Frequency inverter

MULTIDRIVE
DSV 5444 / ML 2

For dynamic speed and position setpoint control of three-phase AC motors

Commissioning Instructions

CE

Issue 04/00

Dear customer / user,

System DSV 5444 offers you a high-quality, modern and very powerful drive concept.

The customer/user should read these instructions carefully and should have understood them before starting work.

The following products:

DSV 5442 ; DSV 5432 ; DSV 544 CNC ; DSV 5444 ; DSV 5445 ; DSV 5452 ; DSV 5453 ;
UZV 0012 ; UZV 0013 ; UZV 0014 ; UZV 0015 ; UZV 0016 ; DSV 5445/5453-Plus-Serie ;
GNV 2710 ; GNV 252 ; GNE 211 ; GNE 2410 ; GSV 544x , 122 DZE ; 122 DZS ,
KD 915 , KD 920 ; Fine HF-SET 93251340268 (DSV 5452 incl. movable cubicle) ;
Brake resistors 4...40 Ohm (Type Cressall, Frizlen, Danotherm),
comply with the following directives and standards:
Low voltages directive 73/23/EWG - Amendment 93/68/EWG
EMC directive 89/336/EWG - amendments 92/31/EWG and 93/68/EWG
including the appropriate amendment directives up to date of drawing.

The following standards are used:

EN 60204-1	1997	IEC 61000-3-2:	1995	EN 55011:	1991
EN 61800-3 pr A.1.1	1999	IEC 61000-3-2/A1:	1997	EN 55011/A1:	1997
EN 61800-3 pr A11 ;	1999	IEC 61000-3-2/A2:	1998	EN 55011/A2:	1996
EN 61800-1	1999	EN 61800-2	1999	prEN 61800-4	2000
EN 12015	1998	EN 12016	1998	VDE 0660 Part 500 (IEC 439, EN 60439)	

The declaration covers the modules and units delivered by us, but the user must ensure that the machine complies with the directives applicable to the end product after mounting or installation.

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Contents

1 Overview of commissioning

Cut down the commissioning time for your VECTORDRIVE DSV 5444 by only carrying out the steps needed for your own application. The relevant section titles in these instructions can be found in the individual boxes.

Connection power circuit

- Power circuit
- Motor connection
- Brake module (optional)
- Intermediate circuit coupling (optional)

Customized construction with control program

Connection control unit

- note customer application information on terminal assignment
- Freely programmable inputs and outputs (connector X2) (optional)
- Fixed programmable inputs and outputs (connector X1)
- Interface (connector X4)
- Transducer input (connector X3) and transducer cable

Connect unit

Optimise parameters

- Operation
- Set parameters
- List parameters (see note below)

Setting ended

Standard construction

Connect control unit

- Freely programmable inputs and outputs (connector X2) (optional)
- Fixed programmable inputs and outputs (connector X1)
- Interface (connector X4)
- Transducer input (connector X3) and transducer cable

Connect unit

Set parameters

- On-line mode «F3» in terminal program TER.EXE (auto-parameter setting)

Optimise parameters

- Operation
- Set parameters
- List parameters

Create control program

- Programming

As a rule there is customer application documentation as well, i.e. the DSV already includes a program «Kunde.KOM» (Customer command) which can be altered by means of the «Kunde.CNF» menu guide. There are assignment lists and explanations for this in the form of auxiliary files such as «KUNDE.TXT», «KUNDE.DOC» or «KUNDE.INF».

In this case follow the procedures stated!

2 General notes

2.1 Selecting the assembly site

- The VECTORDRIVE DSV 5444 frequency inverter is designed for use indoors.
- When selecting your assembly site, make sure that there is adequate ventilation. There must be a gap of at least 10cm for the top and bottom cover sheets.
- A side gap of at least 1 cm must be maintained on units of size I-III and at least 10 cm on units of size IV. The specified installation position is vertical.
- To ensure trouble-free operation of your installation, it is advisable to install the frequency inverter and ancillary equipment in a switch-cubicle of appropriate design, complying with the applicable EMC regulations.
- The ambient temperature for the standard design should not fall below 0 °C or exceed 60 °C.
  From 35 °C, the power output should be reduced to 1.5 %/°C for sizes I - III and 5 %/°C for size IV.
- Do not install the unit where it will be exposed to direct sunlight.

2.2 Lines, cross-sections, fuses, relays

- All connecting lines and connections should be short and of adequate cross-section. Refer to our proposed sizes for cable sections in the corresponding section, together with the standards listed. Suitable cut-off devices (e.g. main switch, main fuse) should be provided in the mains feeder.
- Never lay signalling and control cables together with the mains or motor lines, or else maintain adequate spacing. Screened lines improve immunity to interference and should therefore be used for preferences.
- Contactor and relay coils with fuses must be used for the control system. Retrofit resistor-capacitance elements, varistors or diodes if necessary on existing installations. For new installations we recommend using 24 V DC relays for the control system.

See also: *Section Power circuit, Screening of lines*
Section Power circuit, Radio interference supression

2.3 Applicable standards and safety provisions

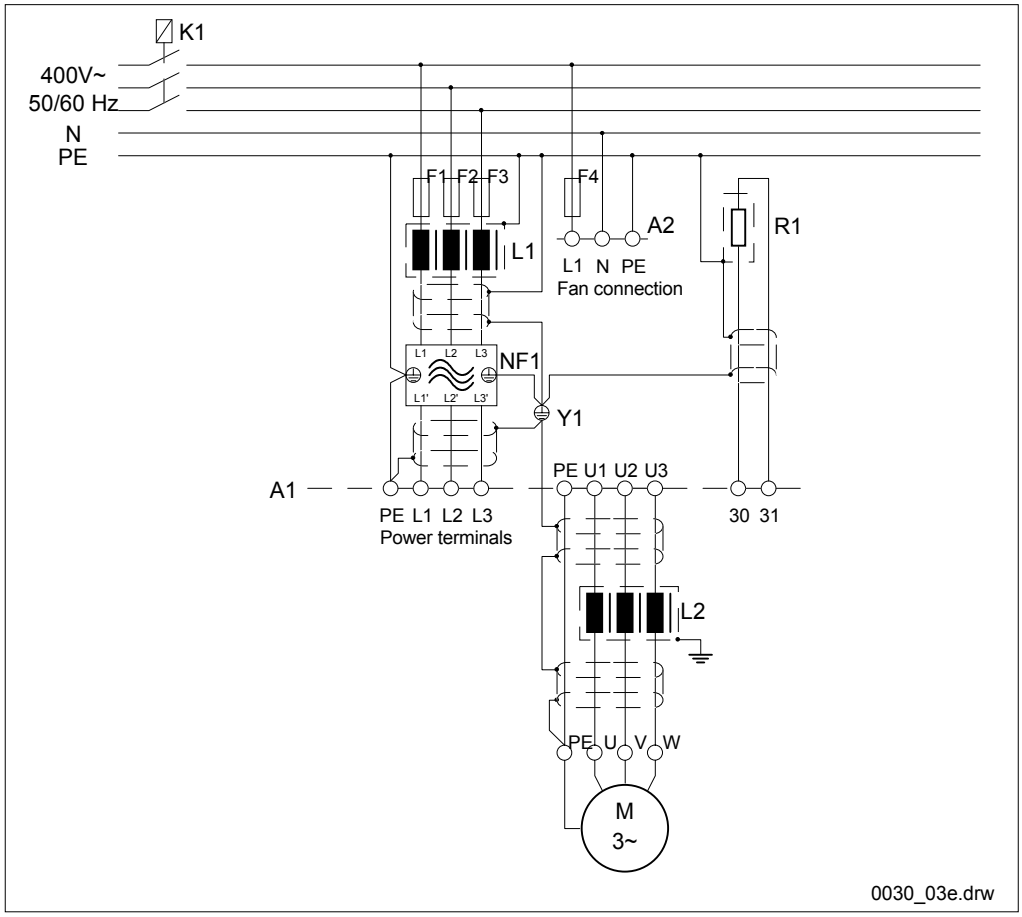
Comply with the relevant standards and safety provisions governing your application on installation. The following standards apply in particular:

- DIN VDE 0100 Provisions for the erection of heavy power installations with rated voltages up to 1000 V
- DIN VDE 0113 Provisions for the electrical equipment of processing and machining equipment
- DIN VDE 0160 Equipment of heavy power installations with electronic operating resources

3 Power circuit

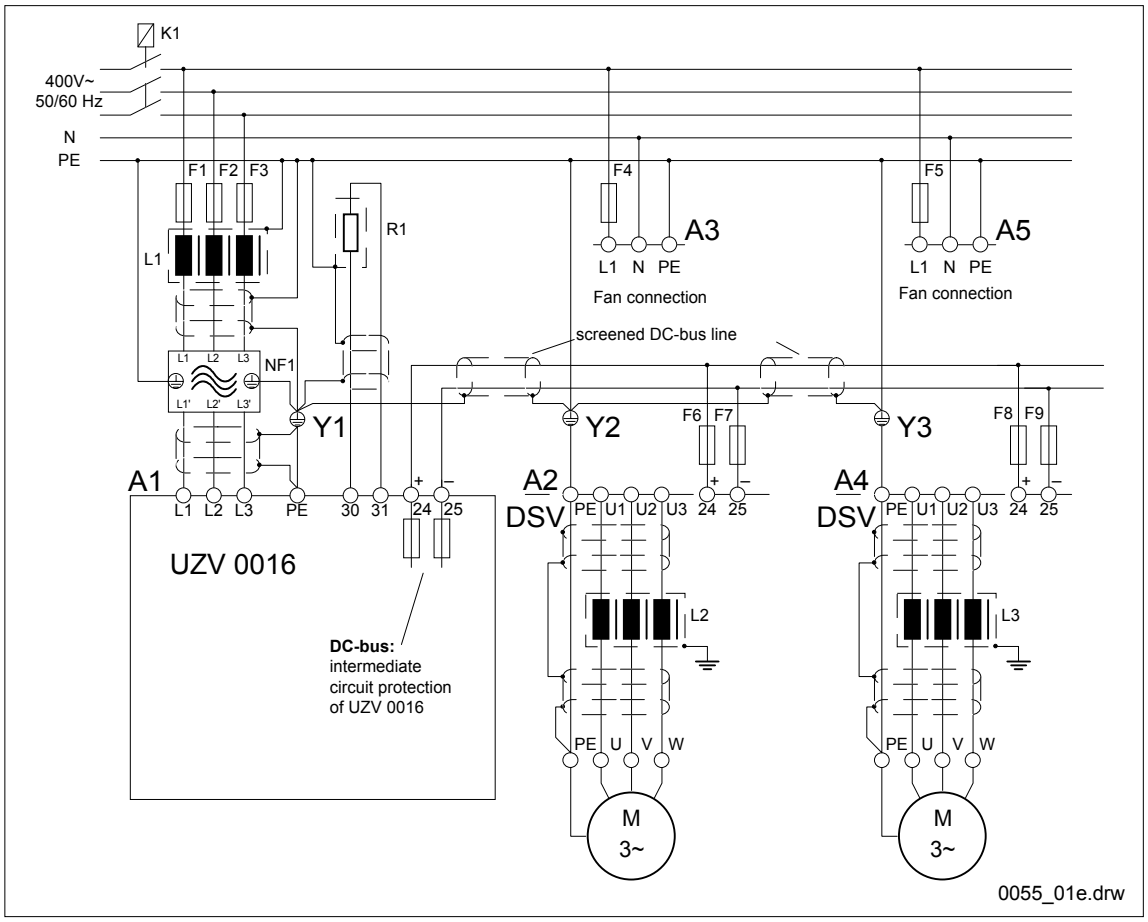
The power circuit of the VECTORDRIVE DSV 5444 contains a six-pulse bridge connection with DC voltage intermediate voltage and IGBT end stage. The output voltage is pulse-width modulated. The inverter outputs are earthing-, short-circuit- and idling-proof.

3.1 Power connection with external mains filter



L1: Power choke
L2: Motor choke (only for motor cable lengths > 15 m)
A1: Power terminals (underside of unit)
A2: Fan connection (top side of unit, size 4 only)
E1: External braking resistance
Y1: Equipotential bonding rails
NF1: External mains filter

3.2 Multiple axis application with UZV 0016



L1: Power choke
L2, L3: Motor choke (only for motor cable lengths > 15 m)
A1: Connection terminals of UZV 0016
A2, A4: Connection terminals of frequency converters
A3, A5: Fan connection (top side of unit, size 4 only)
R1: External mains filter
Y1, Y2, Y3: Equipotential bonding rails
NF1: External mains filter
F1...F3: Mains fuses
F6...F9: External intermediate circuit protection

3.3 Mains connection

The VECTORDRIVE DSV 5444 is designed for fixed connection to the 400 V AC 50/60 Hz AC network (optionally 480 V AC 50/60 Hz). Lines for the mains supply L1, L2 and L3 and the safety earth PE are located on the underside of the unit.

From size IV on, (VECTORDRIVE DSV 5444-60...130), the internal fan must have a separate supply. The power consumption is about 70 W.

The corresponding connection terminals 1 AC 230 V (terminals L1 and N) are on the cover plate.

See also: *Section Power circuit, Earthing*
Section Power circuit, Mains fuses and power chokes
Section Power circuit, Mains filter

3.3.1 Mains fuses and power chokes

The unit feeder must be fused and fitted with power chokes to attenuate phase effects. The core of the power choke should be earthed.

The design of fuses and chokes should be determined on the basis of the table below. The minimum cross-section of the mains feeder is dictated by the mains fuse and type of installation.

VECTORDRIVE DSV 5444-	*Mains fuse 3x (time-lag)*	*Power choke 3x 4% u_k [mH]*
3..6 (S/L)	6 A	2,40 - 10 A
9 (S/L)	16 A	2,40 - 10 A
12 (S/L)	16 A	0,70 - 35 A
16 (S/L)	25 A	0.70 - 35 A
25 (S/L)	35 A	0,70 - 35 A
32 (S/L)	50 A	0,70 - 35 A
45 (S/L)	63 A	0,50 - 50 A
60 (S/L)	80 A	0,50 - 50 A
80 (S)	100 A	0,30 - 80 A
80 (L)	125 A	0,30 - 80 A
100 (S/L)	125 A	0,25 -100 A
130 (S/L)	160 A	0,20 -120 A

S = Standard L = Lift version

3.3.2 Operation with leakage current safety device

It is only possible to use leakage current safety devices (F1) in conjunction with frequency inverters in certain circumstances. Check national standards to see whether a leakage current safety device is admissible for your application. In the event of a fault, DC currents can occur on the mains side with frequency inverters. You should therefore only use leakage current safety devices suitable for DC leakage currents.

Mains filters under some operating conditions (e.g. failure of one phase) can cause high discharge current, resulting in spurious tripping of the safety device. Switching devices on the mains side, such as mains switch or fuse, must therefore switch symmetrically. Rotary switches are generally unsuitable for use with mains filters.

3.4 Motor connection

The motor phases U, V, W are connected to the terminals U1, U2, U3 on the underside of the frequency inverter. The motor housing should be earthed, e.g. to the additional PE terminal. Make sure that the phase sequence is maintained for clockwise phase sequence, otherwise the motor will turn to the left for positive setpoint values. The line cross-sections of the motor feeder are dictated by the rated current of your frequency inverter. Only use screened motor feeders if no output filter or add-on filter is used.

Operating with low speeds and high motor currents causes serious overheating of the motor. It may be that self-cooling or self-ventilation are no longer sufficient. In this case the motor must be fitted with an external fan and temperature sensor (thermistor).

With parallel operation of several motors with one inverter, the cumulative motor current must not exceed the rated equipment current.

If the motor is operated above its rated frequency (standard 50 Hz motor), check the limit speed. Ask your motor manufacturer if in doubt.

3.4.1 Power chokes

Irrespective of EMC regulations, power chokes must be used for motor cable lengths of more than 15 m to limit the capacitive discharge current. The chokes also reduce the voltage rise velocity du/dt on the motor winding. We recommend an inductance value per phase as follows for choke inductance:

$$L = \frac{8000}{\text{Rated motor current [A]}} [\mu H]$$

The power chokes are to be designed for the inverter PWM frequency of 5 kHz. If our add-on filter option is used, power chokes will be required for cable lengths of 45 m and over.

With high-frequency motors, power chokes must in principle be incorporated irrespective of cable length, as, compared to standard motors, the harmonic content of the current and hence motor temperature rise are increased.

High frequency motors in this respect are motors with the following rated motor voltage to rated motor frequency value:

$$\frac{\text{Rated motor voltage}}{\text{Rated motor frequency}} \leq 1.5 \text{ Vs}$$

Example: Rated motor voltage U_n= 380V

Motor frequency f_n = 300Hz

$$\frac{U_n}{f_n} = \frac{380 \text{ V}}{300 \text{ Hz}} = 1.27$$

as 1.27 < 1.5, power chokes must be used.

3.4.2 Thermistor

The motor temperature monitoring system protects the connected motor against thermal overload. In the event of excessive temperature rise in the winding, the inverter automatically cuts out. Connect the motor thermistor with a screened line to terminals 23 and 24 on the front panel. For motors without a thermistor, terminals 23 and 24 are to be bridged.

3.5 Earthing

Earthing consists of a safety earth and a functional earth. If earthing is inadequate or missing, this can cause malfunctions, or even damage the inverter. Particular care should therefore be taken with installation, noting the following points:

- Select the optimum earthing solution for integration (e.g. switch-cubicle mounting plate).
- Ensure that all metallically conductive housing components are connected with suitable lines of adequate cross-section.
- Ensure maximum contact surfaces of the components (skin effect). Remove any paint to ensure a sound, flat contact surface.
- Identify a central earthing point, e.g. on a potential compensating rail. Start the earth from this in a star layout to the corresponding connections.
- Avoid earthing loops.
- Iron choke cores must be earthed.
- The motor housing must be included in the equipotential bonding.

3.6 Screening of lines

- Cables between the inverter output and the motor must be screened (if an output filter is not used). For long cables, the screen must in addition be earthed every 25 m.
- For digital transmission systems, connect the screen on both sides with the equipotential bonding.
- For high impedance analog control lines the screen should be in contact on one side on the source side, as control signal effects due to the 50 Hz ripple current cannot be ruled out.
- All screen connections should have a large contact surface if possible with 360° contact to PE.

3.7 Radio interference suppression

Our inverters are set for radio interference suppression by means of a metal screen on the equipment itself.

The unit complies with EN55011 Radio interference of electrical operating resources and installations, limit value class B, and ENV50141 Radio interference suppression - Test intensity III taking into account the following sections:

- *Power circuit, Mains filter*
- *Power circuit, Installation instructions for radio interference*

3.7.1 Mains filter

A mains filter or our add-on filter (optional) must be provided in the mains feeder between the power choke and unit input.

Make sure that, depending on type, the filter can produce discharge currents up to some 100 mA in the event of failure of one or two phases or major load unbalance in the AC current system. **Filters must therefore be earthed before switching on !!!**

The mains filters we recommend are given in the table below.

VECTORDRIVE DSV 5444-.../400				***Arcotronics***
3	3 x 400 V	50/60 Hz	5 A	F.LL.D3.005A.AN.R1
6	3 x 400 V	50/60 Hz	8 A	F.LL.D3.008A.AN.R1
9	3 x 400 V	50/60 Hz	8 A	F.LL.D3.008A.AN.R1
12...25	3 x 400 V	50/60 Hz	16 A	F.LL.D3.016A.AN.R1
32	3 x 400 V	50/60 Hz	25 A	F.LL.D3.025A.AN.R1
45	3 x 400 V	50/60 Hz	36 A	F.LL.D3.036A.AN.R1
60	3 x 400 V	50/60 Hz	50 A	F.LL.D3.050A.AN.R1
80...100	3 x 400 V	50/60 Hz	80 A	F.LL.D3.080A.AN.R1
130	3 x 400 V	50/60 Hz	110 A	F.LL.D3.110A.AN.R1

3.7.2 Installation instructions for radio interference suppression

- The unit, power chokes, filter and accessories must be incorporated in a metal switch-cubicle.
- The line lengths between external mains filter and unit input must not exceed 0.5 m. The line must be screened.
- Screened motor lines must be connected on both sides to the equipotential bonding. The total length of screening breaks (e.g. for power chokes, motor fuses) must not exceed 10 cm per phase.
- Control lines and mains feeders should be laid separately from the motor cables.
- Connecting cables for braking resistors and intermediate circuit connections, where applicable, must be screened.

CE

Products bearing the CE symbol meet the requirements of EU Guidelines 89/336EEC «Electromagnetic compatibility» and the standardized European standards contained therein. If installation complies with the stated instructions, the requirements of EU guidelines Machines 89/392/EEC are fulfilled.

The EU compliance certification will be made available in line with the above EU guidelines, Article 10, at:

Dietz-electronic GmbH & Co
Max-Planck-Str. 15
D-72639 Neuffen

3.8 Braking module (optional)

The units can be retro-fitted as a special design with a braking option to dissipate braking energy in fast braking operations or with large centrifugal masses. In addition, an external braking resistor with screen line as per the table must then be connected to terminals 30 and 31. The power loss of the braking resistor must, depending on braking frequency, be between 0.2 kW and 11.0 kW. In the case of assembly by customer, proper heat dispersal and safe contact protection must be ensured. We also recommend fitting the external baking resistor with a temperature monitoring facility, which cuts out the frequency inverter mains fuse if the braking resistor gets too hot.

The braking resistors we recommend are listed in the table below:

VECTORDRIVE DSV 5444-	***Braking resistor [Ω]***	***Power loss S1 Standard [kW]***	***Cross-section Standard [mm²]***	***Power loss S1 Lifting system [kW]***	***Cross-section of lifting system [mm²]***
3..9	63,0	0,25	1,5	0,25	1,5mm^2
12..16	41,0	0,33	1,5mm^2	0,33	1,5mm^2
25	20,0	0,45	1,5mm^2	1,00	1,5mm^2
32..45	18,8	1,00	1,5mm^2	2,00	2,5mm^2
60..80	14,4	2,00	2,5mm^2	4,00	2,5mm^2
100	13,0	4,00	2,5mm²	6,50	2,5mm^2
130	13,0	6,50	2,5mm^2	6,50	4,0mm^2

3.9 Intermediate circuit coupling (optional) and Intermediate circuit protection

On units of DC-bus 570 V design and external supply, several drives can be connected to one power supply unit. In this case connect terminals 24 (+UB) and terminals 25 (-UB) together on the underside of the unit.

Each intermediate circuit (+UB and -UB) must be protected against short-circuit separately. The DC connection installation between the individual units should be as short as possible and constructed with screened lines. Connections with polarity reversal on the intermediate circuit connections cause immediate damage to the units. Make sure that you check for the correct polarity before switching on !

Intermediate circuit protection

To ensure safe operation of the VECTORDRIVE DSV 5444-3...130/570, we recommend using semiconductor fuses as listed in the table below:

VECTORDRIVE DSV 5444-.../570	***ZK-fuses 2x gR 660/690V [A]***	***Minimum cross-section [mm²]***
3..9	25	4
12..16	35	6
25..32	50	10
45	63	16
60	80	25
80	125	35
100	160	50
130	200	50

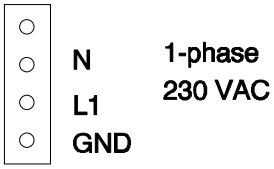
3.10 Voltage Supply of the Fans at Dimension 4 and 5

On request becomes the devices of the DSV 54** -series in the size 4 and 5 too for an fan voltage of 400 VAC equip delivered as up to now 230 VAC. A small autotransformer is integrated into the device. Dimension 5 is a new dimension which covers the range from 75 kW up to 100 kW.

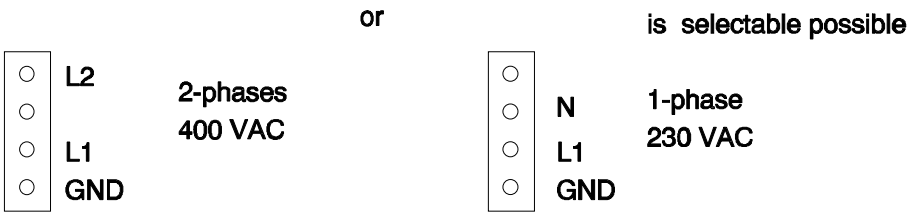
Considering is the pin assignments at the 4-pole supply connector:

1) Standard (without autotransformer):

The most uppermost Pin of the connector must not become engaged here!



2) Version "Focus dynamics" (with autotransformer, devices as from 01.05.99):



Important: Only if the supplied connector has the denotation "L2" at the most uppermost pin, the selectable pin allocation is possible with 400 VAC or 230 VAC!

Considering is with the 400 VAC connection, that two external fuses between 2AT and 4AT are to be planned for the two phases L1 and L2.

Free pins may never be engaged i.e. never engage L1, L2 and N!

4 Control unit / Inputs and Outputs

4.1 Digital inputs and outputs

The inverter has freely programmable inputs and outputs as well as several fixed wired inputs and outputs. This enables simple control tasks to be handled. A voltage of 30 V DC must not be exceeded under any circumstances on inputs and outputs. The control voltage must be smoothed with electrolytic capacitors. Each output can handle a maximum current of 0.1A with a maximum voltage of 24 V DC. The power supply to the outputs is via pin 11 and pin 12 on connector X1 from an external power source. The power supply should have a 2AT fuse. Inputs operate with a voltage of 15 - 24 V DC. They require a current of 10 mA each. The voltage relates to the frame earth terminal on pin 11 of connector X1.

4.2 Freely programmable inputs and outputs on connector X2 (optional)

The freely programmable inputs and outputs are accessible on connector X2.

Treminal	*Abbreviation*	*Assignment*
1	A7	Output 7
2	A6	Output 6
3	A5	Output 5
4	A4	Output 4
5	A3	Output 3
6	A2	Output 2
7	A1	Output 1
8	A0	Output 0

Terminal	*Abbreviation*	*Assignment*
9	E7	Input 7
10	E6	Input 6
11	E5	Input 5
12	E4	Input 4
13	E3	Input 3
14	E2	Input 2
15	E1	Input 1
16	E0	Input 0

Each input can also be interrogated statically by means of flags. The addresses are given in the *section Programming, Inputs* and *Outputs.*

4.3 Fixed programmable inputs and outputs on connector X1

The fixed wired inputs on connector X1 are dominant. This means that the commands of a control program are overridden, and a control program must be set accordingly. The supply conductors for the ISP, INT and E8 signals and for the setpoint values must be screened to prevent any feedthrough.

The following functions are provided:

Terminal	*Name*	*Function*
2	A9 (SI)	This output A9 is freely programmable
3	BB	Ready for operation. The output is set when the inverter and supply unit are ready for operation. The signal is also displayed by the left LED on the front panel.
5	ISP	Pulse barrier, blocks the end stage of the inverter.
6	E8	Freely programmable input. If this input is not used, it must be set at 24 V (high) (see *section Programming, Blocks*)
8	INT	This input is used for an external transducer zero pulse.
11	0 V	Earth for external 24 V supply voltage
12	24 V	Connection for external 24 V supply voltage
19	1SW+	1st setpoint value "+"
17	1SW-	1st setpoint value "-"
18	SGND	Setpoint earth
25	2SW-	2nd setpoint value "-"
15	2SW+	2nd setpoint value "+"
20	+15 V	Internal +15 V
22	-15 V	Internal -15 V
23	KMR	Thermistor input, input for motor temperature monitoring
24	KMH	Thermistor input, input for motor temperature monitoring

☞ Examples of terminal assignment for specified analog setpoint values can be found in the Appendix.

4.4 Interface (connector X4)

The serial interface is used to set the parameters for, operate, and control the inverter. The interface can be operated optionally in accordance with RS-232 or RS-485 standards.

- Use the RS-232 configuration if you want to set and run the inverter with the TER.EXE terminal program and a PC or Laptop.
- The RS-485 configuration is used to control several inverters with a higher ranking control or a control computer (multiple axis application).

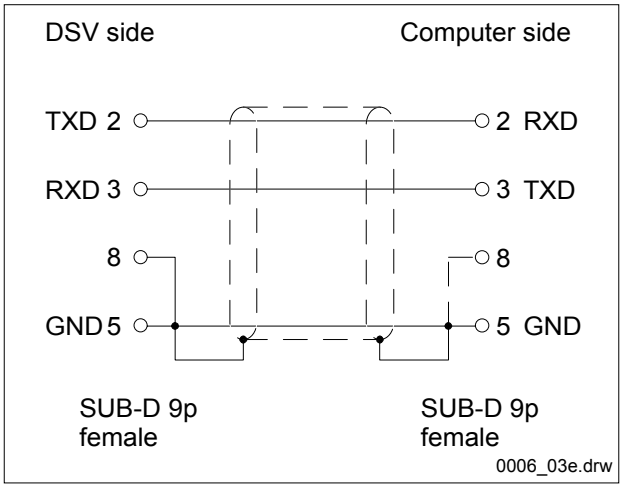
The serial interface has a fixed setting for: 9600 Baud
8 bits
1 Stop bit
no parity

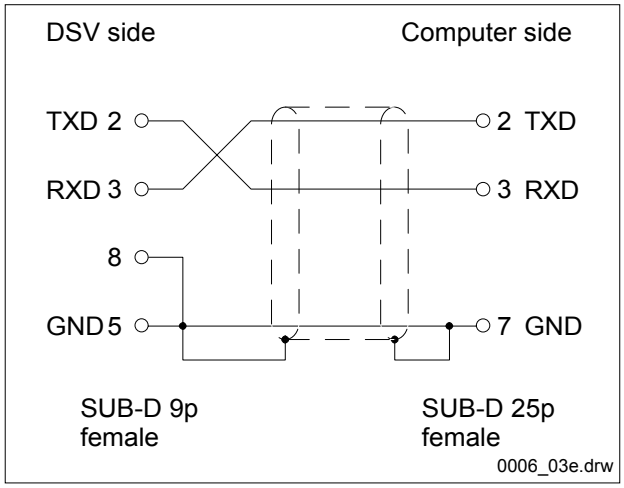
Interface assignment:

Terminal	***Designation***
1	RS485+
2	RS232 TXD
3	RS232 RXD
4	RS485-
5	GND
6	RS485 transfer: bridge to GND
7	GND
8	External interface: bridge to GND (FI control deactivated)
9	+5 V

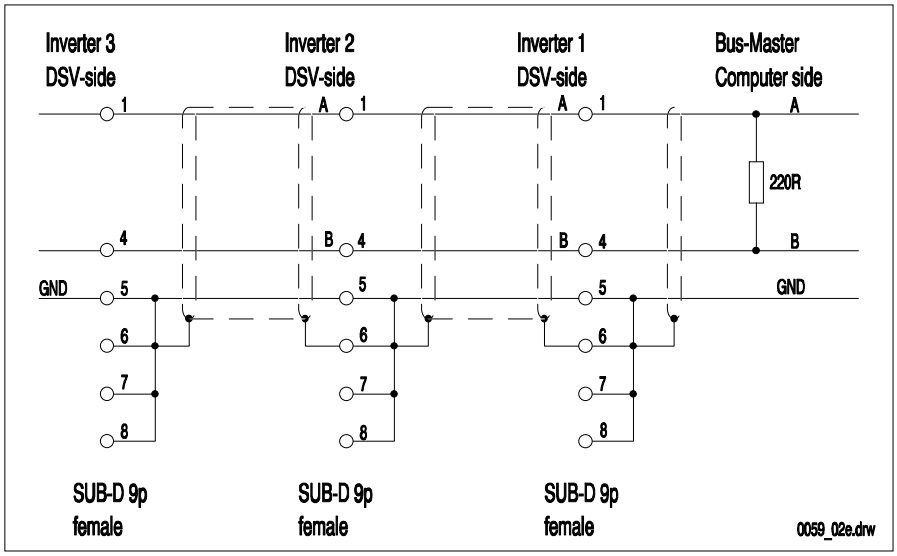
- For RS232 operation, pin 8 must be connected to GND (pin 5 or 7). Pin 6 may not be bridged.
- For RS485 operation, pin 8 and pin 6 must be connected to GND (pin 5 or 7).

RS232 cable (connection VECTORDRIVE DSV 5444 ↔ computer)





RS485 terminal assignment for multiple axis application



4.5 Transducer input (connector X3) and transducer cable

Rotary position transducer input assignment (15-pole male D-unit connector) and connector on rotary position transducer (12-pole round connector IP65):

Connector X3	*12-pole round connector (IP-65)*	*Assignment*
1	5	UA1-IN+
2	6	UA1-IN-
3	12	VCC
4	10	GND
5	8	UA2-IN+
6	1	UA2-IN-
7	3	UA0-IN+
8	4	UA0-IN-
9	-	I-screen
10	-	-15 V
11	(11 if required)	GND-Sense
12	Housing (9 if required)	A-screen
13	(2 if required)	VCC-Sense
14	(7 if required)	Alarm
15	-	+15 V

- Use our transducer cable for preference (order N° 95441812)
- The unit has a default setting for a transducer with 1 Vss - level 4 x 90°, 1024 pulses as standard.

Jumper JP3 can be used to switch from the sinusoidal transducer (standard) to a rectangular transducer (see section Appendix, Installin firmware on control card and in FI control). For this, the address 708h should be loaded in block 16 as 255!

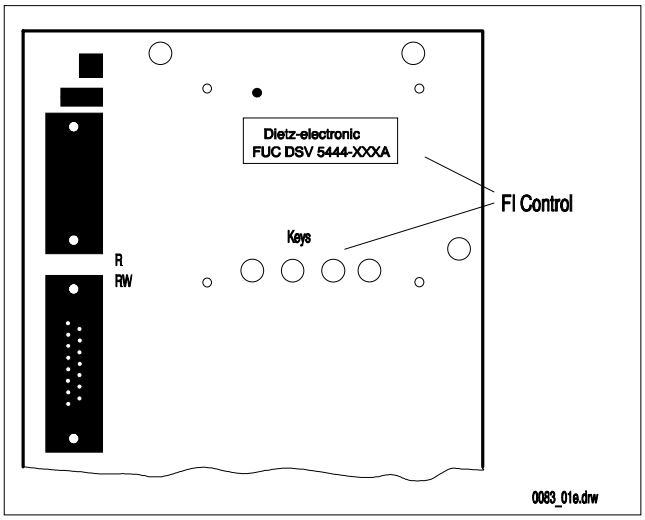
4.6 Operation

The parameters for the VECTORDRIVE DSV 5444 frequency inverter can be set via the internal operator unit (FI Control) or the PC program "TER.EXE".

During programming, data amendment and data storage, make sure that there is no change of signal at I/O level (connectors X1 and X2).

4.7 Frequency inverter (FI) control

The FI control consists of a two-line display with clear text and 4 keys. The FI control is only active if there is no connection to connector X4 (RS232/RS485 interface). In passive status only error and status messages are displayed.



4.7.1 Operation of FI control

The four keys of the FI control have the following functions:

Key		***Assignment/Explanation***
⇑	Up arrow key	Select required menu point
⇓	Down arrow key	Select required menu point
⇐	Left arrow key	Leave a menu point (without changing a value => Quit option)
⇒	Right arrow key	Activates selected menu point
	Edit a value	If the required menu point is activated, the right and left arrow keys can be used to move the cursor to the corresponding position. The up and down arrow keys are used to change the figure or sign. To accept a modified value, the right key should be pressed until the FI control displays the message «VALUE ACCEPTED». The modified values are only stored in the FI control until the «STORE VALUES» menu point is activated.

4.7.2 Menus

By pressing the ⇑- or ⇓- keys, all the requisite parameters are first read into the FI control from the inverter. A selection menu is then presented with the following menu points:

Menu point	***Assignment / Explanations***
Change variables	The variables in the free working memory E00h to E60h can be changed.
Change parameters	Parameters F0 to F31, I, K, T, Y0 and Y1 of the inverter can be changed.
View interface	With this menu point, outputs from the inverter are displayed on the interface. Line feed is denoted by a rectangle.
Store values	This menu point transfers the values to the inverter and stores them in the EEPROM to safeguard against mains failure. The inverter then enables a RESET. This process takes about 10 seconds. During that time, the inverter must not be switched off or the connection with the FI control interrupted. After storage in memory, the inverter is reset. The selection menu then reappears. **WARNING:** If the original values are still present after storing the modified values, the data save switch (R/RW switch) must be changed over between terminals X3 and X4 into the RW position.
Change operating mode	There are currently two different operating mode options available for the FI control. Lift variants: the function is designed specifically for this application (this operating mode is automatically selected with the lift). Standard operating mode: all parameters and variables are freely accessible, but there is no customer application commentary. **WARNING:** after change-over, all values are read in again. Any values not stored therefore resume their former status.

To select, activate, quit and edit a menu point, see previous table in *section Operation of FI control* and *section Procedure for changing variables and parameters.*

4.7.3 Status designation

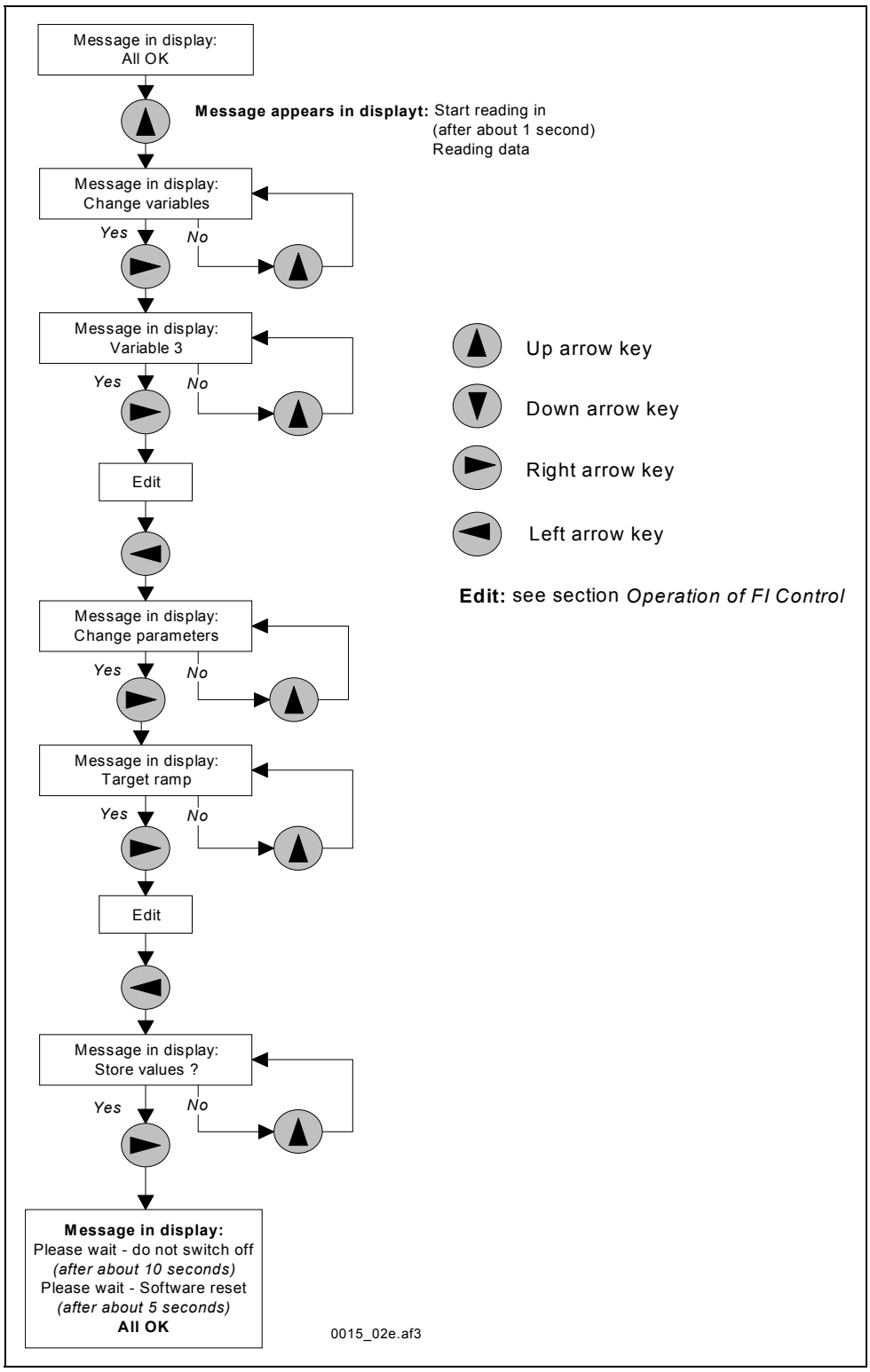
Status designation	***Meaning***
Ready for connection	Inverter is ready for operation, it can be switched on
Speed control	Inverter in speed control mode
Position control	Inverter in position control mode
Position synchronization	Inverter running with position synchronization
Speed synchronization	Inverter running with speed synchronization
Pulse barrier	Pulse barrier (ISP input) not connected
Control off	Control switched off due to fault
Controlled	Inverter running without transducer actual value (switch = 00h)
Analog operation	Inverter running in analog mode

4.7.4 LEDs

LED	***Colour***	***Meaning***
BB	yellow	Ready for operation: the output is set if the inverter and power supply unit are ready for operation. If there is no ready for operation message, check the error message on the integral operator unit. Some faults have to be reset using the RESET function.
A9	green	User-defined: dependent on command program.

4.7.5 Procedure for changing variables and parameters

The flow-chart below shows the procedure for changing variables and parameters with an example. Variable 3 is taken from the selection menu «Change variables» and the target ramp from the selection menu «Change parameters».



4.8 TER.EXE terminal program

The terminal program TER.EXE is designed for changing parameters and variables. Parameter and variable selection can be designed for specific customer applications. Operation is menu-controlled.

Configuration file: File containing addresses and names of variables and parameters which can be adapted individually.The file name has a «CNF» ending.

Command file: File containing the control program with associated parameters and variables.

4.8.1 Operation

Insert the floppy disk with the terminal program in the disk drive of your PC/Laptop. Copy all the files on the floppy disk into a sub-directory (e.g. terminal) of your choice on the hard disk. Change to the sub-directory.

Before starting the terminal program, connect the interface between the PC and the DSV (take care with interface cable assignment). After fitting the connection, operation via the FI control is no longer possible.

There are two ways of calling in the program.

1. TER
   The program asks for the required field name.
   Start, e.g. with: **TER <*CR*>**
2. TER configuration file
   The program read out of the inverter for the parameters and variables defined in the *Customer.CNF*.
   Start e.g. with TER Customer.CNF <*CR*>
3. For desk parameter setting, the terminal program can be started with the following input: **TER *Customer*.CNF *Customer*.KOM <CR >**
   For the customer input the name of the configuration file or the name of the command program for which the parameters are to be set.

Do not change, read or transmit data when the installation is running!

Once the TER.EXE terminal program is started, the following menu appears:

Function keys	***Selection menu***	***Explanation***
F1	Function for changing user data	All parameters stated in the *List of parameters* section can be read in and changed.
F2	Function for changing configuration file	
F3	Standard terminal program	Use for on-line programming
F4	Change-over of serial interface	COM1 or COM2
F5	Transfers data from a file to the inverter	
F6	Stores data from the inverter in a file	
F9	Graphic actual value display	Simultaneous presentation of two actual values (e.g. speed and current)

4.8.2 Procedure for changing parameters

- After pressing the function key F1, the parameters are read out of the frequency inverter.
- The parameters can be changed once they have been read.
- After changing the parameters, the values have to be stored by pressing function key F2.

The following appears in the display:

Programming EEPROM. Please wait !
(after 2 seconds)
Checking parameters
(peep tone)
if a parameter is rejected:
- press any key
- press F10
- press F1

To change parameters or optimise them, please see *section Setting parameters*.

4.8.3 Graphic actual value display „F9“

In the basic position, the display shows the speed in customer units and the torque. The resolution of the travel curve can be changed. Other DSV dimensions can also be shown.

The actual values displayed can be stored in memory and reloaded at a later stage.

With software versions as of November 1996, a small input window is provided for short key message commands, in which commands can be input as the curves are plotted.

Example: interruption in travel by PC with F1 V <CR> F1 a <CR>

4.8.4 On-line mode «F3»

After pressing function key F3 in the terminal program TER.EXE, on-line mode is enabled. This is used:

- for automatic parameter-setting and basic initializing of motor type plate data.
- for monitoring the signal sequence;
- for direct action on the DSVs.

Prerequisites for automatic parameter-setting (SHIFT-F7)
- Inverter ready for use
- PC or Laptop connected to serial interface of inverter

Information necessary for parameter-setting can be taken from the inverter and motor rating plates.

The following menu functions are available in on-line mode:

Function key	***Explanation***
F1	Delete screen page
F2	Save current DSV outputs in a file
F3	Delete all blocks and variables
F4	File transfer (deletes old program and transfers a new file into the EEPROM)
F5	File transfer (overwrites and supplements a program and variables in EEPROM)
F6	README file (multi-page help text) displayed
SHIFT-F6	Change-over between interfaces
F7	EEPROM content loaded in a file from DSV (scrollable)
SHIFT-F7	Automatic parameter-setting and basic initializing from motor type plate data
F8	Block editor for modifying an individual block
F9	Functional overview of terminal program (*HLP-file)
F10	EXIT (return to menu surface of off-line mode → TER,EXE)

5 Setting parameters

5.1 Speed control parameters

A prerequisite for this is that the motor parameters are input or set and the inverter is ready for operation.

The following default settings are provided for the control parameters:

Motor output:	Parameter:
< 5.5 kW	Time constants I = 16 and gain K = 200
> 5.5 kW	Time constants I = 8 and gain K = 400

The run-up and return ramps should be set for steep values (Y0 = Y1 = 10000). Let motor turn over at low speed (e.g. 10 rpm).

High-flexibility coupling between motor and load	***Rigid coupling between motor and load***
Motor moves a weight which is much greater than that of the motor by means of a coupling with high spring constant (long belts, bellows or torsion).	Motor idling, the inert mass is driven directly by the motor shaft, using a low-play gearing (transmission ratio i > 3) or a short gear belt
Time constant I multiplied by four and gain K increased in increments of 50 until motor starts to hum.	Gain K increased in increments of 100 until motor starts to hum.

- When the motor is warmed up ready for operation, the gain K is reduced by a quarter, or by a third if the motor is cold.
- Run the drive at full speed. If the motor is not running smoothly, the time constant I must be doubled.
- If the motor is operated with field control, the rotor time constant T must be increased by about 25 % if necessary.
- The run-up and return ramps should now be set steep enough to not quite reach the torque threshold. The torque limit (address 74h) can be set on an output. The parameter F4 (target ramp of position control) must always be smaller than the return ramp Y1 (F4 ≤ Y1 - 16).

If position control is not used, the remaining parameters should nonetheless be set as follows:

Parameter	***Setting***
F3	With high-flexibility coupling F3 = 20, with rigid coupling F3 = 80.
F4	Target ramp of position control F4 ≤ y1 - 16
F6	The integration time constant of the position control is selected as F6 = 2 × I. If field control is used for running, the input should be F6 = 1.
F7	Control gain in the position control is selected as F7 = K.

5.2 Position control parameters

A prerequisite for this is that the motor parameters and parameters for the speed control are either input or set. The following default settings are provided for the position control parameters:

Parameter	***Setting***
F11	F11 = F1 (positioning speed default)
F12	F12 = F1 /10 (speed for reference travel)
G	G = F1 (positioning speed active)
F21	F21 = 256 (standardization factor for position control)

High-flexibility coupling between motor and load	*Rigid coupling between motor and load*
F5 = F1 / 2 (speed for second root sector)	F5 ≤ F1 (speed for second root sector)
Halve Y0	Y0 = F4 (run-up ramp)
Y1 = F4 + 16	Y1 ≥ F4 + 16 (return ramp)
F4 = Y0 / 2	F4 = Y0 target ramp of position control)
F3 = 20 - 40	F3 = 50 - 80 (gain in position control)
F6 ≤ 4 × i	F6 = 2 × i (time constant of speed control in position control)
F7 = K	F7 = K (time constant of speed control in position control)

The drive must now be run with position control. If the setting is correct, the drive will run in the target position without overshooting. If this does not occur, the target ramp (parameter F4) must be set at a flatter angle.

The setting for the control parameters F3, F6 and F7 given in the table is normally sufficient. If the required control properties are not achieved, these parameters must be adapted to suit the installation. The performance of the position control loop is best assessed with the graphic actual value display (function key F9).

With synchronous operation, the values for the ramps (parameters F4, Y0 and Y1) are doubled on the follower drive.

The positioning speed ("G" command, parameters F11 and F27), reference travel speed (parameter F12) and standardization factor for position control (parameter F21) and the zero position offset (parameters F8 and F26) must likewise be adapted to suit the purpose if necessary.

5.3 Standardization

Parameters F1, F2 and F5 are generally stated in revolutions per minute.

The speeds for the "O" and "G" commands and parameters F11, F12 and F27 can be standardized with parameters F10 and F22 to enable input in customer units. If data input in rpm is required, the parameters are set according to the following formula (IZ_AKT = effective number of increments):

Effect on standardized speed (parameters F10 and F22): $\frac{F22}{F10} = \frac{4 \times IZ\_AKT}{b \times c}$

b = Number of path units per motor revolution (standard value: b = 1)
c = Number of scans per time unit (standard value c = 75000).

For gearing ratio or expression in a customer unit (e.g. metres per second), the break must be multiplied by the corresponding factors. For both parameters, two integer number values lower than 32767 must be found.

With standard settings (rotary position transducer with 1024 points, no gearing and IZ_AKT = 65536) and expression of speed in rpm, the following values are obtained:

F22 = V_FKT = 6994
F10 = V_TEIL = 2001

5.4 Number of rotary position transducer points

The inverter can be adapted to suit the number of points on the rotary position transducer. If parameter F24 = 1, only the number of strokes incorporated on the machine software will be used. If F24 = 2, the incremental number factor entered in parameter F23 is used. The following dimensions are significant here:

F23	(IZ_FKT) increment number factor
F24	Changeover of transducer transmission
F22	V_FKT
F10	V_Teil
IZ	Increment number, number of increments per motor revolution (standard: 65536)
IZ_AKT	effective number of increments
z	Number of points on rotary position transducer, corresponding to number of sinusoidal periods per revolution
a	n-times evaluation of a sinusoidal period. The interval between two points, a sinusoidal signal, is divided into "a" sections. This multiplied by the number of points on the rotary position transducer gives the number of increments per motor revolution (standard setting: a = 64).
$n_{transducer}$:	Transducer speed
n_{motor}:	Motor speed

The value for transducer transmission can now be calculated by the following formula:

$$IZ\_AKT = z \times a \times \frac{n_{transducer}}{n_{motor}} \qquad IZ\_FKT = \frac{IZ\_AKT}{IZ \times 256}$$

If IZ is not the same as IZ_AKT, parameters F10, F22 and F21 change accordingly.

Effect on standardization of analog setpoint (parameter F9):

$$ANA\_FKT = \frac{F22}{8 \times F10} \times \frac{10V}{U_{analog}} \times \frac{Speed}{Speed\ \ unit}$$

Effect on route factor F21:

$$F21 = STR\_FKT = \frac{IZ\_AKT}{b}$$

STR_FKT	Route factor (parameter F21)
b	Number of path units per motor revolution (standard value: b = 1)

The route factor F21 affects parameters F8 and F26 as well as the "C", "D" and "H" commands.

6 List of parameters

F0 *Rotor flow*

Explanation Caution, if this function is activated, the maximum torque is set ("S" command) and the $I^2 \times dt$ limit is set at the maximum value.

Adress 09Eh R ***FI-control menu*** Parameter

Value range min. 25 max. 1200 **Resolution** 1 **Unit**

Note

$$F0 = 50 \times I_{\text{rated motor}} \times \sin\varphi \times \frac{\text{series}}{I_d} \quad \text{(for standart motor)}$$

Series: values should be taken from the table in the section *Appendix, Other information*
sinφ : see section *Appendix, Conversion table for sinφ, cosφ und tanφ.*

A more precise result can be achieved with measurement. For this, the motor voltage is measured with a moving-iron instrument. The motor must run at half the rated speed. The rotor flow F0 is now set so that the moving-iron instrument shows half the rated voltage. If the voltage is too low, the rotor flow should be increased. If the voltage is too high, the rotor flow should be reduced.

Extended anchoring adjustment range (delta connection with 87 Hz characteristic):

$$F0 = 0.9 \times \sqrt{3} \times 55 \times I_{\text{Nenn-Motor}} \times \sin\varphi \times \frac{\text{Serie}}{I_d}$$

($I_{\text{motor rating}}$ for 50 Hz operation (star connection))

F1 *Max. speed for const. torque*

Explanation Maximum speed for constant torque.

Adress 0A2h R ***FI control menu*** Parameter

Value range min. 200 max. N_MAX **Resolution** 1 rpm **unit** [rpm]

F2 *Speed at safe commutation limit (synchronous speed)*

Explanation Speed at safe commutation limit

Address 0A4h R ***FU-control menu*** Parameter

Value range min. 500 max. N_MAX **Resolution** 1 rpm **Unit** [rpm]

F3 *PCG* *Position control loop*

Explanation Position control loop gain in proportional range

Address 0A6h R ***FI control menu*** Parameter

Value range min. 10 max. 400 **Resolution** 1 **Unit**

F4 *Target ramp* *Position control loop*

Explanation Target ramp (number always less than Y1)

Address 0A8h R ***FI control menu*** Parameter

Value range min. 1 max. 4000 **Resolution** **Unit**

F5 *Speed (3rd -> 2nd root section)* *Position control loop*

Explanation Maximum speed for 2nd root braking curve range

Address 0AAh R ***FI control menu*** Parameter

Value range min. 200 max. N_MAX_1 **Resolution** **Unit**

F6 *Int. time const. pos. cntrl* *Position control loop*

Explanation Integration time constant of speed control in position control

Address 0B0h R ***FI control menu*** Parameter

Value range min. 8 max. 256 **Resolution** **Unit**

F7 *Gain for position cntrl.* *Position control loop*

Explanation	Gain of speed control loop in position control						
Address	0B2h	R		***FI control menu***	Parameter		
Value range	min.	100	max. 2000	**Resolution**		**Unit**	

F8 *Offset 1 for zero position* *Position control loop*

Explanation	Offset for zero position for F11 (in the same direction of rotation)						
Address	0BAh	R		***FI control menu***	Parameter		
Value range	min.	-32767	max. +32767	**Resolution**		**Unit**	

F9 *Factor for analog setpoint value* *Speed control loop*

Explanation	Standardization for analog setpoint value (ANA_FAKT)/Operating mode B1						
Address	0BCh	R		***FI control menu***	Parameter1		
Value range	min.	1	max. 4095	**Resolution**	1	**Unit**	

F10 *Speed distributor* *Speed control loop*

Explanation	Used in conjunction with parameter F22 (see Section *Setting parameters, Standardization* and *Number of transducer points*)						
Address	0B4h	R		***FI control menu***	Parameter		
Value range	min.	+ 1	max. 32767	**Resolution**	1	**Unit**	

F11 *reduz.Drehz.1f.Position* *Position control loop*

Explanation	Reduced positioning speed; positioning in the same direction as the machine is running						
Address	0BEh	R		***FI control menu***	Parameter		
Value range	min.	1	max. N_MAX	**Resolution**	1	**Unit**	

F12 *Ref. cycle speed* *Position control loop*

Explanation	Speed of reference cycle						
Address	0C0h	R		***FI control menu***	Parameter		
Value range	min.	-N_MAX	max. +N_MAX	**Resolution**	1	**Unit**	

F13 *Speed tolerance SET/ACTUAL on* *Speed control loop*

Explanation	Maximum speed deviation (tolerance window) for setting the "Required = Actual" message						
Address	0C2h	R		***FI control menu***	Parameter		
Value range	min.	4	max. 500	**Resolution**	1	**Unit**	

F14 *Speed SET/ACTUAL scan on* *Speed control loop*

Explanation	F14 × 0.8 milliseconds (scan time) gives the period in which the speed must fall within the tolerance window to set the message "Set = ACTUAL"						
Address	0C4h	R		***FI control menu***	Parameter		
Value range	min.	1	max. 400	**Resolution**	1	**Unit**	

F15 *Speed tolerance SET/ACTUAL off* *Speed control loop*

Explanation	Minimum speed deviation (tolerance window) for deleting the "Required = Actual" message						
Address	0C6h	R		***FI control menu***	Parameter		
Value range	min.	1	max. 1000	**Resolution**	1	**Unit**	

F16 *Speed SET/ACTUAL scan off* *Speed control loop*

Explanation	F16 × 0.8 milliseconds (scan time) gives the period in which the speed must fall outside the tolerance window to reset the message "Set = ACTUAL"						
Address	0C8h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	400	**Resolution**	1	**Unit**

F17 *Position tolerance SET/ACTUAL on* *Position control loop*

Explanation	Maximum position deviation (tolerance window) for setting the "Required = Actual" message						
Address	0CAh	R			***FI control menu***	Parameter	
Value range	min.	4	max.	1000	**Resolution**		**Unit**

F18 *Position SET/ACTUAL scan on* *Position control loop*

Explanation	F18 × 0.8 milliseconds (scan time) gives the period in which the position must fall within the tolerance window to set the message "Set = ACTUAL"						
Address	0CCh	R			***FI control menu***	Parameter	
Value range	min.	1	max.	400	**Resolution**	1	**Unit**

F19 *Position tolerance SET/ACTUAL off* *Position control loop*

Explanation	Minimum position deviation (tolerance window) for deleting the "Required = Actual" message						
Address	0CEh	R			***FI control menu***	Parameter	
Value range	min.	8	max.	2000	**Resolution**	1	**Unit**

F20 *Position SET/ACTUAL scan off* *Position control loop*

Explanation	F20 × 0.8 milliseconds (scan time) gives the period in which the position must fall outside the tolerance window to reset the message "Set = ACTUAL"						
Address	0D0h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	400	**Resolution**	1	**Unit**

F21 *Insert factor* *Position control loop*

Explanation	Standardization factor for position control commands ("C", "D", "H") and parameters F8 and F26						
Address	0D2h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	32767	**Resolution**	1	**Unit**

F22 *Speed factor* *Speed control loop*

Explanation	Standardization for specified standard setpoint (operating mode B0)/Standardization factor for speed control commands ("O", "G") and parameters F11, F12 and F27 (see Section *Setting parameters, Standardization* and *Number of rotary position transducer points*).						
Address	0D4h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	32767	**Resolution**	1	**Unit**

F23 *Increment number factor*

Explanation	Increment number factor (see Section *Setting parameters, Standardization* and *Number of rotary position transducer points*). (for transmission between motor and transducer, range : 1 - 32767)						
Address	0D6h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	32767	**Resolution**	1	**Unit**

F24 *Change-over of transducer transmission*

Explanation	Change-over of transducer transmission: without transmission F24 = 1, with transmission F24 = 2 (see Section *Setting parameters, Standardization* and *Number of rotary position transducer points*)						
Address	0D8h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	2	**Resolution**	1	**Unit**

F25 *Bus - Address*

Explanation	Sets the unit address if there are several units connected to one bus. For F25 = 0, communication via bus operation is cut off. Default setting: 1						
Address	0DAh	R			***FI control menu***	Parameter	
Value range	min.	0	max.	99	**Resolution**	1	**Unit**

F26 *Offset 2 for zero position* *Position control loop*

Explanation	Offset for zero position for F27 (in the positioning direction)						
Address	0DCh	R			***FI control menu***	Parameter	
Value range	min.	-32767	max.	+32767	**Resolution**	1	**Unit**

F27 *Reduced speed 2 for postg.* *Position control loop*

Explanation	Reduced positioning speed; direction of rotation reversed for reference travel						
Address	0DEh	R			***FI control menu***	Parameter	
Value range	min.	-N_MAX	max.	+N_MAX	**Resolution**	1	**Unit**

F28 *Torque dampening*

Explanation	Torque dampening, maximum change in acceleration per scan interval. The higher F28, the faster the setpoint value is sought.						
Address	0E0h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	2047	**Resolution**	1	**Unit**

F29 *Inc. follower* *Synchronous operation*

Explanation	Increment number ratio of follower drive (IK_FOLGE, increment number of follower drive)						
Address	0E2h	RW			***FI control menu***	Parameter	
Value range	min.	-32767	max.	+32767	**Resolution**	1 ine.	**Unit**

F30 *Inc. master drive* *Synchronous operation*

Explanation	Increment number ratio of master drive (IK_LEIT, increment number of master drive in relation to follower drive speed); only the speed value is evaluated.						
Address	0E4h	RW			***FI control menu***	Parameter	
Value range	min.	+1	max.	+32767	**Resolution**	1ine.	**Unit**

F31 *N° of poles*

Explanation	Motor pole N°						
Address	0E6h	RW			***FI control menu***	Parameter	
Value range	min.	2	max.	64	**Resolution**	1	**Unit**

Y0 / NSOLL_ACC *Run-up ramp* Speed control loop

Explanation	Run-up ramp						
Address	0B6h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	16384	**Resolution**		**Unit**

Y1 / NSOLL_DEC *Return ramp* Speed control loop

Explanation	Return ramp						
Address	0B8h	R			***FI control menu***	Parameter	
Value range	min.	1	max.	16384	**Resolution**	1	**Unit**

I *TIN_N* Speed control loop

Explanation	Integration time constants for speed control loop for speed control						
Address	0AEh	R			***FI control menu***	Parameter	
Value range	min.	1	max.	10000	**Resolution**	1	**Unit**

K *VPN_N* Speed control loop

Explanation	Amplification factor for speed controllers with speed control						
Address	0B6h	R			***FI control menu***	Parameter	
Value range	min.	100	max.	5000	**Resolution**	1	**Unit**

T *Rotor time constant*

Explanation	Rotor time constant						
Address	0A0h	R			***FI control menu***	Parameter	
Value range	min.	25	max.	1000	**Resolution**	1	**Unit**

Note

$$T = \frac{P_{motor}[kW]}{\tan\varphi} + 60 \quad \text{(for standard motors)}$$

tan φ : see Section *Appendix, Conversion tables for sinφ, cosφ und tanφ*

The rotor time constant T can also be determined using an ammeter instrument. In this case leave the motor running under load and change the value of t until minimum motor current throughput is obtained.

Extended anchoring adjustment range (delta connection with 87 Hz characteristic)):

Parameter T is determined using the above formula with the motor rating plate data for 50 Hz operation (star connection). Although the overall rotor time constant is dependent on the size of the motor, it does not change if the output and speed increase proportionally.

7 Errors

7.1 Error messages on integral operator unit (FI CONTROL)

Fault	*Cause*	*Remedy*
Cooling unit temperature	Temperature of cooling unit too high. Fault in output stage or rectifier. Output stage disabled.	Check that the unit is properly ventilated and that the maximum ambient temperature is not exceeded Press RESET after cooling.
I²dt	I²dt disconnection activated. Inverter has cut off to protect the connected motor. The parameter required is the torque at which the motor can run continuously (torque IS_MAX input in storage location ED8h, scale corresponding to "S command", range: 64 - ISQ_SETPOINT_MAX) and the time IS_T in which the motor can produce double the continuous torque IS_MAX (IS_T input in storage location EE0h in seconds, range 1 - 17). Caution: If function F0 is used, the I²dt limit is set at the maximum value.	The assignment between the motor rotary field (phase sequence) and the rotary position transducer is incorrect or the transducer is not properly connected to the shaft. This fault can also occur on run-up (inverter running at current limit).
Intermediate circuit over-voltage	Intermediate circuit over-voltage, braking resistor ohm value too high, braking energy too high.	Reduce return ramp, acknowledge with RESET.
Program stops	CPU fault (program run interrupted), not ready for operation	Please contact us.
Short-circuit	Short-circuit or earth fault, output stage disabled immediately.	Check connecting wiring, acknowledge with RESET
Parameter error	Invalid parameter set in EEPROM	Check parameters for value range and validity
Phase error	Phase failure, output stage disabled immediately	Check mains input voltage and mains fuses.
Thermistor	Motor overheating, output stage disabled	Thermistor not connected, cable faulty or motor too hot
Power unit fault	Power unit faulty (internal fault), not ready for operation	Check the ±15 V power supply to connectors X1, X3 for short-circuit. If all the connectors mentioned are removed and the error message still does not reset, please contact us.
EEPROM Checksum	Parameter error (check sum in EEPROM incorrect), not ready for operation	Please contact us.
Intermediate circuit under-voltage	Voltage on intermediate circuit too low or internal fault on intermediate circuit fuse	Check mains input voltage and mains fuses.
Watch-dog	CPU fault (watch-dog timer)	Please contact us.
Module fault	IGBT module signalling excess current	Please contact us.
Transducer fault 1/2?	Fault on motor transducer or 2nd transducer, cable incorrectly wired, short-circuit in connector, incorrect rotary position transducer (TTL instead of 1Vss or vice versa).	Check rotary position transducer cable construction. Check rotary position transducer. (Use our rotary position transducer cable => Order N° 95441812 for preference)

7.2 Other faults:

Motor running at half speed maximum and overheats
- Pole number input too low.
- Number of transducer points lower than specified (parameter F23 too large).

Motor running faster than setpoint value
- Pole number input too high.
- Number of transducer points greater than specified (parameter F23 too small).

Motor not positioning, runs constantly at reference speed
- If positioning on an external reference pulse, check this signal.
- If the internal reference pulse is used, this signal can be measured on connector X1 pin 4.

Motor output inadequate. Motor does not produce load.

- Check rotor flow F0 and rotor time constant T. Measure motor voltage with a moving-iron instrument if necessary and set parameter F0 to produce half the motor voltage when idling.
- The optimum setting for the rotor time constant T is achieved when the minimum current is required for maximum motor torque (the poorer the cos f value of the motor and the smaller the construction size, the lower the value of "T").
- Check motor terminal block for correct circuit (star/delta connection).

Rotary field function test

- If not factory-set, the VECTORDRIVE DSV 5444 frequency inverter parameters should be set by means of the automatic parameter-setting facility (terminal program Shift-F7) based on the motor rating plate. Then connect the control system ("E" command). The motor should stay silent and a slight whistling sound should be audible (cycle noise of frequency inverter). If after switching on the error message I^2dt appears, the motor rotary field to transducer rotary field assignment is incorrect. In this case, the rotary field of the motor should be changed by interchanging two connecting lines on the motor. If this does not produce the required result, the transducer must be checked (see "I^2dt" fault in the troubleshooting section). It is advisable to heavily reduce the current limit for the test ("S" command) (e.g. S = s_{max}/10) to keep the current load on the motor low. In this case the motor will oscillate or vibrate if the rotary field is incorrect.

Motor reacts independently of setpoint value at very low speed and draws high current levels

Attention: In the case of high current and low speed, the signal A6 is active for some seconds what means the torque curve (TER.EXE) runs to the limit. This state causes a strong overloading of the motor and the converter. Stop the drive **immediately** and search for the error!

- Rotary field on motor incorrect or rotary position transducer not running with motor.
- Pole number "F31" incorrect
- Transducer point number not suitable (1024 1Vss is standard)
- Change two motor phases

Rotary position transducer error message or erratic running

- Cable wired incorrectly (no screening)
- TTL type rotary position transducer fitted instead of 1Vss
- Rotary position transducer faulty
- Coupling faulty or transducer screen not provided on both sides
- Pin 12 on connector X3 must have connection to DSV PE.

Motor hums when static or buzzes loudly at low speeds

- Gain values too high
- Reduce P value of stopping, starting and running.

External 24 V voltage supply short-circuited as soon as an input is activated or connected on the DSV

- 24 V level exceeded by more than 25%
- The fuse elements on the DSV have been activated
- Please return the unit to our factory for checking

Static message displayed although the motor is turning slowly

- Transducer coupling loose.

8 Programming

Customer application models are already pe-programmed. You should only change the programming on your unit if you wish to undertake extensions or changes yourself. If you have a standard unit, we recommend letting our applications engineers produce command programs for you.

The VECTORDRIVE DSV 5444 unit series has a freely programmable sector for a command program, and customer variables. The program part consists of individual blocks, which may in turn contain conditions, commands and jump instructions. After switching on or RESET, the initialization block (16) will in principle be implemented.

When the frequency inverter leaves the factory, it normally has a running basic set-up. You will find the file name (e.g. "5444.KOM") on the VECTORDRIVE DSV 5444 rating plate 2, together with the machine firmware (e.g. "DSV5444.HEX"). Before changing the programming yourself, you should read off the temporary command program, parameters and variables with the terminal program TER.EXE and save them in your PC.

There are two ways of programming the inverter:

- Create a command file (ASCI file) with a text editor, invoked in the terminal program TER.EXE with function key F5 or using on-line mode (function key F3) and function key F4 in the inverter. A command file then generally contains parameters, variables and the command program.
- In the terminal program, using the block editor (F8), in on-line mode you can change blocks in the inverter directly or create new blocks of a command program. The parameters and variables can then be set manually or you can load a file with parameters and variables.

The values in the EEPROM can only be changed if the data save switch is in the lower "RW" position. If the switch is in the "R" position, the data cannot be overwritten. The data save switch is accessible by unscrewing the front panel and is located between connectors X3 and X4.

8.1 Command interpreter

The following rules should be observed when creating a command program:

- A command program can contain a maximum of 3116 characters (including <CR>)
- A maximum of 32 blocks are available
- Each block can contain up to 255 characters
- Comment lines start with ";". If the line also contains a program code, the comment must be separated from the code by at least one blank character.
- The parameter and variable part always starts with the command "P=<CR>" and end with "u1<CR>=P<CR>.
- The command part always starts with the block opening, e.g. ":16<CR> for the initialization block and/or ":1<CR>" for a work block.

Explanation of syntax:

{0..9}	A number between 0 and 9
{number}	The number range is determined by another variable. Both positive and negative numbers are allowed.
{number +}	The number range is determined by another variable. Only positive numbers are allowed.
{number -}	The number range is determined by another variable. Only negative numbers are allowed.
{H-number}	hexadecimal number
STRG+{A..X}	press the CTRL key and corresponding letters
200N	Negative values are input with an "N" afterwards, e.g. 200N means -200.

8.1.1 Blocks

Block number	*Function*
0..7	Blocks 0 to 7 are initiated when there is a positive edge on the corresponding input ("voltage 15 - 24 V DC applied")
8..15	Blocks 8 to 15 are initiated when there is a negative edge on the corresponding input ("voltage removed")
16	This block is initiated on initialization of the frequency inverter
17, 18	The blocks are initiated via input E8 if the control byte US_PA5_STB = AAh (address 92h) is set. When input E8 is set, block 18 is invoked, and block 17 on reset. Masking is possible over the two least significant bits of E5_MASK (address EEAh). Invoking is also possible with the "W" command.
0..31	All blocks can be initiated with the "W" command or a conditional jumps ("!").
0..15	Blocks 0 to 15 can be masked. A masked block cannot be initiated either with an input or with the "W" command or a conditional jump ("!"). After switching on the inverter, these are disabled as standard. They must therefore be cleared in block 16 if necessary. See "$" command.

8.1.2 Conditions

The inverter contains a number of flags. These are set or reset automatically by the inverter depending c circumstances. With some flags there is also a counter-flag which occupies the next higher ranking address. Th counter-flag contains the inverse value of the flag. In the command program, a condition can be set on the fla address. This address is used for conditions until replaced by another.

There are now two options for responding to a condition. Either wait until the condition is fulfilled ("." command) or initiate a block ("!" command).

```
?[808   ; sets the condition on the position setpoint value = position actual value flag
.       ; waits until the set condition is fulfilled
```

In the example below, block 25 is initiated, when the actual position value reaches the setpoint value.

```
?[808   ; sets the condition on position setpoint value = position actual value flag
!25     ; invokes block 25 when the condition is fulfilled
```

8.2 List of all commands

8.2.1 General commands

Command	*Explanation*
STRG+A{0..31}	Shows the selected block and enables creation of a new block
:{0..31}	Open block for editing
STRG+D{0..31}	Ends block creation
U0	Read command program and user variables from EEPROM into working memory
U1	User variables written from working memory into EEPROM
U4	Saves command program (blocks and variables) in EEPROM
U8-U9	SSI system special commands
;	Interrupt dialogue in command program running
STRG+F	Print out parameter list on screen
STRG+G	Save parameter list in EEPROM
B3	Enable terminal dialogue operation
B4	Disable terminal dialogue operation
B2	Transfer message between PC and DSV
B5	Switch message transfer into broadcast mode
W{0..31}	Start a block 0 to 31
$[{0.FFFFh}	Masking blocks 0 to 15. Invoking masked blocks is disabled. If a bit is not set in binary presentation, the corresponding block is disabled. This means that it cannot be invoked with either an input or the "W" command.

E	Switch on control loop.
A	Switch off control loop.
N	Negate the last input. If the control loop is in speed control mode, the speed is negated. In position control mode, the last setpoint position is negated. In addition, the input is negated by adding an N.

8.2.2 Speed control

Befehl	***Explanation***
V	Switch to speed control (reference points are then lost)
O{number}	Standard speed, speed setpoint value given in rpm
P	Position from speed control to transducer zero pulse (stops at next transducer zero pulse)
S{number}	Set maximum motor torque.
B0	Specified digital setpoint value
B1	Specified analog setpoint value via connector X1 pin 17/18/19
U2	Converts the speed trigger thresholds given in customer units into an incremental speed. The output values are taken from the storage locations EA4h (N1_TRIG), EA6h (N1_TRIG) and EA8h (N1_TRIG) and loaded directly in the corresponding speed trigger thresholds (N_TRIG1/1B6h, N_TRIG2/1B8h, N_TRIG3/1BAh).

8.2.3 Position control

Command	***Explanation***
R	Set reference point when static (actual position is reference point)
R1	Reference travel, stop at zero mark
R2	Set synchronization point (if 2nd transducer option selected) when stationary (actual position is synchronization point)
R3	First set reference point when at standstill (as for "R1") then synchronized operation after transducer zero pulse from master drive (only with follower drive)
P	Position from speed control to transducer zero pulse
H{number}	Move to absolute position (in relation to reference point)
D{number}	Move positioning in incremental dimension (relative to actual setpoint value)
Q1	Return to reference point
Q2	Return to synchronization point or second reference point
G{Zahl+}	Positioning speed in rpm; move to required position at this speed
U3	Interrupts a position step if position setpoint value is loaded with actual position values
U6	Sets all incremental positions at zero. The command affects the actual position value, position setpoint value and reference position.
U7	Load position_sol3_LW/HW to position_soll_LW/HW

8.2.4 Synchronous operation

Only with 2nd transducer option. All position commands are possible in the follower system in synchronous operation.

Command	***Explanation***
R2	Determines the synchronization point of the drives when stationary and switches on synchronous operation
R3	The follower drives executes reference travel ("R1" command), waits for the transducer zero pulse of the master drive (this is the synchronization point) and switches on synchronous operation.
R4	Run at speed in synchronous mode (only available with 2nd transducer option card)
Q2	Return to synchronization point

8.2.5 Change-over

Command	***Explanation***
C{number}	Set change-over range; the sign determines the positioning direction (modifies storage location 936h).
U5	Switch on change-over operation
Q	Switch off change-over operation, the drive returns to the reference point and the reference is retained.

8.2.6 Memory commands

Command	*Explanation*
L[{H-number}	Load address indicator and display content
J	Increase address indicator
%	Decrease address indicator
M{number}	Load memory area with 16-bit decimal number (address indicator must be set first with "L" or "J" command)

Note on memory commands

If an "R" is entered for the memory location, the memory location can only be read; with "RW" both read and write are possible. For some flags there is a corresponding counter-flag. This is set if the corresponding condition is not fulfilled. A *not* is then appended to the variable name. In the parameter list, addresses are assigned to the parameters. The memory locations are "RW" so can be written, but parameters should only be set with the TER.EXE terminal program, as standardization and conversion operations take place in this.

8.2.7 Computer commands

Command	*Explanation*
[	Next number is expressed in hexadecimal form
]	Indexed address, using 16-bit arithmetic.
)	Indexed address, using 32-bit arithmetic.
+	Add
-	Subtract
*	Multiply
/	Divide
“	Set amount
N	Negate value, input negative numbers
&	Logic AND link
@	Logic NAND link
<	Rotate byte to the left with carry
>	Numerical comparison (result stays unchanged)

8.2.8 Output commands

Command	*Explanation*
X1	
{H-number}	Content of address output on D/A inverter 1 (standard setting: N_SETPOINT)
X2	
{H-number}	Content of address output on D/A inverter 2 (standard setting: N_ACTUAL)
X3	
{13..20}	Set scale of D/A inverter 1 (top 12 bits normally output) 13 - 20
X4	
{13..20}	Set scale of D/A inverter 2 (top 12 bits normally output) 13 - 20

8.2.9 Other commands

Command		*Range*	*Explanation*
Z0	{1..32767}		Set timer 0, time will be given in milliseconds
Z1	{1..32767}		Set timer 1, time will be given in milliseconds
Z2	{1..32767}		Set counter 2. The counter counts down only
Z3	{1..32767}		Set counter 3. The counter counts down only
Z4	{1..32767}		Set counter 4. The counter counts down only via interrupt (set bridge on control card)
\2			Set counter 2 lower
\3			Set counter 3 lower
#{0..7}	{H-number}		Set or reset output 0 - 7, H-number represents any flag (true = 41Eh, false = 420h)
#9	{H-number}		Set or reset pin 2, connector X1, H-number represents any flag (true = 41Eh, false = 420h)

? {H-number} Set condition (flag checked on FFh)
! {0..31} Wait for conditional block invoke until condition is fulfilled

8.3 List of main memory locations

If "R" appears in the "RW" column, this means that the memory location can only be read; "RW" signifies both read and write.

For some flags there is a corresponding counter-flag. This is set if the corresponding condition is not fulfilled. A *not* is then appended to the variable name.

8.3.1 General

Address	*Name*	*RW*	*Explanation*
41Eh	TRUE	R	Contains the value for "true"
420h	FALSE	R	Contains the value for "false"
0F2h	FREIGABE_STB	R	FFh = control switched on
10Ch	BEREIT_MZ	R	FFh if frequency inverter not ready
EE6h	BEREIT_MZ_STB	RW	This control byte is set at 01h as standard. This means that all faults are locked in and can only be cleared with RESET. EE6H = 0 -> After a fault, the drive continues to operate as soon as the fault goes (compatible with older models).
E98h	SOFTFREI	RW	In this location FFh must be input to activate the ready-for-operation output on connector X1. This location must at any event be set at the end of the initialization bock 16. This means that the ready-for operation signal appears immediately after initialization.
0FAh	ANA_SOL_STB	RW	FFh = Analog operation selected
074h	PIN_BGZ_FLAG	R	Flag is set if the setpoint torque limit is reached.
1AEh	STEHT	R	Drive stopped (N_SETPOINT_V = 0 and NS_GL_NI or LS_GL_LI).
1AFh	STEHT*nicht*	R	Counter-flag for "STOPPED"
10Eh	EK_MZ	R	FFh if earth fault or short-circuit
17Ch	ACHT_MZ		If FFh, a program run interrupt can only be cleared by pressing the reset key or switching off the inverter.
102h	NOT_HALT_MZ	R	FFh = emergency stop triggered
094h	NOT_HALT_STB	RW	If 00h, emergency stop only reset by intermediate circuit voltage, "M" command or RESET, otherwise automatically when the emergency stop has ended. With FFh, the inverter is ready for operation again 3 seconds after the end of the emergency stop signal (standard setting).
73Ah	ISD_SOLL	R	Longitudinal current (forming field)
73Ch	ISQ_SOLL	R	Transverse current (forming torque)
07Ah	ISQ_SOLL_MAX	R	Maximum torque (dependent on maximum possible inverter current)
1C2h	RICHT_FLAG	R	Actual direction of rotation
116h	TEMP_FLAG	R	Temperature fault
0F2h	REG_EIN	R	This flag is set when the control is switched on.
0F3h	REG_AUS	R	This flag is set when the control is switched off
06Eh	M_SOLL_MAX	RW	Maximum motor torque specified by "S" command. The upper limit is ISQ_SOLL_MAX. Caution: if the F0 function is invoked, the maximum torque ("S" command) and $I^2 \times dt$ limit are set at maximum value.
ED8h	IS_MAX	RW	Maximum torque for $I^2 \times dt$ cut-off which the motor can run continuously. Scaling corresponds to "S" command. Range: 64 - ISQ_SOLL_MAX and can be calculated as follows: IS_MAX = ISQ_SOLL_MAX $\times$ interior motor/I_{dyn}_inverter
EE0h	IS_T	RW	Time for $I^2 \times dt$ cut-off. The motor must be able to provide double the continuous torque IS_MAX for the time IS_T.
700h	ANA_SOLL	R	Analog setpoint value standardized with F9.
792h	ANA_OFST	RW	Hysteresis for analog specified setpoint value (5 mV/value,

Address	*Name*	*RW*	*Explanation*
			standard: 792h = 2 corresponds to 10 mV)
EB2h	ANA_ADD	RW	The value entered here is added as a basic offset to the value read in by the analog input. The offset is also active in "B1" mode.
EB4h	ANA_SOLL_SW	RW	Selects the dimension affected by the analog input. 0 -> Speed setpoint value (in "B1" mode only) 1 -> Parameter F29 2 -> Parameter F30 3 -> Maximum torque (M_SOLL_MAX, "S" command). 4 -> Position setpoint value in customer units (A_LAGE_SOLL).
EF2h	ANA_FAK	RW	Scale factor (corresponding to parameter F9 on first analog input).
EF4h	ANA_ADD	RW	Offset for value read in.
EF6h	ANA_OFS_1	RW	Hysteresis for second analog input. The value input here gives the hysteresis for the second input in steps of 5 mV.
EF8h	ANA_STB	RW	Control byte for second analog input. 0 -> Analog input switched off 1 -> Value read written directly in the address input in the memory location EFCh. 2 -> Value read in added to content of memory location, whose address was input in the memory location EFCh.
EFCh	ANA_MEMO_1	RW	This is used to enter the address to be processed by the analog input. The scaled value read in (with offset) is either stored directly at the address given here or added to the content (depending on the control byte EF8h). With this function all memory locations can be written. The user must check for a suitable function.
830h	N_F_KNST	R	Over this speed, the unit runs with constant longitudinal current for magnetization (Used for motors with large voltage drops in the upper speed range and normally preset to a maximum speed).
E7Eh	NIMPX_STB	RW	If this flag is set = 0, positioning takes place to the internal transducer zero pulse (standard setting: decimal point illuminated in diagnostics display). With a value of 255, positioning is to an external transducer zero pulse.
EAAh	SOFTRESET	RW	If this memory location is set at 255, the inverter executes a RESET and re-initializes.
08Eh	STB_NR5367	RW	Content 00h -> Enable dialogue messages Content Offh-> Disable dialogue messages, i.e. commands can be sent to the frequency inverter but there is no acknowledgment
200h	SWITCH	RW	Operating mode selection: = 00h U/f- characteristic curve = 01h Speed control = 02h Position control = 03h Synchronized position = 04h Synchronized speed

8.3.2 Speed control

Address	*Name*	*RW*	*Explanation*
710h	N_IST	R	Actual speed value in increments / (4 × scan time)
78Ch	N_IST2	R	Actual speed value in increments / (4 × scan time) at second transducer input
214h	V_IST	R	Actual speed value in customer units
210h	N_SOLL	R	Speed setpoint value in increments / (4 × scan time)
20Eh	N_SOLL_V	R	Speed setpoint value before ramp in increments / (4 × scan time)

Address	*Name*	*RW*	*Explanation*
212h	V_DREHZ	R	Speed setpoint value in customer units
178h	N_MAX	RW	Maximum speed setpoint value in increments / (4 × scan time)
064h	N_MAX_MIN	RW	Maximum speed setpoint value in revolutions per minute (calculated from N_MAX and not used for limit)
062h	DPHI_MAX	RW	Double the maximum possible output frequency (actual speed) in Hertz
830h	N_F_KNST	RW	Over this speed, the unit runs with constant longitudinal current for magnetization (Used for motors with large voltage drops in the upper speed range and normally preset to a maximum speed).
774/776h	IZ_AKT_LW/HW	R	Actual increment number read out
092h	US_PA5_STB	RW	If the control byte is loaded with 0, the E8 input (connector X1, pin 5) determines the direction of rotation of the "O" command. With FFh, the drive positions with a signal on the E8 input from the speed control on the transducer zero pulse. If AAh is input here, the input is used to invoke blocks 17 and 18.
ED4h	DREHZAHL_DREH	RW	Direction of rotation determined by the software with the "O" command. If zero is input here, a positive value in the "O" command gives right-hand rotation, with FFh left-hand rotation. This function is only active if US_PA5_STB = 0.
066h	IZ	R	Increment number
0B6h	Y0 / NSOLL_ACC	R	Run-up ramp, range: 1 .. 6400
0B8h	Y1 / NSOLL_DEC	R	Return ramp, range: 1 .. 6400
82Ch	NSOLL_ACC_N	R	Negative run-up ramp
82Eh	NSOLL_DEC_N	R	Negative return ramp
1AEh	STEHT	R	Flag is set (=FFh) if the motor is stationary and the setpoint value is reached. The signal is also set when the motor is disabled.
1AFh	STEHT*nicht*	R	Counter-flag set at "STOPPED"
802h	NS_GL_NI	R	The flag is set if the speed setpoint value is the same as the actual speed (to set the flag the speed must remain for a time determined by the parameter F14 × 0.8 ms in a tolerance window (parameter F13). To disconnect, the parameter F16 × 0.8 ms for time and parameter F15 for tolerance window are used.
803h	NS_GL_NI*nicht*	R	Counter flag for NS_GL_NI
1C2h	N_RICHT_FLAG		Flag for reversal of direction of rotation
190h	TRIG	RW	Content = 0 -> no response (standard) otherwise for each leading "zero" of the 16 bit number, a transducer zero pulse (03h -> 14 transducer zero pulses jumped) from the transducer will be jumped in reference travel. "TRIG" is then loaded with "SET_TRIG".
18Eh	SET_TRIG	RW	See above (standard value = 0)
EA4h	N1_TRIG	RW	Speed threshold in customer units. These must be converted before use with the "U2" command in the incremental thresholds.
EA6h	N2_TRIG	RW	-„-
EA8h	N3_TRIG	RW	-„-
1B6h	N_TRIG1	RW	First speed trigger threshold in increments / (4 × scan time); speed amount only evaluated.
1B8h	N_TRIG2	RW	Second speed trigger threshold in increments / (4 × scan time); speed amount only evaluated
1BAh	N_TRIG3	RW	Third speed trigger threshold in increments / (4 × scan time); speed amount only evaluated.
1BCh	N_FLAG1	R	Flag for first speed trigger threshold in increments /(4 × scan time)
1BDh	N_FLAG1*nicht*	R	Counter-flag for N_FLAG1
1BEh	N_FLAG2	R	Flag for second speed trigger threshold in increments /(4 × scan

Address	*Name*	*RW*	*Explanation*
			time)
1BFh	N_FLAG2*nicht*	R	Counter-flag for N_FLAG2
1C0h	N_FLAG3	R	Flag for third speed trigger threshold in increments /(4 × scan time)
1C1h	N_FLAG3*nicht*	R	Counter-flag for N_FLAG3

8.3.3 Position control

Address	*Name*	*RW*	*Explanation*
770/772h	LAGE_IST_LW/HW	RW	Actual position value with position control in increments
77A/77Ch	LAGE2_IST_LW/HW	RW	Actual position value with position control on second transducer in increments
928/92Ah	LAGE_SOLL_LW/HW	RW	Position setpoint value for position control in increments
926h	A_LAGE_SOLL	RW	Position setpoint value for position control in customer units
0D2h	STR_FKT	RW	Standardization factor for section data in positioning (plus parameter F21)
20Ah	V_POS	R	Positioning speed in increments
0C0h	F12/N_REF_ZYK_KUN	RW	Speed for reference cycle, Range: -N_MAX .. N_MAX
808h	LS_GL_LI	R	The flag is set if the position setpoint value = actual position (to set the flag the position must remain for a time determined by the parameter F18 × 0.8 ms in a tolerance window (parameter F17). To disconnect, the parameter F20 × 0.8 ms for time and parameter F19 for tolerance window are used.
809h	LS_GL_LI*nicht*	R	Counter-flag for LS_GL_LI
20Ch	NSOLL_MAX_STB	RW	If FFh, the positioning speed is specified in similar manner and the "G" command ignored
1A2/1A4h	LAG_TRIG1_LW/HW	RW	First trigger threshold in increments for actual position value in relation to reference point
1A6/1A8h	LAG_TRIG2_LW/HW	RW	Second trigger threshold in increments for actual position value in relation to reference point
1AAh	LAG_FLAG1	R	Flag set at FFh if the first trigger threshold is exceeded, content = 00h if the value falls below this
1ABh	LAG_FLAG1*nicht*	R	Counter-flag to LAG_FLAG1
1ACh	LAG_FLAG2	R	Flag set at FFh if the second trigger threshold is exceeded, content = 00h if the value falls below this
1ADh	LAG_FLAG2*nicht*	R	Counter-flag to LAG_FLAG2
200h	SWITCH	RW	Operating mode selection: = 00h U/f- characteristic curve = 01h Speed control = 02h Position control = 03h Synchronized position = 04h Synchronized speed
70A/70Ch	LAGE_SOL3_LW/HW	RW	Intermediate storage of message command "T" (5444 firmware as of 06.11.95)

8.3.4 Temporary synchronization

Address	*Name*	*RW*	*Explanation*
E80h	FLIEG_STB	RW	Control byte for floating saw. Choice of three different operating modes.
EC0h	VORHALT_FLAG	RW	If FFh is input, automatic speed-related set-up is activated.
E82h	RICH_FLAG	RW	Used in conjunction with the sign in parameter F29 for correcting direction of rotation
1A6/1A8h	LAG_TRIG2_LW/HW	RW	Start offset for modes 1 and 2, and offset for mode 3.
EBC/EBEh	LAGE2_TRIG1_LW/HW	RW	Offset for modes 1 and 2
1AAh	LAG_FLAG1	R	Flag set at FFh if the first trigger threshold is exceeded, content = 00h if value falls below
1ABh	LAG_FLAG1*nicht*	R	Counter-flag to LAG_FLAG1

8.3.5 Speed control

Address	*Name*	*RW*	*Explanation*
79Ch	CHG_R_Z	R	Flag for change-over operation: FFh -> travel in Target direction 00h -> travel in Start direction (reference point)
206h	CHG_STB	RW	Change-over control byte: FFh -> Change-over operation switched on 00h -> Change-over operation switched off 0Fh -> Change-over operation is already switched off and drive returns to Start (reference point)
79Eh	LS_GL_LI_CHG	R	This flag is only set in change-over operation if the actual position value = position setpoint. It is not automatically reset
936h	CHG_STRECKE	RW	Memory location for change-over range ("C" command).

8.3.6 mathematic operations

Address	*Name*	*RW*	*Explanation*
500h	OPD_LW	RW	Low-Word arithmetic operand
502h	OPD_HW	RW	High-Word arithmetic operand
504h	ERG_LW	RW	Result of arithmetic operation (Low-Word)
506h	ERG_HW	RW	Result of arithmetic operation (High-Word)
508h	L_OPD	RW	Logic operand (8-bit)
50Ah	L_ERG	RW	Logic result (8-bit)
50Ch	SIGN_FLAG	R	Flag for sign (negative is 255)
50Eh	ZERO-FLAG	R	Flag set if result = 0 (0 corresponds to 255)
510h	CARRY_FLAG	R	Flag set with rotation of a number

8.3.7 Counter and Timer

Address	*Name*	*RW*	*Explanation*
428h	TIME0_FLAG	R	Timer-0-flag
429h	TIME0_FLAG*nicht*	R	Timer-0-counter-flag
430h	TIME1_FLAG	R	Timer-1-flag (Reference Point)
431h	TIME1_FLAG*nicht*	R	Timer-1 counter-flag
432h	ZAEHLER2	RW	Counter 2 counter status
434h	ZAEHLER2_FLAG	RW	Counter 2 flag
436h	ZAEHLER3	RW	Counter 3 counter status
438h	ZAEHLER3_FLAG	RW	Counter 3 flag
43Ah	ZAEHLER4	RW	Counter 4 counter status
43Ch	ZAEHLER4_FLAG	RW	Counter 4 flag

8.3.8 Inputs and outputs

Address	*Name*	*RW*	*Explanation*
43E/43Fh	IO_E0	R	Input 0 conducting with 43Fh = FFh
440/441h	IO_E1	R	Input 1 conducting with 441h = FFh
442/443h	IO_E2	R	Input 2 conducting with 443h = FFh
444/445h	IO_E3	R	Input 3 conducting with 445h = FFh
446/447h	IO_E4	R	Input 4 conducting with 447h = FFh
448/449h	IO_E5	R	Input 5 conducting with 449h = FFh
44A/44Bh	IO_E6	R	Input 6 conducting with 44Bh = FFh
44C/44Dh	IO_E7	R	Input 7 conducting with 44Dh = FFh
122h	ZUS_EIN	R	Inputs 0..7
E78h	BCD_STB	RW	Start BCD input if the flag value is 255
E7Ah	BCD_VAL	R	Contains input BCD value
092h	US_PA5_STB	RW	If the control byte is loaded with 0, the E8 input (connector X1, pin 5) determines the direction of rotation of the "O" command. With FFh, the drive positions with a signal on the E8 input from the speed control on the transducer zero pulse. If AAh is input here, the input is used to invoke blocks 17 (input set) and 18

Address	*Name*	*RW*	*Explanation*
			(input reset).
EEAh	E5_MASK	RW	Masking for input E8 and blocks 17 and 18. If block 17 is invoked, bit 0 must be set, and bit 1 for block 18. The blocks are masked (disabled) as standard, but initiation with the "W" command is still possible..
454h	AUS_WERT	RW	This memory location is used for setting or resetting all outputs directly. Only those outputs which are not masked with memory location 452h are changed. Each bit corresponds to an output here, with the least significant bit corresponding to output 0, etc.
19Ch	ZUS_AUS	R	Outputs 0 - 7
452h	AUS_MASK	RW	Masking word for direct changing of all outputs. The outputs can be masked via the memory location 452h, i.e. an output can only be changed if 1 is input in 542h in the corresponding bit. All other outputs remain unchanged. Masking is needed if the outputs contain a flag. The mask is also active with direct writing of memory location 454h
EB6h	PORT5	RW	The flag connected to output A9 on connector X1 pin 2 has the address input in this memory location. The right-hand LED on the front panel is activated accordingly at the same time. As standard, the output has the setpoint = actual signal (address 19Eh).
EE8h	A8_STB	RW	The flag connected to output A8 on connector X1 pin 1 has the address input in this memory location. As standard, the output has the temperature fault signal (address 116h).

8.3.9 Variables for test purposes

Address	*Name*	*RW*	*Explanation*
200h	SWITCH	RW	Operating mode selection: = 00h Controlled operation = 01h Speed control = 02h Position control = 03h Synchronized position = 04h Synchronized speed
124h	FRF_MZ	RW	FFh content disables position control. Reference travel is still possible.
090h	REF_ZYK_STB	RW	Only used for analog specified setpoints. If the content = 00h, the starting value is the analog speed setpoint. With a content of FFh, the drive travels at reference speed as specified in F12 (digital setpoint). It stops on the reference signal. After the end of the signal, speed control continues with the analog setpoint. (Simplified with command interpreter).
EAAh	SOFTRESET	RW	If this memory location is set at 255, the inverter activates a reset and reinitializes.
744h	ZUORD_G_F	RW	Master transducer initialized.
746h	UMSCH_BIT	RW	Master transducer initialized.
796h	ZUORD_G_F2	RW	Slave transducer initialized.
798h	UMSCH_BIT2	RW	Slave transducer initialized.
74Ch	IMPZ	R	Increment number without fine evaluation. The sinusoidal periods of the rotary position transducer are counted.
75Ch	PHI1	RW	Rotor angle (used for initializing synchronous motors)
75Ah	PHI	R	-„-
EAEh	RHO_SHIFT	RW	Correction factor for synchronous motors. Corrects the speed-related angular deviation in synchronous motors (the idle current is reduced with the end speed)
EB0h	RHO_STB	RW	Control byte for correction on synchronous motors
052h	BRUSH	RW	A value of 255 switches to brushless operation (N.B. magnet wheel search required)
768h	RHO1	R	Dynamic magnet wheel angle RHO = RHO_FIXED + N_IST / RHO_SHIFT

Address	*Name*	*RW*	*Explanation*
EACh	RHO_FIXED	R	Angle obtained on magnet-wheel search
72Ah	RHO_0	R	Magnet wheel angle in synchronous motors
244h	MEMO_ADR	R	Address indicator of "L" command
44Eh	EEP_F_STB	R	Contains FFh if the EEPROM is already programmed
19Ah	EEPROM_RDY	R	= 00h for writing directly in the EEPROM
708h	RECHT_FLAG	RW	= 00h Sinusoidal transducer (standard) = FFh Rectangular transducer
73Eh	RECHT2_FLAG	RW	= 00h Sinusoidal transducer (2nd transducer option) = ffh Rectangular transducer
E7Eh	NIMPX_STB	RW	= 00h internal zero pulse of transducer = ffh external zero pulse on X1 pin 8
740h	NIMPX2_STB	RW	= 00 internal zero pulse of 2nd transducer = ffh external zero pulse on X22 pin 3/4

8.3.10 Example of command program "DEMO.KOM"

```
; Example: Das Offline-Programm "DEMO.KOM":
; ----------------------------------------
;
P=
;
;
f12       Reference speed (customer unit)
150       in rpm
;
;
f21       Distance factor
64        65536/f21=1024 increments Customer value for one motor revolution
;
;
l[e00     Customer variable 1
m1000     Positioning speed here
l[e02     Customer variable 2
m10240    Input positioning distance here
l[e04     Customer variable 3
m500      Speed threshold here
l[e06     Customer variable 4
m5120     Position threshold here
l[e08     Customer variable 5
m1500     Endless speed here
;
;
u1
;         End of parameter/variable part, default transferred
=P
;         Start command program level:
;         ----------------------------
;
:16       Initialization block (runs automatically after RESET)
b3        Interface operating mode, here "normal dialogue"
l[e7e     Reference mark should be read out of transducer zero pulse
m0        ("m255" -> externally from pin 8 on connector X1)
l[500     Load arithmetic battery L-word
m[e06]    with content of customer variable 4
j         Switch to next even-numbered address
m0        Load battery H-word with 0
*[d2]     Multiply battery with content of RAM location of distance factor f21
l[1a2     Load trigger threshold "1"
m[504)    with content of 32 bit result of location 504h and 506h
l[ea4     Load speed threshold "1"
m[e04]    with content of customer variable 3
u2        Use automatic conversion command ([ea4] * f22 / f10 = [1b6])
```

```
#0        Reserve output 0 for "Basic setting OK"
420       on "false" flag (41e = "true")
#1        Reserve output 1 for "Position reached"
420       on "false" (deleted)
#2        Reserve output 2 for "Indicate intermediate position"
420       on "false" (deleted)
#3        Indicates output 3
1bc       Speed threshold exceeded (deleted, as long as below)
#4        Indicates output 4
802       Speed generally reached
#5        Indicates output 5
808       Position generally reached
#6        Indicates output 6
74        General overload
#7        Indicates output 7
1ae       General shutdown
#9        Indicates output 9(#8 only available with 5442)
f2        Control operative
$[0c0f    Inputs/blocks 0,1,2,3 High-Fl., Low-Fl. 2,3 (block 10,11) free
l[e98     Initialize output BB and
m255      indicate ready for operation for first time
;
;
:0        Input E0, block 0 (reference travel, basic position)
#1        Position message A1
420       delete...
?[808     If position control already active,
!20       then further on in subroutine block 20
#0        basic setting A0
420       to be deleted...
e         Switch on control
v         Select speed control
?[1ae     wait until drive ready
.         then when condition is fulfilled,
r1        move to reference point
?[808     if position found,
.         then continue
u6        to set all incremental positions at "0"
#2        Output 2 now indicates status
1aa       of "Position trigger point 1 exceeded" flag
#0        Basic position
41e       to be set...
;
;
:1        Input E1, block 1 (move to position)
#0        Basic setting A0
420       to be deleted...
g[e00]    Positioning speed from customer variable 1
h[e02]    Move to absolute position from customer variable 2
?[808     If this position is reached,
.         then
#1        Output A1 (In position)
41e       to be set...
;
;
:20       Run subroutine for basic setting (block 20)
h0        Absolute positioning position setpoint value = 0
?[808     If this position is reached,
.         then
#0        Output 0 (basic setting OK)
41e       to be set...
;
;
:2        Run continuous speed - positive (input E2)
```

```
$[0c0c    only blocks 2,3 and 10, 11 free
e         Control on
v         Switch to speed control
#0        Basic setting A0
420       to be deleted...
#1        Position message A1
420       to be deleted
o[e08]    Travel with customer variable 5
;
;
:10       Counter-edge to input E2
w21       continue in subroutine block 21
;
;
:3        Run continuous speed - negative (input E3)
$[0c0c    only blocks 2,3 and 10,11 free
e         Control on
v         Switch to speed control
#0        Basic setting A0
420       to be deleted...
#1        Position message A1
420       to be deleted...
o[e08]n   Run customer variable 5 (negative)
;
:11       Counter-edge to input E2
w21       continue in subroutine block 21
;
:21       Interrupt speed subroutine (block 21)
v         Speed control on
o0        Stop
?[1ae     if motor stationary,
.         then continue
a         Control off
$[0c0f    Inputs/blocks 0,1,2,3 High-Fl., Low-Fl. 2,3 (block 10,11) free
```

8.4 Inverter communication modes

The description below of the transmission protocol only applies to the X4 serial interface.

8.4.1 "B3 mode" dialogue operation

Dialogue operation is available in on-line mode (function key F3) in the terminal program TER.EXE. The user is guided by clear text messages. Dialogue operation is exited by selecting another communication mode. To speed up a command program, switch to short message operation "B2 mode".

8.4.2 "B2 mode" short message operation

For communication with higher ranking control systems, the VECTORDRIVE DSV 5444 frequency inverter has a high performance protocol. In contrast to dialogue operation, there is no clear text message exchange, only short protocol units. The short message commands are identical to those of the terminal program. In answer to a command, the inverter transmits the acknowledgment sign "*", if the command has been properly executed. For certain commands, the acknowledgment sign is followed by a status message in round brackets, e.g. "(Z20)".
Messages consist of three characters, apart from the "W" command.
Number values transferred as ASCII characters must be made up with blanks. The commands have the same functions as in dialogue operation. Short message operation presupposes that the inverter is ready for operation.

8.4.2.1 Communication time-frame

For transmission, a time-lag must be maintained between the individual short message commands before the next command is transmitted to allow for internal processing of the command.

Without synchronous control	***with synchronous control***	***Operating mode***
3ms	5ms	RS232
12ms	20ms	RS485
5ms	10ms	RS485 im „B5“ broadcast mode

With communication via an RS485 interface, an interval of 0.5 ms must be maintained between two strings.

8.4.2.2 Short message commands

The protocol units which the control system sends to the VECTORDRIVE DSV 5444 are commands. They must have the following syntax:

Syntax	***Meaning***
|	„or“
[09]	"Blank or ASCII character 0 to 9"
{exp}n	"n-times repetition of exp"
<CR>	"ASCII 13" or "Carriage Return"
dddddd	16-bit decimal number as ASCII characters
xxxx	16-bit hexadecimal number as ASCII characters
yyyy	16-bit hexadecimal number as ASCII characters
number_31	31-bit decimal number as ASCII characters

[*Aaddress*]command[=][value]<CR>

with following substitutions:

address = 00 | 01 | 02 | ... | 99
value = {[09]}5 | {[09]}6 | {[09AFaf]}4

8.4.2.3 Short message mode commands and messages

In response to the commands, the VECTORDRIVE DSV 5444 transmits messages in round brackets. Apart from the "W" command, messages consist of three places. In the command program, a message can contain a maximum of 239 characters. Only alphanumeric characters are allowed. Round brackets "(" and ")", diaereses and symbols such as "STRG+d" are not allowed inside messages. For example:

:20<CR>
(clear text)<CR>

If a block is started with Wnumber<CR>, the inverter executes a message contained in this as clear text on the interface. This is useful for troubleshooting, for example. VECTORDRIVE DSV 5444 inverters connected to an RS485 bus ignore these messages.

A< CR > Disconnects control.

A*address*<CR>	The command disconnects the control and specifies an address. It can also occur individually and then only separates the unit just activated from the command flow. If the *address* is an address of a unit on the bus, all further commands go to that unit.
B3<CR>	Switches to dialogue operation. This command may not be used with RS485 bus operation.
C=dddddd<CR>	The ASCII decimal number "dddddd" gives the change-over section. The sign determines the direction of positioning. The stated value is stored in memory location 936h. This value can be loaded into another memory location by means of a continuous loop if the change-over function is not needed. This is useful if the higher ranking control cannot generate hexadecimal figures. Response "*".
D=dddddd<CR>	With the position control connected ("P" and "R" commands), the six-figure ASCII decimal number "dddddd" gives the relative position in customer units in relation to the actual position (incremental dimension). "dddddd" can contain leading zeros or blanks. The number range is -32767 to 32768. If the control is disconnected ("A" command), the message "(Z00)" appears. If speed control is connected ("V" command), the message "(Z20)" appears. In both cases, the command is rejected. If the command is not input correctly, an error message "(E00)" appears if the format was not observed or "(E01)" if the number range was exceeded.
D<CR>	Reproduces the last relative position specified in the form "(d:dddddd)". If the control is disconnected, the message "(Z00)" appears, if it is in speed control, the message "(Z20)" appears. Example: "(d: 0)" for relative position zero.
E<CR>	Connection of control. The response is "*(Z20)" if the control was previously switched off. "(Z20)" or "(Z40)" are the response otherwise..
G=dddddd<CR>	Gives the positioning speed in rpm.
G<CR>	Reads off the positioning speed.
H=dddddd<CR>	Gives the absolute position in customer units with regard to the reference point (set with the "P" or "R" command). Otherwise the conditions and messages stated for the "D" command apply.
H<CR>	Reads off the absolute position. Conditions and messages as for "D" command.
L=xxxx<CR>	Specifies an address whose content is to be read or written with the M command. "xxxx" is interpreted as a four-digit hexadecimal address. The possible address range is 0000 to FFFF. The response message is "(I:dddddd)". "dddddd" is the content of the memory location addressed with "xxxx".
M=yyyy<CR>	Describes the current address ("L" command) with the hexadecimal value "yyyy". The response message is "*". If an error was made in input (e.g. not a four-digit number), the message is "(E00)". The "M" command in conjunction with the "L" command represents the highest command of the DSV 5444, as all the variables can be changed with this. The range 0000 to 004F 4000 to 7FFF and 8000 to 87FF must not be written under any circumstances as these contain system variables. In general only those memory locations should be written which are specifically mentioned in the VECTORDRIVE DSV 5444 operating instructions.
V<CR>	Switches the inverter to speed control and sets the speed at zero. Response "*"
O=dddddd<CR>	Specified as the speed in rpm. Responses: "*" for a correct value, "(E00)" or "(E01)" for errors, "(Z00)" for disconnected control or "(Z40)" for position control.
O<CR>	Current speed query. The response is in the form "(o:dddddd)". "(E00)" or "(E01)" is given in the event of errors, "(Z00)" if the control is disconnected or "(Z40)" for position control.

P<CR>	If the control is switched to speed control and the motor shaft is turning, the response "*" is given. If the zero position of the transducer is reached, the drive stops. The message "(Z54)" then appears (reference cycle terminated). The system switches to position control. This function only operates from speed control with the motor running. In position control, the message "(Z40)" appears, and with the control disconnected "(Z00)".
Q<CR>	Disconnect change-over operation, the drive continues to return towards the reference point and the reference is maintained. Responses: "*" if the command was executed correctly, otherwise there is a corresponding error message.
Q1<CR>	Return to reference point. Responses: "*" if the command was executed correctly, otherwise there is a corresponding error message.
Q2<CR>	Return to synchronization point. Responses: "*" if the command was executed correctly, otherwise there is a corresponding error message.
R<CR>	The current position of the motor shaft is set as the reference point. The absolute position (command H) is now counted from that point. The system switches to position control and the message "*" appears. This command is only operative if the motor shaft is static, otherwise the error message "(E31)" appears.
R1<CR>	Reference travel, stops at zero mark. Responses: "*" if the command was executed correctly, otherwise a corresponding error message. If the reference position is reached, the message is "(Z54)".
R2<CR>	Determination of synchronization point (if 2nd transducer option present) at standstill (current position becomes synchronization point). Responses: "(Z55)" if the command was executed correctly, otherwise a corresponding error message
R3<CR>	First determine reference point at standstill (as for "R1") then synchronous operation after transducer zero pulse from master drive (only with follower drive). Responses: "*" if the command was executed correctly, otherwise a corresponding error message. If the reference point is reached, the response will be "(Z54)", and after the master drive reference signal (synchronization point) the message is "(Z55)".
U0<CR>	Retrieves 56 variables (16 bit value) from the EEPROM in the working memory. The message "*" appears.
U1<CR>	Saves 56 variables (16 bit value) in the EEPROM from the above working memory from 0E00. The message "*" appears..
U2<CR>	Converts the speed trigger thresholds given in customer units into an incremental speed. The output values are taken from the storage locations EA4h (N1_TRIG), EA6h (N2_TRIG) and EA8h (N3_TRIG) and loaded directly in the corresponding speed trigger thresholds (N_TRIG1, N_TRIG2, N_TRIG3). Response: "*"
U3<CR>	Interrupts a position step if position setpoint value is loaded with actual position values. Response: "*"
U5<CR>	Switch to change-over mode. Responses: "*" if the command was executed correctly, otherwise a corresponding error message
U6<CR>	Sets all incremental positions at zero. The command affects the actual position value, position setpoint value and reference position.Response: "*"
U7< CR >	Load position_sol3_LW/HW to position_soll_LW/HW
Wnr< CR >	Invokes a command program with the number "nr". Only blocks 0 - 15 can be invoked. "nr" is a single-digit hexadecimal number. Range 0 - Fh. Response: "*"
N< CR >	Negate the last input. If the control loop is in speed control mode, the speed is negated. In position control mode, the last setpoint position is negated. In addition, the input is negated by adding an N.

T< CR >	Poll 31-bit position setpoint. (Variable: LAGE_SOL3_LW/HW. Address: 70ah/70ch)
TZahl_ 31< CR >	Specifies a 31 bit position setpoint. Value entered in the variables (LAGE_SOL3_LW/HW). Positioning must be activated with the U7 command
X< CR >	Poll 31-bit position setpoint. (Variable: LAGE_SOLL_LW/HW. Address: 928h/92ah)
XZahl_31< CR >	Specifies a 31 bit position setpoint. Value entered in the variables (LAGE_SOLL_LW/HW) and positioning must start at the new position setpoint.

Example for C, D, G, H and O commands:

For a positive speed, e.g. 1500 rpm, the following command should be used:

O= 01500<CR>

Make sure that a blank is input after the "equals" sign. The number must be made up to five places with zeros. For a negative speed, e.g. -1500 rpm, the following command applies:

O=-01500<CR>

The same applies to the C, D, G and H commands.

Example for L and M commands:

Set the address indicator at 0E08h and load this memory location with 16 (10h):

L=0E08<CR>
M=0010<CR>

Make sure that the number is made up to four places with zeros after the "equals" sign

Example for X and T commands:

For a positive 31 bit position, such as 1.5 million increments, the command is as follows:

X= 0001500000<CR>

Make sure that there is a blank after the "equals" sign. The number must be made up to ten places with zeros.

For a negative 31 bit position, such as 1.5 million increments, the command is as follows

X=-0001500000<CR>

The same applies to the T command.

As an example, run the drive for reference travel with subsequent positioning step:

For unaddressed short message traffic and F25=0:

Control commands	Inverter messages
E<CR>	*(Z20)
V<CR>	*
R1<CR>	*nach Erreichen des Referenzpunktes(Z54)
D= 01024<CR>	*

For addressed short message traffic and F25=1:

Control commands	Inverter messages
A01E<CR>	*(Z20)
A01V<CR>	*
A01R1<CR>	*
A01D= 01024<CR>	*

There is no separate message now when the reference point is reached.

8.4.2.4 Three-digit short-message system messages

Status messages

Z00	Control switched off
Z01	Control disabled externally
Z02	EMERGENCY STOP
Z03	Not ready for operation
Z10	Ready for operation, disabled externally
Z11	Ready for operation, cleared externally
Z20	Control switched on, speed control
Z21	Feed disabled, speed = 0
Z22	Speed setpoint <> actual speed
Z31	Feed cleared
Z32	Speed setpoint = actual speed
Z40	Control switched on, position control
Z43	Position setpoint <> actual position
Z53	Position setpoint = actual position
Z54	Reference cycle terminated
Z55	Synchronization position

Status messages

E00	Input syntax
E01	Number range
E02	Division error
E10	Block masked
E30	Analog setpoint input
E31	Drive moving
E32	Drive change-over
E33	Signal: position set
E34	No reference point
E35	No synchronization point

8.4.3 Optimized short message traffic for RS485

The "B5" operating mode affords improved performance for multiple axis operation on RS485 bus lines. The commands are identical to the addressed short message commands.
An acknowledged and unacknowledged system is proposed.

8.4.3.1 Acknowledged "B5 mode "

With acknowledged "B5" mode, there is a uniform end symbol available for communication with a higher ranking control system. This transmission protocol corresponds to B2 mode. The only difference is a uniform ASCII character 3 (ETX or <STRG>c) as an end character. This end character is transmitted in place of "*" as an acknowledgment for commands and after short messages. The "ETX" character is used by the higher ranking control system as end identification for the inverter response.

8.4.3.2 Unacknowledged "B5 mode "

The unacknowledged (broadcast) service is introduced in "B5" mode with the ASCII character 2 (STX or <STRG>b). Thereafter, several inverters can be addressed in direct sequence and, for example, supplied with setpoint values. In this mode, the inverter check-back signals are disconnected. A control system does not therefore need to wait for individual check-back signals from the inverter.
The unacknowledged service is ended with "ETX" (on all inverters). For this, the last inverter addressed responds in the normal way ("B5" mode).
Short message commands which return a value, cannot be used in unacknowledged service.

Example:

<STX>A01o=- 345<CR>A02o= 2345<CR>A03a<CR><ETX>

8.5 Addressed bus mode

Every inverter is assigned a bus address (parameter F25), that has to be input before the RS-485 bus lines in the inverter are commissioned for the first time. Each of the total of 99 bus addresses can only be assigned once. The bus addresses are expressed in decimals.

Note: For addressed bus operation, the connected inverter must be initialized by the control system, otherwise the inverter will be in unaddressed communication mode. The following command must be transmitted: **A00<CR>**

In addressed bus mode, the inverter addresses is present in the short message commands.

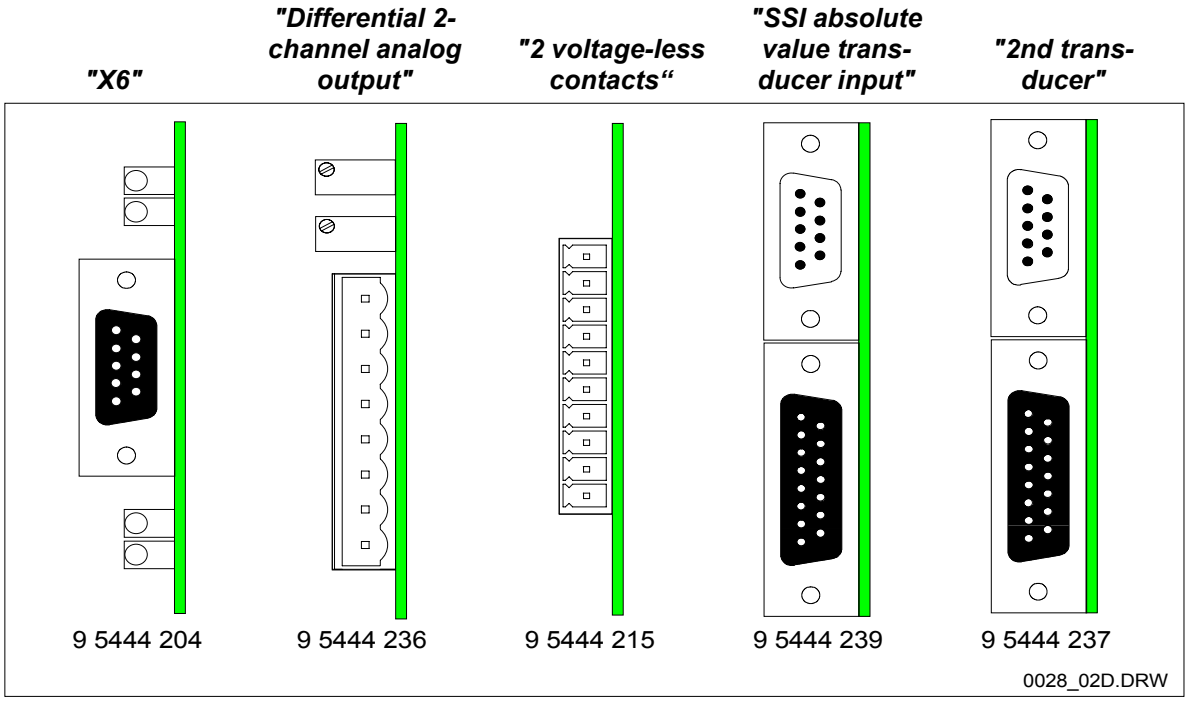
Example: Inverter address F25 = 01

A01E<CR>
A01V<CR>

9 Appendix

9.1 Options

- "X6" option for further processing rotary position transducer signals
- "Differential 2-channel analog output" option for analog presentation of travel curves
- "2 voltage-less contacts" option
- "SSI absolute value transducer input" option
- "2nd transducer" option



9.1.1 Transducer output connector X6

The transducer output supplies rectangular signals with TTL level on all four 90° tracks. The zero track is not available on connector X6.

For size I "X6" only (instead of X2) size ≥ II „X6“. plug-in station „XB“ DB9RF:

Terminal	*Meaning*
1	No connection
2	No connection
3	No connection
4	No connection
5	No connection
6	No connection
7	No connection
8	No connection
9	No connection
10	No connection
11	No connection
12	UA2-OUT\
13	UA2-OUT
14	GND
15	UA1-OUT\
16	UA1-OUT

Terminal	*Meaning*
1	UA1-OUT
2	UA1-OUT\
3	No connection
4	No connection
5	UA2-OUT
6	UA2-OUT\
7	No connection
8	No connection
9	GND

9.1.2 Option card: Differential 2-channel analog output

All channel tracks have ESD protection and supply a max. ±10V at max. ±4 mA:

Terminal	*Abbr.*	*Meaning*	*I/O-type*
1	K1	Channel 1	Output
2	K1\	Channel 1 inverted	Output
3	GND	Earth to channel 1	Output
4	K2	Channel 2	Output
5	K2\	Channel 2 inverted	Output
6	GND	Earth to channel 2	Output
7	PE	PE (earth)	Output
8	PE	PE (earth)	Output

Loading capability: max. ±4 mA at max. ±10 V

2 potentiometers provided for offset correction.

Resolution:
12bit inverter = ±11 bitr = ±2047 increments for setting via "X" commands, x1 -> dimension 1 to be represented, x2 dimension 2, x3 shift factor dimension 1, x4 shift factor 2!

9.1.3 Option card: 2 voltage-less contacts

Both independent relays operate a maximum of 60 W, coils 15 V DC/24 V DC selectable:

Terminal	*Abbr.*	*Meaning*	*I/O-type*
1	V1+	Relay coil 1 +	Input
2	V2+	Relay coil 2 +	Input
3	V-.	Relay coil 1 / 2	Input
4	PE	PE (earth)	Output
5	Ö1	Break contact 1	Output
6	W1	Change-over contact 1	Input
7	S1	Make contact 1	Output
8	Ö2	Break contact 2	Output
9	W2	Change-over contact 2	Input
10	S2	Make contact 2	Output

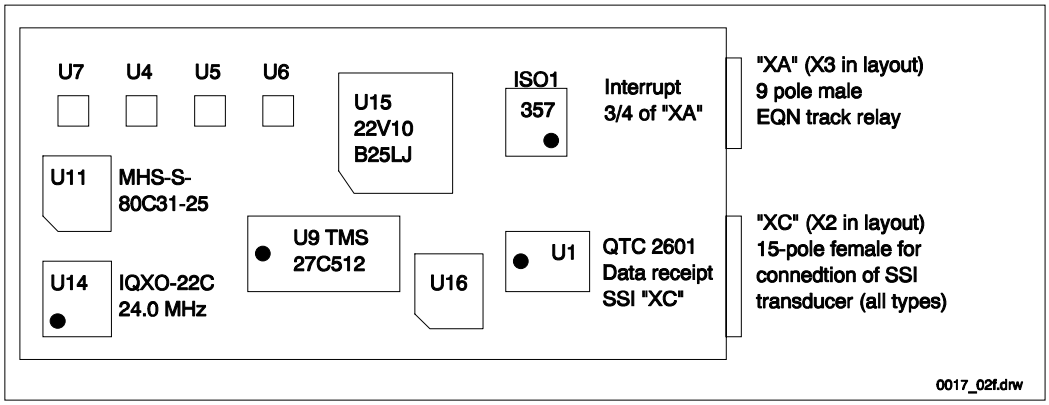
Data:

Bridges in basic setting: relay coils 30 mA approx. at 15 V DC
if bridges are bidirectional: relay coils 30 mA approx. at 24 V DC

Contacts per change-over contact with switching capacity of 50 W max. at 0.5 A max for 230 V AC or 48 V DC at max. 0.5 A.

9.1.4 Option card: "SSI absolute value transducer input"

Pin assignment on option-card „SSI interface“ (95444439) for the DSV 5444 system (SSIIBSX3/04):

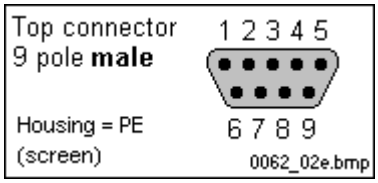


Accessories for "SSI Interface" option:

8042341 Flat strap cable connector 50 pole on 50 pole option -> VECTORDRIVE DSV 5444
8003039 15 pole SUB-D male connector; 8003042 Cover for this connector
8004074 95 pole SUB-D female connector; 8003041 Cover for this connector
95444813 0.6 m UD cable DSV5444 + 2nd transducer; 9 pole to 15 pole if required

Pin assignment on "SSI Interface" option card :

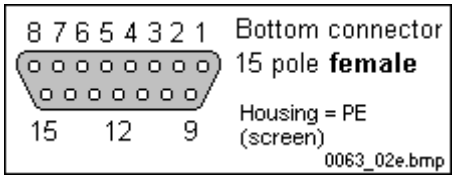
Plug-in connector "XA" (reproduction of EQN sine/cosine signal after "X3")



Pin 1 = UA1-OUT
Pin 2 = UA1-OUT\
Pin 3 = INT2-IN+
Pin 4 = INT2-IN-
Pin 5 = UA2-OUT
Pin 6 = UA2-OUT\
Pin 7 = GND
Pin 8 = GND
Pin 9 = GND

(„INT2“ is defined as input as for option 95444437)

Plug-in connector "XC" (SSI input, also suitable for R/W-SSI transducer and EQN):



Pin 1 = UA1-IN	Pin 9 = Cycle /
Pin 2 = UA1-IN\	Pin 10 = -15 V
Pin 3 = VCC	Pin 11 = GND-Sense
Pin 4 = GND	Pin 12 = PE (screen)
Pin 5 = UA2-IN	Pin 13 = VCC-Sense
Pin 6 = UA2-IN\	Pin 14 = Cycle
Pin 7 = Data	Pin 15 = + 15 V
Pin 8 = Data\	Gehäuse = PE (screen)

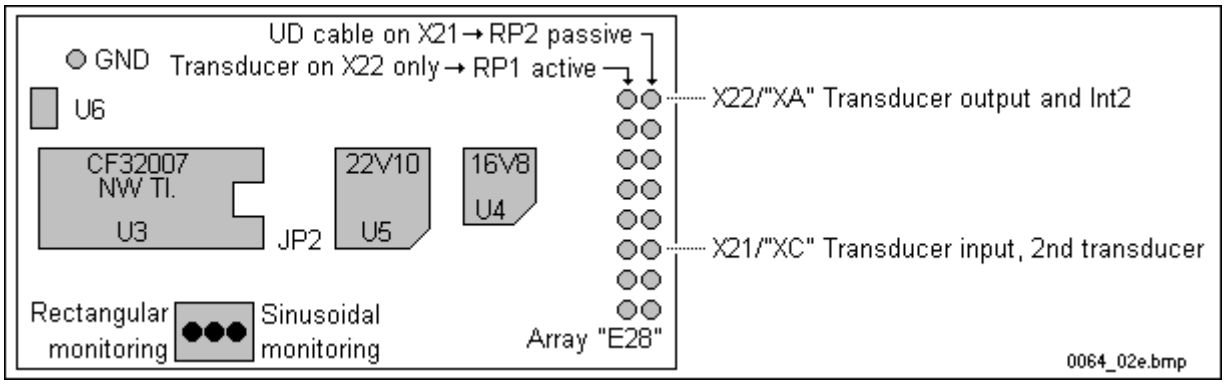
With the UD cable (95444813), the signals on the 9-pole connector can be routed back on DSV5444 connector "X3" if the EQN transducer is used, in which case the analog tracks are available as well as the SSI tracks.

Commands for firmware SSI.HEX (11.10.96):

l[4318 <CR> m0	= Delete SSI, m1 = 25bit, m2 = 24 bit, .. m14 = 12 bit
l[0144 <CR> m255	= Run in curve, m0 = run out curve
l[072c <CR> 00FF	= SSI values valid, FF00 = SSI values incorrect!
l[0736 <CR> m255	= SSI values active on position slippage, m0 = normal position

9.1.5 Option card: 2nd transducer

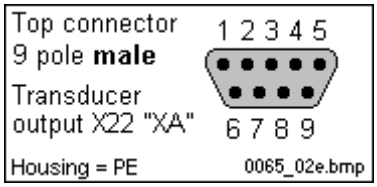
The 2nd transducer option (95444437):



Accessories for 2nd transducer option for connection/loop through of master signal:

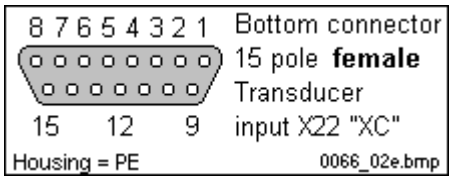
8042341	Flat strap cable connector 50 pole on 50 pole option -> VECTORDRIVE DSV 5444
8003039	15 pole SUB-D male connector; 8003042 Cover for this connector
8004074	9 pole SUB-D female connector; 8003041 Cover for this connector
95444813	UD cable 9 pole to 15 pole for through-loop of master transducer
95441812	Transduce cable 15 pole on IP65 12 pole for master transducer

Pin assignment on 2nd transducer option card :



X6 Pin 1 = UA1-OUT	X6 Pin 6 = UA2-OUT\
X6 Pin 2 = UA1-OUT\	X6 Pin 7 = UA0-OUT
X6 Pin 3 = INT2-IN+	X6 Pin 8 = UA0-OUT\
X6 Pin 4 = INT2-IN-	X6 Pin 9 = GND-OUT
X6 Pin 5 = UA2-OUT	

All signals on this connector work on a through-loop from connector X21. A UD cable is needed for further loop-through (length 0.6 m). PIN assignment::



X3 Pin 1 = UA1-IN
X3 Pin 2 = UA1-IN\
X3 Pin 3 = VCC
X3 Pin 4 = GND
X3 Pin 5 = UA2-IN
X3 Pin 6 = UA2-IN\
X3 Pin 7 = UA0-IN
X3 Pin 8 = UA0-IN\
X3 Pin 9 = GND
X3 Pin 10 = -15 V
X3 Pin 11 = GND
X3 Pin 12 = Screen
X3 Pin 13 = VCC
X3 Pin 14 = Free
X3 Pin 15 = + 15 V

The assignment corresponds to connector DSV-X3; the jumper on the card enables distinction between a rectangular or sinusoidal signal. Basic setting: sinusoidal. The array on this version has a basic setting of "Transducer cut out at 6 x 1 kOhm" (i.e. spurious conductance).

On the options card, array E28 should be set in the “active“ position, but on all other cards the “passive” array position should be selected.

New commands in firmware "RSDZA3.HEX 094472 17.01.96 L-8808 H-0F79":

r4 <CR> same meaning as |[200<CR> -> synchronous speed operating mode (note on r4<CR>: flags 1ae/1af and 802/803 supported here)

l[740<CR>m255<CR> "NIMPX2_STB" -> 2nd external zero pulse via "Pin 3+4X22"

l[73e<CR>m255<CR> "RECHT2_FLAG" -> 2nd transducer has converted JP2 rectangle

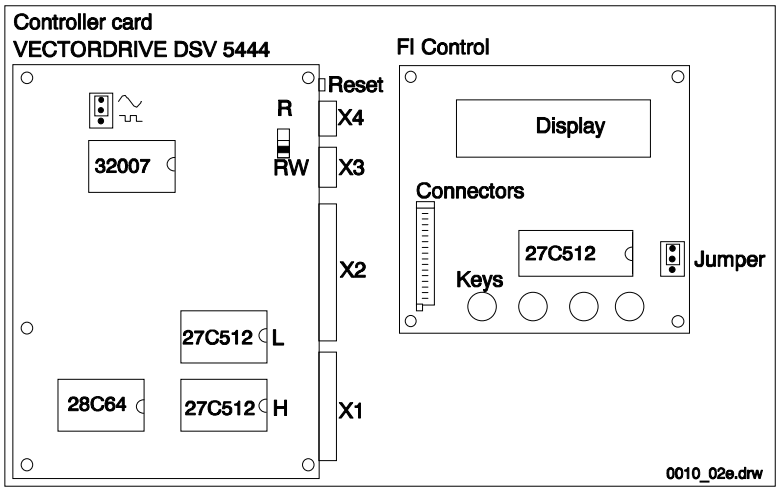
lm "b2" / "b5" -> polling of "LAGE_IST2" (30 bit mode) possible with k<CR>.

9.2 Bus connection options

(for further information see supplementary descriptions)

- Interbus S remote bus terminal option (voltage-less)
- Profibus DP remote bus terminal option (voltage-less)
- 2nd RS485 (on application)

9.3 Installing firmware on control card and in FI Control



If VECTORDRIVE DSV 5444 is opened, any guarantee becomes invalid!

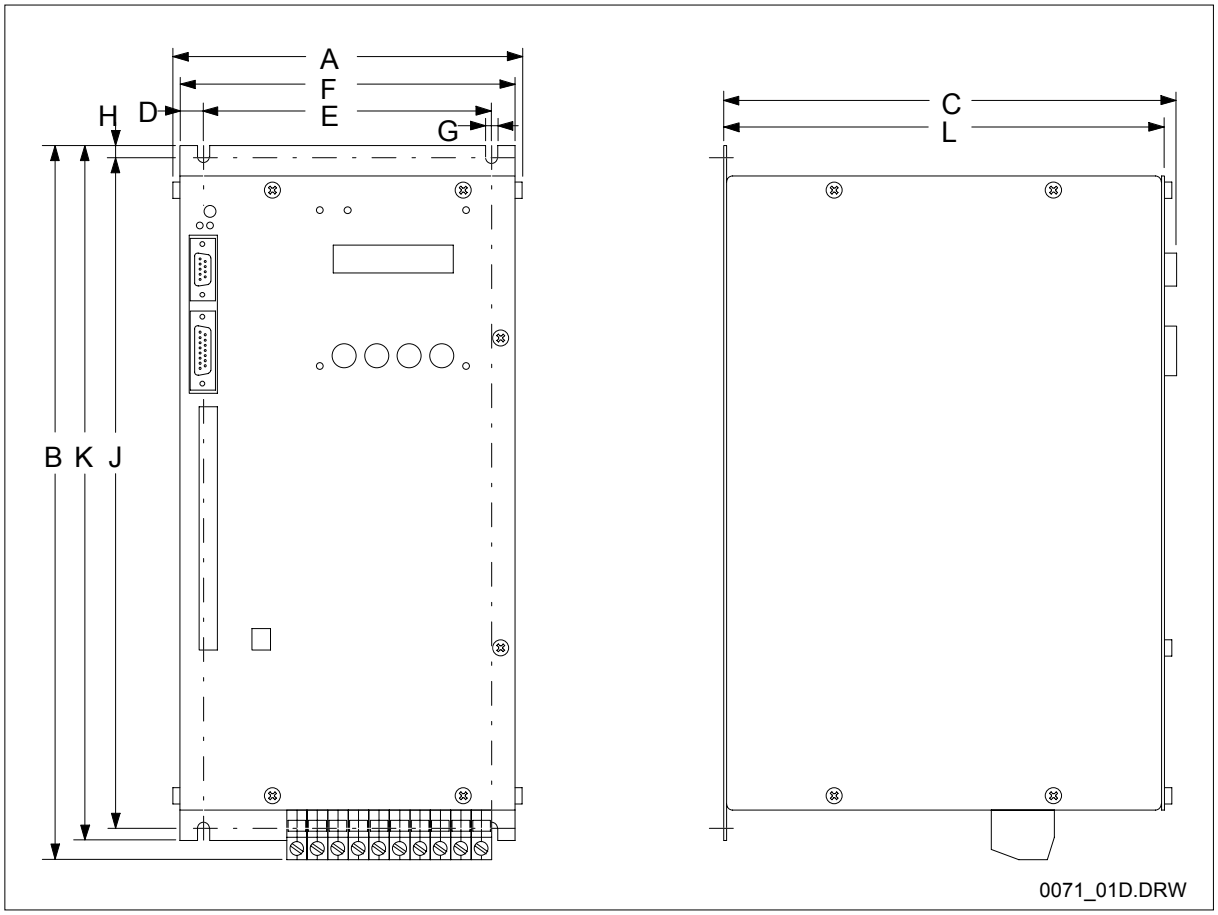
9.4 Conversion table for cosφ, sinφ and tanφ

cos	*sin*	*tan*	*cos*	*sin*	*tan*
0,5	0,87	1,73	0,76	0,65	0,86
0,52	0,85	1,64	0,78	0,63	0,80
0,54	0,84	1,56	0,8	0,60	0,75
0,56	0,83	1,48	0,82	0,57	0,70
0,58	0,81	1,40	0,84	0,54	0,65
0,6	0,80	1,33	0,86	0,51	0,59
0,62	0,78	1,27	0,88	0,47	0,54
0,64	0,77	1,20	0,9	0,44	0,48
0,66	0,75	1,14	0,92	0,39	0,43
0,68	0,73	1,08	0,94	0,34	0,36
0,7	0,71	1,02	0,96	0,28	0,29
0,72	0,69	0,96	0,98	0,20	0,20
0,74	0,67	0,91			

9.5 Other information

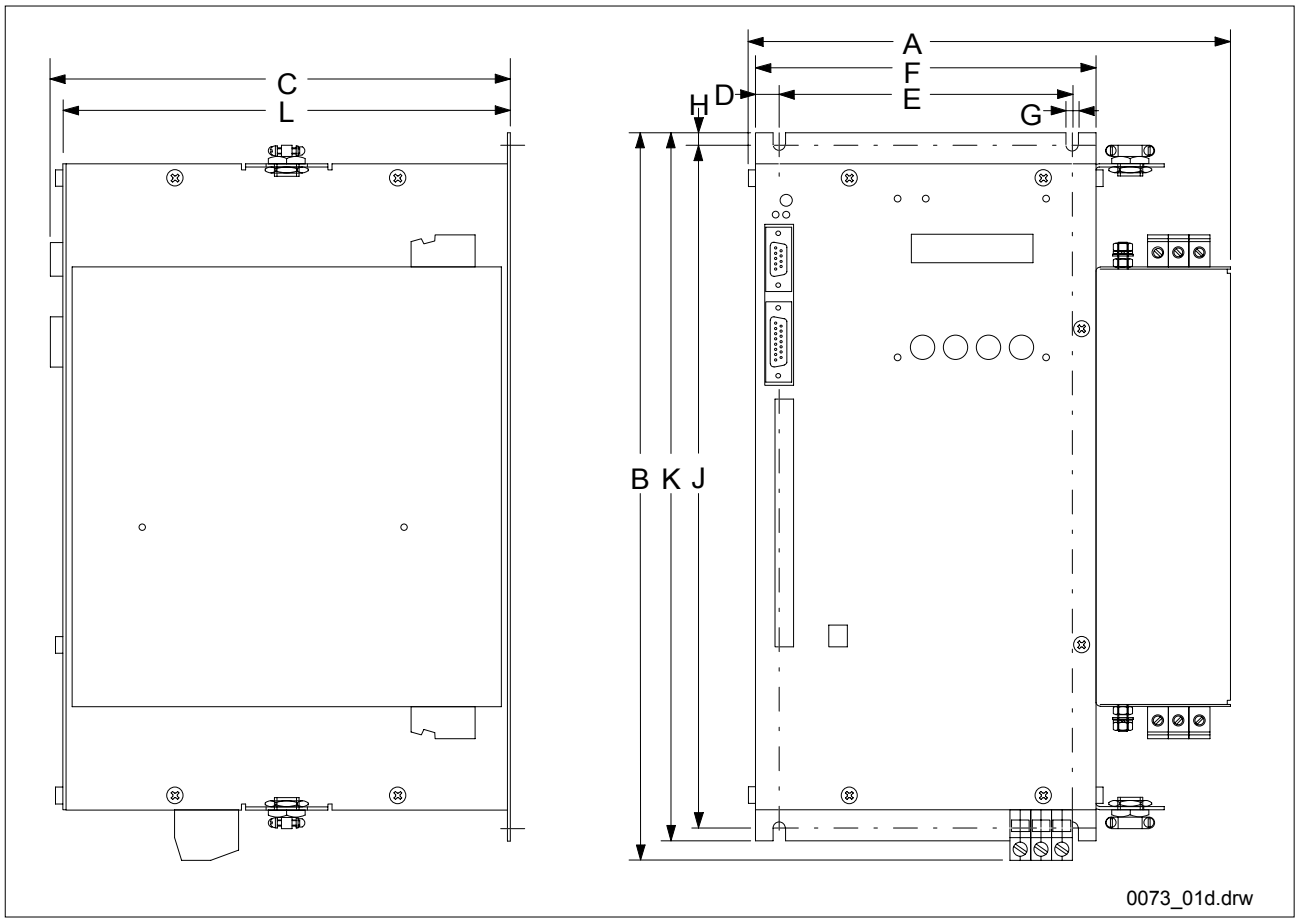
VECTORDRIVE DSV 5444-	*Series*	I_d
03/400	"32"	4
06/400	"32"	8
09/400	"28"	12
12/400	"28"	14
16/400	"28"	25
25/400	"28"	28
32/400	"40"	40
45/400	"48"	50
60/400	"40"	80
80/400	"48"	90
100/400	"40"	120
130/400	"30"	150

9.6 Dimension and weight



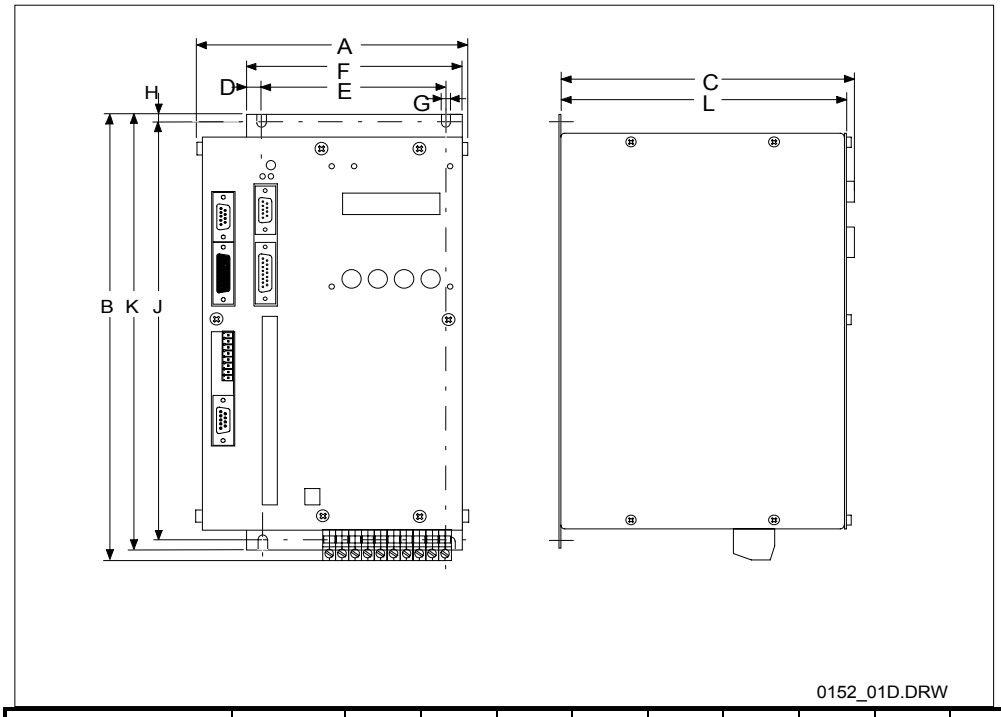
VECTORDRIVE DSV 5444	*Size*	*A [mm]*	*B [mm]*	*C [mm]*	*D [mm]*	*E [mm]*	*F [mm]*	*G [mm]*	*H [mm]*	*J [mm]*	*K [mm]*	*L [mm]*	*Weight [kg]*
3 - 9 A	I	137	281	177	11,5	107	130	6	6	264	276	171	6,0
12 - 16 A	II	172	353	223	11,5	142	165	6	6	331	343	217	10,0
25 - 45 A	III	172	473	223	11,5	142	165	6	6	451	463	217	14,0
60 - 130 A	IV	220	762	310	26,5	160	213	6,5	6	745	757	304	35,0

9.7 Dimension and weight with add-on filter



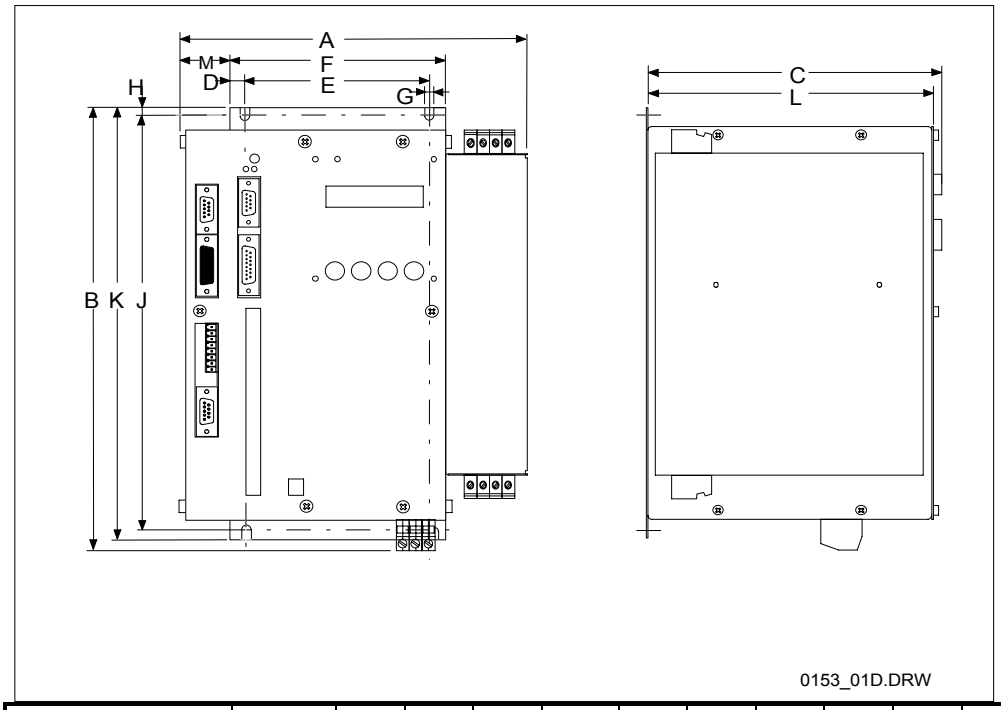
VECTORDRIVE DSV 5444	*Size*	*A [mm]*	*B [mm]*	*C [mm]*	*D [mm]*	*E [mm]*	*F [mm]*	*G [mm]*	*H [mm]*	*J [mm]*	*K [mm]*	*L [mm]*	*Weight [kg]*
3 - 9 A	I	193	281	177	11,5	107	130	6	6	264	276	171	10,2
12 - 16 A	II	234	353	223	11,5	142	165	6	6	331	343	217	16,5
25 - 45 A	III	234	473	223	11,5	142	165	6	6	451	463	217	23,0
60 - 80 A	IV	297	758	310	26,5	160	213	6,5	6	745	757	304	57,0
100 - 130 A													59,0

9.8 Dimension and weight with 2 options



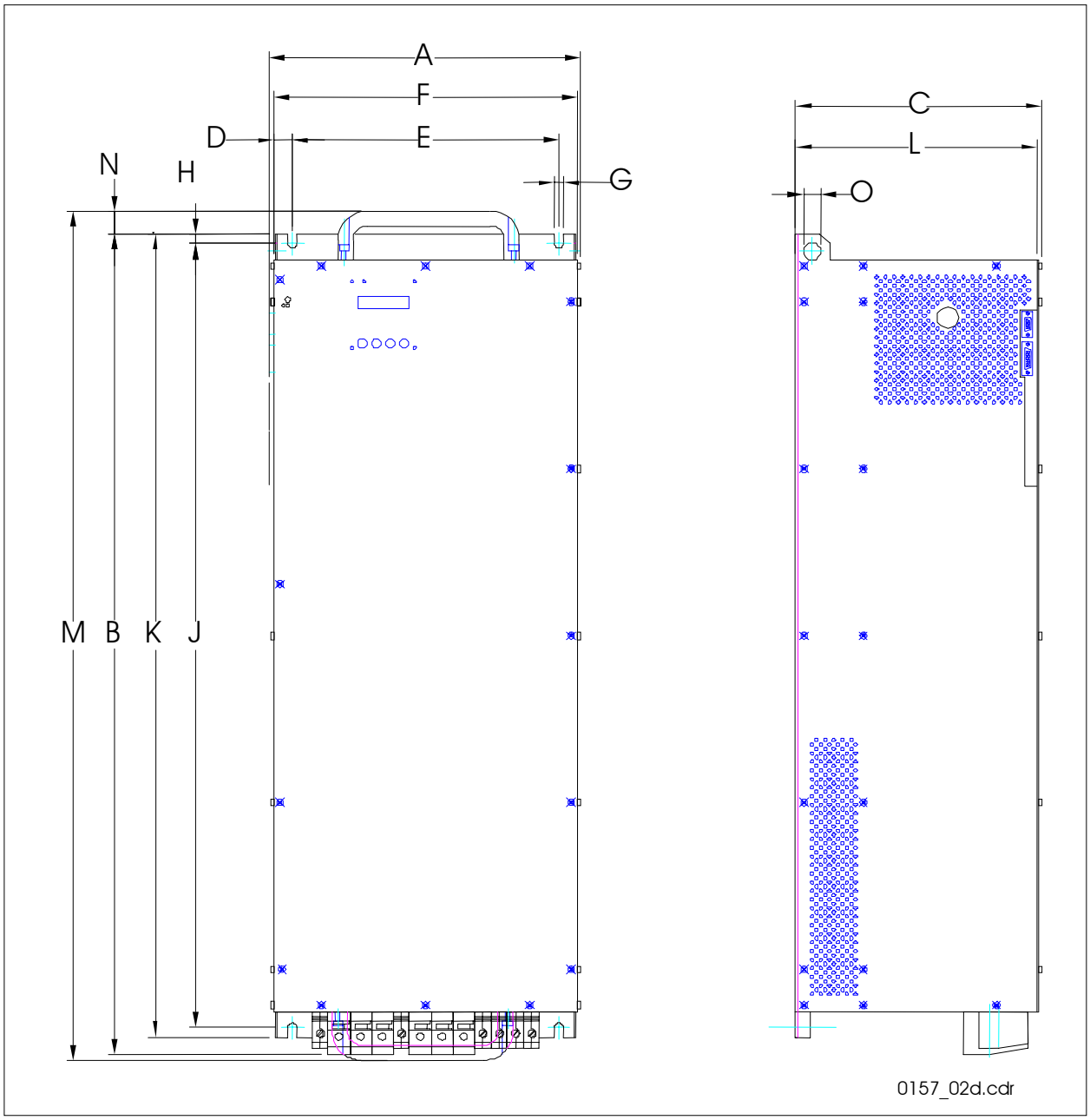
VECTORDRIVE DSV 5444	*Size*	*A [mm]*	*B [mm]*	*C [mm]*	*D [mm]*	*E [mm]*	*F [mm]*	*G [mm]*	*H [mm]*	*J [mm]*	*K [mm]*	*L [mm]*	*Weight [kg]*
3 - 9 A	I	165	281	177	11,5	107	130	6	6	264	276	171	6,7

9.9 Dimension and weight with 2 options and add-on filter



VECTORDRIVE DSV 5444	*size*	*A [mm]*	*B [mm]*	*C [mm]*	*D [mm]*	*E [mm]*	*F [mm]*	*G [mm]*	*H [mm]*	*J [mm]*	*K [mm]*	*L [mm]*	*M [mm]*	*weigth [kg]*
3 - 9 A	I	223	281	177	11,5	107	130	6	6	264	276	171	32	10,9

9.10 Dimension and weight size 5

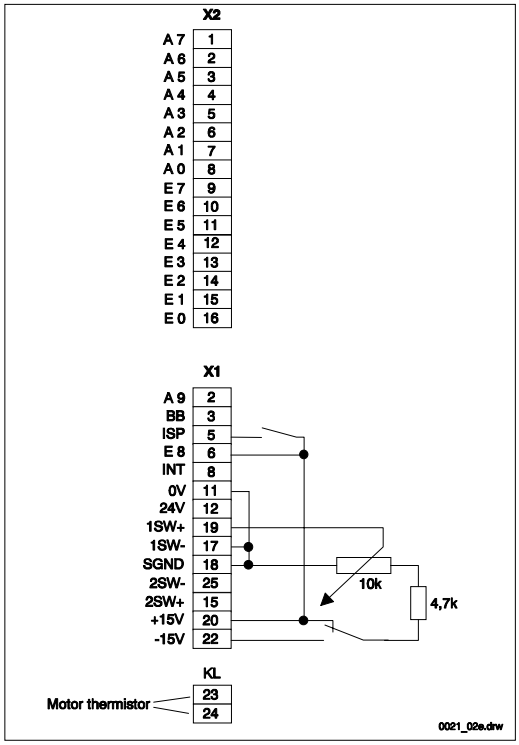


DSV 5444	Size	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [mm]	L [mm]	M [mm]	N [mm]	O [mm]	Weight [kg]
150 A	V	357	953	286	21,5	307	350	11	10	913	933	280	990	28,5	20	60,0
200 A	V	357	953	286	21,5	307	350	11	10	913	933	280	990	28,5	20	65,0

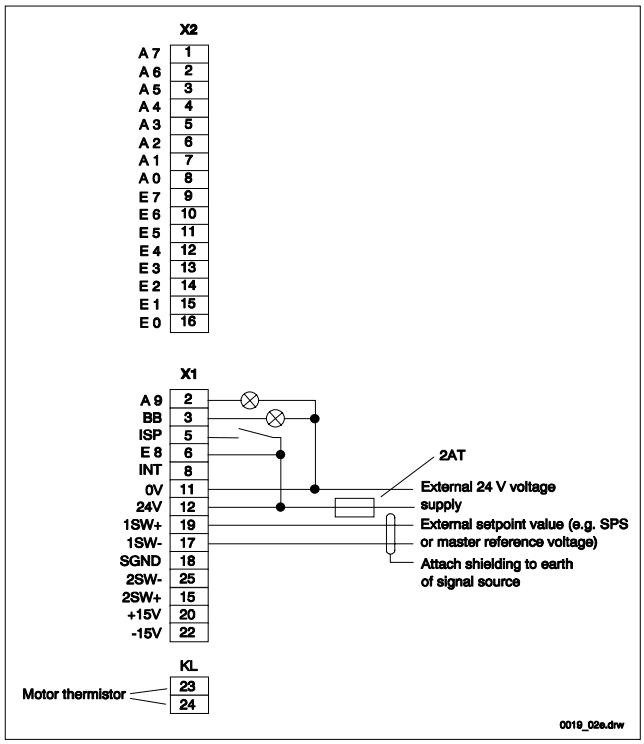
Note: AddOn-filter on request

9.11 Connection layouts

Minimum connection arrangement



External 24 V voltage supply with external analog specified setpoint value (SPS or master reference voltage)



External 24 V voltage supply with analogous specified setpoint via potentiometer