill indicate incorrect values.

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Position controller

Table 2-20 Position controller

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–134	–	online	4	0.0...180.0 degrees	**Intervention point P–136**
P–135	–	online	4	0.0...180.0 degrees	**Intervention point P–137/P–138**
P–136	–	online	4	0...FFFF hex	**P gain, gradient 1**
P–137	–	online	4	0...FFFF hex	**P gain, gradient 2** Gain setting when positioning with spindle encoder.
P–138	–	online	4	0...FFFF hex	**P gain, gradient 2 (HMS)** Gain setting when positioning with motor encoder.
P–139	–	online	4	0...FFFF hex	**Multiplier for braking parabola** Factor to set the gradient of the braking characteristic, refer to Fig. 2-1.

Control parameters

Table 2-21 Open–loop control parameters

Parameter attributes: Number Mot. 1	Number Mot. 2	Change effective	P–051	Setting range	Description: Bit	Value	
P–141	–	online via P–143	4	0...FFFF hex	**Switching parameters, positioning**		
					Bit	Value	
					0	0000H 0001H	Evaluation of the motor encoder signals (HMS evaluation) Evaluation of the spindle encoder signals Note: X432 must be configured as spindle encoder input. This is only possible for board versions 6SN1121–0BA12 (always) and 6SN1121–0BA1□ (using P033=0). Otherwise, fault message F–10 is output. Spindle encoder signals are always evaluated as squarewave, including the pulse quadrupling.
					1	0000H 0002H	Zero pulse from the encoder External zero pulse (e.g. Bero)
					2	0000H 0004H	Spindle encoder phase sequence is not inverted Spindle encoder phase sequence is inverted (actual value reversal)
					8	0100H	Setpoint multiplication factor 2 for positioning to a motor encoder with internal zero mark.
					9	0200H	Setpoint multiplication factor 4 for positioning to a motor encoder with internal zero mark.
					10	0400H	Setpoint multiplication factor 8 for positioning to a motor encoder with internal zero mark.
					11	0800H	Setpoint multiplication factor 16 for positioning to a motor encoder with internal zero mark.
					12	1000H	Setpoint multiplication factor 32 for positioning to a motor encoder with internal zero mark.
					Note: After changing the setpoint multiplication factor (bits 8 to 12), before transferring the new settings the pulse number must be adapted in P–131 using P–143. The changed settings must then be activated using P–143. The setting of parameter P–141 is transferred and activated, by changing the contents of parameter P–143 from 0 to 1!		

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Table 2-21 Open–loop control parameters

<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Setting range</th><th rowspan="3" colspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Change effective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td>P–143</td><td>–</td><td>online</td><td>4</td><td>0...1 hex</td><td colspan="3">Transfer parameter P–141
Values changed in P–141 are transferred if P–143 = 1. The parameter is automatically reset to 0.</td></tr>
<tr><td rowspan="6">P–142</td><td rowspan="6">–</td><td rowspan="6">online</td><td rowspan="6">4</td><td rowspan="6">0...21 hex</td><td colspan="3">Flag for speed increase</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td rowspan="2">0</td><td>000<u>0</u>H</td><td>The drive first accelerates to search speed, if positioning is started from a speed which is lower than the search speed, and then the position is approached (faster positioning).</td></tr>
<tr><td>000<u>1</u>H</td><td>The spindle is not accelerated to the search speed, and the spindle moves into position from the instantaneous speed.</td></tr>
<tr><td rowspan="2">5</td><td>00<u>0</u>0H</td><td>Zero mark monitoring (fault FP–02) is enabled. When positioning with a BERO, the zero mark is evaluated at each positioning sequence, otherwise, only after gearbox stage changeovers. The zero mark monitoring is also inhibited after gearbox stage changeover, with P–142, bit 0 = 1.</td></tr>
<tr><td>00<u>2</u>0H</td><td>Zero mark monitoring (fault FP–02) is inhibited.</td></tr>
</table>

Function parameter 2

Table 2-22 Function parameter 2

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–144	–	online	4	0.00...18.00 degrees	**Response bandwidth, relay 1** Setting for the relay signal ”in position 1” (refer to Section 3.3.2)
P–145	–	online	4	0.00...18.00 degrees	**Response bandwidth, relay 2**
P–146	–	online	4	0...4 · n_{rated}	**Search speed** Speed setting value, where the position approach sequence is started.
P–148	–	online	4	0.0...180.0 degrees	**Motion window** If the spindle is moved out of its position for pulse inhibit during positioning operation, then when the pulses are re–enabled, the reference position is re–approached through the shortest path. If bit 3 is set in P–149, this is only realized, if the motion window (P–148) was not exited, and the terminal with function No. 28 (high) was not switched.

HS

Table 2-22 Function parameter 2

Parameter attributes: Number Mot. 1	Number Mot. 2	Change effective	P–051	Setting range	Description: Bit	Value	
P–149	–	online	4	0...FFFF hex	**Start–up parameter, C axis/position.**		
					0	0000H	Positioning inhibited, the control is not processed for positioning, i. e., positioning is not possible, and any position actual value displays are not accurate!
						0001H	The control is processed for positioning, and positioning is possible.
					1	0000H	When a positioning command is received (terminal with function No. 28, high), then the spindle is re–synchronized, if the signal changes at a freely– programmable terminal, assigned with the select terminal function ”gearbox stage bit 0 to bit 2”.
						0002H	The spindle is only re–synchronized, if there was a positive edge at a select terminal, with function 29, before the positioning command.
					2	0000H	Position reference values are not mirrored.
						0004H	The absolute position reference values are mirrored.
					3	0000H	For positioning sequences the position is approached from the selected direction.
						0008H	The position always approached with the same direction of rotation; the direction of rotation is specified by the polarity of the search speed. (Exception, refer to P–148)
					5	0000H	The speed controller integral action time is active.
						0020H	The speed controller integral action time is disabled. In the target range (can be set via P–126), the integral action time becomes active again.
					6	0040H	Overshoot reduced after braking to the search speed FW 2.00
					7	0000H	Speed setpoint rounding–off (P–019) is also effective during positioning.
						0080H	Speed setpoint rounding–off (P–019) is deactivated when the positioning command is received. The speed setpoint smoothing (P–018) is never active during positioning, independent of P–149.

Diagnostic parameters

Table 2-23 diagnostics parameter

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
(P–100)	–	–	–	–	**Operating display P–100** (refer to Section 2.2.1)
(P–128)	–	–	–	–	**Actual position reference value** The actual reference position is displayed in parameter P–128 in encoder pulses. The value is only updated, if the positioning software is enabled with P–149 = 1.
(P–132)	–	–	–	–	**Absolute position actual value without zero mark offset**
(P–133)	–	–	–	–	**Difference between 2 ext. zero marks** Displays the difference between two consecutive BERO zero marks (P–141 = 2).
(P–140)	–	–	–	–	**Absolute position actual value with zero mark shift**
(P–147)	–	–	–	–	**Position counter status with reference to the BERO** The position counter status when positioning with a BERO is displayed.
(P–320)	–	–	–	–	**Diagnostics, motor encoder zero mark**
(P–321)	–	–	–	–	**Diagnostics, spindle encoder zero mark**

HS

Short start–up

Start–up example

Hardware design: Encoder signals and zero pulse from the motor encoder

P–149 must be set to 1H to enable the position program.

Enter the hardware configuration via parameter P–141
0 corresponds to the encoder signals from the motor encoder
Set P–141 to 0H (this is the pre–setting; if P–141 is changed, the change must be transferred with P–143 = 1 .

Enter a pulse number between two zero marks in P–131

Can the position be set by manually rotating the spindle?

Yes

1. Issue controller– and pulse inhibit.
2. Rotate the spindle through a complete revolution, and then rotate it to the reference position (the position actual value is displayed via P–140).

No

1. Enable drive (terminals 663, 65, 81)
2. With the speed setpoint entered, rotate the spindle through at least one revolution and then stop in position.
3. Disconnect terminals 65 and 663.

Write 1H into P–129: The parameter value automatically resets itself, so that this position is defined as software zero mark.
The offset to the hardware zero mark is displayed in parameter P–130.

Test position value:

1. Enable the drive (terminals 663, 65, 81)
2. Enter the speed setpoint
3. Select the select terminal (E1 to E9) with function No. 28 for positioning
   The motor brakes to the search speed, and stops in the specified reference position. (The position reference value and actual value can be checked using P–128 and P–140.)

Required position reached?

No

Change position value via P–121

Yes

Optimize position using parameters P–134 to P–139.
The search speed can be changed via P–146. Additional functions (refer to the parameter description, tables 2-21 and 2-22) via parameters P–142 and P–149. The response bandwidth for both relay signals
can be changed via P–144 and P–145.

Store the changed parameters in FEPROM (P–052).

End

2.3.4 Open–loop torque controlled operation (master/slave)

Overview

- function description
- parameter settings
- Parameter description
- slip monitoring

Function description

Open–loop torque controlled operation is necessary if the speed controller in the NC is used or for the slave drive for master/slave applications. The open–loop torque controlled mode can be selected via a select terminal, E1 to E9 (refer to Section 3.2.2). For master/slave operation
(2 spindle drives can be operated rigidly coupled), the torque setpoint must be fed from the master via a D/A converter output (adaptation **P–066** or **P–068** refer to Section 3.3.5) to the slave drive (adaptation **P–048**, **P–049**).

Warning

If the mechanically rigid coupling is released, the slave drive must be changed–over to ”closed–loop speed control”, otherwise the drive will accelerate to max. speed, although the M_d setpoint input is 0.

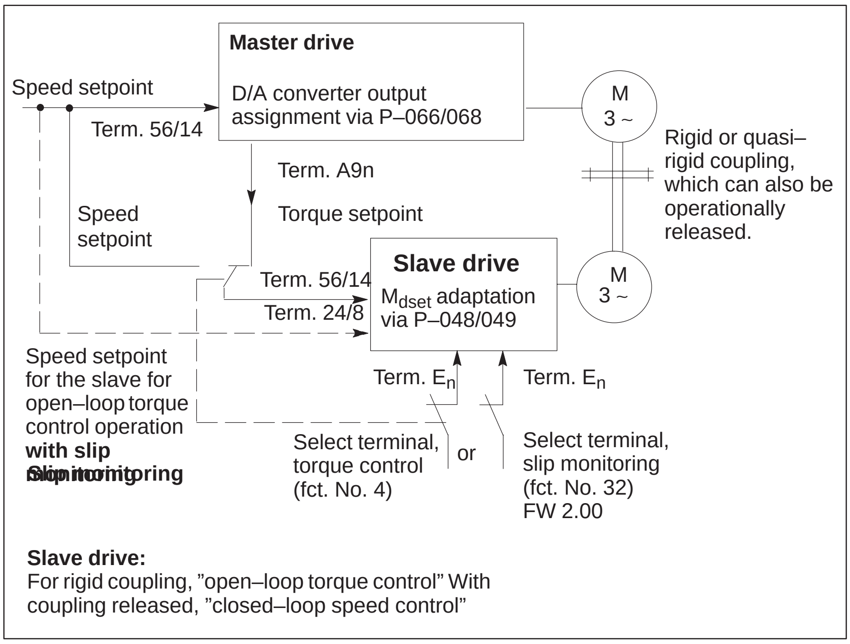


Fig. 2-2 Master/slave operation

Note

For controller inhibit in the open–loop torque controlled mode, the spindle must be braked via the M_d setpoint input; the pulses are only internally canceled after the shutdown speed (**P–022**) has been reached.

Parameter–settings

Example:

In order that the torque setpoint is available at terminals A92 and M of the master drive torque setpoint, address 0C6CH must be written into parameter **P–068**. Parameter **P–069** can be used, by shifting, to define which voltage is available at a specific torque.

The normalization of the rated motor torque can be taken from the contents of address 0F52H. Address 0F52H must be entered into **P–250** in order to determine this value, and the normalization value for the rated torque can be read–out of **P–251**.

Contents, P–251 (hex)	Shift factor P–069	Value to be changed (hex)	Output voltage D/A converter 2 [V] at M_{drated}
0C00	0 1 2 3	0C00 1800 3000 6000	0.94 1.88 3.75 7.50
1000	0 1 2	1000 2000 4000	1.25 2.50 5.00

At the max. output voltage, the torque limit in **P–039** must be taken into account (160 % corresponds to $M_{drated} \cdot 1.6$), and it must be ensured, that saturation does not occur (> 10 V).

If the slave drive is switched to the torque mode, parameters **P–048** and **P–049** are still effective. Torque adaptation can be executed using **P–048** (corresponding to **P–014** in closed–loop speed controlled operation) and torque drift can be compensated with **P–049** (corresponding to **P–015** in closed–loop speed controlled operation). Parameter **P–049** is not suitable for compensating for frictional forces. **P–048** and **P–049**, are ineffective in the closed–speed controlled mode.

From firmware release 3.00
The torque data is updated every 1 ms via address 304C (previously 20 ms) and is normalized with 5 V ≙ the rated motor torque.

Example:
Output via terminals A92 and M
P68=304CH P69=0H
Normalization can be influenced by P26.
For P26=100%, 5 V corresponds to the rated torque.
For P26=160%, 8 V corresponds to the rated torque.

Parameter description

Table 2-24 Parameter description

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–048	–	online	4	–250...250 %	**Normalization, M_{dset}** The setting is referred to the rated motor torque.
P–049	–	online	4	C000...4000 hex	**Torque setpoint offset**

Open–loop torque control with slip monitoring FW 2.00

The mechanical coupling between drives through a friction connection can cause the open–loop torque controlled slave drive to slip.

Using this function, the slave drive monitors the speed actual value deviation from the speed setpoint, and reduces the drive torque when a specific speed tolerance has been exceeded.

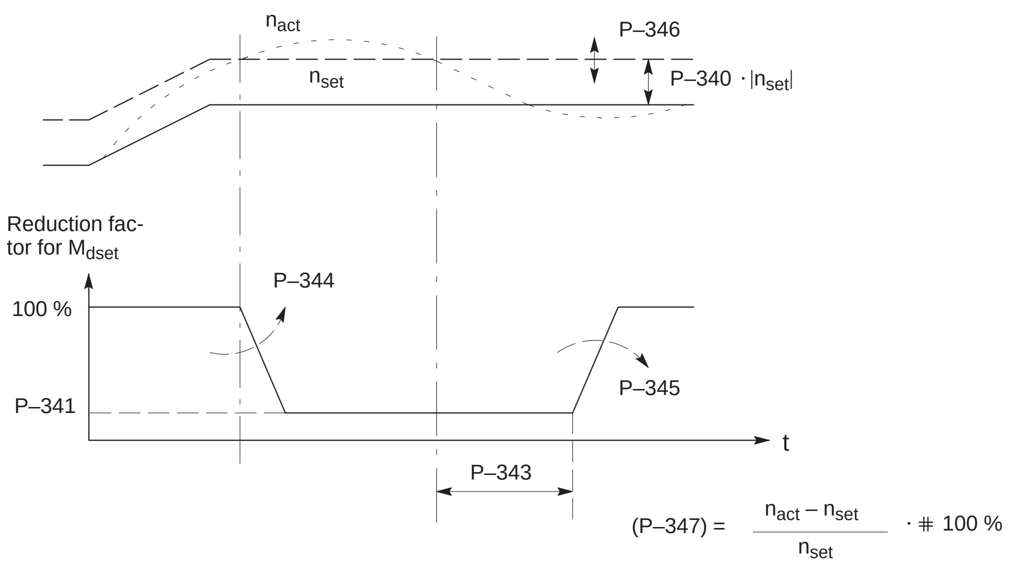
Assignment, speed setpoint channels:

- master drive, terminals 56/14
- slave drive, terminals 24/8

The slip monitoring function can be activated using the select terminal function No. 32 (refer to Fig. 2-2).

Table 2-25 slip monitoring

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–340	–	online	4	0.1...100.0 %	**Speed deviation, slip monitoring** Permissible speed deviation referred to the actual speed setpoint.
P–346	–	online	4	0.0...100.0 %	**Hysteresis to P–340**
P–341	–	online	4	0.0...100.0 %	**Torque reduction, slip monitoring** If the speed deviation, parameterized in P–340, is fallen below, the torque setpoint is reduced.
P–343	–	online	4	0...999 ms	**Delay time, slip monitoring** Delay time, until the torque reduction has been canceled.
P–344	–	online	4	0.01...100.00 %/ms	**Torque reducing speed, slip monitoring** Speed, at which the torque setpoint is reduced.
P–345	–	online	4	0.01...100.00 %/ms	**Torque increasing speed, slip monitoring** Speed, at which the torque setpoint is increased.
(P–347)	–	online	–	–	**Speed deviation, actual slip monitoring** If the displayed value is greater than the threshold set in P–340, slip occurs and the monitoring becomes active.



2.3.5 Monitor function

The address contents (data in the RAM area) of the main spindle drive module can be read via parameters **P–249** to **P–251**.

Note

A list of important measurement quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).

Table 2-26 Monitor function

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–249	–	online	10	0...FFFF hex	**Segment, memory location monitor** Segment address selection
P–250	–	online	10	0...FFFF hex	**Address, memory location monitor** **Offset address selection**
P–251	–	online	–	–	**Value display, memory location monitor** Displays the contents of address P–249/P–250

2.3.6 HPC axis (FW 2.00)

In the HPC–axis mode, only the freely–programmable terminals E1 to E6 can be assigned with functions.

Overview

- function description
- system configuration
- converter interfaces
- controller optimization
- diagnostics

Function description

The **H**igh**P**recision **C** axis (HPC) mode permits improved load– and control characteristics by reducing the speed controller clock to 0.5 or 0.6 ms. 0.3 or 0.35 ms is possible from FW 3.0.

Expanded functional scope in the HPC–axis mode:

– flux adaptation (noise reduction)

– it is possible to parameterize 2 digital filters in the torque setpoint channel for 0.6 ms speed controller clock (from FW 3.0=0.35 ms possible)

The following functions are not available in the HPC–axis mode:

– torque setpoint smoothing
– reciprocation
– NC auxiliary function M19
– 2nd torque limit value
– ramp–function generator
– Speed contr. adaptation
– gearbox stage changeover
– spindle positioning
– reduced terminal– and relay functions
– smoothing D/A converter P/P_{max} display

System configuration

Prerequisites for HPC–axis operation:

– speed range: ± $n_{rated\ motor}$
– selection only possible for motor 1 (star operation)
– HPC axis has priority over a standard C axis
– changeover into the standard mode is realized online; all functions are then available again.

- **Selecting HPC axis**

Table 2-27 Selecting HPC axis

Parameter attributes				Setting range	Description		
Number		Change effective	P–051				
Mot. 1	Mot. 2						
P–149	–	online	4	0...FFFF hex	**Start–up parameter, C axis/position.**		
					Bit	Value	
					8	0000H 0100H	HPC axis cannot be selected HPC axis can be selected
					The HPC–axis mode is selected via the select terminal function No. 30		

- **Torque limit values**

Table 2-28 Torque limit values

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–109	–	online	4	5...180 %	**Torque limit value, HPC** Sets the max. permissible torque, referred to the rated motor torque.
P–110	–	online	4	5...100 %	**Regenerative limit, HPC** Limits the torque in regenerative operation, referred to P–109.

Drive converter interfaces

- **Analog setpoint**

  The analog speed setpoint or Md setpoint can only be entered via setpoint channel 2
  (terminal 24/8).

  The speed setpoint is limited to $\pm$ $n_{rated\ motor}$.

Table 2-29 Analog speed setpoint

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–093	–	online	4	C000...4000 hex	**Offset correction, speed setpoint HPC** Drift adjustment for the analog speed setpoint input
P–094	–	online	4	$-n_{rated}-1$... $+n_{rated}-1$ RPM	**Normalization, speed setpoint HPC** The speed, which should be reached, at the analog input voltage, which was set in P–024, can be set using P–094.

HS

- **Permanently–wired terminal functions**

  Terminals 663, 65 and 81 are also available in the HPC–axis mode.

- **Freely–programmable terminal functions**

  Only the input terminals E1 to E6 (P–081 to P–086) are evaluated.

  The following terminal functions are available (refer to Section 3.2.2)

Table 2-30 Terminal functions

Terminal functions	Function No.
Reset fault memory (R) (fault acknowledgment)	3
Open–torque loop controlled operation	4
Integrator inhibit, speed controller	8
Speed setp. smoothing	25
Suppress F–11 (travel to endstop)	26
HPC axis	30
Inverter clock frequency	33.34

- **Permanently–wired relay functions**

  Terminals 672/673/674 are also available in the HPC–axis mode.

- **Freely–programmable relay functions**

  The statuses of the non–available relay functions are frozen when the HPC–axis mode is selected.

  The following relay functions are available (refer to Section 3.3.2):

Table 2-31 Relay functions

Terminal functions	Function No.
$n_{act} < n_{min}$	1
Motor overtemperature, alarm	5
Converter overtemperature, alarm	6
Variable relay function 1	7
Variable relay function 2	8

Controller optimization

- **Speed setpoint smoothing**

Table 2-32 Speed setp. smoothing

Parameter attributes				Setting range	Description		
Number		Change effective	P–051				
Mot. 1	Mot. 2						
P–106	–	online	4	3...10000 ms	**Smoothing time, speed setpoint HPC** (switched–in/out using P–053 or via select terminal function No. 25)		
P–053	–	online	4	0...FFFF hex	**Control word**		
					Bit	Value	
					4	0000H 0010H	Speed setpoint smoothing inactive Speed setpoint smoothing active

- **Speed controller gain, integral action time**

Table 2-33 Speed controller gain, integral action time

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–111	–	online	4	3.0...240.0 dec	**P gain, speed controller HPC** The P–gain setting is, for the same gain factor, a factor of 4 smaller than in the standard mode.
P–112	–	online	4	2...6000 ms	**Speed controller integral action time, HPC**

- **Flux adaptation**

Table 2-34 Flux adaptation

Parameter attributes: Number Mot. 1	Mot. 2	Change effective	P–051	Setting range	Description
P–119	–	online	4	5...100 %	**Flux adaptation, HPC** Reduction of the motor magnetic flux (noise reduction)

- **Digital filter, torque setpoint channel**

  2 digital filters can be parameterized in the HPC–axis mode, which are connected in series.

  However, a filter can only be activated, if the speed controller sampling time is set to 0.6 ms via **P–117**.

  The actual sampling time can be seen in the operating display (Section 2.2.1).
  (digital filter, also refer to Section 4.1).

Table 2-35 digital filter, torque setpoint channel

<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Setting range</th><th colspan="3" rowspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Change effective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td rowspan="5">P–118</td><td rowspan="5">–</td><td rowspan="5">online</td><td rowspan="5">4</td><td rowspan="5">0...FFFF hex</td><td colspan="3">Typ. torque setpoint filter</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>0</td><td>0000H
0001H</td><td>Bandstop characteristics, standard mode
Low pass characteristics, standard mode</td></tr>
<tr><td>8</td><td>0000H
0100H</td><td>Bandstop, filter 1 HPC–axis mode
Low pass filter 1 HPC–axis mode FW 2.00</td></tr>
<tr><td>9</td><td>0000H
0200H</td><td>Bandstop filter 2 HPC–axis mode
Low pass filter 2 HPC–axis mode FW 2.00</td></tr>
<tr><td>P–091</td><td>–</td><td>online</td><td>4</td><td>45...750 Hz</td><td colspan="3">Frequency filter 1 HPC
Low pass filter: 3 dB transition frequency
Bandstop: Center frequency</td></tr>
<tr><td>P–092</td><td>–</td><td>online</td><td>4</td><td>0.50...10.00 dec</td><td colspan="3">Quality, filter 1 HPC
Filter quality of the bandstop filter,
quality = 1, corresponds to 1.00</td></tr>
<tr><td>P–107</td><td>–</td><td>online</td><td>4</td><td>45...750 Hz</td><td colspan="3">Frequency, filter 2 HPC</td></tr>
<tr><td>P–108</td><td>–</td><td>online</td><td>4</td><td>0.50...10.00 dec</td><td colspan="3">Quality, filter 2 HPC</td></tr>
</table>

HS

Table 2-35 digital filter, torque setpoint channel

Parameter attributes: Number, Mot. 1	Mot. 2	Change effective	P–051	Setting range	Description		
P–117	–		4	0...FFFF hex	**Torque setpoint filter selection**		
					Bit	Value	
		online			0	0000H 0001H	Filter, standard mode inactive Filter, standard mode active
		online			8	0000H 0100H	Filter 1 HPC–axis mode inactive Filter 1 HPC–axis mode active FW 2.00
		online			9	0000H 0200H	Filter 2 HPC–axis mode inactive Filter 2 HPC–axis mode active FW 2.00
		RESET			10	0000H 0400H	Speed controller sampling time 0.5 ms, no filter is possible in the HPC axis mode. 0.3 ms possible from FW 3.00 Speed controller sampling time 0.6 ms, filters can be activated in the HPC–axis mode, FW 2.00. 0.35 ms possible from FW 3.00.

Diagnostics

The following diagnostic functions are **not** available in the HPC axis mode:

- diagnostics parameter **P–020** (dn/dt monitoring), P–320, P–321
- transient recoder function
- I/f controlled operation (open–loop)

■

Parameterization of the drive converter interfaces

3

3.1 Analog speed setpoint interface

Overview

- speed setpoint channel selection
- normalization, analog speed setpoint
- unipolar speed setpoint input (fixed direction of rotation)
- Steady–state minimum speed

HS

Speed setpoint channel selection

Table 3-1 Speed setpoint channel selection

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–113	–	online	4	0...3 dec	**Channel selection, speed setpoint**

P–113	Term. 56/14	Term. 24/8
0	off	off
1	on	off
2	off	on
3 1)	on	on

1) Setpoint inputs are added

Normalization, analog speed setpoint

Table 3-2 Normalization, analog speed setpoint

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–014.1	**P–258.1**	online	4	$-n_{maxMot}$... n_{maxMot} RPM	**Speed for max. motor operating speed** Speed, which is achieved for the analog input voltage in P–024. + = clockwise direction of rotation for a positive speed setpoint – = counter–clockwise direction of rotation for a negative speed setpoint
P–024	–	online	4	5.0...15.0 V	**Normalization, setpoint** Analog speed setpoint voltage for P–014/P–258 Note: Maximum setpoint voltage at terminal 56/14 and terminal 24/8, ± 11 V.
P–015.1	–	online	4	C000...4000 hex	**Offset correction, speed setpoint** e.g. positive correction value 2FH negative correction value FF00H

Unipolar speed setpoint input

Table 3-3 Unipolar speed setpoint input

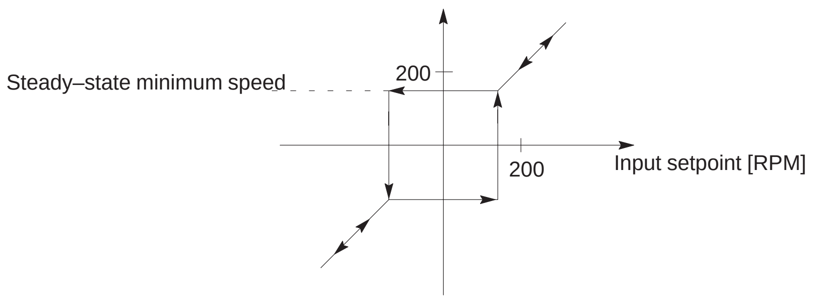
Parameter attributes				Setting range	Description		
Number		Change effective	P–051				
Mot. 1	Mot. 2						
P–053	–	online	4	0...FFFF hex	**Control word**		
					Bit	Value	
					13	0000H 2000H	Speed setpoint, bipolar by generating the absolute value of the speed setpoint, only one direction of rotation is permitted. The direction of rotation is defined using P–014/P–258. FW 2.00

Steady–state minimum speed

Table 3-4 Steady–state minimum speed

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–030	online	4	0...n_{maxMot} RPM	**Steady–state minimum speed** No steady–state operation in the speed range around zero. The range is run–through with the current ramp–up or ramp–down times, if the speed setpoint exceeds the steady–state minumum speed in the opposite direction of rotation. Zero speed can only be achieved by inhibiting the permanently–wired enable signals. FW 2.00

Effective setpoint [RPM]



HS

3.2 Input terminals

Warning

Terminal function parameters **P–081** to **P–089** may only be programmed when the pulses are canceled (terminal 63 or terminal 663 open).

3.2.1 Permanently–wired terminal functions

Table 3-5

Terminal function	Description	Terminal number
Axis– specific pulse enable	The inverter enable (motor control) is realized if the enable voltage is connected at terminal 663 (axis–specific pulse enable) and terminal 65 (controller enable). If the axis–specific pulse enable is removed with the motor is still rotating, the inverter is inhibited after 20 ms and the motor coasts down in a no–current condition.	663
Controller enable	If terminal 65 is opened while the motor is still rotating, the drive brakes along the ramp–function generator ramp. If the absolute speed falls below the n_{min} threshold (P–022), the inverter is inhibited and the motor is brought to a standstill with no overshoot.	65
Ramp– function generator fast stop	If the enable voltage is connected to terminal 81, the speed setpoint is enabled. If the input is left open, the speed setpoint is digitally set to zero. The drive brakes along the torque limit without ramp–function generator. If bit 1 is set in P–053, the pulses are inhibited when the speed becomes zero.	81

3.2.2 Freely–programmable terminal functions

Overview

- Terminal function assignment
- terminal functions

Terminal function assignment

Table 3-6 Terminal function assignment

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–081 **to P–089**	–	online	4	1...34 dec	**Terminal function assignment E1 to E9** Terminals E1 to E9 are assigned by entering the function number. The factory setting is provided in the following table.

HS

Terminal functions

Table 3-7 Terminal functions

Terminal function	Description	Fct. No.	Input terminal when supplied
2nd torque limit	The 2nd limit torque becomes active if this terminal is energized and the changeover speed in P–050 is exceeded.	1	E1 (P–081)
Reciprocation	The speed setpoints, described in Section 2.2 ”Standard applications”, are entered to changeover gearbox stages.	2	E6 (P–086)
Reset fault memory (R) (fault acknowledgment)	Remote acknowledgment of fault messages. Terminal 65 (controller enable) must be open to acknowledge faults.	3	E3 (P–083)
Open–loop torque controlled mode	Changeover from speed controlled to torque controlled operation	4	E5 (P–085)
Star/delta operation	Changeover between star– (open) and delta operation (enable voltage)	5	–
M19 operation	NC auxiliary function for oriented spindle stop. When this terminal is energized, the setpoint normalization, entered in P–054 is selected, if the speed falls below the value entered in P–054.	6	E4 (P–084)
Ramp–up time = 0	If the enable voltage is connected to this terminal, the internal ramp–function generator is bypassed	7	E2 (P–082)
Integrator inhibit speed controller	The integral component of the speed controller can be inhibited via this terminal	8	–
Gearbox stage	1 2 3 4 5 6 7 8 — Using these terminals, a total of eight parameter sets can be entered for setpoint normalization, speed monitoring, controller setting, torque limiting and torque monitoring.		
Bit 0	0 1 0 1 0 1 0 1	9	E7 (P–087)
Bit 1	0 0 1 1 0 0 1 1	10	E8 (P–088)
Bit 2	0 0 0 0 1 1 1 1	11	E9 (P–089)
Setpoint enable (only for speed setpoint)	If this terminal is open, the setpoint is a digital zero. When the enable voltage is connected to this terminal, the setpoint is enabled (analog setpoint or oscillation setpoint). If the terminal function is not selected, the setpoint is enabled.	16	–
Incremental positioning	If the spindle is in position, and if the enable voltage is connected to the terminal, then the incremental position reference value in P–0123 is added to the actual position reference value. The drive then moves to the thus calculated new position.	22	–
Position ref. values 1...2	Together with the terminal, function number 27, this terminal is used to select the position reference value defined via parameters P–121, P–122, P–124, and P–125 (Section 2.3.3.)	23	–
C–axis	The more finely graduated setpoint normalization, set in P–114 is used in the C–axis mode. Only setpoint 2 (terminal 24 and terminal 8) are evaluated.	24	–
Speed setpoint smoothing	By connecting the enable voltage to this terminal, a speed setpoint smoothing function is activated. The smoothing time is entered in P–018 (also with P–053).	25	–
Suppressing F–11	By connecting the enable voltage to this terminal, fault message F–11 (speed controller at its limit) can be suppressed.	26	–
Position reference values 3..4	Together with the terminal, function No. 23, this terminal is used to select the position reference value, defined using parameters P–121, P–122, P–124, and P–125 (Section 2.3.3.)	27	–
Positioning on	By connecting the enable voltage to this terminal, positioning is initiated.	28	–
Spindle re– synchronization	A positive edge at this terminal results in re–synchronization when the next positioning command is received via terminal, function No. 28.The function latches.	29	–
HPC axis	By connecting the enable voltage to this terminal, the HPC axis mode is selected when bit 8 was set in P–149. FW 2.00	30	–
Slip monitoring	By connecting the enable voltage to this terminal, the open–loop torque control is activated with slip monitoring. FW 2.00	32	–
Inverter clock frequency	Parameter P053 P331 P332 P333 0 1 0 1 0 0 1 1 — It is possible to toggle between four clock frequencies using these terminals. (from FW 3.00)	 33 34	

3.3 Output terminals

Warning

It is only permissible to program the relays (**P–241** to **247**) if the pulses are canceled (terminal 63 or 663 open).

3.3.1 Permanently–wired relay functions

Table 3-8 Permanently–wired relay functions

<table>
<tr><th>Terminal function</th><th colspan="3">Description</th><th>Terminal number</th></tr>
<tr><td rowspan="3">Ready/ no axis–specific fault</td><td colspan="3">The relay function can be selected using P–053:</td><td rowspan="3">672
673
674</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>0</td><td>0000H

0001H</td><td>The relay pulls–in, if there is no fault, and the pulses and controller are enabled.
Ready relay pulls–in, if there is no fault.</td></tr>
<tr><td>Checkback signal, start inhibit</td><td colspan="3">The relay (NC contact) pulls–in, if the enable voltage is connected to terminal 663, axis–specific pulse enable.</td><td>AS1
AS2</td></tr>
</table>

3.3.2 Freely–programmable relay functions

Overview

- Message assignment
- relay functions
- Messages which can be parameterized
- Control word messages

Note

The relay signals are updated with 20 ms for a 1 ms speed controller clock. For a 0.5 ms speed controller clock, every 10 ms (refer to P–90 bit 3).

Message assignment

Table 3-9 Message assignment

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–241 to **P–246**	–	online	4	1...20 dec	**Programmable messages 1 to 6** Relay outputs A11 to A61 are assigned by entering the function number. The factory setting is provided in the following table.

Relay functions

Table 3-10 relay functions

Relay function	Description	Fct. No.	Relay output
Ramp–up completed	The relay pulls–in, if the calculated speed actual value, after a setpoint step, enters the tolerance bandwidth around the new setpoint and has stayed within this tolerance bandwidth at least 200 ms. The message is latched in the activated position, until the speed setpoint changes. The tolerance bandwidth can be parameterized in P–027. Even if the calculated speed actual value exits the tolerance bandwidth again after 200 ms, the signal remains active, unless, in the meantime, the setpoint has changed. If the tolerance bandwidth is re–exited before 200 ms, the ”acceleration completed” message remains inactive. The relay does not drop–out due to speed fluctuations caused by load changes. The time of 200ms can be parameterized via P–256 FW 3.00 onwards.	2	A11 (P–241)
$\|M_d\| < M_{dx}$	The relay pulls–in at $\|M_d\| < M_{dx}$ . . This can be set using P–047. If the relay $n_{act} = n_{set}$ drops–out when the speed setpoint is changed, then the $\|M_d\| < M_{dx}$ relay can only drop–out 800ms after the relay $n_{act} = n_{set}$ has pulled–in again. The time of 800ms can be parameterized via P–257 from FW 3.00.	3	A21 (P–242)
$\|n_{act}\| < n_{min}$	The relay pulls–in for $\|n_{act}\| < n_{min}$; this can be set via P–021.	1	A31 (P–243)
$\|n_{act}\| < n_x$	The relay pulls–in at $n_{act} < n_x$; this can be set via P–023.	4	A41 (P–244)
Motor overtemperature alarm	The relay drops–out when the motor has an overtemperature condition; this can be set via P–063. If the fault condition remains, the drive converter shuts down with fault message F–14 after the time, set in P–065.	5	A51 (P–245)
Drive converter temperature alarm	The relay drops–out, if the thermoswitch of the main heatsink responds. If the overtemperature condition remains, the conv. shuts down after approx. 20 s with the F–15 fault mess.	6	–
Variable relay function 1	Refer to the description, ”variable relay function”, Section 3.3.3	7	A61 (P–246)
Variable relay function 2	Refer to the description, ”variable relay function”, Section 3.3.3	8	–
In position 1	The relay pulls–in if the positioning program was executed, and the spindle is located within the tolerance bandwidth, set in P–144.	9	–
In position 2	The relay pulls–in if the positioning program was executed, and the spindle is located within the tolerance bandwidth, set in P–145.	10	–
Relay, star operation	The external auxiliary contactor to change over the winding into the star configuration, can be controlled via this relay.	11	–
Relay, delta operation	The external auxiliary contactor to change over the winding into the delta configuration, can be controlled via this relay.	12	–
$n_{act} = n_{set}$ (actual)	The message ”$n_{act} = n_{set}$ (actual)” is active, after the calculated speed actual value has entered the speed tolerance bandwidth around the setpoint, and has remained in this tolerance bandwidth for at least 200 ms. If the tolerance bandwidth is exited, then the message ”$n_{act} = n_{set}$ (actual)” immediately becomes inactive. The time of 200ms can be parameterized via P–256 from FW 3.00.	20	–

HS

Messages which can be parameterized

Table 3-11 Messages which can be parameterized

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–021.1	**P–260.1**	online	4	0...n_{rated} RPM	**n_{min} for "$n_{act} < n_{min}$" message** Response value of the $\|n_{act}\| < n_{min}$ relay
P–023.1	**P–262.1**	online	4	0...n_{maxMot} RPM	**n_x for "$n_{act} < n_x$" message** Response value of the $\|n_{act}\| < n_x$ relay
P–027.1	**P–263.1**	online	4	0...n_{rated}/16 RPM	**Tolerance bandwidth for the "$n_{act} = n_{set}$" message**
P–047.1	–	online	4	0...100 %	**M_{dx} for the "$M_d < M_{dx}$" message** The setting refers to the actual torque limiting
P256	**–**	online	4	0.00...0.50	Delay time "n_{act}=n_{set}" message FW 3.00
P257	**–**	online	4	0.00...1.00	Delay time "$M_d < M_{dx}$" message FW 3.00

Control word messages

Table 3-12 Control word messages

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–247	–	online	4	0...FFFF hex	**Control word messages**

Bit	Value	
0	0001H	Relay function, term. A11 is inverted
1	0002H	Relay function, term. A21 is inverted
2	0004H	Relay function, term. A31 is inverted
3	0008H	Relay function, term. A41 is inverted
4	0010H	Relay function, term. A51 is inverted
5	0020H	Relay function, term. A61 is inverted

3.3.3 Variable relay function

Table 3-13 Variable relay function

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–185	–	online	4	0...FFFF hex	**Address for monitoring 1** Address of the RAM variables
P–186	–	online	4	0...FFFF hex	**Threshold for monitoring 1** Comparison value for RAM variables, contents (addresses, Section 6.5)
P–187	–	online	4	0.00...10.00 s	**Pull–in delay, monitoring 1**
P–188	–	online	4	0.00...10.00 s	**Drop–out delay, monitoring 1**
P–189	–	online	4	0...FFFF hex	**Hysteresis, monitoring 1** (hysteresis for threshold, P–186)
P–190	–	online	4	0...FFFF hex	**Address for monitoring 2**
P–191	–	online	4	0...FFFF hex	**Threshold for monitoring 2**
P–192	–	online	4	0.00...10.00 s	**Pull–in delay, monitoring 2**
P–193	–	online	4	0.00...10.00 s	**Drop–out delay, monitoring 2**
P–194	–	online	4	0...FFFF hex	**Hysteresis, monitoring 2** (hysteresis for threshold, P–191)
P–247	–	online	4	0...FFFF hex	**Control word message**

Bit	Value	
8	0000H 0100H	Variable relay function 1 with sign interrogation Variable relay function 1 with absolute value interrogation
9	0000H 0200H	Variable relay function 2 with sign interrogation Variable relay function 2 with absolute value interrogation
12	0000H 1000H	Variable relay function 1 with P–186 as threshold Variable relay function 1 as bit test. The threshold (P–186) is ANDed with the RAM variables to be monitored (P–185) FW2.00
13	0000H 2000H	Variable relay function 2 with P–191 as threshold Variable relay function 2 as bit test, FW2.00

Note

A list of the most important measured quantities (RAM variables) and their addresses is provided in the Appendix (Section 6.5).

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3.3.4 Motor encoder signals for NC

Table 3-14 Motor encoder signals for the NC

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–033	–	online	4	0...7 dec	**Encoder resolution for the NC** When using square–wave converted motor encoder signals, the following multiplication factors can be set.

P–033	Factor	Square–wave pulses	Limiting speed [RPM] for RON350/ ERN 1387
1	1	2048	16000
3	0.5	1024	16000
5	2	4096	5000
7	4	8192	2500
0	Pulses are not output from FW 3.00		
			Toothed–wheel encoder 256 I/rev.
1	1	256	24000
3	0.5	128	24000
5	2	512	24000
7	4	1024	12000
			Toothed–wheel encoder 512 I/rev.
1	1	512	12000
3	0.5	256	12000
5	2	1024	12000
7	4	2048	6000

3.3.5 Analog outputs

Overview

- Function
- technical data
- Parameterization DAU 1, DAU 2
- Fine normalization

Function

analog output of RAM variables for measurement and diagnostics

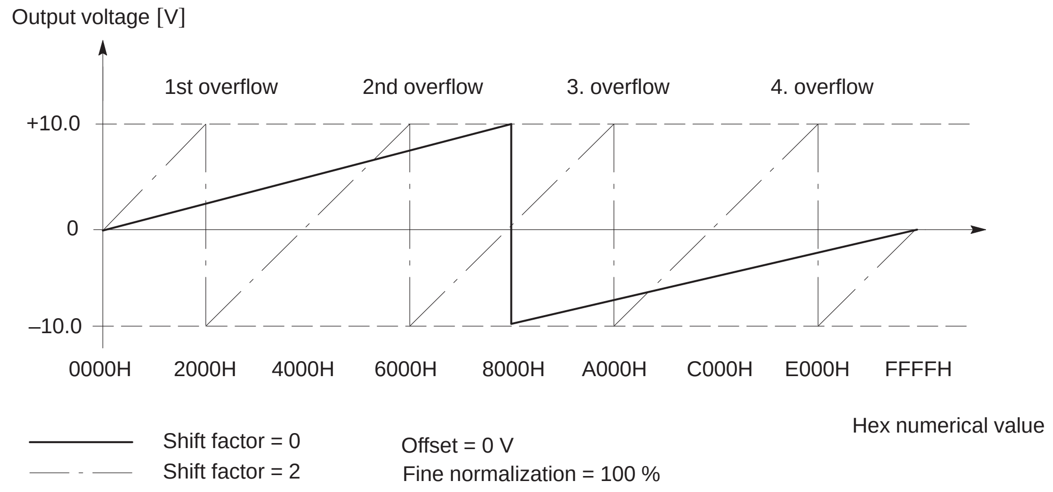
Technical data

- 2 output channels at terminal A91 (DAU 1) and terminal A92 (DAU 2)
- ± 10 V range
- rough normalization, offset compensation
- fine normalization for
  - absolute speed actual value
  - Utilization
  - M/M_{rated}
- polarity of the output voltage can be set through fine normalization (± 200 %)

Parameterization DAU 1, DAU 2

Table 3-15 Parameterization DAU 1, DAU 2

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–066	–	online	4	0...FFFF hex	**Address, DAU 1** Address of the RAM variables, which are to the output at DAU 1. Pre–setting: n/n_{max} (RAM address: 3044H)
P–067	–	online	4	0...15 dec	**Shift factor, DAU 1** Selected data values are shifted to the left 1 corresponds to multiplying by 2 n corresponds to multiplying by 2^n
P–078	–	online	4	7F...FF80 hex	**Offset, DAU 1** Compensation of a possible offset for DAU 1
P–068	–	online	4	0...FFFF hex	**Address, DAU 2** Pre–setting: Utilization (M/M_{max} or P/P_{max}) (RAM address: 3048H) A smoothing function can be set using P–071.
P–069	–	online	4	0...15 dec	**Shift factor, DAU 2**
P–079	–	online	4	7F...FF80 hex	**Offset, DAU 2**



Fine normalization The coarse normalization (**P–067**, **P–069**) must be set to 0H.

Table 3-16 Fine normalization

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–012	–	online	4	–200.0...200.0 %	**Normalization DAU n_{act} display** For P–012 = 100 %, the following is valid: |Max. speed (P–029)| corresponds to +10 V. Only effective at address 3044H, pre–set to DAU1. Update clock is 1 ms from FW 3.00 (previously 20ms)
P–013	–	online	4	–200.0...200.0 %	**Normalization DAU Utilization display** Utilization display n = 0 to n_{rated}: M_d/M_{dmax} n > n_{rated}: P/P_{max} (taking into account the actual torque limits P–039, P–041) The following is valid for P–013 = 100 % : |Max. torque | or |output| corresponds to +10 V. Only effective at address 3048H, pre–set to DAU2. Update clock is 1 ms from FW 2.40 1ms (previously 20ms)
P–026	–	online	4	–200.0...200.0 %	**Normalization DAU M/M_{rated}** For P–026 = 100 %, the following is valid: |rated torque| corresponds to +5 V M/M_{rated} is signed, i.e. a negative rated torque corresponds to –5 V. Only effective at address 304CH. Update clock is 1 ms from FW 3.00 1ms (previously 20ms)
P–071	–	online	4	2...32767 ms	**Smoothing time, DAU utilization display** (from FW 2.40, not in the HPC–axis mode) Output via address 3048 H, preset at DAU2.

Note

A list of the most important measured quantities (RAM variables) and their addresses is provided in the Appendix (Section 6.5).

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Controller optimization

4

4.1 Optimization, speed controller

Overview

- speed setpoint smoothing
- Speed actual value smoothing
- Ramp–function generator
- Gain, integral action time
- Speed controller adaptation
- Torque setpoint smoothing (pT_1)
- Digital filter, torque setpoint channel
- Delay time, ”speed controller at endstop”

Speed setpoint smoothing

Table 4-1 Speed setpoint smoothing

<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Change effective</th><th rowspan="3" colspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Change effective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td>P–018</td><td>–</td><td>online</td><td>4</td><td>3...10000 ms</td><td colspan="3">Smoothing time, speed setpoint smoothing
(switch–on/off using P–053 or via select terminal function No. 25)</td></tr>
<tr><td>P–019</td><td>–</td><td>online</td><td>4</td><td>0...30 dec</td><td colspan="3">Degree of rounding–off, speed setpoint
(pT_2 element)
Is only effective for active speed setpoint smoothing.
0: no rounding–off
30: max. rounding–off</td></tr>
<tr><td rowspan="3">P–053</td><td rowspan="3">–</td><td rowspan="3">online</td><td rowspan="3">4</td><td rowspan="3">0...FFFF hex</td><td colspan="3">Control word</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>5</td><td>0000H
0010H</td><td>Speed setpoint smoothing inactive
Speed setpoint smoothing active, if simultaneously, P–090 bit 3=0</td></tr>
</table>

Speed actual value smoothing

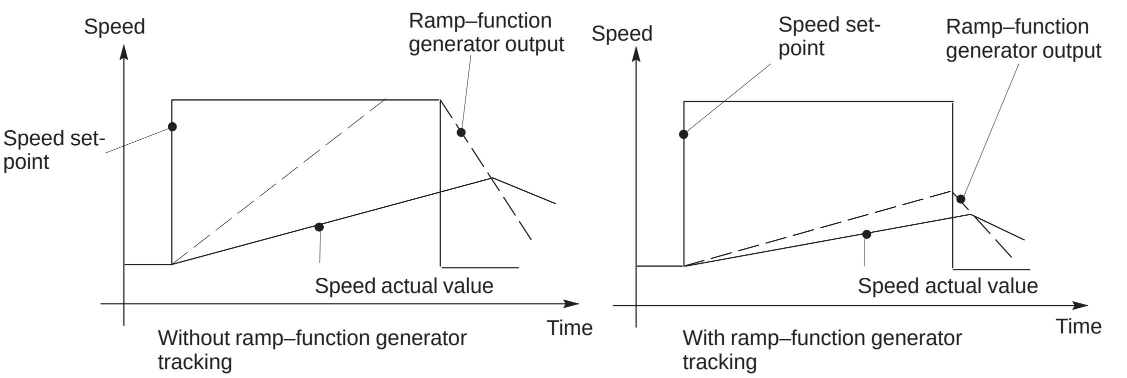
Table 4-2 Speed actual value smoothing

Parameter attributes: Number Mot. 1	Number Mot. 2	Change effective	P–051	Change effective	Description
P–034	–	online	4	1...10 ms	**Smoothing time, speed actual value smoothing** (Enabled/disabled using P–053 bit 5) FW 3.00
P–053	–	online	4	0...FFFF hex	**Control word** Bit / Value 4: 0000H Speed actual value smoothing inactive 0020H Speed actual value smoothing active

Ramp–function generator

Table 4-3 Ramp–function generator

Parameter attributes: Number Mot. 1	Number Mot. 2	Change effective	P–051	Change effective	Description
P–016.1	–	online	4	0.01...64.00 s	**Ramp–up time, ramp–function generator** (from n = 0 to n_{max} → P–029)
P–017.1	–	online	4	0.01...64.00 s	**Ramp–down time, ramp–function generator** (from n_{max} to n = 0 → P–029)
P–053	–	online	4	0...FFFF hex	**Control word** Bit / Value 12: 0000H Ramp–function generator trakking active 1000H Ramp–function generator trakking inactive



Gain, integral action time

Table 4-4 Gain, integral action time

<table>
<tr><th colspan="4">Parameter attributes</th><th rowspan="3">Change effective</th><th colspan="3" rowspan="3">Description</th></tr>
<tr><th colspan="2">Number</th><th rowspan="2">Change effective</th><th rowspan="2">P–051</th></tr>
<tr><th>Mot. 1</th><th>Mot. 2</th></tr>
<tr><td>P–031.1</td><td>–</td><td>online</td><td>4</td><td>3.0...120.0 dec</td><td colspan="3">P gain, speed controller</td></tr>
<tr><td>P–032.1</td><td>–</td><td>online</td><td>4</td><td>5...6000 ms</td><td colspan="3">Integral action time, speed controller</td></tr>
<tr><td rowspan="3">P–090</td><td rowspan="3">–</td><td rowspan="3">online</td><td rowspan="3">4</td><td rowspan="3">0...FFFF hex</td><td colspan="3">Control word</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>6</td><td>0000H

0040H</td><td>If the speed controller is at its max, the integral component is set to 0.

If the speed controller is at its max, the integrator is held.
FW 2.00</td></tr>
</table>

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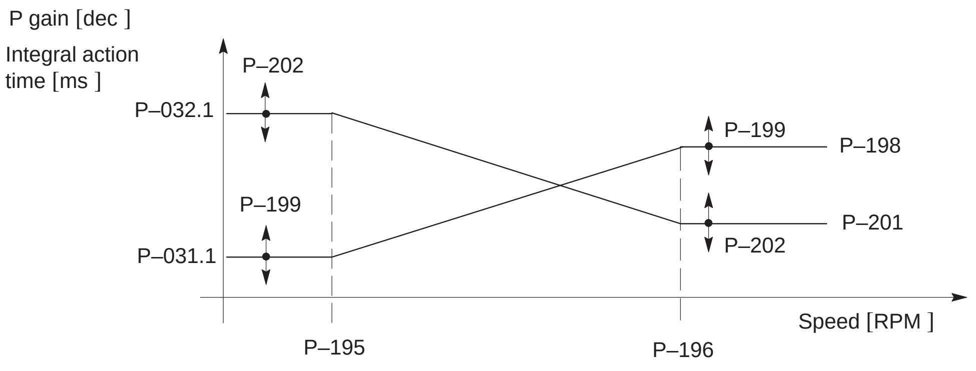
Speed controller adaptation

Table 4-5 Speed controller adaptation

Parameter attributes					
Number		Change effective	P–051	Change effective	Description
Mot. 1	Mot. 2				
P–195	**P–283**	online	4	0...n_{maxMot} RPM	**Lower adaptation speed**
P–196	**P–284**	online	4	0...n_{maxMot} RPM	**Upper adaptation speed**
P–198	**P–285**	online	4	1.0...120.0 dec	**P gain, upper adaptation speed**
P–199	**P–286**	online	4	1...200 %	**Reduction factor, P gain** (multiplication of the P–gain characteristic over the complete speed range)
P–201	**P–288**	online	4	5...6000 ms	**Integral action time, upper adaptation speed**
P–202	**P–289**	online	4	1...200 %	**Reduction factor, integral action time** (multiplication of the integral action time characteristic over the complete speed range)
P–203	**P–293**	online	4	0...7 dec	**Control word adaptation, speed controller** Adaptation only possible in gearbox stage 1! Bit / Value 1 / 0000H: No adaptation 1 / 0002H: Speed controller adaptation active



Torque setpoint smoothing (pT_1)

Table 4-6 Torque setpoint smoothing (pT_1)

Parameter attributes				Change effective	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–035	–	online	4	3...10000 ms	**Smoothing time, torque setpoint smoothing**
P–045	**P–274**	online	4	1...n_{maxMot} RPM	**Switch–in speed, torque setpoint smoothing** The torque setpoint smoothing is switched–in above this speed
P–046	**P–275**	online	4	0...n_{rated} RPM	**Hysteresis P–045/P–275**
P–044	–	online	4	0...1 hex	**Select, torque setpoint smoothing** 0: no torque setpoint smoothing 1: torque setpoint smoothing above the switch–in speed P–045

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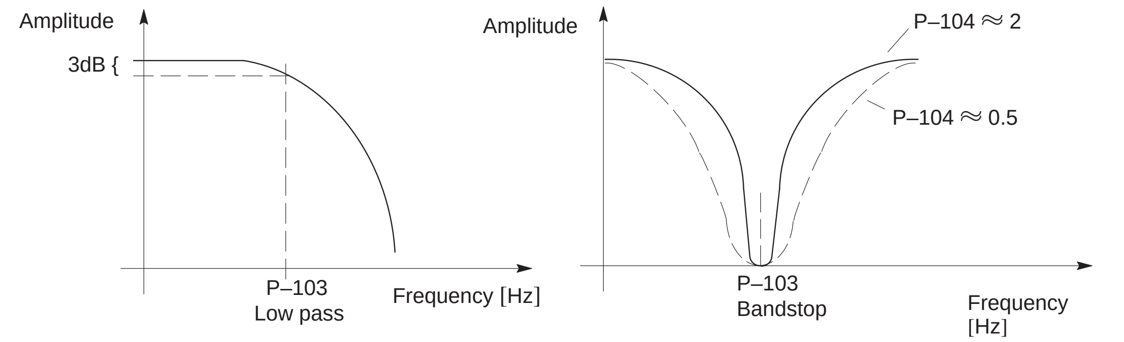
Digital filter torque setpoint channel

Table 4-7 Digital filter, torque setpoint channel

Parameter attributes				Change effective	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–118		online	4	0...FFFF hex	**Torque setpoint filter** type 0: bandstop characteristics 1: low pass characteristics
	P–281	online	4	0...1 hex	
P–103	**P–276**	online	4	50...450 Hz	**Frequency, torque setpoint filter** Low pass: 3 dB transition frequency Bandstop: center frequency
P–104	**P–277**	online	4	0.10...10.00 dec	**Quality, torque setpoint filter** Filter quality of the bandstop, quality = 1, corresponds to 1.00
P–117		online	4	0...FFFF hex	**Select torque setpoint filter** 0: disable digital filter 1: enable digital filter
	P–280	online	4	0...1 hex	



Delay time ”speed controller at its endstop”

Table 4-8 Delay time, ”speed controller at endstop”

Parameter attributes				Change effective	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–248	–	online	4	100...10000 ms	**Delay time, fault message F–11** The fault message is output, if the speed controller is at its limit in the time specified in P–248 and the speed actual value does not exceed the internal threshold n_{rated}/256.

4.2 Optimization, current controller

Note

Normally, it is not necessary to change the following parameters, as the optimum current controller setting is calculated from the motor– and power section data.

Overview

- Current controller
- Inverter clock frequency

Current controller

Table 4-9 Current controller

Parameter attributes				Change effective	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–116	**P–278**	online	4	–225...255 dec	**Correction, P gain, current controller** A signed offset is added to the current contr. P gain.
P–120	**P–292**	online	4	500...10000 RPM	**Changeover speed, current controller adaptation** The current controller P gain is increased when the speed is exceeded.
(P–316)	–	online	4	–	**Display, P–gain, current controller** Displays the actually effective current contr. P gain.

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Inverter clock frequency

Table 4-10 Inverter clock frequency 1

Parameter attributes: Number Mot. 1	Mot. 2	Change effective	P–051	Change effective	Description
P–053	–	online	4	0...FFFF hex	**Control word**

Bit	Value	Pulse freq. [kHz]
8	0000H	3.2
9	0200H	4.7
10	0400H	6.3
	0600H	7.8
	0100H	2.8 from FW 3.00
	0300H	5.0 from FW 3.00
	0500H	3.9 from FW 3.00
	0700H	5.9 from FW 3.00

Note: An inverter clock frequency > 3.2 kHz is only possible with de–rating (refer to Table 1–3).

Table 4-11 Inverter clock frequency 2

Parameter attributes: Number Mot. 1	Mot. 2	Change effective	P–051	Change effective	Description
P–331	–	online	4	0–7Hex	Inverter clock frequency 2 from FW 3.00
P–332	–	online	4	0–7Hex	Inverter clock frequency 3 from FW 3.00
P–333	–	online	4	0–7Hex	Inverter clock frequency 4 from FW 3.00
(P–330)	–	online	–	2.8–7.8kHz	Display of the actual clock frequency

Setting possibility (P–331 to P–333)

Value	Pulse freq. [kHz]
0000	3.2
0001	2.8
0002	6.3
0003	5.0
0004	4.7
0005	3.9
0006	7.8
0007	6.1

■

Diagnostics and fault analysis 5

5.1 Diagnostic aids

5.1.1 Measured value displays

Table 5-1 Measured value displays

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
(P–001)	–	–	–	–20000...20000 RPM	**Speed setpoint**
(P–002) (P–102)	–	–	–	–20000...20000 RPM	**Speed actual value**
(P–003)	–	–	–	0...500 V	**Motor voltage**
(P–004)	–	–	–	0...100.0 %	**Utilization** (referred to the actual torque limit)
(P–006)	–	–	–	0...700 V	**DC link voltage**
(P–007)	–	–	–	0...150 A	**Motor current**
(P–008)	–	–	–	0...100 kVA	**Motor reactive power**
(P–009)	–	–	–	0...100 kW	**Motor active power**
(P–010)	–	–	–	0...150 °C	**Motor temperature**
(P–101)	–	–	–	–200...200 %	**Setpoint for torque–controlled operation**
(P–330)	–	–	–	2.8...7.8 kHz	**Inverter clock frequency**

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5.1.2 Status displays

P–000, P–100 operating display

refer to Section 2.2.1, Table 2-10

P–011
Status of the binary inputs

Table 5-2 P–011, status of the binary inputs

Display						H
Display value						
1	–	**Term. 63** central pulse enable NE	**Term. E6** freely–programmable via P–086	**Term. E2** freely–programmable via P–082	**Term. 663** axis–specific pulse enable	
2	–	**Term. 64** central controller enable NE	**Term. E7** freely–programmable via P–087	**Term. E3** freely–programmable via P–083	**Term. 65** axis–specific controller enable	
4	–	–	**Term. E8** freely–programmable via P–088	**Term. E4** freely–programmable via P–084	**Term. 81 open** ramp–function generator fast stop	
8	–	–	**Term. E9** freely–programmable via P–089	**Term. E5** freely–programmable via P–085	**Term. E1** freely–programmable via P–081	

Several messages can be displayed. The hexadecimal addition is displayed.
Example: 4H + 8H = CH

P–254
Display of active functions 1

Table 5-3 P–254 display of active functions 1

Display						H
Display value						
1	–	–	**Fct. No. 9** gearbox stage bit 0	**Fct. No. 5** star/delta	**Fct. No. 1** 2. torque limit	
2	–	–	**Fct. No. 10** gearbox stage bit 1	**Fct. No. 6** M19 operation	**Fct. No. 2** oscillation	
4	–	–	**Fct. No. 11** gearbox stage bit 2	**Fct. No. 7** T_H = 0	**Fct. No. 3** reset fault memory (fault acknowledgment)	
8	–	**Fct. No. 16** setpoint enable	–	**Fct. No. 8** integrator inhibit, speed controller	**Fct. No. 4** torque– controlled operation	
Several messages can be displayed. The hexadecimal addition is displayed. **Example:** 4H + 8H = CH						

HS

P–255 Display of active function 2

Table 5-4 P–255 display of active functions 2

Display						H
Display value						
1	–	**Fct. No. 26** suppress F–11	–	–	**Fct. No. 32** slip monitoring	
2	–	**Fct. No. 23** position ref. values 1...2	**Fct. No. 30** HPC axis	–	**Fct. No. 33** Inverter clock frequency bit 0	
4	–	**Fct. No. 27** position ref. values 3...4	**Fct. No. 24** C axis	**Fct. No. 22** incremental positioning	**Fct. No. 34** Inverter clock frequency bit**1**	
8	–	**Fct. No. 28** positioning on	**Fct. No. 25** speed setpoint smoothing active	**Fct. No. 29** Spindle re–synchronization	–	
Several messages can be displayed. The hexadecimal addition is displayed. **Example:** 4H + 8H = CH						

5.1.3 Diagnostic parameters

Table 5-5 Diagnostic parameters

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
(P–020)	–	–	–	–	**Diagnostic, speed actual value** When continuously increasing by several increments, there is an increased noise level. (counter for dn/dt monitoring) Possible causes: • encoder shield not grounded • encoder defective • electronic ground not OK • motor ground not connected to the main spindle drive module • measuring circuit 1 defective • entered motor moment of inertia was too high (P–159, P–219)
(P–028)	–	–	–	–	**Diagnostic** Bit | Value | 3 | 0008H | Alarm, temperature sensor • interrupted • short circuit 13 | 2000H | Division–interrupt due to an error in the calculation routine as incorrect data were input.
(P–299)	–	–	–	–	**Checksum, parameter** For each save (P–052 = 1H), the checksum is generated over the parameter contents. Thus, if there is a change in the drive–machine data, this will be identified.
(P–320)	–	–	–	–	**Diagnostics, motor encoder zero mark** from FW 3.00 There is an increased noise/disturbance level if this continuously increases by several increments. Possible causes: • encoder shield not grounded • encoder defective • electronic ground not OK • motor ground not connected to the main spindle drive module • Defective measuring circuit
(P–321)	–	–	–	–	**Diagnostics spindle encoder zero mark** from FW 3.00 Prerequisite: Positioning with spindle encoder has been selected, spindle encoder pulse number in P–131.x is to the power of 10. There is an increased noise/disturbance level if this is continuously increased by several increments. Possible causes: • encoder shield not grounded • encoder defective • electronic ground not OK • motor ground not connected to the main spindle drive module • measuring circuit defective

HS

5.1.4 Test sockets X1, X2, IR

Overview

- function
- technical data
- assignment
- Normalization, IR
- Parameterization X1 (DAU 3), X2 (DAU 4)

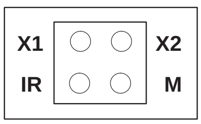
Function

Analog output of the phase current actual value and RAM variables for measurement and diagnostics.

Technical data

- phase current actual value at test socket IR
- 2 output channels at X1 (DAU 3) and X2 (DAU 4)
- voltage range 0...+ 5 V (0 corresponds to +2.5 V)
- rough normalization, offset compensation for X1 and X2 via parameter

Assignment



X1: Test socket DAU 3
X2: Test socket DAU 4
IR: Current act. value, phase R
M: Reference ground

Fig. 5-1 Assignment, test sockets

Normalization, phase current IR

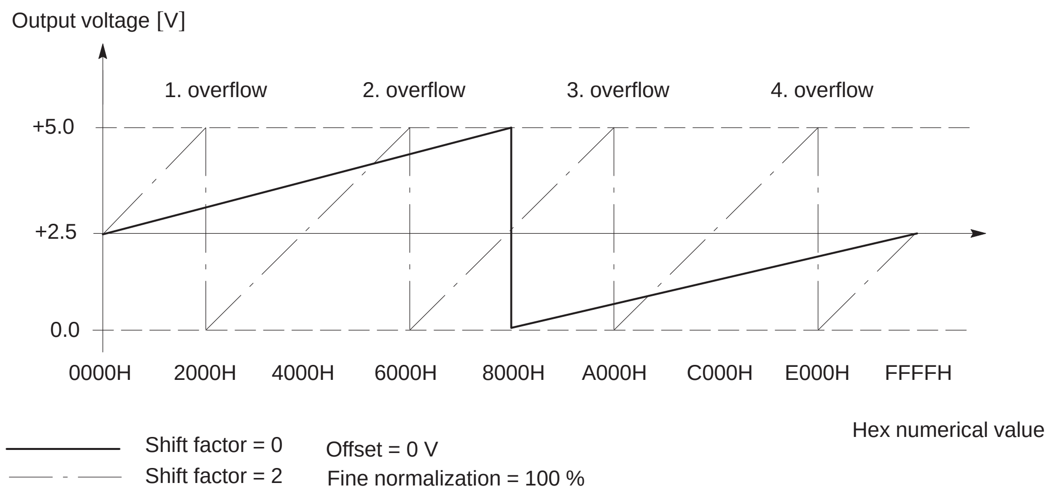
Table 5-6 Normalization, IR

Power module	Power module code numbers (P–095)	Normalization, IR
50 A	6	50 A corresponds to 8.25 V
80 A	7	80 A corresponds to 8.25 V
120 A	8	160 A corresponds to 8.25 V
160 A	9	160 A corresponds to 8.25 V
200 A	10	200 A corresponds to 8.25 V
300 A	11	300 A corresponds to 8.25 V
400 A	12	400 A corresponds to 8.25 V
108 A	13	120 A corresponds to 8.25 V

Parameterization X1 (DAU 3), X2 (DAU 4)

Table 5-7 Parameterization X1 (DAU 3), X2 (DAU 4)

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–076	–	online	4	0...FFFF hex	**Address, DAU 3** Address of the RAM variables which are to be output at DAU 3. Pre–setting: $\|P/P_{rated}\|$ (RAM address: 3050H)
P–077	–	online	4	0...15 dec	**Shift factor, DAU 3** Selected data values are shifted to the left 1 corresponds to multiplication by 2 n corresponds to multiplication by 2^n
P–080	–	online	4	7F...FF80 hex	**Offset, DAU 3** A possibly existing offset is compensated for DAU 3
P–072	–	online	4	0...FFFF hex	**Address, DAU 4** Pre–setting: n_{act} (RAM address: C04H)
P–073	–	online	4	0...15 dec	**Shift factor, DAU 4**
P–074	–	online	4	7F...FF80 hex	**Offset, DAU 4**



Note

A listing of the most important measured quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).

HS

5.1.5 Minimum/maximum value memory

Function

Monitoring RAM variables for minimum– and maximum values.

Table 5-8 Minimum/maximum value memory

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–181	–	online	4	0...FFFF hex	**Address for min/max memory** Address for RAM variable
P–179	–	online	4	0...2 hex	**Min/max memory selection** 0H: stop memory function 1H: start memory function with absolute value generation 2H: start memory function with bipolar evaluation
(P–182)	–	–	–	–	**Minimum value, min/max memory**
(P–183)	–	–	–	–	**Maximum value, min/max memory**

Note

A listing of important measured quantities (RAM variables) and addresses is provided in the Appendix (Section 6.5).

5.1.6 Transient recorder function

Function

Simultaneous tracing of 2 RAM variables and output via test sockets X1 and X2.

Technical data

- parallel tracing of two 16–bit signals
- 640 values tracing depth
- 1 ms sampling time (P–090, bit 3=0) or 0.525 ms (P–090, bit 3=1, from FW 3.00)
- start– and stop conditions (trigger conditions)
- cyclic output via D/A converters
- trigger condition for data output

Parameterization

Table 5-9 Parameterization

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–207	–	online	4	0...10 hex	**Transient recorder setting** 1H: start via P–206 without start– and stop condi-tion 2H: start condition P–208 and P–209, no stop condi– tion, start via P–206 5H: stop condition via P–210 and P–211, no start condition, start via P–206 6H: trace with start– and stop condition 4H: pre–assigning the trace memory via P–217
P–212	–	online	4	0...FFFF hex	**Address, signal 1** A listing of important measured quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).
P–213	–	online	4	0...FFFF hex	**Address, signal 2**
P–208	–	online	4	0...FFFF hex	**Address for the start condition** Address of the RAM variables, which start the trace
P–209	–	online	4	0...FFFF hex	**Threshold for the start condition** Start condition mask, is compared with the RAM variable in P–208
P–210	–	online	4	0...FFFF hex	**Address for the stop condition**
P–211	–	online	4	0...FFFF hex	**Threshold for the stop condition**
P–206	–	online	4	0...1 hex	**Transient recorder selection** The transient recorder function is started by set-ting to 1H.
P–215	–	online	4	0...15 dec	**Shift factor, signal 1** Refer to the description, test sockets X1, X2, Sec-tion 5.1.4
P–216	–	online	4	0...15 dec	**Shift factor, signal 2**
P–217	–	online	4	0...FFFF hex	**Trigger signal 1** Trigger signal amplitude ”low” for D/A converter output
P–218	–	online	4	0...FFFF hex	**Trigger signal 2** Trigger signal amplitude ”high” for D/A converter output
P–214	–	online	4	0...1 hex	**Start output for tracing** Cyclic outputs of the traced values on the D/A converter Trace signal 1 → DAU 3 (X1) Trace signal 2 → DAU 4 (X2) The previous assignment of the D/A converters are buffered and are reset after output has been completed.

HS

Note

A listing of the most important measured quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).

5.1.7 Open–loop current/frequency control

Function

Diagnosing motor encoder faults

Function information

Above the field weakening speed **(P–173)**, the absolute current should be selected to be less than the no–load current, as otherwise voltage limiting will be initiated. The result is then erratic running and torque surges.
The frequency should be slowly changed, as I/f operation is prone to stalling.

Table 5-10 Current/frequency control (open–loop)

Parameter attributes				Setting range	Description
Number		Change effective	P–051		
Mot. 1	Mot. 2				
P–311	–	online	4	0.0...100.0 %	**Current for I/f control** (referred to the rated motor current)
P–312	–	online	4	0.0...800.0 Hz	**Frequency for I/f control**
P–313	–	online	4	0...1hex	**Selection, I/f control** 0H: I/f control off 1H: I/f control on

5.2 Fault analysis

5.2.1 Fault display, fault acknowledgment

Fault display

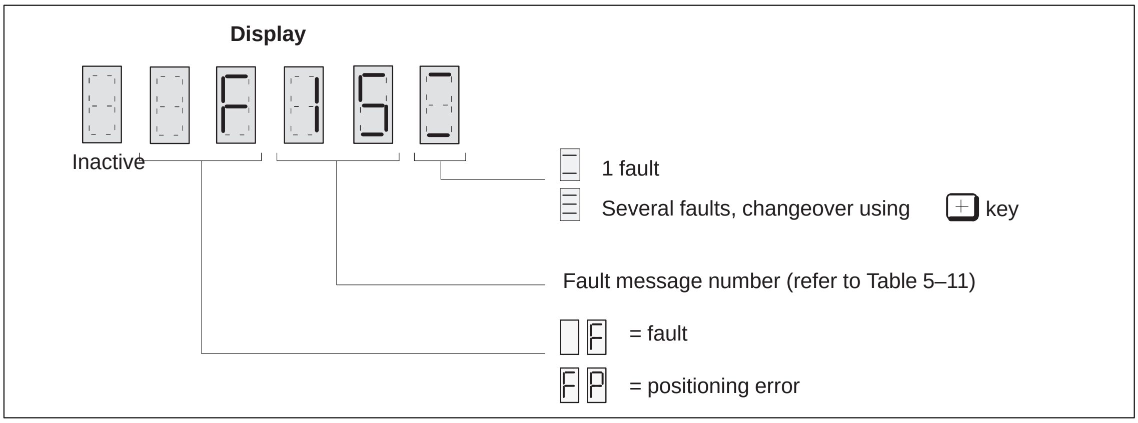


Fig. 5-2 Fault display

HS

Fault acknowledgment

by

- **P key**
-

  Depress the P key with the controller inhibited.

  If the fault can be acknowledged, the system returns to the operator control program.

  If the fault cannot be acknowledged, for example, there is a defect, then this can be temporarily suppressed in the display.

- **remote acknowledgment**

  One of the following terminals is energized, with the controller inhibited:

  – terminal ”R” reset at the NE– or monitoring module

  – terminal ”reset fault memory” at the main spindle drive module

- **power–down**

  Power–down the converter and after the display has disappeared after approx. 2 s, power–up again.

Fault suppression

by

- **– key**
-

  The system returns to the – operator control program for approx. one minute after depressing the key, without acknowledging the fault.

5.2.2 Fault message list

Table 5-11 Fault message list

Fault message	Fault	Cause	Troubleshooting
F–04	Erroneous setpoint conversion	• A/D converter (setpoint channel) faulted	If this repeatedly occurs, replace the control board
F–07	Data save on FEPROM unsuccessful	• If the fault message is repeatedly output during data save, then the FEPROM is defective. • If the fault message occurred directly after the drive–converter was powered–up, then the drive converter was previously powered–down during a data save. The last parameter changes have therefore not been saved. A new data save must be initiated.	1Restart data save via P52=1 2Replace the control board if fault F–07 re–occurs
F–08	Irretrievable data loss	• Defective FEPROM	Replace the control board
F–09	Fault encoder system 1 (motor encoder)	• Motor encoder not connected or defective • Motor encoder cable defective • Measuring circuit 1 (speed actual value sensing) defective, incorrectly inserted or incorrect device (P–150). The fault message can be suppressed using P–090 bit 1 from FW2.00.	Check the encoder cable/screen or – replace the motor encoder, or – replace the control board
F–10	Fault, equipping parameterization, encoder system 2	• Positioning with spindle encoder selected (P141=1, P143=1), incorrect board version FW 1/2 • Positioning with spindle encoder selected (P141=1, P143=1), there is no spindle encoder inserted at X432 FW 3.00 • Positioning with spindle encoder selected (P141=1, P143=1) with output of square–wave–converted motor encoder signals X432 (P033<>0) FW 3.00 • Output of square–wave–converted motor encoded signals at X432 (P033<>0) selected, a spindle encoder is inserted at X432 FW 3.00	– Correctly adapt P33 (refer to the Start–up Guide, Section 3.3.4) – Use the correct control board version – Connect–up the spindle encoder

Fault message	Fault	Cause	Troubleshooting
F–11	Speed controller is at its limit, speed actual value missing	• Motor overloaded • DC link busbar not connected • DC link fuse defective • Transistor in the power module defective • Motor encoder not connected • Motor encoder cable defective • Motor encoder defective • Motor ground not connected • Screen, motor encoder cable not connected • Motor not connected or phase missing • Motor stalled/rotor locked • Measuring circuit 1 (speed actual value sensing) defective or incorrectly connected (the delay time can be set via P–248.)	– Prevent motor overload (P004<100%) – Tighten–up DC link busbar – Replace the power module – Connect–up the motor encoder – Replace the motor encoder – Secure the PE/motor connection – Ground the screen or replace the encoder cable – Connect–up the motor with the correct phase sequence – Remove the mechanical blockage – The contactor between the motor and drive converter must be closed – Replace the control board
F–14	Motor overtemperature Motor	• Motor overloaded • Motor current too high, e.g. due to incorrect motor data (P–096) • Temperature sensor defective (motor) • Motor fan defective • Measuring circuit 1 (speed actual value motor) defective • Motor winding short–circuit	– Reduce motor load – Correct motor data – Changeover to the 2nd temperature sensor – Connect–up the fan – Replace the control board or motor encoder – Replace the motor
F–15	Drive converter overtemperature	• Drive converter overloaded (incorrect motor/ drive converter assignment, incorrect load duty cycle) • Ambient temperature too high • Fan failed • Defective temperature sensor Acknowledgment: Only after cooling down to below 50°C ± 15K, by powering–down and powering–up again	– Correct motor/drive converter assignment (P95/96) – Reduce $M_d$limit (P39) – Power module too small – Replace power module
F–16	Incorrect power module code	• Incorrect code number 3 selected in P–095 (for power modules without automatic identification) • Incorrect code number selected in P–095 (for power modules with automatic identification) from FW3.00	– Load the correct code number
F–17	I_0 motor > I_{rated} power module	• Incorrect motor/drive converter assignment	– I_0 correctly set motor or – select a larger power module

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Fault message	Fault	Cause	Troubleshooting
F–18	Fault encoder system 2 (spindle encoder)	• Spindle encoder not connected or defective FW 3.00 • Spindle encoder cable defective FW 3.00 • Measuring circuit 2 defective FW 3.00 The fault message can be suppressed via P–090 bit 5.	– Connect a spindle encoder or replace – Check the encoder/drive converter connecting cable – Replace the control board
F–19	Temperature sensor • Interrupted • Short–circuited	• Temperature sensor defective (PTC thermistor at 20°C ≈ 600 Ω, if required, use the 2nd PTC thermistor of the motor) • Connection to the sensor interrupted • Measuring circuit 1 defective Acknowledgment: Only by switching the supply voltage off and on	– Replace the temperature sensor – Re–establish the connection between the temperature sensor motor/drive converter – Replace the control board
F–61	Maximum motor frequency exceeded	• Encoder pulse number (P–098) incorrectly entered FW 2.00 • No force–locked connection between the master/slave	– Correctly enter the encoder pulse number (P98) – Re–establish the mechanical force–locked connection (slave–drive)
F–79	Division interrupt (this message can be suppressed by setting P–053, bit 11)	• Incorrect motor data in P–159 to P–176 or P–219 to P–236	– Enter the correct motor data (field weakening > 1:16)
FP–01	Setpoint > encoder pulse number	• Setpoint input too high (P–to P–125, P–131). Position reference value, external	– Setpoint input must be set lower (max P131)
FP–02	Zero mark monitoring has responded	• Zero mark signal from the encoder or BERO interrupted • Incorrect parameterization (P–131)	– Set the BERO clearance lower or replace the BERO – Replace the cabling – Replace the encoder – Parameter setting in P131 greater than the pulse number per revolution

Fault message	Fault	Cause	Troubleshooting
FP–03	Zero mark offset > encoder pulse number	• Value in P–130 > the pulse number in P–131	– The entry in P–130 must be set lower than the value set in P–131
FP–04	No valid zero mark	• When setting P–129=1, there is no valid zero mark, e.g. – after power–on – after the gearbox stage change	– The spindle must rotate through at least one revolution (rotate through 360^0, and then set P129 to 1 again). If the fault still occurs, check the zero mark – If a BERO is used, adjust the clearance, check the cabling or replace the BERO – For spindle/motor encoder, check the cabling or replace the encoder

Faults

HS

after

- **supply ON**

  Operating control display inactive

  – at least two phases missing (NE module)

  – at least two input fuses have ruptured (NE module)

  – defective electronics power supply in the NE module

  – converter bus connection (ribbon cable), main spindle drive module ↔ NE module not inserted or defective

  – control components defective

  – EPROM/FEPROM defective

  – firmware not loaded

- **Controller enable (without fault message)**

  Motor rotates at a max. 30 RPM at n_{set} > 30 RPM or the motor oscillates (oscillation is not selected) at n_{set} < 30 RPM

  – incorrect motor phase sequence as the feeder cable is interchanged (change 2 phase connections).

  – motor encoder pulse number which was entered is too high

  Motor remains stationary for speed setpoints other than zero

  – reciprocation function is selected (P–154, P–155=0)

  Motor briefly moves

  – defective power module

■

Appendix 6

HS

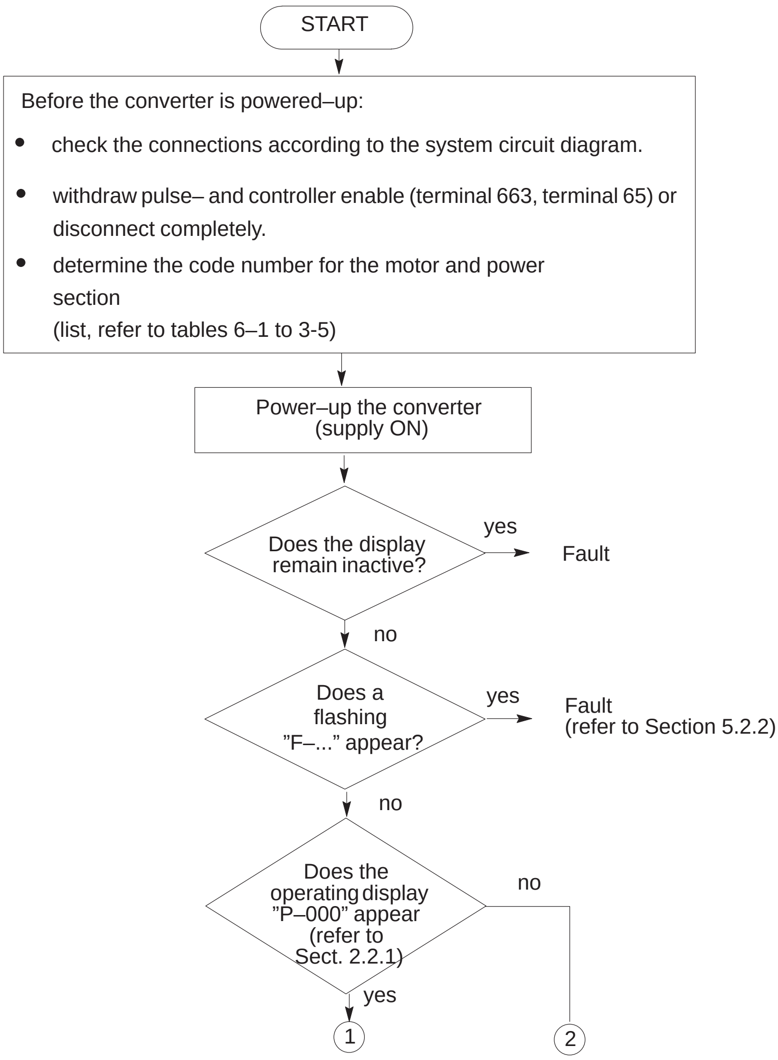
6.1 Flow diagram for short start–up

Warning

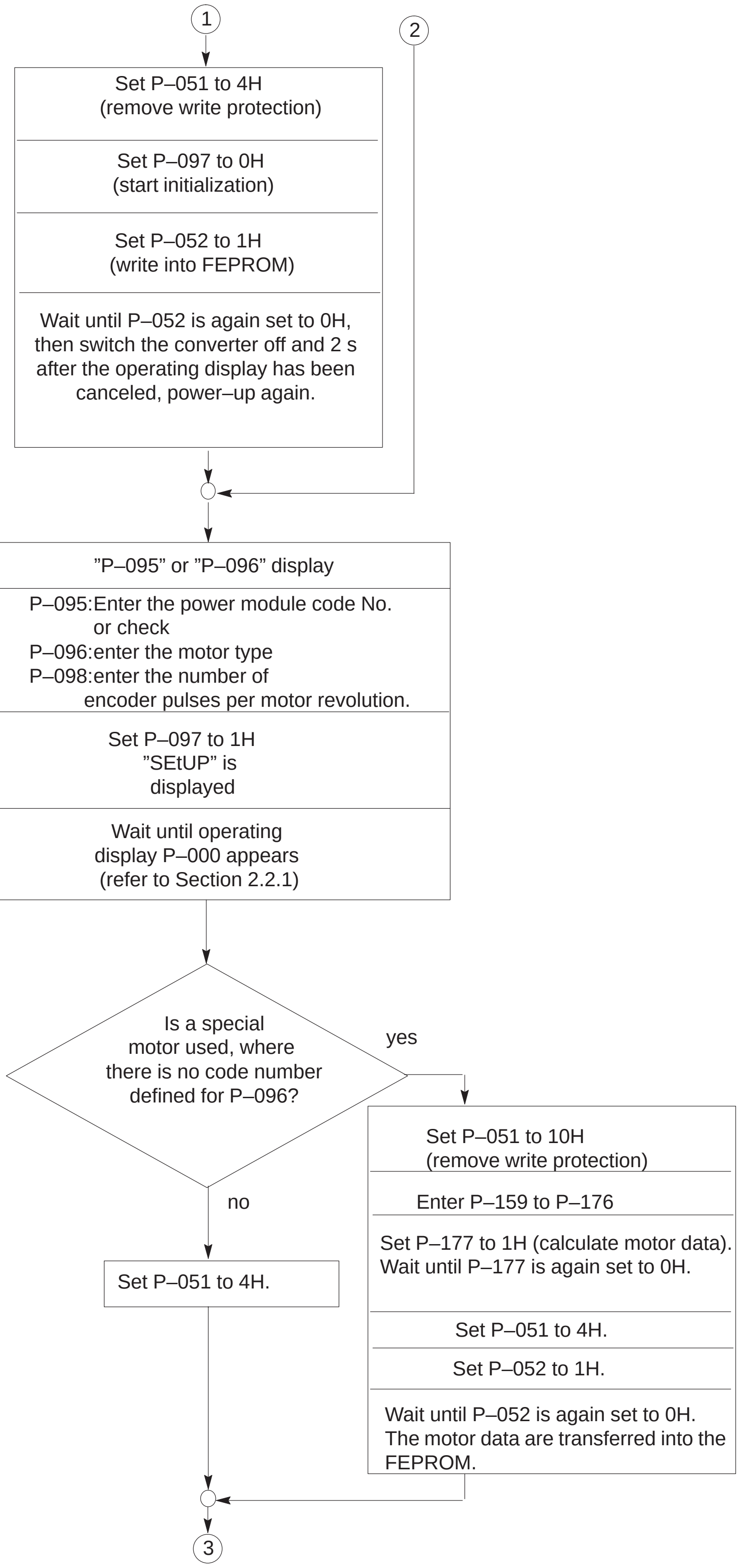
If a fault is acknowledged at the **NE module**, with the main spindle drive module enabled, then the drive accelerates to $n_{set.}$

Note

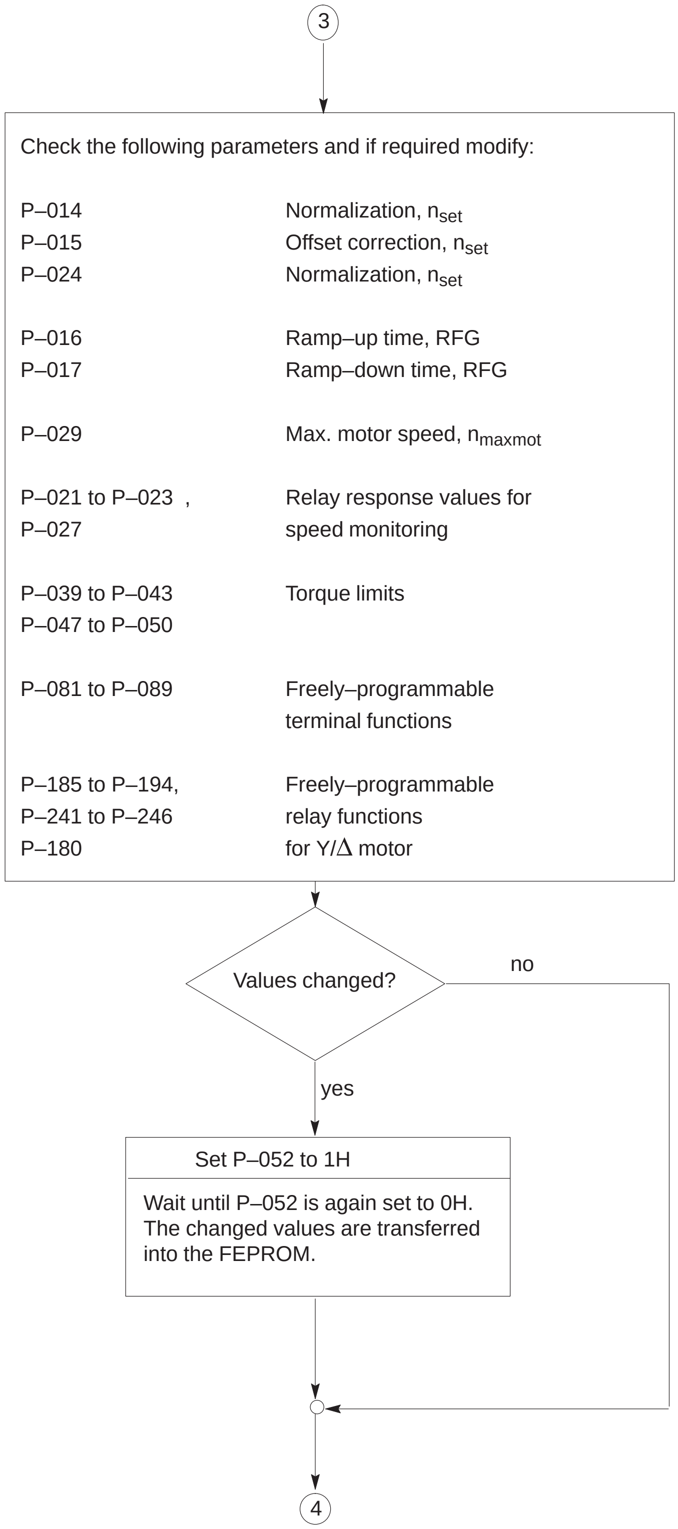
If data save is interrupted due to power failure or the power being disconnected, then the values which were changed since the last data save are lost, and the drive converter displays fault message ”F–07” after the power returns. The parameter values can be reset after acknowledging fault message ”F–07” (refer to Section 5.2.2).

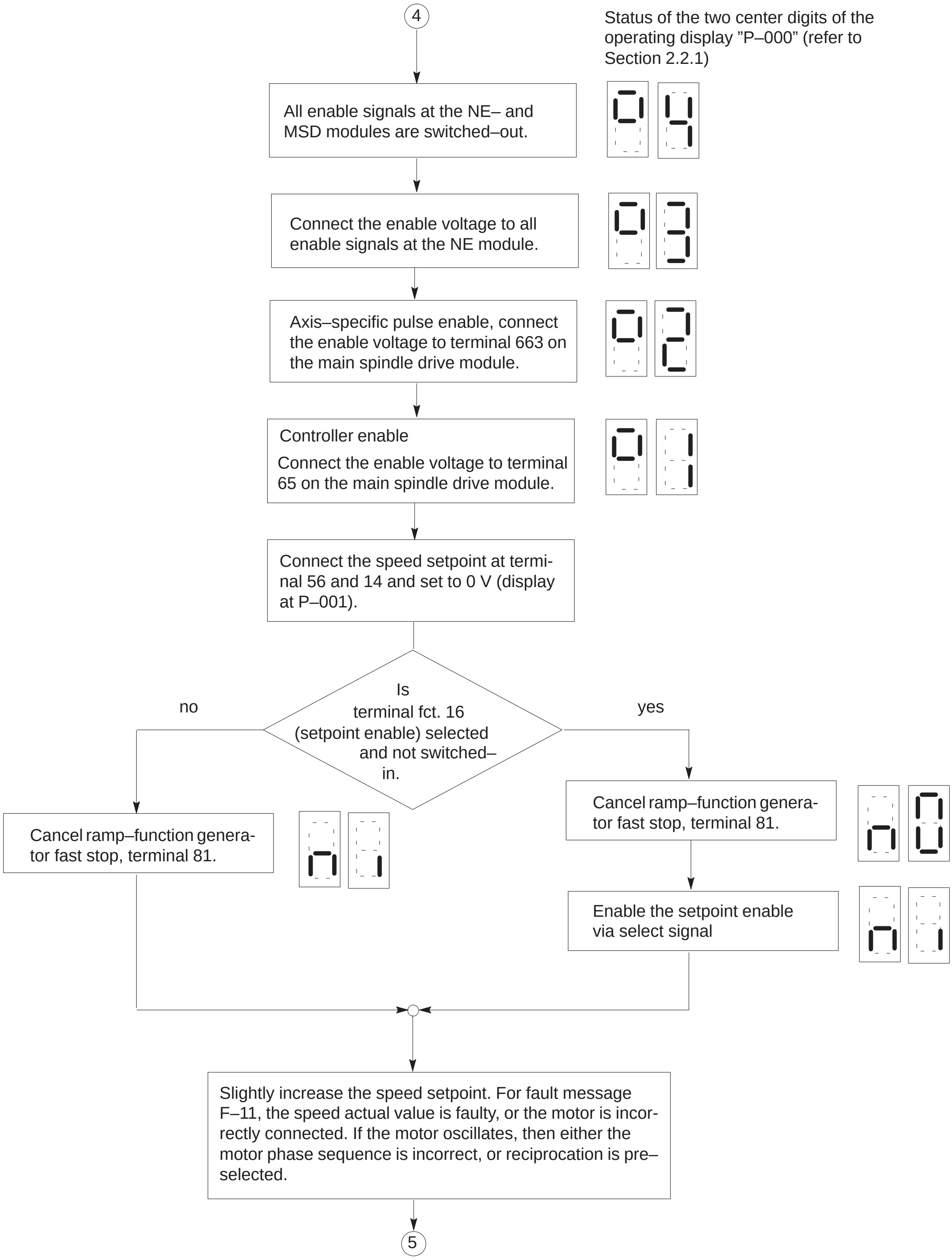


The module was already commissioned once. In order to adapt a new motor, the initialized status must be estab–lished.

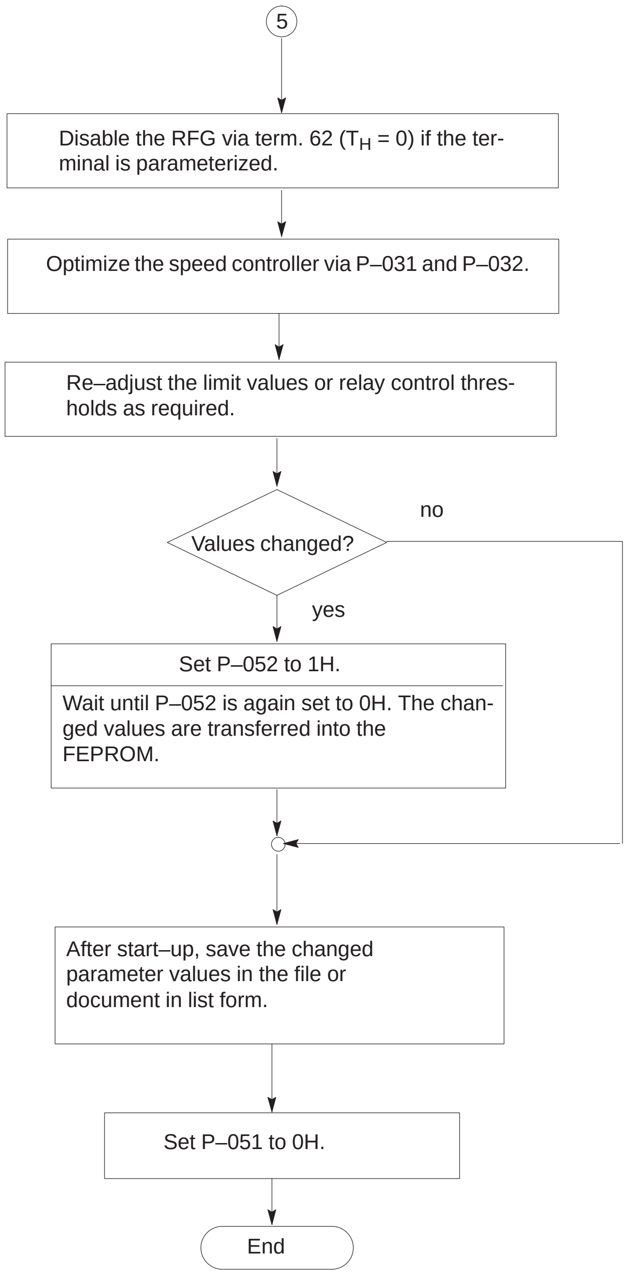


HS


3
Check the following parameters and if required modify:
P–014 Normalization, n_{set}
P–015 Offset correction, n_{set}
P–024 Normalization, n_{set}
P–016 Ramp–up time, RFG
P–017 Ramp–down time, RFG
P–029 Max. motor speed, n_{maxmot}
P–021 to P–023 , P–027 Relay response values for speed monitoring
P–039 to P–043 Torque limits
P–047 to P–050
P–081 to P–089 Freely–programmable terminal functions
P–185 to P–194, Freely–programmable
P–241 to P–246 relay functions
P–180 for Y/Δ motor
Values changed?
no
yes
Set P–052 to 1H
Wait until P–052 is again set to 0H.
The changed values are transferred into the FEPROM.
4


4
Status of the two center digits of the operating display ”P–000” (refer to Section 2.2.1)
All enable signals at the NE– and MSD modules are switched–out.
Connect the enable voltage to all enable signals at the NE module.
Axis–specific pulse enable, connect the enable voltage to terminal 663 on the main spindle drive module.
Controller enable
Connect the enable voltage to terminal 65 on the main spindle drive module.
Connect the speed setpoint at terminal 56 and 14 and set to 0 V (display at P–001).
Is terminal fct. 16 (setpoint enable) selected and not switched–in.
no
yes
Cancel ramp–function generator fast stop, terminal 81.
Cancel ramp–function generator fast stop, terminal 81.
Enable the setpoint enable via select signal
Slightly increase the speed setpoint. For fault message F–11, the speed actual value is faulty, or the motor is incorrectly connected. If the motor oscillates, then either the motor phase sequence is incorrect, or reciprocation is pre–selected.
5

HS


5
Disable the RFG via term. 62 (T_H = 0) if the terminal is parameterized.
Optimize the speed controller via P–031 and P–032.
Re–adjust the limit values or relay control thresholds as required.
Values changed?
no
yes
Set P–052 to 1H.
Wait until P–052 is again set to 0H. The changed values are transferred into the FEPROM.
After start–up, save the changed parameter values in the file or document in list form.
Set P–051 to 0H.
End

6.2 Code numbers for the power modules and standard motors

Table 3-1 Power module code number

Power mod. type	Order No. 6SN1123–1AA0□ 6SN1124–1AA0□ 6SN1135–1BA1□	Rated output current [A]	Peak output current, briefly S6–40 % 10 min [A]	Peak output current, briefly S6–40 %. 10 s [A]	Power module code number P–095
50 A	–0CA□	24	32	32	6
80 A	–0DA□	30	40	51	7
108 A	–0LA□	45	60	76	13 FW 2.40
120 A	–0GA□	45	60	76	8
160 A	–0EA□	60	80	102	9
200 A	–0FA□	85	110	127	10
300 A	–0JA□	120	150	193	11 FW 2.00
400 A	–0KA□	200	250	257	12 FW 2.00

HS

Table 3-2 Motor code number

MLFB 1PH6...3–ph. motor	Rated motor output [kW]	Rated motor current [A]	Motor no–load current [A]	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
101–□NF4	3.7	12.5	6.2	1500	9000	**101**
101–□NG4	4.7	13.7	6.9	2000		**102**
103–□NF4	5.5	17.9	9.1	1500		**103**
103–□NG4	7.0	19.4	9.9	2000		**104**
105–□NF4	7.5	22.5	11.5	1500		**105**
105–□NG4	9.5	25.3	13.1	2000		**106**
105–□NZ4	12.0	27.0	15.6	3000		**140**
107–□NC4	5.0	22.7	11.7	750		**131**
107–□NF4	9.0	26.9	14.2	1500		**107**
107–□NG4	11.5	29.8	15.6	2000		**108**
131–□NF4	9.0	27.2	11.7	1500	8000	**109**
131–□NG4	12.0	32.1	13.6	2000		**110**
131–□NZ0	8.0	23.2	10.9	1500		**141** FW 2.00
133–□NB4	4.5	26.0	9.8	525		**132**
133–□NF0	11.0	26.7	11.5	1500		**111**
133–□NF4	11.0	31.3	13.4	1500		**112**
133–□NG0	14.5	31.5	14.5	2000		**136**
133–□NG4	14.5	37.5	16.1	2000		**113**
135–□NF0	15.0	35.0	16.1	1500		**114**
135–□NF4	15.0	41.3	18.8	1500		**115**
135–□NG4	20.0	50.6	22.8	2000		**116**
137–□NB4	7.9	43.6	18.6	525		**133**
137–□NF4	18.5	50.2	22.9	1500		**117**
137–□NG0	24.0	50.0	23.2	2000		**137**
137–□NG4	24.0	57.8	26.5	2000		**118**
137–□NZ4	11.0	41.8	18.0	750		**143** FW 3.00
138–□NF0	22.0	51.5	24.6	1500		**119**
138–□NF4	22.0	61.0	28.7	1500		**120**
138–□NG4	28.0	66.1	31.4	2000		**121**

Table 3-2 Motor code number

MLFB 1PH6...3–ph. motor	Rated motor output [kW]	Rated motor current [A]	Motor no–load current [A]	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
161–□NF0	22.0	53.5	23.9	1500	6500	**122**
161–□NF4	22.0	60.8	26.9	1500		**123**
161–□NG4	28.0	68.1	31.3	2000		**124**
163–□NB4	11.5	66.2	27.8	500		**134**
163–□NF0	30.0	72.5	33.3	1500		**125**
163–□NF4	30.0	86.0	40.3	1500		**126**
163–□NG4	38.0	84.0	37.5	2000		**127**
163–□NZ0	19.0	56.0	25.2	950		**139**
167–□NB4	14.5	78.0	34.4	500		**135**
167–□NF0	37.0	79.6	36.3	1500		**128**
167–□NF4	37.0	95.7	43.5	1500		**129**
167–□NG0	45.0	83.3	32.2	2000		**138**
167–□NG4	45.0	91.0	41.0	2000		**130**
168–□NF0	40.0	84.0	38.0	1500		**142** FW 2.00
186–□NB4	26.8	66.0	35.5	610	6100	**161**
186–□NB9	30.8	67.0	35.0	700		**167**
186–□NB4	22.0	66.0	35.5	500	5000	**160**
186–□NE4	42.0	86.0	46.0	1250		**163**
186–□NF4	50.0	100.0	52.0	1500		**164**
206–□NB4	32.0	96.0	48.0	500		**162**
206–□NE4	63.0	125.0	64.0	1250		**165**
206–□NF4	76.0	149.0	68.0	1500		**166**
226–□NF4	100.0	192.0	79.0	1500		**168** FW 2.00

MLFB1PH7... motor	Rated motor output [kW]	Rated motor current [A]	Motor no–load current [A]	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
101–xNF4	3.7	8.9	4.82	1500	9000	**400** FW 3.00
103–xNF4	7	16.2	7.84	2000	9000	**402** FW 3.00
105–xNF4	7	16.4	8.36	1500	9000	**403** FW 3.00
107–xNF4	9	20.8	9.91	1500	9000	**404** FW 3.00
131–xNF4	11	23.1	8.36	1500	8000	**406** FW 3.00
133–xND4	12	28	12.7	1000	8000	**408** FW 3.00
133–xND4	20	43	17.4	2000	8000	**409** FW 3.00
137–xND4	17	40.7	18.5	1000	8000	**411** FW 3.00
137–xNG4	28	58.6	21.4	2000	8000	**412** FW 3.00
163–xND4	22	52.7	24.1	1000	6500	**414** FW 3.00
163–xNF4	30	70.3	30.1	1500	6500	**415** FW 3.00
167–xNF4	37	77.8	31.9	1500	6500	**417** FW 3.00
184–2NE□	40.0	85.0	46.2	1250	5000	**418** FW 2.40
184–2NB□	22.0	54.0	34.7	500	5000	**419** FW 2.40
184–xNTx	21.5	76	40	500	5000	**424** FW 3.00
186–2NE□	60.0	120.0	63.0	1250	5000	**420** FW 2.40
186–2NB□	29.6	75.0	42.5	500	5000	**425** FW 3.00
186–xNTx	29.6	106	56	500	5000	**421** FW 2.40
224–2NF□	100.0	188.0	73.0	1500	4500	**422** FW 2.40
224–2NC□	55.0	117.0	63.5	700	4500	**423** FW 2.40

Table 3-3 Star/delta±motors

MLFB 1PH6... Y/Δ motors	Rated motor output [kW]	Rated motor current [A] Y/Δ	Motor no–load current [A] Y/Δ	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
133–4NB8 137–4NB8	4.3 7.5	15.3/13.5 25.2/22.5	6.4/8.0 11.7/13.5	525/1250 525/1250	8000	**200** **202**
163–4NB8 167–4NB8	11.5 14.5	39.5/35.2 45.5/40.5	14.3/20.8 17.9/23.2	500/1250 550/1250	6500	**204** **206**
186–4NB8 206–4NB8 226–4NB8	22.0 32.0 42.0	55.0/50.0 76.0/73.0 94.0/88.0	31.0/35.0 38.0/49.0 56.0/55.0	500/1250 500/1250 500/1250	5000	**208** **210** **214** FW 2.00

Table 3-4 Water–cooled motors

MLFB 1PH4... motors	Rated motor output [kW]	Rated motor current [A]	Motor no–load current [A]	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
103–4NG6	8.5	36.4	17.7	2000	18000	**301**
105–4NG6	12.0	51.3	24.4	2000	17000	**303**
107–4NG6 133–4NF6	16.0 14.0	55.5 55.9	26.9 21.4	2000 1500	16000	**305** **307**
135–4NF6	20.0	76.6	29.7	1500	15000	**309**
137–4NF6	25.0	92.8	35.9	1500	14000	**311**
138–4NF6	28.0	102.2	40.0	1500	13000	**313**
163–4ND6	25.0	103.8	42.4	1000	12000	**315**
167–4ND6	31.0	129.4	50.7	1000	11000	**317**
168–4ND6	35.0	143.9	58.6	1000	10000	**319**
103–4NF2 105–4NF2 107–4NF2	7.5 11.0 14.0	25.2 36.6 45.0	11.5 16.4 19.0	1500 1500 1500	9000	**300** **302** **304**
133–4NF2 135–4NF2 137–4NF2 138–4NF2	15.0 22.0 27.0 30.0	53.1 70.7 81.9 97.3	17.4 25.5 30.3 33.8	1500 1500 1500 1500	8000	**306** **308** **310** **312**
163–4NF2 167–4NF2 168–4NF2	37.0 46.0 52.0	103.0 115.0 143.0	44.0 49.2 58.8	1500 1500 1500	6500	**314** **316** **318**

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Table 3-5 Built–in motors

MLFB 1PH2... motors	Rated motor output [kW]	Rated motor current [A]	Motor no–load current [A]	Rated speed [RPM]	Maximum speed [RPM]	Motor code No. P–096
092–4WG4 096–4WG4	4.7 10.0	20.6 41.6	10.6 21.5	2000 2000	18000	**326** **327**
123–4WF4 127–4WF4 128–4WF4	11.5 21.0 25.0	54.5 80.8 97.1	21.1 33.4 37.4	1500 1500 1500	16000	**328** **329** **330**
143–4WF4 147–4WF4	30.0 38.0	96.5 111.3	41.8 43.7	1500 1500	12000	**331** **332**
093–6WF4 095–6WF4 113–6WF4 115–6WF4 117–6WF4 118–6WF4	7.5 10.0 15.0 16.5 18.0 23.0	23.1 28.4 53.3 52.7 58.9 78.9	10.9 13.6 21.8 21.9 24.7 32.8	1500 1500 1500 1500 1500 1500	10000	**320** **321** **322** **323** **324** **325**
182–6WC4 184–6WP4 186–6WB4	11.8 14.5 18.3	37.0 56.0 62.5	17.0 25.7 31.0	750 600 525	8000	**333** FW 2.00 **334** FW 2.00 **335** FW 2.00
188–6WB4 254–6WB4	23.6 28.8	78.0 118.0	38.0 42.0	500 500	6000	**336** FW 2.00 **337** FW 2.00
256–6WB4	39.3	119.0	54.0	500	4000	**338** FW 2.00

Measuring system pulse No. 256 or 512 depending on the encoder used

6.3 Connections

Overview

- Connecting diagram
- connecting terminals
- Relay terminals
- star/delta changeover

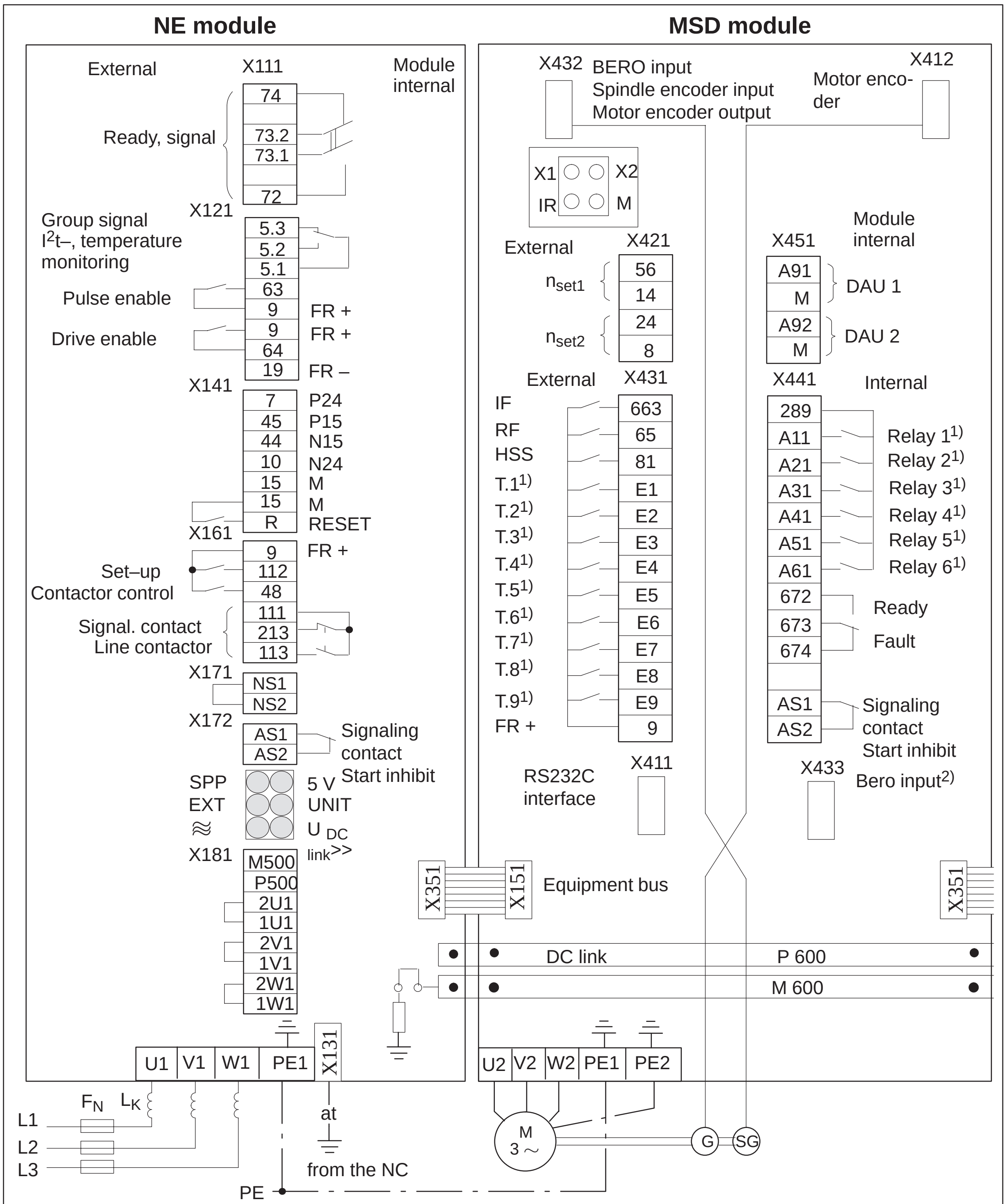
Warning

Cable shields and cores of power cables which are not used (e.g. cores for brakes) must be connected to PE potential in order to discharge charging currents caused by capacitive coupling.

If this is not observed, hazardous voltages can occur which can result in death or severe bodily injury.

Note: If non-PELV circuits are used at terminals AS1 and AS2, connector coding must be used so that the connector cannot be interchanged (refer to EN 60204–1, Section 6.4)
Order No. for the coding connector, refer to Catalog NC 60.1

Connection diagram
SIMODRIVE 611 analog system



Warning! If a power contactor is used between the motor and main spindle drive module, then it must be ensured, that this contactor only switches in a no–current condition. (When shutting down, first cancel the pulses (terminal 663), then 40 ms later the contactor).

Fig. 6-1 Connecting diagram

1) freely–programmable inputs and outputs
2) from MLFB (Order No.) 6SN1121–0BA11–0AA1

Connecting terminals

Table 3-6 connecting terminals

Term. No.	Designation	Function	Type 1)	Typ. voltage/ limit values	Max. cross–section
U2 V2 W2		Motor connection	O	3–ph. 0...450 V AC	Acc. to the Configuring Guide
PE1 PE2		Protective conductor Protective conductor	I O	0 V 0 V	Bolt Bolt
P600 M600		DC link DC link	I/O I/O	+300 V –300 V	Busbar Busbar
	X151/351	Equipment bus	I/O	Various	Ribbon cable
56 14 24 8	X421 X421 X421 X421	Speed setpoint 1 (differential input) Speed setpoint 2 (differential input) C–axis– or supplementary speed setpoint	E E E E	±10V/0.5mA (max. ±11 V) ±10V/0.5mA (max. ±11 V)	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
663	X431	Axis–specific pulse enable	I	+21V...+33V	1.5 mm^2
65	X431	Controller enable	I	+13V...+30V	1.5 mm^2
81	X431	RFG fast stop	I	+13V...+30V	1.5 mm^2
E1	X431	Freely–program. enable t. 1[2)]	I	+13V...+30V	1.5 mm^2
E2	X431	Freely–program. enable t. 2[2)]	I	+13V...+30V	1.5 mm^2
E3	X431	Freely–program. enable t. 3[2)]	I	+13V...+30V	1.5 mm^2
E4	X431	Freely–program. enable t. 4[2)]	I	+13V...+30V	1.5 mm^2
E5	X431	Freely–program. enable t. 5[2)]	I	+13V...+30V	1.5 mm^2
E6	X431	Freely–program. enable t. 6[2)]	I	+13V...+30V	1.5 mm^2
E7	X431	Freely–program. enable t. 7[2)]	I	+13V...+30V	1.5 mm^2
E8	X431	Freely–program. enable t. 8[2)]	I	+13V...+30V	1.5 mm^2
E9	X431	Freely–program. enable t. 9[2)]	I	+13V...+30V	1.5 mm^2
9[3)]	X431	Enable voltage	O	+24V	1.5 mm^2
A91	X451	Analog output, DAU1	O	±10 V 3 mA	1.5 mm^2
M	X451	Ref. potential for DAU1	O	0 V	1.5 mm^2
A92	X451	Analog output, DAU2	O	±10 V 3 mA	1.5 mm^2
M	X451	Ref. potential for DAU2	O	0 V	1.5 mm^2
X1		Test socket	O	0 V...5 V 3 mA	Test socket ∅ 2 mm diameter
X2		Test socket	O	0 V...5 V 3 mA	Test socket ∅ 2 mm diameter
I_R		Test socket	O	±10 V 3 mA	Test socket ∅ 2 mm diameter
M		Test socket	O	0 V	Test socket ∅ 2 mm diameter

1) I = input, O = output
2) can be freely–programmed via operator control parameters
3) refer to Section 3.1...3.2

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Relay terminals

Table 3-7 Relay terminals

Term. No.	Designa-tion	Function	Type 1)	Typ. voltage/ limit values	Max. cross–section
289	X441	Center contact signals	I	30 V/6.0 A max[3]	1.5 mm^2
A11	X441	Freely–program. relay fct. 1[2]	NO	30 V/1.0 A max	1.5 mm^2
A21	X441	Freely–program. relay fct. 2[2]	NO	30 V/1.0 A max	1.5 mm^2
A31	X441	Freely–program. relay fct. 3[2]	NO	30 V/1.0 A max	1.5 mm^2
A41	X441	Freely–program. relay fct. 4[2]	NO	30 V/1.0 A max	1.5 mm^2
A51)	X441	Freely–program. relay fct. 5[2]	NO	30 V/1.0 A max	1.5 mm^2
A61	X441	Freely–program. relay fct. 6[2]	NO	30 V/1.0 A max	1.5 mm^2
672	X441	Ready/no axis– speci-fic fault	NO	30 V/1.0 A max	1.5 mm^2
673	X441		I	30 V/1.0 A max	1.5 mm^2
674	X441		NC	30 V/1.0 A max	1.5 mm^2
AS 1	X441	Signaling contact	I	250 V_{AC}/1 A, 30 V_{DC}/2 A	1.5 mm^2
AS 2	X441	Start inhibit	NC		1.5 mm^2

1) I = input NC = NC contact NO = NO contact
2) can be freely–programmed via operator control parameters
3) when using several relays, the total current of 6 A may not be exceeded.

Star/delta changeover

The motors with star/delta changeover permit a wide constant power range. At low speeds, the drive is operated in the star circuit configuration (high torque) and at high speeds, in the delta circuit configuration (high stall torque). Changeover is also possible during operation. The changeover command (star/delta) must be entered externally (similar to a gearbox stage changeover).

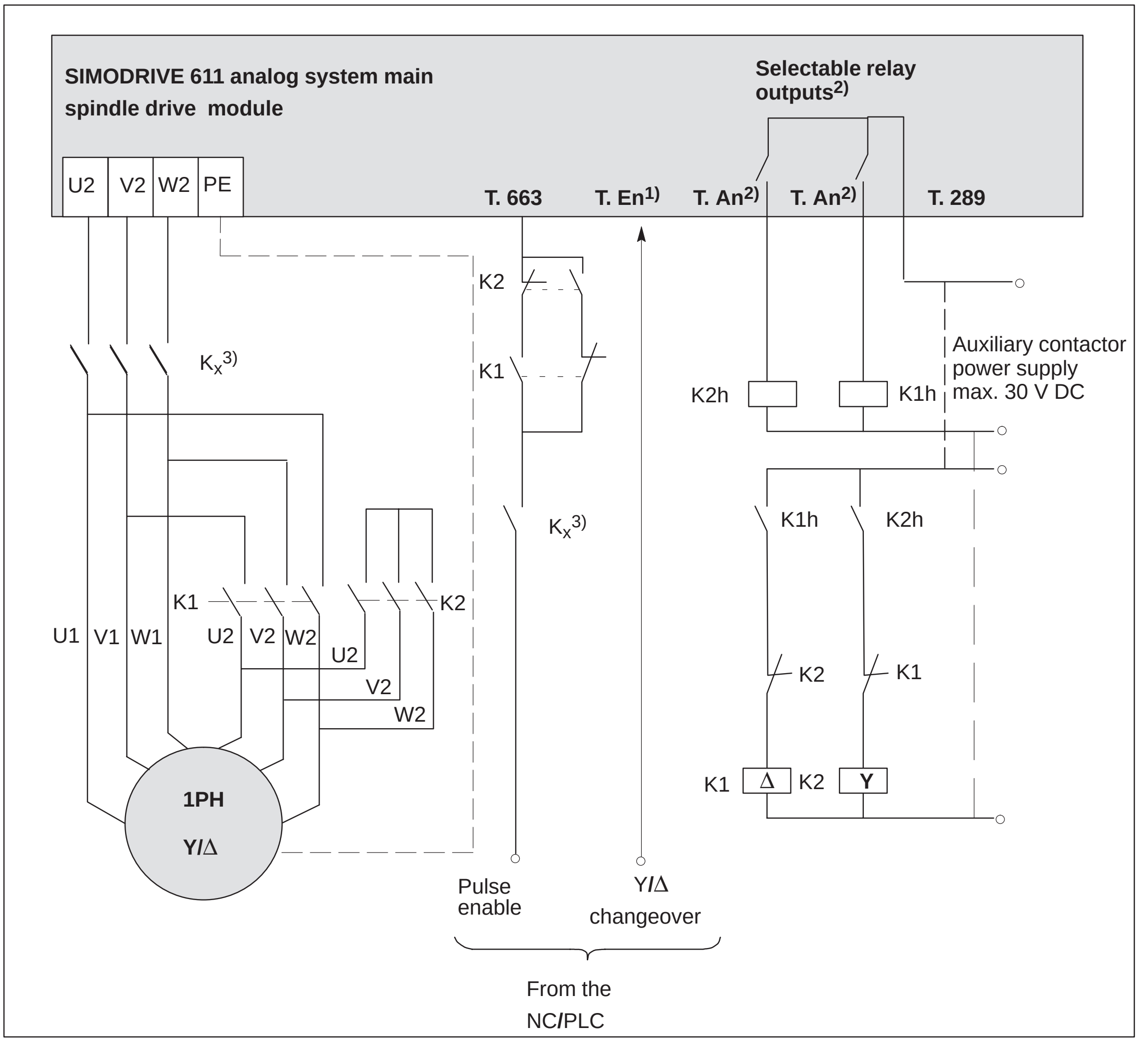

Fig. 6-2 Connecting diagram for Y/Δ changeover

1) an input terminal, selectable from terminals E1 to E9.

2) two relay outputs, selectable from terminals A11 to A61.

3) safety hold is not guaranteed by just opening K1 and K2.Thus, for safety–related reasons, electrical isolation must be realized using contactor K_x. This contactor may only be switched in a no–current condition, i. e. the pulse enable must be removed 40 ms before the protective trip.

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6.4 Connector assignment

Overview

- connector assignment X412 and motor connector
- connector assignment X432 for the spindle encoder
- connector assignment X432 for BERO
- connector assignment X432 for motor encoder signal output for NC

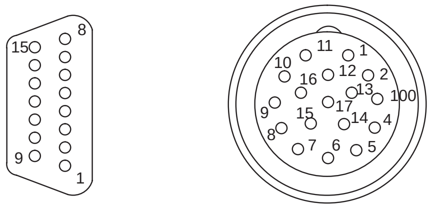
Connector assignment X412 and motor connector

X412: 15–pin sub–D socket connector, shift locking
motor connector: 17–pin round connector

Note: The connector may only be inserted or withdrawn when the system is in a no–voltage condition.

Table 3-8 Connector assignment: Motor encoder signals

Signal name	X412/PIN No.	Motor connector /PIN No.
P encoder	1	10
M encoder	2	7
A	100	1
$\overline{A}$	4	2
Inner shield	5	17
B	6	11
$\overline{B}$	7	12
5 V sense	9	16
R	10	100
0 V sense	11	15
$\overline{R}$	12	13
+ Temp	14	8
– Temp	15	9



External shield is connected to the connector housing.

Connector assignment X432 for spindle encoder

15–pin sub–D plug connector: shift catch

Note: The connector may only be inserted or withdrawn when the system is in a no–voltage condition.

Table 3-9 Connector assignment: Evaluation for incremental encoders with TTL square–wave signals

PIN No.	Signal name	Explanation
1	5 V	Encoder power supply
2	0 V	Ground, encoder power supply
100	A	Signal A
4	$\overline{A}$	Signal A, inverted
5	May not be used	
6	B	Signal B
7	$\overline{B}$	Signal B, inverted
8	May not be used	
9	5 V sense	Sensor line
10	May not be used	
11	0 V sense	Sensor line, ground
12	R	Signal R
13	$\overline{R}$	Signal R, inverted
14	May not be used	
15	May not be used	

Connector assignment X432 for BERO

Note: The connector may only be inserted or withdrawn when the system is in a no–voltage condition.

Table 3-10 Connector assignment: External reference mark evaluation

PIN No.	Signal name	Explanation
10	FR +	24V
14	BERO	Signal
15	FR –	Ground

Connector assignment X433 for BERO

Note: The connector may only be inserted or withdrawn when the system is in a no–voltage condition.

Table 3-11 Connector assignment: External reference mark evaluation

PIN No.	Signal name	Explanation
1	FR +	24V
2	BERO	Signal
100	FR –	Ground

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Connector assignment X432 for motor encoder signal output for NC

Note: The connector may only be inserted or withdrawn when the system is in a no–voltage condition.

Table 3-12 Connector assignment: Output of motor encoder signals with TTL square–wave signals

PIN No.	Signal name	Explanation
1	May not be used	
2	0V	Ground, encoder power supply
100	A	Signal A
4	$\overline{A}$	Signal A, inverted
5	May not be used	
6	B	Signal B
7	$\overline{B}$	Signal B, inverted
8	May not be used	
9	May not be used	
10	May not be used	
11	May not be used	
12	R	Signal R
13	$\overline{R}$	Signal R, inverted
14	May not be used	
15	May not be used	

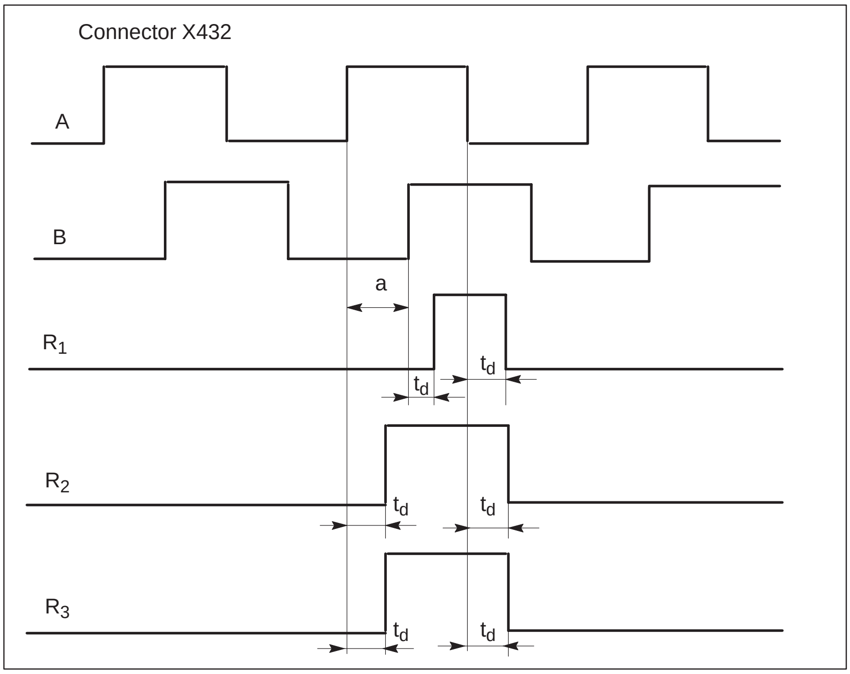

Fig. 6-3 X432: Output signals for the numerical control

R_1: Multiplication factor 1 and 0.5

R_2: Multiplication factor 2

R_3: Multiplication factor 4

Incremental signals:	TTL square–wave pulse trains A and B, and their inverted pulse trains $\overline{A}$ and $\overline{B}$. When the shaft is rotating clockwise, B lags A.
Edge distance:	a ≥ 200 ns, if the maximum permissible encoder signal input frequency is notexceeded
Reference signal:	One square–wave pulse R per mechanical revolution and its inverted pulse $\overline{R}$.
Delay time:	$\|t_{d\|}$ ≥ 50 ns
Load capability:	$-Ia_{high}$ ≥ 20 mA Ia_{low} ≥ 20 mA C_{load} ≥ 1000 pF
Signal level:	Open output (internal 270 Ω) 3.5 V, for minimum terminating resistance, of a total of 60 Ω, 2.5 V. More detailed information can be taken from the description of the RS422A interface.

6.5 Addresses, RAM variables

The following is valid for all address information: Segment address = 0H

Table 3-13 Addresses, RAM variables

Variable	High address	Low address	Value	Corres-ponds to
Speed setpoint	0C02H	0C00H	10 0000H	n_{rated}
Speed actual value	0C06H	0C04H	10 0000H	n_{rated}
Absolute speed actual value (1 ms)	–	1402H	1 000H	n_{rated}
Speed setpoint–actual value diffe-rence	0C0AH	0C08H	10 000H	n_{rated}
Torque setpoint from the speed con-troller	–	0C66H	Adr. 0F52H	M_{drated}
Torque setpoint for K/P converter	–	0C6CH	Adr. 0F52H	M_{drated}
Actual M_{dset} for M_d operation	–	0C6EH	Adr. 0F52H	M_{drated}
Ramp–function generator input	0E00H	0E02H	10 0000H	n_{rated}
Ramp–function generator output	0E04H	0E06H	10 0000H	n_{rated}
Magnetizing current setpoint	–	0F5CH	2 000H	I_{rated}
Active current setpoint	–	0F5EH	2 000H	I_{rated}
Slip frequency setpoint	–	0F7CH	2 000H	f_{rated}
Stator temperature	–	0FC2H	64H	100 °C
Digital filter input	–	1B08H	Adr. 0F52H	M_{drated}
Digital filter output	–	1B0AH	Adr. 0F52H	M_{drated}
DC link voltage	–	906H	3593	600 V
Output P/P_{rated}	–	3064H	4000H	P_{rated}
Output $\|P/P_{rated}\|$	–	3050H	4000H	P_{rated} [1)]

1) from FW2.00

6.6 Setting and check data (parameter list)

	Fields with grey background: Data entry is not possible

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P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
(P–000)	Operating display	2.2.1	1.20	–	–	–								
(P–001)	Speed setpoint	5.1.1	1.20	–	–	RPM								
(P–002)	Speed actual value	5.1.1	1.20	–	–	RPM								
(P–003)	Motor voltage	5.1.1	1.20	–	–	V								
(P–004)	Utilization	5.1.1	1.20	–	–	%								
(P–006)	DC link voltage	5.1.1	1.20	–	–	V								
(P–007)	Motor current	5.1.1	1.20	–	–	A								
(P–008)	Motor reactive power	5.1.1	1.20	–	–	kVA								
(P–009)	Motor active power	5.1.1	1.20	–	–	kW								
(P–010)	Motor temperature	5.1.1	1.20	–	–	°C								
(P–011)	Status of the binary inputs	5.1.2	1.20	–	–	hex								
P–012	Normalization, DAU RPM_{act} display	3.3.5	1.20	–200.0...200.0	100.0	%								
P–013	Normalization,, utilization display	3.3.5	1.20	–200.0...200.0	100.0	%								
P–014	Speed for max. motor useful speed mot 1	3.1	1.20	$-n_{maxmot}$ ... n_{maxmot}	RPM_{maxmot}	RPM								
P–015	Offset correction, speed setpoint	3.1	1.20	C000...4000	0	hex								
P–016	Ramp–up time, RFG	4.1	1.20	0.01...64.00	2.00	s								
P–017	Ramp–down time, RFG	4.1	1.20	0.01...64.00	2.00	s								
P–018	Smoothing time, speed setpoint smoothing	4.1	2.40	3...10000	5	ms								
P–019	Degree of rounding–off, speed setpoint	4.1	1.20	0...30	0	dec								
(P–020)	Diagnostics, speed actual value	5.1.3	1.20	–	–	hex								
P–021	RPM_{min} for ”$n_{act} < RPM_{min}$” signal mot 1	3.3.2	1.20	0...n_{rated}	12	RPM								
P–022	Shutdown speed, pulse cancellation mot 1	2.2.3	1.20	1...n_{rated}	$RPM_{rated}/256$	RPM								
P–023	RPM_x for ” $RPM_{act} < RPM_x$” signal mot 1	3.3.2	1.20	0...n_{maxmot}	6000	RPM								
P–024	Normalization, setpoint	3.1	1.20	5.0...15.0	10.0	V								
P–025	Timer stage, pulse cancellation	2.2.3	3.00	0...15000	0	ms								
P–026	Normalization, DAU M/M_{rated}	3.3.5	1.20	–200.0...200.0	100.0	%								
P–027	Toler. bandw. for ”$n_{act} = n_{set}$” signal mot 1	3.3.2	1.20	0...$n_{rated/16}$	20	RPM								
(P–028)	Diagnostics	5.1.3	1.20	–	–	hex								
P–029	Speed limiting	2.2.3	1.20	0...n_{maxmot}	RPM_{maxmot}	RPM								

P No.	Designation		Sec.	Firm–ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
P–030	Min. steady–state speed		3.1	2.00	0...n_{maxmot}	0	RPM								
P–031	P gain, speed controller	mot 1	4.1	1.20	3.0...120.0	32.0	dec								
P–032	Integral action time, speed controller	mot 1	4.1	1.20	5...6000	20	ms								
P–033	Encoder resolution for NC		3.3.4	1.20	0...7	0	dec								
P–034	Smoothing time, speed actual value smoothing		4.1	3.00	0...10	100	ms								
P–035	Smoothing time, torque setpoint	mot 1	4.1	1.20	3...1000	100	ms								
P–036	Encoder phase error correction		2.2.3	1.20	–400...400	0	dec								
P–037	Changeover speed, motor encoder evalu.	mot 1	2.2.3	1.20	32000	32000	RPM								
P–038	Hysteresis, P–037	mot 1	2.2.3	1.20	0...500	50	RPM								
P–039	1st torque limit	mot 1	2.2.3	1.20	5...300	100	%								
P–040	Regenerative limiting	mot 1	2.2.3	1.20	5...100	100	%								
P–041	2nd torque limit	mot 1	2.2.3	1.20	5...100	50	%								
P–042	Changeover speed for P–040	mot 1	2.2.3	1.20	1...n_{maxmot}	500	RPM								
P–043	Hysteresis, P–042	mot 1	2.2.3	1.20	0...n_{maxmot}	20	RPM								
P–044	Selection, torque setpoint smoothing		4.1	1.20	0...1	1	hex								
P–045	Switch–in speed, torque setpoint smooth.	mot 1	4.1	1.20	1...n_{maxmot}	4000	RPM								
P–046	Hysteresis, P–045	mot 1	4.1	1.20	0...n_{rated}	50	RPM								
P–047	M_{dx} for "$M_d < M_{dx}$" signal	mot 1	3.3.2	1.20	0...100	90	%								
P–048	Normalization, torque setpoint		2.3.4	1.20	–250...250	100	%								
P–049	Offset, torque setpoint		2.3.4	1.20	C000...4000	0	hex								
P–050	Changeover speed from M_{d1} to M_{d2}	mot 1	2.2.3	1.20	0...n_{maxmot}	4 · RPM_{rated}	RPM								
P–051	Write protection		1.3	1.20	0...7FFF	0	hex								
P–052	Transfer parameters into FEPROM		1.3	1.20	0...1	0	hex								
P–053	Control word		1.3	2.40	0...FFFF	11	hex								
P–054	M19, speed setpoint normalization		2.3.1	1.20	$-n_{maxmot}$ ... n_{maxmot}	RPM_{rated}	RPM								
P–055	M19, speed setpoint offset correction		2.3.1	1.20	C000...4000	0	hex								
P–056	M19, changeover speed		2.3.1	1.20	0...n_{maxmot}	RPM_{rated}	RPM								
P–058	Switch–off threshold, rounding–off M19		2.3.1	2.00	0...n_{maxmot}	0	RPM								
P–062	M19 changeover threshold, I comp., speed cont.		2.3.1	1.20	0...n_{maxmot}	RPM_{rated}/128	RPM								

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P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent							
							1	2	100	4	5	6	7	8
P–063	Max. motor temperature mot 1	2.2.3	1.20	0...170	Mot.typ–dep.	°C								
P–064	Fixed temperature	2.2.3	1.20	0...170	0	°C								
P–065	Timer stage, motor temperature alarm	2.2.3	1.20	0...600	240	s								
P–066	Address, DAU 1	3.3.5	1.20	0...FFFF	3044	hex								
P–067	Shift factor, DAU 1	3.3.5	1.20	0...15	0	dec								
P–068	Address, DAU 2	3.3.5	1.20	0...FFFF	3048	hex								
P–069	Shift factor, DAU 2	3.3.5	1.20	0...15	0	dec								
P–071	DAU smoothing time, utilization display	3.3.5	2.40	0...32767	20	ms								
P–072	Address, DAU 4	5.1.4	1.20	0...FFFF	C04	hex								
P–073	Shift factor, DAU 4	5.1.4	1.20	0...15	0	dec								
P–074	Offset, DAU 4	5.1.4	1.20	7F...FF80	0	hex								
P–076	Address, DAU 3	5.1.4	1.20	0...FFFF	3050	hex								
P–077	Shift factor, DAU 3	5.1.4	1.20	0...15	0	dec								
P–078	Offset, DAU 1	3.3.5	1.20	7F...FF80	0	hex								
P–079	Offset, DAU 2	3.3.5	1.20	7F...FF80	0	hex								
P–080	Offset, DAU 3	5.1.4	1.20	7F...FF80	0	hex								
P–081	Terminal function assignment E1	3.2.2	1.20	1...34	1	dec								
P–082	Terminal function assignment E2	3.2.2	1.20	1...34	7	dec								
P–083	Terminal function assignment E3	3.2.2	1.20	1...34	100	dec								
P–084	Terminal function assignment E4	3.2.2	1.20	1...34	6	dec								
P–085	Terminal function assignment E5	3.2.2	1.20	1...34	4	dec								
P–086	Terminal function assignment E6	3.2.2	1.20	1...34	2	dec								
P–087	Terminal function assignment E7	3.2.2	1.20	1...34	9	dec								
P–088	Terminal function assignment E8	3.2.2	1.20	1...34	10	dec								
P–089	Terminal function assignment E9	3.2.2	1.20	1...34	11	dec								
P–090	Control word	1.3	1.20	0...FFFF	002D	hex								
P–091	Frequency filter 1, HPC	2.3.6	2.00	45...750	300	Hz								
P–092	Quality filter 1, HPC	2.3.6	2.00	0.50...10.00	1.00	dec								

P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent							
							1	2	100	4	5	6	7	8
P–093	Offset correction, speed setpoint HPC	2.3.6	2.00	C000...4000	0	hex								
P–094	Normalization, speed setpoint HPC	2.3.6	2.00	$-n_{rated}-1...+n_{rated}-1$	$RPM_{rated}/8$	RPM								
P–095	Power section code number	2.1	1.20	6...13	7	dec								
P–096	Motor code number mot 1	2.1	1.20	101...425	101	dec								
P–097	Initialization	2.1	1.20	0...1	0	hex								
P–098	Encoder pulse number, motor measuring system	2.1	1.20	128...4096	2048	dec								
(P–099)	Firmware release	2.2.2	1.20	0.00...99.00	–	dec								
(P–100)	Operating display	2.2.1	1.20	–	–	–								
(P–101)	Setpoint for open–loop torque controlled oper.	5.1.1	1.20	–	–	%								
(P–102)	Speed actual value	5.1.1	1.20	–	–	RPM								
P–103	Frequency, torque setpoint filter mot 1	4.1	1.20	50...450	300	Hz								
P–104	Quality, torque setpoint filter mot 1	4.1	1.20	0.10...10.00	1.00	dec								
P–106	Smoothing time, speed setpoint, HPC	2.3.6	2.00	3...10000	100	ms								
P–107	Frequency, filter 2 HPC	2.3.6	2.00	45...750	300	Hz								
P–108	Quality, filter 2 HPC	2.3.6	2.00	0.50...10.00	1.00	dec								
P–109	Torque limit, HPC	2.3.6	2.00	5...180	100	%								
P–110	Regenerative limit, HPC	2.3.6	2.00	5...100	100	%								
P–111	P gain, speed controller HPC	2.3.6	2.00	3.0...240.0	10.0	dec								
P–112	Integral action time, speed controller HPC	2.3.6	2.00	2...6000	20	ms								
P–113	Channel selection, speed setpoint	3.1	1.20	0...3	1	hex								
P–114	Normalization, speed setpoint, C axis	2.3.2	1.20	$-n_{rated}-1...+n_{rated}-1$	$RPM_{rated}/8$	RPM								
P–115	Offset correction, speed setpoint, C axis	2.3.2	1.20	C000...4000	0	hex								
P–116	Correction, P gain, current controller mot 1	4.2	1.20	–255...255	0	dec								
P–117	Selection, torque setpoint filter mot 1	4.1	1.20	0...FFFF	0	hex								
P–118	Typical torque setpoint filter mot 1	4.1	1.20	0...FFFF	0	hex								
P–119	Flux adaptation HPC	2.3.6	2.00	5...100	100	%								
P–120	Changeover speed, current contr. adapt. mot 1	4.2	1.20	500...10000	Mot.typ–dep.	RPM								

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P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent							
							1	2	100	4	5	6	7	8
P–121	Position reference value 1	2.3.3	1.20	0...64000	0	dec								
P–122	Position reference value 2	2.3.3	1.20	0...64000	0	dec								
P–123	Position reference value, incremental	2.3.3	1.20	–32768...32767	256	dec								
P–124	Position reference value 3	2.3.3	1.20	0...64000	0	dec								
P–125	Position reference value 4	2.3.3	1.20	0...64000	0	dec								
P–126	Bandwidth, integrator enable speed controller	2.3.3	1.20	0.0...180.0	10.0	dec								
(P–128)	Actual position reference value	2.3.3	1.20	–	–	dec								
P–129	Setting the internal zero mark	2.3.3	1.20	0...1	0	hex								
P–130	Zero mark offset	2.3.3	1.20	0...64000	0	dec								
P–131	Max. pulse number between 2 zero marks	2.3.3	1.20	128...64000	2048	dec								
(P–132)	Absol. pos. act. value without zero mark offset	2.3.3	1.20	–	–	dec								
(P–133)	Difference between 2 external zero marks	2.3.3	1.20	–	–	dec								
P–134	Initiation point for P–136	2.3.3	1.20	0.0...180.0	10.0	degr.								
P–135	Initiation point for P–137/P–138	2.3.3	1.20	0.0...180.0	2.0	degr.								
P–136	P gain, gradient 1	2.3.3	1.20	0...FFFF	220	hex								
P–137	P gain, gradient 2	2.3.3	1.20	0...FFFF	220	hex								
P–138	P gain, gradient 2 (HMS)	2.3.3	1.20	0...FFFF	44	hex								
P–139	Multiplier for braking parabola	2.3.3	1.20	0...FFFF	100	hex								
(P–140)	Absol. pos. actual value with zero mark offset	2.3.3	1.20	–	–	dec								
P–141	Changeover parameter, positioning	2.3.3	1.20	0...FFFF	0	hex								
P–142	Flag for speed increase	2.3.3	1.20	0...21	0	hex								
P–143	Transfer parameter P–141	2.3.3	1.20	0...1	0	hex								
P–144	Response bandwidth, relay 1	2.3.3	1.20	0.00...18.00	1.00	degr.								
P–145	Response bandwidth, relay 2	2.3.3	1.20	0.00...18.00	5.00	degr.								
P–146	Search speed for spindle positioning	2.3.3	1.20	0... 4 · RPM_{rated}	500	RPM								
(P–147)	Position counter status regarding the BERO	2.3.3	1.20	–	–	dec								
P–148	Motion window, spindle positioning	2.3.3	1.20	0.0...180.0	1.0	degr.								

P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
P–149	Start–up parameter C axis/position.	2.3	1.20	0...FFFF	40	hex								
(P–150)	Board identification	2.2.2	1.20	Dep. on module expansion		hex								
P–151	Write protection	1.3	1.20	0...7FFF	0	hex								
P–152	Transfer parameter into the EEPROM	1.3	1.20	0...1	0	hex								
P–154	Oscillation setpoint 1	2.2.3	1.20	$-n_{maxmot} \ldots n_{maxmot}$	0	RPM								
P–155	Oscillation setpoint 2	2.2.3	1.20	$-n_{maxmot} \ldots n_{maxmot}$	0	RPM								
P–156	Oscillation interval time 1	2.2.3	1.20	10...10000	1000	ms								
P–157	Oscillation interval time 2	2.2.3	1.20	0...10000	1000	ms								
P–158	Series reactor inductance mot 1	2.1	3.00	0.000...65.535	0.000	mH								
P–159	Motor moment of inertia mot 1	2.1	1.20	0.002...32.000	Mot.typ–dep.	kgm^2								
P–160	Rated motor output mot 1	2.1	1.20	0.0...150.0	Mot.typ–dep.	kW								
P–161	Rated motor current mot 1	2.1	1.20	0.00...200.0	Mot.typ–dep.	A								
P–162	Rated motor voltage mot 1	2.1	1.20	0.0...500.0	Mot.typ–dep.	V								
P–163	Rated motor speed mot 1	2.1	1.20	0...4096	Mot.typ–dep.	RPM								
P–164	Rated motor frequency mot 1	2.1	1.20	0.0...409.6	Mot.typ–dep.	Hz								
P–165	Motor no–load voltage mot 1	2.1	1.20	0.0...500.0	Mot.typ–dep.	V								
P–166	Motor no–load current mot 1	2.1	1.20	0.00...200.00	Mot.typ–dep.	A								
P–167	Stator resistance, cold mot 1	2.1	1.20	0...32767	Mot.typ–dep.	mΩ								
P–168	Rotor resistance, cold mot 1	2.1	1.20	0...32767	Mot.typ–dep.	mΩ								
P–169	Stator leakage reactance mot 1	2.1	1.20	0...32767	Mot.typ–dep.	mΩ								
P–170	Rotor leakage reactance mot 1	2.1	1.20	0...32767	Mot.typ–dep.	mΩ								
P–171	Main field reactance mot 1	2.1	1.20	0...65535	Mot.typ–dep.	mΩ								
P–172	Upper speed, L_h characteristic mot 1	2.1	1.20	100...24000	Mot.typ–dep.	RPM								
P–173	Speed at the start of field weakening mot 1	2.1	1.20	100...6000	Mot.typ–dep.	RPM								
P–174	Max. motor speed mot 1	2.1	1.20	0...20000	Mot.typ–dep.	RPM								
P–175	Gain factor L_h characteristic mot 1	2.1	1.20	50...300	Mot.typ–dep.	%								
P–176	Stall torque reduction factor mot 1	2.1	1.20	50...150	Mot.typ–dep.	%								
P–177	Start calculation, motor 1 (P–096)	2.1	1.20	0...1	0	hex								

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P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
P–179	Select, min/max memory	5.1.5	1.20	0...2	0	hex								
P–180	Enable motor changeover (star/delta)	2.1.3	1.20	0...1	0	hex								
P–181	Address for min/max memory	5.1.5	1.20	0...FFFF	0	hex								
(P–182)	Min. value min/max memory	5.1.5	1.20	–	–	hex								
(P–183)	Max. value min/max memory	5.1.5	1.20	–	–	hex								
P–185	Address for monitoring 1	3.3.3	1.20	0...FFFF	C06	hex								
P–186	Threshold for monitoring 1	3.3.3	1.20	0...FFFF	0	hex								
P–187	Pull–in delay, monitoring 1	3.3.3	1.20	0.00...10.00	0.00	s								
P–188	Drop–out delay, monitoring 1	3.3.3	1.20	0.00...10.00	0.00	s								
P–189	Hysteresis, monitoring 1	3.3.3	1.20	0...FFFF	1	hex								
P–190	Address for monitoring 2	3.3.3	1.20	0...FFFF	C06	hex								
P–191	Threshold for monitoring 2	3.3.3	1.20	0...FFFF	0	hex								
P–192	Pull–in delay, monitoring 2	3.3.3	1.20	0.00...10.00	0.00	s								
P–193	Drop–out delay, monitoring 2	3.3.3	1.20	0.00...10.00	0.00	s								
P–194	Hysteresis, monitoring 2	3.3.3	1.20	0...FFFF	1	hex								
P–195	Lower adaptation speed mot 1	4.1	1.20	0...n_{maxmot}	1000	RPM								
P–196	Upper adaptation speed mot 1	4.1	1.20	0...n_{maxmot}	1200	RPM								
P–198	P gain, upper adaptation speed mot 1	4.1	1.20	0.0...120.0	24.0	dec								
P–199	Reduction factor, P gain mot 1	4.1	1.20	1...200	100	%								
P–201	Integral action time, upper adapt. speed mot 1	4.1	1.20	5...6000	80	ms								
P–202	Reduction factor, integral action time mot 1	4.1	1.20	1...200	100	%								
P–203	Control word, speed controller adapt. mot 1	4.1	1.20	0...7	0	dec								
P–206	Selection, transient recorder	5.1.6	1.20	0...1	0	hex								
P–207	Set transient recorder	5.1.6	1.20	0...10	1	hex								
P–208	Address for start condition	5.1.6	1.20	0...FFFF	0	hex								
P–209	Threshold for start condition	5.1.6	1.20	0...FFFF	0	hex								
P–210	Address for stop condition	5.1.6	1.20	0...FFFF	0	hex								

P No.	Designation		Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent							
								1	2	100	4	5	6	7	8
P–211	Threshold for the stop condition		5.1.6	1.20	0...FFFF	0	hex								
P–212	Address, signal 1		5.1.6	1.20	0...FFFF	0	hex								
P–213	Address, signal 2		5.1.6	1.20	0...FFFF	0	hex								
P–214	Start trace output		5.1.6	1.20	0...1	0	hex								
P–215	Shift factor, signal 1		5.1.6	1.20	0...15	0	dec								
P–216	Shift factor, signal 2		5.1.6	1.20	0...15	0	dec								
P–217	Trigger signal 1		5.1.6	1.20	0...FFFF	0	hex								
P–218	Trigger signal 2		5.1.6	1.20	0...FFFF	0	hex								
P–219	Motor moment of inertia	mot 2	2.1.3	1.20	0.002...32.000	Mot.typ–dep.	kgm^2								
P–220	Rated motor output	mot 2	2.1.3	1.20	0.0...150	Mot.typ–dep.	kW								
P–221	Rated motor current	mot 2	2.1.3	1.20	0.00...200.00	Mot.typ–dep.	A								
P–222	Rated motor voltage	mot 2	2.1.3	1.20	0.0...500.0	Mot.typ–dep.	V								
P–223	Rated motor speed	mot 2	2.1.3	1.20	0...4096	Mot.typ–dep.	RPM								
P–224	Rated motor frequency	mot 2	2.1.3	1.20	0.0...409.6	Mot.typ–dep.	Hz								
P–225	Motor no–load voltage	mot 2	2.1.3	1.20	0.0...500.0	Mot.typ–dep.	V								
P–226	Motor no–load current	mot 2	2.1.3	1.20	0.00...200.00	Mot.typ–dep.	A								
P–227	Stator resistance, cold	mot 2	2.1.3	1.20	0...32767	Mot.typ–dep.	mΩ								
P–228	Rotor resistance, cold	mot 2	2.1.3	1.20	0...32767	Mot.typ–dep.	mΩ								
P–229	Stator leakage reactance	mot 2	2.1.3	1.20	0...32767	Mot.typ–dep.	mΩ								
P–230	Rotor leakage reactance	mot 2	2.1.3	1.20	0...32767	Mot.typ–dep.	mΩ								
P–231	Main field reactance	mot 2	2.1.3	1.20	0...65535	Mot.typ–dep.	mΩ								
P–232	Upper speed, L_h characteristic	mot 2	2.1.3	1.20	100...24000	Mot.typ–dep.	RPM								
P–233	Speed at the start of field weakening	mot 2	2.1.3	1.20	100...6000	Mot.typ–dep.	RPM								
P–234	Max. motor speed	mot 2	2.1.3	1.20	0...20000	Mot.typ–dep.	RPM								
P–235	Gain factor L_h characteristic	mot 2	2.1.3	1.20	50...300	Mot.typ–dep.	%								
P–236	Stall torque reduction factor	mot 2	2.1.3	1.20	50...150	Mot.typ–dep.	%								
P–237	Start calculation, other motor		2.1.3	1.20	0...1	0	hex								
P–238	Motor code number	mot 2	2.1.3	1.20	101...425	101	dec								

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P No.	Designation		Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
P–239	Start calculation, motor 2 (P–238)		2.1.3	1.20	0...1	0	dec								
P–241	Programmable, signal 1		3.3.2	1.20	1...20	2	dec								
P–242	Programmable, signal 2		3.3.2	1.20	1...20	100	dec								
P–243	Programmable, signal 3		3.3.2	1.20	1...20	1	dec								
P–244	Programmable, signal 4		3.3.2	1.20	1...20	4	dec								
P–245	Programmable, signal 5		3.3.2	1.20	1...20	5	dec								
P–246	Programmable, signal 6		3.3.2	1.20	1...20	7	dec								
P–247	Control word signal		3.3.2	1.20	0...FFFF	0	hex								
P–248	Delay time, fault message F–11		5.2.2	2.00	100...10000	750	ms								
P–249	Memory loc. segment, monitor		2.3.5	1.20	0...FFFF	0	hex								
P–250	Memory loc. address, monitor		2.3.5	1.20	0...FFFF	0	hex								
P–251	Value display, monitor memory location		2.3.5	1.20	–	–	hex								
(P–254)	Display of active functions 1		5.1.2	1.20	–	–	hex								
(P–255)	Display of active functions 2		5.1.2	1.20	–	–	hex								
P–256	Delay time "$n_{set} = n_{act}$" signal		3.3.2	3.00	0.00...0.50	0.20	s								
P–257	Delay time "Md < Mdx" signal		3.3.2	3.00	0.00...1.00	0.80	s								
P–258	Speed for max. motor useful speed	mot 2	3.1	1.20	$-n_{maxmot}$ ... n_{maxmot}	RPM_{maxmot}	RPM								
P–260	RPM_{min} for "$n_{act} < RPM_{min}$" signal	mot 2	3.3.2	1.20	0...n_{rated}	12	RPM								
P–261	Shutdown speed, pulse cancellation	mot 2	2.2.3	1.20	1...n_{rated}	RPM_{rated}/256	RPM								
P–262	RPM_x for "$RPM_{act} < RPM_x$" signal		3.3.2	1.20	0...n_{maxmot}	6000	RPM								
P–263	Toler. bandw. for "$n_{act} = n_{set}$" signal	mot 2	3.3.2	1.20	0...n_{rated}/16	20	RPM								
P–264	Speed limiting	mot 2	2.2.3	1.20	0...n_{maxmot}	RPM_{maxmot}	RPM								
P–265	P gain, speed controller	mot 2	4.1	1.20	3.0...120.0	32.0	dec								
P–266	Integral action time, speed controller	mot 2	4.1	1.20	5...6000	20	ms								
P–267	Changeover speed, mot. encoder select.	mot 2	2.2.3	1.20	32000	32000	RPM								
P–268	Hysteresis, P–267	mot 2	2.2.3	1.20	0...500	50	RPM								
P–269	1st torque limit	mot 2	2.2.3	1.20	5...300	100	%								
P–270	Regenerative limiting	mot 2	2.2.3	1.20	5...100	100	%								

P No.	Designation		Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent							
								1	2	100	4	5	6	7	8
P–271	2nd torque limit	mot 2	2.2.3	1.20	5...100	50	%								
P–272	Changeover speed for P–270	mot 2	2.2.3	1.20	1...n_{maxmot}	500	RPM								
P–273	Hysteresis, P–272	mot 2	2.2.3	1.20	0...n_{maxmot}	20	RPM								
P–274	Switch–in speed, torque setpoint smooth.	mot 2	4.1	1.20	1...n_{maxmot}	4000	RPM								
P–275	Hysteresis, P–274	mot 2	4.1	1.20	0...n_{rated}	50	RPM								
P–276	Frequency, torque setpoint filter	mot 2	4.1	1.20	50...450	300	Hz								
P–277	Quality, torque setpoint filter	mot 2	4.1	1.20	0.10...10.00	1.00	dec								
P–278	Correction, P gain, current controller	mot 2	4.2	1.20	–255...255	0	dec								
P–280	Selection, torque setpoint filter	mot 2	4.1	1.20	0...1	0	hex								
P–281	Typical torque setpoint filter	mot 2	4.1	1.20	0...1	0	hex								
P–283	Lower adaptation speed	mot 2	4.1	1.20	0...n_{maxmot}	1000	RPM								
P–284	Upper adaptation speed	mot 2	4.1	1.20	0...n_{maxmot}	1200	RPM								
P–285	P gain, upper adaptation speed	mot 2	4.1	1.20	0.0...120.0	24.0	dec								
P–286	Reduction factor, P gain	mot 2	4.1	1.20	1...200	100	%								
P–288	Integral action time, upper adapt. speed	mot 2	4.1	1.20	5...6000	80	ms								
P–289	Reduction factor, integral action time	mot 2	4.1	1.20	1...200	100	%								
P–290	Changeover speed from M_{d1} to M_{d2}	mot 2	2.2.3	1.20	0...n_{maxmot}	4 · RPM_{rated}	RPM								
P–291	Max. motor temperature	mot 2	2.2.3	1.20	0...170	Mot.typ–dep.	°C								
P–292	Changeover speed, current contr. adapt.	mot 2	4.2	1.20	500...10000	Mot.typ–dep.	RPM								
P–293	Control word, speed controller adapt.	mot 2	4.1	1.20	0...7	0	dec								
P–294	Series reactor inductance	mot 2	2.1.2	3.00	0.000...65.535	0.000	mH								
(P–299)	Checksum, parameters		5.1.3	2.00	–	–	hex								
P–311	Current for I/f open–loop control		5.1.7	1.20	0.0...100.0	0.0	%								
P–312	Frequency for I/f open–loop control		5.1.7	1.20	0.0...800.0	0.0	Hz								
P–313	Selection, I/f open–loop control		5.1.7	1.20	0...1	0	dec								
(P–316)	Display, P gain, current controller		4.2	1.20	–	–	dec								

HS

P No.	Designation	Sec.	Firm-ware status	Setting range	Setting	Dim.	Setting, gearbox stage–dependent 1	2	100	4	5	6	7	8
(P–320)	Diagnostics, motor encoder zero mark	5.1.3	3.00											
(P–321)	Diagnostics, spindle encoder zero mark	5.1.3	3.00											
(P–330)	Inverter clock frequency	5.1.1	3.00			kHz								
P–331	Inverter clock frequency 2	4.2	3.00	0...7	4	hex								
P–332	Inverter clock frequency 3	4.2	3.00	0...7	2	hex								
P–333	Inverter clock frequency 4	4.2	3.00	0...7	6	hex								
P–340	Speed deviation, slip monitoring	2.3.4	2.00	0.1...100.0	10.0	%								
P–341	Torque reduction, slip monitoring	2.3.4	2.00	0.0...100.0	50.0	%								
P–343	Delay time, slip monitoring	2.3.4	2.00	0...999	200	ms								
P–344	Torque–reduction speed, slip monitoring	2.3.4	2.00	0.01...100.00	0.50	%/ms								
P–345	Torque increase speed, slip monitoring	2.3.4	2.00	0.01...100.00	0.10	%/ms								
P–346	Hysteresis to P–340	2.3.4	2.00	0.0...100.0	0.00	%								
(P–347)	Speed deviation, actual slip monitoring	2.3.4	2.00											

■

Induction motor modules (AM)

1 First steps

Warning

Professional transport, storage, installation and mounting as well as careful operator control and service are absolutely necessary to guarantee perfect and safe operation of this drive converter.

Severe bodily injury or material damage can occur if this warning information is not observed.

The boards contain components which can be destroyed by electrostatic discharge.
Please observe the ESDS instructions in the foreword.

Note

The board, MLFB (Order No.) 6SN1121–0BA11–0AA1 can only be operated with firmware from 3.00.

The boards, MLFB (Order Nos.):
6SN1121–0BA11–0AA0
6SN1121–0BA12–0AA0
can only be operated **up to** Firmware 2.xx.

1.1 Start–Up Guidelines

Structure of the Start–Up Guide

The Start–Up Guide is structured according to the sequence of the various start–up steps.

To start–up standard applications, where the preset drive converter interfaces (Section 1.5) and controller optimization when shipped, are adequate, then only the start–up steps which are highlighted are of significance.

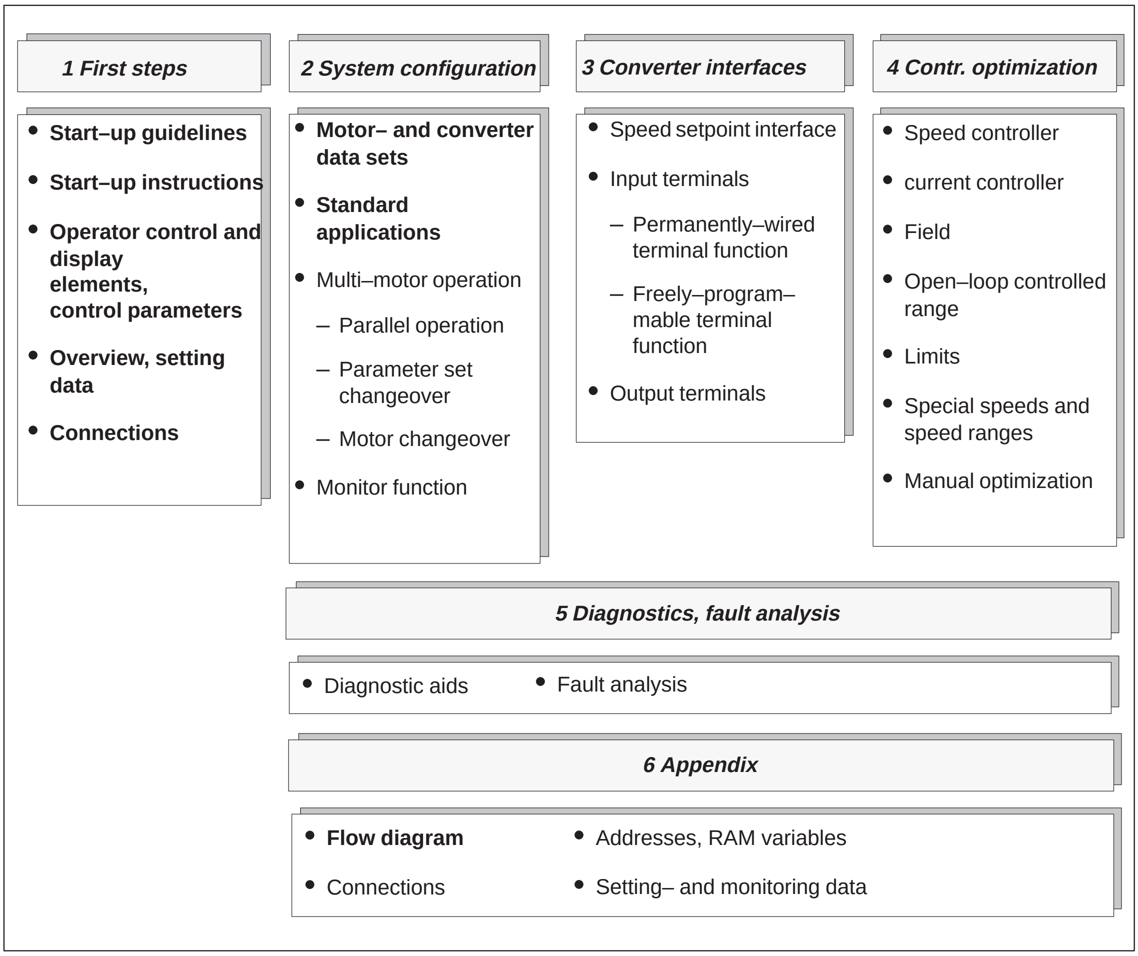


Fig. 1-1 Start–up steps

Parameter listing

Warning

Parameter settings, which are not listed in the parameter list (refer to Section 6.6) may not be changed.

The parameter descriptions are in the form of tables.

The sequence in which they are listed is the actual parameterizing sequence.

Table 1-1 Example of the parameter display

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–024 **P–014.M** **P–039.G** **P–114.F** **(P–001)**	online after initialization	4 10	Value range dimensions	**Parameter designation** Brief description of the parameter FW x.xx

Parameter attributes

- **Number**
  - P–024
    generally valid parameter
  - P–014.**M**
    motor–dependent parameter
    sub–parameter P–014.1...P–014.4
  - P–039.**G**
    gearbox stage–dependent parameter
    sub–parameter P–039.1...P–039.8
  - P–114.**F**
    fixed setpoint–dependent parameter
    sub–parameter P–114.1...P–014.7
  - **(**P–001**)**
    display parameter; value cannot be changed.

AM

- **Change effective**
  - online
    Change is immediately effective.
  - After initialization
    Initialization is started by setting P–097 to 1H.
- **P–051**

  Write protection parameters
  Remove the write protection by entering 04H and
  remove the special write protection by entering 0010H.

Setting range

For several control words, the functions are activated by setting the bits of a binary number and these are then entered in a hexadecimal form.

Example:

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	0	1	0		
Bit 6:	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	Bin	00<u>4</u>0H
Bit 7:	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	Bin	00<u>8</u>0H

A combination of several functions is entered by adding binary– or hexadecimal values.

Example:

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	0	1	0		
Bit 6+Bit 7	0	0	0	0	0	0	0	0	**1**	**1**	0	0	0	0	0	0	Bin	00<u>C</u>0H

Description

- **FW x.xx**

  Firmware–release dependent coding of the function– and parameter extensions. The extension is available from the specified firmware release.

1.2 Start–up instructions

Start–up possibilities

via

- operator control and display elements (refer to Section 1.3)
- RS232C interface with an IBM AT–compatible computer and start–up software (refer to foreword).

Re–initialize drive converter (if necessary)

If an already initialized drive converter is to be re–initialized, then the following procedure must be observed:

- if required, save setting data (parameters)
- remove write protection: Set P–051 to 4H.
- start initialization: Set P–097 to 0H.
- overwrite the parameters in the drive–machine data memory:
  Set P–052 to 1H, and wait until P–052 resets itself to 0H.
- power–on reset:
  Power–down the unit and power–up approximately 2 s after the display has disappeared:
  P–095 must then appear in the display.
- initialize (Section 2.1).

Firmware replacement (if required)

The firmware can be replaced using the user–prompted start–up software for main spindle– and induction motor modules from version V2.00.
Dependency, firmware release/board

Firmware release	Board
before 3.00	6SN1122–0BA1□–0AA0
from 3.00	6SN1122–0BA12–0AA1y

Procedure:

- back–up setting data (parameters)
- replace the firmware using the start–up program
- initialize with the pulses and controller inhibited (Section 2.1).
- re–load the backed–up settings.
- adjust the power offset (refer to Table 4–1, from FW 3.00, this is not necessary)
- back–up the settings in the drive–machine data memory (Section 1.3)

Start–up of series machines, module replacement, component replacement

The drive converter setting data (parameters) can be saved on floppy disk using the start–up software. Proceed as follows for series start–up of additional drive converters:

1. Initialize with the pulses and controller inhibited:
   Enter P–095 power module code acc. to Table 6–1 . [1)]
   – motor code numbers are saved on floppy disk
   and therefore do not have to be entered.
   – start initialization.
2. Load setting data from the floppy disk.
3. Adjust the power offset according to Table 4–1. This is not necessary from FW 3.00.
4. Save.

1) Power modules with MLFB (Order No.=) 6SN112□–1A□0□–□□A1 from FW 3.00, are automatically identified. Then, it is no longer possible/necessary to enter P–095.

1.3 Operator control and display elements, control parameters

Operator control– and display elements

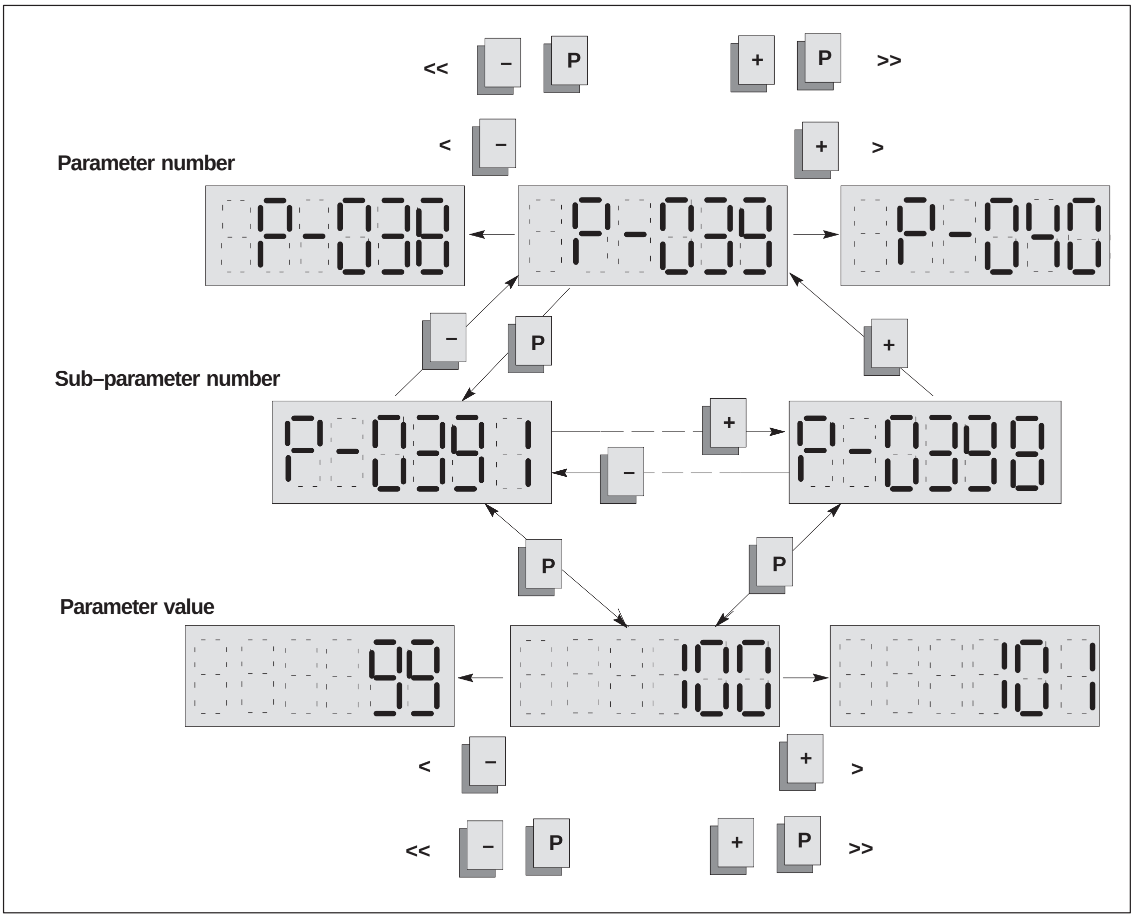
The following operator control– and display elements are available on the front panel to start–up and parameterize the SIMODRIVE 611–A induction motor module:

- 3 op. control keys (+ , P and – key)
- 6–digit LCD display

Gearbox stage–dependent parameters and the fixed setpoint–dependent P–114 are represented using 8 sub–parameter numbers (e. g. P–039.1 to P–039.8).

Motor–dependent parameters are represented with 4 sub–parameter numbers (e. g. P–014.1 to P–014.4).

The operator control element functions are represented using, as an example, parameter P–039.



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Control parameters

Note

If data storage (P–052) is interrupted due to power failure or the power being disconnected, then the modified/changed values are lost, and when the power returns, the converter displays fault message ”F–07” (refer to Section 5.2.2). The parameter values can be reset after fault message ”F–07” is acknowledged (refer to Section 5.2.2).

Table 1-2 open–loop control parameter

Parameter attributes						
Number	**Change effective**	**P–051**	**Setting data**	**Description**		
P–051 **P–151**	online	–	0...FFFF hex	**Write protection** Remove write protection by entering 4H. Remove special write protection by entering 10H.		
P–052 **P–152**	online	4	0...1 dec	**Parameter transfer into the FEPROM** Transfer into the non–volatile drive–machine data memory is started by setting to 1. The parameter is reset automatically after parameter transfer.		
P–053	online	4	0...FFFF hex	**Control word**		
				Bit	Value	
				0	0000H	The ready relay pulls–in if there is no fault and the pulses and controller are enabled.
					0001H	The ready relay pulls–in if there is no fault.
				1	0000H	Motor parameter set is changed–over after selecting another motor with subsequent pulse cancellation (motor changeover).
					0002H	The motor parameter set is immediately changed–over after another motor is selected (parameter set changeover)
				0	0000H	For a ramp–function generator fast stop (T. 81), the pulses are not canceled when the absolute speed n_{min} (P–022) is fallen below.
					0004H	For a ramp–fct. generator fast stop (term. 81), the pulses are canceled when the absolute speed n_{min} (P–022) is fallen below.
				3	0000H	The ramp–function generator is not tracked.
					0008H	The ramp–function generator is trakked. Ramp–function generator tracking means that there is an immediate response to an opposing setpoint change if the ramp–function generator is set too fast.

Table 1-2 open–loop control parameter

Parameter attributes: Number	Change effective	P–051	Setting data	Bit	Value	Description
P–053	online	4	0...FFFF hex	**Control word**		
				Bit	Value	
				5	0000H	Faults are not influenced by a controller inhibit at terminal 65.
					0020H	Faults can be acknowledged by a controller inhibit at terminal 65.
				7	0000H	The speed actual value is searched for from the speed setpoint. If the pulses are enabled with a stationary motor or a motor rotating in the opposite direction of rotation, then optimal acceleration is not guaranteed.
					0080H	The speed actual value is searched for from 0. If the pulses are enabled with the motor rotating, the motor is first braked and accelerated from the open–loop controlled speed range to the speed setpoint.
				8	0000H	The field controller integral component is deleted for voltage limiting. The voltage limiting might be able to exited again.
					0100H	The field controller integral component is not influenced for voltage limiting. However, voltage limiting cannot be automatically exited, as the field–generating current is continuously increased.
				13	0000H	Type KTY84 motor temperature sensor acc. to IEC 134
					2000H	PTC type motor temperature sensor acc. to IEC 134; from FW 3.00
				15	0000H	Parameter numbers are cyclically displayed on the LCD
					8000H	Parameter numbers are not cyclically displayed on the LCD; from FW 3.00
P–090	online	4	0...FFFF hex	**Control word**		
				Bit	Value	
				0	0000H	Parameter display, hex format **Caution!** **Parameter setting limits in the hex format are ineffective!**
					0001H	Parameter display, decimal– or hexadecimal format

AM

Table 1-2 open–loop control parameter

Parameter attributes			Setting data	Description		
Number	**Change effective**	**P–051**				
				0	0000H	Field weakening speed and stall torque to the DC link voltage, specified by P–061, is inhibited.
					0004H	Field weakening speed and stall torque adaptation to the DC link voltage specified by P–061 are enabled (from FW 2.00).
				3	0000H	Speed controller clock, Standard
					0008H	Speed controller clock, fast When bit 3 is changed, this only becomes effective after saving in the FEPROM and powering the supply down/up; from FW 3.00
P–153	online	10	–1...1 dec	**Calculate motor/controller data** **Parameters are changed during the calculation** **+1 equivalent circuit diagram data calculation** **–1 controller data calculation** **The parameters are automatically reset after calculation.**		

1.4 Overview setting data

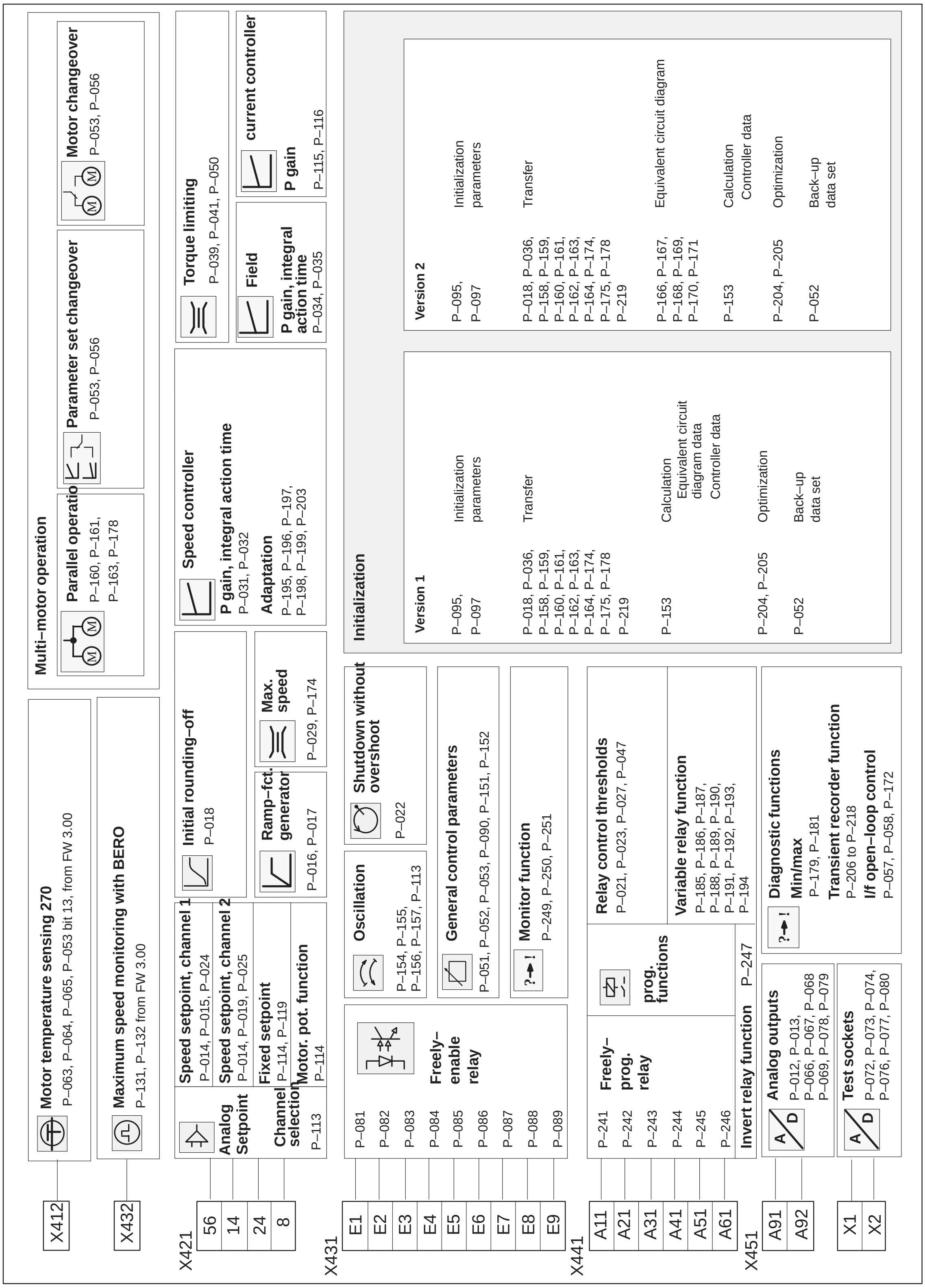

Fig. 1-2 Setting data

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1.5 Connections

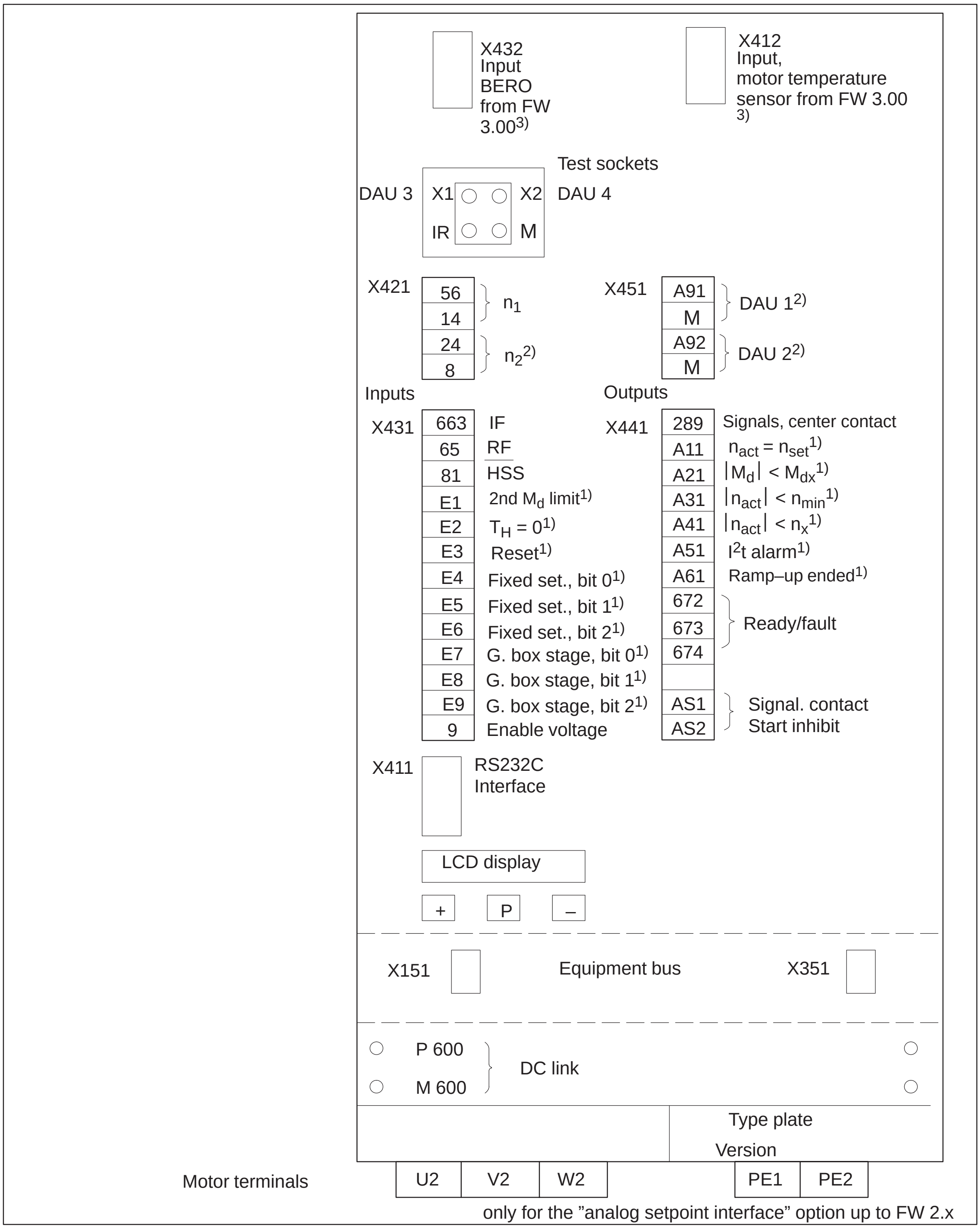

Fig. 1-3 Connections

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1) Freely–programmable terminals and relay functions when supplied
2) Function not possible for MLFB (Order No.) 6SN1122–0BA11–0AA0
3) Only for MLFB (Order No.) 6SN1122–0BA11–0AA1; for boards with MLFB (Order No.) 6SN1121–0BA1□–0AA0 it is not permissible that this input is assigned

■

Determining and setting the system configuration

2

Warning

The motor could accelerate to inadmissibly high speeds and terminal 64 (NE: Central
drive inhibit) and Terminal 65 (controller inhibit) are not effective.
Only terminal 63 ”open” (NE: Central pulse inhibit) and terminal 663 ”open” (axis–specific pulse inhibit) are then effective.

2.1 Motor and drive converter data sets

Overview

- initialization
- DC link voltage sensing
- motor data set
- Speed ranges

Initialization

Table 2-1 Initialization

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–095	after initialization	–	1...13 dec	**Power module code number** Pre–setting: 7 from FW 3.0 presetting: 3 1) Enter the power module code number (refer to Section 6.2)
P–096.M	after initialization	–	0...7 dec	**Motor code number** Pre–setting: 0 (do not change)
P–097	online	–	0...1 hex	**Initialization** • ”SEtUP” is displayed The selected power section data set is loaded in the drive–machine data memory • ”P–000” operating display appears after successful initialization

Sensing the DC link voltage

Table 2-2 DC link voltage sensing

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–061	online	10	0...700 V	**Fixed DC link voltage** 0 The DC link voltage is sensed via NE and the equipment bus Can be identified at: P–061 = 0 Parameter (P–006) indicates the DC link voltage value. 1...700 The actual DC link voltage is entered when a monitoring module is used without voltage sensing.

1) Power module with MLFB (Order No.) 6SN112□–1A□0□–□□A**1** is automatically identified with/from FW 3.00. It is then no longer possible to change P–095.

Motor data set

For special motors, the motor data must be entered. The controllers can then be subsequently optimized using the self–setting routing according to Section 4.

Table 2-3 Motor data set

Parameter attributes Number	Change effective	P–051	Setting range	Description
P–158.M	online	10	0.000...65.000 mH	**Inductance of the series reactor** Used for motors with f_{max} > 150 Hz
P–159.M	online	10	0.0...6535.5 gm^2	**Moment of inertia, motor and external** application–specific Total moment of inertia referred to the motor shaft The motor moment of inertia is calculated using P–153 = +1 The total moment of inertia is set using P–204 =5 and P–205 = +1
P–219.M	online	10	0...15 kgm^2	**Additional moment of inertia** The parameterized value is internally added to P–159.M. It is only necessary to enter into P–219.M when the setting range, P–159.M, is exceeded. (from FW 2.00)
P–160.M	online	10	0.00...650.00 kW	**Rated motor output** 1) Rated output for S1 duty For force–vent. motors, refer to the following information
P–161.M	online	10	0.00...650.00 A	**Rated motor current** 1) Rated current for S1 duty Y or Δ configuration
P–162.M	online	10	0.00...650.00 V	**Rated motor voltage** Rating plate data 1) Y or Δ configuration
P–163.M	online	10	0...65000 RPM	**Rated motor speed** 1) Asynchronous speed at rated frequency and rated load $n_{rated} < (f_{rated} \cdot 60$ s/min)/p
P–164.M	online	10	0...1200.0 Hz	**Rated motor frequency** 1) $f_{rated} > n_{rated} \cdot p/(60$ s/min)
P–166.M	online	10	0...$I_{rated\ pwr.\ section}$	**No–load motor current** equiv. cct. dia val Calculated using P–153 = +1 Adjusted using P–204 = 3 and P–205 = +1
P–167.M	online	10	0.000...65.000 Ω	**Motor stator resistance, cold** equivalent circuit diagram value Calculated using P–153 = +1
P–168.M	online	10	0.000...65.000 Ω	**Motor rotor resistance, cold** Equivalent circuit diagram value Calculated using P–153 = +1 Adjusted using P–204 = 6 and P–205 = +1
P–169.M	online	10	0.000...65.000 Ω	**Stator leakage reactance** equivalent circuit diagram value Calculated using P–153 = +1
P–170.M	online	10	0.000...65.000 Ω	**Rotor leakage reactance** equivalent circuit diagram value Calculated using P–153 = +1

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Table 2-3 Motor data set

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–171.M	online	10	0.00...650.00 Ω	**Main field reactance** Equivalent circuit diagram value Calculated using P–153 = +1 Adjusted using P–204 = 4 and P–205 = +1
P–172.M	online	10	0...32000 RPM	**Changeover speed, closed–loop/open–loop control** Calculated using P–153 = +1
P–173.M	online	10	0...32000 RPM	**Speed at the start of field weakening** Calculated using P–153 = +1 For operation from an uncontrolled infeed and FW<2.00, the calculated value must be multiplied by the factor (V_{supply}/500V) (corresponds to 0.8 for V_{supply}=400V). From FW 2.00 onwards, the closed–loop control algorithm is automatically adapted to the DC link voltage (P–006). Automatic adaptation can be disabled by resetting bit 2 in P–090.
P–174.M	online	10	0...32000 RPM	**Maximum motor speed** 1) To optimize the no–load current Input $n_{max} \geq (f_{rated} \bullet 60$ s/min)/p, otherwise ”F–60” (p=pole pair number)
P–175.M	online	10	0.0...500.0 min	**Motor thermal time constant** 1) 2)
P–176.M	online	10	0...32000 RPM	**Stall torque speed** Calculated using P–153 = +1 For operation from an uncontrolled infeed and FW<2.00, the calculated value must be multiplied by the factor $(V_{supply}/500V)^2$ (corresponds to 0.64 for V_{supply}=400V). From FW 2.00 onwards, the closed–loop control algorithm is automatically adapted to the DC link voltage (P–006). Automatic adaptation can be disabled by resetting bit 2 in P–090.
P–178.M	online	10	0.000...1.000	**Power factor cos φ** 1)
P–018.M	online	10	4.00...100.00 ms	**Initial rounding–off** For motors with deep–bar squirrel–cage rotors: Increase parameter to approx. 30 ms
P–036.M	online	10	0...7 hex	**Inverter clock frequency** The current controller dynamic performance is improved by increasing the clock frequency, however, it reduces the permissible continuous current load capability. The clock frequency, especially for high–speed motors, should be selected as high as possible but the power reduction should be maintained. If the clock frequency is changed, then the current controller must be re–optimized.

1) Manufacturers data according to VDE 0530, Part 1
2) Only when the motor temperature simulation function for relay function 5 is used (I^2t alarm)

Parameter attributes				
Number	**Change effective**	**P–051**	**Setting range**	**Description**
P–153	online	10	–1...1 dec	**Calculation, equivalent circuit diagram data** of the actual motor **+1** entered for pulse inhibit, term. 63 or term. 663. The calculations for the entered special motor are started.
P–153	online	10	–1...1 dec	**Calculation, controller data** of the actual motor **–1** entry for pulse inhibit, term. 63 or term. 663. The calculations for the entered special motor are started.
For high–speed motors, increase the speed limiting P–029 = 6000 RPM to maximum speed.				

Note

The motor configuration should be selected, so that neither the required terminal voltage exceeds the maximum converter output voltage, nor that the induction motor module is operated with $I_{rated\ motor} < 0.1 \cdot I_{cont.\ module}$ (refer to examples 1 and 2).

Example 1

If a motor, with V_{rated} 230 V Δ/400 V Y is operated from an uncontrolled infeed module in a Y circuit configuration, then the motor does not have the same output as when operated from an uncontrolled I/R module with $V_{DC\ link}$ = 600V / 625 V from a 400 V supply due to the reduced speed at the start of field weakening (P–173) and the lower stall torque speed (P–176).

If the motor is changed–over to the delta configuration, then this can achieve the full rated output when connected to a converter dimensioned for I▽¿∮╖n motor .

Example 2

If a motor is to be operated at rated current in a Y circuit configuration $I_{ratedY\ motor} < 0.1 \cdot I_{cont.\ module}$, this can be adapted to the induction motor module using the Δ circuit, if the following is valid:

$I_{rated\Delta\ motor} \geq 0.1 \cdot I_{cont.\ module}$

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Note

If only S6–duty values are specified in the rating plate data, then these should be converted to S1–duty for parameterization, and the limits increased **after** optimization. For force–cooled motors, the rating plate data for parameterization should be converted to data for S1–duty of a motor with **natural air cooling** having the same size, and the limits increased **after** optimization.

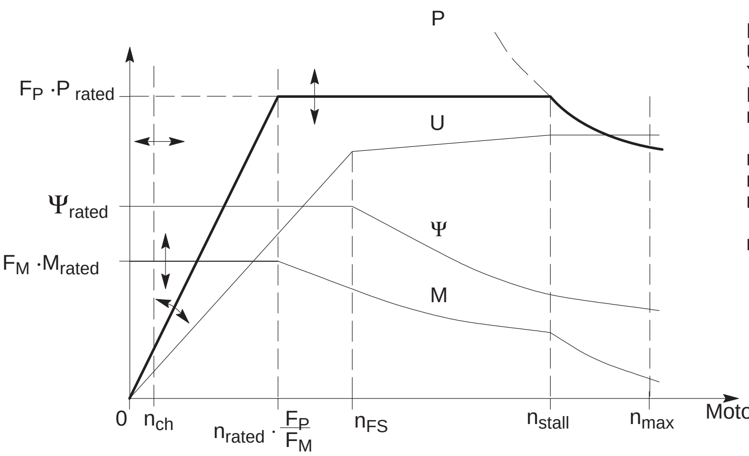
Conversion, rating plate data

- determine the no–load current I_0 , refer to Section 4
- determine the rated current for S1 duty: $I_{rated\ S1} = (2...2.5) \cdot I_0$
- determine the rated output for S1 duty: $P_{rated\ S1} = P_{rated\ S6} \cdot \frac{I_{rated\ S1}}{I_{rated}}$
- start–up using S1 values and optimize with limits $\leq$ 100 %
- increase the limits for S6 duty and for force–ventilated operation.

Speed ranges

Table 2-4 Speed ranges

Parameter attributes				
Number	**Change effective**	**P–051**	**Setting range**	**Description**
P–172.M	online	10	0...32000 RPM	**Changeover speed, closed–loop/open–loop control** Start of the closed–loop controlled speed range Above this speed and hysteresis, the speed is controlled according to the calculated speed actual value.
P–173.M	online	10	0...32000 RPM	**Speed at the start of field weakening** Start of the field weakening range The converter output voltage and frequency are no longer changed in proportion to one another above this speed.
P–176.M	online	10	0...65535 RPM	**Stall torque speed** Start of de–rating The output in field–weakening operation is reduced above this speed in order to prevent the motor stalling.



P	output characteristic
U	voltage characteristic
Y	flux characteristic
M	torque characteristic
n_{ch}	changeover speed, open–/closed–loop control
n_{rated}	rated speed
n_{stall}	stall torque speed
n_{FS}	speed at the start of field weakening
n_{max}	max.motor speed

The torque– and output limits can be modified with factor F_M (parameters P–039, P–041) or F_P (P–060). The following speed ranges are obtained:

- $0 \le |n| \le n_{ch}$ open–loop controlled speed range
- $n_{ch} \le |n| \le n_{rated} \cdot F_P/F_M$ constant torque range
- $n_{rated} \cdot F_P/F_M < |n| \le n_{stall}$ constant output range
- $|n| > n_{FS}$ field–weakening range
- $n_{stall} < |n| < n_{max}$ stall power range, maximum output voltage range

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2.2 Standard applications

2.2.1 Operating display

The actual drive converter operating status is displayed in P–000 and P–100.

Table 2-5 Operating display

Display

Function group

Motor number	Relay function	Operating mode	Equipment status	Setpoint source	Gearbox stage
1 motor 1 is selected 2 motor 2 is selected 3 motor 3 is selected 4 motor 4 is selected Motor selection 1...4 Selected via freely–programmable terminal functions P–081...P–089 =20, 21	freely–prog. relay function 1 terminal A11 P–241 $n_{act} = n_{set}$[1)] freely–prog. relay function 2 terminal A21 P–242 $\|M_d\| < M_{dx}$[1)] freely–prog. relay function 3 terminal A31 P–243 $\|n_{act}\| < n_{min}$[1)] freely–prog. relay function 4 terminal A41 P–244 $\|n_{ist}\| < n_x$[1)] freely–prog. relay function 5 terminal A51 P–245 I^2t alarm[1)] freely–prog. relay function 6 terminal A61 P–246 ramp–up ended[1)] ready/ fault terminals 672 to 674 P–053 ready[1)] **The segment is lit, if the appropriate relay has pulled–in.**	drive not enabled: Progress condition, refer to the "converter status" column n all enable signals present: Open–loop or closed–loop controlled operation	4 pulse enable at the NE module missing (T.63/T.48) 3 axis–specific pulse enable missing (T.663) 2 controller enable missing at the NE module (T.64) and/or controller enable missing at the IM module (T.65) 1 RFG enable missing (t.81) 0 setpoint enable missing (select terminal, fct. No. 16) Operating mode display for enabled motor: motor operation generator operation Speed controller clock, fast Clock is active	A analog setp. ch. 1 P–113=1 ch. 2 P–113=2 ch. 1+2 P–113=3 A. analog setp.+ fixed setpoint ch. 1 + freely–prog. terminal function 17, 18, 19, 24 P–113=9 0 zero setp. P–113=0 P–113=7 P–113=8 1 ... 7 fixed setp. 1...7 0. ... 7. fixed setp. 8...15 Selec. via freely–progr. term. fct. P–081...P–089 =17, 18, 19, 24 speed setting with P–114.1...7,f P–119.1...8 8 setpoint from the mot.. pot. fct. P–113=6 P–114.8 speed or P–081.P–089=14, 15 P setp. from oscillation gen. P–113=4 or P–081...P–089=2 P–154, P–155 speeds P–156, P–157 times setp. from self–opt. SW P–204=1...6 P–205=1	1 gearbox stage 1 is selected 2 gearbox stage 2 is selected 3 gearbox stage 3 is selected 4 gearbox stage 4 is selected 5 gearbox stage 5 is selected 6 gearbox stage 6 is selected 7 gearbox stage 7 is selected 8 gearbox stage 8 is selected Gearbox stages 1...8 selected via freely–programmable terminal function P–081...P–089 =9, 10, 11

1) As supplied

2.2.2 Firmware version

Table 2-6 Firmware version

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
(P–099)	–	–	0.00...99.99	**Firmware release** Indicates the release of the firmware which has been loaded.

2.2.3 Setting parameters for standard applications

Overview

- speed settings
- maximum speed monitoring via BERO
- torque limits
- motor temperature monitoring
- motor temperature simulation
- reciprocation

AM

Speed setting value

Table 2-7 speed settings

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–022.M	online	10	2...16000 RPM	**Shutdown speed, pulse cancellation** The drive is switched into a no–current state when the controller is inhibited and the shutdown speed is fallen below (the drive is shutdown without overshoot).
P–029.G	online	10	0...32000 RPM	**Speed limiting** The actual motor speed is limited to the limit of the current gearbox stage. Selected using freely–programmable terminal function 9, 10, 11.

Maximum speed monitoring via BERO

A BERO switch can be connected via X432 to monitor the maximum speed. When the threshold is exceeded, the pulses are canceled and fault message F–90 is output. FW 3

Cable interruption monitoring

If BERO pulses are not received for a calculated speed greater than 1200 RPM/ pulse number, then it can be assumed that the cable is interrupted. F–90 is also output.

Table 2-8

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–131.M	online	10	0...10 1 RPM	Pulse number, BERO speed monitoring The speed monitoring is active for a value of zero.
P–132.M	online	10	0...65535 RPM	Shutdown threshold, BERO speed monitoring

Torque limits

Table 2-9 Torque limits

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–039.G	online	10	0...399 %	**1st torque limit** The torque is limited to the set percentage of the rated torque of the actual motor.
P–041.G	online	10	0...399 %	**2nd torque limit** The torque is limited to the set percentage of the rated torque of the actual motor. The 2nd torque limit is selected using a freely–programmable terminal with terminal function 1 and speed greater than P–050, changeover speed M_{d1} to M_{d2}

Motor temperature monitoring

A motor temperature sensor can be connected at X412.
(from FW 3.00)

Temperature sensor types

Can be selected between

- KTY84: The measured resistance is converted into a temperature. The maximum permissible temperature can be parameterized.
- PTC: Resistance values which are measured to be less than 1330 Ohms are considered to be permissible, resistance values greater than 1330 Ohms should be interpreted as an overtemperature condition.

Alarm– and shutdown characteristics

- After approx. 1s: Relay ”alarm, motor overtemperature”
  after a time in P–065: Pulse cancellation and error message F–14

Sensor cable interrupted and short–circuit

- KTY84: Temperatures which are measured below approx. 0 degrees C or above approx. 200 degrees C cause pulses to be canceled and a fault message, F–19
- PTC: Interrupted sensor cable and short–circuit are not identified.

Table 2-10

Parameter attributes Number	Change effective	P–051	Setting range	Description
P–053.M	online	10	0...FFFFhex	**Control word** Bit | value 13 | 0000H | KTY84 motor temperature sensor | 2000H | PTC motor temperature sensor
P–063.M	online	10	0...170 degrees C	**Max. motor temperature** only effective for KTY84. The shutdown threshold cannot be parameterized for PTC.
P–064.M	online	10	0...170 degrees C	**Fixed temperature** The motor temperature monitoring is activated by entering the value zero.
P–065.M	online	10	0...600 s	**Timer stage, motor temperature alarm**

Motor temperature simulation

Table 2-11 Motor temperature simulation

Parameter attributes Number	Change effective	P–051	Setting range	Description
P–175.M	online	10	0.0...500 min	**Thermal motor time constant** For freely–programmable relay function 5 I^2t monitoring

Note

A temperature model is calculated for every motor parameter set.

However, quantities such as fan effect and air intake temperature cannot be taken into account. Thus, it is preferable if the temperature is monitored using a motor temperature sensor.

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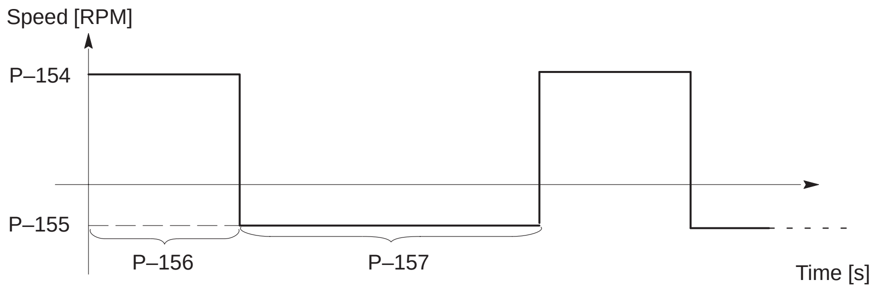
Oscillation mode

Table 2-12 Reciprocation

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–154	online	10	–32000...32000 RPM	**Oscillation setpoint 1**
P–155	online	10	–32000...32000 RPM	**Oscillation setpoint 2**
P–156	online	10	0.002...60 s	**Oscillation interval time 1**
P–157	online	10	0.002...60 s	**Oscillation interval time 2**
				Selected using a freely–programmable terminal function 2 or P–113=4



2.3 Multi–motor operation

The following applications can be combined with one another:

- parallel operation
- parameter set changeover
- motor changeover

Motor selection

Table 2-13 Motor selection

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–056	online	10	0...4	**Motor selection** The actual motor is selected 0 selected via freely–programmable terminal function 20, 21. 1...4 motor 1...4 active

Note

If P–053, bit 1 = 0, then changeover is only realized after the pulses have been canceled.

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2.3.1 Parallel operation

Several motors can be operated simultaneously from one induction motor module. The motors are supplied with the same voltage and frequency as they are fed in parallel. Thus, the motors must have the same voltage–frequency characteristic, i. e., the ratios of rated voltage to rated frequency of the individual motors must be the same. If different motor types are used, an output ratio of 1 : 10 should not be exceeded.

If the motors, connected in parallel, have the same pole pair number, then they rotate at approximately the same speed.

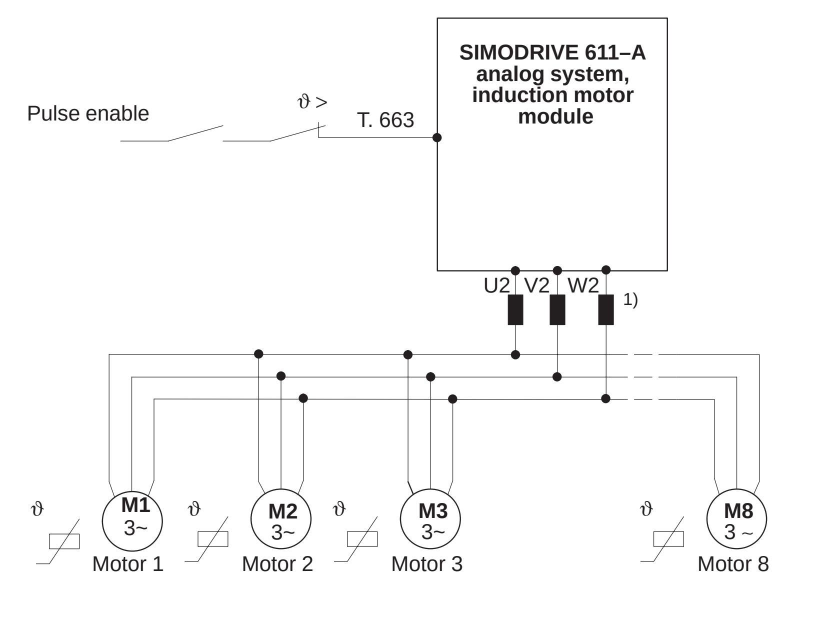
Warning

With different loads, the speeds differ by the slip speed differences, i. e., an individual motor can have a different speed than the calculated speed of the complete system, and can exceed a set speed limit.

The tendency to stall is higher in parallel operation than in single–motor operation. In order to be able to correct load surges, it is recommended that the current limit **P–059** is set to 150 % of the total current. If a steady–state rated torque is required in the lower speed range, **P–057** should also be increased (current in the open–loop controlled range). The induction motor module should be dimensioned for this current rating and it should be ensured that the motors are adequately cooled.

In parallel operation, the total current can only be sensed, which is sub–divided between the individual motors, depending on the load. Thus, these should be externally and **individually** thermally monitored. If a monitoring function responds, it **is not permissible** that the power cables are interrupted before pulse cancellation.

For high–speed special motors (f_{max} > 150 Hz), it is recommended that a reactor is switched between the induction motor module and the motor group.



1) Only required for special high–speed motors

Fig. 2-1 Parallel operation from the SIMODRIVE 611–A analog system, induction motor module

The motor data must be entered as follows for parallel operation:

Table 2-14 Parallel operation

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–158.M	online	10	0.000...65.000 mH	**Series reactor inductance** Used for motors with f_{max} > 150 Hz.
P–160.M	online	10	0.00...650.00 kW	**Rated motor output** 1) Sum of the rated outputs for S1 duty $\sum P_{rated\ i} = P_{rated\ total}$
P–161.M	online	10	0.00...650.00 A	**Rated motor current** 1) Sum of the rated currents for S1 duty $\sum I_{rated\ i}$ Circuit configuration, Y or Δ
P–162.M	online	10	0.00...650.00 V	**Rated motor voltage** 1) Rated voltage of the common V/f characteristic Circuit configuration, Y or Δ
P–163.M	online	10	0...65000 RPM	**Rated motor speed** 1) Output–weighted average value of the rated speed $\sum \frac{P_{rated\ i}}{P_{rated\ total}} \cdot n_{rated\ i}$ Asynchronous speed at rated frequency and rated load $n_{rated} < (f_{rated} \cdot 60\ s/min)/p$
P–164.M	online	10	0...1200.0 Hz	**Rated motor frequency** 1) Rated frequency of the common V/f characteristic $f_{rated} > n_{rated} \cdot p/(60\ s/min)$
P–174.M	online	10	0...32000 RPM	**Max. motor speed** manufacturers data Lowest max. speed of the motor group reduced by the maximum slip difference. To optimize the no–load current, enter $n_{max} \geq (f_{rated} \bullet 60\ s/min)/p$, otherwise ”F–60” (p=pole pair number)
P–178.M	online	10	0.000...1.000	**Power factor cos φ** 1) Current–weighted average power factor value $\sum \frac{I_{rated\ i}}{I_{rated\ total}} \cdot \cos \varphi_i$
P–018.M	online	10	4.0...100.00 ms	**Initial rounding–off** application–specific For motors with deep–bar squirrel–cage rotors: Increase parameter to approx. 30 ms
P–036.M	online	10	0...7 hex	**Inverter clock frequency** The current controller dynamic performance is improved when the switching frequency is increased, however the permissible continuous current load capability is reduced. The switching frequency should be selected as high as possible, especially for high–speed motors, but still maintaining the specified de–rating. The current controller must be re–optimized if the switching frequency is changed.

1) Manufacturers data according to VDE 0530, Part 1

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Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–159.M	online	10	0.0...6535.5 gm^2	**Motor and external moment of inertia** application–specific Total moment of inertia referred to the motor shaft Calculation, motor moment of inertia using P–153 = +1 Adjustment, total moment of inertia using P–204 = 5 and P–205 = +1
P–219.M	online	10	0...15 kgm^2	**Additional moment of inertia** The parameterized value is internally added to P–159.M. It is only necessary to enter P–219.M if the setting range of P–159.M is exceeded.
P–166.M	online	10	0...$I_{rated\ pwr.\ section}$	**Motor no–load current** equivalent circuit diagram value Calculated using P–153 = +1 Adjusted using P–204 = 3 and P–205 = +1
P–167.M	online	10	0.000...65.000 Ω	**Motor stator resistance, cold** equivalent circuit diagram value Calculated using P–153 = +1
P–168.M	online	10	0.000...65.000 Ω	**Motor rotor resistance, cold** equivalent circuit diagram value Calculated using P–153 = +1 Adjusted using P–204 = 6 and P–205 = +1
P–169.M	online	10	0.000...65.000 Ω	**Stator leakage reactance** equivalent circuit diagram value Calculated using P–153 = +1
P–170.M	online	10	0.000...65.000 Ω	**Rotor leakage reactance** equivalent circuit diagram value Calculated using P–153 = +1
P–171.M	online	10	0.00...650.00 Ω	**Main field reactance** equivalent circuit diagram value Calculated using P–153 = +1 Adjusted using P–204 = 4 and P – 205 = +1
P–175.M	online	10	0.0...500.0 min	**Thermal motor time constant** manufacturers data Lowest time constant of the motor group External individual monitoring is recommended. refer to Section 2.2.3
P–172.M	online	10	0...32000 RPM	**Changeover speed, open–/closed–loop control** Calculated using P–153 = +1

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–173.M	online	10	0...32000 RPM	**Speed at the start of field weakening** Calculated using P–153 = +1 For operation from an uncontrolled infeed and FW<2.00, the calculated value must be multiplied by the factor (V_{supply}/500V) (corresponds to 0.8 for V_{supply}=400V). From FW 2.00 onwards, the closed–loop control algorithm is automatically adapted to the DC link voltage (P–006). The automatic adaptation can be disabled by resetting bit 2 in P–090.
P–176.M	online	10	0...32000 RPM	**Stall torque speed** Calculated using P–153 = +1 For operation from an uncontrolled infeed and FW<2.00, the calculated value must be multiplied by the factor $(V_{supply}/500V)^2$ (corresponds to 0.64 for V_{supply}=400V). From FW 2.00 onwards, the closed–loop control algorithm is automatically adapted to the DC link voltage (P–006). Automatic adaptation can be disabled by resetting bit 2 in P–090.

2.3.2 Parameter set changeover

The induction motor module allows four complete motor data sets to be simultaneously set–up. The actual data set can be selected via freely–programmable terminals (refer to Section 3.3.2) or via parameter P–056. If various parameter sets have to be loaded in the induction motor module, this function can be used for parameter set changeover. The currently valid motor data set is displayed in the first position at the left in the operating display (P–000, P–100).

If bit 1 = 1 in parameter P–053, the motor data sets are changed–over, even when the pulses are enabled. This can be used to adapt motor– and controller data.

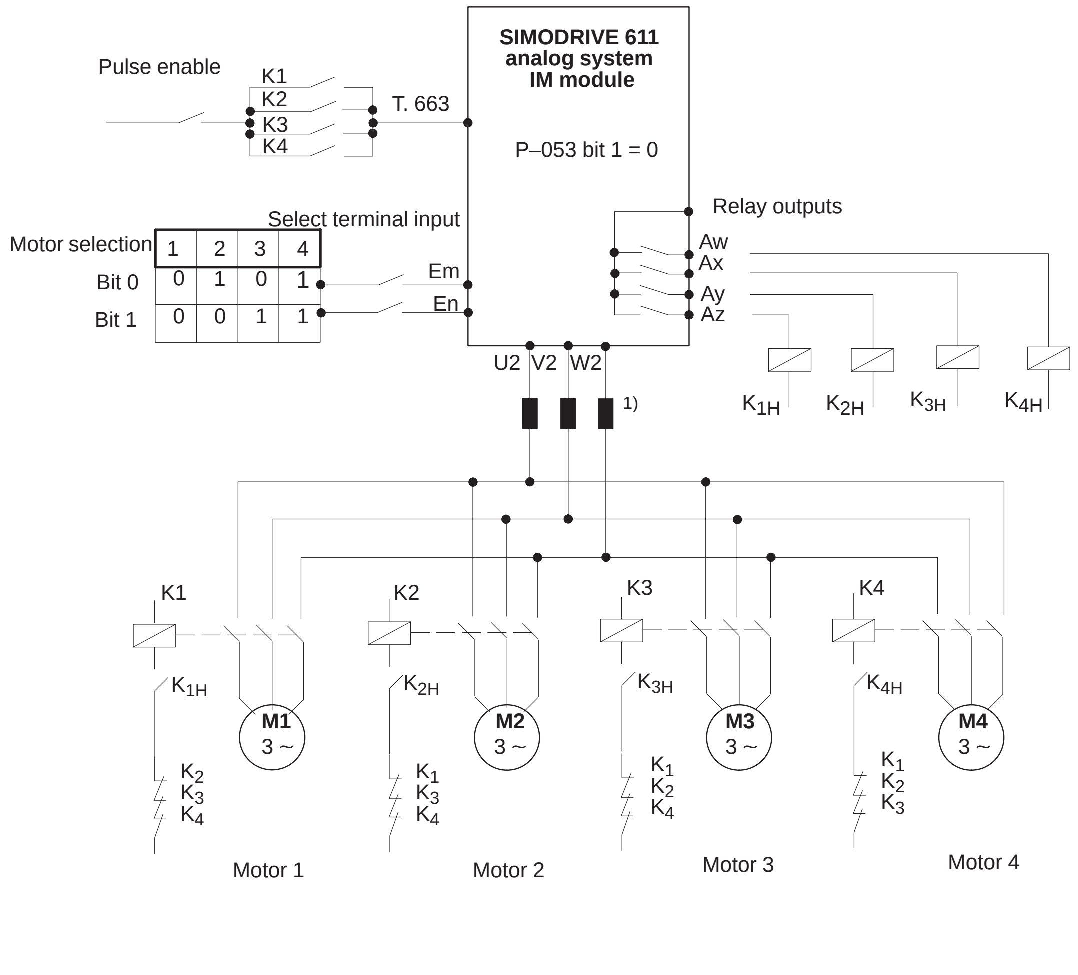
2.3.3 Motor changeover

The induction motor module allows four complete motor data sets to be simultaneously set–up. The current data set can be selected via freely–programmable terminals (refer to Section 3.2.2) or via parameter P–056. There are freely–programmable relay functions for the four motor data sets (refer to Section 3.3.1), which indicate which data set is active.

If various motors are to be operated from the induction motor module, one after another, then this function can be used for motor changeover.

In this case, bit 1 should be set to 0 in parameter P–053. Thus, after a motor changeover request, the motor data are first changed–over, when the induction motor module pulses are inhibited (refer to Section 1.3). The user can decide which of the enable terminals is used for pulse inhibit. The pulse inhibit is latched–in for approx. 20 ms during the changeover operation.
This latch is then canceled and the relay ”motor ... active” of the newly loaded motor, pulls–in. This relay signal can be used to control a contactor for motor changeover. The currently valid motor data set is displayed in the first position at the left in the operating display (P–000, P–100).

A recommended circuit for the contactor control to changeover a motor is shown in the following diagram. In this case, the freely–programmable terminal Em is assigned terminal function 20 ”motor selection bit 0” and En with terminal function 21 ”motor selection bit 1” and the freely–programmable relay outputs Aw, Ax, Ay, Az, with relay functions 11, 12, 13, 14 ”motor 1, 2, 3, 4 active”. The mutual relay interlocking is implemented using the induction motor module software, but the recommended contactor interlocking guarantees, that not more than one motor is connected to the converter even if parameterization errors have been made.



Motor selection	1	2	3	4
Bit 0	0	1	0	1
Bit 1	0	0	1	1

1) Only required for special high–speed motors

Fig. 2-2 Motor changeover

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2.4 Operating motors at maximum speeds > 32000 RPM

Pulse number P131

Warning

All parameters which physically represent a speed with the units RPM, as well as the BERO pulse number P131, are entered or displayed decreased by a factor as follows:

Motor speed	Factor
32000...64000 RPM	1/2
> 64000 RPM	1/3

Parameter–settings

In order to be able to operate motors with a maximum motor speed > 32000 RPM, settings must be made according to Table 2–13.

Table 2-15

Parameter attributes: Number	Change effective	P–051	Setting range	Description	
P–163.M	online	10	0...64000 RPM	**Rated motor speed** [1)] Asynchronous speed at rated frequency and rated load $n_{rated} < (f_{rated} \cdot 60\ s/min)/p$	
				motor speed	Input
				32000...64000 RPM	Rated motor speed / 2
				> 64000 RPM	Rated motor speed / 3
P–174.M	online	10	0...64000 RPM	**Max. motor speed** [1)]	
				motor speed	Input
				32000...64000 RPM	Max. motor speed / 2
				> 64000 RPM	Max. motor speed / 3
P–153	online	10	–1 ... 1 dec	**Calculating the equivalent circuit diagram data of the current motor** +1 input for pulse inhibit, terminal 63 or terminal 663 The calculations for the entered special motor are started. The following equivalent circuit diagram data are calculated:	
				motor speed	Equivalent circuit diagram data
				32000...64000 RPM	P–159: Motor and external moment of inertia • 4
				> 64000 RPM	P–159: Motor and external moment of inertia • 9
P–153	online	10	–1 ... 1 dec	**Calculating the controller data of the current motor** –1 input for pulse inhibit, terminal 63 or terminal 663 The calculations for the entered special motor are started. The following controller data are calculated:	
				motor speed	Controller data
				32000...64000 RPM	**P–114:** Speed for the max. useful motor speed • 1/2 **P–029:** Speed limiting • 1/2 **P–172:** Changeover speed, open/closed–loop control • 1/2 **P–173**:Speed at start of field weakening • 1/2 **P–176:** Stall torque speed • 1/2
				> 64000 RPM	**P–114:** Speed for max. motor useful speed • 1/3 **P–029:** Speed limiting • 1/3 **P–172:** Changeover speed, open/closed–loop control • 1/3 **P–173:** Speed at start of field weakening • 1/3 **P–176:** Stall torque speed • 1/3

If speed setting values with units of RPM are manually entered, **all** values must be multiplied by factors 1/2 or 1/3.

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1) Manufacturers data according to VDE 0530, Part 1

2.5 Monitor function

Address contents (data in the RAM area) of the induction motor module can be read via parameters **P–249** to **P–251**.

Note

A list of important measurement quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).

Table 2-16 Monitor function

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–249	online	10	0...FFFF hex	**Segment, memory location monitor** Segment address of a RAM location
P–250	online	10	0...FFFF hex	**Address, memory location monitor** Offset address of a RAM location
(P–251)	–	–	0...FFFF hex	**Value display memory location, monitor** Contents of a RAM location

■

Parameterization of the drive converter interfaces 3

3.1 Speed setpoint interfaces

Overview

- speed setpoint channel selection
- normalization, analog speed setpoint
- fixed setpoints/motorized potentiometer setpoint
- setpoint priority

Speed setpoint channel selection

Table 3-1 Speed setpoint channel selection

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–113	online	4	0...9 hex	**Channel selection, speed setpoint** 0H: digital setpoint 0 1H: analog setpoint, channel 1, terminal 56/14 2H: analog setpoint, channel 2, terminal 24/8 3H: analog setpoint, sum of channel 1 + channel 2, terminal 56/14 + terminal 24/8 4H: digital setpoint from the oscillation generator 6H: digital setpoint from the electronic motorized potentiometer 9H: sum of the analog setpoint + fixed setpoint, channel 1 + fixed setpoint from the freely–programmable terminal function 17, 18, 19, 24 (10)H: digital setpoint; is internally input from the firmware during self–optimization

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Normalization, analog speed setpoint

Table 3-2

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–014.M	online	4	–32000...32000 RPM	**Speed for maximum motor useful speed** Speed, which should be reached, at the analog input voltage in P–024 (channel 1 active) and in P–025 (channel 2 active). P–114 >0 = clockwise phase sequence for a positive speed setpoint P–114 < 0 = counter clockwise phase sequence for a positive speed setpoint
P–024	online	4	2...10 V	**Normalization, setpoint channel 1** Analog speed setpoint voltage for P–014
P–015	online	4	E000...2000 hex	**Offset correction, setpoint channel 1** E. g. positive correction value:002FH negative correction value: FF00H
P–025	online	4	2...10 V	**Normalization, setpoint channel 2** Analog speed setpoint voltage for P–014
P–019	online	4	E000...2000 hex	**Offset correction, setpoint channel 2** E. g. positive correction value:002FH negative correction value: FF00H

Fixed setpoints, motorized potentiometer setpoint

Table 3-3

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–114.F	online	4	–32000...32000 RPM	**Fixed setpoint 1** to **7** Adjustable speed setpoint Selected via freely–programmable terminal function 17, 18, 19 (refer to Section 3.2.2).
P–119.F	online	4	–32000...32000 RPM	**Fixed setpoint 8** to **15** Selectable speed setpoint Selected via freely–programmable terminal function 17, 18, 19, 24 (refer to Section 3.2.2) from FW 2.00
P–114.8	online	4	–32000...32000 RPM	**Motorized potentiometer setpoint** Adjustable speed setpoint Set via freely–programmable terminal function 14, 15 (refer to Section 3.2.2).

Setpoint priority

Table 3-4

Priority	Setpoint	Setpoint source			Effect
		Selectable using		Desig.	
High	I_{mot} = 0	T63 or T663	Open	Pulse enable inhibited	Motor coasts down in a no–current condition
	n = 0	T81	Open	Ramp–function generator fast stop	Braking without ramp–down time, pulse enable or pulse inhibit
	n = 0	T64 or T65	Open	Controller enable inhibited	Braking with ramp–down time, pulse inhibit
	n = 0	T.–fct. 16	Open	Setpoint enable inhibited	Braking with ramp–down time, pulse enable
	$n \geq n_{min}$	P–030	Value entry	Min. steady–state speed	Minimum speed, also for lower setpoint, lower priority
	$n \neq \Delta n$	P–054 P–055	Value entry	Range suppression	No steady–state operation in the suppressed speed range
	n = +n/–n	T.–fct. 12	Act–ivated	Cw/ccw phase sequence	Only one direction of rotation possible
	n = P–114.8	P–113 = 6	Value entry	Mot. pot. function	Increase/decrease setpoint
	n1 = P–154 n2 = P–155	T.–fct. 2	Con–trolled	oscillation	reciprocation
	n1 = P–114.1 to n7 = P114.7 n8 = P–119.1 to n15 = P–119.8	T.–fct. 17 T.–fct. 18 T.–fct. 19 T.–fct. 24	Con–trolled	Fixed setpoint	Selected fixed speed
Low	Standard setpoint source	P–113	Value entry	Standard setpoint	Parameterized standard setpoint

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3.2 Input terminals

3.2.1 Permanently–wired terminal functions

Warning

When the motor pulses are canceled, there is no information on the motor speed. The calculated speed actual value is then set to 0. Thus, all of the speed actual value signals, and relay signals, which monitor the speed ($|n_{act}| < n_{min}$, ramp–up ended, $n_{act} < n_x$, $|n_{act}| = n_{set}$) no longer provide any information if the motor pulses have been canceled. The motor pulses can be canceled by removing the enable signals or with fault signals.

Warning

If a drive is shutdown using a ramp–function generator fast stop (terminal 81 open), and is kept at zero speed for a longer time with the inverter enabled, then adequate motor cooling must be ensured, as a current is impressed in the motor which is approximately the rated current (percentage in P–057).

Caution for self–ventilated motors.

Table 3-5

Terminal function	Description	Terminal number
Axis–specific pulse enable	The inverter enable (motor gating) is realized, if terminal 663 (axis–specific pulse enable) and terminal 65 (controller enable) are at the enable voltage potential. If terminal 663 (axis–specific pulse enable) is disconnected/disabled while the motor is still rotating, the inverter is inhibited after 20 ms, and the motor coasts down in a no–current condition.	663
Controller enable	If terminal 65 (controller enable) is disconnected/disabled while the motor is still rotating, the drive brakes along the braking ramp. When the absolute value of the n_{min} threshold (P–022) is fallen below, the inverter is inhibited and the motor is shutdown without any overshoot.	65
Ramp–function generator fast stop	If terminal 81 (ramp–function generator fast stop) is energized, the speed setpoint is enabled. If the input is open–circuit, a digital setpoint of zero is entered. If terminal 81 is disconnected/disabled while the motor is still rotating, the motor brakes without the ramp–function generator along the effective limiting characteristic (current limiting P–057...P–059, torque limiting P–039, P–041, power limiting P–060). Once zero speed has been reached, the current from P–057 is still impressed. If bit 2 is set in P–053, after the speed in P–022 has been fallen below, the pulses are inhibited, and the motor is switched to a no–current condition.	81

Note

To start a motor, the enable signals must be provided step by step in the sequence of their priority (refer to Table 3-5).

3.2.2 Freely–programmable terminal functions

Warning

It is only permissible to program terminal function parameters P–081 to P–089 when the pulses are canceled (terminal 63 or terminal 663 open).

Overview

- terminal function assignment
- Terminal functions

Terminal function assignment

Table 3-6 Terminal function assignment

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–081 to P–089	online	4	1...24 dec	**Terminal function assignment E1 to E9** The assignment of functions 1 to 24 to terminals E1 to E9 is realized by entering the function number. The factory setting can be taken from the following table.

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Terminal functions

Table 3-7 Terminal functions

Terminal function	Description	Fct. No.	Input terminals, as supplied
2nd torque limit	If this function is selected, the 2nd torque limit in P–041 becomes active, if the changeover speed from P–050 is exceeded.	1	E1 (P–081)
Oscillation	If this function is selected, the oscillation generator speed setpoint from P–154 to P–157 becomes active.	2	
Reset fault memory (R) fault acknowledgment	If this function is selected, a fault message is acknowledged when the controller is inhibited (terminal 65 or terminal 663 open–circuit).	3	E1 (P–081)
Ramp–up time = 0	If this function is selected, the internal ramp–function generator is bypassed.	7	E1 (P–081)
Gearbox stage	1 2 3 4 5 6 7 8 — Using this terminal, a total of 8 binary–coded parameter sets can be selected for setpoint normalization, speed monitoring, controller setting, torque limiting and torque–monitoring.		
Bit 0	0 1 0 1 0 1 0 1	9	E1 (P–081)
Bit 1	0 0 1 1 0 0 1 1	10	E1 (P–081)
Bit 2	0 0 0 0 1 1 1 1	11	E1 (P–081)
Clockwise/ counter clockwise	If this function is activated, only positive setpoints are permitted, negative setpoints result in speed n=0. If the appropriate terminal is energized, only a counter–clockwise rotating field, otherwise a clockwise rotating field is output.	12	
Ramp–function generator 2	If this function is selected, the 2nd parameter set P–042 and P–043 of the internal ramp–function generator is activated.	13	
Increase setpoint	Motorized potentiometer function P–113=6 If one of these terminals is energized, the digital speed setpoint P–114.8 of the motorized potentiometer function is increased or decreased corresponding to the ramp–up and ramp–down times of ramp–function generator 2 (exception, TH = 0). If both are energized simultaneously, the setpoint is changed towards 0.	14	
Decrease setpoint		15	
Setpoint enable	If this function is activated, then the appropriate terminal must also be energized in order to move the drive. If the terminal is opened (de–energized), the drive brakes with the appropriate deceleration time, and remains at standstill, but with current flowing through it.	16	
Fixed setpoint selection	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 — A total of 15 binary–coded fixed values P–114.1 to P–114.7 and P–119.1 to P–119.8 can be selected using these terminals. If all of these terminals remain open–circuit, the setpoint, defined in P–113, remains valid.		
Bit 0	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	17	E1 (P–081)
Bit 1	0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1	18	E1 (P–081)
Bit 2	0 0 0 0 1 1 1 1 0 0 0 0 1 1 1 1	19	E1 (P–081)
Bit 3	0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1	24	
Motor selection	1 2 3 4 — A total of 4 binary–coded motor data sets, motor 1 to motor 4 can be selected using these terminals.		
Bit 0	0 1 0 1	20	
Bit 1	0 0 1 1	21	

3.3 Output terminals

Warning

When the motor pulses are canceled, there is no information on the motor speed. The calculated speed actual value is then set to 0. Thus, all of the speed actual value signals, and relay signals, which monitor the speed ($|n_{act}| < n_{min}$, ramp–up ended, $n_{act} < n_x$, $|n_{act}| = n_{set}$) no longer provide any information if the motor pulses have been canceled. The motor pulses can be canceled by removing the enable signals or with fault signals.

Caution

All relays drop–out when the electronics power supply fails or is shutdown.

3.3.1 Permanently–wired relay functions

Table 3-8 Permanently–wired relay functions

<table>
<tr><th>Terminal function</th><th colspan="3">Description</th><th>Terminal number</th></tr>
<tr><td rowspan="3">Ready/no axis–specific fault</td><td colspan="3">The relay function can be toggled using P–053:</td><td rowspan="3">672
673
674</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>0</td><td>0000H

0001H</td><td>The relay pulls–in, if no fault is present, and the pulses and controller are enabled.
The relay pulls–in, if there is no fault present.</td></tr>
<tr><td>Checkback signal, start inhibit</td><td colspan="3">The relay (NC contact) pulls–in, if the enable voltage is connected to terminal 663, axis–specific pulse enable.</td><td>AS1
AS2</td></tr>
</table>

3.3.2 Freely–programmable relay functions

Warning

It is only permissible to program the relays (P–241 to 247) when the pulses are inhibited (terminal 63 or 663 open).

Overview

- Assignment of the signals/messages
- Relay functions
- Signals which can be parameterized
- Control word, signals

Note

The relay signals are updated with 20ms
for the standard speed controller clock.
For a fast speed controller clock with 10ms (refer to P–090, bit 3, FW 3.00).

Assignment of the signals/messages

Table 3-9 Assignment of the signals/messages

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–241 to **P–246**	online	4	1...20 dec	**Programmable messages 1 to 6** Functions 1 to 20 are assigned to relay outputs A11 to A61 by entering the function number. The factory setting can be taken from the following table.

Relay functions

Table 3-10 Relay functions

Relay function	Description	Funct. –No.	Relay output, as supplied
$\lvert n_{act} \rvert < n_{min}$	The relay pulls–in, if the calculated speed falls below the current value set in P–021.1 to P–021.8.	1	A31 (P–243)
Ramp–up completed	The relay pulls–in if, after the setpoint jump, the calculated speed actual value enters the actual tolerance bandwidth around the new setpoint, and has remained within this tolerance bandwidth for at least 200 ms. If the tolerance bandwidth is exited before the 200ms has expired, the ”acceleration ended” relay remains inactive. The tolerance bandwidth is set via P–027.1 to P–027.8. The signal is interlocked (latched) in the activated setting, until the speed setpoint changes. If the tolerance bandwidth is exited after 200 ms, the signal remains active, unless, the setpoint has, in the meantime, changed. The relay does not drop–out as a result of speed fluctuations due to load changes.	2	A61 (P–246)
$\lvert M_d \rvert < M_{dx}$	The relay pulls–in, if the torque falls below the actual limit value. The limit value is set via P–047.1 to P–047.8. If the relay $n_{act}=n_{set}$ drops–out during speed setpoint changes, the $\lvert M_d \rvert < M_{dx}$ relay can drop–out only 800ms after the relay $n_{act} = n_{set}$ has pulled–in again.	3	A21 (P–242)
$\lvert n_{act} \rvert < n_x$	The relay pulls–in if the speed falls below the n_x threshold. The setting n_x is realized via P–023.1 to P–023.8.	4	A41 (P–244)
I^2t–alarm	The relay drops–out, if the actual thermal motor model is overloaded. The thermal time constant setting for each motor is separately realized in P–175.1 to P–175.4. The user is responsible in responding to this alarm. The function of the fan and air intake temperature are not taken into account. Thus, it is preferable if a temperature sensor is evaluated.	5	A51 (P–245)
Drive converter overtemperature alarm	The relay drops–out, if the main heatsink temperature monitoring responds. If the overtemperature condition remains, the drive converter shuts down after approx. 20 s with the fault message F–15.	6	–
Variable relay function 1	Refer to the description of the ”variable relay functions”.	7	–
Variable relay function 2	Setting via P–185 to P–189 and via P–190 to P–194.	8	–
	Reserved	9	–
	Reserved	10	–
Motor 1 active	One of these relays pulls–in if the appropriate motor data set is active. Using this relay function, the external contactor can be controlled for motor change-over. It is recommended that the contactor pulse enable are mutually interlocked.	11	–
Motor 2 active		12	–
Motor 3 active		13	–
Motor 4 active		14	–
Motor overtemperature, alarm	The relay drops–out when the motor temperature is too high. If the fault condition remains, the drive converter shuts down after the time, set in P–065, with the fault message F–14. From FW 3.00	16	–
$n_{act} = n_{set}$	The relay pulls–in, if the calculated speed actual value enters the tolerance bandwidth around the setpoint before the ramp–function generator and has remained in this tolerance bandwidth for at least 200 ms. The tolerance bandwidth is set using P–027.1 to P027.8 . If the tolerance bandwidth is exited, the relay ”$n_{act} = n_{set}$” immediately drops–out. The relay drops–out as a result of speed fluctuations due to load changes.	20	A11 (P–241)

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Messages which can be parameterized

Table 3-11 Signals which can be parameterized

Parameter attributes				
Number	**Change effective**	**P–051**	**Setting range**	**Description**
P–021.G	online	4	2...16000 RPM	**n_{min} for ”n_{act} < n_{min}” signal** Response value for a freely–programmable relay signal 1 ”$\lvert n_{act}\rvert$ < n_{min}”
P–023.G	online	4	0...32000 RPM	**n_x for ”n_{act} < n_x” signal** Response value for a freely–programmable relay signal 4 ”$\lvert n_{act}\rvert$ < n_x”
P–027.G	online	4	0...29000 RPM	**Tolerance bandwidth for ”n_{set} = n_{act}” signal** Tolerance for freely–programmable relay signal 1 ”ramp–up completed” and for freely–programmable relay signal 20 ”n_{set} = n_{act}”
P–047.G	online	4	0...100 %	**M_{dx} for ”M_d < M_{dx}” signal** Response value for freely–programmable relay signal 3 ”M_d < M_{dx}” The setting refers to the actual torque limit.

Control word messages

Table 3-12 Control word, signals

Parameter attributes						
Number	**Change effective**	**P–051**	**Setting range**	**Description**		
P–247	online	4	0...FFFF hex	**Control word, signals**		
				Every relay signal can be individually and independently inverted by setting the appropriate bit.		
				Bit	Value	
				0	0001H	Relay function, terminal A11 is inverted
				1	0002H	Relay function, terminal A21 is inverted
				2	0004H	Relay function, terminal A31 is inverted
				3	0008H	Relay function, terminal A41 is inverted
				4	0010H	Relay function, terminal A51 is inverted
				5	0020H	Relay function, terminal A61 is inverted

3.3.3 Variable relay function

Table 3-13 Variable relay function

<table>
<tr><th colspan="3">Parameter attributes</th><th rowspan="2">Setting range</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Number</th><th>Change effective</th><th>P–051</th></tr>
<tr><td>P–185
to
P–189</td><td>–</td><td>–</td><td>–</td><td colspan="3">**Variable relay function 1**</td></tr>
<tr><td>**P–185**</td><td>online</td><td>4</td><td>0...FFFF hex</td><td colspan="3">**Address for monitoring 1**</td></tr>
<tr><td>**P–186**</td><td>online</td><td>4</td><td>0...FFFF hex</td><td colspan="3">**Threshold for monitoring 1**</td></tr>
<tr><td>**P–187**</td><td>online</td><td>4</td><td>0.00...10.00 s</td><td colspan="3">**Pull–in delay, monitoring 1**</td></tr>
<tr><td>**P–188**</td><td>online</td><td>4</td><td>0.00...10.00 s</td><td colspan="3">**Drop–out delay, monitoring 1**</td></tr>
<tr><td>**P–189**</td><td>online</td><td>4</td><td>0...7FFF hex</td><td colspan="3">**Hysteresis, monitoring 1**
Hysteresis for threshold P–186</td></tr>
<tr><td>**P–190**
to
P–194</td><td>–</td><td>–</td><td>–</td><td colspan="3">**Variable relay function 2**</td></tr>
<tr><td>**P–190**</td><td>online</td><td>4</td><td>0...FFFF hex</td><td colspan="3">**Address for monitoring 2**</td></tr>
<tr><td>**P–191**</td><td>online</td><td>4</td><td>0...FFFF hex</td><td colspan="3">**Threshold for monitoring 2**</td></tr>
<tr><td>**P–192**</td><td>online</td><td>4</td><td>0.00...10.00 s</td><td colspan="3">**Pull–in delay, monitoring 2**</td></tr>
<tr><td>**P–193**</td><td>online</td><td>4</td><td>0.00...10.00 s</td><td colspan="3">**Drop–out delay, monitoring 2**</td></tr>
<tr><td>**P–194**</td><td>online</td><td>4</td><td>0...7FFF hex</td><td colspan="3">**Hysteresis, monitoring 2**
Hysteresis for threshold P–191</td></tr>
<tr><td rowspan="10">**P–247**</td><td>online</td><td>4</td><td>0...FFFF hex</td><td colspan="3">**Control word, signals**</td></tr>
<tr><td rowspan="9"></td><td rowspan="9"></td><td rowspan="9"></td><td>Bit</td><td>Value</td><td></td></tr>
<tr><td rowspan="2">8</td><td>0000H</td><td>Variable relay function 1 with sign interrogation</td></tr>
<tr><td>0100H</td><td>Variable relay function 1 with absolute value interrogation</td></tr>
<tr><td rowspan="2">9</td><td>0000H</td><td>Variable relay function 2 with sign interrogation</td></tr>
<tr><td>0200H</td><td>Variable relay function 2 with absolute value interrogation</td></tr>
<tr><td rowspan="2">12</td><td>0000H</td><td>Variable relay function 1 with P–186 as threshold</td></tr>
<tr><td>1000H</td><td>Variable relay function 1 as bit test.
The threshold (P–186) is ANDed with the RAM variables to be monitored (P–185).</td></tr>
<tr><td rowspan="2">13</td><td>0000H</td><td>Variable relay function 2 with P–191 as threshold</td></tr>
<tr><td>2000H</td><td>Variable relay function 2 as bit test</td></tr>
</table>

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Note

A list of important measured quantities (RAM variables) and their addresses are listed in the Appendix (Section 6.5).

3.3.4 Analog outputs

Note

Analog outputs are not possible for MLFB (Order No.) 6SN1122–0BA11–0AA0.

Overview

- Function
- technical data
- Parameterization, DAU 1, DAU 2
- connection for analog displays

Function

Analog output of RAM variables for measurement purposes via two 8–bit **D/A c**onverters.

Note

A list of important measured quantities (RAM variables) and their addresses are listed in the Appendix (Section 6.5).

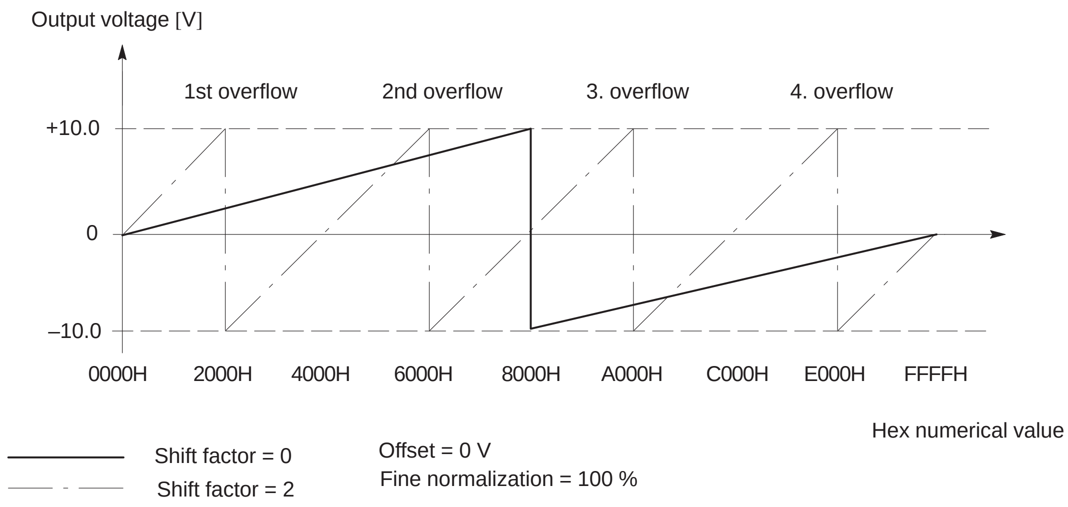
Technical data

- 2 output channels at terminal A91 (DAU 1) and terminal A92 (DAU 2)
- ± 10 V voltage range
- rough– and fine normalization, offset compensation
- output voltage polarity can be set via the fine normalization (± 1000 %)

Parameterization DAU 1, DAU 2

Table 3-14 Parameterization, DAU 1, DAU 2

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–066	online	4	0...FFFF hex	**Address, DAU 1** Address of the RAM variables which are to be output at DAU 1. Pre–setting: 11B6H absolute calculated speed actual value
P–067	online	4	0...F hex	**Shift factor, DAU 1** Rough normalization of the selected data value by shifting the binary number to the left. Shift to the left by 1 = multiplication by 2 Max. gain: 32768
P–012	online	4	–1000.0...1000.0%	**Normalization, DAU 1** Fine normalization of the selected data value
P–078	online	4	–127...127 dec	**Offset, DAU 1** Compensation of a possible offset for DAU 1
P–068	online	4	0...FFFF hex	**Address, DAU 2** Pre–setting: 11B8H utilization
P–069	online	4	0...F hex	**Shift factor, DAU 2**
P–013	online	4	–1000.0...1000.0%	**Normalization, DAU 2**
P–079	online	4	–127...127 dec	**Offset, DAU 2**



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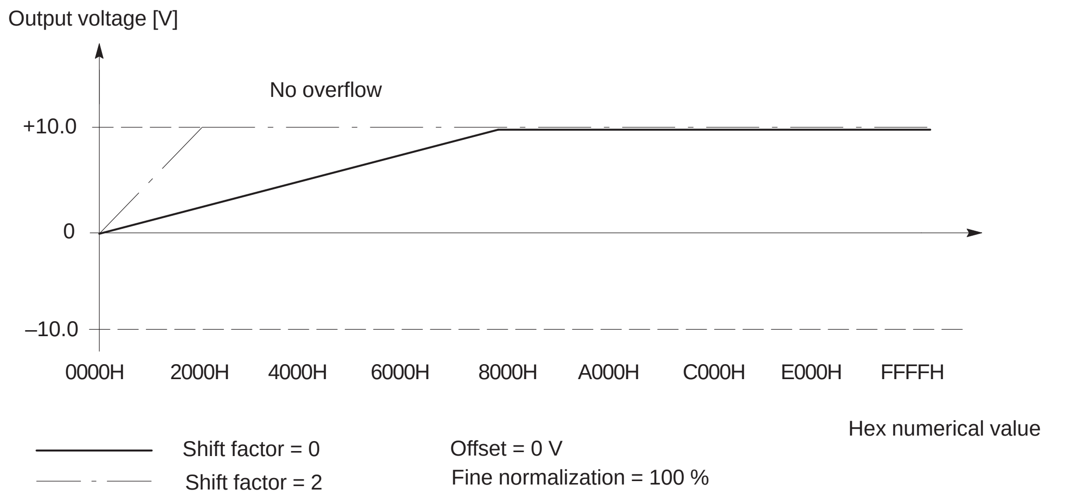
Connection for analog displays

Application: The following DAU assignment is used to connect unipolar display instruments and the operating range is therefore limited to 0...+10 V without overflow.

Table 3-15 Connection for analog displays

Parameter attributes				
Number	Change effective	P–051	Setting range	Description
P–012	online	4	–1000.0...1000.0	**Normalization, DAU 1** P–066 = 11B6H $\lvert n_{act} \rvert$ display For P–012 = 100 % and P–067 = 0H, the following is valid: Standstill = 0 V Max. speed (minimum from P–029, P–174) = +10 V 1 V corresponds to 10 %
P–013	online	4	–1000.0...1000.0	**Normalization, DAU 2** P–068 = 11B8H utilization Displays the utilization in the following ranges Constant torque: M_d/M_{dmax} Constant power: P/P_{max} (taking into account the actual torque limits P–039, P–041 and the current– and power limits P–059 and P–060) For P–013 = 100 % and P–069 = 0H, the following is valid: No–load = 0 V Max. torque or power = + 10 V 1 V corresponds to 10 %



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4 Controller optimization

Automatic functions can be selected to set important motor parameters. The drive must be enabled.

Warning

During the automatic optimization runs, the motor is under voltage and can reach its maximum speed. The optimization runs involved are identified with the following symbol:

Note

When using an UE module, to reduce the regenerative power, the ramp–down time P–017 or P–043 must be increased, until braking can be achieved from maximum motor speed down to 0 without a fault message being issued (DC link overvoltage).

Table 4-1 Control optimization

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
Optimization: Controller data of the actual motor with the drive enabled				
				• **Optimization, current controller,** refer to Section 4.2
P–204	online	10	0...8 dec	Input **1** selection: current controller optimization
P–205	online		0...1 dec	Input **1**, start optimization
				• **Adjust power offset**[1)]
P–204	online	10	0...8 dec	Input **2** selection: Power offset adjustment
P–205	online		0...1 dec	Input **1** start adjustment
				• **Optimization, speed contr.,** ref. to Sec. 4.1 and Sec. 4.7
P–031	online	4	0.0...255.9	**P gain, speed controller**
P–032	online	4	10.0...6000.0 ms	**Integral action time, speed controller**

1) From FW 3.0 no longer necessary

Table 4-1 Control optimization

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
				• **Optimization, field controller,** refer to Section 4.3
P–034	online	4	0.0...600.0 A/V s	**P gain, field controller**
P–035	online	4	5.0...600.0 ms	**Integral action time, field controller**
				• **Adjustment, no–load current**
P–204	online	10	0...8 dec	Input **3** selection: No–load current adjustment
P–205	online		0...1 dec	Input **1** start adjustment
				• **Adjustment, main field reactance**
P–204	online	10	0...8 dec	Input **4** selection: Adjustment, main field reactance
P–205	online		0...1 dec	Input **1** start adjustment
				• **Adjustment, field weakening speed** (from FW 2.00)
P–204	online	10	0...8 dec	Input **8** selection: Adjustment, field weakening speed
P–205	online		0...1 dec	Input **1** start adjustment
				• **Adjustment, total moment of inertia**
P–204	online	10	0...8 dec	Input **5** selection: Adjustment, total moment of inertia
P–205	online		0...1 dec	Input **1** start adjustment
				• **Adjustment, rotor resistance** (not required for motors with deep–bar squirrel–cage rotors)
P–204	online	10	0...8 dec	Input **6** selection: Adjustment, rotor resistance
P–205	online		0...1 dec	Input **1** start adjustment
				• **Calculate speed controller setting** (from FW 2.00) Not required, if speed controller optimization was executed (refer above)
P–204	online	10	0...8 dec	Input **7** selection: Speed controller setting calculation
P–205	online		0...1 dec	Input **1** start calculation
P–052	online	4	0...1 hex	Transfer parameters into FEPROM

Note

If the no–load current adjustment with F–60 is aborted, a possibly effective speed limiting via the no–load speed should be increased.

If the adjustment with F–60 is aborted due to voltage limiting, the sequence can be repeated with a lower value in P–166, or the DC link voltage can be increased to 625 V (refer to the NE module).

Note

To adjust the total moment of inertia, the ramp–up time (accelerating time) P–016 and P–042 should be set to the lowest possible value (preferably to zero).

If the speed controller requires an integral action time P–032 > 250 ms, then the total moment of inertia adjustment must be manually executed according to Section 4.7.

To reduce the regenerative power in conjunction with a UE module, the ramp–down time P–017 and P–043 can be increased.

Note

If the motor shaft rotates when optimizing the current controller, then the optimization point must be repeated by entering speed setpoint zero (e.g. using terminal 81 $\overline{\text{HSS}}$).

4.1 Speed controller

Overview

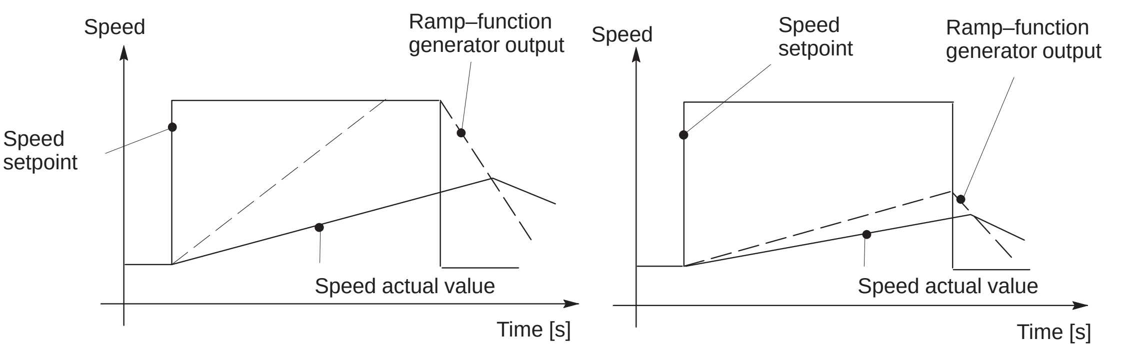
- Ramp–function generator
- Gain, integral action time
- Speed contr. adaptation
- Speed controller clock
- Total moment of inertia

Ramp–function generator

Table 4-2 Ramp–function generator

Parameter attributes: Number	Change effective	P–051	Setting range	Description
P–016.M	online	4	0.00...320.00 s	**Ramp–up time, ramp–function generator 1** (From n = 0 to n_{max} → P–174)
P–017.M	online	4	0.00...320.00 s	**Ramp–down time, ramp–function generator 1** (From n_{max} → P–174 to n = 0)
P–042.M	online	4	0.00...320.00 s	**Ramp–up time, ramp–function generator 2** (From n = 0 to n_{max} → P–174)
P–043.M	online	4	0.00...320.00 s	**Ramp–down time, ramp–function generator 2** (From n_{max} → P–174 to n = 0)
P–018.M	online	4	4.00...100.00 ms	**Initial rounding–off** Torque setpoint smoothing
P–053	online	4	0...FFFF hex	**Control word**

Bit	Value	
3	0000H	Ramp–function generator is not tracked
	0008H	Ramp–function generator is trakked



Without ramp–function generator tracking

With ramp–function generator tracking

Gain, integral action time

Table 4-3 Gain, integral action time

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–031.M	online	4	0.0...255.9	**P gain, speed controller**
P–032.M	online	4	10...6000 ms	**Speed controller integral action time**

When calculating the controller data P–153 = –1, the speed controller parameters are, among other parameters, defined.

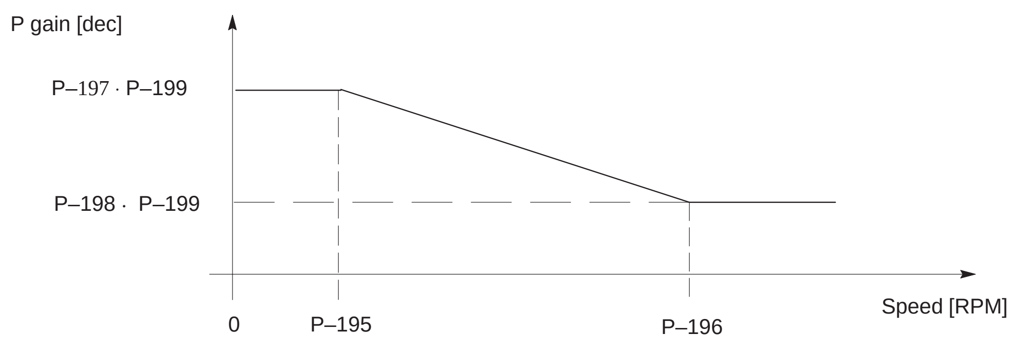
In several cases, the control characteristics can still be improved (refer to Section 4.7)

Speed controller–adaptation

The speed controller adaptation can be activated if another speed controller P gain is required in the upper speed range.

Table 4-4 Speed contr. adaptation

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–195.M	online	4	0...32000 RPM	**Lower adaptation speed**
P–196.M	online	4	0...32000 RPM	**Upper adaptation speed**
P–197.M	online	4	0.0...255.9 dec	**P gain, lower adaptation speed**
P–198.M	online	4	0.0...255.9 dec	**P gain, upper adaptation speed**
P–199.M	online	4	1...150 %	**P gain, reduction factor** (The P gain characteristic is multiplied over the complete speed range)
P–203.M	online	4	0...1 hex	**Select, speed controller adaptation** 0: No adaptation P–031 effective 1: Speed controller adaptation active P–031 ineffective



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Speed controller clock

Table 4-5 Speed controller clock

Parameter attributes			Setting range	Description		
Number	Change effective	P–051				
P–090		4	0...FFFFHex	**Control word**		
				Bit	Word	
				3	0000H 0008H	Speed controller clock, Standard Speed controller clock, fast If bit 3 is changed, it only becomes effective after saving in the FEPROM and powering–on and off.

Total moment of inertia

Table 4-6 Total moment of inertia

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–159.M	online	4	0.0...6535.5 gm^2	**Motor and external moment of inertia** Sum of the motor moment of inertia + external moment of inertia referred to the motor shaft
P–219.M	online	4	0...15 kgm^2	**Additional moment of inertia** The parameterized value is internally added to P–159.M. Entry into P–219.M is only required if the setting range of P–159.M is exceeded (From FW 2.00)

4.2 Current controller

Overview

- Current controller optimization
- No–load motor current

Current controller

Warning

The module could be destroyed if the current controller P gain, P–115 or P–116 is set too high.
If the inverter clock frequency is increased, then the power de–rating, specified in Table 4–8 must be maintained.

Table 4-7 Current controller optimization

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–036.M	online	4	0...3 hex	**Inverter clock frequency** If the clock frequency is increased, the current controller dynamic performance is improved, however, the permissible continuous current load capability is reduced as a result of the switching losses. If the clock frequency is changed, the current controller must re–optimized. **Inverter clock frequency** 0 3.2 kHz 4 2.8 kHz 1 4.7 kHz 5 3.9 kHz 2 6.3 kHz 6 5.0 kHz 3 7.8 kHz 7 5.9 kHz
(P–037)	–	–	2.8...7.8 kHz	Displays the actual inverter clock frequency

Table 4-8 Currents are dependent on the inverter clock frequency IM analog f_T

Power module type	Order Nos. 6SN1123–1AA0□– 6SN1123–1AA0□– 6SN1123–1AA0□–	Code No.	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A
			f_T:3.2kHz	f_T:4.7kHz	f_T:6.3kHz	f_T:7.8kHz
8 A	–0HA□	1	3 / 3 / 3	2.5 / 2.5 / 2.5	2 / 2 / 2	1.6 / 1.6 / 1.6
15 A	–0AA□	2	5 / 5 / 8	4.2 / 4.2 / 6.8	3.4 / 3.4 / 5.4	2.6 / 2.6 / 4.2
25 A	–0BA□	4	8 / 10 / 16	6.9 / 8.6 / 13.8	5.7 / 7.1 / 11.4	4.6 / 5.7 / 9.1
50 A	–0CA□	6	24 / 32 / 32	20 / 26 / 26	15 / 20 / 20	10 / 14 / 14
80 A	–0DA□	7	30 / 40 / 51	26 / 34 / 44	21 / 28 / 36	17 / 23 / 29
108 A	–0LA□	13	45 / 60 / 76	39 / 52 / 65	32 / 43 / 54	26 / 34 / 43
120 A	–0GA□	8	45 / 60 / 76	39 / 52 / 65	32 / 43 / 54	26 / 34 / 43
160 A	–0EA□	9	60 / 80 / 102	51 / 68 / 86	41 / 54 / 69	31 / 42 / 53
200 A	–0FA□	10	85 / 110 / 127	73 / 95 / 109	60 / 78 / 90	48 / 63 / 72
300 A	–0JA□	11	120 / 150 / 193	101 / 127 / 163	81 / 102 / 131	62 / 78 / 101
400 A	–0KA□	12	200 / 250 / 257	169 / 211 / 217	135 / 169 / 174	104 / 130 / 134

Power module type	Order Nos. 6SN1123–1AA0□– 6SN1123–1AA0□– 6SN1123–1AA0□–	Code No.	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A	**In / Is6 / Imax** in A
			f_T: 2.8 kHz	f_T: 3.9 kHz	f_T: 5.0 kHz	f_T: 5.9 kHz
				from FW3.00		
8 A	–0HA□	1	3 / 3 / 3	2.8 / 2.8 / 2.8	2.4 / 2.4 / 2.4	2.2 / 2.2 / 2.2
15 A	–0AA□	2	5 / 5 / 8	4.6 / 4.6 / 7.4	4.1 / 4.1 / 6.5	3.6 / 3.6 / 5.8
25 A	–0BA□	4	8 / 10 / 16	7.5 / 9.3 / 15	6.7 / 8.3 / 13.3	6 / 7.5 / 12
50 A	–0CA□	6	24 / 32 / 32	22 / 29 / 29	19 / 25 / 25	16 / 21 / 21
80 A	–0DA□	7	30 / 40 / 51	28 / 37 / 48	25 / 33 / 42	22 / 30 / 38
108 A	–0LA□	13	45 / 60 / 76	42 / 56 / 71	37 / 50 / 63	34 / 45 / 57
120 A	–0GA□	8	45 / 60 / 76	42 / 56 / 71	37 / 50 / 63	34 / 45 / 57
160 A	–0EA□	9	60 / 80 / 102	56 / 74 / 95	49 / 65 / 83	43 / 58 / 73
200 A	–0FA□	10	85 / 110 / 127	79 / 103 / 119	71 / 91 / 106	63 / 82 / 95
300 A	–0JA□	11	120 / 150 / 193	111 / 139 / 179	98 / 122 / 157	86 / 108 / 139
400 A	–0KA□	12	200 / 250 / 257	185 / 232 / 238	163 / 203 / 209	144 / 180 / 185

P–115.M	online	4	0...255 dec	**P gain, current controller, base speed range**
P–116.M	online	4	0...300 dec	**P gain, current controller, field–weakening range**

$$P116.M = 255–(255–P115.M) \cdot \frac{P173.M}{P174.M}$$

No–load motor current

Table 4-9 No–load motor current

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–166.M	online	4	0.00...$I_{rated\ LT}$	**No–load motor current** Freely rotating motor without load

4.3 Field controller

Gain, integral action time

Table 4-10 Gain, integral action time

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–034.M	online	4	0.0...600.0 100 A/Vs	**Field controller P gain**
P–035.M	online	4	5.0...600.0 ms	**Field controller integral action time**

When calculating the controller data P–153 = –1, the field controller parameters are, among other parameters, defined.

In several cases, the control behavior can be improved (refer to Section 4.7)

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4.4 Optimization open–loop controlled range

Warning

If a drive is operated for a longer period of time in the open–loop controlled speed range, adequate motor cooling should be ensured, as a current is impressed in the motor which is approximately the rated current (percentage in P–057).

Caution for self–ventilated motors.

Table 4-11 Optimization, open–loop controlled range

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–057.M	online	4	0...150 %	**Current setpoint for the open–loop controlled range** Percentage of the rated motor current Current setpoint for the current–frequency control (open–loop)
P–058.M	online	4	0...399 %	**Accelerating torque in the controlled range** Percentage of the rated motor torque
P–172.M	online	4	0...32000 RPM	**Changeover speed, closed–/open–loop control** The changeover is realized with a 200 RPM hysteresis.

Note

If the current is limited by the maximum available converter current when accelerating, then the torque–generating components are reduced.

A reduction of the current in P–057 in this case shortens the ramp–up time.

4.5 Limits

Table 4-12 Limits

Parameter attributes			Setting range	Description
Number	Change effective	P–051		
P–174.M	online	4	0...32000 RPM	**Max. motor speed** Highest permissible motor speed
P–059.M	online	4	0...399 %	**Current limiting** Percentage of the rated motor current
P–060.M	online	4	0...399 %	**Output limiting** Percentage of the rated motor output
P–029.G	online	4	0...32000 RPM	**Speed limiting** Highest required motor speed
P–039.G	online	4	0...399 %	**1st torque limit** Percentage of the rated motor torque
P–041.G	online	4	0...399 %	**2nd torque limit** Percentage of the rated motor torque Selected via freely–programmable terminal function 1. Changeover, if the actual changeover speed from M_{d1} to M_{d2}, P–050, is exceeded.
P–050.G	online	4	0...32000 RPM	**Changeover speed from M_{d1} to M_{d2}** Changeover condition for the limit value changeover

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Note

If a drive is to be operated in the overload range, the limits must first be increased **after** the controller has been optimized.

The various limits are always simultaneously taken into account.

If an overload is permitted, then generally more than one limit has to be increased.

If the ramp–up time is to be shortened, it is also practical to make a change in the open–loop controlled range.

4.6 Special speeds and speed ranges

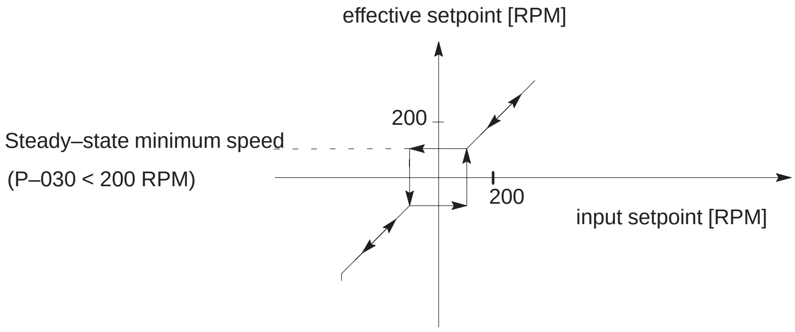
Overview

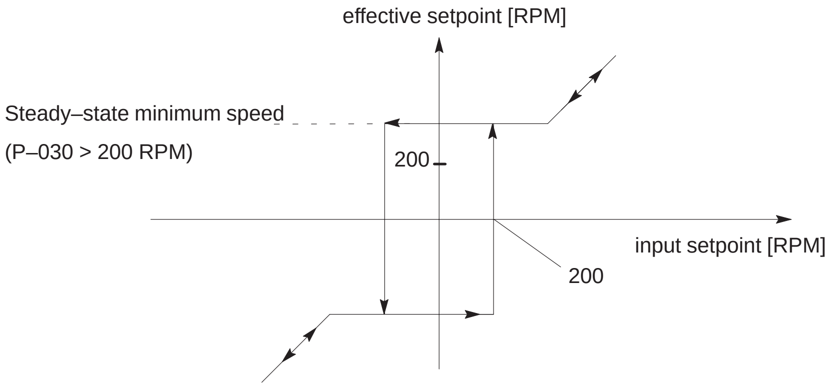
- Min. steady–state speed
- Speed range suppression
- Shutdown without overshoot

Steady–state minimum speed

Table 4-13 Min. steady–state speed

Parameter attributes: Number	Change effective	P–051	Setting range	Description
P–030.M	online	4	0...32000 RPM	**Steady–state minimum speed** No steady–state operation in the speed range around zero. The range is run–through with the actual ramp–up or ramp–down times if the speed setpoint exceeds the steady–state minimum speed in the opposite direction of rotation. Zero speed can only be forced by inhibiting the permanently–wired enable signals or the freely–programmable terminal function 16, setpoint enable.

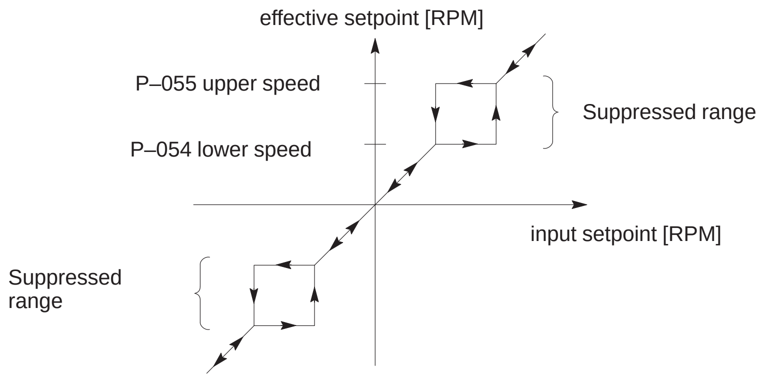




Speed–range suppression

Table 4-14 Speed range suppression

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–054.M **P–055.M**	online online	4 4	0...32000 RPM 0...32000 RPM	**Suppressed range, lower speed** **Suppressed range, upper speed** No steady–state operation in the suppressed speed range. The range is run–through with the actual ramp–up or ramp–down times, if the speed setpoint either exceeds or falls below the other corner speed.



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Shutdown without overshoot

Table 4-15 Shutdown without overshoot

Parameter attributes			Setting range	Description
Number	**Change effective**	**P–051**		
P–022.M	online	4	2...32000 RPM	**Shutdown speed, pulse cancellation** Shutdown without overshoot When the controller is inhibited, and the shutdown speed is fallen below, the motor is switched into a no–current condition, in order to prevent overshoot when zero speed is approached.

4.7 Manual optimization

Overview

- current controller
- speed controller
- field controller
- No–load motor current
- main field reactance
- motor and external moment of inertia
- motor rotor resistance

If manual optimization is required, the specified signals at the appropriate measuring points should be traced using a storage oscilloscope, and the parameters set, so that the required signal characteristics are obtained. The sequence can be triggered by the first of the specified signals.

For several adjustments, the settling characteristics of setpoint jumps have to be evaluated (if possible, ramp–up time P–016 or P–042 = 0) (step response). These can be entered using the oscillation generator (refer to Section 2.2.3). In this case, braking energy can be fed back into the supply when I/R modules are used.
When UE modules are used, this energy is converted into heat.
Ramp–down time P–017 or P–043 can be increased to reduce the braking power.

Current controller

P–115 P gain, current controller, base speed range
P–116 P gain, current controller, field–weakening range

Table 4-16

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Phase current	I_R test socket	–	–

Setting, with the drive enabled and speed n = 0

Parameter P–115 is increased from the pre–set value until the characteristic remains stable. If oscillations occur, reduce the value until the characteristic again becomes stable.

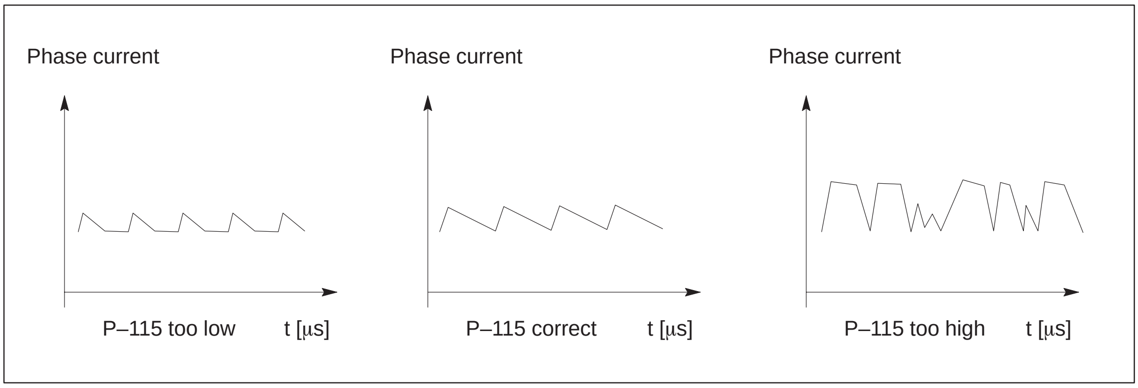

Fig. 4-1 Optimization, current controller, base speed range

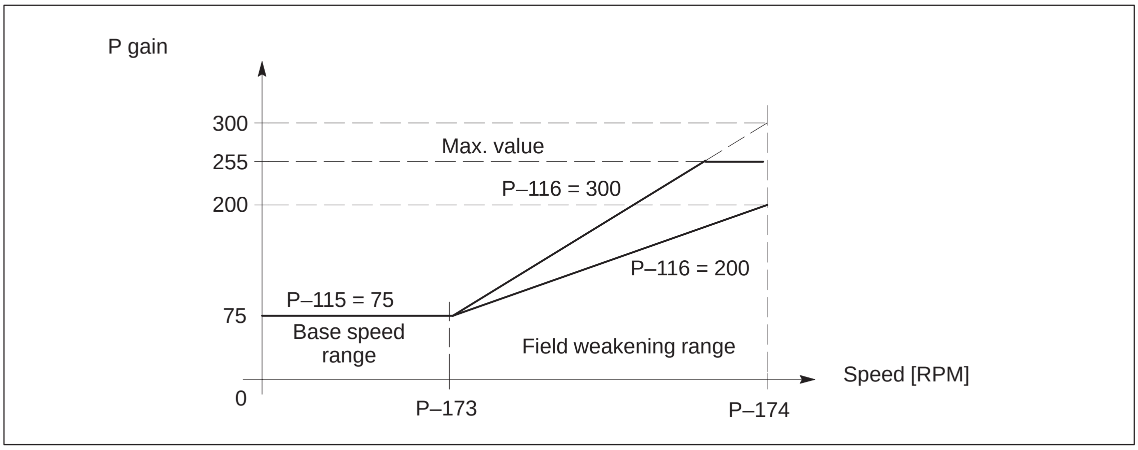

Fig. 4-2 Optimization, current controller, field–weakening range

From the field weakening speed P–173, the current controller gain is linearly increased, and, at maximum speed P–174, reaches the value of P–116, but, a maximum of 255.·

If a value > 255 is entered in P–116, the current controller gain reaches the maximum value already at speeds < P–174.

$$P116.M = 255-(255-P115.M) \cdot \frac{P173.M}{P174.M}$$

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In some cases, the behavior can be further improved using a somewhat higher value.

Table 4-17 P gain, current controller, base speed range

P–115 P gain, current controller, base speed range			
Increase value for		Decrease value for	
No.	Fault profile	No.	Fault profile
F–11	Low current controller dynamic performance	F–11	Increased current ripple, whistling noises, etc.

Table 4-18 P gain, current controller, field–weakening range

P–116 P gain, current controller, field–weakening range			
Increase value for		Decrease value for	
No.	Fault profile	No.	Fault profile
–	Erratic no–load operation in the upper speed range, torque surges	F–11	Spontaneous stall

Speed controller

P–031 P gain, speed controller
P–032 integral action time, speed controller

Table 4-19

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Torque–generating current	X1 test socket	P–076 = 10D2H	P–077 = 0H
Speed actual value	X2 test socket	P–072 = 1110H	P–073 = 4H

Setting, when the drive is enabled in the oscillation mode:

Enter small setpoint steps in the upper speed range using the oscillation generator.

Using P–031 and P–032 set the required settling characteristic of the speed actual value after the actual limit has been left.

If different controller settings are required at various speeds, the speed controller adaptation can be activated (refer to Section 4.1).

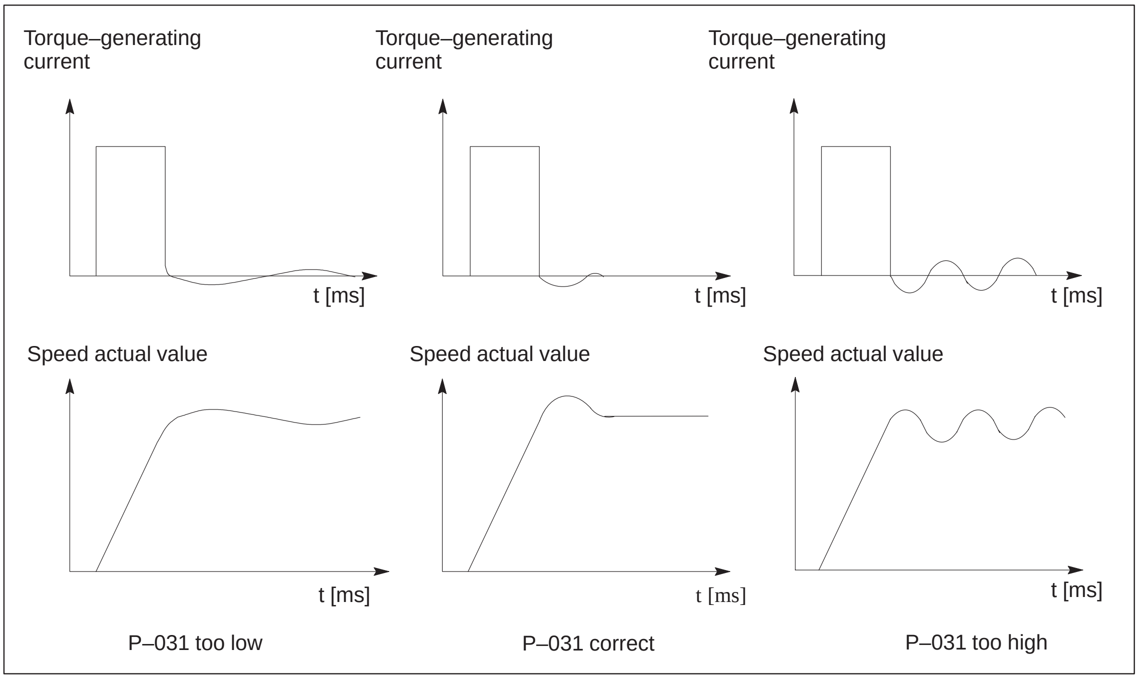

Fig. 4-3 Optimization, speed controller

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Table 4-20 P gain, speed controller

P–031 P gain, speed controller			
Increase value for		Decrease value for	
No.	Fault profile	No.	Fault profile
–	High rise time Overshoot with a large period interval for speed steps	–	Speed oscillations with a low period interval for speed steps

Table 4-21 Speed controller integral action time

P–032 Speed controller integral action time			
Increase value for		Decrease value for	
No.	Fault profile	No.	Fault profile
–	Tendency to oscillate when there is an elastic coupling and a high external moment of inertia	–	Long settling characteristics when speed changes occur

Field controller

P–034 P gain, field controller
P–035 integral action time, field controller

Table 4-22

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Speed actual value	X1 test socket	P–076 = 1110H	P–077 = 0H
Field–generating current	X2 test socket	P–072 = 10CAH	P–073 = 2H

Setting with the drive enabled in oscillation mode.

Using the oscillation generator and ramp–function generator, brake the drive from the maximum speed to changeover speed P–172 via a ramp.

Increase parameter P–034 from the calculated value until the field–generating current remains stable. If oscillations occur, reduce the value or increase P–035 until the characteristic re–stabilizes.

Check:

- setpoint steps in the field weakening range
  if there is a tendency to stall (F–11), increase P–034.
- no–load characteristics over the complete speed range
  for erratic no–load operation with torque surges, down to stalling (F–11), reduce P–034.

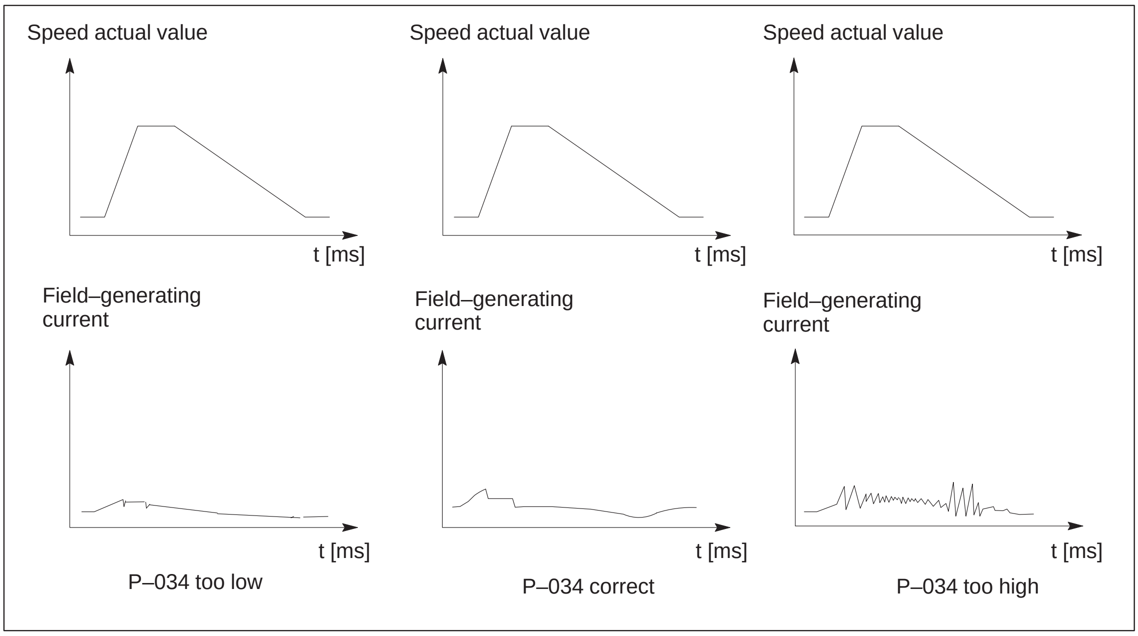

Fig. 4-4

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Table 4-23 Field controller P gain

P–034 P gain, field controller			
Increase value for		Decrease value for	
No.	Fault profile	No.	Fault profile
F–11	Stalling, especially in the field–weakening range during speed steps	F–11	The field–generating current has a tendency to oscillate Speed ripple Torque surges Stalling under no–load conditions

P–166 No–load motor current

Note

If the value of parameter P–166 is changed, the main field reactance P–171 should be re–adjusted.

Table 4-24

Signal name	Test point	Parameterization	
		Address	**Shift factor, e. g.**
Phase current	IR test socket	–	–
Motor current	(P–007) display	–	–
Voltage actual value	(P–010) display	–	–

Table 4-25

Setting with the drive enabled and load de–coupled	
parameter	**Procedure**
P–172	**Changeover speed,closed–loop/open–loop control** **Set** P–172 > P–164 · 60/p s/min Note the original value
P–057	**Current setpoint for the open–loop controlled range** Set P–057 = 50 % Note the original value
Speed setpoint	Adjust so that $(P–005) = \dfrac{U_A}{(P–162/P–164) + 2\pi \sqrt{3} \cdot P–158 \cdot P–161}$ **with UA output voltage, induction motor module** UA ≤ 400 V at UDClink = 600 V UA ≤ 420 V at UDClink = 625 V UA ≤ 0.8 · Usupply at UDClink uncontrolled
P–057	**Current setpoint for the open–loop controlled range** Adjust so that (P–010) = U_A
P–166	**Motor no–load current** Set P–166 = P–161 · P–057/100 %
P–172	Changeover speed, open–/closed–loop control Enter the original value
P–057	**Current setpoint for the open–loop controlled range** Enter the original value

P–171
Magnetizing reactance

Note

If the value of parameter P–171 is changed, the motor no–load current P–166 must be re–adjusted.

Table 4-26

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Integral component, field controller	X1 test socket	P–076 = 116A	P–077 = 2

Set with the drive enabled at the field weakening speed P–173.

Adjust the field controller integral component with parameter P–171 to zero.

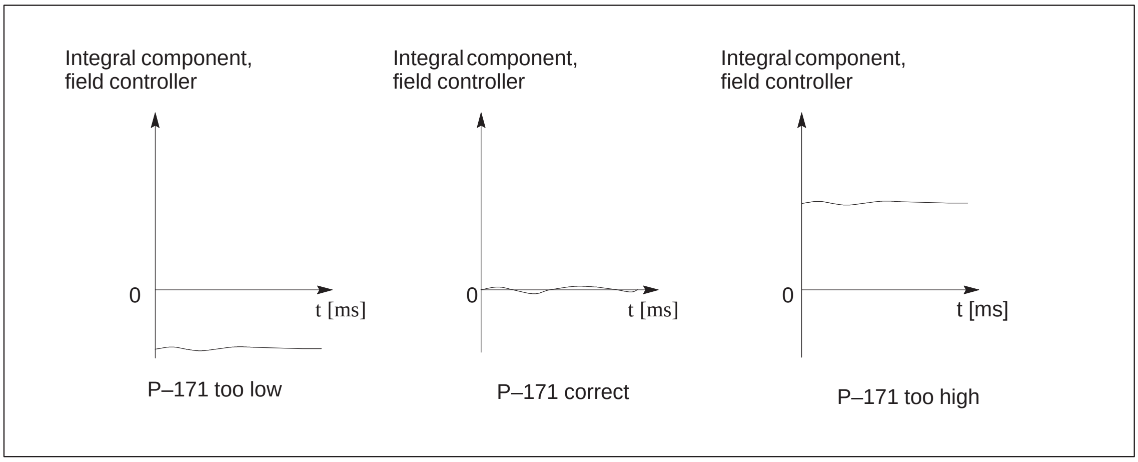

Fig. 4-5

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P–159
motor and external moment of inertia

P–219
additional moment of inertia

Table 4-27

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Speed actual value	X1 test socket	P–076 = 1110H	P–077 = 0H
Integral component, speed controller	X2 test socket	P–072 = 117CH	P–073 = 2H

Setting with load coupled and the drive enabled in the oscillation mode.

Enter setpoint steps from n = 2 · P–172 to n_{max} with the oscillation generator.

Set the speed controller integral component with parameter P–159 or P–219 so that this remains at approximately zero during acceleration.

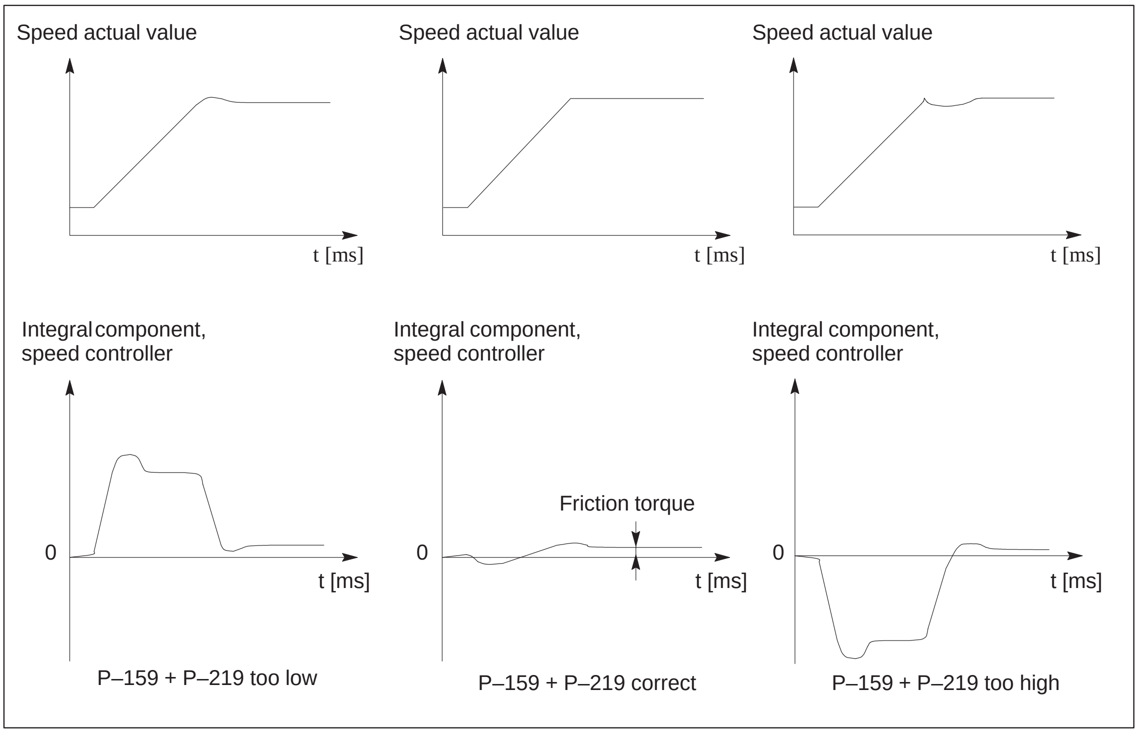

Fig. 4-6

P–168 motor rotor resistance

Note

Motor rotor resistance setting is not required for motors with deep–bar squirrel–cage rotors.

Table 4-28

Signal name	Test point	Parameterization	
		Address	Shift factor, e. g.
Speed actual value	X1 test socket	P–076 = 1110H	P–077 = 0H
Integral component, speed controller	X2 test socket	P–072 = 117CH	P–073 = 2H

Setting with the drive enabled in oscillation mode.

Using the oscillation generator, enter setpoint steps in the speed range from $n = 2 \cdot$ P–172 to $n = n_{max}$.

Adjust the speed controller integral component using parameter P–168 so that an overshoot at the end of acceleration is compensated.

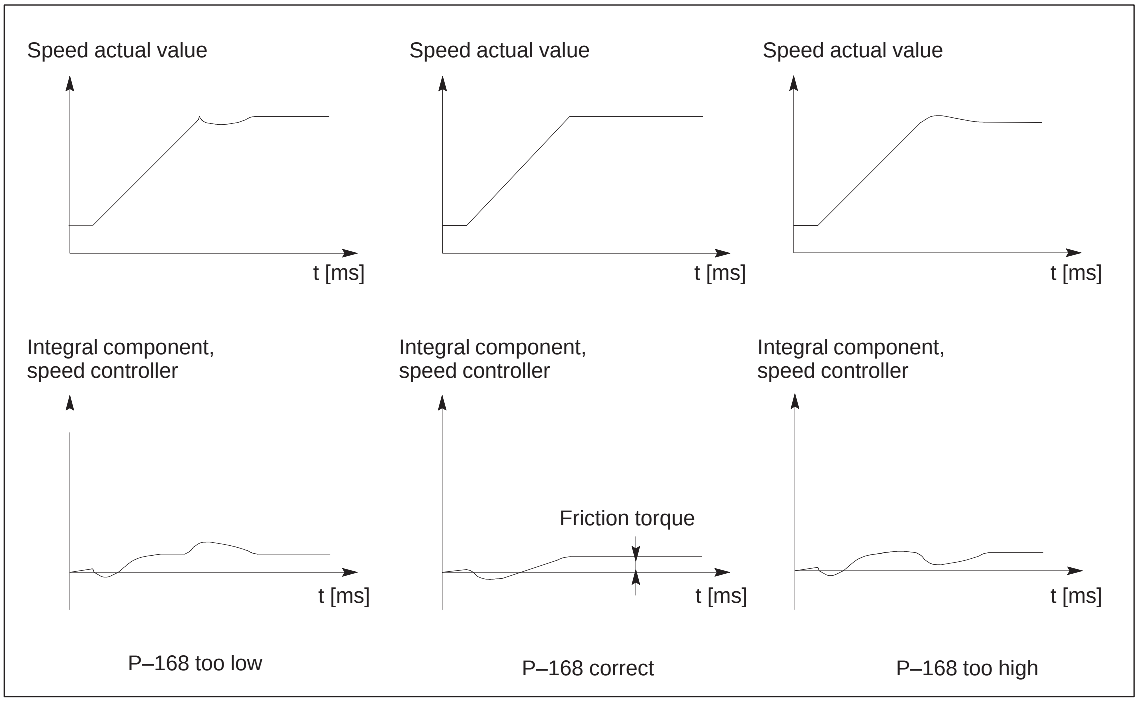

Fig. 4-7

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5 Diagnostics and fault analysis

5.1 Diagnostic aids

5.1.1 Measured value displays

Warning

When the motor pulses are canceled, there is no information regarding the motor speed. The calculated speed actual value is then set to zero. Thus, all speed actual value displays no longer provide any information.
In addition to P–133, BERO speed actual value if the speed is monitored.

Table 5-1 Measured value displays

Parameter–Attribute			Setting range	Description
Number	Change effective	P–051		
(P–001) **(P–101)**	–	–	–32000...32000 RPM	**Speed setpoint**
(P–002) **(P–102)**	–	–	–32000...32000 RPM	**Speed actual value**
(P–003)	–	–	–399.0...399.0 %	**Torque–generating current** Referred to the rated motor current
(P–004)	–	–	0.0...100.0 %	**Utilization** Referred to the effective limiting
(P–005)	–	–	–1250...1250 Hz	Motor frequency
(P–006)	–	–	0...700 V	DC link voltage Realized via NE– or the monitoring module or using P–061
(P–007)	–	–	–399.0...399.0 %	**Motor current** Referred to the rated motor current
(P–008)	–	–	0.0...399.0 %	**Field current component**s Referred to the rated motor current
(P–009)	–	–	0.0...399.0 %	**Active power** Referred to the rated motor output
(P–010)	–	–	0...450 V_{eff}	**Voltage actual value**
(P–110)	–	–	0...170°C	**Motor temperature**
(P–133)	–	–	0...65535 RPM	**Speed actual value BERO**
(P–037)	–	–	2.8 kHz...7.8 kHz	**Inverter clock frequency**

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5.1.2 Status displays

P–000, P–100 operating display

Refer to Section 2.2.1

P–011 Status of the binary inputs

Table 5-2 P–011 status of the binary inputs

Display						H
Display value						
1	–	**Term. 63** central pulse enable	**Term. E9** freely–programm. via P–089	**Term. E5** freely–programm. via P–085	**Term. E1** freely–programm. via P–081	
2	–	**Term. 64** central drive enable	**Term. 663** axis–specific pulse enable	**Term. E6** freely–programm. via P–086	**Term. E2** freely–programm. via P–082	
4	–	**Term. 112 open** setting–up operation	**Term. 65** axis–specific controller enable	**Term. E7** freely–programm. via P–087	**Term. E3** freely–programm. via P–083	
8	–	**Term. R** central fault acknowledgment	**Term. 81 open** ramp–function generator fast stop	**Term. E8** freely–programm. via P–088	**Term. E4** freely–programm. via P–084	

It is possible to display several messages. The hexadecimal addition is displayed.
Example: 4H + 8H = CH

P–254
Display of active functions 1

Table 5-3 P–254 display, active functions 1

Display						H
Display value						
1	–	**Fct. No. 13** ramp–function generator 2	**Fct. No. 9** gearbox stage bit 0	–	**Fct. No. 1** 2nd torque limit	
2	–	**Fct. No. 14** increase setpoint	**Fct. No. 10** gearbox stage bit 1	–	**Fct. No. 2** oscillation	
4	–	**Fct. No. 15** decrease setpoint	**Fct. No. 11** gearbox stage bit 2	**Fct. No. 7** ramp–up time $T_H = 0$	**Fct. No. 3** reset fault memory (fault acknow-ledgment)	
8	–	**Fct. No. 16** setpoint enable	**Fct. No. 12** clockwise/ counter–clock-wise phase sequence	–	–	
It is possible to display several messages. The hexadecimal addition is displayed. **Example:** 4H + 8H = CH						

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P–255
Display of active functions 2

Table 5-4 P–255 display, active functions 2

Display						H
Display value						
1	–	–	–	**Fct. No. 21** motor selection bit 1	**Fct. No. 17** fixed setpoint bit 0	
2	–	–	–	**Fct. No. 24** fixed setpoint bit 3	**Fct. No. 18** fixed setpoint bit 1	
4	–	–	–	–	**Fct. No. 19** fixed setpoint bit 2	
8	–	–	–	–	**Fct. No. 20** motor selection bit 0	
It is possible to display several messages. The hexadecimal addition is displayed. **Example:** 4H + 8H = CH						

5.1.3 Diagnostic parameters

P–020
Executed self–setting

Table 5-5 P–255 executed self–setting

Display						H
Display value						
1	–	–	–	self–optimization **5** setting, moment of inertia	self–optimization **1** optimization, phase current controller	
2	–	–	–	self–optimization **6** setting, rotor resistance	self–optimization **2** setting, power offset	
4	–	–	–	self–optimization **7** calculation, speed controller	self–optimization **3** setting, no–load current	
8	–	–	–	self–optimization **8** setting, field–weakening speed	self–optimization **4** setting, main field reactance	

It is possible to display several messages. The hexadecimal addition is displayed.
Example: 4H + 8H = CH

AM

Table 5-6

<table>
<tr><th colspan="3">Parameter–Attribute</th><th rowspan="2">Setting range</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Number</th><th>Change effective</th><th>P–051</th></tr>
<tr><td rowspan="3">(P–028)</td><td rowspan="3">–</td><td rowspan="3">–</td><td rowspan="3">0...FFFFH</td><td colspan="3">Diagnostics</td></tr>
<tr><td>Bit</td><td>Value</td><td></td></tr>
<tr><td>13</td><td>2000H</td><td>Division interrupt
Error in the calculation routine by incorrect data entry</td></tr>
<tr><td>(P–200)</td><td>–</td><td>–</td><td>0...FFFFH</td><td colspan="3">Checksum, parameter
At every back–up (P–052=1H), the checksum is formed over the parameter contents.
Thus, a change in the drive–motor data is identified.</td></tr>
</table>

5.1.4 Test sockets X1, X2, IR

Overview

- Function
- technical data
- assignment
- Normalization, IR
- Parameterization, X1 (DAU 3), X2 (DAU 4)

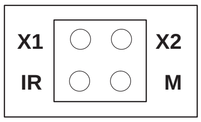
Function

Analog output of the phase current actual value and RAM variables for measurement– and diagnostic purposes.

Technical data

- phase current actual value at test socket IR
- 2 output channels at X1 (DAU 3) and X2 (DAU 4)
- voltage range 0...+ 5 V (value 0 corresponds to +2.5 V)
- rough normalization, offset compensation for X1 and X2 via parameter

Assignment



X1: Test socket DAU 3
X2: Test socket DAU 4
IR: Current actual value, phase R
M: Reference ground

Fig. 5-1 Assignment, test sockets

Normalization IR

Table 5-7 Normalization, IR

Power module code number (P–095)	Normalization, IR
1	8 A corresponds to 8.25 V
2	15 A corresponds to 8.25 V
4	25 A corresponds to 8.25 V
6	50 A corresponds to 8.25 V
7	80 A corresponds to 8.25 V
8	160 A corresponds to 8.25 V
9	160 A corresponds to 8.25 V
10	200 A corresponds to 8.25 V
11	300 A corresponds to 8.25 V
12	400 A corresponds to 8.25 V
13	120 A corresponds to 8.25 V

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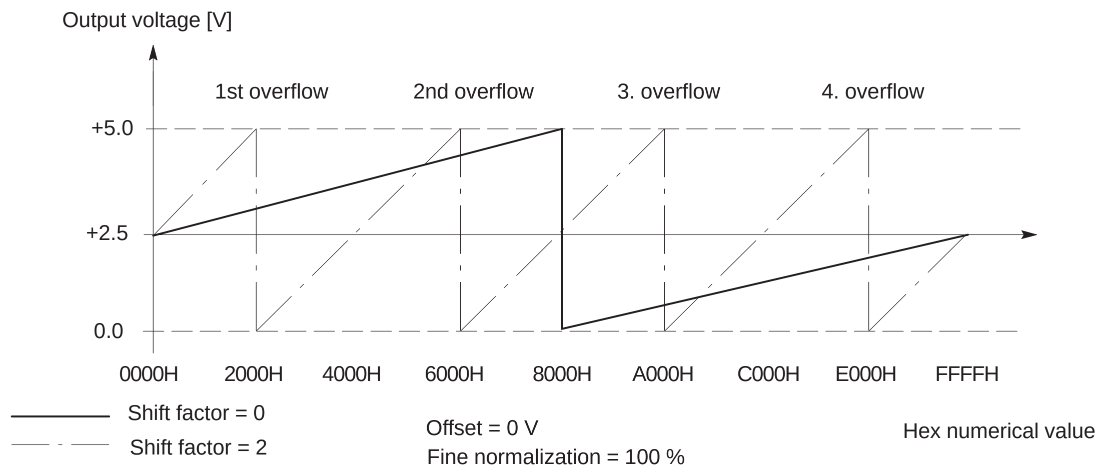
Parameterization
X1 (DAU 3),
X2 (DAU 4)

Table 5-8 Parameterization, X1 (DAU 3), X2 (DAU 4)

Parameter–Attribute			Setting range	Description
Number	**Change effective**	**P–051**		
P–076	online	4	0...FFFF hex	**Address, DAU 3** Address of the RAM variables which are to be output at DAU 1. Pre–setting: 1110H calculated speed actual value 1 V corresponds to 15000 RPM
P–077	online	4	0...F hex	**Shift factor, DAU 3** Rough normalization of the selected data value by shifting the binary number to the left. Shifting to the left by 1 = multiplication by 2 Max. gain: 32768
P–080	online	4	–127...127 dec	**Offset, DAU 3** Compensation of a possible offset for DAU 3
P–072	online	4	0...FFFF hex	**Address, DAU 4** Pre–setting: 10D2H Torque–generating current 1 V corresponds to 1.6 · $I_{rated\ motor}$
P–073	online	4	0...F hex	**Shift factor, DAU 4**
P–074	online	4	–127...127 dec	**Offset, DAU 4**



Note

A listing of important measured quantities (RAM variables) and their addresses is listed in the Appendix (Section 6.5).

5.1.5 Minimum/maximum value memory

Function Monitoring RAM variables for minimum and maximum values.

Table 5-9 Minimum/maximum value memory

Parameter–Attribute			Setting range	Description
Number	Change effective	P–051		
P–181	online	4	0...FFFF hex	**Address for min/max memory** (addresses of the monitored RAM variable) Value can be backed–up in the drive–machine data memory.
P–179	online	4	0...3 hex	**Selection, min/max memory** 0H: Stop memory function 1H: Start memory function with absolute value evaluation 2H: Start memory function with bipolar evaluation 3H: Stop memory function
(P–182)	–	–	0...FFFF hex	**Min. value min/max memory**
(P–183)	–	–	0...FFFF hex	**Max. value min/max memory**

Note

A listing of important measured quantities (RAM variables) and their addresses is listed in the Appendix (Section 6.5).

AM

5.1.6 Transient recorder function

Function

Simultaneous tracing of two RAM variables and output via test sockets X1 and X2.

Technical data

- two 16–bit signals are traced in parallel
- 640 words trace depth
- 1 ms sampling time (P–090, bit3=0) or 0.6ms (P–090, bit3=1, from FW 3.00)
- start– and stop condition (trigger conditions)
- cyclic output via D/A converters
- trigger edge for the output

Parameterization

Table 5-10 Parameterization

Parameter–Attribute			Setting range	Description
Number	Change effective	P–051		
P–207	online	4	0...C hex	**Setting the transient recorder** Two RAM variables are recorded over 640 ms with 1 ms sampling time. 1H: Start via P–206 without start– and stop condition Start via P–206 = + 1. stop 640 ms after input 2H: Start condition P–208 and P–209, no stop condition. Start via P–206 = +1. stop 640 ms after start condition. 5H: Stop condition via P–210 and P–211, no start condition. Start via P–205 = +1. tracing the last 640 ms before the stop condition 6H: Record with start– and stop condition, max. 640 ms 4H: Trace memory pre–assigned a value via P–217 Parameter is reset to 0 after successful trace.
P–212	online	4	0...FFFF hex	**Address signal 1** A list of all of the important measured quantities (RAM variables) and their addresses are provided in the Appendix (Section 6.5).
P–213	online	4	0...FFFF hex	**Address, signal 2**

Table 5-10 Parameterization

Parameter–Attribute			Setting range	Description
Number	Change effective	P–051		
P–208	online	4	0...FFFF hex	**Address for the start condition** Address of the RAM variables which start the trace.
P–209	online	4	0...FFFF hex	**Threshold for the start condition** Start condition mask, is compared with the RAM variable in P–208.
P–210	online	4	0...FFFF hex	Address for stop condition
P–211	online	4	0...FFFF hex	Threshold for the stop condition
P–206	online	4	0...1 hex	**Select transient recorder** The transient recorder function is started by setting P–206 to +1. The parameter is reset to 0 after a successful trace.
P–215	online	4	0...15 dec	**Shift factor, signal 1** Refer to the description, test socket X1, X2
P–216	online	4	0...15 dec	Shift factor, signal 2
P–217	online	4	0...FFFF hex	**Trigger signal 1** Trigger signal amplitude ”low” for D/A converter output with 1 ms duration. An edge is output, which follows the traced signal when entering various signal levels in P–217 and P–218.
P–218	online	4	0...FFFF hex	**Trigger signal 2** Trigger signal amplitude ”high” for 1 ms D/A converter output.
P–214	online	4	0...1 hex	**Start trace output** Cyclic outputs of the traced values on D/A converter. The output is repeated until the parameter is reset to 0. Trace signal 1 → DAU 3 (X1) Trace signal 2 → DAU 4 (X2) The previous assignment of the D/A converters is buffered and is set again after the output function has been terminated.

Note

A listing of important measured quantities (RAM variables) and their addresses is listed in the Appendix (Section 6.5).

AM

5.1.7 Open–loop current/frequency control

Warning

If a drive is operated for a longer period of time in the open–loop controlled speed range, it should be ensured that the motor is adequately cooled, as a current is impressed in the motor which is approximately the same as the rated current (percentage in P–057).

Caution for self–ventilated motors.

Function

Diagnostics for incorrect parameterization in the closed–loop controlled range.

The motor can be operated in the open–loop current/frequency controlled range for test purposes. In this case, the closed–loop speed and current control are ineffective.

Function information

The changeover speed, closed–loop/open–loop control P–172 should be set so high, that this is not exceeded in test operation.

Above the field weakening speed (P–173), the absolute current value should be selected lower than the no–load current, as otherwise the voltage limiting will intervene. This will result in erratic running and torque surges.

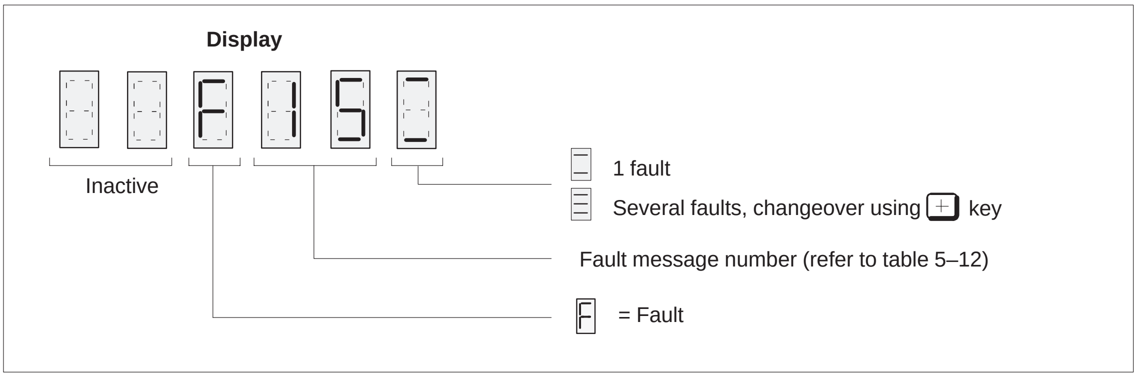
Table 5-11 Open–loop current/frequency control

Parameter–Attribute			Setting range	Description
Number	Change effective	P–051		
P–057.M	online	4	0...150 %	**Current setpoint in the open–loop controlled range** Percentage of the rated motor current Current setpoint for open–loop current/frequency control
P–058.M	online	4	0...399 %	**Accelerating torque in the open–loop controlled range** Percentage of the rated motor torque
P–172.M	online	4	0...32000 RPM	**Changeover speed, closed–loop/open–loop control** Changeover is realized with a 200 RPM hysteresis.

5.2 Fault analysis

5.2.1 Fault display, fault acknowledgment

Fault display



Fault acknowledgment

using the

P key

Depress the **P** key with the controller inhibited.

If the fault can be acknowledged, the system returns to the operator control program.

If the fault cannot be acknowledged, for example, there is a defect, then this can be temporarily suppressed in the display.

- **remote acknowledgment**

  One of the following terminals is energized, with the controller inhibited:

  – terminal ”R” reset at the NE– or monitoring module

  – terminal ”reset fault memory” (freely–programmable terminal function) at the induction motor module

  – terminal ”65” interrupt controller enable (only if P–053, bit 5 =1)

- **power–down**

  Power–down the converter and after the display has disappeared after approx. 2 s, power–up again.

Fault suppression

using the

– key

The system returns to the operator control program for approx. one minute after depressing the **–** key, without the fault being acknowledged.

AM

5.2.2 Fault message list

Warning

When the motor pulses are canceled, there is no information regarding the motor speed. The calculated speed actual value is then set to 0.The motor impulses can be canceled by fault messages.

Table 5-12 Fault message list

Fault message	Fault	Cause
F–04	D/A conversion error	• if the control board repeatedly manifests defects
F–05	Motor current = 0	• all enable signals have been issued, but no motor is connected or • a motor contactor has not pulled–in. • all enable signals have been issued, but at least one of the parameters P–160, P–166, P–057, P–059 is zero. • DC link fuse ruptured • DC link busbar interrupted
F–07	Data save unsuccessful on FEPROM	• if the error message repeatedly occurs during data save, then the FEPROM is defective. • if the error message occurs directly after the converter is powered–up, then the converter was previously powered–down during a data save operation. The last parameter changes have therefore not been saved. The data save must be repeated.
F–08	Irretrievable data loss	• defective FEPROM → replace module
F–11	Frequency setpoint > maximum frequency	• ribbon cable between the control– and gating board is defective or is not connected • motor is not connected or a phase is missing • defective power supply of the gating board • DC link fuse ruptured • DC link busbar interrupted • motor stalled, as the motor– or controller parameters completely wrong • induction motor module is connected to a monitoring module without DC link voltage sensing, and no value for the DC link voltage was entered in P–061 • for the gearbox stage changeover, the speed limiting P–029 was lowered, although the motor rotated above this limit.
F–13	Field controller is at its limit	• motor data or controller data completely incorrect • entered motor data and motor circuit configuration Y/Δ do not coincide • motor stalled, as the motor– or controller data are completely wrong

Table 5-12 Fault message list

Fault message	Fault	Cause
F–14	Overtemperature, motor	• motor overloaded • motor current too high, e.g. due to incorrect motor data • defective temperature sensor (motor) • motor fan defective • winding short circuit, motor
F–15	Overtemperature, converter	• converter overloaded (incorrect motor/converter assignment, incorrect duty cycle) • ambient temperature too high • induction motor module fan failed • defective temperature sensor in the induction motor module • acknowledge after cooling below 50° C ±15 K only by switching the supply voltage off and on
F–16	Illegal power module code number	• incorrect code number 3 selected in P–095 (for power modules without automatic identification) • incorrect code number in P–095 selected (for power modules with automatic identification). from FW 3.00
F–17	$I_{0\ motor} > I_{rated\ power\ section}$	• incorrect motor/converter assignment
F–19	Temperature sensor, motor • interrupted • short circuit only KTY 84	• temperature sensor defective • connection to the sensor interrupted or short–circuited
F–51	Parameterizing error: Rated torque too high	• rated torque (calculated) from P160.M and P163.M greater than 650 Nm from FW 2.00
F–52	Parameterizing error: Torque constant inadmissible	• illegal ratio of $\frac{P\text{–}160.M \cdot P\text{–}164.M}{P\text{–}161.M \cdot P\text{–}163.M \cdot P\text{–}171.M}$ from FW 2.00
F–53	Parameterizing error: Rated motor current too low	Ratio of the rated motor current to rated power module current too low
F–60	Error for self–setting	• self–setting was interrupted • self–setting did not provide any useful values • speed limiting (P–029, P–174) effective $n_{max} < (f_{rated} \bullet 60\ s/min)/p$ • circuit configuration Y/Δ and nominal data interchanged • additional causes, refer to Section 4
F–90	Maximum speed BERO exceeded	• pulse number P131.M incorrectly parameterized • cable interrupted

AM

Faults

after

- **supply ON**

  Operating control display inactive

  – at least two phases missing (NE module)

  – at least two input fuses have ruptured (NE module)

  – defective electronics power supply in the NE module

  – converter bus connection (ribbon cable) induction motor module ↔ NE module not inserted or defective

  – defective induction motor module

  – defective EPROM/FEPROM

  – firmware not loaded

- **controller enable**

  Motor rotates counter–clockwise, although the induction motor module outputs a clockwise rotating field, or vice versa

  – motor phase sequence incorrect, as the feeder cables are interchanged (interchange 2 phase connections)

■

Appendix 6

AM

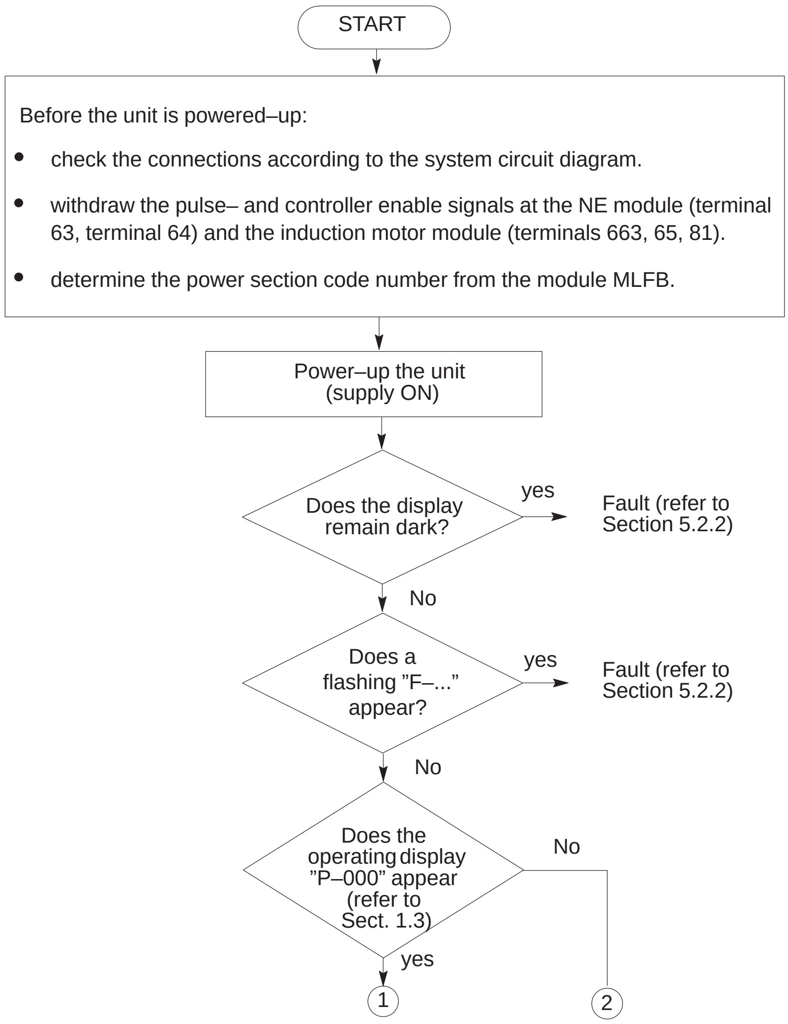
6.1 Flow diagram for new start–up

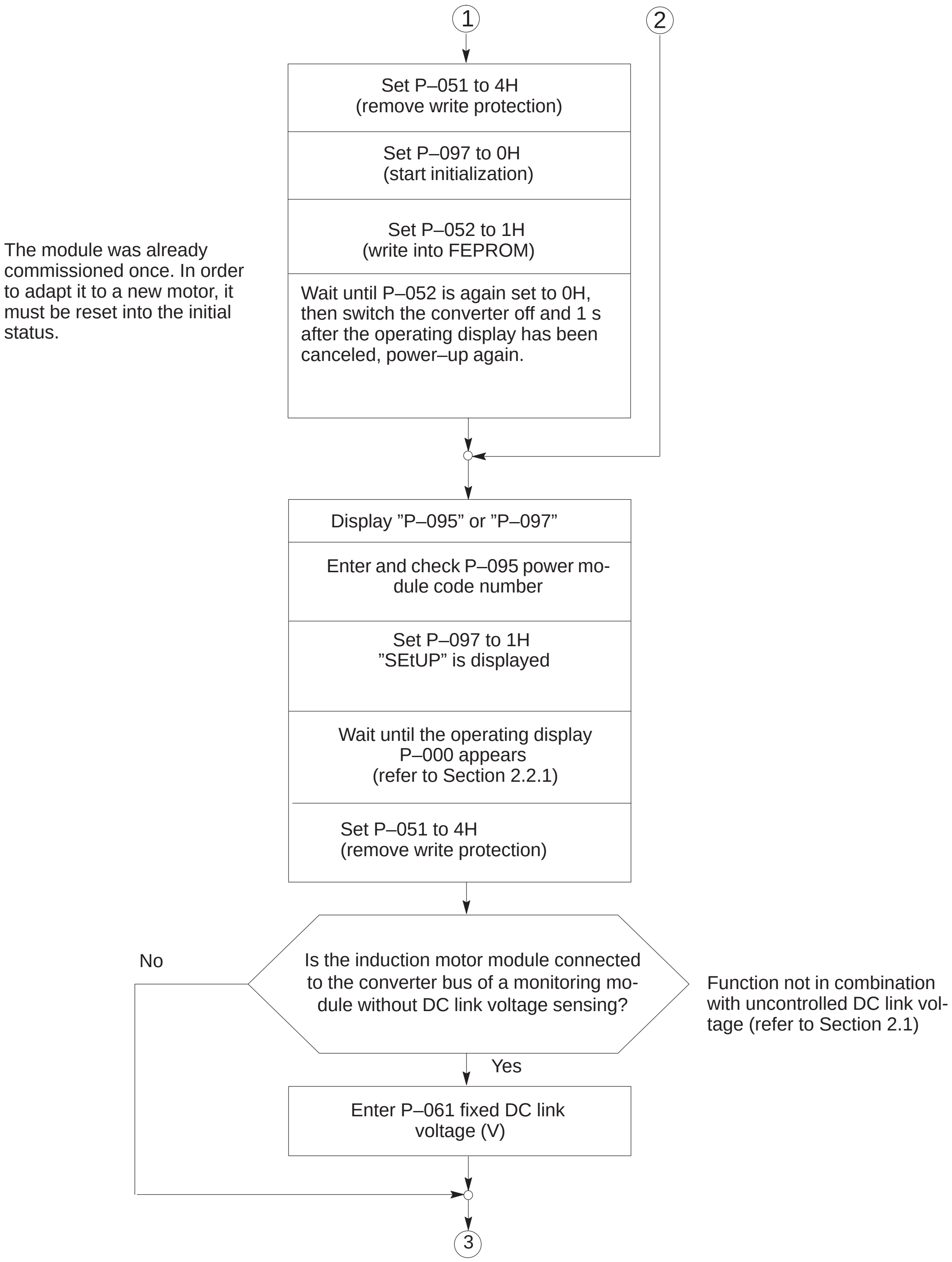
Warning

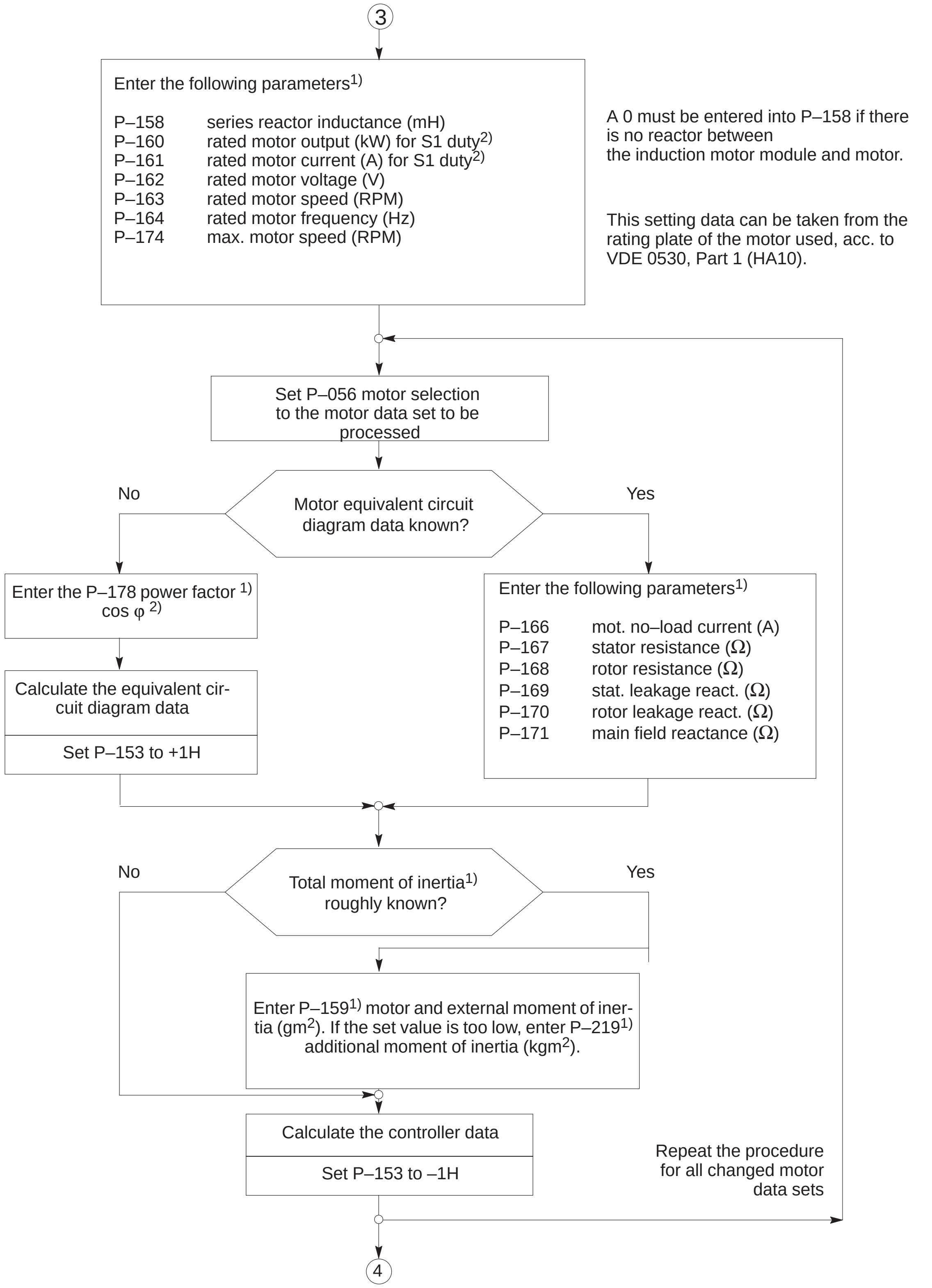
The drive accelerates up to n_{set} if a fault on the **NE module** is acknowledged with the induction motor module enabled.

Note

If data save is interrupted due to a power failure or the power being disconnected, then the values which were changed since the last data save are lost, and the drive converter displays fault message ”F–07” after the power returns. The parameter values can be reset after acknowledging fault message ”F–07” (refer to Section 5.2.2).

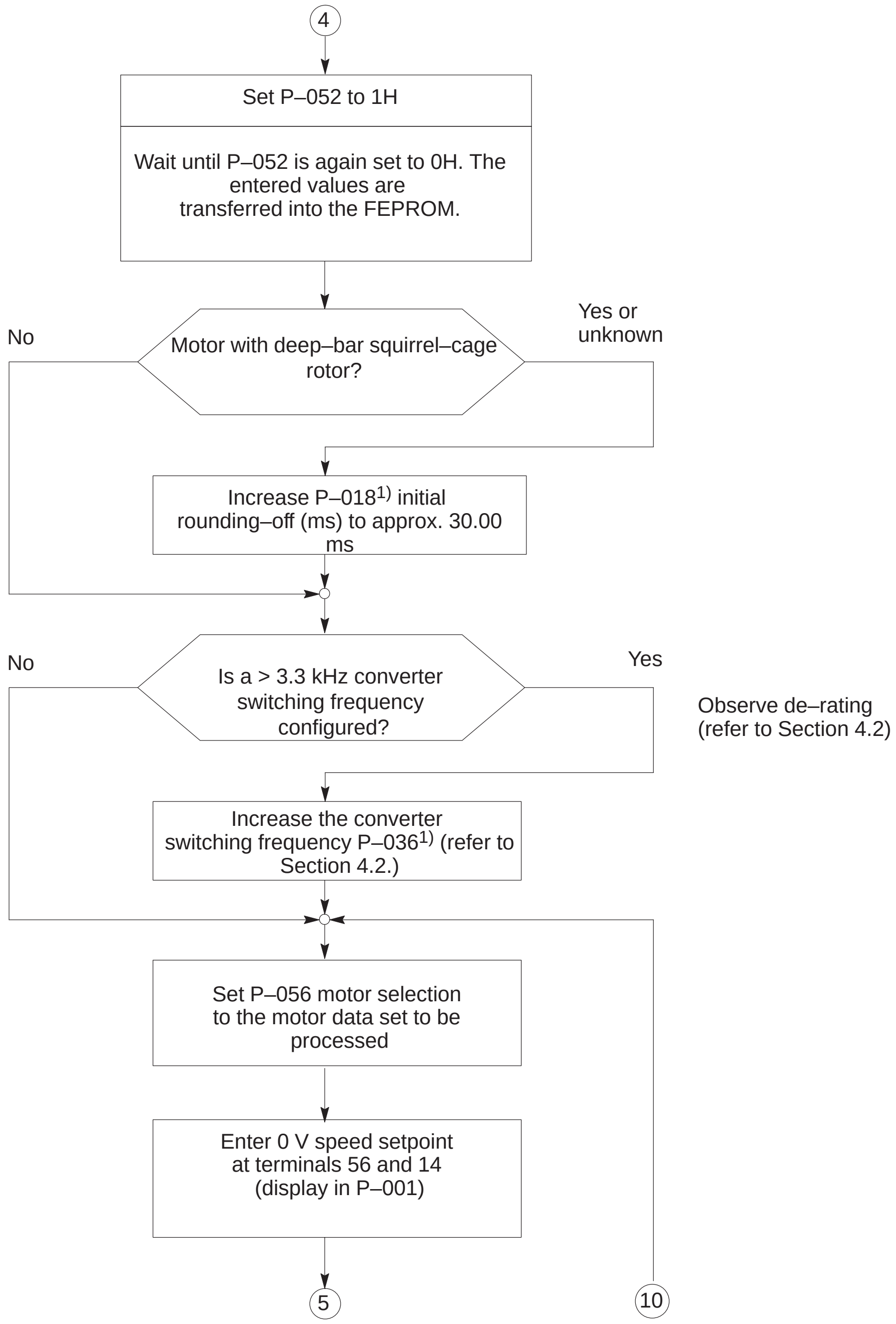



1
2
Set P–051 to 4H
(remove write protection)
Set P–097 to 0H
(start initialization)
Set P–052 to 1H
(write into FEPROM)
The module was already commissioned once. In order to adapt it to a new motor, it must be reset into the initial status.
Wait until P–052 is again set to 0H, then switch the converter off and 1 s after the operating display has been canceled, power–up again.
Display ”P–095” or ”P–097”
Enter and check P–095 power module code number
Set P–097 to 1H
”SEtUP” is displayed
Wait until the operating display P–000 appears (refer to Section 2.2.1)
Set P–051 to 4H
(remove write protection)
No
Is the induction motor module connected to the converter bus of a monitoring module without DC link voltage sensing?
Function not in combination with uncontrolled DC link voltage (refer to Section 2.1)
Yes
Enter P–061 fixed DC link voltage (V)
3

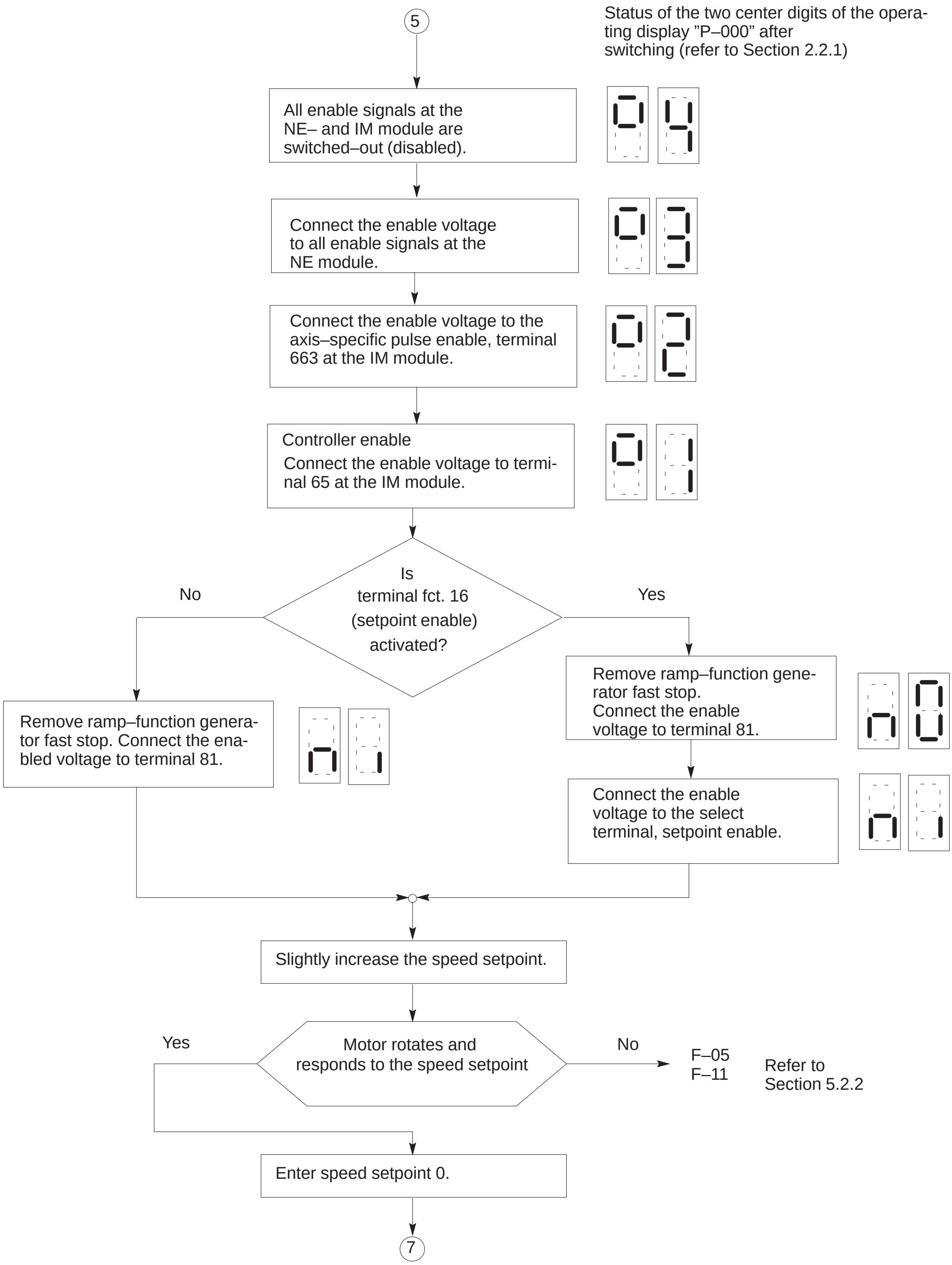


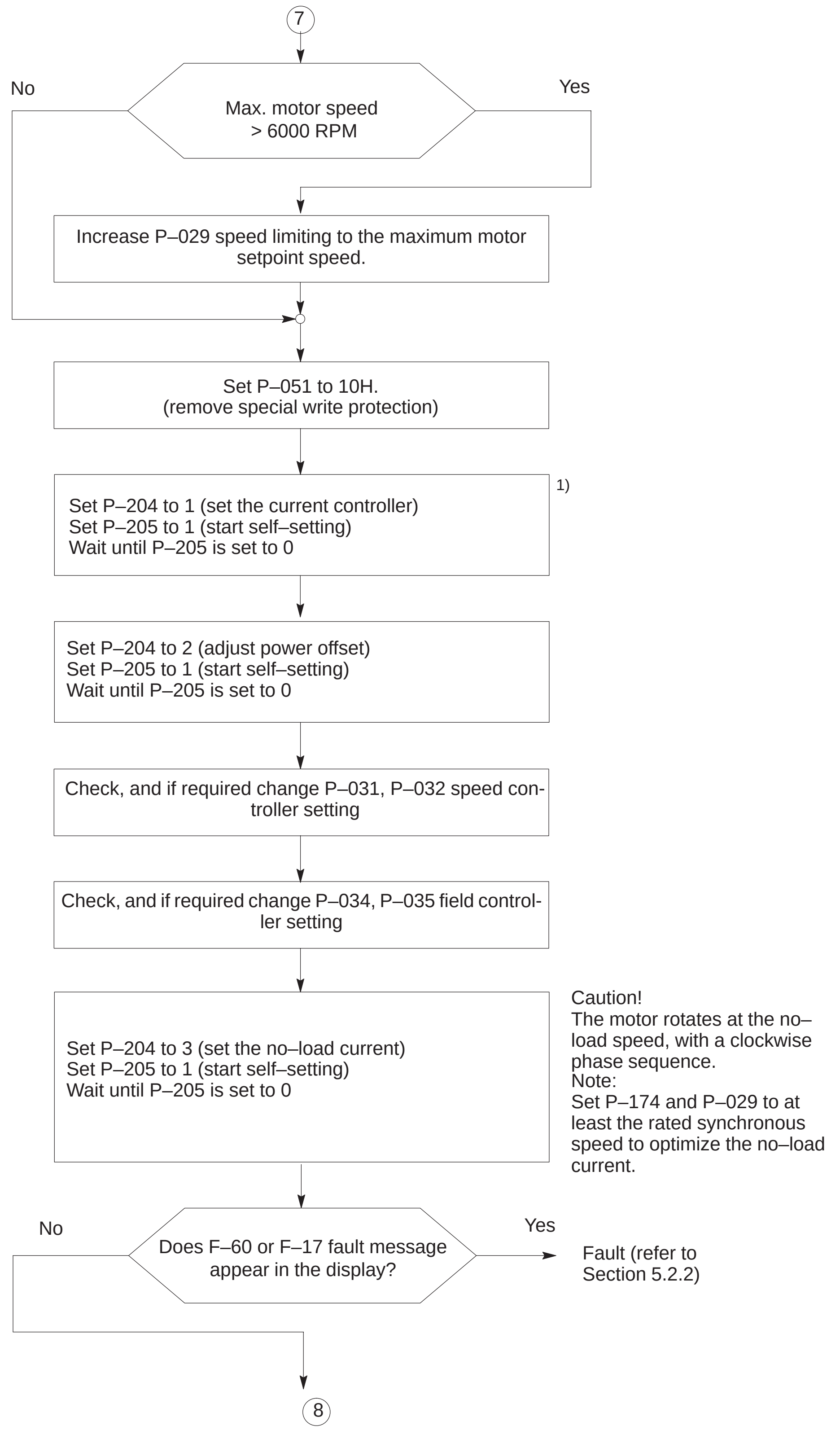
1) Setting data for up to four different motors can be entered (sub–parameters 1 to 4)

2) For force–ventilated motors, refer to the information, Section 2.1

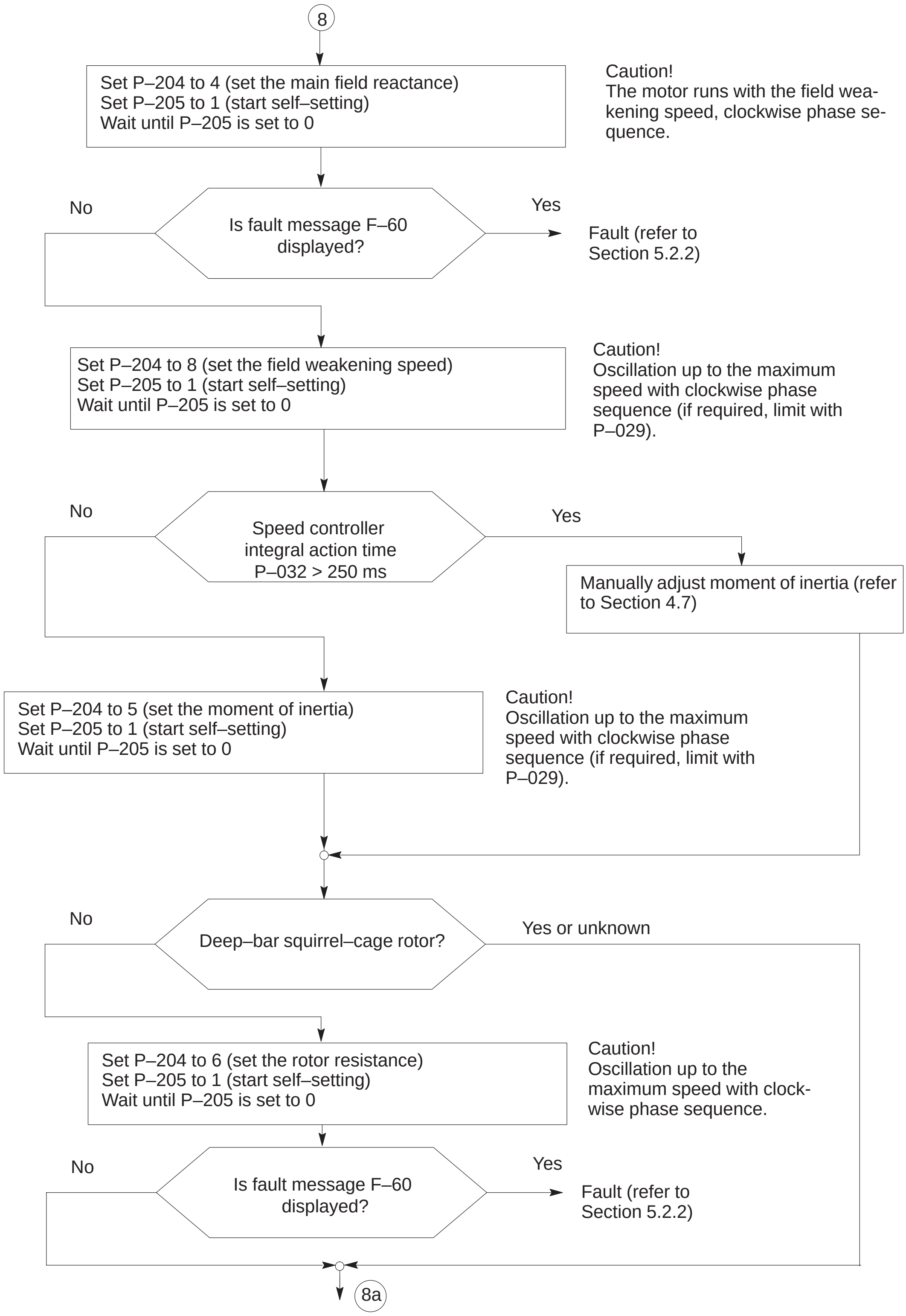


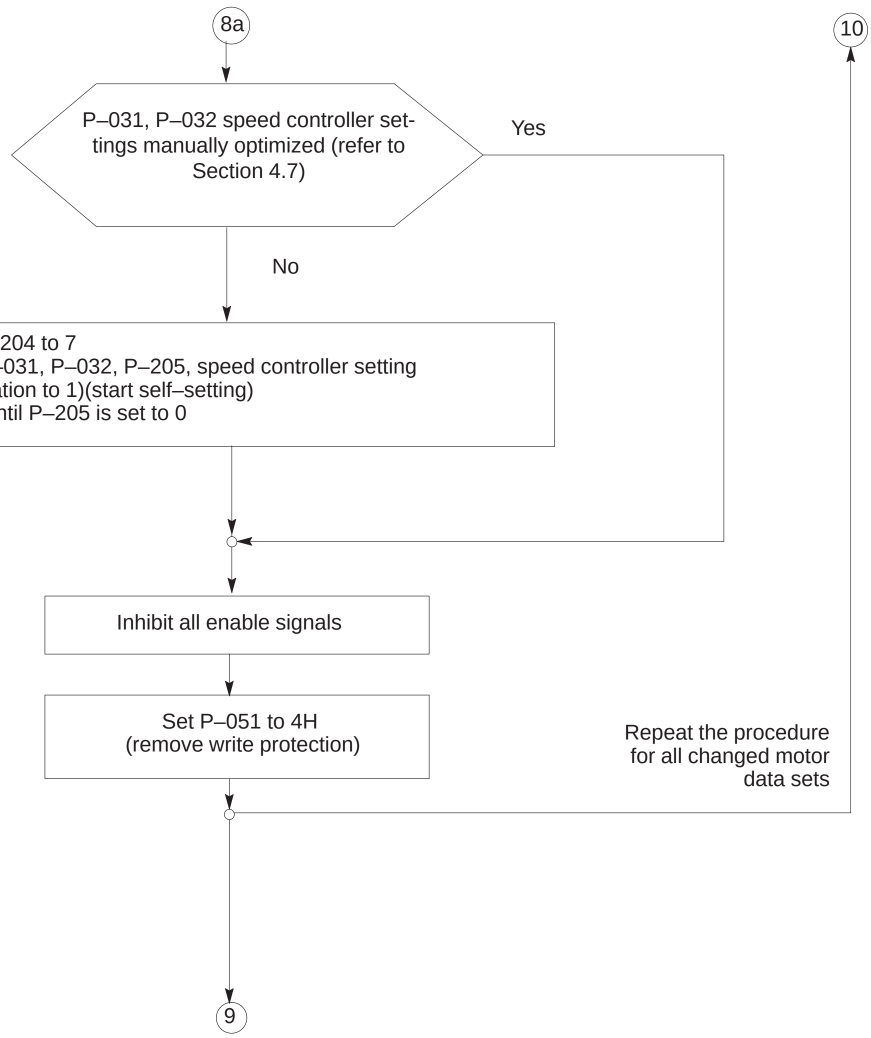
1) Setting data for up to four different motors can be entered (sub–parameters 1 to 4)


Status of the two center digits of the opera-
ting display ”P–000” after
switching (refer to Section 2.2.1)
5
All enable signals at the
NE– and IM module are
switched–out (disabled).
Connect the enable voltage
to all enable signals at the
NE module.
Connect the enable voltage to the
axis–specific pulse enable, terminal
663 at the IM module.
Controller enable
Connect the enable voltage to termi-
nal 65 at the IM module.
Is
terminal fct. 16
(setpoint enable)
activated?
No
Yes
Remove ramp–function genera-
tor fast stop. Connect the ena-
bled voltage to terminal 81.
Remove ramp–function gene-
rator fast stop.
Connect the enable
voltage to terminal 81.
Connect the enable
voltage to the select
terminal, setpoint enable.
Slightly increase the speed setpoint.
Motor rotates and
responds to the speed setpoint
Yes
No
F–05
F–11
Refer to
Section 5.2.2
Enter speed setpoint 0.
7



1) no longer required from FW 3.00


8
Set P–204 to 4 (set the main field reactance)
Set P–205 to 1 (start self–setting)
Wait until P–205 is set to 0
Caution!
The motor runs with the field weakening speed, clockwise phase sequence.
Is fault message F–60 displayed?
No
Yes
Fault (refer to Section 5.2.2)
Set P–204 to 8 (set the field weakening speed)
Set P–205 to 1 (start self–setting)
Wait until P–205 is set to 0
Caution!
Oscillation up to the maximum speed with clockwise phase sequence (if required, limit with P–029).
Speed controller integral action time P–032 > 250 ms
No
Yes
Manually adjust moment of inertia (refer to Section 4.7)
Set P–204 to 5 (set the moment of inertia)
Set P–205 to 1 (start self–setting)
Wait until P–205 is set to 0
Caution!
Oscillation up to the maximum speed with clockwise phase sequence (if required, limit with P–029).
Deep–bar squirrel–cage rotor?
No
Yes or unknown
Set P–204 to 6 (set the rotor resistance)
Set P–205 to 1 (start self–setting)
Wait until P–205 is set to 0
Caution!
Oscillation up to the maximum speed with clockwise phase sequence.
Is fault message F–60 displayed?
No
Yes
Fault (refer to Section 5.2.2)
8a


8a
10
P–031, P–032 speed controller settings manually optimized (refer to Section 4.7)
Yes
No
Set P–204 to 7
(set P–031, P–032, P–205, speed controller setting calculation to 1)(start self–setting)
Wait until P–205 is set to 0
Inhibit all enable signals
Set P–051 to 4H
(remove write protection)
Repeat the procedure for all changed motor data sets
9

AM

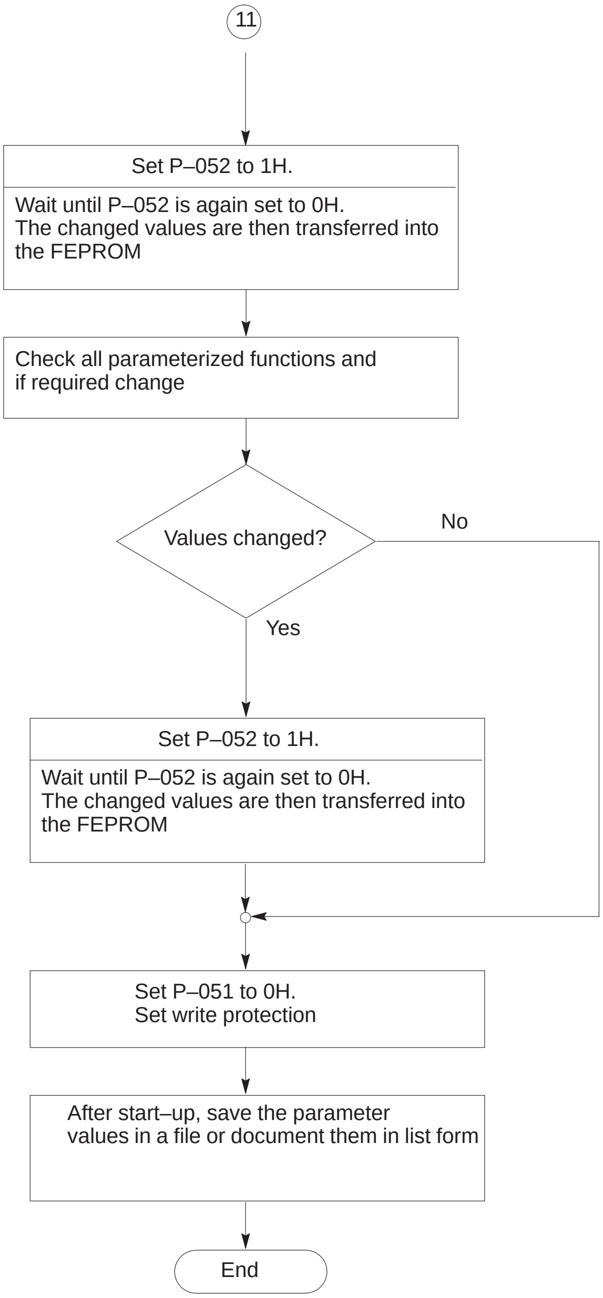
9

Set P–056 again to 0 H

Check, and if required, change the following parameters:

P–014	normalization n_{set}
P–015	offset correction n_{set}
P–024	normalization n_{set}
P–016	ramp–up time, ramp–fct. generator 1
P–017	ramp–down time, ramp–fct. generator 1
P–029	maximum motor speed n_{maxmot}
P–021 to P–023, P–027	relay response values of the speed monitoring
P–039 to P–043 P–047	torque limits
P–057 to P–058	open–controlled range
P–059 to P–060	limits
P–081 to P–089	freely–programmable terminal functions
P–113 to P–114	speed setpoints
P–185 to P–194, P–241 to P–246	freely–programmable Relay functions

11


11
Set P–052 to 1H.
Wait until P–052 is again set to 0H.
The changed values are then transferred into the FEPROM
Check all parameterized functions and if required change
Values changed?
No
Yes
Set P–052 to 1H.
Wait until P–052 is again set to 0H.
The changed values are then transferred into the FEPROM
Set P–051 to 0H.
Set write protection
After start–up, save the parameter values in a file or document them in list form
End

AM

6.2 Power module code numbers

Table 6-1 Power module code numbers

Power mod. type	Order No. 6SN1123–1AA0□– 6SN1124–1AA0□– 6SN1140–1BA1□–	Rated output current [A]	Peak output current, briefly S–60% 10min [A]	Peak output current, briefly S–60% 10s [A]	Power module code number P–095	
8 A	–0HA□	3	3	3	1	FW 2.10
15 A	–0AA□	5	5	8	2	FW 2.10
25 A	–0BA□	8	10	16	4	
50 A	–0CA□	24	32	32	6	
80 A	–0DA□	30	40	51	7	
108 A	–0LA□	45	60	76	13	FW 2.10
120 A	–0GA□	45	60	76	8	
160 A	–0EA□	60	80	102	9	
200 A	–0FA□	85	110	127	10	
300 A	–0JA□	120	150	193	11	FW 2.00
400 A	–0KA□	200	250	257	12	FW 2.00

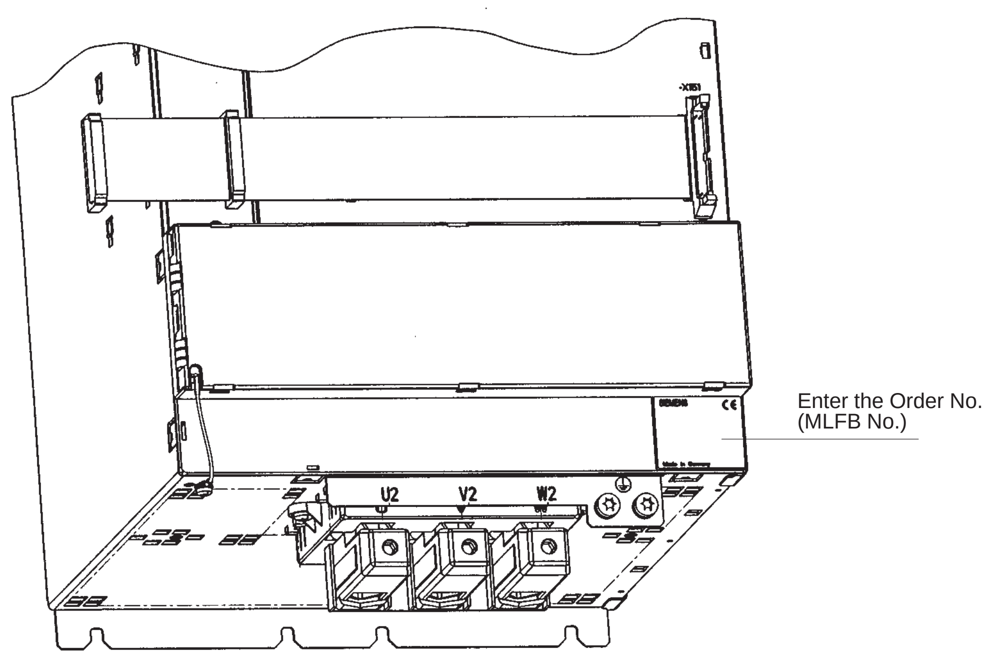


Fig. 6-1 Position of the Order No. (MLFB No.)

6.3 Connections

Overview

- Connecting diagram SIMODRIVE 611 analog system
- Terminals
- relay terminals

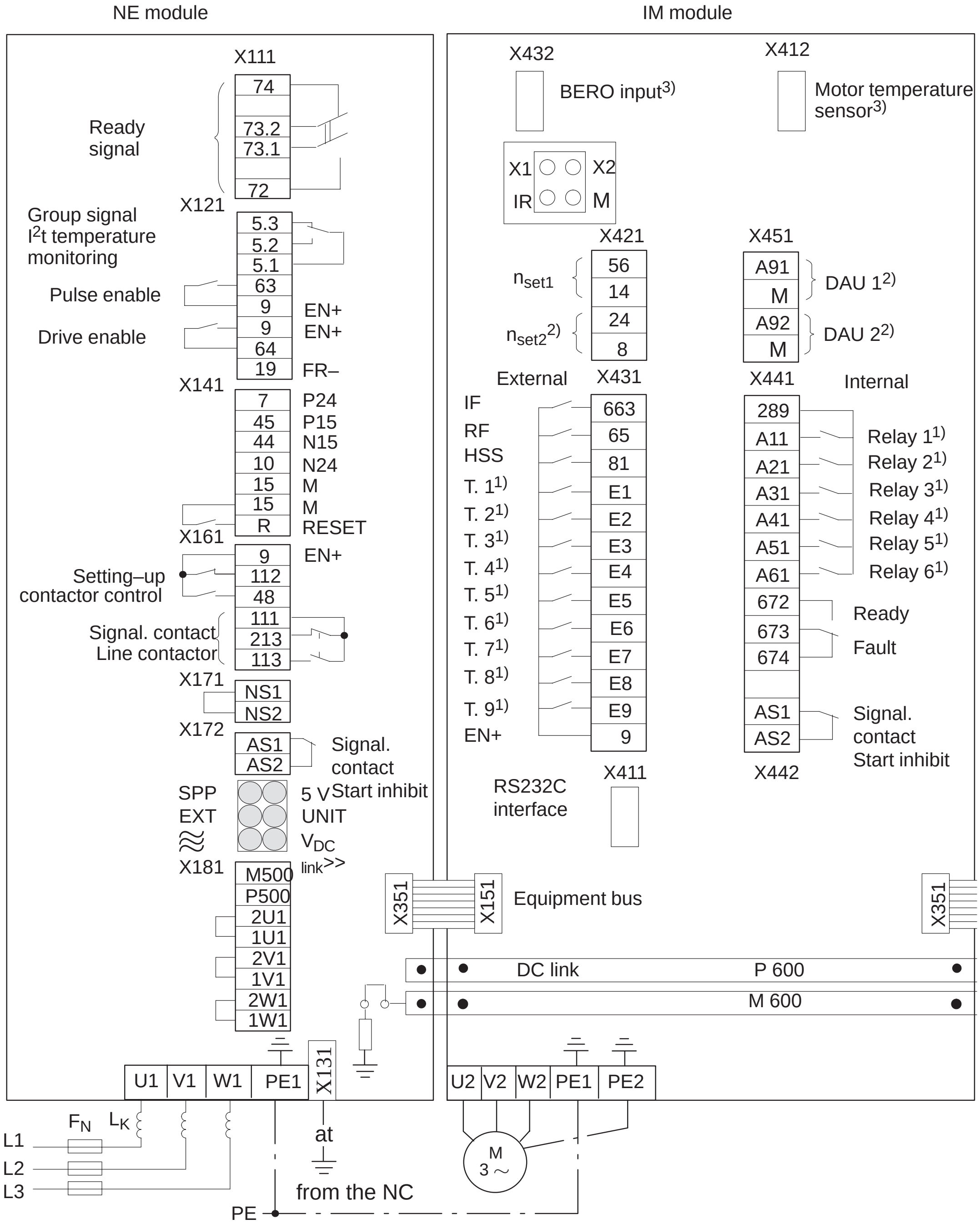
Warning

The shields and unused cores of power cables (e.g. unused brake conductors in the cable) must be connected to PE potential in order to discharge charging currents cause by capacitive coupling effects.

Hazardous voltages could be present, resulting in death or serious injury, if this is not observed.

Note: When non-PELV circuits are used at terminals AS1, AS2, connector coding must be used so that the connector cannot be interchanged (refer to EN60204–1, Section 6.4)
Order No. of the coding connector, refer to Catalog NC60.1

Connection diagram
SIMODRIVE 611 analog system



Warning! If a power contactor is used between the motor and the induction motor module, then it must be ensured that this contactor is only switched in a no–current condition. (When shutting down, first cancel the pulses (terminal 663), then 40 ms later, the contactor).

Fig. 6-2 connecting diagram

1) freely–programmable inputs and outputs
2) Function not possible with Order No. 6SN1122–0BA11–0AA0
3) From Order No. 6SN112□–1A□0□–□□A**1**

Connecting terminals

Table 6-2 Terminals

T. No.	Location	Function	Type 1)	Typ. voltage/ limit values	Max. cross–section
U2 V2 W2		Motor connection	O	3–ph. 0...450 V AC	Acc. to configuring guide
PE1		Protective conductor	I	0 V	Bolt
PE2		Protective conductor	O	0 V	Bolt
P600		DC link	I/O	+300 V	Busbar
M600		DC link	I/O	–300 V	Busbar
	X151/351	Equipment bus	I/O	Various	Ribbon cable
56	X421	Speed setpoint 1 (differential input)	I	±10 V (max. ±11 V)	1.5 mm^2
14	X421		I		1.5 mm^2
24	X421	Speed setpoint 2 (differential input)	I	±10 V (max. ±11 V)	1.5 mm^2
8	X421		I		1.5 mm^2
663	X431	Axis–specific pulse enable	I	+21 V...+33 V	1.5 mm^2
65	X431	Controller enable	I	+13 V...+30 V	1.5 mm^2
81	X431	RFG fast stop	I	+13 V...+30 V	1.5 mm^2
E1	X431	Freely–programm. enable t. 1[2)]	I	+13 V...+30 V	1.5 mm^2
E2	X431	Freely–programm. enable t. 2[2)]	I	+13 V...+30 V	1.5 mm^2
E3	X431	Freely–programm. enable t. 3[2)]	I	+13 V...+30 V	1.5 mm^2
E4	X431	Freely–programm. enable t. 4[2)]	I	+13 V...+30 V	1.5 mm^2
E5	X431	Freely–programm. enable t. 5[2)]	I	+13 V...+30 V	1.5 mm^2
E6	X431	Freely–programm. enable t. 6[2)]	I	+13 V...+30 V	1.5 mm^2
E7	X431	Freely–programm. enable t. 7[2)]	I	+13 V...+30 V	1.5 mm^2
E8	X431	Freely–programm. enable t. 8[2)]	I	+13 V...+30 V	1.5 mm^2
E9	X431	Freely–programm. enable t. 9[2)]	I	+13 V...+30 V	1.5 mm^2
9[4)]	X431	Enable voltage	O	+24 V	1.5 mm^2
A91	X451	Analog output, DAU 1[3)]	O	±10 V 3 mA	1.5 mm^2
M	X451	Ref. potential for DAU 1[3)]	O	0 V	1.5 mm^2
A92	X451	Analog output, DAU 2[3)]	O	±10 V 3 mA	1.5 mm^2
M	X451	Ref. potential for DAU 2[3)]	O	0 V	1.5 mm^2
X1		Test socket	O	0 V...5 V 3 mA	Test socket, 2 mm diameter
X2		Test socket	O	0 V...5 V 3 mA	Test socket, 2 mm diameter
IR		Test socket	O	±10 V 3 mA	Test socket, 2 mm diameter
M		Test socket	O	0 V	Test socket, 2 mm diameter

1) I = input O = output
2) can be freely–programmed via operator control parameters
3) Function not possible with Order No. 6SN1122–0BA11–0AA0
4) Refer to Section NE 3.1... 3.2

AM

Relay terminals

Table 6-3 relay terminals

T. No.	Location	Function	Type 1)	Typ. voltage/ limit values	Max. cross–section
289	X441	Center contact signals	I	30 V/6.0 A max	1.5 mm^2
A11	X441	Freely–programm. relay fct. 1[2)]	NO	30 V/1.0 A max	1.5 mm^2
A21	X441	Freely–programm. relay fct. 2[2)]	NO	30 V/1.0 A max	1.5 mm^2
A31	X441	Freely–programm. relay fct. 3[2)]	NO	30 V/1.0 A max	1.5 mm^2
A41	X441	Freely–programm. relay fct. 4[2)]	NO	30 V/1.0 A max	1.5 mm^2
A51	X441	Freely–programm. relay fct. 5[2)]	NO	30 V/1.0 A max	1.5 mm^2
A61	X441	Freely–programm. relay fct. 6[2)]	NO	30 V/1.0 A max	1.5 mm^2
672	X441	Ready/ no axis–specific fault	NO	30 V/1.0 A max	1.5 mm^2
673	X441		I	30 V/1.0 A max	1.5 mm^2
674	X441		NC	30 V/1.0 A max	1.5 mm^2
AS 1	X441	Signal. contact Start inhibit	I	250 V_{AC}/2.9 A max	1.5 mm^2
AS 2	X441		NC	250 V_{AC}/2.9 A max	1.5 mm^2

6.4 Interfaces

6.4.1 X432 connector assignment for BERO

PIN NO.	Signal name	Explanation
10	EN+	+24V
14	BERO	Signal
15	FR–	Ground

The other pins may not be assigned.

6.4.2 X412 connector assignment for the motor temperature sensor

PIN NO.	Signal name
14	+ Temp
15	– Temp

The other pins may not be assigned.

6.4.3 X411 serial interfaces

PIN NO.	Signal name
2	TxD
3	RxD
5	M 5

1) I = input NC = NC contact NO = NO contact
2) can be freely–programmed via operator control parameters

6.5 Addresses, RAM variables

The following is valid for all address information:
Segment address P–249 = 0H

Table 6-4 Addresses, RAM variables

Variable	Address	Value	Corresponds to
Calculated speed actual value (absolute value)	11B6H	7FFFH	n_{max} (P–174/P–029)
Utilization	11B8H	7FFFH	Act. torque limit
Calculated speed actual value	1110H	7FFFH	37499 RPM
Torque setpoint	10ECH	2000H	M_{drated}
Absolute current value (actual value)	10C6H	2000H	$I_{mot. n}$
Absolute current value (setpoint)	10C4H	2000H	$I_{mot. n}$
Torque–generating current (setpoint)	10D2H	2000H	$I_{mot. n}$
Field–generating current (setpoint)	10CAH	2000H	$I_{mot. n}$
Speed setpoint (after the ramp–function generator)	0E02H	7FFFH	37499 RPM
Field angle (setpoint)	1140H	10000H	2π
Field angle (actual value)	1142H	10000H	2π
Active power (actual value)	1148H	2000H	$P_{S\ rated}$
Reactive power (actual value)	114AH	2000H	$P_{S\ rated}$
Integral component, speed controller	117CH	2000H	M_{drated}
Integral component, field controller	116AH	2000H	$I_{mot. n}$
Magnetization current (calculated)	10E6H	2000H	$I_{mot. n}$

AM

6.6 Setting and checking data (Parameter list)

Fields with grey background: Data entry not possible

Dependent parameters/sub–parameters

No data	generally–valid parameters
M	motor–dependent parameters
G	gearbox stage–dependent parameters
F	fixed setpoint–dependent parameters

P–No.	Desig.		Sec.	Firm-ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
(P–000)	Operating display		2.2.1	1.10	special characters	–	–								
(P–001)	Speed setpoint		5.1.1	1.10	–32000...32000	–	maxmot								
(P–002)	Speed actual value		5.1.1	1.10	–32000...32000	–	maxmot								
(P–003)	Torque–generating current		5.1.1	1.10	–399.0...399.0	–	%								
(P–004)	Utilization		5.1.1	1.10	0.0...100.0	–	%								
(P–005)	Motor frequency		5.1.1	1.10	–1250...1250	–	Hz								
(P–006)	DC link voltage		5.1.1	1.10	0...700	–	V								
(P–007)	Motor current		5.1.1	1.10	0.0...399.0	–	%								
(P–008)	Field current component		5.1.1	1.10	0.0...399.0	–	%								
(P–009)	Active power		5.1.1	1.10	–399.0...399.0	–	%								
(P–010)	Voltage actual value		5.1.1	1.10	0.0...450.0	–	V								
(P–011)	Status of the binary inputs		5.1.2	1.10	0...FFFF	–	hex								
P–012	Normalization, DAU, channel 1		3.3.4	1.10	–1000.0...1000.0	100.0	%								
P–013	Normalization, DAU, channel 2		3.3.4	1.10	–1000.0...1000.0	100.0	%								
P–014	Speed for max. motor useful speed	M	3.1	1.10	–32000...32000	n_{RPM}	maxmot								
P–015	Offset correction, setpoint channel 1		3.1	1.10	E000...2000	0	hex								
P–016	Ramp–up time, RFG 1	M	4.1	1.10	0.00...320.00	0.00	s								
P–017	Ramp–down time, RFG 1	M	4.1	1.10	0.00...320.00	0.00	s								
P–018	Initial rounding–off	M	4.1	1.10	4.00...100.00	0.00	dec								
P–019	Offset correction, setpoint channel 2		3.1	1.10	E000...2000	0	hex								
(P–020)	Executed self–setting	M	5.1.3	1.10	0...00FF	–	hex								
P–021	n_{min} for "$n_{act} < n_{min}$" signal	G	3.3.2	1.10	2...16000	10	maxmot								
P–022	Shutdown speed, pulse cancellation	M	2.2.3	1.10	2...16000	8	maxmot								
P–023	n_x for "$n_{act} < n_x$" signal	G	3.3.2	1.10	0...32000	3000	maxmot								
P–024	Normalization, setpoint channel 1		3.1	1.10	2.0...10.0	10.0	V								
P–025	Normalization, setpoint channel 2		3.1	1.10	2.0...10.0	10.0	V								
P–027	Toler. bandwidth for "$n_{set} = n_{act}$" signal	G	3.3.2	1.10	0...32000	100	maxmot								
(P–028)	Diagnostics		5.1.3	1.10	0...FFFF	–	hex								

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P–No.	Desig.		Sec.	Firm–ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
P–029	Speed limiting	G	2.2.3	1.10	0...32000	6000	maxmot								
P–030	Min. steady–state speed	M	4.6	1.10	0...32000	0	maxmot								
P–031	P gain, speed controller	M	4.1	1.10	0.0...255.9	50.0	dec								
P–032	Integral action time, speed controller	M	4.1	1.10	10.0...6000.0	140.0	dec								
P–034	P gain, field controller	M	4.3	1.10	0.0...600.0	40.0	100 A/Vs								
P–035	Integral action time, field controller	M	4.3	1.10	5.0...600.0	30.0	dec								
P–036	Inverter clock frequency	M	4.2	1.10	0...7	0	hex								
P–037	Actual inverter clock frequency		5.1.1	3.0	2.8 ... 7.8	–	kHz								
P–039	1st torque limit value	G	2.2.3	1.10	0...399	100	%								
P–041	2nd torque limit value	G	2.2.3	1.10	0...399	50	%								
P–042	Ramp–up time, RFG 2	M	4.1	1.10	0.00...320.00	5.00	s								
P–043	Ramp–down time, RFG 2	M	4.1	1.10	0.00...320.00	5.00	s								
P–047	M_{dx} for "$M_d < M_{dx}$" signal	G	3.3.2	1.10	0.0...100.0	90.0	%								
P–050	Changeover speed from M_{d1} to M_{d2}	G	4.5	1.10	0...32000	6000	maxmot								
P–051	Write protection		1.3	1.10	0...7FFF	0	hex								
P–052	Transfer parameter into FEPROM		1.3	1.10	0...1	0	dec								
P–053	Control word		1.3	1.10	0...FFFF	1	hex								
P–054	Suppress range, lower speed	M	4.6	1.10	0...32000	0	maxmot								
P–055	Suppress range, upper speed	M	4.6	1.10	0...32000	0	maxmot								
P–056	Motor selection		2.3	1.10	0...4	0	dec								
P–057	Current setp. for open–loop controlled op.	M	4.4	1.10	0...150	90	%								
P–058	Accel. torque in the open–l. contr. range	M	4.4	1.10	0...399	100	%								
P–059	Current limiting	M	4.5	1.10	0...399	100	%								
P–060	Output limiting	M	4.5	1.10	0...399	100	%								
P–061	Fixed DC link voltage		2.1	1.10	0...700	0	V								
P–063	Maximum motor temperature (KTY84)	M	2.2.3nd	3.00	0...170	150	deg. C								
P–064	Fixed temperature		2.2.3nd	3.00	0...170	30	deg. C								
P–065	Timer stage, motor temperature alarm		2.2.3nd	3.00	0...600	240	s								

P–No.	Desig.	Sec.	Firm-ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
P–066	Address, DAU 1	3.3.4	1.10	0...FFFF	11B6	hex								
P–067	Shift factor, DAU 1	3.3.4	1.10	0...F	0	hex								
P–068	Address, DAU 2	3.3.4	1.10	0...FFFF	11B8	hex								
P–069	Shift factor DAU 2	3.3.4	1.10	0...F	0	hex								
P–072	Address, DAU 4	5.1.4	1.10	0...FFFF	10D2	hex								
P–073	Shift factor, DAU 4	5.1.4	1.10	0...F	0	hex								
P–074	Offset, DAU 4	5.1.4	1.10	–127...127	0	incr.								
P–076	Address, DAU 3	5.1.4	1.10	0...FFFF	1110	hex								
P–077	Shift factor, DAU 3	5.1.4	1.10	0...F	0	hex								
P–078	Offset, DAU 1	3.3.4	1.10	–127...127	0	incr.								
P–079	Offset, DAU 2	3.3.4	1.10	–127...127	0	incr.								
P–080	Offset, DAU 3	5.1.4	1.10	–127...127	0	incr.								
P–081	Terminal function assignment E1	3.2.2	1.10	1...21	1	dec								
P–082	Terminal function assignment E2	3.2.2	1.10	1...21	7	dec								
P–083	Terminal function assignment E3	3.2.2	1.10	1...21	3	dec								
P–084	Terminal function assignment E4	3.2.2	1.10	1...21	17	dec								
P–085	Terminal function assignment E5	3.2.2	1.10	1...21	18	dec								
P–086	Terminal function assignment E6	3.2.2	1.10	1...21	19	dec								
P–087	Terminal function assignment E7	3.2.2	1.10	1...21	9	dec								
P–088	Terminal function assignment E8	3.2.2	1.10	1...21	10	dec								
P–089	Terminal function assignment E9	3.2.2	1.10	1...21	11	dec								
P–090	Control word	1.3	1.10	0...FFFF	000D	hex								
P–095	Power section code number	2.1	1.10	4...10	3	dec								
P–096	Motor code number M	2.1	1.10	0...7	0	dec								
P–097	Initialization	2.1	1.10	0...1	0	hex								
(P–099)	Firmware release	2.2.2	1.10	0.00...99.99	–	dec								
(P–100)	Operating display	2.2.1	1.10	special characters	–	–								
(P–101)	Speed setpoint	5.1.1	1.10	–32000...32000	–	maxmot								

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P–No.	Desig.		Sec.	Firm-ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
(P–102)	Speed actual value		5.1.1	1.10	–32000...32000	–	maxmot								
(P–110)	Motor temperature		5.1.1	3.00	0...170		deg. C								
P–113	Channel selection, speed setpoint		3.1	1.10	0...9	1	dec								
P–114	Fixed setpoints, 1 to 7	F	3.1	1.10	–32000...32000	0	maxmot								
P–114	Motorized potentiometer setpoint		3.1	1.10	–32000...32000	0	maxmot								
P–115	P gain current controller base speed range	M	4.2	1.10	0...255	2	dec								
P–116	P gain current controller field weaken. range	M	4.2	1.10	0...300	2	dec								
P–119	Fixed setpoints 8 to 15	F	3.1	2.00	–32000 ... 32000	0	maxmot								
P–131	Pulse number, speed monitoring BERO	M	2.2.3	3.00	0...10	0									
P–132	Shutdown threshold, speed monitoring BERO	M	2.2.3	3.00	0...65535	65535	maxmot								
(P–133)	Speed actual value amount BERO		5.1.1	3.00	0...65535		maxmot								
P–151	Write protection		1.3	1.10	0...7FFF	0	hex								
P–152	Transfer parameter into FEPROM		1.3	1.10	0...1	0	dec								
P–153	Calculate motor–/controller data		1.3	1.10	–1...1	0	dec								
P–154	Oscillation setpoint 1		2.2.3	1.10	–32000...32000	0	maxmot								
P–155	Oscillation setpoint 2		2.2.3	1.10	–32000...32000	0	maxmot								
P–156	Oscillation interval time 1		2.2.3	1.10	0.002...60.000	1.000	s								
P–157	Oscillation interval time 2		2.2.3	1.10	0.002...60.000	1.000	s								
P–158	Series reactor inductance	M	2.1	1.10	0.000...65.000	0.000	mH								
P–159	Motor and external moment of inertia	M	4.1	1.10	0.0...6535.5	0.0	gm^2								
P–160	Rated motor output	M	2.1	1.10	0.00...650.00	0.00	kW								
P–161	Rated motor current	M	2.1	1.10	0.00...650.00	0.00	A								
P–162	Rated motor voltage	M	2.1	1.10	0.00...650.00	379.00	V								
P–163	Rated motor speed	M	2.1	1.10	0...65000	1500	maxmot								
P–164	Rated motor frequency	M	2.1	1.10	0.0...1200.0	50.0	Hz								
P–166	Motor no–load current	M	4.2	1.10	0.00...$I_{\text{rated pow.sec.}}$	0.00	A								
P–167	Stator resistance, cold	M	2.1	1.10	0.000...65.000	0.000	Ω								
P–168	Rotor resistance, cold	M	2.1	1.10	0.000...65.000	0.000	Ω								
P–169	Stator leakage reactance	M	2.1	1.10	0.000...65.000	0.000	Ω								

P–No.	Desig.		Sec.	Firm-ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
P–170	Rotor leakage reactance	M	2.1	1.10	0.000...65.000	0.000	Ω								
P–171	Main field reactance	M	2.1	1.10	0.00...650.00	0.00	Ω								
P–172	Changeover speed, open–/closed l. control	M	2.1	1.10	0...32000	300	maxmot								
P–173	Speed at start of field weakening	M	2.1	1.10	0...32000	1500	maxmot								
P–174	Max. motor speed	M	2.1	1.10	0...32000	1500	maxmot								
P–175	Thermal motor time constant	M	2.2.3	1.10	0.0...500.0	1.0	min								
P–176	Stall torque speed	M	2.1	1.10	0...65535	32767	maxmot								
P–178	Power factor cos φ	M	2.1	1.10	0.000...1.000	0.800	–								
P–179	Selection, min/max memory		5.1.5	1.10	0...3	0	hex								
P–181	Address for min/max memory		5.1.5	1.10	0...FFFF	1110	hex								
(P–182)	Min. value, min/max memory		5.1.5	1.10	0...FFFF	–	hex								
(P–183)	Max. value, min/max memory		5.1.5	1.10	0...FFFF	–	hex								
P–185	Address for monitoring 1		3.3.3	1.10	0...FFFF	1110	hex								
P–186	Threshold for monitoring 1		3.3.3	1.10	0...FFFF	0	hex								
P–187	Pull–in delay, monitoring 1		3.3.3	1.10	0.00...10.00	0.00	s								
P–188	Drop–out delay, monitoring 1		3.3.3	1.10	0.00...10.00	0.00	s								
P–189	Hysteresis, monitoring 1		3.3.3	1.10	0...7FFF	1	hex								
P–190	Address for monitoring 2		3.3.3	1.10	0...FFFF	1110	hex								
P–191	Threshold for monitoring 2		3.3.3	1.10	0...FFFF	0	hex								
P–192	Pull–in delay, monitoring 2		3.3.3	1.10	0.00...10.00	0	s								
P–193	Drop–out delay, monitoring 2		3.3.3	1.10	0.00...10.00	0	s								
P–194	Hysteresis, monitoring 2		3.3.3	1.10	0...7FFF	1	hex								
P–195	Lower adaptation speed	M	4.1	1.10	0...32000	0	maxmot								
P–196	Upper adaptation speed	M	4.1	1.10	0...32000	0	maxmot								
P–197	P gain lower adaptation speed	M	4.1	1.10	0.0...255.9	50.0	dec								
P–198	P gain upper adaptation speed	M	4.1	1.10	0.0...255.9	10.0	dec								
P–199	P gain reduction factor	M	4.1	1.10	1...150	100	%								
(P–200)	Checksum parameter		5.13	2.00	0 ... FFFF	–	hex								
P–203	Select, speed controller adaptation	M	4.1	1.10	0...1	0	dec								

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P–No.	Desig.	Sec.	Firm-ware status	Setting range	Setting	Dim.	Settings 1	2	3	4	5	6	7	8
P–204	Self–optimization, function selection	4	1.10	0...7	0	dec								
P–205	Start self–optimization	4	1.10	0...1	0	dec								
P–206	Select transient recorder	5.1.6	1.10	0...1	0	hex								
P–207	Set transient recorder	5.1.6	1.10	0...C	0	hex								
P–208	Address for the start condition	5.1.6	1.10	0...FFFF	0	hex								
P–209	Threshold for the start condition	5.1.6	1.10	0...FFFF	0	hex								
P–210	Address for stop condition	5.1.6	1.10	0...FFFF	0	hex								
P–211	Threshold for the stop condition	5.1.6	1.10	0...FFFF	0	hex								
P–212	Address, signal 1	5.1.6	1.10	0...FFFF	1110	hex								
P–213	Address, signal 2	5.1.6	1.10	0...FFFF	10D2	hex								
P–214	Start trace output	5.1.6	1.10	0...1	0	hex								
P–215	Shift factor, signal 1	5.1.6	1.10	0...15	0	dec								
P–216	Shift factor, signal 2	5.1.6	1.10	0...15	0	dec								
P–217	Trigger signal 1	5.1.6	1.10	0...FFFF	0	hex								
P–218	Trigger signal 2	5.1.6	1.10	0...FFFF	7FFF	hex								
P–219	Additional moment of inertia M	4.1	2.00	0 ... 15	0	kgm^2								
P–241	Programmable signal 1	3.3.2	1.10	1...20	20	dec								
P–242	Programmable signal 2	3.3.2	1.10	1...20	3	dec								
P–243	Programmable signal 3	3.3.2	1.10	1...20	1	dec								
P–244	Programmable signal 4	3.3.2	1.10	1...20	4	dec								
P–245	Programmable signal 5	3.3.2	1.10	1...20	5	dec								
P–246	Programmable signal 6	3.3.2	1.10	1...20	2	dec								
P–247	Control word signal	3.3.2	1.10	0...FFFF	0	hex								
P–249	Segment, memory location monitor	2.4	1.10	0...FFFF	0	hex								
P–250	Address, memory location monitor	2.4	1.10	0...FFFF	0	hex								
(P–251)	Value display, memory location monitor	2.4	1.10	0...FFFF										
(P–254)	Display of active functions 1	5.1.2	1.10	0...FFFF	–	hex								
(P–255)	Display of active functions 2	5.1.2	1.10	0...FFFF	–	hex								

Customer:			Machine:			Date:
Initialization values and motor type **Parameter**	**No.**	**Value**				**Comments**
Power section code number	P–095		IM module: / / A			
Motor code number	P–096	0	Motor type: 2p =			Deep–bar squirrel–cage rotor yes/no
Motor selection	P–056		Motor parameter set			Changeover, with/without pulse cancel.
Firmware release	P–099					
Motor data **Parameter**	**No.**	**Rating plate data**	**Units**			**Comments**
Rated motor output	P–160		kW			
Rated motor current	P–161		A			
Rated motor voltage	P–162		V			
Rated motor speed	P–163		maxmot			
Rated motor frequency	P–164		Hz			
Max. motor speed	P–174		maxmot			
Power factor cos ö	P–178		dec			
Circuit configuration Y / Δ						Jumpers in the terminal box
Equivalent circuit diagram data **Parameter**	**No.**	**Calculated value P–153 = +1**	**Self–optimized value P–204 =**	**Post–optimized value**	**Units**	**Comments**
Motor no–load current	P–166		3		A	
Stator resistance, cold	P–167				Ω	
Rotor resistance, cold	P–168		6		Ω	
Stator leakage reactance	P–169				Ω	
Rotor leakage reactance	P–170				Ω	
Main field reactance	P–171		4		Ω	
Changeover speed, open–/closed l. control	P–172				maxmot	
Speed at start of field weakening	P–173		8		maxmot	
Stall torque speed	P–176		8		maxmot	
Controller data **Parameter**	**No.**	**Calculated value P–153 = –1**	**Self–optimized value P–204 =**	**Post–optimized value**	**Units**	**Comments**
P gain, speed controller	P–031		7		dec	
Integral action time, speed controller	P–032	140	7		dec	
P gain, field controller	P–034				100 A/Vs	
Integral action time, field controller	P–035				dec	
P gain current controller, base speed range	P–115		1		dec	
P gain current controller, field–weakening range	P–116		1		dec	
Motor and external moment of inertia	P–159		5		gm^2	
Additional moment of inertia	P–219		5		kgm^2	
Offset, active power P–250 =	(P–251)		2		hex	
Offset, reactive power P–250 =	(P–251)		2		hex	
Special settings **Parameter**	**No.**	**Value**	**Units**			**Comments**
Initial rounding–off	P–018		dec			
Converter switching frequency	P–036		hex			
Series reactor inductance	P–158		mH			

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Spare parts (Sp)

ES

Components 1

All of the components listed in Catalogs NC 60.1 and NC Z (motors, modules, control boards, cables, connectors, etc.) are available as spare part.

■

ES

Accessories 2

2.1 Connectors

When required, the connectors listed in Table 2-1 (customer interfaces) can be ordered as spare parts.

Table 2-1 Connectors

Pin No./connector type	Grid dimension	Order No. MLFB
2	5.08	6SY9433
3	5.08	6SY9906
4	5.08	6SY9432
6	5.08	6SY9896
7	5.08	6SY9898
8	5.08	6SY9897
8 [1)]	7.60	6SY9900
12	5.08	6SY9901
13	5.08	6SY9903
15	5.08	6SY9902
Power connector motor connection	3 pin	6SY9904
Power connector pulsed resistor connection	3 pin	6SY9905

Connector, BERO, temperature sensor
The external radial blower is connected via a connector, which is comprised of the following components from the AMP company:

Connector housing	Mate–N–Lok	350766–1
Crimp contacts		926884–1

1) only for connector X181 at the supply infeed modules

ES

2.2 Cable

50 mm equipment bus cable, Item No. 462 0080126.00

2.3 Fuses

Refer to the Planning Guide for recommended line fuses.

2.4 Connecting clamps for cable shields

Refer to the Planning Guide (dimension drawings).

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