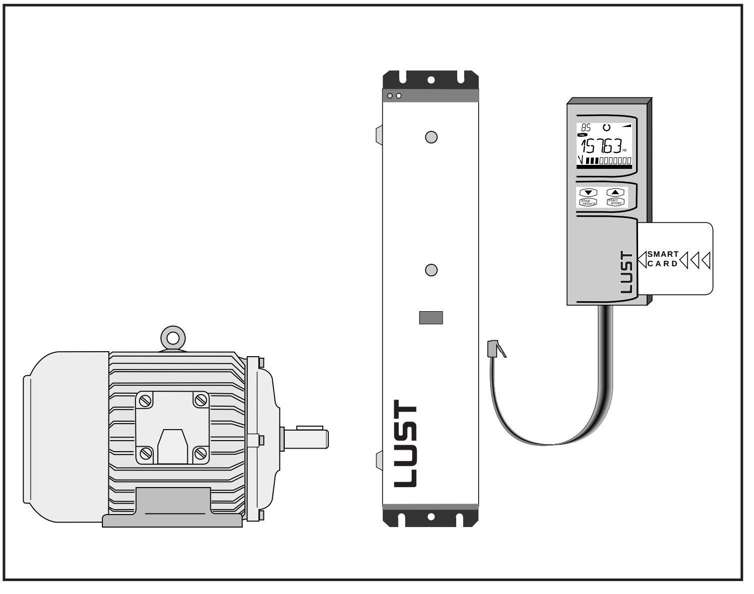
LUST
ANTRIEBSTECHNIK

EN

# SMARTDRIVE VF1000 · Series M

# Frequency inverter 1.1 to 4 kW




Operation Manual

# Operation Manual for static frequency inverter

**1 x 230 V - Version**

VF1205M - 1.1 kW
VF1207M - 1.5 kW

**3 x 400/460 V - Version**

VF1404M - 1.5 kW
VF1406M - 2.2 kW
VF1408M - 3.0 kW
VF1410M - 4.0 kW

Applies as from software edition V 1.2

ID No.: 0809.21B.1-01
Issued January 2001

Dear customer!

Thank you for the trust which you have placed in us at Lust Antriebs-technik GmbH by purchasing the SMARTDRIVE frequency inverter.

Installation and commissioning should be carried out by a trained engineer. Please take the time to read this Operation Manual carefully before starting work. If you follow all the instructions, you will save yourself much time and many questions during the commissioning stage.

It is essential to read this Operation Manual because both the inverter itself and further components of the system can be damaged by improper handling.

If after reading the Manual, however, you still have questions, do please contract us as given below.

Lust Antriebstechnik GmbH
Gewerbestr. 5-9
D-35633 Lahnau
Phone: +49 64 41 966 - 0
Fax: + 49 64 41 966 - 137

# A Useful information on the Operation Manual

The details in this manual apply for all frequency inverters belonging to the SmartDrive VF1000M family of devices. The housing design is designated with the letter M for “Medium”.

The Operation Manual consists altogether of 6 chapters, which are listed under the title “Directly to your goal”.

General information about device versions, safety instructions as well as CE acceptance test is given.

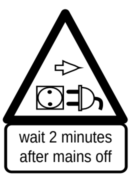
Chapters 1, 2 and 3 are important for commissioning. Chapters 4, 5 and 6 relate to the operation of the inverter with the control unit KeyPad KP100 and give information on the individual parameters.

**According to the customer-specific requirements on the frequency inverter, there are also device versions with special functions. The specifications which deviate from those of the standard device are marked in the appropriate descriptions.**

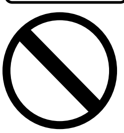
The following pictograms for warning and instruction occur in the Operation Manual to improve clarity.

⇒ Caution! Danger of death by electrocution.

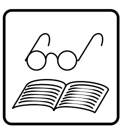
⇒ Caution! It is essential that you follow these instructions.



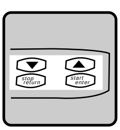

⇒ Caution! Disconnect device from mains and wait 2 minutes to allow the DC link capacitors to discharge.



⇒ Prohibited! Incorrect operation may cause damage to equipment.



⇒ Useful information, tip.



⇒ Setting with the KeyPad is alterable.

# Directly to your goal

*Accessories

## A.1 Safety instructions

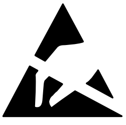
While in operation, inverters may have live, uninsulated, also if required moving or rotating parts as well as hot surfaces, depending on the degree to which they are protected. This means that a frequency inverter drive is a source of potentially fatal injuries.

To prevent serious physical injuries or considerable material damage, only qualified persons familiar with electrical drive equipment may work on the device. Only those persons who are familiar with mounting, installing, commissioning and operating inverters and have appropriate qualifications shall be regarded as qualified. These persons must read the Operation Manual carefully before installation and commissioning and follow the safety instructions.
In this connection, the Standards IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC-Report 664 or VDE 0110 and national accident prevention provisions or VBG 4 must be respectively observed.
Repairs to the equipment may only be carried out by the manufacture or by authorized workshops. Unauthorized opening and unprofessional intervention can result in physical injury or material damage.

## A.2 Intended use

Inverters are components that are intended for installation in electrical systems or machines. They should be basically only used for installation in control cabinets.
When installed in machines, the inverter may not be commissioned (i.e. it may not be put to its intended use) until such time as it is established that the machine corresponds to the provisions of the EC Directive 89/392/ EEC (Machine Directive), EN60204 should be observed.
In addition to the Directive on Low Potential 73/23/EEC the harmonized standards of the Series prEN 50178/DIN VDE 0160 in conjunction with EN 60439-1/DIN VDE 0660 Part 500 and EN 60146/DIN VDE 0558 are applied with regard to inverters.
The technical data and the information concering conditions of connection can be taken from the type plate and the documentation and are to be adhered to under all circumstances.

The inverters should be protected against unauthorised loading. In particular components may not be bent and/or insulation distances changed during transport and use.



Inverters contain electrostatically endangered components, which can be easily damaged when incorrectly handled. Electrical components may not be mechanically damaged or destroyed.

When work is being carried out on live inverters, the applicable national accident-prevention regulations (e.g. VBG 4) should be observed.

Electrical installation should be carried out according to the applicable regulations (e.g. cable diameter, fusing, grounding cable connection). Additional details are contained in the documentation.

Electronic devices are not intrinsically fail-safe. The user himself shall be responsible for securing the drive if the device breaks down.

**If the inverter is used for special applications (e.g. explosion-proof area), the required standards and regulations (e.g. EN50014 and EN50018), must be observed.**

## A.3 Design and accessories

The standard design of the VF1000M is only signified on the type plate. Other deviations from the standard are indicated by the appending of design codes to the type designation.
Each design code has a special meaning.

**Standard order or type designation**

| V | F | 1 | x | x | x | M |
|---|---|---|---|---|---|---|

M range
Effective continuous current
Mains voltage: 2 = 230 V
4 = 400/460 V
SmartDrive VF1000 product line

**Standard design:**

- Painted all metal housing with metal lid for KeyPad KP100 installation, protection IP20
- With braking chopper power electronics, without braking resistance in the device cooling body
- Operation Manual

Design code when deviating from standard

V F 1 x x x M, ☐☐, ☐☐, ☐☐, ☐☐, ☐☐

The design code is separated with a comma and can be arranged in any sequence.

Example:

**VF1408M, FA, G16**

Housing design G16 (IP20)

With built-in mains filter to comply with the limiting value curve Class A (Industrial area)

More precise details can be found in the "Data booklet VF1000".

## A.4 Manufacturer's declaration for frequency inverter

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# Manufacturer`s Declaration

| | |
|---|---|
| Document No: | 0809.04E.1 p 1/2 |
| Month, Year: | October 1996 |
| Manufacturer: | Company |
| | Lust Antriebstechnik GmbH |
| Address: | Gewerbestraße 5 - 9 |
| | D - 35633 Lahnau (Germany) |
| | Tel.: 06441 / 966-0 |
| Product Description: | Frequency Inverter |
| Type: | VF1203M; VF1205M; VF1207M; VF1404M; VF1406M; VF1408M ; VF1410M |

The product described is intended exclusively to be installed in another machine or in an installation in the sense of the Machinery Directive.
Commissioning is prohibited until such time as conformity of the end product with Directive 89/392/EEC is established.

The standards relevant to Directive 89/338/EEC (EMC) which have been used in type testing the product described are listed in the annexe.
In order to comply with EMC legislation the installation instructions described in the product documentation must be observed.

| | |
|---|---|
| Manufacturer: | Company |
| | Lust Antriebstechnik GmbH |
| Place, Date: | Lahnau, 25.10/1996 |
| Legally binding signature: | K.H. Lust Managing Director |

The annexe forms part of this declaration.
This declaration does not imply any assured characteristics.
The installation directions and safety instructions in the product documentation must be observed.

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# Annexe
# to Manufacturer`s Declaration

| | |
|---|---|
| Document No: | 0809.04E.1 p 2/2 |
| Month, Year: | October 1996 |
| Description: | Frequency Inverter |
| Type: | VF1203M; VF1205M; VF1207M;<br>VF1404M; VF1406M; VF1408M ; VF1410M |

Harmonized European Standards to EMC:

| Title | Reference Number | Date of Issue |
|---|---|---|
| Generic Standard: **Interference emission** | EN 50081-1 | 1992 |
| Part 1: **Domestic** | | |
| | | |
| Generic Standard: **Interference immunity** | EN 50082-2 | 1993 |
| Part 2: **Industrial** | | |

National Standards:

| Reference Number | Date of Issue | Reference Number | Date of Issue |
|---|---|---|---|
| | | | |
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| | | | |
| | | | |

IEC - Standards :

| Reference Number | Date of Issue | Reference Number | Date of Issue |
|---|---|---|---|
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## A.5 VF1000M with CE - acceptance test

**Prüfzentrum für Umweltsimulation und Typprüfungen der CARL SCHENCK AG**

SCHENCK

AKKREDITIERT VON DER DEUTSCHEN AKKREDITIERUNGSSTELLE TECHNIK (DATech) e.V.

**Zusammenfassung des Prüfberichtes**
**Summary of protocol**

Bericht-Nr. 9 2 4

Deutscher AkkreditierungsRat
DAR
DAT-P-028/92-00

| | | |
|---|---|---|
| **Gegenstand**<br>Object | Frequenzumrichter | Die Prüfung erfolgte auf der Grundlage des zwischen der Deutschen Akkreditierungsstelle Technik (DATech) und CSD geschlossenen Vertrags. Dieser Prüfbericht dokumentiert die Rückführbarkeit auf die relevanten europäischen Richtlinien durch die Anwendung der von den Sektorkomitees des DATech vorgegebenen technischen Begutachtungsbausteine. |
| **Hersteller**<br>Manufacturer | Fa. Lust<br>Antriebstechnik GmbH<br>Gewerbestr. 5-9<br>D-35631 Lahnau | |
| **Typ**<br>Item | VF 1207-M<br>VF 1205<br>VF 1203 | |
| **Auftraggeber**<br>Customer | Fa. Lust<br>Antriebstechnik GmbH | |
| **Auftragsnummer**<br>Order No. | 1 HID 3925 | |
| **Anzahl der Seiten des Prüfberichts**<br>Report volume | 63 | |
| **Datum der Anlieferung**<br>Date of delivery | 07.08.95 | |
| **Datum der Prüfung**<br>Date of test | 07.08.95-10.08.95 | |

Dieser Prüfbericht darf nur vollständig und unverändert weitergegeben werden. Auszüge bedürfen der Genehmigung des Prüfzentrums für Umweltsimulation und Typprüfungen (QST). Prüfberichte ohne Unterschrift und Stempel haben keine Gültigkeit. Die Prüfergebnisse beziehen sich ausschließlich auf den oben genannten Prüfgegenstand.
This test report may only be reproduced in full lenght. Extracts puplishing needs permission of the issuing laboratory. Test result without signature and seal are not valid. The test results relating only the tested device.

| Stempel | Leiter der Prüfstelle | Bearbeiter |
|---|---|---|
| Prüfzentrum für Umweltsimulation und Typprüfungen – geprüft und getestet | (K.Pätschke) | (K.-P. Hielscher) |

QEZ0004

All the inverters described in this Manual have passed the test at the Carl Schenk AG Test Centre and fulfilled the stated European norms. As an example, the CE-test certificate for the device VF1207M have been reproduced. Details of the test itself can be ordered from Lust Antriebstechnik GmbH.

## 3 Prüfergebnisse

### Allgemein:

Bei diesem Schreiben handelt es sich um eine Zusammenfassung aller Meßungen d.h. Diagramme, Tabellen, Fotos, Angaben zum Testaufbau, usw. sind nicht unbedingt Bestandteil dieses Schreibens. Die Meßwerterfassungsprotokolle (handschriftlich) enthalten alle Details und können unter der Angabe der Prüfnummer über das Prüfzentrum angefordert werden bzw. für Zulassungen kann ein Prüfbericht (QEZ0002) gemäß der EN 45 001 erstellt werden.
Die Anforderungen basieren auf europäische Fachgrundnormen (generics standards), diese ermöglichen die Beurteilung für die es keine produktspezifischen EMV-Normen gibt.
Die in der nachfolgenden Tabelle aufgeführten Prüfungen sind Konformitätstests gemäß dem EMV-Gesetz, für elektrische Betriebsmittel die für eine Verwendung im typischen Wohngebiet sowie im rauhen Industriebereich vorgesehen sind.
Die Bewertung der Störfestigkeitsprüfungen erfolgte nach den Bewertungskriterien der EN 50082-2/03.95 (Generics).

### Tabelle Prüfergebnisse:

| Titel | EG-Richtl. Europäische Norm | Formular | erfüllt Ja | erfüllt Nein |
|---|---|---|---|---|
| Niederspannungsrichtlinie<br>(SEB=Sicherheit elektrischer Betriebsmittel) | 73/23/EWG<br>prEN 50278:1994<br>EN 61010-1 | QEF0001 | + | |
| EMV-Richtlinie bzw. EMVG<br>Fachgrundnorm **Störfestigkeit** Teil 2: Industriebereich | 89/336/EWG<br>EN 50 082-2 | QEF0005 | + | |
| EMV-Richtlinie bzw. EMVG<br>Fachgrundnorm **Störaussendung** Teil 1: Wohngebiete | 89/336/EWG<br>EN 50 081-1 | QEF0007 | + | |

### Bemerkungen zu den SEB-Prüfergebnissen:

Bei den sicherheitsrelevanten Prüfungen gab es keine Beanstandungen (siehe hierzu Prüfergebnisse SEB). Zusätzlich zur prEN 50178:1994 wurde die EN 61010-1:1993 herangezogen.

### Bemerkungen zu den EMV-Prüfergebnissen:

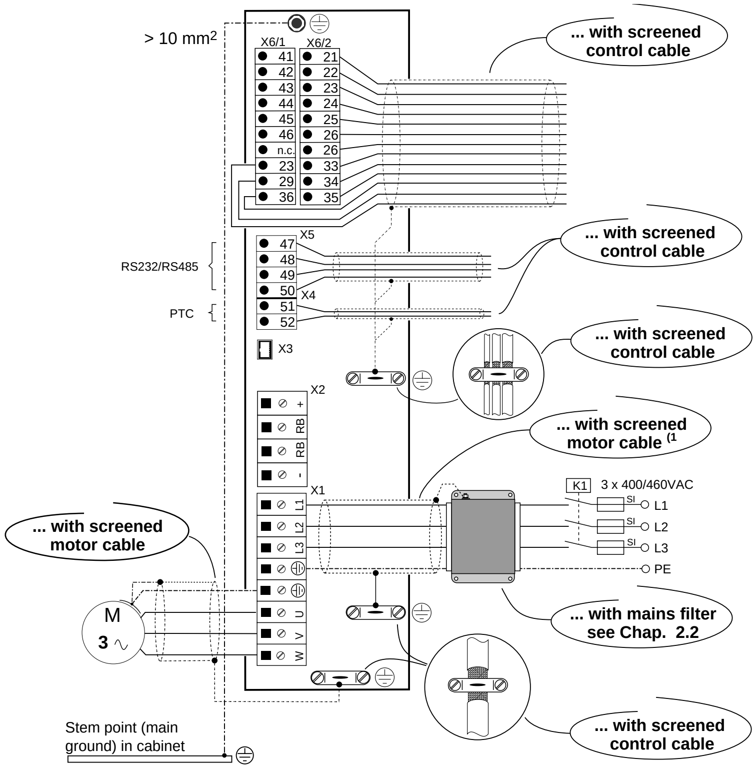
Der Frequenzumrichter wird entsprechend des Einsatzgebietes mit den entsprechenden Netzfilter ausgeliefert (siehe Konfiguration auf Seite 3).

## A.6 Instructions for correct EMC installation

According to EMC, means:
The VF1000M inverter series has been so developed, that not only the Low Voltage Directive is complied with, but also with suitable measures, the EMC Directives - even strict directives for residential areas can be observed. The acceptance of the device takes place under laboratory conditions at the accredited Schenk Commercial Test Centre and is not bindingly transferrable to a machine or system in its installed condition.

Installation information is given in the diagram below to aid the achievement of optimum installation.

You will achieve correct EMC installation ...

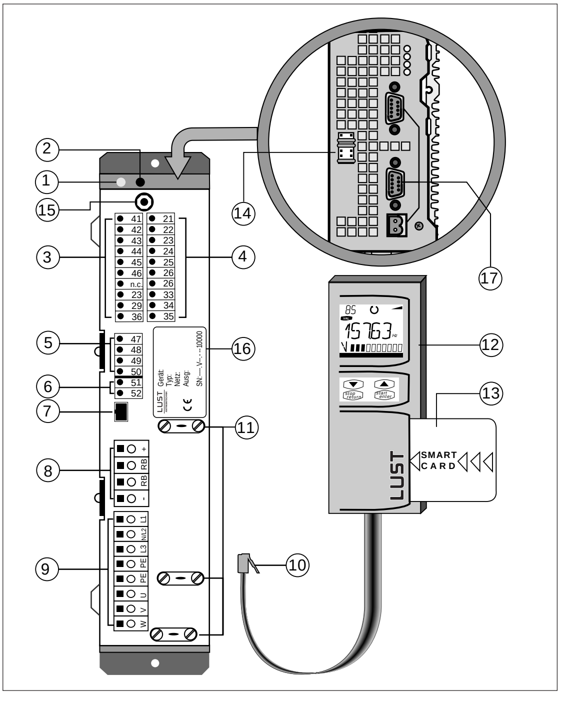



[1] Necessary cable lengths > 0.3 m

**Important:** For further information see Chapter 2

# 1 Technical data

## 1.1 Assembly and layout plan




**1** LED H2 (green) operation indicator

**2** LED H1 (yellow) error indicator

**3** Terminal X6/1 control outputs

**4** Terminal X6/2 control inputs

**5** Terminal X5 for interface design (RS485/RS232)**

**6** Terminal X4, for motor PTC**

**7** Connection socket for X3 for control unit KEYPAD KP100

**8** Terminal X2, connection for ext. braking resistance* and DC-link coupling (+,-)

* Accessories, see data booklet VF1000

** Designs, see data booklet VF1000

**9** Terminal X1 power connections

**10** KEYPAD plug

**11** EMC ground clamps for cable screen

**12** Control unit KEYPAD KP100*

**13** SMARTCARD* memory card

**14** Jumper rail J1 ... J6

**15** ⏚ Connecting point for grounding line

**16** Type plate

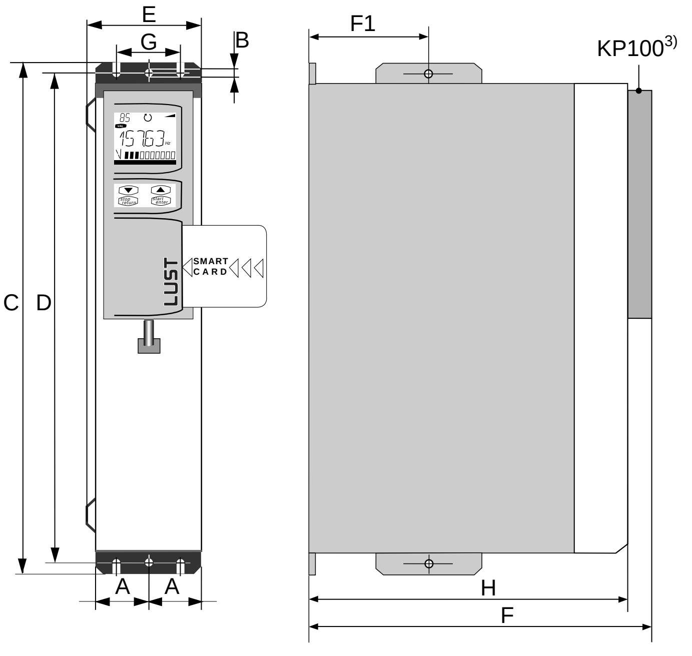
**17** Bus connections (CAN-Bus, INTERBUS-S, ...)**

## 1.2 Data table

| | Des. | Dim. | VF1205 M | VF1207 M | VF1404 M | VF1406 M | VF1408 M | VF1410 M |
|---|---|---|---|---|---|---|---|---|
| *Output on motor side* | | | | | | | | |
| Recom. rated power with 4 pole standard motor | P | kW | 1.1 | 1.5 | 1.5 | 2.2 | 3 | 4 |
| Device power | S | kVA | 1.9 | 2.6 | 2.6 | 4.0 | 5.3 | 6.3 |
| Rated current [1] (230 V) | $I_N$ | A | 4.5 | 6.2 | - | - | - | - |
| Rated current [1] (400/460 V) | $I_N$ | A | - | - | 3.5/3.1 | 5.5/4.7 | 7.2/6.3 | 8.9/7.7 |
| Cont. current [1] (230 V) | $1.1xI_N$ | A | 5.0 | 6.8 | - | - | - | - |
| Cont. current [1] (400/460 V) | $1.1xI_N$ | A | - | - | 3.8/3.4 | 6.0/5.1 | 7.9/6.9 | 9.8/8.5 |
| Overload current [1] for 60s | $1.5xI_N$ | A | 6.8 | 9.3 | 5.3/4.7 | 8.3/7.7 | 10.8/9.5 | 13.3/11.6 |
| Voltage | U | V | 3 x 0...230 | | 3 x 0 ... 400/460 | | | |
| Rotary field frequency | f | Hz | 0...400 | | | | | |
| Frequency definition | f | % | 0.1 of FMAX (0.05 Hz min.) | | | | | |
| Load type | - | - | ohmic/inductive | | | | | |
| Short circuit proof | - | - | at the terminals | | | | | |
| Ground-fault proof | - | - | according to each mains in. | | | | | |
| *Input on mains side* | | | | | | | | |
| Mains voltage | U | V | 1 x 230 +15/-20% | | 3 x 400/460 +10/-15% | | | |
| Mains frequency | f | Hz | 50/60 +/- 10% | | | | | |
| Connection diameter | A | mm² | max. 2.5 | | | | | |
| Recom. fusing | I | AT | 1 x 16 | 1 x 16 | 3 x 10 | 3 x 10 | 3 x 16 | 3 x 16 |
| Assymetry of mains volt. | U | % | - | | 3 maximum | | | |
| *General* | | | | | | | | |
| Operating mode | - | - | 2 quadrats (4 quadrats)[2] | | | | | |
| Peak braking power[2] | $P_{Sp}$ | kW | 1.65 max. | | | | | |
| Cyclical braking mode[2] | $P_{eff}$ | W | 90 | | | | | |
| Power loss[3] | $P_V$ | W | 65 | 82 | 80 | 100 | 120 | 150 |
| Efficiency[3] | $\eta$ | % | 95 | 95 | 95 | 95 | 95 | 95 |
| *Ambient conditions* | | | | | | | | |
| Cooling air temperature | T | °C | 0 ... 40 (to 1000 m and NN) | | | | | |
| Ventilation type | - | - | Convection | | | force-ventilated | | |
| Relative air moisture | - | % | 15 ... 85 not saturated | | | | | |
| Power reduction in relation to cooling air temperature - | $\Delta P_T$ | - | 2.5 % /°C (in range 40 ... 50 °C) | | | | | |
| Power reduction in relation to the installation height | $\Delta P_H$ | - | 5 % per 1000 m (in range 1000 ... 2000 m and NN) | | | | | |
| Permissible vibration | - | - | 2 g (IEC 68-2-6) | | | | | |
| *Mechanics* | | | | | | | | |
| Weight (without packaging) | - | kg | 3.75 | | | | | |
| Protection | - | - | IP20, VBG4, NEMA 1 | | | | | |
| Installation | - | - | upright wall mounting | | | | | |

1) based on the switching frequency of the end level of 8 kHz
2) only with BR1 design
3) with rated voltage and rated current

## 1.3 Scale drawing




### Dimension table

| Device type | A | B | C | D | E | F | F1 1) | G | H |
|---|---|---|---|---|---|---|---|---|---|
| VF1205M...VF1404M | 32.5 | 4.8 $\phi$ | 330 | 315 | 69 | 260 | 112 | 40 | 245 |
| VF1406M...VF1410M | 32.5 | 4.8 $\phi$ | 344 2) | 315 | 69 | 260 | 112 | 40 | 245 |

All dimensions in mm

1) For level assembly see Chapter 1.4 Device assembly

2) Devices have a fan on their bottom side, also applies for **all** VF1000M devices equipped with integrated mains filter

3) Accessories see data booklet VF1000

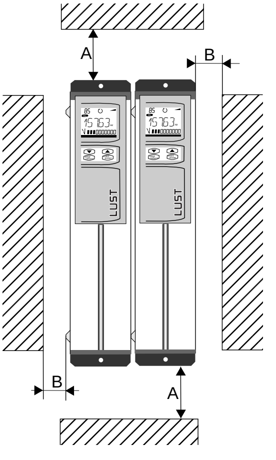
## 1.4 Device assembly

**In general:**
The installation site must be free from conductive and corrosive substances as well as dampness. Frequency inverters are intended for installation in cabinets with external air through-flow. They are fixed with 4 M4 screws on a mounting plate.
It is essential that the minimum distances above and below the device are observed to avoid overheating. The ventilation opening on the top side may not be covered or blocked under any circumstances.
The arrangement of several devices in a row is permissible.

**Caution:**
It should be ensured that foreign bodies such as drilling chips or screws do not drop into the device during installation of the inverter. This could result in destruction of the device.

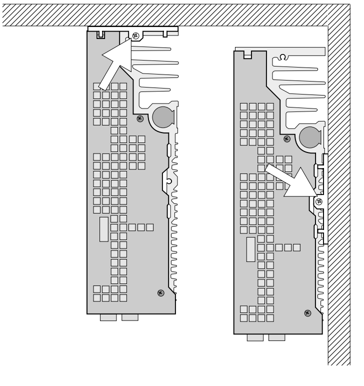
**Installation distances:**
Among other factors, the size of the cabinet is related to the power losses of the inverter (see power table). In order to avoid overheating in the cabinet, it is essential that the appropriate installation distances are observed. This guarantees safe long-term operation.

A = 100 mm
B = 50 mm



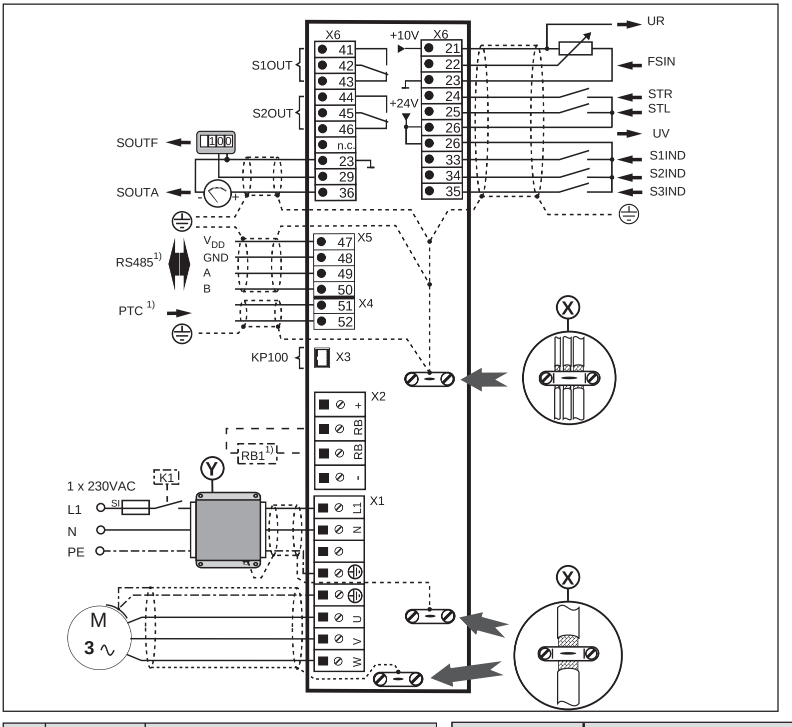

**Level assembly:**
Under special installation conditions it is possible to install the device level with the heat sink mounted against the wall. For this purpose the two supporting brackets must be re-mounted according to the drawing.

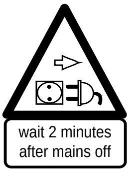
**Exception:**
Level installation is not possible with VF1406M, VF1408M,VF1410M and with all VF1000Ms with integrated network filter design



# 2 Electrical Connections

## 2.1 Connection plan



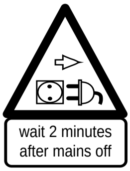

Attention:
Starting torque of terminal X1 and X2 max. 0,4-0,5 Nm

VF1205M
VF1207M

| X6 | Des. | Control connections |
|---|---|---|
| 21 | UR | Ref. voltage 10 V<br>for ref. pot. |
| 22 | FSIN | Freq. ref. input |
| 23 | Ground | Control unit ref. point |
| 24 | STR | Start clockwise input |
| 25 | STL | Start counter-clockwise input |
| 26 | UV | Control voltage 24 V DC |
| 29 | SOUTF | Digital freq. output |
| 33 | S1IND | Prog. digital input |
| 34 | S2IND | Prog. digital input |
| 35 | S3IND | Prog. digital input |
| 36 | SOUTA | Prog. analog output |
| 41<br>42<br>43 | S1OUT | Break contact of relay 1<br>Cent. spring of relay 1<br>Make contact of relay 1 |
| 44<br>45<br>46 | S2OUT | Break contact of relay 2<br>Cent. spring of relay 2<br>Make contact of relay 2 |

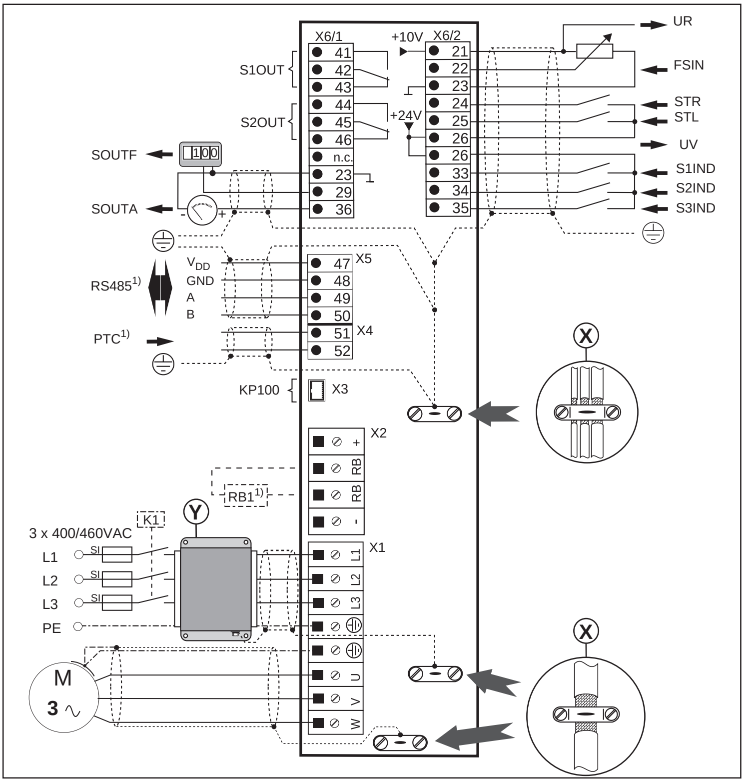
| X1 | Power connections |
|---|---|
| L1,N,⏚ | Mains connection 1 x 230 V |
| ⏚U,V,W | Motor connection 3 x 230 V |
| **X2/ + , -** | Connection for DC-link coupling |
| **X2/ RB** | Connection for ext. braking resistor |
| **X3** | Socket for<br>control unit KeyPad KP100 |
| **X4/51, 52** | Motor PTC connection[1)] |
| **X5/<br>47,48,49,50** | Connection terminal for<br>interface RS485[1)] or RS232[1)] |
| **K1** | Example of mains protection<br>connection |
| **Y** | Example of connection for ext.<br>mains filter |
| ⏚ | Ground line |
| **X** | EMC ground clamps for easy<br>installation of cable screen |

1) Terminal assignment depends on design ordered




Attention:
Starting torque of terminal X1 and X2
max. 0,4-0,5 Nm

VF1404M
VF1406M
VF1408M
VF1410M




| | | |
|---|---|---|
| 21 | UR | Ref. voltage 10 V<br>for ref. pot. |
| 22 | FSIN | Freq. ref. input |
| 23 | Ground | Control unit ref. point |
| 24 | STR | Start clockwise input |
| 25 | STL | Start counter-clockwise input |
| 26 | UV | Control voltage 24 V DC |
| 29 | SOUTF | Digital freq. output |
| 33 | S1IND | Prog. digital input |
| 34 | S2IND | Prog. digital input |
| 35 | S3IND | Prog. digital input |
| 36 | SOUTA | Prog. analog output |
| 41<br>42<br>43 | S1OUT | Break contact of relay 1<br>Cent. spring of relay 1<br>Make contact of relay 1 |
| 44<br>45<br>46 | S2OUT | Break contact of relay 2<br>Cent. spring of relay 2<br>Make contact of relay 2 |

| **X1** | **Power connections** |
|---|---|
| L1,L2,L3 ⏚ | Mains connection 3 x 400/460 V |
| ⏚ U,V,W | Motor connection 3 x 400/460 V |
| **X2/ + , -** | Connection for DC-link coupling |
| **X2/ RB** | Connection for ext. braking resistor |
| **X3** | Socket for<br>control unit KeyPad KP100 |
| **X4/51, 52** | Motor PTC connection[1)] |
| **X5/<br>47,48,49,50** | Connection terminal for<br>interface RS485[1)] or RS232[1)] |
| **K1** | Example of mains protection connection |
| **Y** | Example of connection for ext. mains filter |
| ⏚ | ground line |
| **X** | EMC ground clamps for easy installation<br>of cable screen |

1) Terminal assignment depends on design ordered

**Caution:** The connected mains may not exceed the following effective voltages for all devices in this manual:

| | | | | |
|---|---|---|---|---|
| VF1205M... VF1207M | L1 **->** | | N | 230VAC |
| | L1 **->** | | ⏚ | 230VAC |
| VF1404M... VF1410M | L1 **->** | L2 **->** | L3 | 460VAC |
| | L1/L2/L3 **->** | | ⏚ | 270VAC |

## 2.2 Fault transmission/interference immunity (EMC)

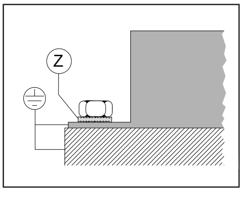
All SmartDrive frequency inverters of the M series fulfil the requirements of EMC interference immunity in industrial areas according to the EC Directives/European Norms 89/336/EEC, prEN 50 062-2 (for this also see CE acceptance test in Chapter A).

The certified EMC testing of the fault resistance of the inverter is according to prEN 50082-2/01.93.

**It is essential the following instructions are observed when installing an inverter in a machine for example, so that the EMC statute is complied with:**

⇒ The motor cable, the mains cable and the control cables should be separated from each other and screened.

⇒ The device should be screwed onto a well grounded mounting plate. A toothed washer (Z) must be placed under each of the fixing screws of the device, so that the inverter housing has good contact to the mounting plate.




⇒ The screen of the mains and motor cable is clamped in place directly with the conductive cable clamps labelled in the circuit diagram.

⇒ The screen of the control cables is also directly clamped in place with the cable clamps labelled in the circuit diagram. As long as the sum of diameters allow it, several control cables can be clamped under one cable clip.

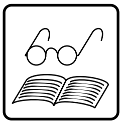
⇒ The terminal box of the motor must be HF-proof. It must therefore be made from metal or metallised plastic.

⇒ The bushing for the motor cable at the terminal box should be made from a conductive cable screw connection with screen linkage.

## 2.3 Power connections

### 2.3.1 Mains connection

**In general**
The inverters must be connected to the mains according to VDE regulations, so that they can be isolated from the mains at any time with appropriate releasing devices e.g main switches.

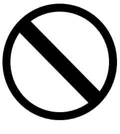


**Note:**
Once the inverter is connected to the mains, the internal DC-link is then loaded. This means that the inverter is not ready for operation until a certain switch-on delay has elapsed. Hence mains connection can only be repeated at long time intervals **(at least 60 s)**. Jogging operation with the mains protection is not possible.

**Caution:**
Due to the high current flows (> 3.5 mA) the use of fault current breakers on their own is not permissible. Hence a ground line is urgently prescribed.

The mains fusing must be laid out, according to the current loading of the connecting cable according to DIN 57100 (see recommendation in the power table). When using circuit breakers, only those with triggering characteristics B or C can be employed.

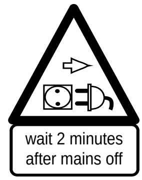
**VF1205M, VF1207M connection**
The mains connection (1 x 230 V) is via terminals L1, N, ⏚.
Technical data see data table.



**Caution!**
Never connect 400/460 V to terminals L1 and N. The device would be destroyed by the excess voltage.

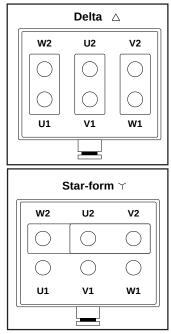
**VF1404M ... VF1410M connection**
The mains connection (3 x 400/460V) is via terminals
L1, L2, L3, ⏚. Technical data see data table.

## 2.3.2 Motor connection




**In general:**
Standard phase motors are designed in the power range up to 4 kW according to IEC34 for various mains supplies in delta- (3∗230 V) and in star-form (3∗400 V).

When using special phase motors not in accordance with IEC34, information in relation to the connection type should be obtained from the manufacturer.




**VF1205M, VF1207M connection**

The motor connection is via terminals ⏚,U,V, W.
The motor must be connected to (3∗230 V).

**VF1404M... VF1410M connection**

The motor connection is via terminals ⏚,U,V,W.
The motor must be connected to (3∗400 V).

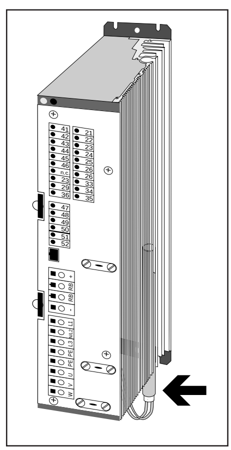
## 2.3.3 Braking chopper (BR1)

**In general:**
If the rotor speed is greater than the corresponding stator speed (rotary field of the inverter), the motor feeds energy back into the inverter. In this braking mode, the inverter brakes the motor, by means of the DC-link capacitors absorbing the braking energy.

**BR1 design:**

In this design, a braking resistance is built into the device's heat sink which is connected via the standard braking chopper electronics installed.

| | | |
|---|---|---|
| Peak braking power | $P_{BrSp}$ | = 1650 W |
| Switching duration | $t_{on}$ | = 12 s max. |
| switch-on duration | - | = 6 % |
| Cyclical braking mode | $P_{BrD}$ | = 90 W |



*Example:*

| **Braking time:** | **Pause time:** |
|---|---|
| $t_{on}$ = 12 s (6 %) ⇒<br>$t_{on}$ = 3 s (6 %) ⇒<br>$t_{on}$ = 1 s (6 %) ⇒ | $t_{off}$ = 200 s (94 %)<br>$t_{off}$ = 50 s (94 %)<br>$t_{off}$ = 17 s (94 %) |

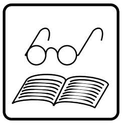
## 2.3.4 Motor temperature monitoring (PTC/ PT1 design)

A thermistor (PTC) or a thermal circuit breaker can be connected to the terminals X4/ 51 + 52 for monitoring the motor coil. The input is potential-free. There are 2 design versions available:

| | | |
|---|---|---|
| **PTC design** | ⇨ | Thermistor evaluation according to DIN 44081/44082 with short circuit detection |
| **PT1 design** | ⇨ | For use of thermal circuit breaker (Klixon) |

**Specification:**

| **PTC and PT1 design** | | |
|---|---|---|
| Terminal voltage | $U_{MAX}$ | ≤ 7.5 V |
| Current | $I_{MAX}$ | ≤ 3 mA |
| Switching threshold | $R_{ST}$ | 3600 Ω (nominal) |
| Reactivation value | $R_{WST}$ | < 1600 Ω |
| **Only PTC design** | | |
| Switching point with short circuit | $R_K$ | < 50 Ω |

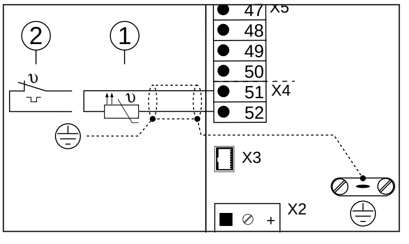


**Note:** In the PTC or PT1 design, the device is supplied with an installed resistance (100Ω on Cl. X4/51or 52). When connecting a motor PTC or thermal circuit breaker, the resistance should be removed in advance.

**Terminal assignment**:

(1) = Motor PTC

(2) = Thermal circuit breaker



## 2.4 Control connections

### 2.4.1 Specification

| Connection | Specification |
|---|---|
| Reference output UR | 10 V ± 2.5%<br>short circuit proof<br>Load capacity max. 10 mA |
| Supply output UV | 24 V ± 10%<br>short circuit proof<br>Load capacity max. 100 mA |
| Frequency reference input FSIN (analog) | 0...10 V, $R_i$ = 100 kΩ<br>4...20 mA, $R_i$ = 500 Ω<br>Resolution 10 BIT<br>Deviation ± 2.5% from final value<br>Software filter up to123 ms |
| Frequency reference input FSIN (digital) | LOW < 5 V, HIGH > 5 V (max. 30 V)<br>Pulse width 10 ms min.<br>Deviation ± 0.8 % |
| Digital control inputs STR, STL, S1IND, S2IND, S3IND | LOW < 7 V, High > 14 V (max. 30 V)<br>Current intake (at 24 V) = 10 mA max.<br>SPS compatible, +24 V-logic against ground<br>Hardware filter 3.3 ms |
| Digital frequency output SOUTF | Not short circuit proof, switching current = 12 mA<br>LOW-Impulse, LOW-Level approx. 1 V<br>Pulse-Pause Ratio 1 : 1<br>6-fold output frequency<br>with stand still HIGH = 24 V (int. pull-up resist.) |
| Analog output SOUTA | Not short circuit proof<br>Output voltage 10 V<br>Load capacity (up to 10 V) = 8 mA<br>Resolution 10 BIT |
| Relay outputs S1OUT, S2OUT | Switching voltage 250VAC<br>Switching current 1 A max.<br>Switching delay 10 ms max. |

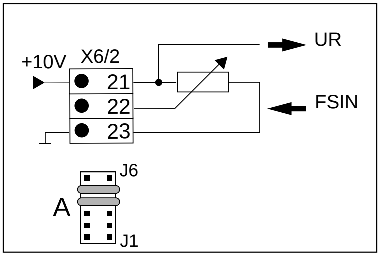
## 2.4.2 Function of the FSINA reference input

### Analog frequency FSINA reference input

The rotary field frequency is preset via the X6/2-22 terminal. The input is adapted to the respective triggering method via the J3, J4, J5, J6 jumpers. There are three options for this:

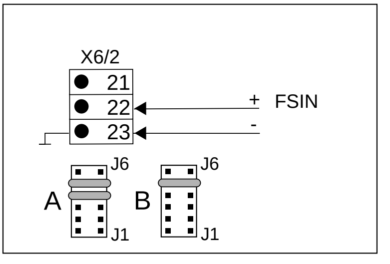
**Connection of a potentiometer (4.7... 10 kΩ)**

Adaption:
Jumper position A
04-FSSEL = 0 factory setting



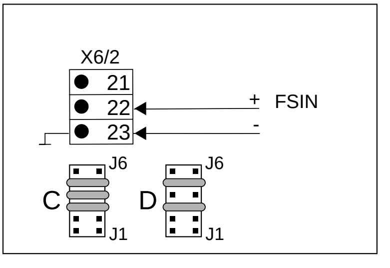

**External voltage reference 0 (2)...10 V DC**

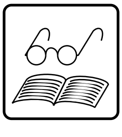
Adaption:
Jumper position A 0... 10 V
Jumper position B 2... 10 V
04-FSSEL = 0 factory setting




**External current reference 0(4)...20 mA**

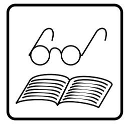
Adaption:
Jumper position C 0... 20 mA
Jumper position D 4... 20 mA
04-FSSEL = 0 factory setting



Position of jumpers J1...J6, on the device upper side (see layout plan Chap.1).

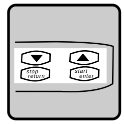
**Note:**
The inverter can be started via the frequency reference input with preset direction of rotation.



FS > 0.5 Hz → START

FS < 0.25 Hz → STOP

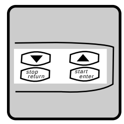
In addition to the adaption of the FSINA input to the jumper rail, the device software offers adaption options with the KEYPAD or via the interface.



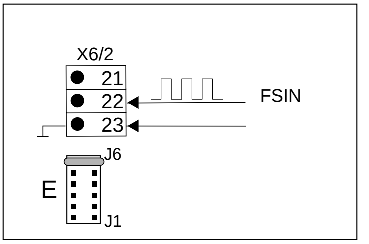

The parameter 04-FSSEL (frequency reference selector) determines the origin of the frequency reference (see table). Also see parameter description.

**FSINA(F) digital frequency reference input**

| 04-FSSEL | Function |
|---|---|
| 0 | Analog input active, adaption via jumper rail J1...J6 |
| 1, 2 | No function |
| 3 | FSIN as frequency input 0 to 1 kHz active |
| 4 | FSIN as frequency input 0 to 10 kHz active |
| 5 | FSIN as PWM input 20 to 100% active |
| 6 | FSIN as PWM input 0 to 100% active |
| 7 | FSIN not active, reference via KP100 (CTRL-menu) |
| 8 | Reference preset via interface |
| 9 to 16 | Reference presetting see Chapter 6 Page 6-4 |
| 17 to 22 | Correction of the analog reference via S1IND/S2IND (MOP function) active |
| 23 | Inverted analog input: 10 V => FMIN, 0 V => FMAX |

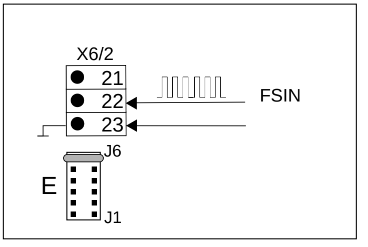


**External frequency reference input 0...1 kHz**



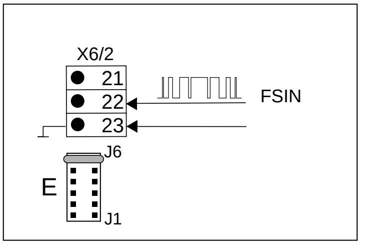

| | |
|---|---|
| Scaling: | FMIN → FMAX |
| | 0 . . . 1 kHz |
| Adaption: | Jumper position E |
| | 04-FSSEL = 3 |
| Amplitude: | 30 V max. |
| Impulse width: | 10 µs min. |

**External frequency reference input 0 ... 10 kHz**



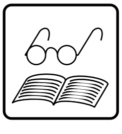

| | |
|---|---|
| Scaling: | FMIN → FMAX |
| | 0 . . . 10 kHz |
| Adaption: | Jumper position E |
| | 04-FSSEL = 4 |
| Amplitude: | 10 V max. |
| Impulse width: | 10 µs min. |

**External frequency reference default with PWM-Signal**




| | |
|---|---|
| Scaling: | 20 . . . 100% (FMAX) |
| Adaption: | Jumper position E |
| | 04-FSSEL = 5 |
| Scaling: | 0 . . . 100% (FMAX) |
| Adaption: | Jumper position E |
| | 04-FSSEL = 6 |

Condition: PWM basic frequency 0.9...8 kHz

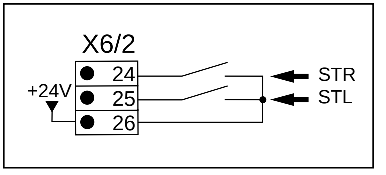


For further details see Chapter 6.1 Reference input. Position of jumpers J1...J6, on the top side of the device (see layout plan, Chap.1).

## 2.4.3 Control functions with STR/STL

**Mains connection with STL/STR**
For reasons of safety, the inverter may not be connected to the mains with the preselected control function STL or STR. The start function does not recognize the inverter until it has been activated **after** power on and self-test.

The direction of rotation is selected via the inputs STR or STL, using 2 switch contacts according to the circuit diagram. Alternatively, direction of rotation selection via 2 external voltage signals according to the specification of the control connections is also possible.




**START**

The inverter starts up when an STL or STR control signal and a reference for the rotary field frequency of at least 0.5 Hz = 0.1 V at FSIN are available.

**STOP**

The inverter stops when the STL or STR control signals are returned. The connected motor comes to a halt by itself, i.e. without braking.

**BRAKING/STOP**

The inverter brakes the motor until STOP, when two control signals are simultaneously available at STL and STR. When both signals are set to zero there is a restart.

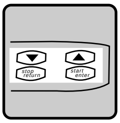
**REVERSING**

The direction of rotation is reversed if the control signal is changed directly from one control input (e.g. STL) to another (e.g. STR).

The overlap time must be a min. of **8 ms**.

| STL | STR | Explanation |
|---|---|---|
| 0 | 0 | STOP, Motor uncontrolled |
| 1 | 0 | START, Counter-clockwise with RACC/RDEC |
| 0 | 1 | START, Clockwise with RACC/RDEC |
| 1 | 1 | BRAKING, Motor is controlled to STOP |
| 0 | 1 | Reverse direction of rotation |
| 1 | 0 | |

## 2.4.4 Control function via S1IND/S2IND/S3IND



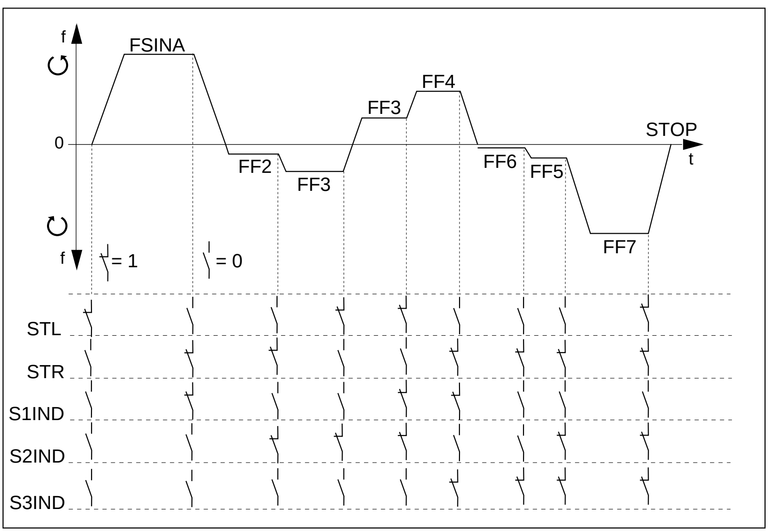
**Selection of fixed frequencies**
In addition to the FSINA input, the frequency reference can be preselected via the control inputs S1IND/S2IND/S3IND as fixed frequency. 3 fixed frequencies can be selected, which can be activated according to the truth table.
The truth table below relates to the factory settings,
Parameter **31-KSEL = 0** (data set selector).

Truth table

| S1IND | S2IND | S3IND | Speed reference | Factory setting |
|---|---|---|---|---|
| 0 | 0 | 0 | FSIN Analog input* | FMAX = 50 Hz |
| 1 | 0 | 0 | 20-FF2-1 [27FF2-2] | FF2 = 5 Hz [3 Hz] |
| 0 | 1 | 0 | 23-FF3 | FF3 = 15 Hz |
| 1 | 1 | 0 | 24-FF4 | FF4 = 30 Hz |
| 0 | 0 | 1 | 25-FF5 | FF5 = 3 Hz |
| 1 | 0 | 1 | 26-FF6 | FF6 = 0 Hz |
| 0 | 1 | 1 | 30-FF7 | FF7 = 50 Hz |
| 1 | 1 | 1 | 22-FMAX1 [29-FMAX2] | FMAX = 50 Hz |

*Note the settiing of 04-FSSEL.

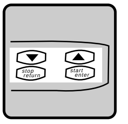
Example of sequence diagram



**Data set changeover**

The inverter has two data sets, which can be switched with the control inputs S1IND/S2IND. Each data set has a total of l8 parameters, which can be set individually (see parameter description).

The truth table below refers to parameter **31-KSEL = 2** (data set selector)




Truth table

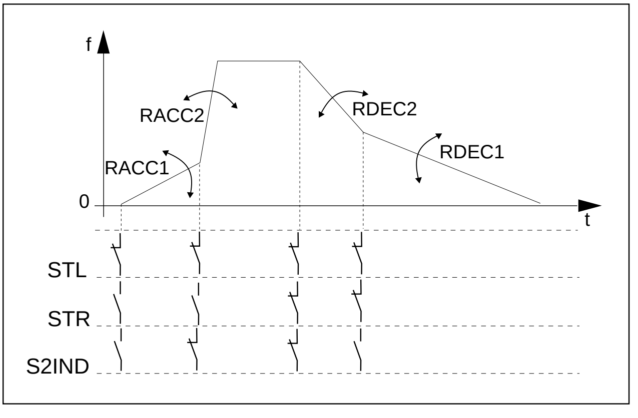
| S1IND | S2IND | Explanation | Data set |
|---|---|---|---|
| 0 | 0 | FSINA input active | 1 active |
| 1 | 0 | FF2-1 fixed frequency active | 1 active |
| 0 | 1 | FSINA input active | 2 active |
| 1 | 1 | FF2-2 fixed frequency active | 2 active |

**Ramp changeover**

As a consequence of the data set changeover option, the inverter has 2 ramp pairs available. The following sequence diagram illustrates the function of the ramp changeover (with 31-KSEL = 2).

For more detailed information see parameter description.

Sequence diagram



## 2.4.5 MOP function with S1IND/S2IND

### Definitions

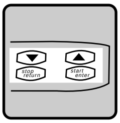
Base value preset analog speed reference at FSIN input

Offset Ratio of elevation or lowering from base value, influenced by inputs S1IND and S2IND

S1IND Input of offset setting for reference increase

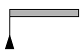
S2IND Input of offset setting for reference decrease

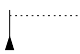
Reference input, which is raised or lowered by the ratio of the offset (Base value +/- Offset)




| 04-FSSEL = > | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|
| Reset offset with S1IND = 1, S2IND = 1 | | x | | x | | x |
| Reset offset with braking ramp RSTOP | | | | | x | x |
| Retain offset when power off (EEPROM memory) | | | x | x | | |

### Explanation of diagrams in examples:


Input active


Input inactive


RDEC1 Braking ramp with counter-clockwise rotation

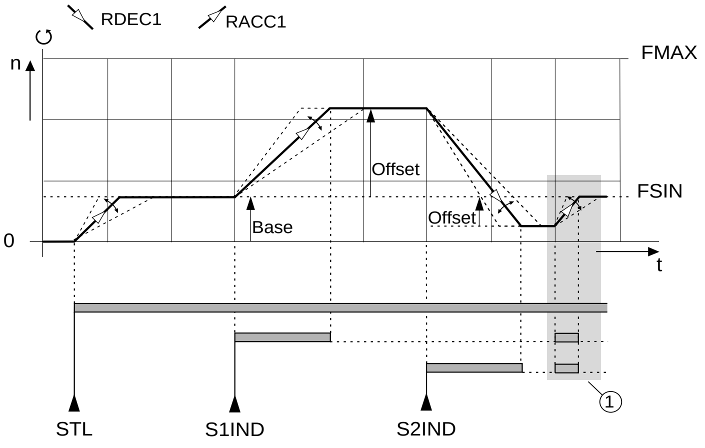

RDEC1 Braking ramp with clockwise rotation


RACC1 Acceleration ramp with clockwise rotation


RACC1 Acceleration ramp with counter-clockwise rotation


RSTOP Braking ramp (Param. 36-RSTOP)

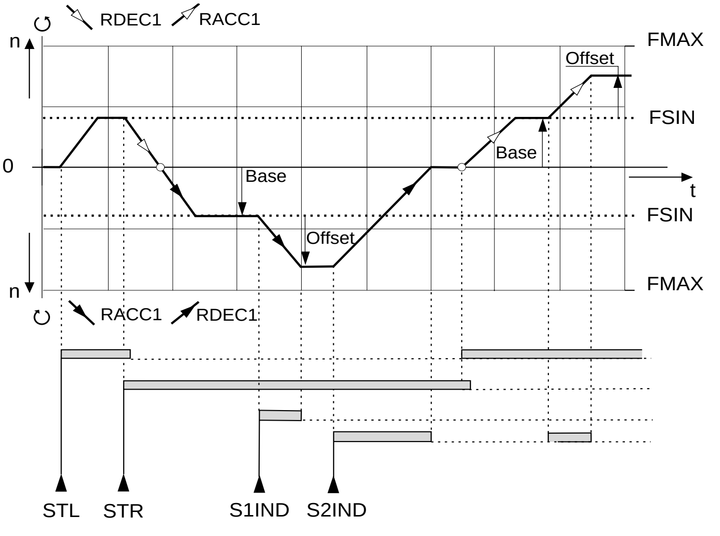
**Example: Basic function with reset to base value**




**Key:** ① Resetting of the reference to the base value (only possible with 04-FSSEL =18/20/22).

**Example: Direction of rotation with STL and STR**

The setting parameter applies 04-FSSEL = 17/18/19/20/21/22



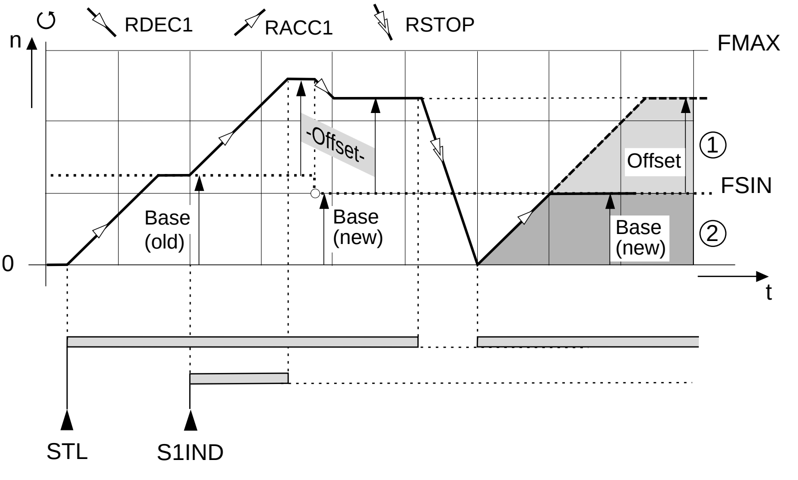

**Note:** When reversing, the signals at STL and STR must overlap by at least. 0.5 s.

**Example: Reduction of the base value, reset offset with RSTOP**

With setting parameter applies 04-FSSEL = 17/18/19/20/21/22

**Important:** The braking ramp RSTOP is only active, if a value ≥ 1 Hz/s is set in the parameter (factory setting = 0 Hz/s).

**Caution:** With the reduction of the base value to 0 Hz the drive comes to a stand still, however the condition should not be confused with a stop command. If the base value is raised while the S2IND signal is at hand, the drive is restarted (to new base value with old offset).



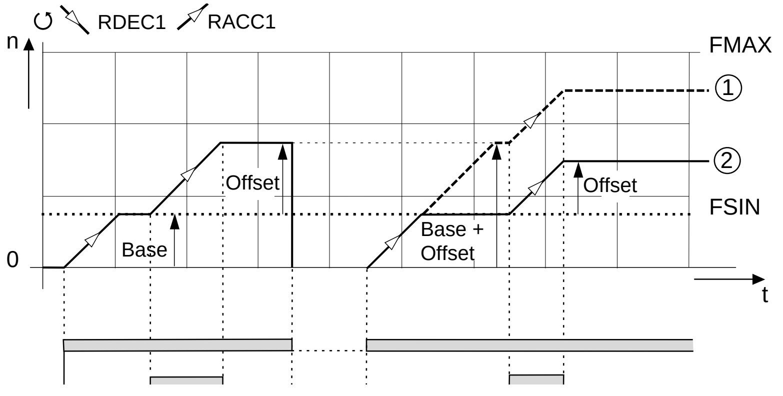

**Key:**

① Only possible with 04-FSSEL = 17/18/19/20
(Offset is retained)

② Only possible with 04-FSSEL = 21/22
(Offset is reset)

**Example: Saving the offset after power off**

**Note:** If the mains is switched off, the drive comes to a stop by itself. When the mains is reconnected and a new start signal, the drive is accelerated from 0 Hz.
If the STL contact remains active during power off, the drive does not start. The drive does not accelerate to the base value until after a new STL edge.
If an automatic restart required after power return, the auto start function must be activated in the parameter 72-STRT (see Chapter 6).



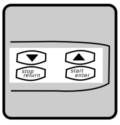

**Key:**

① Offset is saved with power off
(only possible with 04-FSSEL = 19/20).

② Offset is lost with power off
(with 04-FSSEL = 17/18/21/22).

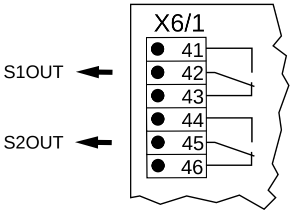
## 2.4.6 Signal outputs

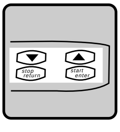
**S1OUT collective error message** (Relay output)
The operating contact Kl. 41/42 is closed, if there is a inverter malfunction. The contact opens again, if the fault has been rectified or the mains have been disconnected.




The error message is acknowledged by pressing the stop/return key for at least 3 secs or by a signal to one of the digital inputs (see Parameter 75-OPT1 Page 6-20).

**S2OUT stand-by** (Relay output)
The make contact Kl. 44/45 is closed, as soon as the pre-charging is completed after power on and there is no fault. The make contact Kl. 44/45 is opened, as soon as a fault arises or the mains is switched off.

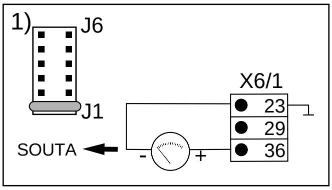


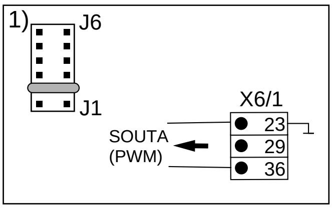

**Programming:**
Both outputs can be set to one of 10 different functions with the KeyPad or via the interface. The function description relates to the following factory settings:
Parameter 62-S1OUT = 10
Parameter 63-S2OUT = 1

Further information see parameter description, Chapter 6.

**SOUTA analog output**
The output operates in the basic setting as an analog frequency output. It delivers a direct voltage, which is proportional to the output frequency of the inverter.

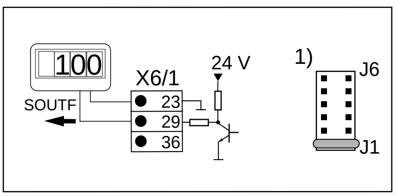



| SOUTA (J1) | Explanation (61-SOUTA = 9) |
|---|---|
| 0 V | F = 0 Hz |
| 10 V | Inverter start, F = FMAX |



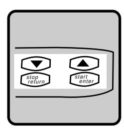

| SOUTA (J2) | Explanation (61-SOUTA = 9) |
|---|---|
| PWM = 0 % | F = 0 Hz |
| PWM = 100 % | Inverter start, F = FMAX |

**SOUTF digital frequency output**
The output SOUTF supplies 24 V impulses. 6 LOW impulses are issued per 1 Hz rotary field frequency at the frequency output. At stand still, the output is at +24 V.




| FSIN | SOUTF |
|---|---|
| < 5 Hz | 30 Hz constant |
| 5...260Hz | 30...1560Hz linear |
| > 260 Hz | 1560 Hz constant |

1) Position of jumpers (J1...J6) at device top side
(see layout plan Chapter 1).



**Programming:**
The outputs SOUTA and SOUTF can be programmed with KeyPad or via the interface to further functions. For both outputs setting is undertaken with the parameter 61-SOUTA. In addition the analog output SOUTA can be scaled with the parameter 69-KOUTA.

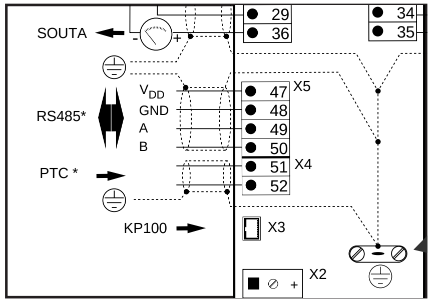
Factory setting: 61-SOUTA = 9
69-KOUTA = 100%

For further information see parameter description

## 2.4.7 LustBus connection (Design C9/ C12)

**C9 design:**
The VF1000 Series M inverters in this design have a potential-free interface connection **RS485.** The inverters can be operated via this interface according to the LustBus data transmission protocol.

Terminal assignment see Fig.:



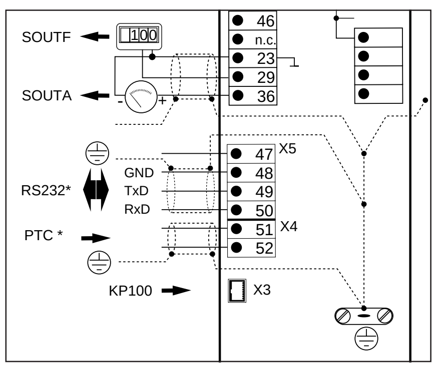

An external 24 V DC supply ($V_{DD}$) is necessary to operate the interface.

Technical data:

| | Des. | RS485 |
|---|---|---|
| Voltage supply ext. | $V_{DD}$ | 24 VDC ±15% |
| Current intake | I | approx. 50 mA |
| Isolation | - | corresponds to VDE 0884, Protective low voltage |
| Driver power | - | RS485: 31 participants, removal < 1000 m |
| Bus termination | - | not installed |
| Transmission rate | - | fixed 9600 Baud |

**C12 design:**
The VF1000 Series M inverters in this design have a potential-free interface connection **RS232**. The inverters can be operated via this interface according to the LustBus data transmission protocol.

Terminal assignment see Fig.:

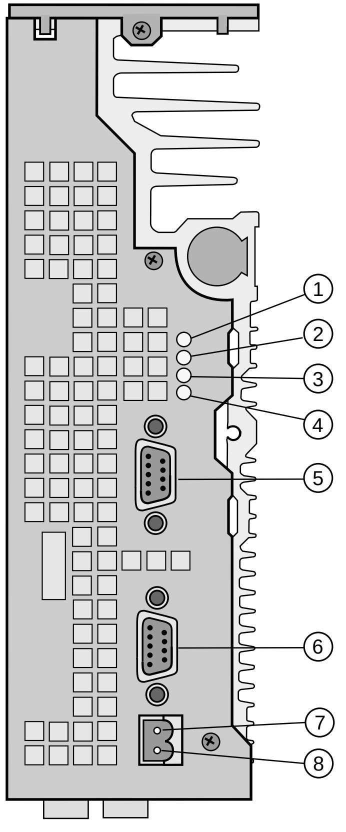



An external power supply is not necessary for the operation of the interface.

## 2.4.8 InterBus-S connection (Design C8)

**In general:**
The inverter VF1000M in the **C8** design, has an InterBus-S coupling (IBS) with external 24 V supply and remote bus interface. The inverter can be operated according to the InterBus-S data transmission protocol**.**

**Layout plan (view from above):**
An external 24V DC power supply is necessary to operate the interface.




| No. | Function |
|---|---|
| 1 | LED [RC] green |
| 2 | LED [RD] red |
| 3 | LED [BA] green |
| 4 | LED [U] green |
| 5 | X7 IBS input |
| 6 | X8 IBS output |
| 7 | Kl.54, input +24 V |
| 8 | Kl.53, GND |

The screen connection is via the plug casing.

**Connection assignment:**

| IBS output (9pin socket) | Des. | Function | IBS input (9 pins) |
|---|---|---|---|
| 1 | DO | Data Out | 1 |
| 2 | DI | Data In | 2 |
| 3 | COM | Ground | 3 |
| 5 | + 5 V | Supply | |
| 6 | /DO | /Data Out | 6 |
| 7 | /DI | /Data In | 7 |
| 9 | RBST | Plug identification | |
| 4, 8 | n.c. | not assigned | 4, 5, 8, 9 |

Technical data:

| | Des. | VF1000M, INTERBUS-S |
|---|---|---|
| Supply voltage: | $V_{DD}$ | 24 V DC, - 7% +15% |
| Current intake: | I | approx. 100 mA |
| Interface design: | - | 2 cable remote bus with ext. +24 V-supply |
| Module ID No.: | - | 59 |
| Data: | - | 2 data words via process data channel (Control word and speed reference) according to DRIVECOM specification<br>1 Data word communication channel for parameterization |

## 2.4.9 CAN-Bus connection (Design C2)

**In general:**

The VF1000 Series M inverter in the **C2 design** has the option of a CAN-Bus coupling (CAN). The Bus-Interface is isolated.

The bus is connected via two 9 pin Sub-D plugs in accordance with CiA Draft Standard 102.V2.0.

The inverters can be driven in a network with CAL protocol.

**Technical data:**

| | Des. | VF1000M, CAN-Bus acc. to ISO 11898 | |
|---|---|---|---|
| Participant number | | maximum 30 | |
| Power supply ext. | $V_{DD}$ | 24 VDC ±10% | |
| Current intake | I | 100 mA max. | |
| Transmission rate | - | up to 1 M Baud | |
| **Transmission and processing time** | | **Time on the bus** | **Time in the inverter** |
| Position command and subsequent status interrogation<br>- for 1 inverter<br>- for 30 inverters | | <br><br>0.3 ms<br>9 ms | <br><br>9 ms<br>8 ms |
| Parameter presetting<br>- for 1 inverter<br>- for 30 inverters | | <br>0.15 ms<br>4.5 ms | <br>approx. 30 ms<br>approx. 30 ms |

**Layout plan:**

To ensure uninterrupted operation of the interface, an external 24 V DC supply is necessary. Connection is via the D-Sub plug connection.

E = CAN input,
9 pin sub D pin rail  X8

A = CAN output,
9 pin sub D socket rail X7

C = jumper rail J7 ... J11

The screen connection is via the plug casing.

**Note:**
No jumpers (plug-in bridges) are inserted in the jumper rail (J7 ... J11). They are enclosed with the device in a separate bag.

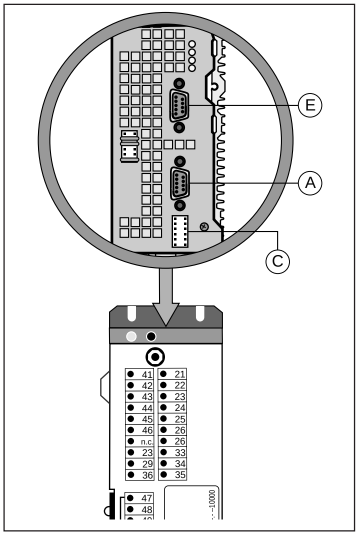
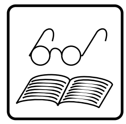



Fig. a



**Connection assignment:**

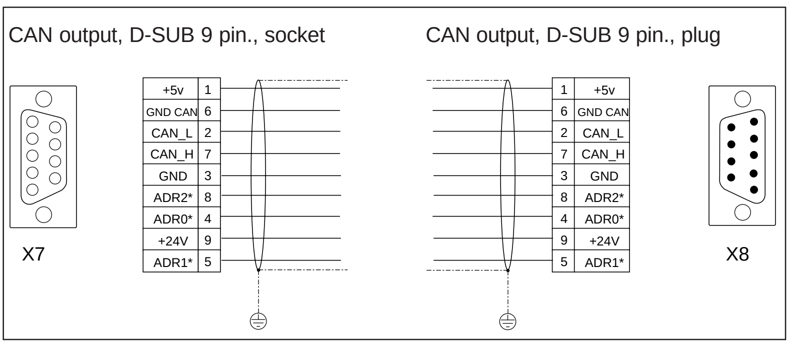


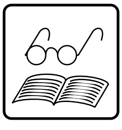

Fig. b

* Address preallocation is possible via the coding plug or optionally also via the jumper rail J7 ... J11 (not switched, if not necessary).

**Address pre-allocation:**
Addresses are allocated in binary (see table). The address pre-allocation can be achieved optionally via,

a) a parameter
b) a jumper rail J7 ... 11 on the top of the device (see Fig. c)
c) via coding plug (ADR0, ADR1, ADR2) (see Fig. b).

| **J11**<br>- | **J10**<br>- | **J9**<br>**ADR2** | **J8**<br>**ADR1** | **J7**<br>**ADR0** | **Address** |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 0 | 2 |
| : | : | : | : | : | : |
| 0 | 1 | 0 | 0 | 0 | 8 |
| : | : | : | : | : | : |
| 1 | 1 | 1 | 0 | 1 | 29 |



**Note:** 0 = Jumper not inserted
1 = Jumper inserted
J12 is unassigned.

Assignment of the jumper position

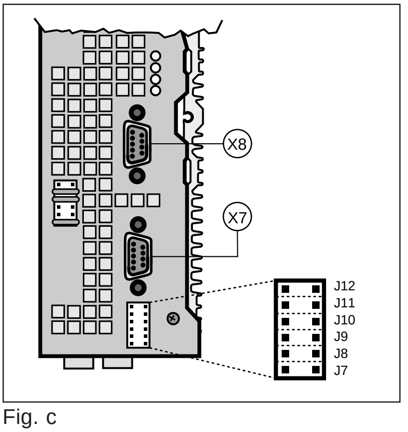


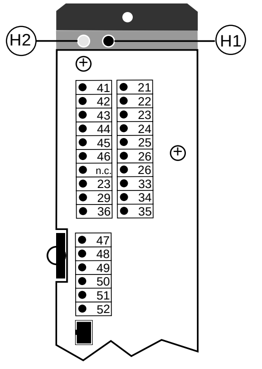

Fig. c

# 3 Operating and error diagnosis

## 3.1 Display

| H1 yellow | H2 green | Meaning |
|---|---|---|
| | | Power off, no function |
| | | Power is switched on, after approximately 0.5 s Selftest, inverter ready |
| | | Inverter is started |
| | | Overload protection active |
| | | Error shut-down, flash rhythm H1 see chap. 3.2.2. Error message |

**Position of LEDs:**




## 3.2 Warning messages (no fault reaction from the device)

**Inverter malfunction**

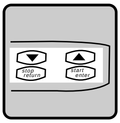
| | |
|---|---|
| ATT1 | Parameter alteration in online- mode (when motor running) not allowed. |
| ATT2 | Motor control via KeyPad in online- mode not permitted. |
| ATT3 | Access to Lust SmartCard in online- mode not permitted. |
| ATT4 | System is in fault condition. Control via KeyPad not permitted. |
| ATT5 | Motor data must be complete for the selected function e.g. I ∗ R Compensation. |
| ERROR | Invalid password |

*Acknowledge error by pressing start/enter-key.*

**Error with SmartCard-mode**

| | |
|---|---|
| ERR91 | SmartCard is write-protected |
| ERR92 | Error with plausiblity check. |
| ERR93 | SmartCard not readable, inverter/servo-controller type incorrect. |
| ERR94 | SmartCard not readable, parameter incompatible. |
| ERR96 | Connection to SmartCard interrupted. |
| ERR97 | SmartCard - data invalid (CS-Test). |
| ERR98 | Insufficient memory on SmartCard (only MC6000). |

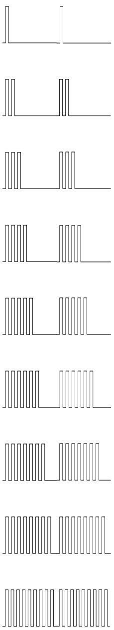
*Acknowledge error by pressing stop/return-key.*




**Programming:**
With the parameter 59-TRIP, the I∗t-trigger current is set. That means currents < $I_N$ (device nominal current) can be set. Motors with outputs smaller than the device nominal output are thus sufficiently protected from overloading .

Factory setting: 59-TRIP = $I_N$ (Device nominal current)

## 3.3 Error messages



| H1 flashes | Errors | Condition/cause | Remedy/comment |
|---|---|---|---|
| once | E-CPU | Error in computer | Switch off at mains and switch on again (Reset) |
| twice | E-OFF | Mains switched off or low voltage | flashes until UZK <150 V VF12xxL < 300 V VF14xxL |
| 3 times | E-OC | Excess current cut-off short circuit | Check drive/ motor cable/ U/f characteristics |
| 4 times | E-OV | Excess voltage, Motor generator | Check mains/drive/ braking chopper |
| 5 times | E-OLM | Motor overloaded, I ∗ t switching off | Check drive /motor/ventilation |
| 6 times | E-OLI | Inverter overloaded, I ∗ t switching off | Check drive/ventilation |
| 7 times | E-OTM | Motor temperature | Motor overloaded, check installation conditions too high* |
| 8 times | E-OTI | Inverter temperature toohigh installation conditions | Inverter overloaded, check |
| 9 times | E-EEP | Error in EE-PROM | Switch off at mains and switch on again (Reset) |

*only possible with the PTC or PT1 designs

*Acknowledge error by pressing stop/return key for at least 3 sec. or with digital signal as described under 75-OPT1 (Chapter 6).*

**Support:**
If contrary to expectations, you should have difficulties when starting up the frequency inverter, we are only to glad to be of assistance with practical help and advice. You can reach our trained technicians as follows:

Address: Lust Antriebstechnik GmbH
Gewerbestraße 5-9
D-35633 Lahnau

Phone: + 49 64 41 966 111
Fax: + 49 64 41 966 137

## 3.4 Motor/inverter-overload protection (I ∗ t monitoring)

The I∗t monitoring provides electronic motor protection and inverter protection against high thermal loading. The trigger characteristic can be taken from the diagram. The details relate to an output frequency of 50 Hz.
It should be noted that with continuous operation with frequencies < 40 Hz the motor requires forced ventilation.

**Rule of thumb:**
An overload phase of 1 min. is possible within a margin of 10 min.s with a DC current of $I = 1,5*I_N$ (150% overload)

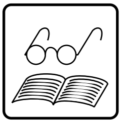
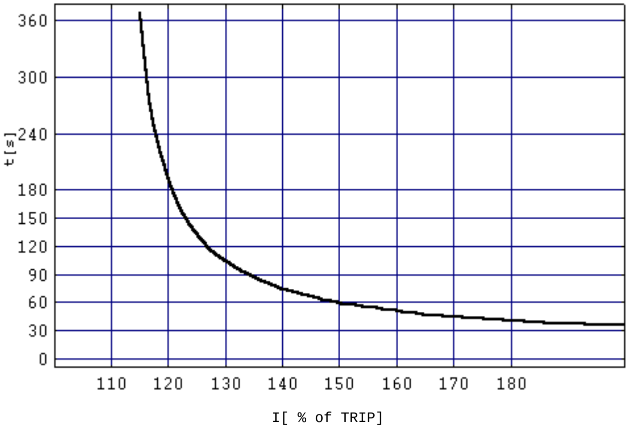
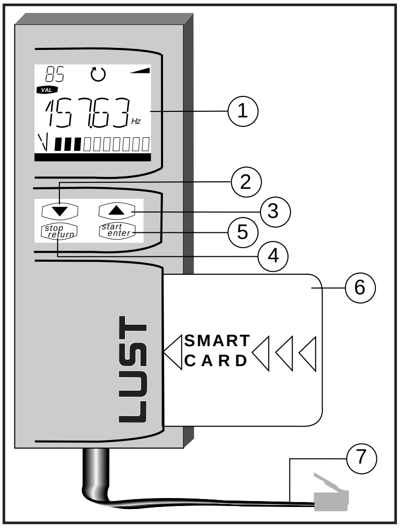


Diagram:



# 4 Operating the control unit KeyPad KP100*

## 4.1 Layout plan




**Key**

| Item | Designation | Function |
|---|---|---|
| 1 | LCD display | 140 segments, backlit in green/red |
| 2 | Arrow key downwards | Back movement (scrolling) within the menu structure |
| 3 | Arrow key upwards | Forward movement (scrolling) within the menu structure |
| 4 | Stop/return key | Stop (Menu CTRL), interrupt or quit selected menu |
| 5 | Start/enter key | Starting (Menu CTRL), confirming or selecting menu |
| 6 | SmartCard | Chip cards-data memory, storing the device setting |
| 7 | Connecting cable | Maximum length 0.30 m |

**Mechanics**

| | | | |
|---|---|---|---|
| Dimensions | WxHxD | mm | 62x158x21 |
| Weight | - | g | 100 |
| Type of protection | - | - | VBG4, IP20 |
| Ambient temperature | T | °C | 0...40 |

* Accessories

## 4.2 In general

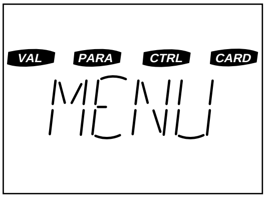
### 4.2.1 Menu branches

Once the mains is switched on, the device carries out a self-test (Display backlit in red).

The **VF1000** concludes this by jumping directly to the current value of the output frequency (Display backlit in green).

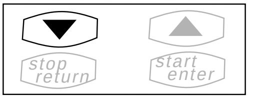
The menu branch VAL is active. When the stop/return key is pressed then the display changes to menu and opens the selection of further menu branches.

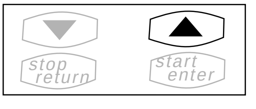
**VAL** = Displays actual values
**PARA** = Change parameter setting (parameterizing).
**CTRL** = Motor control via KEYPAD
**CARD** = Load/save device setting with the SMARTCARD



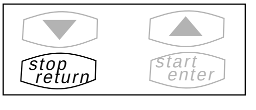

### 4.2.2 Key functions

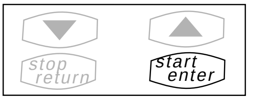
The arrow keys enable the selection of menu branches and enable their modification.
Pressed once they cause a jump to the next menu branch or parameter or the smallest possible alteration of a parameter value.
If a key is kept pressed down, it results in automatic run through (scrolling) which is stopped when the key is released.



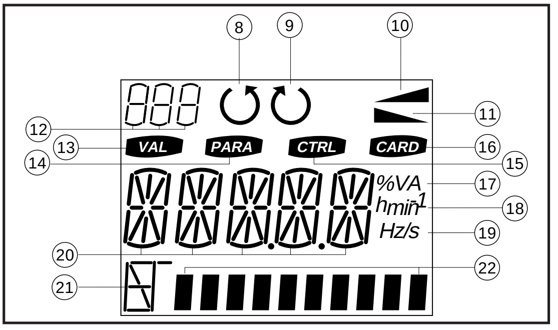




With the stop/return-key, the menu branches are quit or parameter alterations are interrupted (old value is retained).
With the start/enter-key, menu branches or parameters are called up and changes are saved.



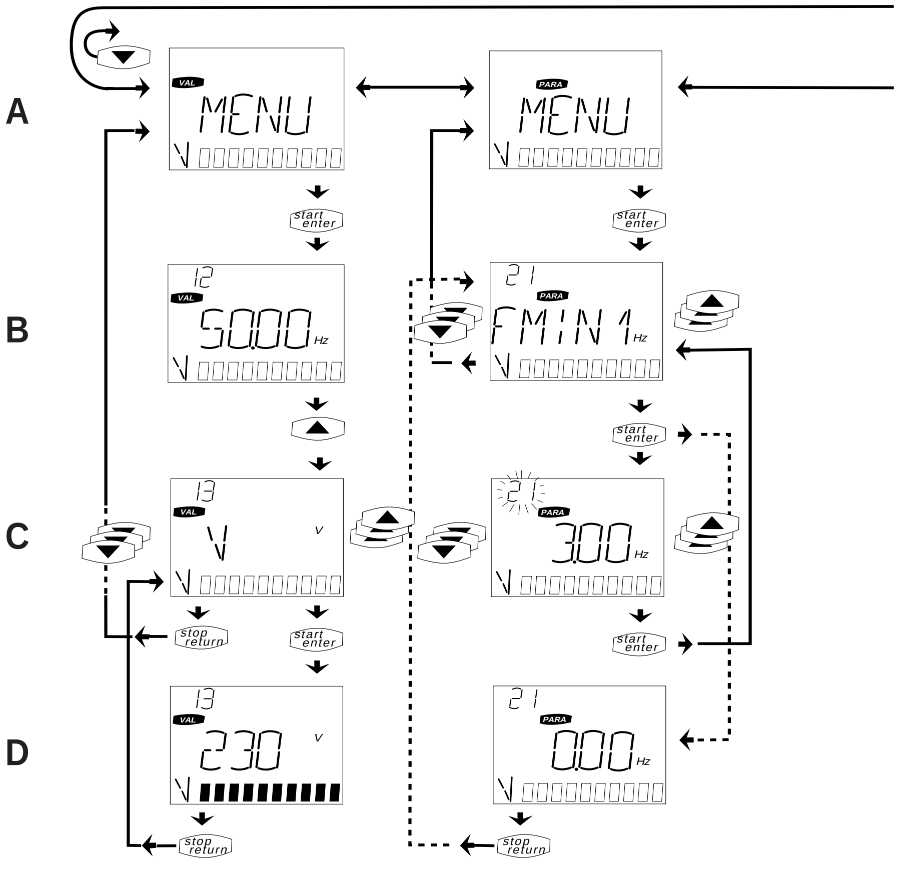
### 4.2.3 LCD- display



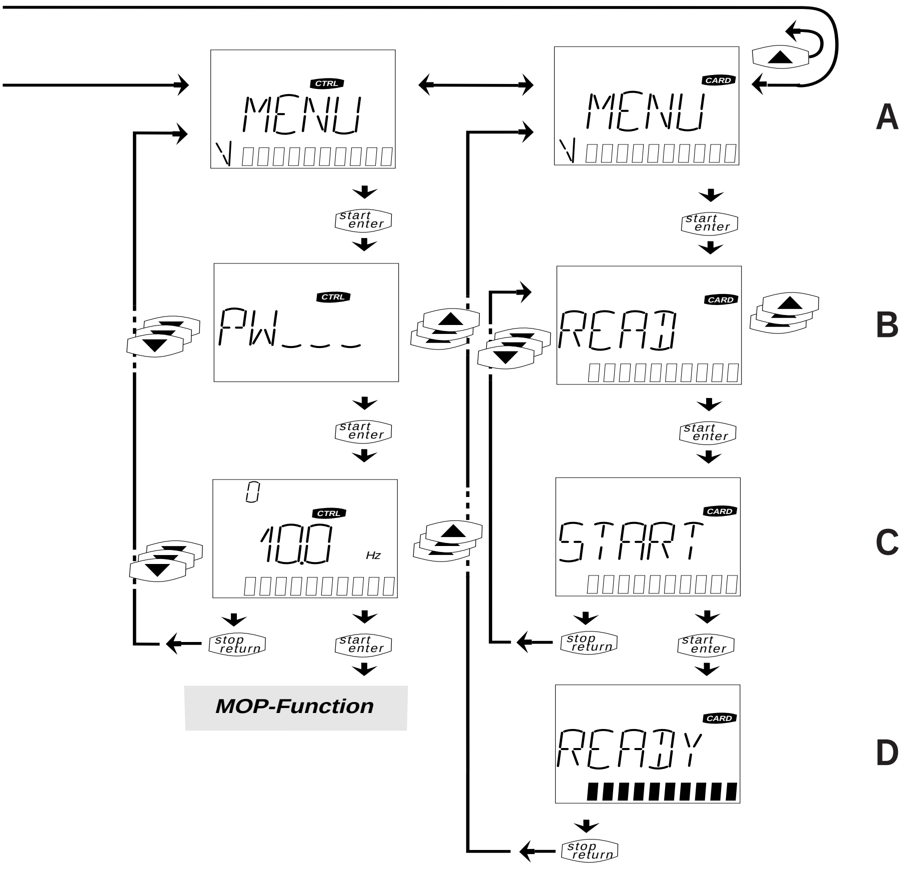

| Item | Designation | Function |
|---|---|---|
| 8 | Counter-clockwise rotation | Control display for output rot. field, counter-clockwise active |
| 9 | Clockwise rotation | Control display for output rot. field, clockwise active |
| 10 | Acceleration ramp | Control display, during acceleration active |
| 11 | Braking ramp | Control display, active during braking |
| 12 | 3 figure numerical display | 7 segment display for actual values, Parameter No. |
| 13 | VAL menu | Shows actual values, e.g. frequency, voltage, current |
| 14 | PARA menu | Changing parameter setting |
| 15 | CTRL menu | Controlling motor via KEYPAD |
| 16 | CARD menu | Loading/saving device setting with the SMARTCARD |
| 17 | Phys. unit at item 20 | shows %, V, A, VA with automatic assignment |
| 18 | Phys. unit at item 20 | displays h, $min^{-1}$ with automatic assignment |
| 19 | Phys. unit at item 20 | displays Hz, s, Hz/s with automatic assignment |
| 20 | 5 figure numerical display | 15 segment display for parameter names and values |
| 21 | Bar graph designation | displays formula letters or physical unit for item 22 |
| 22 | 10 figure bar graph display | shows parameter values, frequency, voltage, apparent or effective current |

## 4.3 Menu structure

### 4.3.1 Overview

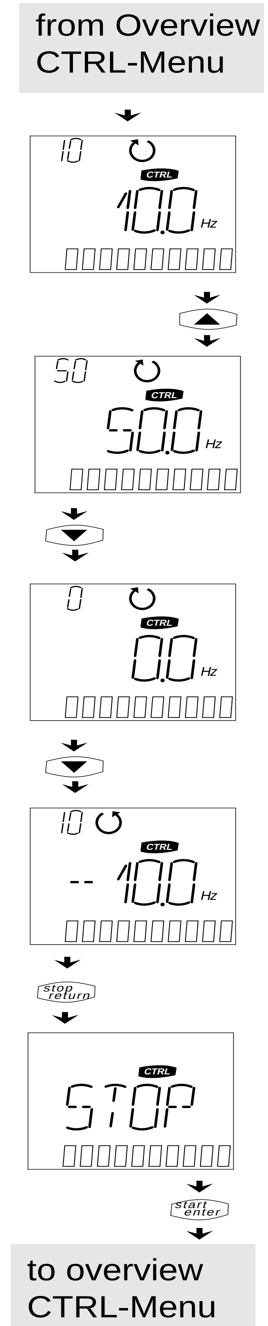



| | | |
|---|---|---|
| **A** | Menu VAL (actual values) selected | Menu PARA selected |
| **B** | Display actual value, change with arrow key to | Select parameters, e.g. FMIN1 |
| **C** | next actual value parameter | Change parameter setting in offline mode (inverter stop) |
| **D** | Scan new actual value | Read parameter setting in online-mode (inverter start) |




| | | |
|---|---|---|
| A | Menu CTRL (Motor control via KeyPad) selected | Load/save Menu device setting (GE) with the SmartCard (SC) |
| B | Enter pass word<br>Factory setting = 573 | READ = GE from SC load<br>WRITE = GE to SC save<br>LOCK = SC write protect<br>UNLCK = cancel write protect |
| C | Frequency set value (KeyPad) preset e.g. 10 Hz | selected with start/enter-key<br>Start function |
| D | Activation of the MOP function (see next page) | Function ended error-free |

### 4.3.2 MOP function with KEYPAD KP100




Once pass word is confirmed the control terminal is blocked. Preset frequency reference (KEYPAD) is e.g. 10 Hz. Start inverter by pressing the start/enter-key.

Actual value (small display) and clockwise rotation are additionally displayed.

Raise the speed reference to 50 Hz for example with the arrow key.

Inverter follows the increase with acceleration ramp.

Reduce speed reference with arrow keys.

Inverter follows the reduction with the braking ramp. With < 0.0 Hz the inverter changes the direction of the rotary field.

Increase speed reference (counter-clockwise) to 10 Hz for example.

In addition sign (--) indicates counter-clockwise.

Press stop/return-key, inverter brakes the motor to stand still.

The MOP function is reactivated with the start/enter-key.

# 5 Parameter list
## 5.1 Operating level 1

| Abbrev. | Name | Unit | Display range | Page | Factory setting | Customer |
|---|---|---|---|---|---|---|
| *Actual values* | | | | | | |
| 10-G | Scaled frequency | - | 0 to 65535 | 6-5 | | |
| 12-F | Output frequency | Hz | 0.0 to 999.0 | 6-5 | | |
| 13-U | Output voltage | V | 0 to 460 | 6-6 | | |
| 14-IS | Apparent current | A | 0.0 to 52.0 | 6-6 | | |
| 15-IW | Effective current | A | 0.0 to 52.0 | 6-6 | | |
| 16-PW | Effective power | W | 0 to 22000 | 6-6 | | |
| 17-UZK | DC-link voltage | VDC | 0 to 900 | 6-6 | | |
| 18-TIME | Switch-on dura. from reset | h | 0.0 to 960.0 | 6-6 | | |
| 19-TOP | Operating hours | h | 0 to 60000 | 6-6 | | |
| *Device data* | | | | | | |
| 91-TYPE | Inverter type | - | 15 types possible | 6-21 | | |
| 92-REV | Software version | - | - | 6-21 | see 2nd cover page | |
| 95-ERR1 | Last error | - | 0-0.0 to 9-1.5<br>11-0.0 to 11 -1.5 | 6-22 | | |
| **Abbrev.** | **Name** | **Unit** | **Setting range** | **Page** | **Factory setting** | **Customer** |
| 1-MODE | Operating mode | - | 0 to 3 | 6-1 | 1 | |
| *Frequencies* | | | | | | |
| 20-FF2-1 | Fixed frequency 2 | Hz | 0.0 to 999.0 | 6-7 | 3 | |
| 21-FMIN1 | Minimum frequency | Hz | 0.0 to 999.0 | 6-7 | 0 | |
| 22-FMAX1 | Maximum frequency | Hz | 4.0 to 999.0 | 6-7 | 50 | |
| 23-FF3 | Fixed frequency 3 | Hz | 0.0 to 999.0 | 6-7 | 15 | |
| 24-FF4 | Fixed frequency 4 | Hz | 0.0 to 999.0 | 6-7 | 30 | |
| 25-FF5 | Comparative freq. S2OUT | Hz | 0.0 to 999.0 | 6-7 | 3 | |
| *Ramps* | | | | | | |
| 32-RACC1 | Acceleration ramp 1 | Hz/s | 0.1 to 999.0 | 6-9 | 20 | |
| 33-RDEC1 | Delay ramp 1 | Hz/s | 0.1 to 999.0 | 6-9 | 20 | |
| 36-RSTOP | STOP-delay ramp | Hz/s | 0.0 to 999.0 | 6-9 | 0 | |
| *Characteristics* | | | | | | |
| 41-V/FC | V/F characteristics selector | - | 1 and 4 | 6-10 | 1 | |
| 42-VB1 | Start voltage (Boost 1) | % | 0.0 to 25.0 | 6-10 | 8 | |
| 43-FN1 | Frequency rated point | Hz | 15.0 to 960.0 | 6-10 | 50/60** | |
| 44-VN1 | Voltage rated point | V | 43%...119% $U_{Rated}$ | 6-10 | * | |

*Dependent on inverter type, **Factory setting B

## 5.2 Operating level 2

| Abbrev. | Name | Unit | Setting range | Page | Factory setting | Customer |
|---|---|---|---|---|---|---|
| *Reference input* | | | | | | |
| 4-FSSEL | Frequency ref. selector | - | 0 to 23 | 6-1 | 0 | |
| *Actual values* | | | | | | |
| 9-BARG | Bar graph assignment | - | 6 Actual values | 6-5 | 13-V | |
| *Frequencies* | | | | | | |
| 20-FF2-1 | 1st Fixed frequency 2 | Hz | 0.0 to 999.0 | 6-7 | 3 | |
| 21-FMIN1 | 1st Minimum frequency | Hz | 0.0 to 999.0 | 6-7 | 0 | |
| 22-FMAX1 | 1st Maximum frequency | Hz | 4.0 to 999.0 | 6-7 | 50 | |
| 23-FF3 | Fixed frequency 3 | Hz | 0.0 to 999.0 | 6-7 | 15 | |
| 24-FF4 | Fixed frequency 4 | Hz | 0.0 to 999.0 | 6-7 | 30 | |
| 25-FF5 | Comparative frequency for S2OUT | Hz | 0.0 to 999.0 | 6-7 | 3 | |
| 26-FF6 | Control frequency (Data set) | Hz | 0.0 to 999.0 | 6-7 | 0 | |
| 27-FF2-2 | 2nd Fixed frequency 2 | Hz | 0.0 to 999.0 | 6-7 | 5 | |
| 28-FMIN2 | 2nd Minimum frequency | Hz | 0.0 to 999.0 | 6-7 | 0 | |
| 29-FMAX2 | 2nd Maximum frequency | Hz | 4.0 to 999.0 | 6-7 | 50 | |
| 30-FF7 | Fixed frequency FF7 | Hz | 0.0 to 999.0 | 6-7 | 50 | |
| *Ramps* | | | | | | |
| 31-KSEL | Data set selector | - | 0 to 3 | 6-8 | 0 | |
| 32-RACC1 | 1st acceleration ramp | Hz/s | 0.1 to 999.0 | 6-9 | 20 | |
| 33-RDEC1 | 1st delay ramp | Hz/s | 0.1 to 999.0 | 6-9 | 20 | |
| 34-RACC2 | 2nd acceleration ramp | Hz/s | 0.1 to 999.0 | 6-9 | 80 | |
| 35-RDEC2 | 2nd delay ramp | Hz/s | 0.1 to 999.0 | 6-9 | 80 | |
| 36-RSTOP | STOP-delay ramp | Hz/s | 0.0 to 999.0 | 6-9 | 0 | |
| *Characteristics* | | | | | | |
| 38-THTDC | Shut-down delay | s | 0.0 to 120.0 | 6-10 | 0 | |
| 39-VHTDC | DC retaining voltage | % | 1 to 25 | 6-10 | 4 | |
| 41-V/FC | V/F characteristics selector | - | 1 and 4 | 6-10 | 1 | |
| 42-VB1 | Starting voltage (Boost 1) | % | 0.0 to 25.0 | 6-10 | 8 | |
| 43-FN1 | Frequency-rated point 1 | Hz | 15.0 to 960.0 | 6-10 | 50/60** | |
| 44-VN1 | Voltage-rated point 1 | V | 43%...119% $U_N$ | 6-10 | * | |
| 45-VB2 | Starting voltage (Boost 2) | % | 0.0 to 25.0 | 6-10 | * | |
| 46-FN2 | Frequency rated point 2 | Hz | 15.0 to 960.0 | 6-11 | 50/60** | |
| 47-VN2 | Voltage rated point 2 | V | 43%...119% $U_N$ | 6-11 | * | |

*Depends on inverter type, **Factory setting B

**Note:** When setting parameter 71-PROG to 1, all programmable parameters are set to the **factory setting** on confirmation of the parameter modification by pressing on the start/enter key (Message "wait").

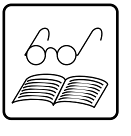
## Operating level 2 (Part 2)

| Abbrev. | Name | Unit | Setting range | Page | Factory setting | Customer |
|---|---|---|---|---|---|---|
| *Special functions* | | | | | | |
| 48-IXR | I*R compensation | - | 0 to 3 | 6-11 | 0 | |
| 49-SC | Slip compensation | - | 0 to 2 | 6-13 | 0 | |
| 50-IN | Motor rated current | A | 0 to 150% $I_{Rated}$ | 6-13 | * | |
| 51-COS | Power factor x100 | % | 0 to 100 | 6-13 | 82 | |
| 52-NN | Motor rated speed | UPM | 0 to 24000 | 6-13 | 1400 (1700**) | |
| 53-KIXR | Correction factor of the I*R compensation | - | 0 to 30 | 6-14 | * | |
| 54-KSC | Correction factor of slip compensation | - | 0.0 to 30.0 | 6-14 | 5 | |
| 55-ISEL | Current control-selector | - | 0 to 2 | 6-14 | 0 | |
| 56-ILIM | Current limit | A | 25 to 150% $I_N$ | 6-16 | * | |
| 57-FILIM | Min. sink frequency | Hz | 0.0 to 999.0 | 6-16 | 15 | |
| 58-RILIM | Delay ramp for current control | Hz/s | 0.1 to 999.0 | 6-16 | 50 | |
| 59-TRIP | I*t monitoring | A | 25 to 150% $I_N$ | 6-16 | * | |
| *Signal outputs* | | | | | | |
| 61-SOUTA | Frequency-/analog-output | - | 0 to 14 | 6-17 | 9 | |
| 62-S1OUT | Output 1 digital | - | 0 to10 | 6-18 | 10 | |
| 63-S2OUT | Output 2 digital | - | 0 to10 | 6-18 | 7 | |
| 67-FST | Filter time constants | - | 0 to 4 | 6-18 | 2 | |
| 69-KOUTA | SOUTA scaling | % | 0 to 200 | 6-19 | 100 | |
| *Program -functions* | | | | | | |
| 71-PROG | Special programs | - | 0 to 4 | 6-19 | 0 | |
| 72-STRT | Start options | - | 0 to 7 | 6-19 | 0 | |
| 74-PWM | Modulation frequency | - | 0 to 2 | 6-20 | 0 | |
| 75-OPT1 | Option 1*** | - | 0. 2 or 4 | 6-20 | 0 | |
| 86-KG | Scaling factor for 10-G | - | 0 to 200 | 6-21 | 0 | |
| 87-DISP | Saved long-term Actual value display | - - | All display parameters | 6-21 | 12-F | |
| 88-PSW1 | Pass word1 <PARA> | - | 0.0 to 999.0 | 6-21 | 0 | |
| 89-PSW2 | Pass word 2 <CTRL> | - | 0.0 to 999.0 | 6-21 | 573 | |
| 94-MAXF | Absolute max. frequency | Hz | 4.0 to 999.0 | 6-22 | 0 | |

*Depends on inverter type, **Factory setting B (see 5-4)

***Caution: This parameter can only be modified in operating mode 01-MODE = 3.

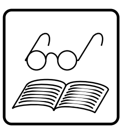
**Note:** $I_N$ => device rated current (see type plate)
$U_N$ => device rated voltage (see type plate)



## 5.3 Inverter-type dependent and nationally-related parameters

| Abbrev. | Page | Name | Unit | WE-A | WE-B | Inverter type |
|---|---|---|---|---|---|---|
| 44-VN1 | 6-10 | Voltage rated point 1 | V | 230 | 230 | VF1205M...VF1207M |
| 44-VN1 | 6-10 | Voltage rated point 1 | V | 400 | 460 | VF1404M...VF1410M |
| 47-VN2 | 6-11 | Voltage rated point 2 | V | 230 | 230 | VF1203M...VF1207M |
| 47-VN2 | 6-11 | Voltage rated point 2 | V | 400 | 460 | VF1404M...VF1410M |
| 50-IN | 6-13 | Motor rated current, | A | 4.5 | 4.5 | VF1205M |
| 56-ILIM | 6-16 | Current limit, | A | 6.2 | 6.2 | VF1207M |
| 59-TRIP | 6-16 | I x t monitoring | A | 3.5 | 3.4 | VF1404M |
| | | | A | 5.4 | 4.8 | VF1406M |
| | | | A | 7.1 | 6.3 | VF1408M |
| | | | A | 8.9 | 7.7 | VF1410M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 7 | 7 | VF1205M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 4 | 4 | VF1207M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 18 | 18 | VF1404M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 12 | 12 | VF1406M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 8 | 8 | VF1408M |
| 53-KIXR | 6-14 | Corr. factor I∗R comp. | - | 8 | 8 | VF1410M |
| 54-KSC | 6-14 | Corr. factor slip comp. | % | 6.7 | 6.7 | VF1205M |
| 54-KSC | 6-14 | Corr. factor slip comp. | % | 6 | 6 | VF1207M |
| 54-KSC | 6-14 | Corr. factor slip comp. | % | 6 | 6 | VF1404M |
| 54-KSC | 6-14 | Corr. factor slip comp. | % | 5.3 | 5.3 | VF1406M |
| 54-KSC | 6-14 | Corr. factor slip comp. | % | 5.3 | 5.3 | VF1408M, VF1410M |

| Solely nationally related parameters | | | | | |
|---|---|---|---|---|---|
| 22-FMAX1 | 6-7 | Maximum frequency 1 | Hz | 50 | 60 |
| 29-FMAX2 | 6-7 | Maximum frequency 2 | Hz | 50 | 60 |
| 43-FN1 | 6-10 | Frequency rated point 1 | Hz | 50 | 60 |
| 46-FN2 | 6-11 | Frequency rated point 2 | Hz | 50 | 60 |
| 52-NN | 6-13 | Rated speed | UPM | 1390 | 1710 |



**Factory setting (FS):**
The factory setting can be adjusted with the KeyPad in the PARA menu. To this end parameter 71-PROG must be set to 1 (WE-A e.g. for Europe) or 71-PROG to 4 (WE-B e.g. for USA).

# 6 Parameter description

**01-MODE Operating mode [Decimal]**
MODE determines the control options for the inverter and defines the effective operating level e.g. for the KEYPAD KP100.

The parameters are allocated in 3 levels.
In Level 1, the most important parameters for commissioning are to be found.
Level 2 enables in addition to the alteration of the parameters contained in Level 1, access to further parameters as well as special and control functions, such as data set changeover or programming the control outputs for example.
Level 3 is reserved for interface parameters (SIO mode) and special parameters (further information about this can be found in the information booklet "Parameter description - Total range").

01-MODE = 1 -> Operating level 1 Commissioning level
01-MODE = 2 -> Operating level 2 Operating and control function
01-MODE = 3 -> Operating level 3 Interfaces and special param.
01-MODE = 0 -> Operating level 0 Only SIO-mode

## 6.1 Reference input

**04-FSSEL Frequency reference selector**
Offers the selection between various types of reference (analog, frequency or PWM-signal) and their origin (KEYPAD, SIO,...).

| 04-FSSEL | Function |
|---|---|
| 0 | Analog input active, adaption via J1 ... J6 |
| 1/2 | Not active |
| 3 | FSIN as frequency input 0 to 1 kHz active |
| 4 | FSIN as frequency input 0 to 10 kHz active |
| 5 | FSIN as PWM input 20 to 100% active |
| 6 | FSIN as PWM input 0 to 100% active |
| 7 | FSIN not active, reference via KP100 (CTRL- menu) |
| 8 | Reference via interface |
| 9 to 16 | Reference input see following |
| 17 to 22 | Correction of the analog reference via S1IND/S2IND (MOP-function active) |
| 23 | Inverted analog input, 10 V = FMIN, 0 V = FMAX |

## Reference input block diagram

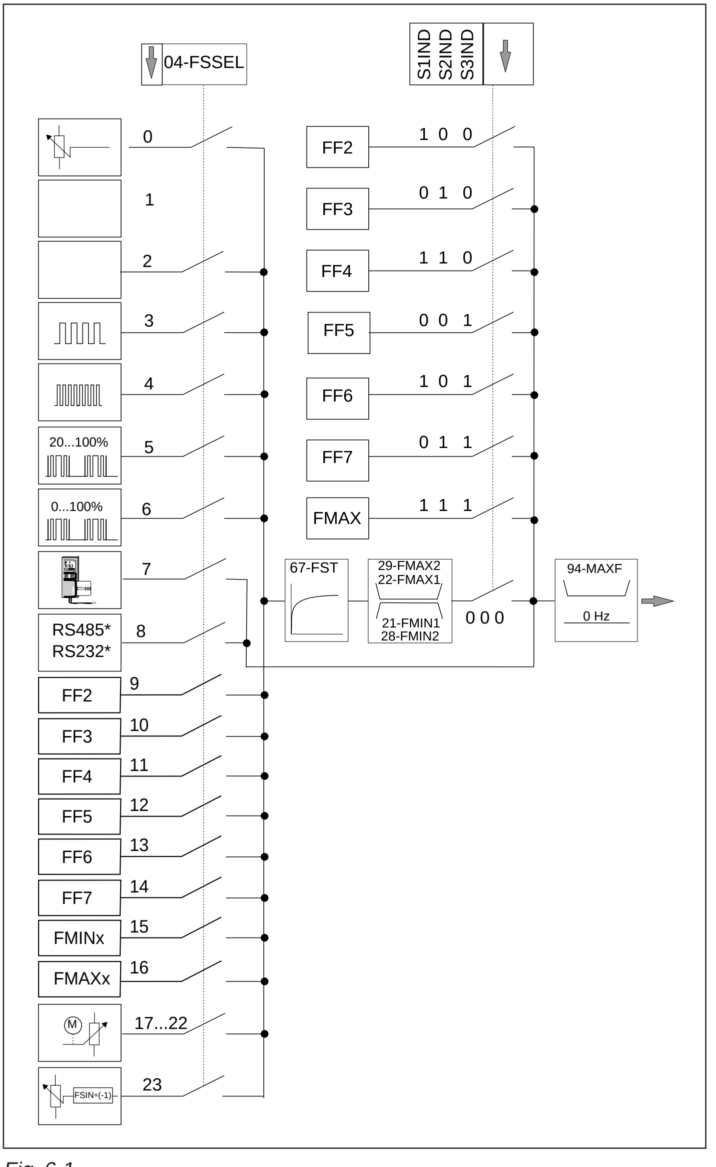



*Fig. 6-1*

* Designs see Chapter 2.4.7

*04-FSSEL = 0*
FSIN is active as analog input. The adaption to 0(2) ... 10 V or 0 (4) ... 20 mA is via jumper rail J1 ... J6.

*04-FSSEL = 1, 2*
Without function.

*04-FSSEL = 3*
FSIN functions as frequency input.
FMIN = 0 Hz FMAX = 1 kHz, adaption via jumper rail J1 ... J6.

*04-FSSEL = 4*
FSIN functions as frequency input.
FMIN = 0 Hz FMAX = 10 kHz, adaption via jumper rail J1 ... J6.

*04-FSSEL = 5*
FSIN operates as clock input for impulse width modulated signal.
FMIN = 20% PWM FMAX = 100% PWM (see Fig. 6-2). The basic signal of the PWM signal must be 0.9 ... 8 kHz, adaption via J1 ... J6.

*04-FSSEL = 6*
FSIN operates as clock input for impulse width modulated signals.
FMIN = 0% PWM FMAX = 100% PWM (see Fig. 6-2). The basic frequency of the PWM signal must be 0.9 ... 8 kHz, adaption via jumper rail J1 ... J6..

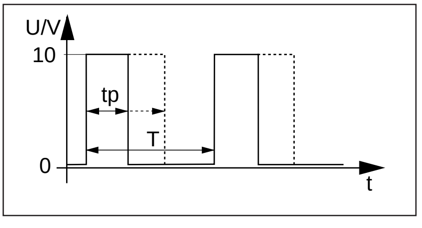



*Fig. 6-2*

$$\mathrm{FSIN[Hz]} = \frac{\mathrm{FMAX} - \mathrm{FMIN}}{(1 - A)} \cdot (K - A) + \mathrm{FMIN}$$

$$K = \frac{t_P}{T}$$

| 04-FSSEL | Adjustment range | A |
|---|---|---|
| 5 | 0 ...100% PWM | 0 |
| 6 | 20...100% PWM | 0,2 |

*04-FSSEL = 7*
FSIN is not active. When starting the MOP function in the CTRL-menu of the KeyPads, 04-FSSEL = 7 is set automatically, and reset to 04-FSSEL = 0 on quitting.

*04-FSSEL = 8*
FSIN input and KeyPad input are not active. Reference can only be entered externally via interface.

*04-FSSEL = 9...16*
FSIN input and KeyPad input are not active. Function see Fig. S.6-2.

*04-FSSEL = 17*[1)]
FSIN input active (base reference). The reference can be continuously raised with S1IND and continuously lowered with S2IND (Reference offset with MOP function).

*04-FSSEL = 18*[1)]
Has same function as 04-FSSEL = 17 with following supplement:
With simultaneous activation of S1IND and S2IND, the reference is reset to the base reference (Reference offset = 0).

*04-FSSEL = 19*[1)]
Has the same function as 04-FSSEL = 17 with following supplement:
With preset reference offset and mains off, this offset is saved until it is modified or reset via S1IND and S2IND.

*04-FSSEL = 20*[1)]
Has the same function as 04-FSSEL = 18 and 19

*04-FSSEL = 21*[1)]
Has the same function as 04-FSSEL = 17 with following supplement:
When the inverter is stopped, the reference is reset to the base reference (Reference offset = 0).

*04-FSSEL = 22*[1)]
Has the same function as 04-FSSEL = 18 and 21

*04-FSSEL = 23*[1)]
The FSIN input functions as inverted analog input.
10 V = FMIN 0V = FMAX

1) see description of the MOP function with S1IND/S2IND in Chapter 2.4.5

## 6.2 Actual values

**09-BARG Bar graph display [Decimal]**
The following parameters can be depicted in the bar graph display.

| 09-BARG | Function |
|---|---|
| STAT | Depiction as bit model, see Fig. 6-3 |
| 12-F | Output frequency as analog bar, Des. < F > |
| 13-V | Output voltage, Des. < V > (Factory setting) |
| 14-IS | Apparent current as analog bar, Des. < I > |
| 15-IW | Effective current as analog bar, Des. < I > |
| SIN | Depiction as bit model, see Fig. 6-3 |

**09-BARG = 11-STAT**

A -> generating current
B -> current limiting value reached
$I_S > 110\% \, I_N$
C -> 12-F > 25-FF5
D -> reference reached

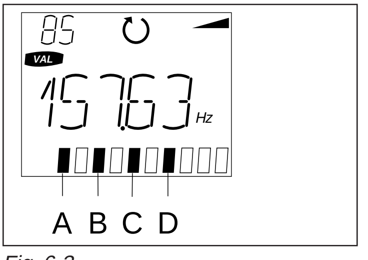


*Fig. 6-3*

**09-BARG = 66-SIN**

A -> S2OUT active
B -> S1OUT active
C -> S2IND active
D -> S1IND active

**10-G Scaled frequency**
Displays the actual output frequency 12-F multiplied with the factor from parameter 86-KG, no decimal fractions or physical units being displayed.

(10_G) = (12_F) ∗ (86_KG)

**12-F Output frequency [Hz]**
Displays the actual output frequency. After error shut-down, the actual value existing before shut down is saved (Hold-Function).

**13-V Output voltage [V]**

Displays the actual output voltage. The output voltage is kept constant independently of the DC-link voltage (DC-link compensation), if a drive reserve is available. After a error shut-down, the actual value existing immediately before shut-down is saved (Hold-Function).

**14-IS Phase current [A]**

Displays the actual apparent phase current. After an error shut-down, the actual value existing immediately before shut-down is saved (Hold-Function).

**15-IW Effective current [A]**

Displays the actual effective phase current. After an error shut-down, the actual value existing immediately before shut-down is saved (Hold-Function).

**16-PW Effective power [W]**

Displays the effective power from the inverter.

$$\boxed{(16\_PW) = \sqrt{3} * (15\_IW) * (13\_V)}$$

**17-VZK DC-link voltage [VDC]**

Displays the actual DC-link voltage. After a error shut-down, the actual value existing immediately before shut-down is saved (Hold-Function).

**18-TIME Switch-on duration from reset [0.1 hour]**

Displays the switch-on duration since last reconnection to mains.

**19-TOP Running time [hours]**

Displays the total running time. The maximum value is 60000 hours. Once this level is reached, there is no further increase.

## 6.3 Frequencies

**20-FF2-1 1st fixed frequency FF2 [Hz]**
Parameter of the 1st data set.
As reference can be selected via S1IND = 1, S2IND = 0 and S3IND = 0

**21-FMIN1 Minimum frequency for analog reference input [Hz]**
Parameter of the 1st data set. Reference input FSIN = 0 (2) V or 0 (4) mA corresponds to an output frequency of FMIN.

**22-FMAX1 Maximum frequency for analog reference input [Hz]**
Parameter of the 1st data set. Reference input FSIN = 10 V or 20 mA corresponds to an output frequency of FMAX.

**23-FF3 Fixed frequency FF3 [Hz]**
As reference can be selected via S1IND = 0, S2IND = 1 and S3IND = 0

**24-FF4 Fixed frequency FF4 [Hz]**
As reference can be selected via S1IND = 1, S2IND = 1 and S3IND = 0

**25-FF5 Fixed frequency FF5 [Hz]**
Frequency thresholds for programmable outputs S1OUT, S2OUT and S3OUT. (also see 62-S1OUT 63-S2OUT, 64-S3OUT)
As reference can be selected via S1IND = 0, S2IND = 0 and S3IND = 1

**26-FF6 Fixed frequency FF6 [Hz]**
Frequency threshold for data set changeover at 31-KSEL = 1
As reference can be selected via S1IND = 1, S2IND = 0 and S3IND = 1

**27-FF2-2 2nd fixed frequency FF2 [Hz]**
Parameter of the 2nd data set
As reference can be selected via S1IND = 1, S2IND = 0 and S3IND = 0

**28-FMIN2 Minimum frequency for analog reference input [Hz]**
Parameter of the 2nd data set (see also 21-FMIN1).

**29-FMAX2 Maximum frequency for analog reference input [Hz]**
Parameter of the 2nd data set (see also 22-FMAX1).

**30-FF7 Fixed frequency 7 [Hz]**
As reference can be selected via S1IND = 0, S2IND = 1 and S3IND = 1

**Fixed frequency selection for digital inputs**

| S1IND | S2IND | S3IND | Speed reference | Factory setting |
|---|---|---|---|---|
| 1 | 0 | 0 | 20-FF2-1 [27-FF2-2] | FF2 = 5 Hz [3 Hz] |
| 0 | 1 | 0 | 23-FF3 | FF3 = 15 Hz |
| 1 | 1 | 0 | 24-FF4 | FF4 = 30 Hz |
| 0 | 0 | 1 | 25-FF5 | FF5 = 3 Hz |
| 1 | 0 | 1 | 26-FF6 | FF6 = 0 Hz |
| 0 | 1 | 1 | 30-FF7 | FF7 = 50 Hz |

## 6.4 Ramps

**31-KSEL Data set selector**
The data set selector determines the control factors for data changeover.
Possible control factors for data changeover:

| 31-KSEL | Function | Example of application |
|---|---|---|
| 0 | Data set changeover inactive, data set 1 remains | Standard, factory setting |
| 1 | Changeover to 2nd data set if: 12-F > 26-FF6 | Heavy load start-up |
| 2 | Changing over data sets with S2IND | Varying operation from 2 motors to 1 inverter |
| 3 | Changing over to 2nd data set with counter-clockwise (STL active) dependent load | Drive with rotation direction |

Two data sets with following parameters are available.

| Parameter | Data set 1 | Data set 2 |
|---|---|---|
| Minimum frequency | 21-FMIN1 | 28-FMIN2 |
| Maximum frequency | 22-FMAX1 | 29-FMAX2 |
| Fixed frequency 2 | 20-FF2-1 | 27-FF2-2 |
| Acceleration ramp | 32-RACC1 | 34-RACC2 |
| Braking ramp | 33-RDEC1 | 35-RDEC2 |
| Voltage increase | 42-VB1 | 45-VB2 |
| Rated voltage | 44-VN1 | 47-VN2 |
| Rated frequency | 43-FN1 | 46-FN2 |

**32-RACC1 Start-up ramp [Hz/s]**
Parameter of the 1st data set, see Fig. 6-4.

**33-RDEC1 Deceleration ramp [Hz/s]**
Parameter of the 1st data set, see Fig. 6-4.

**34-RACC2 Start-up ramp [Hz/s]**
Parameter of the 2nd data set, see Fig. 6-4.

**35-RDEC2 Deceleration ramp [Hz/s]**
Parameter of the 2nd data set, see Fig. 6-4.

**36-RSTOP Stop ramp [Hz/s]**
With activated stop ramp (36-RSTOP > 0) the inverter after setting of the control inputs STR and STL to 0, carries out a deceleration ramp with a gradient of 36-RSTOP, see Fig. 6-5. Subsequent maintenance of the DC current is possible with 38-THTDC > 0. With 36-RSTOP = 0 the motor comes to a halt by itself, if STL and STR are set to 0.

DS1 = Data set 1
DS2 = Data set 2

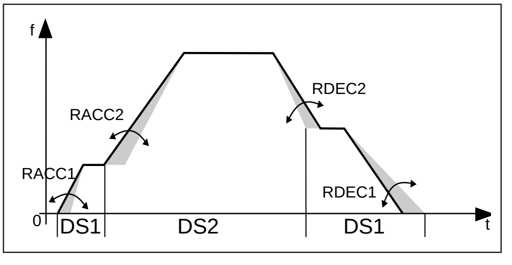



*Fig. 6-4*

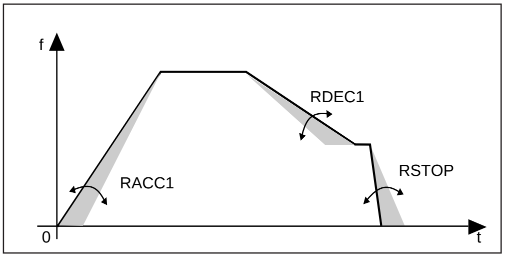



*Fig. 6-5*

## 6.5 Characteristics

**38-THTDC DC hold- shut-down delay [s]**
The DC hold becomes active once the shut-down limit (F < 0.5 Hz) is exceeded. It is unimportant whether braking is with 33-RDEC1 or with 36-RSTOP. The hold time can be set up to 120 s. Permanent hold is not possible.

**39-VHTDC DC hold voltage level [%]**
The output voltage for DC hold can be set with parameter 39-VHTDC in % of the device rated voltage (max. 25 %).

**41-V/FC Characteristics selector [Decimal]**

41-V/FC = 1 -> linear voltage-frequency characteristics
4 -> quadratic voltage-frequency characteristics

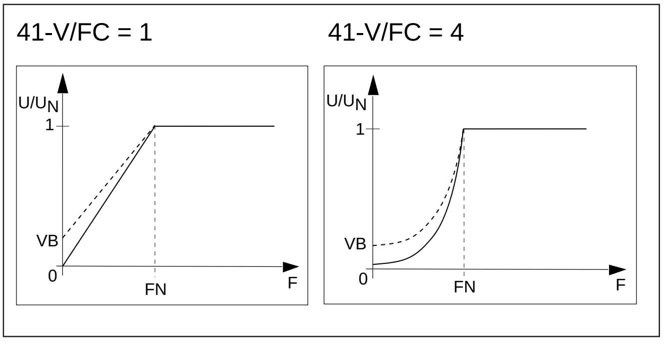



*Fig. 6-6*

**42-VB1 Voltage increase [%]**
Parameter of the 1st data set. Voltage at frequency of 0 Hz.
Raising the torque in the start-up range. See also Fig. 6-6.

**43-FN1 Rated frequency [Hz]**
Parameter of the 1st data set. Frequency point, at which the inverter achieves the rated output voltage (setting from 44VN1). See also Fig. 6-6.

**44-VN1 Rated voltage [V]**
Parameter of the 1st data set. Input the voltage, which the inverter should have when it reaches 43-FN1. See also Fig. 6-6.

**45-VB2 Voltage increase [%]**
Parameter of the 2nd data set. See 42-VB1. See also Fig. 6-6.

**46-FN2 Rated frequency [Hz]**
Parameter of the 2nd data set. See 43-FN1. See also Fig. 6-6.

**47-VN2 Rated voltage [V]**
Parameter of the 2nd data set. See 44-VN1. See also Fig. 6-6.

## 6.6 Special functions

**48-IXR Automatic load control (I∗R-Compensation)**

48-IXR = 0 -> I∗R Compensation inactive
1 -> I∗R Compensation active with 1st and 2nd data set
2 -> I∗R Compensation only active with 1st data set
3 -> I∗R Compensation only active with 2nd data set

Precondition for activation of the I∗R compensation:
Motor data (Type plate) **50-IN**, **51-COS** and **52-NN** entered for the load characteristics.

The purpose of the I∗R compensation is to produce a constant torque and reduced heating of the motor coil. This is achieved by transplacing the load characteristics as determined by the characteristics parameters, by an amount ***ΔU*** determined by the effective current.
See Fig. 6-7.

$$\boxed{\Delta U = (IW - IN * COS) * KIXR}$$

IW = 15-IW (Effective current)
IN = 50-IN (Motor rated current)
COS = 51-COS (cosφ Motor)
KIXR = 53-KIXR (Correction factor)

The I∗R compensation becomes effective from the frequency VB∗FN. It is increased linearly: from 0 % at frequency VB∗FN, to 100 % at frequency 2∗VB∗FN. Furthermore it is effective up to 100% (see Fig. 6-8).

A -> IW > Rated current (Rated load)
B -> IW = 0 (Idling)
C -> Non-compensated characteristics

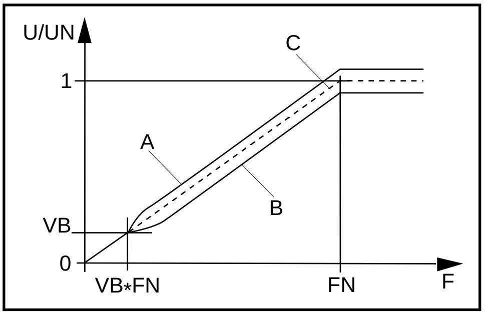



*Fig. 6-7*

Ratio of the I∗R-compensation (I∗R)
Ratio of the slip compensation (SK)

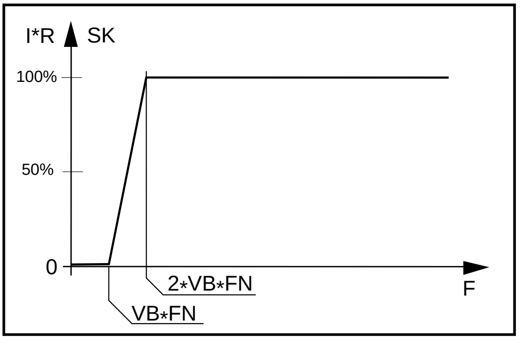



*Fig. 6-8*

**49-SC Slip compensation On/Off [Decimal]**

49-SC = 0 -> Slip compensation inactive
1 -> Slip compensation with 1st and 2nd data set active
2 -> Slip compensation only active with 2nd data set

Precondition for activation of the slip compensation:
Enter motor data (Type plate) **50-IN**, **51-COS** and **52-NN**.

The purpose of the slip compensation is to maintain the speed constant independently of load. In the basic setting range (0 to FN), a frequency correction ΔF proportional to the effective current (15-IW) is added to the actual frequency (12-F).
This ΔF is still corrected by t2he factor F/FN in the field weak range. The frequency increase so calculated is however not displayed in the parameter 12-F.
The slip compensation becomes effective at characteristics point [VB * FN]. It increases linearly from 0 % at frequency [VB * FN], up to 100 % at frequency [2 * VB * FN]. Furthermore it is effective up to 100 % (See Fig. 6-8).
The entry of the frequency is only limited by parameter 94-MAXF. The frequency correction is determined from the formula:

In the base range

$$\Delta F = \frac{KSC * IW}{I_{NU}} * FN$$

IW = 15-IW (Effective current)
INU = Inverter rated current
FN = Param. 43-FN1 (Rated frequency)
KSC = Param. 54-KSC (Correction factor)
F = Param. 12-F (Act. frequency)
In the field weak range

$$\Delta F = \frac{KSC * IW}{I_{NU}} * \frac{F}{FN} * FN$$

**50-IN Motor rated current [A]**
Motor rated current from motor type plate.
Application with I*R and slip compensation.

**51-COS Rated cosφ [%]**
Cosφ from motor type plate (to be entered in %).
Application with I*R and slip compensation.

**52-NN Rated speed [1/min]**
Rated speed from motor type plate.
Application with I*R and slip compensation.

### 53-KIXR    Correction factor, I $*$ R compensation

The correction factor KIXR corresponds to the resistance measured between two cables. The correction factor can either be entered or measured by the inverter.

$\longrightarrow$ The measurement is started, if 48-IXR = 1 and 53-KIXR = 0.

The inverter then issues a max. of 1/16 of the device voltage for approx. 2 s  or permits the flow of a max. current of 50-IN (entered motor rated current ). The measured value is automatically stored under  53-KIXR .

**Caution:**
The motor may turn slowly during the measurement.

### 54-KSC    Slip compensation, correction factor [%]

The correction factor 54-KSC is just like the motor rated slip scaled to the device rated current.

$$KSC = \frac{N_{SYN} - NN}{N_{SYN}} * \frac{I_{NU}}{IN * COS} * 100\ [\%]$$

$N_{SYN}$ = Synchron. speed
NN = 52-NN (Motor rated speed)
$I_{NU}$ = Inverter rated current
IN = 50-IN (Motor rated current)
COS = 51-COS (cos $\varphi$)

The correction factor can be either entered or calculated by the inverter. The calculation is started, when 49-SC = 1 and 54-KSC = 0. The synchronous speed for the calculation is determined from the rated frequency 43-FN1. The calculated value is automatically stored under 54-KSC.

### 55-ISEL    Actual control selector [Decimal]

The actual control selector determines the type of current limit regulation. The controlled dimension is the apparent phase current 14-IS.

| 55-ISEL | Function |
|---|---|
| 0 | Current limit control inactive |
| 1 | Acceleration / braking ramp current controlled, return of the ramp function with I > 125% ILIM |
| 2 | Acceleration / braking ramp current controlled, ramp stop at I > 125% ILIM |
| 3 | Current injection* |
| 4 | As setting 1, but with current injection* |
| 5 | As setting 2, but with current injection* |

*More detailed information on request

**Current controlled start-up (55-ISEL = 1)**
Once the inverter is started, the motor is accelerated with 32-RACC1. On reaching the current limit of 75% of 56-ILIM the acceleration is slowed down. If the phase current 14-IS increases further and exceeds 100% of 56-ILIM, the motor is not further accelerated. When the current limit of 125% of 56-ILIM is exceeded, the rotary field frequency input with FSIN is reduced with the ramp 58-RILIM to the minimum lowering frequency 57-FILIM . When the phase current subsides to below 100% of 56-ILIM, the inverter accelerates the motor further with the ramp 32-RACC1, the same applying for braking. The frequency can then be raised up to 94-MAXF, see Fig. 6-9.

**Current controlled start-up (55-ISEL = 2)**
Operation as above with following difference:
Once the current limit of 125% of 56-ILIM has been exceeded, the ramp 32-RACC1 does not accelerate further. There are no further frequency reductions.

**Current controlled start-up (55-ISEL = 3/4/5)**
More detailed information available on request.

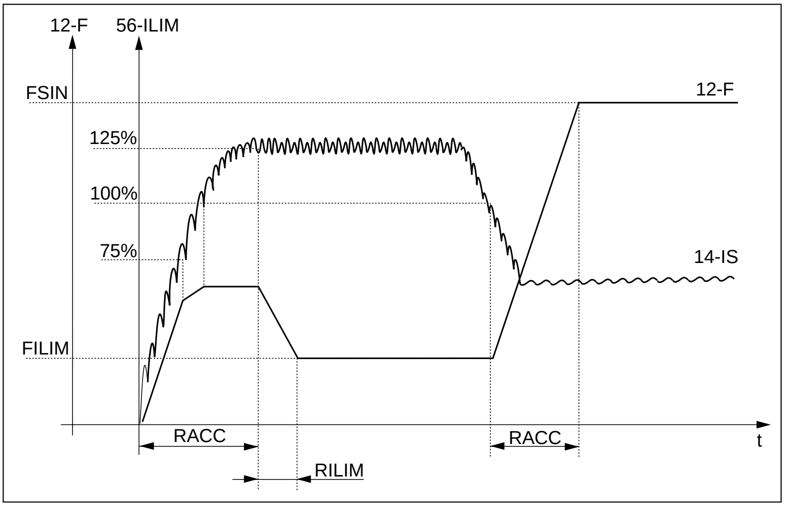



*Fig. 6-9 (Current controlled start-up)*

**56-ILIM Current limit value [A]**
See 55-ISEL and diagram.

**57-FILIM Minimum reduction frequency for current control [Hz]**
See 55-ISEL and diagram.

**58-RILIM Ramp for current control [Hz/s]**
See 55-ISEL and diagram.

**59-TRIP I ∗ t Monitoring (Motor), trigger current [A]**

With the parameter 59-TRIP, the I∗t trigger current is set. Once this current is exceeded there follows after a certain trigger time (see diagram) shut-down with the error message E-OLM.

**Motor protection:**
The setting of the I∗t trigger current must be in accordance with the motor rated current. Thus even motors with smaller power outputs than the device rated power are sufficiently protected from overloading.

Independently from the parameter 59-TRIP, the inverter has a I∗t monitoring (device) which corresponds to one setting 59-TRIP = device rated current and results in shut-down with error message E_OLI after approx.100 ms, with $I = 2 * I_N$.

**Factory setting:** 59-TRIP = $I_N$ (Device rated current)

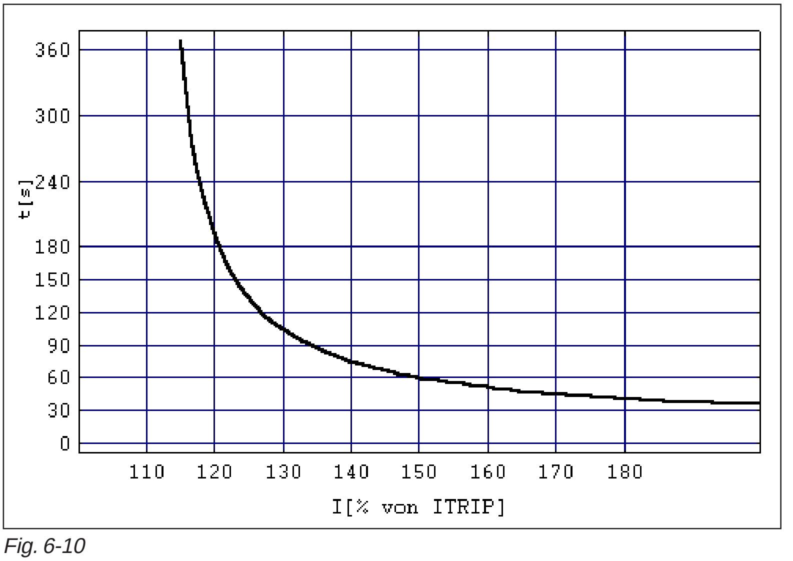


*Fig. 6-10*

## 6.7 Signal outputs

### 61-SOUTA Analog/frequency output

| 61-SOUTA | Function |
|---|---|
| 0/2/7/8/10/11 | Outputs not active SOUTA = 0, *SOUTF = 24V* |
| 1 | SOUTA = 0...10V >> 0 ...FMAX proportional to the output frequency, *SOUTF = 24 V (not active)* |
| 3 | *FOUTF = 6-fold output frequency*,SOUTA = 0 (not active) |
| 4 rated current, | SOUTA = 0...10V => Apparent current scaled to 100% of the device *SOUTF= 24V (not active)* |
| 5 | SOUTA=0...10V => Effective current scaled to 100% of the device rated current, *SOUTF= 24V (not active)* |
| 6 rated power, | SOUTA=0...10V => Effective power scaled to 100% of the device *SOUTF= 24V (not active)* |
| 9 WE | SOUTA as 61-SOUTA= 1, *SOUTF = 6-fold output frequency* |
| 12 | SOUTA as 61-SOUTA= 4, *SOUTF = 6-fold output frequency* |
| 13 | SOUTA as 61-SOUTA= 5, *SOUTF = 6-fold output frequency* |
| 14 | SOUTA as 61-SOUTA= 6, *SOUTF = 6-fold output frequency* |

**Comment:**
If the outputs SOUTA and SOUTF simultaneously in use (Param. 61-SOUTA = 9,12,13,14), the quality of the signals is poorer (Basic frequency = 60Hz). If output SOUTA is in use alone (Param. 61-SOUTA = 1,4,5,6), the quality of the signals is better (Basic frequency = 1.6 kHz).

**62-S1OUT Programmable control output S1OUT [Decimal]**
**63-S2OUT Programmable control output S2OUT [Decimal]**

| 62-S1OUT 63-S2OUT | Function |
|---|---|
| 0,9 | Without function, outputs S_OUT = 0 |
| 1 | active, as soon as inverter on mains and no error existing |
| 2 | active, as long as motor excited |
| 3 | active, as long as counter-clockwise speed > 0 or DC hold active |
| 4 | active, as long as clockwise speed > 0 or DC hold active |
| 5 | active, as long as rotary field frequency 12-F = 0 |
| 6 | active as soon as reference reached |
| 7 | active, if rotary field frequency 12-F > 25-FF5 |
| 8 | active, if apparent current 14-IS > 110%,<br>59-TRIP current limit reached |
| 10 | active, after an error shut-down |

**Factory setting:** 62-S1OUT ->10, 63-S2OUT -> 1

## 6.8 Program functions

**67-FST Filter time constants [Decimal]**
Determines the filter time constants for analog reference input FSIN. (see also 04-FSSEL). Temporal performance as PT1-member (deceleration pass).

| 67-FST | Function |
|---|---|
| 0 | 0 ms |
| 1 | 8.2 ms |
| 2 | 24.6 ms, factory setting |
| 3 | 57.4 ms |
| 4 | 123 ms |

**69-KOUTA Factor for analog output 61-SOUTA [Decimal]**
This parameter enables the scaling of the analog output SOUTA.
When an analog signal is issued, the voltage is multiplied by the factor 69-KOUTA in accordance with the programming and limited to 15 V.

**71-PROG Special programs [Decimal]**
With 71-PROG, special programs can be activated. Possible special programs at present:

| 71-PROG | Function |
|---|---|
| 0 | No special program active |
| 1 | Reset to factory setting "A" e.g. Europe<br>(according to design 71-PROG = 0) |
| 2 | changed significance of the control terminals<br>STR = 0 -> clockwise, STL = 1 -> START<br>STR = 1 -> counter-clockwise, STL = 0 -> STOP |
| 4 | as 1, however factory setting "B" e.g. USA |

**72-STRT Starting options [Decimal]**

| 72-STRT | Function |
|---|---|
| 0 | No starting option active, factory setting |
| 1 | Autostart after mains on with STL or STR bypassed |
| 2 | Synchronisation to running motor |
| 3 | Autostart and synchronisation |
| 4 | Rotation direction block: counter-clockwise<br>rotation blocked |
| 5 | Rotation direction block and autostart |
| 6 | Rotation direction block and synchronisation |
| 7 | Autostart, synchronisation, rotation direction block |

**Autostart 72-STRT = 1**
If one of the start contacts STL or STR is bypassed and the reference input FSIN > 0.5 Hz, the inverter starts automatically once mains supply reconnected.

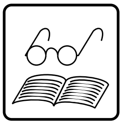
**Synchronisation 72-STRT = 2**
Once the start contact is activated, the inverter first of all carries out a search procedure to determine the current motor speed. The search starts with the maximum frequency 22-FMAX1, meaning that the inverter is working super-synchronously, producing a positive effective current. The rotary field frequency is reduced until the effective current becomes negative. Hence the inverter is operating sub-synchronously. The inverter synchronises to the motor speed thus found with the appropriate rotary field frequency.
The synchronisation functions in both rotation directions.

**Rotation direction block 72-STRT = 4**
With this start option, rotation counter-clockwise with respect to the inverter is blocked in every case. This means that the counter-clockwise rotation direction can neither be activated by the control input STL nor by the CTRL menu.

**74-PWM Switching frequency [Decimal]**
Parameter 74-PWM determines the switching frequency of the final levels.

| 74-PWM | Switching frequency | suitable for | Factory setting |
|---|---|---|---|
| 0 | 7.8 kHz | VF1205M to VF1410M | all VF1000M |
| 1 | 15.6 kHz | VF1205M to VF1410M | |
| 2 | 3.9 kHz | VF1205M to VF1410M | |

**75-OPT1 Options 1**
With this parameter, the special functions for the error acknowledgement for example are possible.



**Note:** This parameter can only be set with 01-MODE = 3.

| 75-OPT1 | Function |
|---|---|
| 0 **0** H | Without function |
| 0 **2** H | Error acknowledgement via S2IND |
| 0 **4** H | Error acknowledgement via STL or STR |

**86-KG Scaling factor for 10-G**

The factor determines the value of the display parameter 10-G according to the formula:

$$\boxed{(10\_G) = (12\_F) * (86\_KG)}$$

**87-DISP Permanent display [Decimal]**

Determines the parameter for the permanent display.
All parameters from the menu „VAL“ are possible.

**88-PSW1 Pass word 1 [Decimal]**

Determines the pass word for the parameterization menu <PARA>

**89-PSW2 Pass word 2 [Decimal]**

Determines the pass word for control via KeyPad <CTRL>menu

**91-TYPE Inverter type [Decimal]**

Issues the type of the identifed end level. All min-max values and factory settings of the voltage and current dimensions, which must be entered absolutely, depending for example from:

VF1207M - 44-VN1 = 230 V factory setting
VF1406M - 44-VN1 = 400 V factory setting

**92-REV Software revision [Decimal]**

States the installed software version (see 2nd cover page).

**94-MAXF Absolute maximum frequency [Hz]**
Is the maximum frequency which is produced by the inverter. The parameter is applied with frequency reference formation, current limit value regulation, slip compensation and synchronisation to running motor. Setting 0 signifies: The limiting of MAXF is switched off. Then only the limitation from 22-FMAX1 or 29-FMAX2 is still active.

**95-ERR1 Error 1 [Decimal-0.1h]**
Stores the last error message.

**Representation:**

*Error No. - Error time*

see table

0.1 h = 6 Min. / max. 1.5 h
is reset after each error message

Possible error messages:

| No. | Significance |
|---|---|
| 1-time | Error in computer component |
| 2-time | Low voltage (no entry in 95-ERR1 ÷ 98-ERR4) |
| 3-time | Excess current, short circuit or earthed after mains on |
| 4-time | Excess voltage |
| 5-time | I * t Motor |
| 6-time | I * t Inverter |
| 7-time | Excess temperature motor |
| 8-time | Excess temperature inverter |
| 9-time | Error in EEPROM |

*Acknowledge error by pressing stop/return-key for at least 3 sec. or with digital signal as described under 75-OPT1.*

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