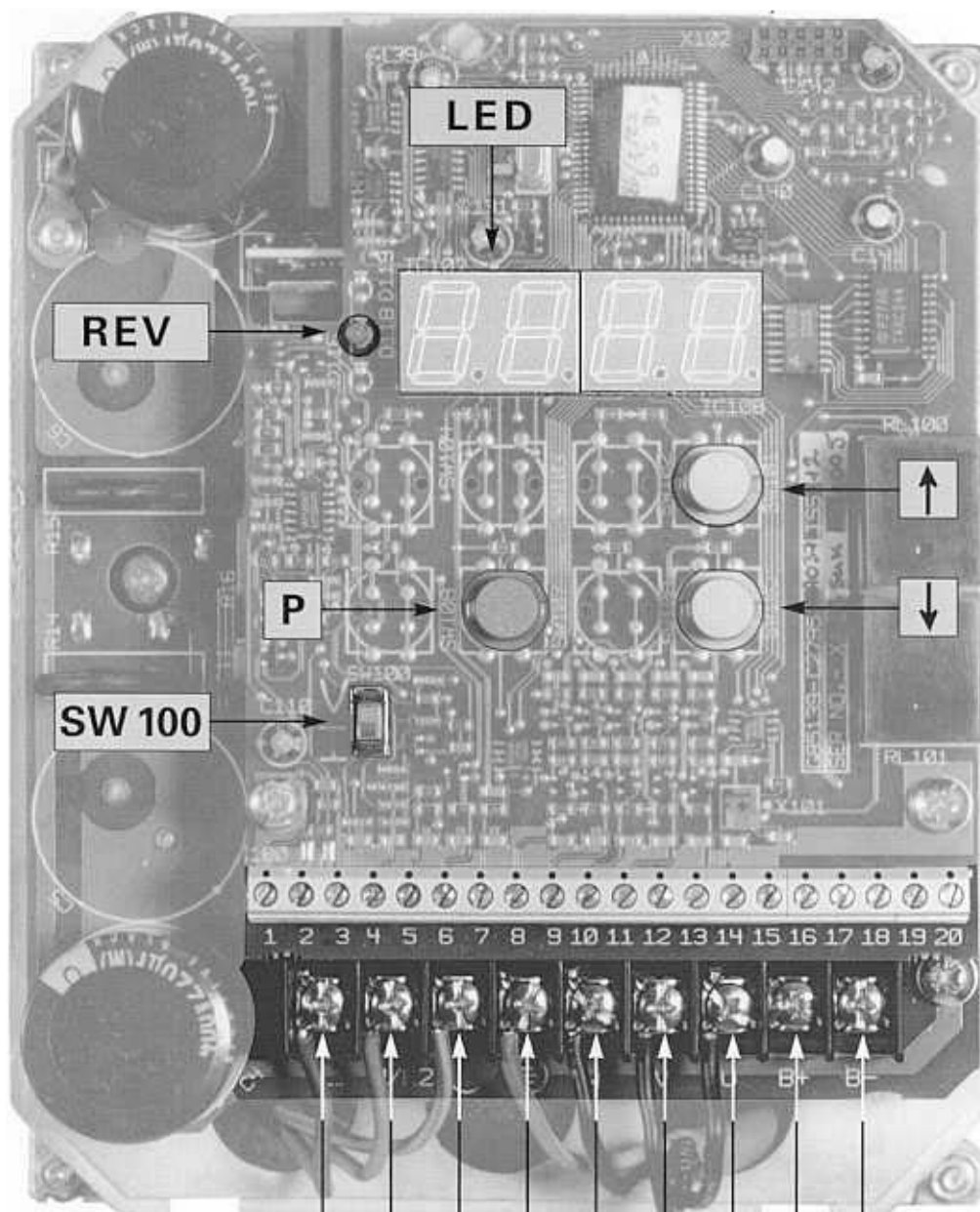# SIEMENS

MICRO MASTER

SIMOVERT
MICRO MASTER

Bedienungsanleitung
Operating instructions
Mode d´emploi
Manuale per l´uso
Instrucciones de servicio

D
G
F
I
E

SIEMENS

6500

SIMOVERT
MICRO MASTER

LED

REV

P

SW 100

↑

↓

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

einphasiges Gerät
singlephase unit
appareil monophasé
apparecchiatura monofase
aparato monofásico

| L1 | N/L2 | ⏚ | ⏚ | W | V | U | B+ | B− |

dreiphasiges Gerät
threephase unit
appareil triphasé
apparecchiatura trifase
aparato trifásico

| L1 | L2 | L3 | ⏚ | ⏚ | W | V | U | B+ | B− |

Bevor Sie das Gerät installieren
und in Betrieb nehmen, lesen Sie bitte
aufmerksam die Sicherheits- und Warnhinweise
auf den Seiten 2 und 3.

Before installing and putting this equipment into
operation, please read the safety precautions and
warnings on pages 36 and 37 carefully.

Avant d'installer l'appareil et de le mettre en
service, veuillez lire attentivement les consignes
de sécurité et les mises en garde énoncés aux
pages 70 et 71.

Prima di effettuare l'installazione e la messa in
servizio dell'apparecchio, leggere attentmente le
indicazioni sulla sicurezza alle pagine 104 e 105.
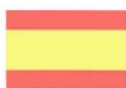
Antes de instalar el aparato y ponerlo en marcha,
lea atentamente las normas de seguridad y las
advertencias de las páginas 138 y 139.

Diese Warnzeichen machen auf die an der Maschine oder in dieser Druckschrift enthaltenen Sicherheitshinweise aufmerksam. Sie bedeuten Verletzungs- bzw. Lebensgefahr!

SICHERHEITSHINWEISE BEFOLGEN

Lesen Sie sorgfältig alle in dieser Bedienungsanleitung enthaltenen Sicherheitshinweise, sowie alle an der Maschine angebrachten Warnschilder. Achten Sie auf lesbaren Zustand der Warnschilder und ersetzen Sie fehlende oder beschädigte Schilder.

Machen Sie sich vor Arbeitsbeginn mit der Handhabung der Maschine und ihrer Kontrolleinrichtungen vertraut. Während der Arbeit ist es dafür zu spät! Lassen Sie nie zu, daß jemand ohne Sachkenntnis die Maschine betreibt.

⚠ WARNUNG

Dieses Gerät erzeugt gefährliche elektrische Spannungen und steuert drehende, mechanische Teile. Tod, schwere Körperverletzung oder erheblicher Sachschaden können die Folge sein, wenn die Anweisungen in dieser Bedienungsanleitung nicht befolgt werden.

Nur entsprechend qualifiziertes Personal sollte an diesem Gerät arbeiten. Dieses Personal muß in allen Warnhinweisen und den Maßnahmen vertraut sein, die in dieser Bedienungsanleitung für das Transportieren, Aufstellen und Bedienen des Gerätes gegeben werden. Der erfolgreiche und sichere Umgang mit diesem Gerät ist vom sachgemäßen und fachgerechten Transportieren, Aufstellen, und Bedienen und Instandhalten des Gerätes abhängig.

– Die MICRO MASTER sind Geräte der Leistungselektronik, die mit hohen Spannungen betrieben werden.

– Durch die Zwischenkreiskondensatoren ist auch nach dem Freischalten kurzzeitig noch hohe Spannung vorhanden. Das Öffnen der Geräte ist daher erst fünf Minuten nachdem das Gerät spannungsfrei geschaltet wurde zulässig. Beim Hantieren am geöffneten Gerät ist zu beachten, daß spannungsführende Teile freiliegen. Es ist deshalb sicherzustellen, daß diese spannungsführenden Teile nicht berührt werden.

– Die Geräte mit dreiphasigem Netzanschluß dürfen nicht an ein Netz mit FI-Schutzschalter angeschlossen werden. (vgl. DIN VDE 0160, Abschnitt 6.5).

– Auch bei Motorstillstand können folgende Klemmen gefährliche Spannung führen:
  – die Netzanschlußklemmen L1, L2, L3 oder L1, N/L2,
  – die Motorklemmen W, V, U
  – die Klemmen für den Bremswiderstand B+, B–

– Anschluß, Inbetriebnahme und Störungsbeseitigung sind nur durch Fachkräfte zulässig. Das Fachpersonal muß gründlich mit allen Warnhinweisen und Instandhaltungsmaßnahmen gem. dieser Bedienungsanleitung vertraut sein.

– Unter bestimmten Einstellbedingungen kann der Umrichter nach einem Netzausfall automatisch anlaufen.

These warning signs draw attention to safety precautions on the machine or included in these instructions.
They indicate danger of injury or death!

omply with the safety precautions

:ad carefully all the safety precautions included in these
)erating instructions and all the warning signs attached
 the machine. Make sure that the warning signs are
pt in a legible condition and replace missing or
ımaged signs.

ıfore starting, familiarize yourself with the operation of
e equipment and the converter. It is too late when you
e already working with the equipment! Never permit
ıqualified personnel to operate the equipment.

⚠ WARNING

his equipment produces dangerous electrical voltages and controls rotating
ıechanical parts. Death, severe injury or substantial damage to property can
:cur if the instructions in this operating manual are not complied with.

nly personnel with appropriate qualifications should work with this equipment. These
ersonnel must be familiar with all the warning signs and precautions laid out in these
perating instructions for the transport, installation and operation of this equipment.
he successful and safe use of this equipment depends on the correct installation,
ɔmissioning, operation and maintenance of the equipment.

The MICRO MASTER operates at high voltages.

The dc-link capacitor remains charged to dangerous voltages even the power is
removed. For this reason it is not permissible to open the equipment until five
minutes after the power has been turned off. When handling the
open equipment it should be noted that live parts are exposed. Do not touch
these live parts.

Machines with three phase power supply must not be connected to a supply
via an ELCB (Earth Leakage Circuit-Breaker), (see DIN VDE 0160, section 6.5).

The following terminals can carry dangerous voltages, even if the motor is
inoperative:

– the power supply terminals L1, L2, L3 or L1, N/L2

– the motor terminals, W, V, U

– the braking resistor terminals B+, B-

Only qualified personnel may connect, start the system up and repair faults.
These personnel must be thoroughly acquainted with all the warnings and
operating procedures contained with this manual.

Certain parameter settings may cause the converter to start up automatically after
an input power failure.

Definitions

Qualified Person

For the purposes of this manual and product labels, a qualified person is one who is familiar with the installation, construction, operation and maintenance of this equipment and with hazards involved. In addition, the person must be:

(1) Trained and authorised to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

(2) Trained in the proper care and use of protective equipment in accordance with established safety practices.

(3) Trained in rendering first aid.

Danger

For the purposes of this manual and product labels, DANGER indicates that loss of life, severe personal injury or substantial property damage **WILL** result if proper precautions are not taken.

Warning

For the purposes of this manual and product labels, WARNING indicates that loss of life, severe personal injury or substantial property damage **CAN** result if proper precautions are not taken.

Caution

For the purposes of this manual and product labels, CAUTION indicates that minor personal injury or property damage **CAN** result if proper precautions are not taken.

Note

For the purposes of this manual and product labels, NOTES merely call attention to information that is especially significant in understanding and operating the drive.

⚠️ **DANGER AND WARNING**

Make sure that the location selected for installation is safe, protected from moisture and splash and drip-proof!

Children and the general public must be prevented from accessing or approaching the equipment!

The equipment may only be used for the purpose specified by the manufacturer.

Unauthorised modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.

Keep these operating instructions within easy reach and give them to all users!

2.1 Description and function

The MICRO MASTER is a converter with a voltage dc-link circuit for variable speed AC drives. AC motors from 250 watt to 5500 watt can be driven. Both 230 V single phase input and 400 - 500 V 3 phase input versions are available.

Control is handled by a built-in microprocessor. A special pulse width modulation method with selectable pulse frequency permits extremely quiet motor operation.

Complete converter and motor protection is achieved by various protective functions.

The mode of operation of the MICRO MASTER can be adjusted to practically all operational conditions, if special parameter values are entered. Sophisticated speed adjustments, ramp times, precise stopping and many other operational features can be set with the aid of microcomputer technology developed for power electronics.

Automatic load compensation is carried out by the current control system which permits automatic adaptation to the system requirement by means of Flux Current Control (FCC). A programmable ramp generator enables defined start up and stopping of the motor with adjustable jerk control.

The programmable or optional automatic boost feature ensures the reliable starting of the motor. High resolution speed adjustment is possible.

A built-in DC injection brake permits rapid and defined stopping. An integral brake-chopper, together with the optional braking resistor allows driving and braking in both directions of rotation (4 quadrant operation) and can also be used for rapid braking.

Five programmable digital inputs allow versatile control.
A serial interface with bus capability permits easy connection to data networks as well as the interconnection of up to 31 MICRO MASTERS. There are two relay outputs available for alarms and system messages.

A block diagram of the MICRO MASTER with possible external connections can be found on the inside page of the rear cover of this manual.

The following options are available

     1. Braking resistor
     2. RFI suppression filter
     3. PC operation program

Contents

⚠ **WARNING**

To guarantee the safe operation of the equipment it must be installed and commissioned properly by qualified personnel in compliance with the warnings laid down in these operating instructions.

Take particular note of the general and regional installation and safety regulations regarding work on high voltage installations (e.g. VDE), as well as the relevant regulations regarding the correct use of tools and personal protective gear.

Make sure that the unobstructed clearance for each of the cooling inlets and outlets above and below the converter is at least 100 mm.

Make sure that a space of 40 mm is kept free at the sides of the converter to permit the cooling air to escape from the side slits.

Ensure that the temperature does not exeed the specified level when the converter is installed in a cubicle.

Avoid excessive vibration and shaking of the equipment.

NOTE

Please consider the possible use of options, such as RFI suppression filters, at the planning stage.

3.1 Mechanical installation

Mount the equipment in accordance with the installation diagram.
For installation you require:

	L1	W1	
MM25			4 Screws M4
MM37	174 mm	138 mm	4 Nuts M4
MM55			4 Washers M4
MM75			Mounting holes: Ø 4.8 mm
MM110			4 Screws M5
MM150			4 Nuts M5
MM220	206 mm	174 mm	4 Washers M5
			Mounting holes: Ø 5.6 mm
MM150/3			
MM220/3			
MM300/3			
MM400/3			
MM550/3			
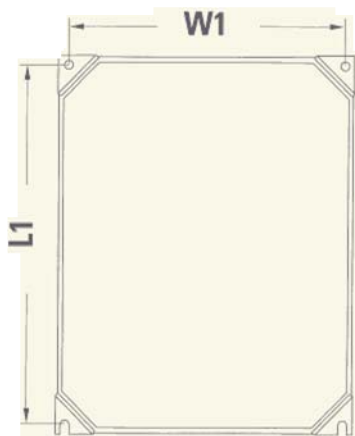
A drilling template is provided.

3.2 Electrical installation

The cover must be removed to connect the electrical leads. The cover is attached to the heatsink by four clips. Release the lower clips with the aid of a screwdriver introduced carefully between the clip and the heatsink. The cover can then be lifted off the converter.

⚠ **CAUTION**

Please make sure that the cover is not tilted or skewed when refitted.
On the printed circuit boards that are now exposed, are highly sensitive MOS components that are particularly sensitive to static electricity. For this reason, avoid touching the boards or components with your hands or metal objects. Only the terminal screws may be touched with insulated screwdrivers when connecting the leads.

The leads are fed into the equipment from the bottom and connected to the power terminal block.

Make sure that the leads are connected correctly and the equipment is properly earthed.

To tighten up the terminal screws please use:

power terminal	=	**crosstip screwdriver 4-5 mm**
control terminal	=	**small screwdriver 2-2.5 mm**

The total length of the motor lead should not exceed 50 m. If a screened motor lead is used, the maximum length should be 25 m. Please consult your service department about longer leads.

Make sure that the power source supplies the correct voltage and is designed for the necessary current (see "Technical specifications").
Take care that the appropriate circuit breakers with the specified current rating are connected between the power supply and converter (see "Technical specifications").

Connect the power input to the power terminals L1 - L2/ N (1 phase) or L1, L2, L3 (3 phase), and the earth by means of a three or four core cable. For cross section of each core see section 10.1.
Use a four core cable to connect the motor. As indicated in the connection diagram (see next page), the cable is connected to the power terminals W/V/U and the earth.

Terminal Connections:

| Single Phase Input | 3 Phase Input |

⚠ **CAUTION**

The control, power supply and motor leads must be laid separately.
They must not be fed through the same cable conduit/trunking.
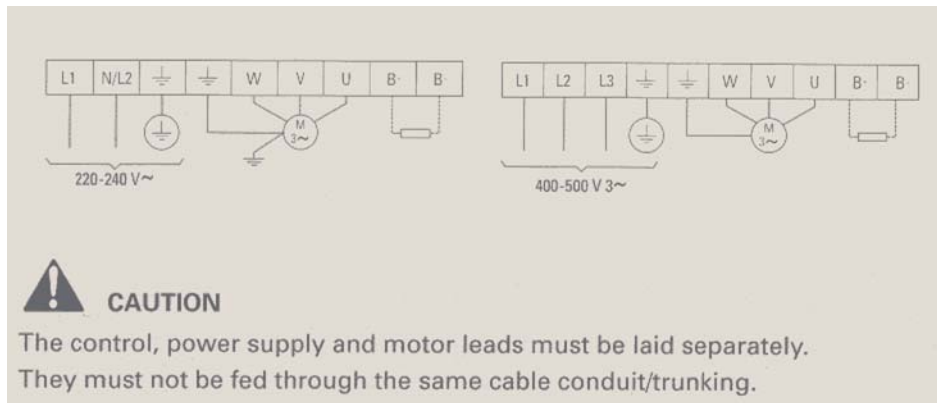
Use screened cable for the control lead.
Use Class 1 60/75°C copper wire only. Tightening torque for field wiring terminals to be 1.1 Nm.

The MICRO MASTER is suitable for use in a circuit capable of delivering not more than 1000/5000 A symmetrical (rms), 240/415 V maximum, when protected by a time delay fuse, as listed below.

1000 A:

240V 1Ph	MM25,37,55:	10A	MM75:	15A	
415V 3 Ph					

5000 A:

240V 1Ph	MM110,150:	20A	MM220:	25A	
415V 3 Ph	MM150/3:	10A	MM220/3, 300/3: 15 A		MM400/3, 550/3: 20 A

3.3 Motor connection

Asynchronous and synchronous machines can be connected to the MICRO MASTER converter, individually or in parallel.
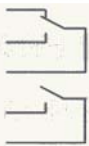
⚠ **WARNING**

Ensure that the motor is configured for the correct supply voltage.
When synchronous machines are connected or when coupling several motors in parallel, the converter must be operated with voltage-frequency control characteristic (P077 = 0 or 2) and the slip compensation must be disabled (P071 =0).

3.4 Connecting up

The following details can be found on the connection diagram inside the cover of the MICRO MASTER and on the fold out page at the front of these operating instructions.

Control terminal	Descr.	Value	Function	Note
1	P10+	+ 10 V	power supply	max. 3mA
2	0V	0 volt	power supply	ground
3	AIN+	0-10V/0-20mA 2-10V/4-20mA	analogue input	+ connection
4	AIN-		analogue input	– connection
5	PTC A		motor PTC input	
6	PTC B		motor PTC input	
7	P15+	+ 15 V	power supply f. DIN1-5	max. 20mA
8	DIN 1		digital input 1	13 to 33 V
9	DIN 2		digital input 2	13 to 33 V
10	DIN 3		digital input 3	13 to 33 V
11	DIN 4		digital input 4	13 to 33 V
12	DIN 5		digital input 5	13 to 33 V
13	A		RS 485 A interface	connection A
14	B		RS 485 B interface	connection B
15	PE		protective earth	
16	RL 1A		relay 1	normally closed
17	RL 1B		relay 1	normally open
18	RL 1C		relay 1	common
19	RL 2B		relay 2	normally open
20	RL 2C		relay 2	common

Power terminal	Function
L1	power connection terminal
N/L2	power connection terminal
L3*	power connection terminal
⏚	protective earth
⏚	protective earth
W	motor connection terminal
V	motor connection terminal
U	motor connection terminal
B+	braking resistor
B-	braking resistor

* not fitted on single phase input units

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⚠ **WARNING AND NOTE**

Before the equipment is switched on, its plastic cover must be fitted.

After the power has been turned off, you must always wait five minutes so that the dc-link capacitors can discharge.
It is not permissible to remove the cover until this time has elapsed.

As a precautionary measure the digital frequency setpoint has been set at 0.0 Hz in the factory. This prevents inadvertent and uncontrolled running of the motor occuring at initial start-up.
Before the motor will run it is necessary to enter a frequency setpoint via parameter P000 with the up button or to set it with parameter P005.

All settings must only be entered by qualified personnel, paying particular attention to the safety precautions and warnings.

GB

The required settings (parameters) can be entered with the three buttons on the parameterisation panel of the MICRO MASTER.
The parameters are indicated on a four digit LED display. A yellow LED indicates the motor direction.
Switch SW100 selects between voltage and current analogue input.
It can only be accessed by removing the cover (see the illustration on the fold-out page at the front).

P ◉		**toggle** between parameter number and parameter value
		display **P000** to **P944** = parameter number
		display **0000** to **9999**= parameter value
↑ ○		button to set parameter numbers and parameter values to **higher** values
↓ ○	=	button to set parameter numbers and parameter values to **lower** values
4 digit LED display		**P000** → **P944** and **0000** → **9999**
REV		LED showing direction of the motor with **LED on** – **to the left** with **LED off** – **to the right**
Switch SW 100	=	**selection of** analogue input type (parameters P021/P022) position V = voltage input position I = current input

NOTE

Most of the displays on the MICRO MASTER have four digits.
In the table of parameters you can find the values, together with the unit of measure.

Example: table 50.0 Hz = display 050.0

When parameters are set the value is automatically stored in the internal memory.

If the output frequency (P001 = 0) is selected as the display with parameter number P000, the corresponding setpoint is displayed approximately every 1.5 seconds when drive is switched to stop.

The equipment is programmed at the factory for standard applications on Siemens four-pole standard motors.

When using other motors it is necessary to enter the specifications from the rating plate into parameters P081 to P085 (access to these parameters is through P009).

Example:
Illustration of the rating plate of a motor with all the details that are marked with P081 to P085.

P081
P084
P083
P085
P082

SIEMENS
MADE IN GERMANY

3 ~Mot
IEC 56
IM 83

50 Hz 220/380 VΔ/Y
0,61/0,35 A
0,12 kW
cosφ 0,81
2745 /min
VDE 0530

1 LA5053-2AA20 ℗
Nr.E D 110 3014   81 003
IP S5   Rot. KL 16   I.CL.F
60 Hz   440 V Y
0,3 A
0,14 kW
cosφ 0,81
3310 /min
S.F. - 1,15
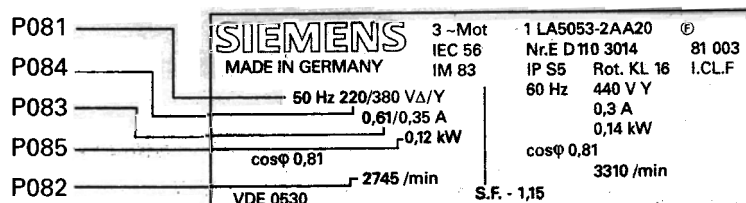
NOTE

Ensure that the motor is configured correctly, i.e. in our example delta connection for 230 V operation or star connection for 400 V operation.

All other parameters are already pre-assigned at the factory.
The factory setting can be reset with parameter P944.
(You can read how to do this in the section "Explanation of settings".)

5.1 Control and operation

Switching the equipment on

The converter does not have a mains power switch and it is therefore live when the mains supply is connected.

Standby mode

The equipment waits with the output disabled for an on command via terminal 8 (to the right) or terminal 9 (to the left).
You can find the specifications for control commands for binary inputs under parameters P051-P055 "Selection of control functions".

Operational condition

When the on command is given the output is enabled.
The motor runs up to the pre-selected frequency (P005) and can be adjusted with the up and down button.

When delivered the frequency is 0.00 Hz, which means that **the motor will not rotate!** To make it start up, a setpoint must be entered with the up button or P005.

Stop condition

Stopping can be achieved in several ways:

- Going down to 0.0 Hz (lowering the setpoint to 0.0 with the down button) causes the motor to come to a slow, controlled standstill.

- Cancellation of the "on" command causes the converter to ramp down at the selected ramp down rate, (see fig. page 49).

- OFF2 - operation causes the motor to coast to a standstill (see table 2, page 60).

- OFF3 - operation causes rapid braking (see table 2, page 60).

- D.C. injection braking up to 250 % causes an abrupt stop after cancellation of the "on" command (see P073).

5.2 If the motor does not start up

If the motor does not start up when the "on" command has been given, please check if a frequency setpoint has been entered and that the motor specifications have been correctly entered under parameters P081 to P085. (P009 must first be set so as to permit access to these parameters – see page 50). The setting of the frequency setpoint on the parameter number P005 should also be checked.

The parameter settings indicate

P081
P082   the required values for these parameters
P083   should be entered from the motor nameplate
P084

P005 = 000.0   indicates that the digital setpoint is at 0.
The setpoint can be raised by changing P005 or
by using the up-down buttons to adjust P000.

P006 = 0000   indicates the digital setpoint is used as the setpoint.

If after inadvertent alteration of parameters the motor does not run, it is advisable to reset the MICRO MASTER.

This is carried out by setting parameter P944 = 1 and then pressing button P.
Then check the motor specifications in P081 - P085 and re-enter them if necessary.

5.3 Possible parameter settings in standard applications

1. Selecting the frequency setpoint

Parameter P006 determines the type of frequency setpoint.
The factory default is P006 = 0.

There are three alternatives:

P006 = 0   digital setpoint as delivered
P006 = 1   analogue setpoint via terminals 3 and 4
(see connection diagram)
P006 = 2   fixed frequency via digital inputs
(terminals 10,11 and 12). Different fixed setpoints are enabled depending on the terminal activated.

Terminal 10	=	20 Hz
Terminal 11	=	10 Hz
Terminal 12	=	5 Hz
Terminal 10+11	=	30 Hz
Terminal 10+12	=	25 Hz
Terminal 11+12	=	15 Hz
Terminal 10+11+12	=	35 Hz

Other fixed frequencies can also be programmed (see "Full parameter set".

2. Settings on the ramp generator

The ramp up time (P002), the ramp down time (P003) and the smoothing (P004) can be set separately.

t1: P002 0-650 s   t2: P003 0-650 s
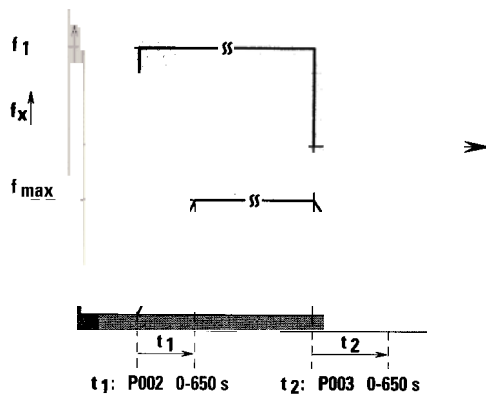
Fig: ramp up and ramp down

P002 = 10 s
P004 = 5 s

Acceleration
time (total):   = 15 s
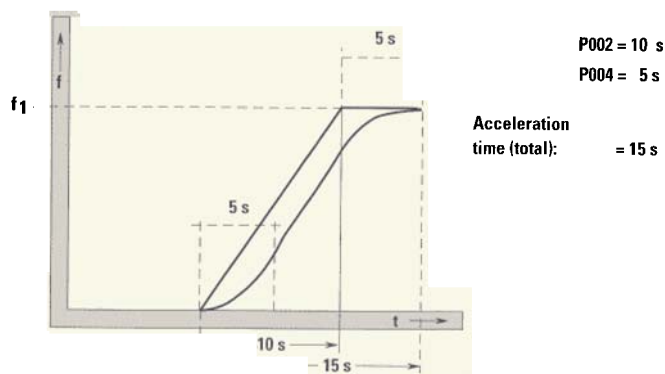
Fig: smoothing

3. Alteration of the display mode

In the delivered condition the output frequency of the MICRO MASTER is displayed in parameter P000. Alternatively, it is possible to display other operating values:

Display selection: 0 = output frequency (as delivered)
(P001)   1 = frequency setpoint
                      2 = motor current in amps
                      3 = dc-link voltage in volts
                      4 = motor torque in percent

⚠ **WARNING**

Before the equipment is switched on its plastic cover must be fitted.

After the power has been turned off you must always wait five minutes so that the dc-link capacitors can discharge. It is not permissible to remove the cover until this time has elapsed.

Parameters can be changed and fixed using the push buttons to adjust the desired properties of the drive such as ramp times, minimum and maximum frequencies, etc.

The parameter numbers selected and the setting of the parameter values are indicated in the four digit LED display.

Access to parameters is determined by the value set in P009.
Please check that the key parameters, necessary for your application have been programmed.

P009 options are:

0	= only the parameters from P001 to P009 can be read and set
1	= the parameters from P001 to P009 can be set and all other parameters can only be read.
2	= all parameters can be set, but P009 automatically sets to 0 the next time power is removed from the converter.
3	= all parameters can always be set

All entries are made on the parameterisation panel using the following system

P ○	= **toggle** between parameter number (e.g. P000) and parameter value (e.g. 000)
↑ ○	= button to set the parameter numbers or the parameter values to **higher values**
↓ ○	= button to set the parameter numbers or the parameter values to **lower values**

NOTE

If you press the button ↑ or ↓ momentarily the values change step by step.

If you keep the buttons pressed for a longer time, the values run through rapidly.

Most of the displays on the MICRO MASTER have four digits.

In the table of parameters you can find the values, together with the unit of measure.

Example: table 50.0 Hz = display 050.0

After a parameter value has been set, the selected value is automatically entered in the internal memory.
If the entry is wrong you just have to correct the value with the buttons ↑ or ↓

Parameter No.	Function	Parameter Value			Factory Setting
P000	operation display				
P001 ●	display mode	0	→	4	0
P002 ●	ramp up time	0	→	650.0 s	10.0 s
P003 ●	ramp down time	0	→	650.0 s	10.0 s
P004 ●	smoothing	0	→	40.0 s	0.0 s
P005 ●¹	freqency setpoint (digital)	0	→	650.0 Hz	0.0 Hz
P006	frequency setpoint selection	0	→	2	0
P009 ●	key parameter	0	→	3	0
P011	frequency setpoint memory	0	→	1	0
P012 ●	minimum motor frequency	0	→	650.0 Hz	0.0 Hz
P013 ●	maximum motor frequency	0	→	650.0 Hz	50.0 Hz
P014 ●	skip frequency	0.0	→	650.0 Hz	0.0 Hz
P015 ●	automatic restart	0	→	1	0
P016 ●	start on the fly	0	→	2	0
P017	not used				
P018	restart after fault	0	→	1	0
P021 ●	minimum analogue frequency	0	→	650.0 Hz	0.0 Hz
P022 ●	maximum analogue frequency	0	→	650.0 Hz	50.0 Hz
P023 ●	analogue input type	0	→	1	0
P024 ●	analogue setpoint addition	0	→	1	0
P031 ●	jog frequency right	0.0	→	650.0 Hz	5.0 Hz
P032 ●	jog frequency left	0.0	→	650.0 Hz	5.0 Hz
P033 ●	jog ramp up time	0.0	→	650.0 s	10.0 s
P034 ●	jog ramp down time	0.0	→	650.0 s	10.0 s
P041 ●	1st fixed frequency	0.0	→	650.0 Hz	5.0 Hz
P042 ●	2nd fixed frequency	0.0	→	650.0 Hz	10.0 Hz
P043 ●	3rd fixed frequency	0.0	→	650.0 Hz	20.0 Hz
P044 ●	4th fixed frequency	0.0	→	650.0 Hz	40.0 Hz
P045	inversion fixed setpoints	0	→	7	0
P051	selection control function digital input 1 (terminal 8)	1	→	2	1
P052	selection control function digital input 2 (terminal 9)	0	→	13	2
P053	selection control function digital input 3 (terminal 10)	0	→	14	6
P054	selection control function digital input 4 (terminal 11)	0	→	15	6
P055	selection control function digital input 5 (terminal 12)	0	→	16	6
P056	digital inputs debounce time	0	→	3	0

The parameters indentified with ● can also be changed during operation.
●¹ on-line changeable only if P011 is set to "1".

You can find the description of the parameters on the following pages

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6.1 Table of settings (parameters)

Parameter No.	Function	Parameter Value	Factory Setting
P061	selection relay output RL 1	0 → 11	6
P062	selection relay output RL 2	0 → 11	8
P063	external brake running time	0 → 20.0 s	1.0 s
P064	external brake stopping time	0 → 20.0 s▲	1.0 s
P065	current threshold for relay		1.0
P071 ●	slip compensation	0 → 200 %	0
P072 ●	slip limit	0 → 500 %	250 %
P073 ●	D.C. injection brake	0 → 250 %	0
P074 ●	motor derating curve as temperature protection	0 → 3	0
P075 ●	braking resistance	0/65 → 250 Ω	0 Ω
P076 ●	pulse frequency	0 → 10	0/2*
P077	control mode	0 → 2	1
P078 ●	continuous boost	0 → 250 %	100 %
P079 ●	starting boost	0 → 250 %	0 %
P081	motor nominal frequency	0 → 650.0 Hz	50.0 Hz
P082	motor nominal speed	0 → 9999 RPM	*** RPM
P083	motor nominal current	0.1 → 50.0 A	*** A
P084	motor nominal voltage	0 → 500 V	*** V
P085	motor nominal power	0.00 → 20.00 kW	*** kW
P086 ●	motor nominal limit	0 → 250 %	150 %
P087 ●	motor PTC enable	0 → 1	0
P088	automatic calibration	0 → 1	0
P089 ●	stator resistance	0.1 → 100.0 Ω	*** Ω
P091 ●	slave address	0 → 30	0
P092 ●	baud rate	3 → 7	6
P093 ●	time out	0 → 240 s	0 s
P094 ●	nominal system setpoint	0 → 650.0 Hz	50.0 Hz
P101 ●	operation EUROPA/USA	0 → 1	0
P111	power rating	0.00 → 20.00 kW	*** kW
P910 ●	local/remote mode	0 → 3	0
P922	software version	0 → 9999	depending on software status
P923 ●	equipment system no.	0 → 9999	0
P930	fault code	0 → 9999	
P931	warning code	0 → 9999	
P944	reset factory setting	0 → 1	

* 3 phase units
*** The value of the factory setting depends on the rating of the inverter.
The parameters indentified with ● can also be changed during operation.
You can find the description of the parameters on the following pages.

Parameter no.	Settings and notes
P000	This displays the output selected in P001 In the event of a failure, the relevant error message is displayed as in the table "Failures/error messages". In the event of a warning the display flashes. If the output frequency has been selected in P001, the corresponding setpoint flashes about every 1.5 seconds when the converter is switched to stop.
P001	Display selection 0 = output frequency 1 = frequency setpoint 2 = motor current 3 = dc-link voltage 4 = motor torque
P002	Ramp up time (0 to f_{max}) from 0 to 650 seconds
P003	Ramp down time (f_{max} to 0) from 0 to 650 seconds
P004	Time from 0 to 40 seconds until full acceleration is activated or deactivated with smoothing of the acceleration curve. (see diagram smoothing: page 49)
P005	Frequency setpoint (digital) can be set between 0 and 650 Hertz
P006	Setpoint selection: 0 = digital 1 = analogue 2 = fixed frequency or motor potentiometer depending on the programming of the binary inputs (P051-P055)
P009	This setting selects which parameters can be set. The key parameters are: 0 = only parameters from P001 to P009 can be set 1 = parameters from P001 to P009 can be set and all other parameters can be read. 2 = all parameters can be set but P009 automatically sets to 0 the next time power is removed from the converter. 3 = all parameters can always be set
P011	Frequency setpoint memory: 0 = disabled 1 = enabled after switch-off i.e. the setpoint alterations made with the up/down buttons or the motorpotentiometer are stored even when the power has been removed from the converter.
P012	Minimum motor frequency can be set between 0.0 and 650.0 Hertz.
P013	Maximum motor frequency can be set between 0.0 and 650.0 Hertz.
P014	To avoid the effects of resonance of the drive, a skip frequency can be set with this parameter. Frequencies within ±2 Hz of this setting are suppressed. Within the suppressed frequency range, stationary operation is not possible – this range is just passed through.

Parameter no.   Settings and notes

|	
▪P015	Automatic restart: 0 = disabled 1 = Automatic restart, operates after power failure
P016	This parameter enables the start of the inverter onto a spinning motor: 0 = function disabled, 1 = function enabled after power up, fault and OFF 2 only, 2 = function always enabled
P017	not used

P018	Automatic restart after fault:
	 0 = disabled
	 1 = After a fault, the inverter will attempt to restart up to 5 times.
	     If the fault is not cleared after the 5th attempt, the inverter will
	     remain in the Fault state.

P021	Frequency corresponding to the analogue setpoints of 0V/0mA or 2V/4mA, depending on the selection in P023. This frequency can be set between 0.0 and 650.0 Hertz and can also be selected higher than P022 (see diagram 1 in the appendix).
P022	Frequency corresponding to the analogue setpoints of 10V/20mA. This frequency can be set between 0.0 and 650.0 Hertz and can also be selected lower than P021 (see diagram 1 in the appendix).
P023	Select analogue input type: 0 = 0 to 10 Volt or 0 to 20 mA 1 = 2 to 10 Volt or 4 to 20 mA
P024	Analogue setpoint addition: 0 = no addition 1 = addition of the analogue setpoint to the fixed frequency and the motorpotentiometer frequency
P031	The jog setpoint right fixes the frequency, from 0.0 to 650.0 Hertz, at which the converter runs if the jog right input is enabled. It can be set lower than the minimum frequency.
P032	The jog setpoint left fixes the frequency, from 0.0 to 650.0 Hertz at which the converter runs if the jog left input is enabled. It can be set lower than the minimum frequency.
P033	The ramp up time for the jog function. The ramp up time can be set between 0 and 650.0 seconds based on f_{max}.
P034	The ramp down time for the jog function. The ramp down time can be set between 0 and 650.0 seconds based on f_{max}.
P041	1st fixed frequency
P042	2nd fixed frequency
P043	3rd fixed frequency
P044	4th fixed frequency

Parameter no	Settings and notes
P045	The direction of rotation for the fixed frequency can be set with this parameter (see table 1 page 59).

Selection of the control functions for the digital inputs

P051	DIN 1 (terminal 8)
P052	DIN 2 (terminal 9)
P053	DIN 3 (terminal 10) — (see table 2 page 60)
P054	DIN 4 (terminal 11)
P055	DIN 5 (terminal 12)

Parameter no	Settings and notes
P056	Digital Input Debounce time: 0 = 12.5 ms 1 = 7.5 ms 2 = 2.5 ms Note that the response time to a digital input will be the debounce time + 7.5 ms (for example P056 = 2, response time = 20ms).
P061	The configuration of the relay output RL1 (terminals 16/17/18) is set with these values (see table 3 page 60).
P062	The configuration of the relay output RL2 (terminals19/20) is set with these values (see table 3 page 60).
P063	The time between 0 and 20 seconds during which the external brake remains controlled via the braking relay, after the drive has been switched on and the motor is operating at the minimum frequency set in P012 (see diagram 2 in the appendix).
P064	The time between 0 and 20 seconds during which the motor continues to be operated at the minimum frequency set in P012 after the external brake is activated (see diagram 2 in the appendix).
P065	Relay current threshold. This parameter is used with option 9 for the relay output (P061 and P069). The relay is switched on when the motor current is greater than P065.
P071	With this parameter the slip of an asynchronous motor when loaded can be compensated for within the range of 0 - 200 % of the nominal slip. Warning When operating synchronous motor and motors connected in parallel the compensation must be set to 0 to disable it.
P072	With this parameter the slip can be limited within the range of 0 - 500% of the nominal slip and "pull out" of the drive can thus be prevented. When it reaches the slip limit the converter reduces the output frequency.

Parameter no.	Settings and notes

P073

For DC-Injection braking, a current of between 0 and 250% of the motor current rating is entered here.
If 0 is entered the D.C. injection brake is disabled
(The braking time is determined by P003).
This function is disabled, when P061 or P062 are set to "4" (brake relay).

P074

To prevent the overheating of selfcooling motors running at low speed, you can select a reduction of the continuous output current.
The additional overload capability is determined by the internal I^2t calculation (150% of the nominal motor current P083 for 1 minute).
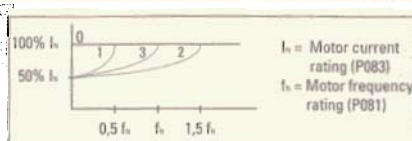
P075

If a braking resistor is used, its resistance between 0/65 Ω and 250 Ω must be entered here.
The value of "0" disables the braking resistor function.

P076

The pulse frequency in the range from 2 to 16 kHz and the PWM mode for the output voltage is set with this parameter.
If silent operation is not absolutely necessary, the losses in the converter as well as the RFI-Emission can be reduced by selecting lower pulse frequencies.
Modulation mode 1 causes the motor to run more smoothly at very small frequencies, while modulation mode 2 causes lower losses in the motor and converter

0	16 kHz modulation mode 1	6	2 kHz modulation mode 1
1	16 kHz modulation mode 2	7	2 kHz modulation mode 2
2	8 kHz modulation mode 1	8	8 - 16 kHz modulation mode 3
3	8 kHz modulation mode 2	9	4 - 8 kHz modulation mode 3
4	4 kHz modulation mode 1	10	2 - 4 kHz modulation mode 3
5	4 kHz modulation mode 2		

Note
When P076 = 0, the display of the current, at frequencies less than 10 Hz, is inaccurate.

P077

You can choose whether to operate the MICRO MASTER current controlled (FCC) or with a voltage - frequency curve

Note
When operating synchronous machines and motors connected in parallel, a voltage/frequency curve must be selected.

P078

To adjust the torque for starting and for low frequency operation, the starting up current can be set in the range of 0 - 250 % of the current rating of the motor.
Warning
If P078 is set too high, overheating of the motor can result.

Parameter no.	Settings and notes
P079	For drives which require a high initial starting torque, it is possible to set an extra voltage increase by boosting the starting current by 0 - 250 % of the nominal motor current. This increase is only effective during initial start up and until the frequency setpoint is reached. **Note** This increase is in addition to P078.
P081	Motor nominal frequency These parameters must be set for the
P082	Motor nominal speed motor used. Please read the specifications
P083	Motor nominal current on the motor nameplate. **Please note**:
P084	Motor nominal voltage the factory settings in the MICRO MASTER
P085	Motor nominal output vary according to the power rating.
P086	With this parameter the motor current can be limited and overheating of the motor prevented. If the set value is exceeded, the output frequency is reduced until the current falls below this limit. During this process the display flashes as a warning indication.
P087	motor PTC enable 0 = disabled 1 = external PTC enabled
P088	If this parameter is set on 1, the next time the motor is switched on an automatic measurement of the stator resistance of the motor is carried out and the value is stored in P089. The parameter is automatically set back to 0.
P089	The stator resistance of the motor can be set manually. Values between 0.1 Ω and 100 Ω can be entered.
P091	If the MICRO MASTER is to be operated by remote control via the RS 485 serial interface, the bus address should be entered in this parameter. Range 0 to 30.
P092	The baud rate of the data telegrams received is entered here.
P093	The telegram timeout is the permissible interval of time between two incoming data telegrams. It starts after reception of the first data message and can be set between 0 and 240 seconds. The 0 value switches the control off.
P094	Setpoints are transmitted in the data telegram in %. Therefore the required frequency in Hz corresponding to 100% must be set in this parameter.

Table for P092:

Value set	Data rate bps
3	1200 baud
4	2400 baud
5	4800 baud
6	9600 baud
7	19200 baud

Parameter no.	Settings and notes
P101	This parameter selects either European standard or USA standard. It also selects the correct motor standard 50 Hz or 60 Hz. 0 = Europe 1 = USA After setting this parameter a reset to factory settings (P944 = 1) has to be done to enable the setting.
P111	Power rating. This is a read only parameter which gives the power rating of the inverter e.g. 04.00 is a 4.0 kW inverter. If P101 is 1 then the power is shown in horsepower.
P910	With this setting either local control or remote control via the RS 485 interface is selected: 0 = local 1 = remote 2 = Local control, with serial control for frequency. 3 = Serial control, with local control for frequency.
P922	This parameter contains the software version of the equipment.
P923	Equipment – system number
P930	This parameter stores the last recorded fault code. (see corresponding table in the section "Failures/error messages")
P931	The last warning that occured is stored in this parameter until power is removed. 2 = current limit active 4 = slip limit exceeded 3 = voltage limit active 5 = motor overtemperature
P944	The factory settings can be reset with this parameter. All parameters are set to the factory defaults: 0 = no change 1 = resets all parameters to the factory defaults.

Table 1
Inversion of the fixed
setpoints P045

Value set	Fixed frequency 1	Fixed frequency 2	Fixed frequency 3	Fixed frequency 4
0	→	→	→	→
1	←	→	→	→
2	→	←	→	→
3	→	→	←	→
4	→	→	→	←
5	←	←	→	→
6	←	←	←	→
7	←	←	←	←

Fixed setpoints not inverted ⟶   ⟵ Fixed setpoints inverted

Table 2

Function selection of the digital inputs

Value set	Function	P 051 DIN 1 (terminal 8)	P 052 DIN 2 (terminal 9)	P 053 DIN 3 (terminal 10)	P 054 DIN 4 (terminal 11)	P 055 DIN 5 (terminal 12)	Active
0	no input		●	●	●	●	—
1	to the right	●					High
2	to the left	●	●				High
3	reverse		●	●	●	●	High
4	OFF 2		●	●	●	●	Low
5	OFF 3		●	●	●	●	Low
6	fixed frequencies		● (4)	● (3)	● (2)	● (1)	High
7	jog right		●	●	●	●	High
8	jog left		●	●	●	●	High
9	remote operation		●	●	●	●	High
10	fault code reset		●	●	●	●	Rising Edge
11	increase frequency		●	●	●	●	High
12	decrease frequency		●	●	●	●	High
13	Disable analogue input (setpoint is 0.0 Hz)		●	●	●	●	High
14	Disable P button			●	●	●	High
15	Enable DC Brake				●	●	High
16	Use Jog ramp times (instead of normal ramp times)					●	High

Table 3

Relay output 1 (P061) and
Relay output 2 (P062)

Value set	Output assignment	Active
0	No output assigned (relay not active)	Low
1	Converter is running	High
2		
3	Motor running direction right	High
4	Brake on (see parameters P063/P064)	Low
5	Converter Frequency less than (or = to) minimum frequency	Low
6	Fault indication	Low
7	Converter Frequency greater than (or = to) setpoint	High
8	Warning	Low
9	Output Current greater than (or = to) P065	High
10	Motor current limit (warning)	Low
11	Motor over temperature (warning)	Low

activ low: In this state the relay is de-energized
activ high: In this state the relay is energized

The MICRO MASTER can either be controlled locally using the control buttons or remotely via a data line connected to the interface A/B terminals (terminals 13/14). Local control is set at the factory.

7.1 Local control

When local control is selected, the microprocessor only reacts to the buttons on the control panel. In this case alterations to the parameter values are carried out with the buttons P or ↑ or ↓.

Control commands that are received via the RS 485 interface have no effect.

7.2 Remote control

For remote control the MICRO MASTER is operated via a RS 485 serial interface. The RS 485 serial interface is designed as a 2 wire connection for bidirectional data transmission.

Several MICRO MASTERS can be connected to an external control unit at the same time. The drives can be addressed individually.

The serial data transmission via the RS 485 interface is carried out using the USS protocol.

For further information please refer to the following documents:

E31930 - T9011 - X - A
Specifications of the USS - Protocol d (d = german)

E31930 - T9011 - X - A 1 - 7600
Specifications of the USS - Protocol e (e = english)

E31930 - T9012 - X - A 2
Application of the USS - Protocol in motive power engineering d

E31930 - T9012 - X - A 2 - 7600
Application of the USS - Protocol in motive power engineering e

E20125 - B0001 - S302 - A 1
Application of the USS - Protocol in SIMOVERT units
6SE 21 and MICRO MASTER d

E20125 - B0001 - S302 - A 1 - 7600
Application of the USS - Protocol in SIMOVERT units
6SE21 and MICRO MASTER e

When operated with an external control system, internal control pulses are not accepted unless the OFF 2 and OFF 3 inputs are activated using P051 to P055 (please refer to table 2 on page 60)

7.3 Frequency setpoint

The converter's output frequency and hence the speed of the motor can be entered and controlled in five different ways. These are:

1. Digital frequency setpoint

The digital setpoint is set in the parameter P005 between 0 and 650 Hz.

2. Analogue setpoint

The analogue frequency setpoint depends on an external setpoint signal that determines the frequency minimum at 0V/0mA or 2V/4mA and the frequency maximum at 10V/20mA. The analogue input is configured using the parameters P021 to P024.

3. Motor potentiometer

With the motor potentiometer function the setpoint can be increased or decreased via the digital inputs. The function is enabled using the parameters P052 to P055. The motor potentiometer setpoint can either be used alone, or added to the fixed frequencies, or the analogue setpoint (see P024).

4. Fixed frequency setpoint

Fixed frequencies are set with the parameters P041 to P045.
The fixed frequencies are enabled via digital inputs (terminals 9-12).
(see parameterisation P052-P055 and table 2 at page 60)

5. Setpoint via remote data transmission

A setpoint of 0 to 100 %, see parameter P094, is transmitted in the data telegram.

In the event of a failure the converter switches off and an error code appears in the display. The last error that arose is stored in parameter number P930.
The display e.g. 0004 indicates that the last error was F004.

Error list

Display	Cause	Measure to correct the fault
F001	overvoltage	Check whether the supply voltage is within the limits indicated on rating plate.
		Increase the ramp down time (P003) or apply braking resistor (option).
		Check whether the required braking power is within specified limits.
F002	overcurrent	Check whether the motor power corresponds to the converter power.
		Check motor lead and motor for short circuits and earth faults.
		Check whether the motor parameters (P081 – P086) which are entered, correspond to the motor that is being used.
		Increase the ramp-up time (P002).
		Reduce the boost set in P078 and P079.
		Check whether the motor is obstructed or overloaded.
F003	overload	Check whether the motor is overloaded.
		Increase the maximum motor frequency if a motor with high slip is used.
F004	overheating of the motor (monitoring with PTC)	Check whether the motor is overloaded. Check the connections to the PTC.
		Check that P087 has not been set to "1" without a PTC being connected.
F005	converter overtemperature	Check that the ambient temperature is not too high.
		Check that the air inlet and outlet is unobstructed.
F008	USS protocol timeout	Check serial interface.
		Check the settings of the bus master and P091 - P093.
		Check whether the time out interval is too short. (P093)

Failures – error messages

Error list

Display	Cause	Measure to correct the fault
F009	undervoltage	Check the supply voltage .
F010	initialisation fault	Check the entire parameter set. Set P009 to 0000 before power down.
F011	internal interface fault	Switch off power and switch on again.
F013	program fault	Switch off power and switch on again.
F106	parameterisation fault P006	Parameterise fixed frequency(ies) and/or motor potentiometer on the digital inputs.
F112	parameterisation fault P012	Set parameter P012 smaller than P013.
F151/F154	parameterisation fault digital inputs	Change the setting of the digital inputs P052 - P055 so that two inputs do not select the same function. This applies to the parameter settings 3 and 6 to 12.

When the fault has been corrected the converter can be reset. To do this press button P twice (once to display P000 and the second time to reset the fault) or erase the fault via a binary input (fault code reset function, see table 2 page 60)

Options

9.1 Accessories

	250 W – 750 W Single Phase	1.1 kW – 2.2 kW Single Phase
Braking resistor	6SE3090–0BA07–2RA0	6SE3090–0BC07–2RA0
RFI Suppression filter	6SE3090–0BA07– 0FB0	6SE3090–0BC07–0FB0

	1.5 kW – 3.0 kW Three Phase, 400 V	4.0 kW – 5.5 kW Three Phase, 400 V
Braking resistor	not yet	not yet
RFI Suppression filter	available	available

10.1 Technical specifications

Converter type	MM25	MM37	MM55	MM75	MM110	MM150	MM220
Input voltage range	1 AC 230 V ±15%				2 AC 208 V ±10%		
Motor output rating[1]	250 W	370 W	550 W	750 W	1.1 kW	1.5 kW	2.2 kW
Continuous output	660 VA	880 VA	1.14 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA
Output current (nominal)	1.5 A	2.0 A	2.6 A	3.4 A	4.8 A	6.4 A	9.0 A
	1.6 A	2.3 A	3.3 A	3.9 A	5.5 A	7.1 A	10.4 A
Input current	3.0 A	3.8 A	5.5 A	6.5 A	14.0 A	18.0 A	20.0 A
Recommended mains fuse[2]	10 A			16 A	20 A		25 A
Recommended lead cross section — input	min 1.0 mm²			min 1.5 mm²	min 2.5 mm²		
Recommended lead cross section — output	min 1.0 mm²				min 1.5 mm²		
Dimensions W x H x D	149 mm x 184 mm x 130 mm				185 mm x 215 mm x 164 mm		
Weight	2.2 kg				4.5 kg		

Converter type	MM150/3	MM220/3	MM300/3	MM400/3	MM550/3
Input voltage range	380 V (−10%) to 500 V (+10%) (342 V to 550 V) three phase				
Motor output rating[1]	1.5 kW	2.2 kW	3.0 kW	4.0 kW	5.5 kW
Continuous output	2.8 kVA	4.0 kVA	5.2 kVA	7.0 kVA	9.0 kVA
Output current (nominal)	3.7 A	5.2 A	6.8 A	9.2 A	11.8 A
	4.0 A	5.9 A	7.7 A	10.2 A	13.2 A
	5.5 A	7.5 A	10.0 A	12.5 A	16.0 A
	10 A	16 A	16 A	20 A	20 A
Recommended lead cross section — input	1.0 mm²	1.5 mm²		2.5 mm²	
Recommended lead cross section — output	min. 1.0 mm²			1.5 mm²	
Dimensions W x H x D	185 mm x 164 mm x 215 mm				
Weight	4.5 kg				

[1] Siemens 4 pole-motor, 1LA5 series or equivalent
[2] use normal distribution type fuses, not semiconductor fuses

GB

Technical specifications and terms

Input frequency	47 Hz to 63 Hz
Power factor	$\lambda \geq 0.7$
Output frequency range	0 Hz to 650 Hz
Resolution	0.1 Hz
Overload capability	150% for 60 s
Protection against	converter overtemperature motor overtemperature over and undervoltage
Additional protection	against short circuits and earth/ground faults pull-out protection, automatic compensation for supply fluctuations
Operating mode	4 quadrants possible
Regulation and control	FCC (Flux Current Control), voltage/frequency curve
Analogue setpoint	0 – 10 Volt / 2–10 Volt (recommended poten- 0 – 20 mA / 4 – 20 mA tiometer: 4.7 kΩ)
Analogue setpoint resolution	10 bit
~~Setpoint stability~~ ————	~~analogue < 1%————————~~
Setpoint stability	digital < 0.02%
Motor temperature monitoring	PTC input, I^2t control
Ramp times	0 - 650 s
Control outputs	2 relays 240 V AC / 1A; 24 V DC / 2 A
Interface	RS 485
Converter efficiency	97 %
Ambient temperature	0°C to + 40°C (up to 50° C without cover)
Max. heatsink temperature	65° C
Ventilation	convection cooling (MM25, MM37, MM55 MM75, MM110, MM150, MM150/3) fan cooling (MM220, MM220/3, MM300/3, MM400/3, MM550/3).
Humidity	90 % without condensation
Installation height above sea level	1000 m
Degree of protection	NEMA 1 (IP 21) (National Electrical Manufacturers Association)

Technical specifications and terms

Converter type:	Order number:
MM 25	6 SE 3011 - 5 BA 00
MM 37	6 SE 3012 - 0 BA 00
MM 55	6 SE 3012 - 6 BA 00
MM 75	6 SE 3013 - 4 BA 00
MM110	6 SE 3014 - 8 BC 00
MM150	6 SE 3016 - 4 BC 00
MM220	6 SE 3018 - 8 BC 00
MM150/3	6 SE 3014 - 0 DC 00
MM220/3	6 SE 3015 - 8 DC 00
MM300/3	6 SE 3017 - 7 DC 00
MM400/3	6 SE 3021 - 0 DC 00
MM550/3	6 SE 3021 - 3 DC 00

10.2 Technical terms

Baud
A unit of measure for the speed of data transmission named after Jean Baudot. One Baud corresponds to one Bit per second = bps

CPU
Abbreviation for central processing unit of a computer.

FCC
Flux current control for optimum motor efficiency and high dynamic range.

Interface
The means by which a micro-computer can be connected to other components.

NEMA
Abbreviation for National Electrical Manufactures Association

PTC
Abbreviation for positive temperature coefficient. A resistance, of which the value increases if the temperature rises.

PWM
pulse width modulation

4 Q Control
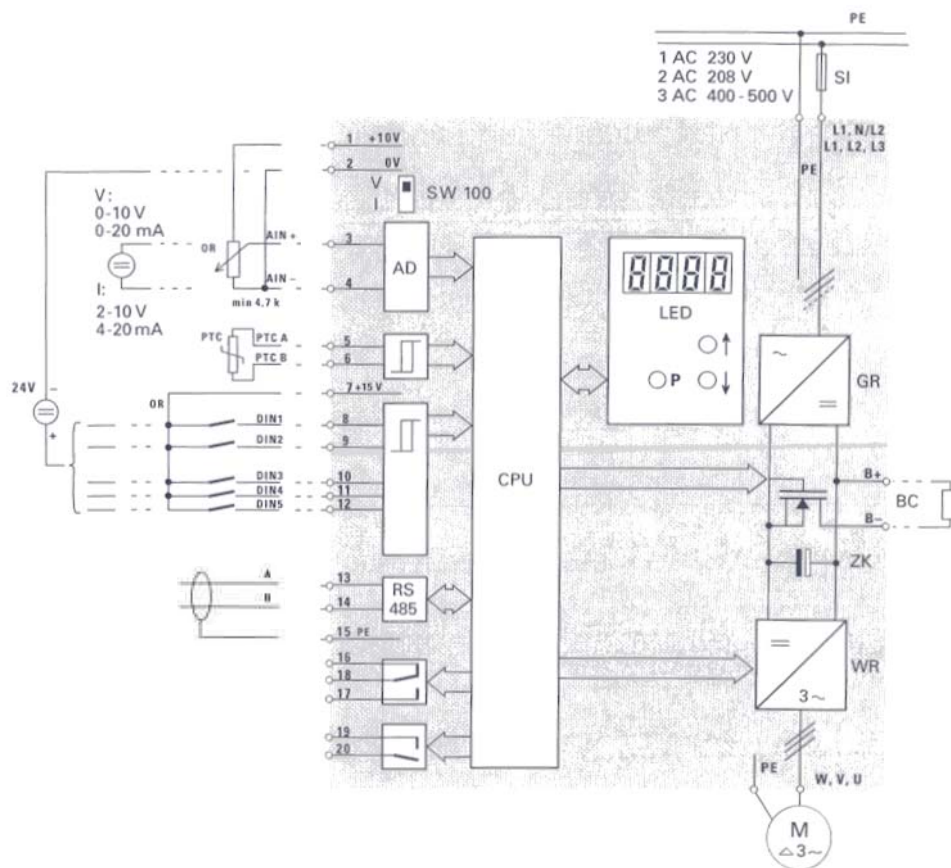four quadrant control of a motor, driving and braking in both directions.

RS 485
recommended standard. Recommended standard for computer interfaces.

Status information
Identification of the status in data processing.

USS-Protocol
Universal serial interface protocol

Änderungen vorbehalten