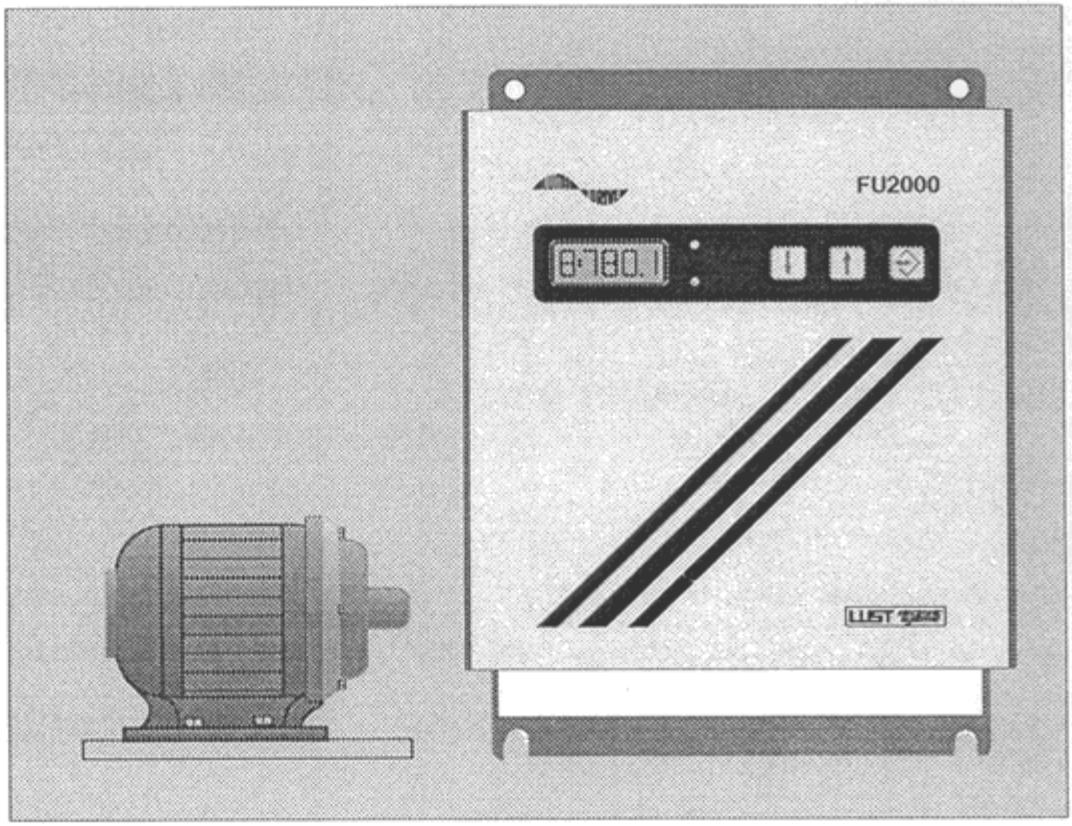
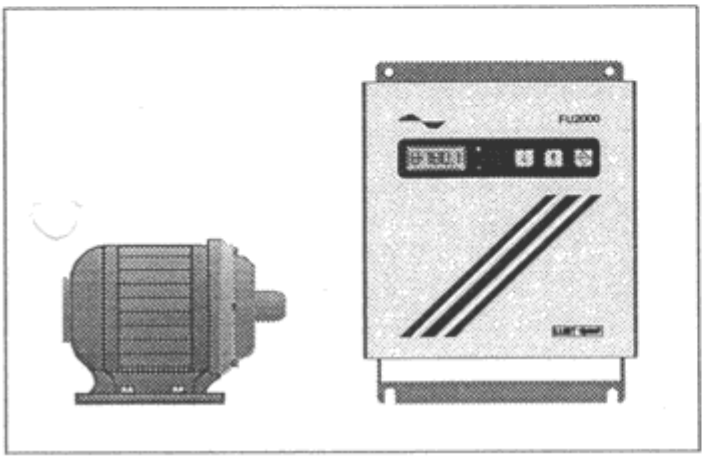
LUST electronic systeme



LUMI DRIVE FU2000
Frequency Inverter 3.0kW

Operation Manual

Operation Manual
Static Frequency Inverter



230V - Version

FU2233 / 2233-RT – 0,75kW
FU2237 / 2237-RT – 1,5kW
FU2239 / 2239-RT – 2,2kW

400V - Version

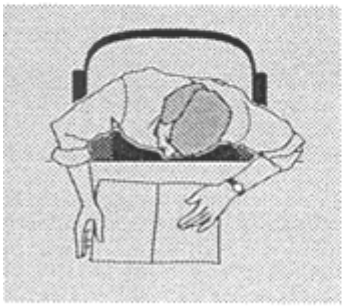
FU2404 / 2404-RT – 1,5kW
FU2408 / 2408-RT – 2,2/3,0kW

Software-Version 7.2D
Applicable from Series No: 00 269
Issued: October 1991

HOW TO USE THIS MANUAL

CAUTION:
Prior to Installation and initial Start-up of the Equipment this Manual should be thoroughly studied by Personnel authorized and qualified to work on Electrical Drive Systems. False Handling of the Equipment could be Hazardous to Personnel and/or Equipment.

CAUTION:
Electronic Components are not 100% Fail-Safe. It is the User's Responsibility to return the Drive System to „SAFE" Mode in Case of Failure of an individual Component. For Passenger Transport Systems it is essential to provide external Safety Precautions operating independently from the System's Circuitry.



Please study this Manual prior to Installation and Start-up.

This Operation Manual is valid for Frequency Inverters Series FU2000.

The front cover can be folded out to illustrate the Frequency Inverter's construction and the location of individual components or modules. This fold-out is provided as a guide line through the entire manual.

Following a tabulation-type listing of abbreviations used in this manual, chapter 1 contains general information related to Frequency Inverters Series FU2000.

Chapters 2 and 3 include essential information concerning technical data as well as instructions related to storage and transportation of the equipment.

Chapters 4 and 5 contain instructions for mechanical as well as for electrical installation. Wiring connections are shown in chapter 6.

Detailed instructions in regard to parameter entries via Digital Control Unit are given in chapter 7.

Information generally applicable to the operation of Frequency Inverters is given in chapter 8.

Finally, chapter 9 describes, in detail, intital assembly and installation, as well as a listing for trouble shooting and repairs.

The manual contains complete information required for normal installation and operation of the equipment; however, should questions arise beyond the scope of this manual, you are kindly requested to contact

LUST electronic systeme

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D-6335 Lahnau 1

Phone 0 64 41 / 6 02-0
Telefax 0 64 41 / 6 02-37

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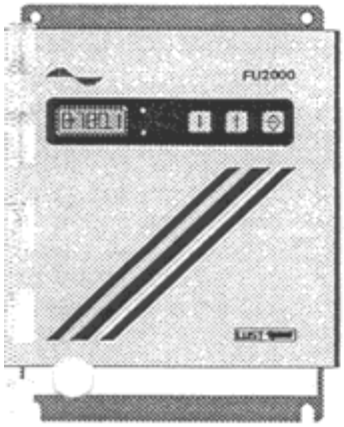
1 GENERAL INFORMATION

1.1 ABOUT FREQUENCY INVERTERS IN GENERAL



Frequency Inverters Series FU2000 are designed for energy-saving, stepless speed variation control of AC motors in the range of 0,75kW through 3,0kW. High-performance Micro-processor technology, as well as SMD assembly techniques, were utilized to provide a compact, easy-to-operate piece of equipment. Application possibilities for electronically controlled speed variation of rugged AC motors have thus been expanded considerably. Frequency Inverters produce AC networks of variable current frequencies.

Simultaneous variation of phase voltage in accordance to a chosen U/f curve serves to operate the motor at constant magnetic flow up to nominal frequency.

This results in constant torque during acceleration up to the desired nominal speed level. Also, the inverter's performance remains constant.

Existing asynchronous AC motors can be retro-fitted for operation via Frequency Inverter.

In addition to advantages realized from controlled speed variation other benefits can be obtained, such as minimized maintenance requirements, reduced wear and tear due to controlled acceleration and deceleration, and reduced work cycle times due to higher average speed ranges. The adaptation of linear speed of a conveyor belt, for example, in correlation to a primary work process is easily realized through frequency conversion. Furthermore, the operation of pumps and venting equipment via Frequency Inverter results in considerable energy savings.

1.2 SPECIAL CHARACTERISTICS

- **Compact design,** permitted through utilisation of SMD assembly techniques,
- **Entirely digital structure** with 16-bit Microprocessor,
- **High device efficiency,**
- **Smooth rotation,** even at lowest speed levels,
- **Control Inputs** and **Outputs** are free of potentials and compatible with SPS (Storage Programmable Control) circuitries,
- **High overload properties** with monitoring of the current/time factor (I x t),
- **High switching frequency,** thus reduction of motor noise,
- **Extensive software options** for numerous applications,
- **Serial interface RS485** for integration with primary control systems,
- **Simplified initial start-up and control** through integration of a digitally structured operation control unit with LCD display and coded messages,
- **Non-volatile occurence memory** for quick detection of malfunctions (failures), minimizing down times.

- **LUWORK** compatible
  PC software for parametring, controlling, monitoring and documenting.
- **Drivecom** compatible
  Connection to real time Drivecom bus system.

1.3 APPLICATION RANGE

Conveyance, Moving, Positioning
If constant, jerk-free progression of motion is critical, or if work cyle times are to be reduced with simultaneous reduction of wear and tear.

Dosage, Climate Control, Regulation
Reduction of of energy consumption as well as of wear and tear on pumps and airconditioning equipmernt; if precise dosage and dosage regulation with high-degree process integration are required.

Machining and Manufacturing
For optimized constant machining speed and work cycle time reduction, and for improvement of machined surface quality.

1.4 MODEL CODES

FU 2 40 4
FU 2 23 9

- Continuous Current of Device
- Power Supply Voltage 230V AC (400V AC)
- Series
- Frequency Inverter

2 TECHNICAL DATA

2.1 POWER OUTPUT

	Code	Dim.	FU2233	FU2237	FU2239 (LA2000)	FU2404	FU2408 without LA2000	FU2408 with LA2000
Motor Rating / 4-Pole Std. Motor	P	kW	0,75	1,5	2,2	1,5	2,2	3,0
Constant Capacity	S	kVA	1,6	2,7	4,2	2,7	3,8	5,5
Current, continuous	I	A	3,5	6,2	9,6	3,5	5,0	7,2
Continuous load	–	%	110					
Overload for 60 seconds	–	%	50		30	50	10 at present (30 from May91)	
Voltage	U	V	3 x 0 ... 230			3 x 0 ... 400		
Rotary Field Frequency	f	Hz	0...400					
Frequency Solution	f	%	0,1 of FMAX, 0,05Hz min.					
Type of Load	–	–	resistive / inductive					
Max. permiss. overload current for 60sec	I_{MAX}	A	5,3	9,3	12,5	5,3	8,0 (9,3)	8,0 (9,3)

2.2 LINE POWER SUPPLY INPUT

Voltage	U	V	230 -30/+15%	3 x 400 -20/+15%
Line Power Frequency	f	Hz	50/60 ±10%	
Perform. Factor of Fundament. Oscillation	–	cosφ	> 0,97 (only effective power)	
Input Wire Gauge	A	mm²	multistrand 1,5 / single strand 2,5	
External Line Fuses (delay-type)	I	A	16	
Permissible Line Voltage Asymmetry	ΔU	%	3	

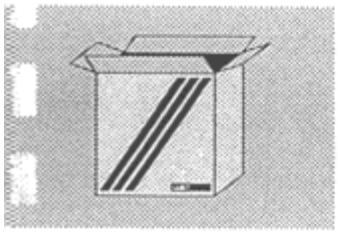
2.3 DIMENSIONAL DATA

Physical Dimensions	WxH xD	mm	216 x 256 x 128	216 x 256 x 162 with LA2000 (216 x 340 x 162)	216 x 340 x 162
Weight	–	kg	appr. 4	appr. 5,5	appr. 6
Protection Rating	–	–	IP10 / VBG4		
Mounting Orientation	–	–	Vertical on wall or panel		

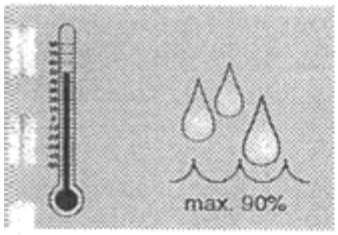
2.4 AMBIENT CONDITIONS

	Code	Dim.	FU2233	FU2237	FU2239 (LA2000)	FU2404	FU2408 without LA2000	FU2408 with LA2000
Max. internal temperature of equipment up to 1000m elevation	T	°C	60					
Max. permissib. ambient Temperature, or Temp. of Coolant up to 1000 m elevation	T	°C	40		30 (40)	40		
Reduction of Output Power related to elevation	H	m	5% Reduction per 1000m (3000Ft.) above 1000m (3000Ft.)					
Reduction of Output Power related to ambient Temperature	–	%/°C	2% per °C above 40°C ambient temperature maximum ambient temperature: 55°C					
Power Loss	P	kW	0,10	0,15	0,23	0,13	0,20	0,25
Relative Humidity	–	%	90% non-dewing					
Vibration	–	–	mechanically 0,4g / electrically 2g					
Efficiency	η	%	94	95	95	95	95	96
Storage Temperature	T	°C	-10°C ... +60°C to VDE 0160					

3 TRANSPORTATION, STORAGE AND MECHANICAL HANDLING

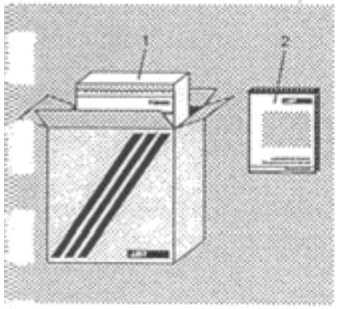


For protection purpose Frequency Inverters Series FU2000 are crated in heavy-duty cardboard boxes with cushioning inserts.

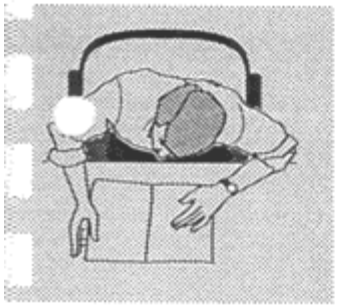


Maximum ambient conditions in storage areas acc. to VDE0160:

- Storage temperature: -10 °C ... +55 °C (14 ... 130 °F)
- Relative humidity: 90%, non-dewing



Shipments include:
1. Frequency Inverter
2. Operation Manual



Please study the Operation Manual before attempting any Installation and/or Start-up activities !

ATTENTION:
Shipments must be checked upon receipt for Quality, Quantity and Type. External damages of crating or contents should be reported to LUST at once.

4 INSTRUCTIONS FOR MECHANICAL INSTALLATION

4.1 OVER-ALL DIMENSIONS, BORE PATTERNS

Illustration of: FU2233 and FU2237

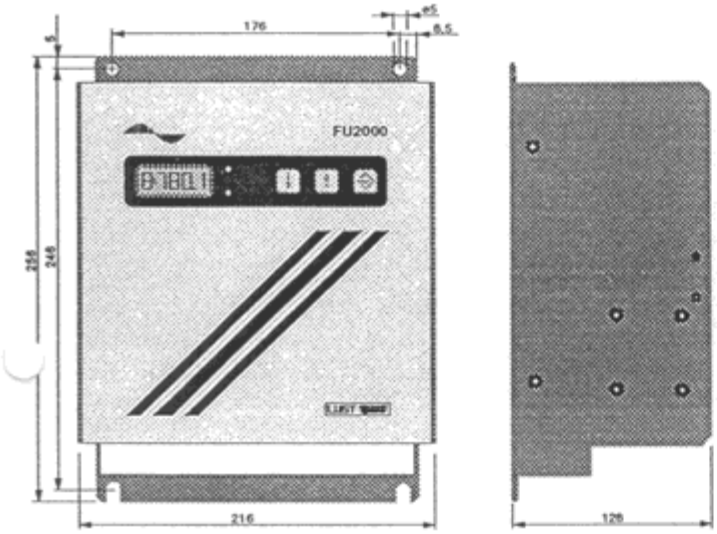


Illustration of: FU2239 , FU2404 and FU2408 without LA2000

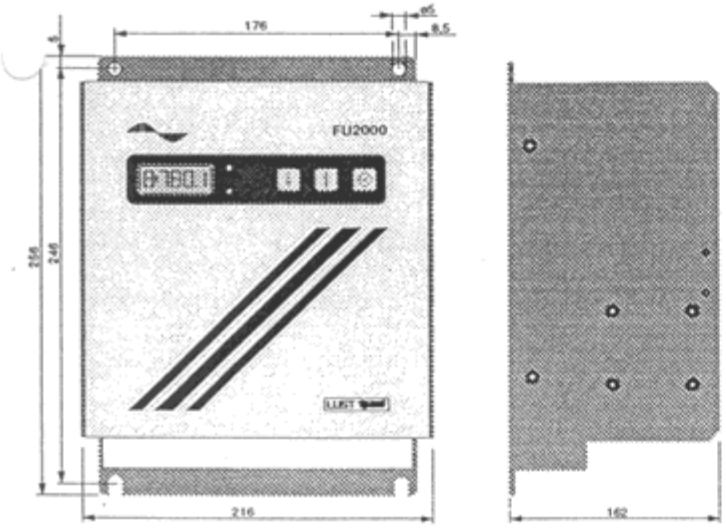
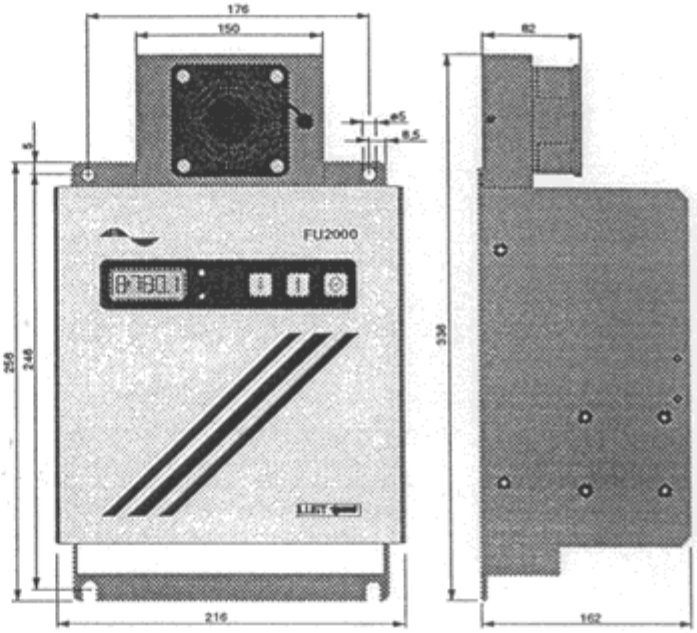


Illustration of:
FU2239 with LA2000
FU2408 with LA2000



4.2 TYPE OF HOUSING PROTECTION

Protection Rating for the housing is IP10 acc.to DIN 40050. Accident Prevention Rule VBG4 is followed, i.e. protection against contact with larger body surfaces (such as hands) is provided.

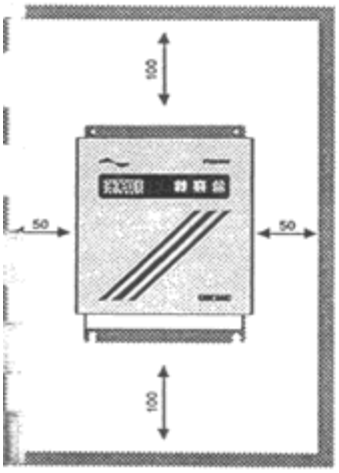
4.3 MOUNTING INSTRUCTIONS

Standard Frequency Inverters Series FU2000 are prepared to be mounted in Control Compartments subjected to flow-through of outside air. The converters are mounted on a panel with 4 screws M4.

The following conditions apply to the mounting location:

- Vertical device orientation
- Max. temperature of inflowing cooling air: 40°C
- Rel. humidity: 0 ... 90%, non-dewing
- Max. elevation: 2500m (Performance reduction above 1000m)
- Max. cooling block temperature: 80°C (176°F)

4.4 MINIMUM SPACING

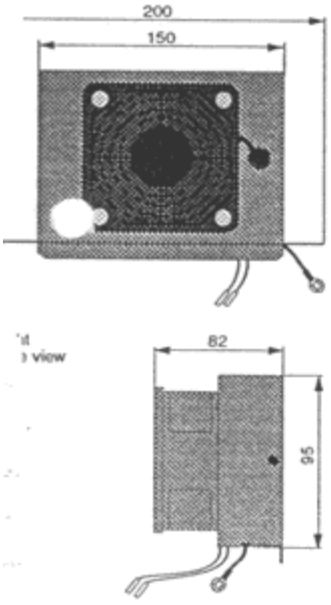


ATTENTION:
Mounting Location must be free of excessive moisture and of conductive, and/or aggressive agents.

4. MOUNTING OF VENTING ATTACHMENT LA2000

CAUTION:
Disconnect Inverter from power source prior to performing the following activities!

stration of Venting achment



Frequency inverters can be fitted with an LA2000 fan kit to improve cooling to suit the specific application (ambient temperature/operating frequency).

Please proceed as follows:

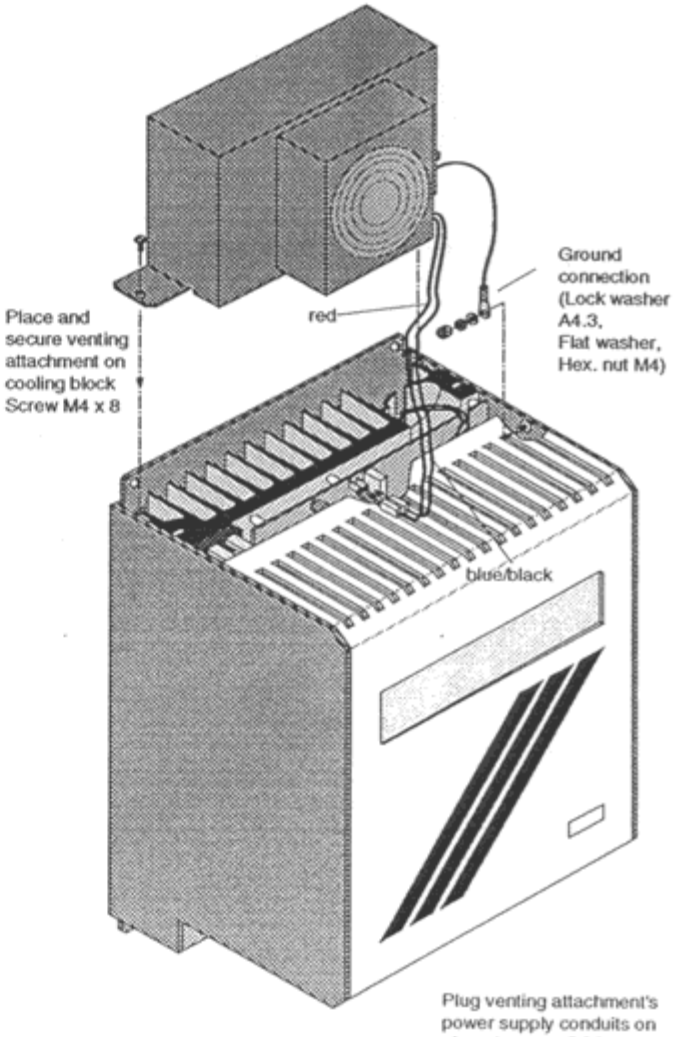
1. Disconnect inverter from power source, then wait appr. 3 minutes to allow the capacitors in the intermediate circuit to discharge completely.
2. Remove cover from Inverter.
3. Place venting attachment on the inverter's cooling block in such fashion that electrical wiring can be performed on the front.
4. Connect venting attachment on cooling block using two self-threading screws (8mm long, in accessories).
5. Connect protective (Ground) conduit to inverter housing's ground terminal (ref. to wiring diagram).
6. Plug venting attachment's conduits on pins of the inverter's master PCB.

ATTENTION:
Observe polarity!
Red to XLU1+.
Blue/black to XLU2-.

7. Double-check correct wiring; Place and secure cover on Inverter.
8. Switch Inverter ON: Acertain that venting fan does NOT run.

CAUTION:
NEVER perform any work on Inverters while they are connected to their power supply source!

Mechanical Installation



5 INSTRUCTIONS FOR ELECTRICAL INSTALLATION

5.1 RULES AND REGULATIONS

General rules pertaining to the installation of electrical equipment must be followed:

VDE 0100
Rules for High-Voltage Equipment up to 1000V.

VDE 0113
Rules for electrical devices of machining and manufacturing equipment.

VDE 0160
Electronic devices on High-Voltage equipment.

Additional rules and regulations may apply depending upon specific application of the equipment.

Hints for the Prevention of Accidents:
Do not enter the inverter compartment nor touch any components, and delay utilization of measuring instrumentation until the capacitors of the intermediate circuitry are fully discharged (observe yellow LED); ref. to item 19 of 'Lay-out Diagram' in front of manual.
Do not attempt to inspect voltage stability of the device, and disconnect line power supply prior to insulation testing.

The separation of potential of power part and control part is not in accordance with VDE rules relating to low voltage devices.

Leakage current is >3,5mA, requiring hard wiring in accordance with VDE 0160.

Wait
2 minutes!

ATTENTION:
Disconnect line power supply prior to entering the inverter's compartment. Wait 2 minutes (for discharge of the intermediate circuitry's capacitors to less than 65V) before performing any work on the device.

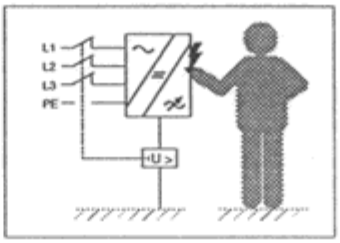
5.2 PROTECTIVE MEASURES

Leakage current of the inverter, without cables, is appr. 10mA. Depending upon local rules and regulations the following measures can be taken:

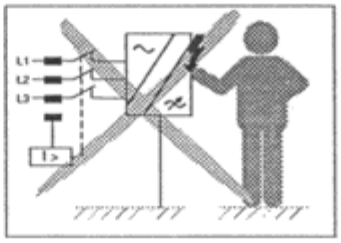
- Protective wiring against false currents
- Protective wiring against false voltages
- Protective grounding
- Protective 'Zero'ing
- Protective conductor system

NOTE:
Protective circuits against false current (FI) can be operated conditionally in conjunction with frequency inverters; however, this is prohibited in some countries.

There are two reasons:



a) All rectifier loads (i.e. not only those on frequency inverters) could generate a direct current (DC) in the supply power network, which would reduce the protective wiring's effectiveness.



b) An FI overload switch could be tripped prematurely by radio interference filters, resulting in undesired drive interruption.

5.3 CONTROL DEVICES

According to VDE rules, Frequency Inverters must be connected to the power supply line in such fashion, that provisions for total disconnection is provided (such as main breaker switches, relays, or power-operated switches etc.). The motor controlled by the Frequency Inverter can be disconnectable via relay or motor overload switch.

ATTENTION:
Add-on of exited motors, reversal of polar circuitry on pole-reversable motors, and/or reversal of the motor's rotational direction (e.g. via reversal relay) during operation is prohibited.

5.4 CABLE ROUTING

Wiring of line power supply, motor power supply and control wiring must be routed in separate cable harnesses.
It is recommended to use shielded cable for control wiring. Shielding must be connected to the inverter only.
Radio interference proofing should be provided as a precautionary measure, e.g. installation of RC-members on relay solenoids.

Instantaneous changes of potential within the motor coils could occur when operating DS motors via Frequency Inverter. Such changes of potential could generate high-frequency currents with negative consequences on other equipment. If such interferences are expected, shielded cable should be provided for motor wiring also. Shielding must be connected to terminal X1/PE.

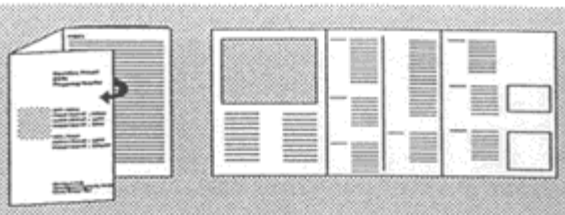
5.5 LISTING OF FUSES

Type / Fuse	FU2233 to FU2408
Intermed. Circuit (11)*	30 A FF / 600 V 10 x 38

* Ref. to 'Lay-out Diagram' in front of manual.

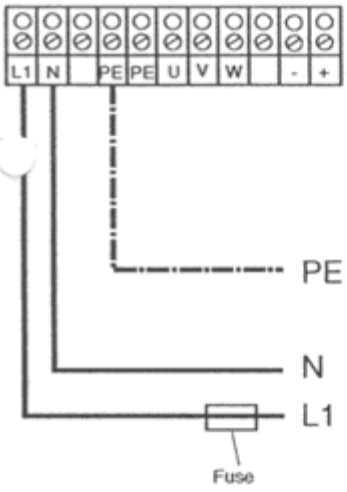
6 ELECTRICAL CONNECTIONS

LAY-OUT AND LOCATION DIAGRAM
Please open the front fold-out, containing Lay-out and Location Diagram of the frequency inverter, for the study of the following chapters of this manual.



6.1 POWER TERMINALS (X1)

6.1.1 POWER SUPPLY CONNECTION FU2230



The customer's power supply line must be connected to Terminals X1/L1, N, and PE.

CAUTION:
A delay of 60 seconds Minimum must be observed between switching OFF and switching ON of the Frequency Inverter.

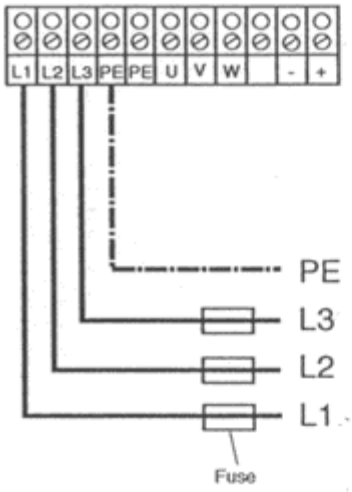
Type	Wire Gauge mm²	Line Fuses A
FU2233	2,5	10
FU2237	2,5	10
FU2239	2,5	16

The following data applies to the power supply network:

Voltage	1 x 230V
Permiss. Line Voltage Fluctuation	-30 / +15%
Permissible Line Voltage Asymmetry	≤ 3%
Network Frequency	50 - 60Hz

CAUTION:
NEVER connect 380/415 VAC on terminals X1/L1 and X1/N!

6.1.2 POWER SUPPLY CONNECTION FU2400



The customer's power supply line must be connected to Terminals X1/L1, L2, L3, and PE.

CAUTION:
A delay of 60 seconds Minimum must be observed between switching OFF and switching ON of the Frequency Inverter.

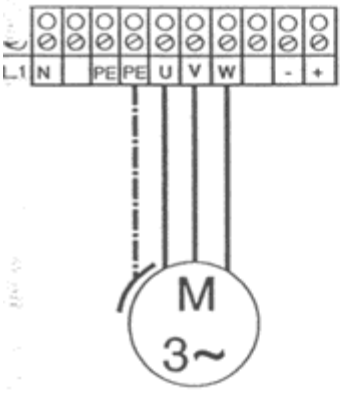
Type	Wire Gauge mm²	Line Fuses A
FU2404	2,5	10
FU2408	2,5	10

The following data applies to the power supply network:

Voltage	3 x 400V
Permiss. Line Voltage Fluctuation	-20 / +15%
Permissible Line Voltage Asymmetry	≤ 3%
Network Frequency	50 - 60Hz

6.1.3

MOTOR CONNECTION FU2230



Power supply to the motor must be connected to terminals X1/ PE, U, V, and W.

Wire gauge must be chosen in correspondence to the expected continuous current rating.

CAUTION:
Standard AC motors 220/ 380V must be internally wired in „DELTA" 220V fashion.

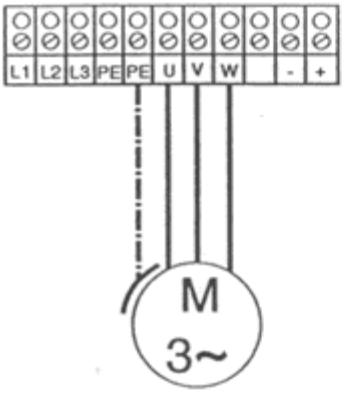
NOTE:
For multiple-motor operation care must be taken not to exceed the Frequency Inverter's maximum current rating.

Frequency Inverter Model	max. Wire Gauge mm²	Continuous Current max. A	Motor Rating (4-pole Motor) kW
FU2233	2,5	3,8	0,75
FU2237	2,5	6,8	1,5
FU2239	2,5	10,5	2,2

ATTENTION:
The type of load must be resistive/inductive; capacitive loads are not permitted.
Add-on of exited motors, reversal of polar circuitry on pole-reversible motors, and/or reversal of the motor's rotational direction (e.g. via reversal relay) during operation is prohibited.

6.1.4

MOTOR CONNECTION FU2400



Power supply to the motor must be connected to terminals X1/ PE, U, V, and W.

Wire gauge must be chosen in correspondence to the expected continuous current rating.

CAUTION:
Standard AC motors 380/ 660V must be internally wired in „DELTA" 380V fashion.

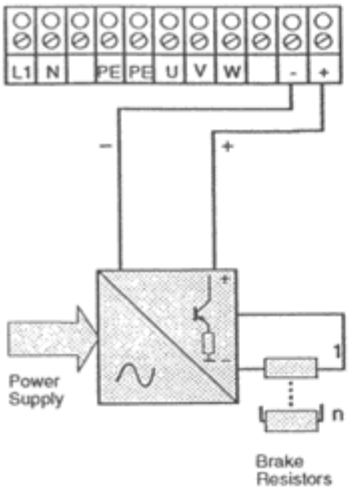
NOTE:
For multiple-motor operation care must be taken not to exceed the Frequency Inverter's maximum current rating.

Frequency Inverter Model	max. Wire Gauge mm²	Continuous Current max. A	Motor Rating (4-pole Motor) kW
FU2404	2,5	3,8	1,5
FU2408	2,5	5,5	2,2
FU2408 with LA2000	2,5	7,9	3,0

ATTENTION:
The type of load must be resistive/inductive; capacitive loads are not permitted.
Add-on of exited motors, reversal of polar circuitry ob pole-reversible motors, and/or reversal of the motor's rotational direction (e.g. via reversal relay) during operation is prohibited.

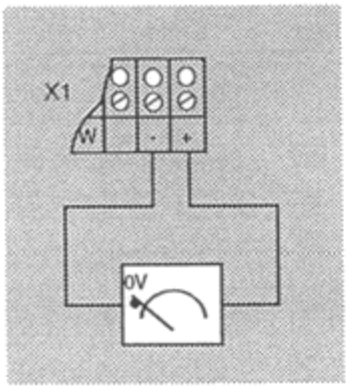
6.1.5

BRAKE CHOPPER TERMINALS (X1)



If the rotor speed (RPM) is higher than the corresponding synchronous speed, energy feed-back into the Frequency Inverter takes place. In this operation mode the motor is subjected to electrical braking action by the Frequency Inverter.
For trouble-free braking operation an external brake chopper should be provided, depending upon the degree of required braking energy.

Installation of an External Brake Chopper:



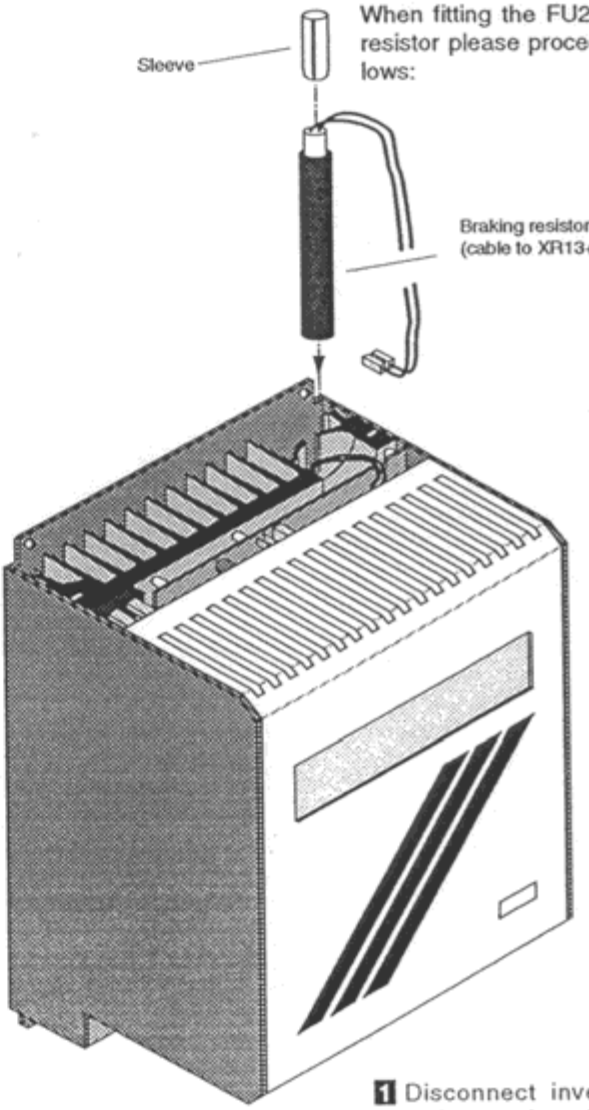
1. Inverter must be disconnected from power source.
2. The intermediate circuit's capacitors must be totally discharged, i.e. 0VDC must be present on terminals
   X1/-
   X1/+
3. The external brake chopper must be connected to terminals
   X1/-
   X1/+

CAUTION:
The Frequency Inverter's power supply must be disconnected prior to performing any work on internal terminals. A delay of 2 minutes from switch-OFF to opening of the compartment must be observed, in order to allow discharge of the capacitors to a voltage below 65V.

6.1.6

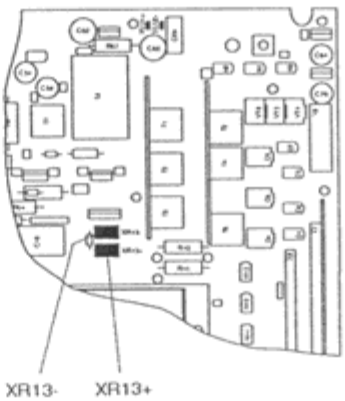
RETROFITTING AN INTERNAL BRAKING RESISTOR RB2239/2400

The FU2239 Frequency Inverter and the FU2400 Frequency Inverter can both, depending on the braking energy, be fitted with an internal braking resistor at a later date.
When fitting the FU2239/2400 resistor please proceed as follows:



1. Disconnect inverter from mains supply and wait about 3 minutes to allow the intermediate circuit capacitors to discharge;
2. Remove cover of frequency inverter;
3. Insert braking resistor in the recess in the heat sink;
4. Close off by pressing in the sleeve;
5. Connect braking resistor to motherboard. Connect one load to XR13+ and the other to XR13- (no plolarity constraints);

FU2000 motherboard



6 Check connections, replace cover;

7 Switch on mains supply to inverter and observe LED 13 (see diagram) to check operation.

Note:
Use: RB2239 resistor for FU2239. RB2400 resistor for FU2404/2408.

6.1.7 RETROFITTING AN EXTERNAL BRAKING RESISTOR RBC2230 / RBC2400

The FU2239 Frequency Inverter and the FU2400 Frequency Inverter can both, depending on the braking energy, be fitted with an external braking resistor at a later date.

When fitting the RBC2230/ RBC2400 resistor please proceed as follows:

1 Disconnect inverter from mains supply and wait about 3 minutes to allow the intermediate circuit capacitors to discharge;

2 Remove cover of frequency inverter;

3 Fit braking resistor to the side of the FU2000 (see diagram);

4 Connect braking resistor to motherboard. Connect one load to XR13+ and the other to XR13- (no polarity constraints);

5 Connect grounding conductor;

6 Connect the thermostatic switch i.e. connect the control safety circuit.

Caution:
The connecting cable must be able to withstand 200°C.

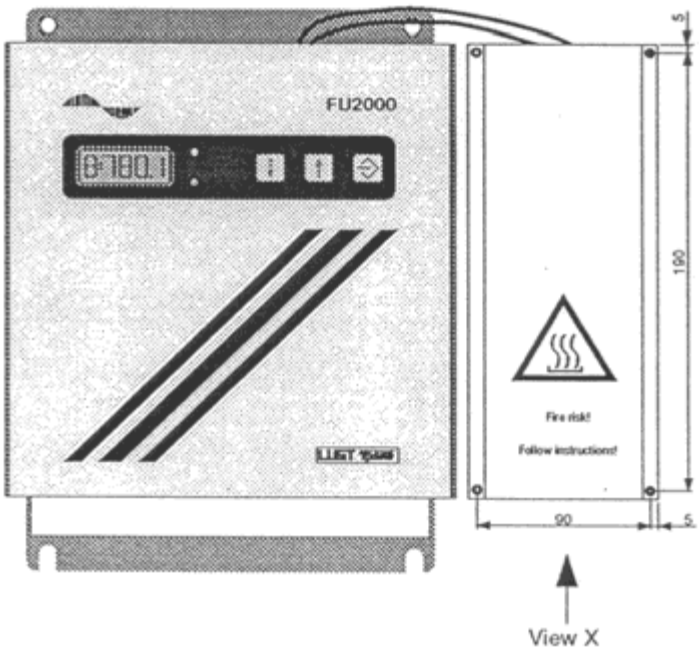
Thermostat specifications

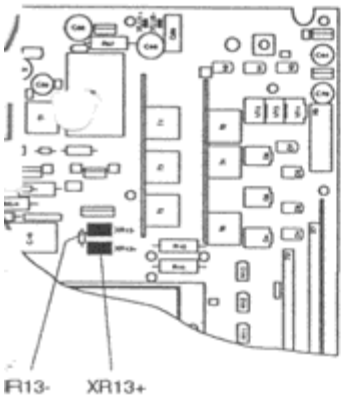
Contacts	silver
Switching capacity	10 (6)A, 250V AC (DC)
Operating cycles	1000
Minimum temperature Change rate	1°k/min.
Switching point	160°C
Differential	10 ... 20°C

7 Check connections, Replace cover;

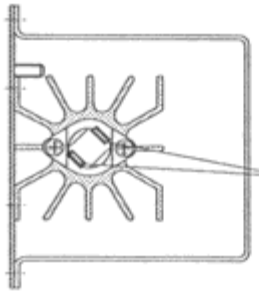
8 Switch on mains supply to inverter and observe LED 13 (see diagram) to check operation.

Note:
Use:
RBC2230 resistor for FU2233/ 2237/2239.
RBC2240 resistor for FU2404/ 2408.

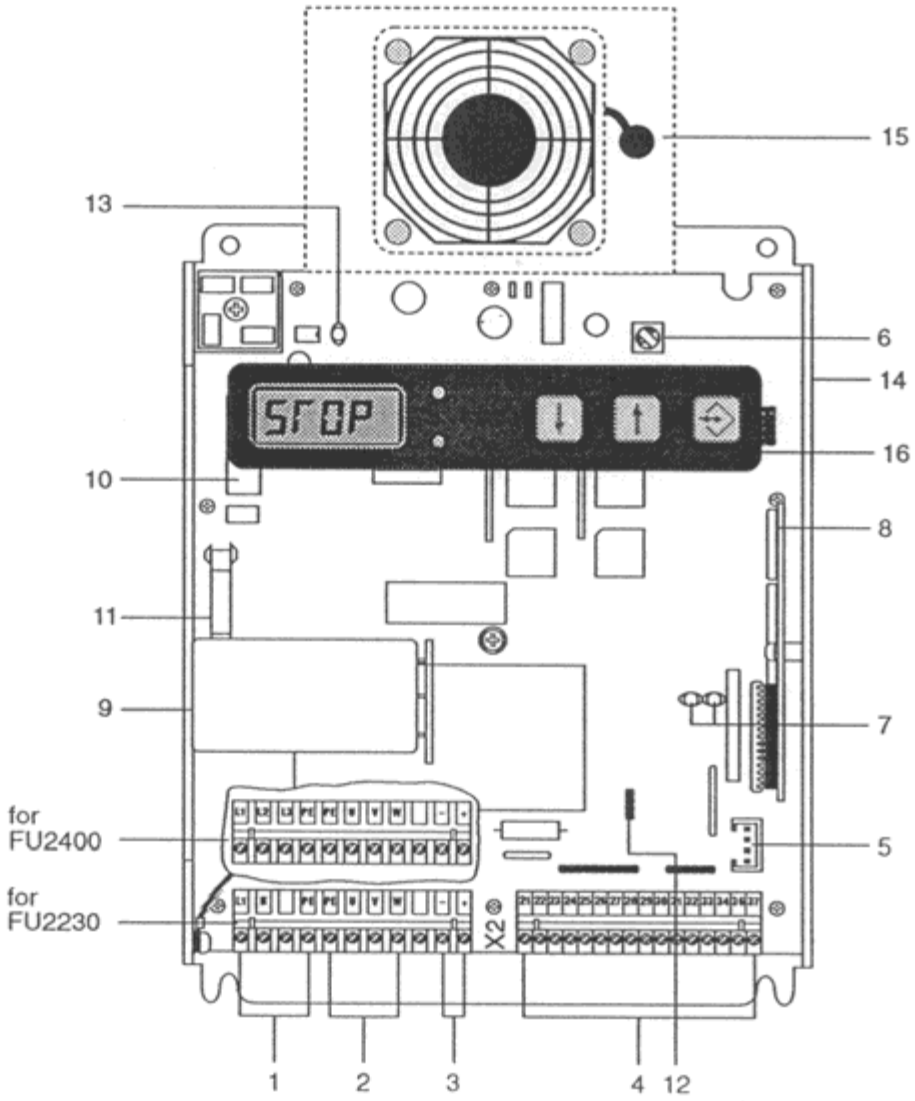




View X



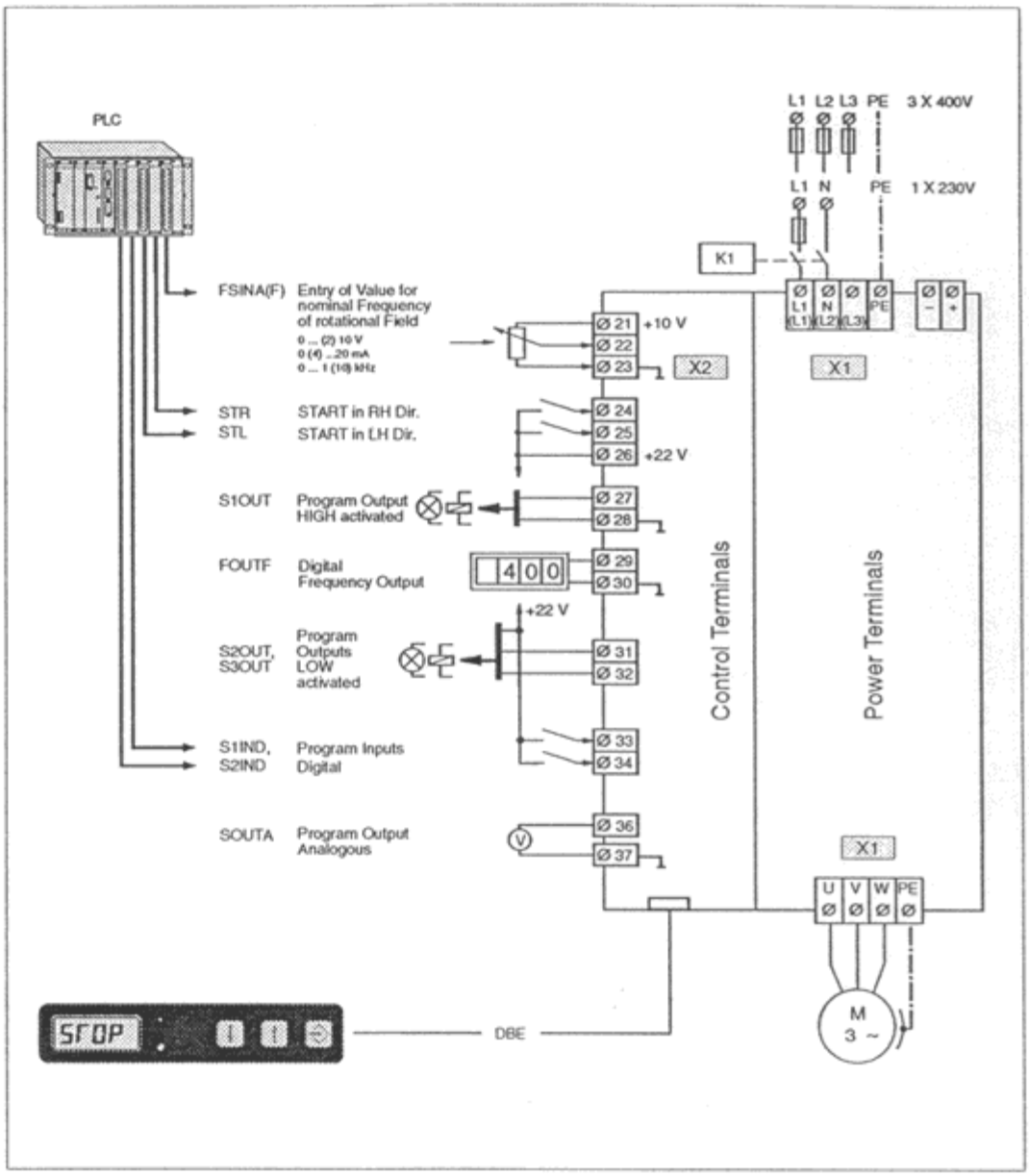
LAY-OUT DIAGRAM FOR FU2000



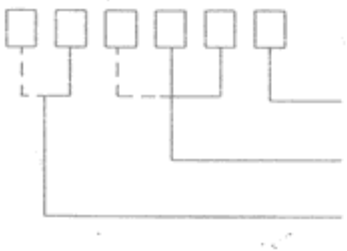
1	Power Supply Terminals (X1)	10	Pre-Load Relay
2	Motor Connection Terminals (X1)	11	Fuse for Intermediate Circuitry
3	External brake chopper port	12	Jumper Strip X11 for Adaptation of Signal 'Nominal Frequency Value'
4	Control Circuit Terminals X2	13	LED (yellow) for Intermediate Circuit and Application of Brake Chopper
5	Serial Interface RS485	14	Probing Point for max. internal Temperature of Converter
6	Potentiometer (ILIM)	15	Option LA2000 fan kit
7	LED Display	16	Digital Control Unit (DBE)
8	Plug Location MC-Print		
9	Intermediate Circuit's Capacitors		

6.2 DIAGRAM OF WIRING TERMINALS

ATTENTION:
It is recommended to use shielded cable for control wiring.



6.2.1 ABBREVIATED CODE FOR CONTROL TERMINALS



Type of Information *

Direction of Information Flow *

Contents of Information

Type of Information *
A = Analogous Signal
D = Digital Signal (High,Low,States)
F = Pulse frequency signal
R = Contact signal (Relay Output)

Direction of Information Flow *
IN = INPUT
OUT = OUTPUT

Contents of Information
F = Rot.Field Frequency on Inverter Output
FS = Nominal Frequency Value
V = Voltage on Inverter Output
I = Current on Inverter Output

- Standard Control Inputs apply if Direction of information flow is not indicated.
- Indication of type and direction of information is omitted if Output or Input information is displayed on a central operation unit.
- An Input or Output is programmable if the corresponding control terminal is denominated 'Special' input or output.

* does not appear on Display

6.3 CONTROL TERMINALS (X2)

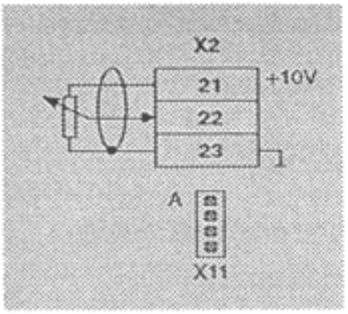
NOTE:
It is recommended to use shielded cable for control wiring.

Connection Group	Specification
Supply Voltages	• +10V ±2% NOT short circuit-proof, max. load, 2mA at 5kΩ • +22V ±5% NOT short circuit-proof, max. load 200mA
	ATTENTION: **The supply voltage of 22V is required for control inputs and control outputs. It is of importance NOT to exceed the maximum permissible load of 200 mA.**
Analogous Input of nominal Frequency Value (FSINA) (ref. to 6.4.1)	• Possibility to cascadize several inverters via nominal voltage value • Solution 8 BIT • Scanning cycle 8msec. • Software filter 50msec.
Digital Input of nominal Frequency Value (FSINA(F)) (ref. to 6.4.2)	• 'Schmitt'-Trigger input LOW < 4V HIGH > 5V (max. 10V) • Limits F_{MAX} = 1kHz or F_{MAX} = 10kHz • Scanning cycle 8msec. • Hardware filter 22msec. • Software filter 50msec.

Connection Group	Specification
Digital Control Inputs (S1IND, S2IND, STR; STL)	• LOW < 3V HIGH > 8V (max. 30V) (other voltages are not permitted) • Current on contacts 10mA • PLC-Compatible, +24V logical circuit against 'Zero' • Scanning cycle 8msec. • Hardware filter 3,3msec. • Software filter 2 x Scanning cycle
Digital Control Outputs (S1OUT, S2OUT, S3OUT)	• Programmable function • 1 driver output (S1OUT), short circuit-proof, 80mA maximum, HIGH activated • 2 open collector outputs (S2OUT, S3OUT), NOT short circuit-proof, 50mA maximum, LOW activated, internally pulling 10kΩ at 22V
Digital Frequency Output (FOUTF)	• NOT short-circuit-proof, • constant pulse width appr. 400µs-LOW • output frequency 6-fold, • HIGH at stop = 22V • to connection of DF40/56
Analogous Output (SOUTA)	• NOT short circuit-proof, • output voltage 10V with 50% overvoltage • max. load 1mA • Solution 7 BIT

6.4 CONTROL FUNCTIONS

6.4.1 ANALOGOUS ENTRY OF NOMINAL FREQUENCY VALUE (FSINA(F))

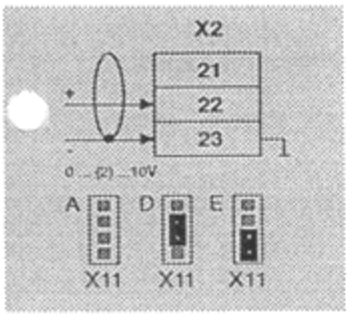


Potentiometer

Ri = 100kΩ

Ratio:
(against X2 : 22)
0kΩ = FMIN
10kΩ = FMAX

X11 Jumper position A

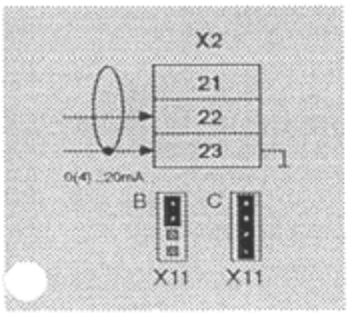


External 0 ... (2) ... 10V

Ri = 100kΩ

Ratio:
(against X2 : 22)
0V (0V; 2V) = fmin
10V (2V; 10V) = fmax

X11 Jumper positions:
A: 0 ...10V
D: 0 ...2V
E: 2 ...10V



External 0 (4) ... 20mA

Ri = 500Ω

Ratio:
(against X2 : 22)
0 (4)mA = fmin
20mA = fmax

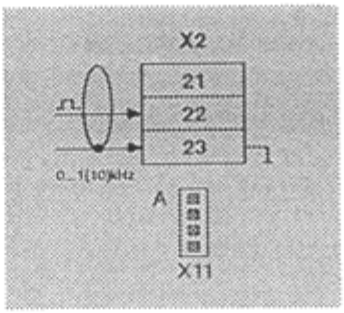
X11 Jumper position
B = 0 ...20mA
C = 4 ...20mA

NOTE:
The location of jumper strip X11 is shown on the front fold-out of this manual.

With preselected rotational direction the inverter can also be started via nominal frequency value input.

FSINA(F)	Meaning
FS > $\frac{FMAX}{68}$	START
FS < $\frac{FMAX}{128}$	STOP

6.4.2 DIGITAL ENTRY OF NOMINAL FREQUENCY VALUE (FSINA(F))



Ri = 100kΩ

Ratio:
(against X2 : 22)
0kHz = fmin
1(10)kHz = fmax

LOW < 4V
HIGH > 5V (max. 10V)

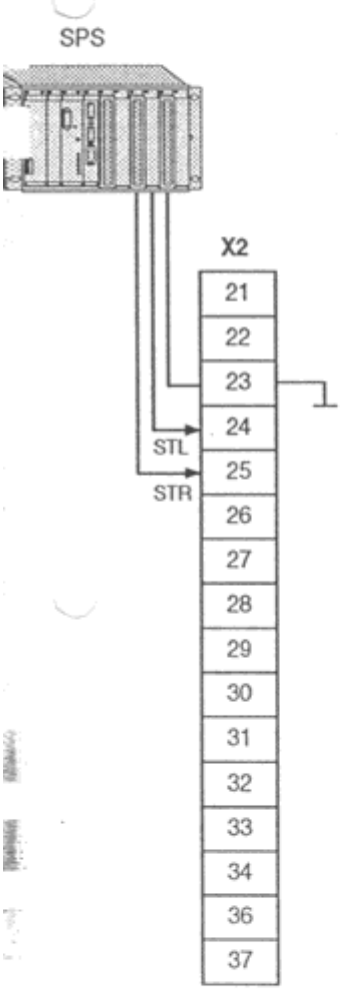
X11 Jumper position A

NOTE:
Reversal from analogous to digital nominal value is performed via digital control unit. Digital and analogous control preclude eachother.

6.4.3

TABLE OF CONTROL FUNCTIONS 'RH START', 'LH START', 'REVERSAL' AND 'RAMP-CONTROLLES BRAKE APPLICATION'

STL	STR	Reaction
0	0	OFF
0	1	RH (Clockw.)
1	0	LH (Ct.Clockw.)
1	1	Braking



PRECONDITION	ACTION / ACTUATION	REAKTION / ABLAUF
RH START		
• Main switch ON • No Malfunction • Nominal Value entered	• Enter STR	1 Output stages released 2 Rotational Field in RH (Clockw.) direction 3 Inverter's output frequency accelerates along preselected ramp to preselected nominal frequency value
	• Clear STR	1 Output stages closed 2 Motor coasts out without control
LH START		
• Main Switch ON • No Malfunction • Nominal Value entered	• Enter STL	1 Output stages released 2 Rotational Field in LH (Ct. Clockw.) direction 3 Inverter's output frequency accelerates along preselected ramp to preselected nominal value
	• Clear STL	1 Output stages closed 2 Motor coasts out without control
REVERSAL		
• Main Switch ON • No Malfunction • Nominal Value entered • STR entered	• Enter STL • Clear STR	1 Inverter decelerates from operational frequency down to '0' along preselected ramp; 2 Change from RH (Clockw.) to LH (Ct. Clockw.) Field rotation; 3 Inverter then accelerates its output frequency along pre-selected acceleration ramp to nominal value.
• Main Switch ON • No Malfunction • Nominal Value entered • STL entered	• Enter STR • Clear STL **ATTENTION: STR and STL must be actuated in over-lapping fashion.**	1 Inverter decelerates from operational frequency down to '0' along preselected ramp 2 Change from LH (Ct. Clockw.) to RH (Clockw.) Field rotation 3 Inverter then accelerates its output frequency along pre-selected acceleration ramp to nominal value
RAMP-CONTROLLED BRAKING		
• Main Switch ON • No Malfunction • Nominal Value entered • STR or STL entered	• Enter opposite direction; both, RH and LH direction must be entered.	1 Inverter decelerates its output frequency along preselected ramp, subsequently closing its output stages.

Control Level No.1	No.2	Abbr.	Dim.	Parameter Name	Page	Setting Range	Factory Setting	Customer Setting
01	01	MODE	–	Operation Mode	28	1 ... 6	1	
	04	FSSEL	–	Selector for Nominal Frequency Value	32	0 ...23	0	
				Modes (Display only)				
	12	F	Hz	Output Frequency	32	0 ...400		
	13	V	%	Output Voltage	32	0 ...100, from U_{line}		
	18	TIME	h	Switch-ON after Reset	32	0 ...960	4	
	19	TOP	h	Operation Hours	32	0 ...65000	4	
				Frequencies				
21	21	FMIN	Hz	Minimum Frequency	28	0 ...400	0	
22	22	FMAX	Hz	Maximum Frequency	28	4 ...400	50	
23	23	FF2	Hz	Fixed Frequency	29	0 ...400	5	
24	24	FF3	Hz	Fixed Frequency	29	0 ...400	0	
25	25	FF4	Hz	Fixed Frequency	29	0 ...400	60	
26	26	FF5	Hz	Reference Frequency for S2OUT	29	0 ...400	3	
	27	FF6	Hz	Control Frequ. Selector for U/f Curve Set	33	0 ...400	0	
	28	FF7	Hz	Fixed Frequency (Program. via Option. Function)		0 ...400		
				Ramps				
	31	KSEL	–	U/f Curve Set Selector	33	0 ...3	0	
32	32	RACC1	Hz/sec	Acceleration Ramp 1*	29	0,1 ...999	20	
33	33	RDEC1	Hz/sec	Deceleration Ramp 1*	29	0,1 ...999	20	
	34	RACC2	Hz/sec	Acceleration Ramp 2*	33	0,1 ...999	80	
	35	RDEC2	Hz/sec	Deceleration Ramp 2*	33	0,1 ...999	80	
36	36	RSTOP	Hz/sec	STOP Deceleration Ramp	30	0 ...999	0 = OFF	
	38	THTDC	sec	OFF Delay of DC Stop Torque	34	0 ...5	0 = OFF	
	39	VHTDC	%	DC Stop Voltage	34	1,0 ...15	3	
				U/f Curve				
41	41	V/F C	–	U/f Curve Selector	30	0 ...5	0	
42	42	VB1	%	Start Torque (Boost 1)*	30	0 ...25, from U_{line}	5	
43	43	FN1	Hz	Nominal Frequency Point 1*	31	26 ...960	50	
	44	VB2	%	Start Torque 2 (Boost 2)*	33	0 ...25, from U_{line}	5	
	45	FN2	Hz	Nominal Frequency Point 2*	33	26 ...960	50	
				Current Boundary Value				
	56	TRIP	%	Overload Protection	34	0 ...3	0	
				Control Circuit				
	61	SOUTA	–	Programming of Analogous Output	35	0 ...3	1	
	62	S1OUT	–	Programming of Control Output 1	35	0 ...10	1	
	63	S2OUT	–	Programming of Control Output 2	35	0 ...10	7	
	64	S3OUT	–	Programming of Control Output 3	35	0 ...10	6	
				Program				
	71	PROG	–	Program No.	36	0 ...9999	0	
72	72	START	–	Start Option	31	0 ...7	0	
	74	PWM	–	Modulation Frequency.	36	0 ...1	0	
				Converter Data				
	95	ERR 1	–	Last Failure	36	F00 ...99		
	96	ERR 2	–	Next to last Failure	36	F00 ...99		
	97	ERR 3	–	Second to last Failure	36	F00 ...99		
	98	ERR 4	–	Third to last Failure	36	F00 ...99		

ese parameters can be reserved in correlation to the U/f Curve Set Selector (Parameter No. 31).

6.4.4 SWITCHING „ON" MAIN POWER SUPPLY VIA STL OR STR

For safety reason the Inverter must not be switched ON while control function STL (or STR) is activated.

If the Frequency Inverter is switched ON (connected to power supply network) while STR or STL is activated, it ignores the start condition until such time that both, RH and LH control contacts are on 'OFF' (Stop) simultaneously.

NOTE:
Activation of function 'AUTO-START' precludes the behavoir described above.

ATTENTION:
Your attention is drawn to VDE rules 0100, part 227 and rule 0113, especially paragraph 5.4, concerning protection against undesired automatic restart after power failure and restoration of voltage, as well as paragraph 5.5, concerning protection against sub-voltage. Jeopardizing personnel, machines and/or production goods must be avoided.
Other rules and regulations pertaining to the specific operation must also be followed.

6.4.5 RESET

The Frequency Inverter resumes 'Ready' mode after having been in 'Failure' mode, if the malfunction no longer exists, and if the main switch is switched 'OFF' and then 'ON'.

6.4.6 CONTROL FUNCTIONS VIA DIGITAL INPUTS S1IND/S2IND

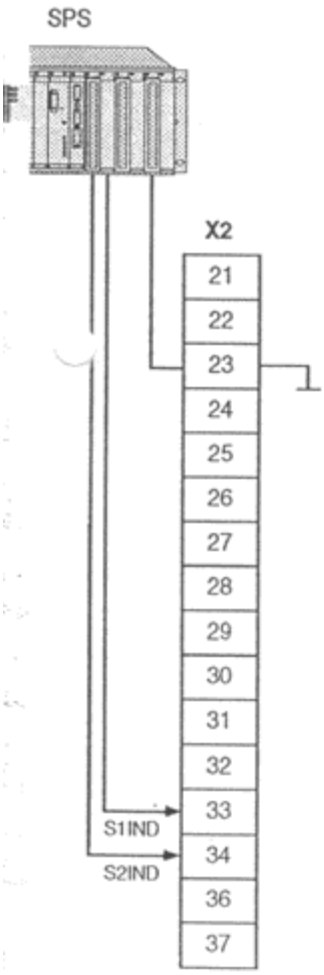
TE:
Iteration of parameters 31-
EL, 23-FF2, 24-FF3, and 25-
is possible via DBE or via
erial interface (ref.to chapter 8).

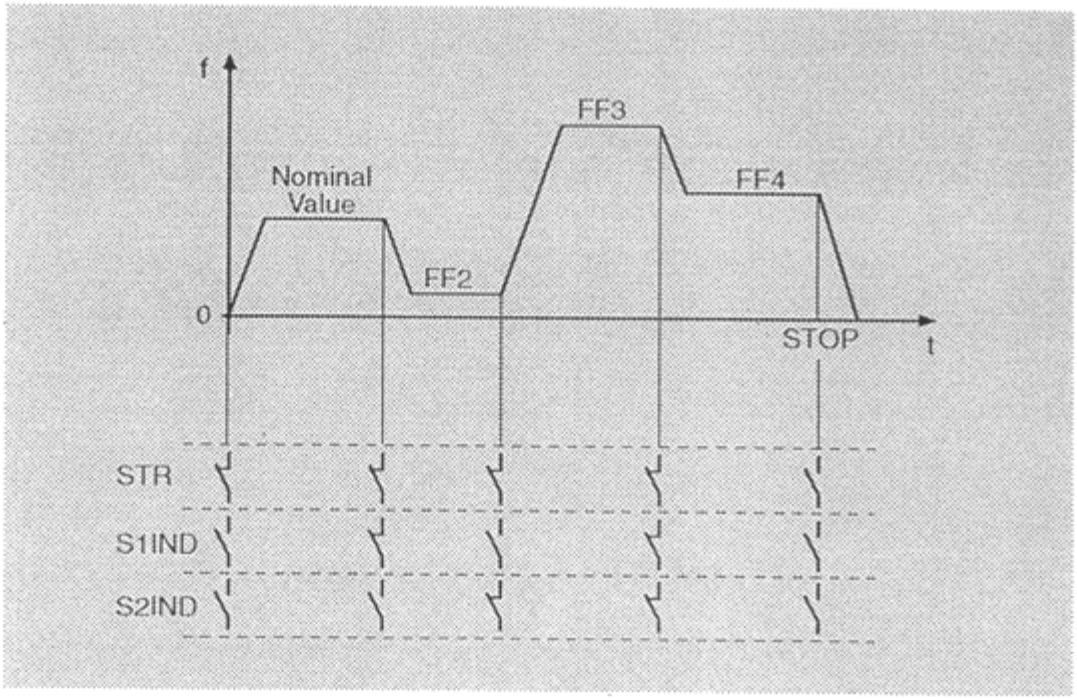
S2IND	S1IND	KSEL ≠ 2	KSEL = 2
0	0	FSINA(F) , U/F Curve set 1	FSINA (F) , U/F Curve set 1
0	1	FF2 , U/F Curve set 1	FF2 , U/F Curve set 1
1	0	FF3 , U/F Curve set 1	FSINA (F) , U/F Curve set 2
1	1	FF4 , U/F Curve set 1	FF2 , U/F Curve set 2

6.4.7 TABLE OF CONTROL FUNCTION 'FREQUENCY REVERSAL'

TE:
ct reversal vom fixed fre-
uency to nominal frequency
ry, and vice-versa, is permit-
(ref.to example 'Frequency
eversal').

PRECONDITION	ACTION / ACTUATION	REACTION / PROCESS
Activation of Fixed Frequency 2 (3) / FF2 (FF3)		
• Main switch ON • No Malfunction • KSEL ≠ 2 • STL or STR ON	• Enter S1IND (S2IND)	• The Frequency Inverter's output frequency is decelerated or accelerated, resp., to the frequency programmed in FF2 (FF3), along the preselected acceleration ramp or deceleration ramp, resp..
Activation of Fixed Frequency 4 / FF4		
• Main switch ON • No Malfunction • KSEL ≠ 2 • STL or STR ON	• Enter S1IND and S2IND	• The Frequency Inverter's output frequency is decelerated or accelerated, resp., to the frequency programmed in FF4, along the preselected acceleration ramp or deceleration ramp, resp..





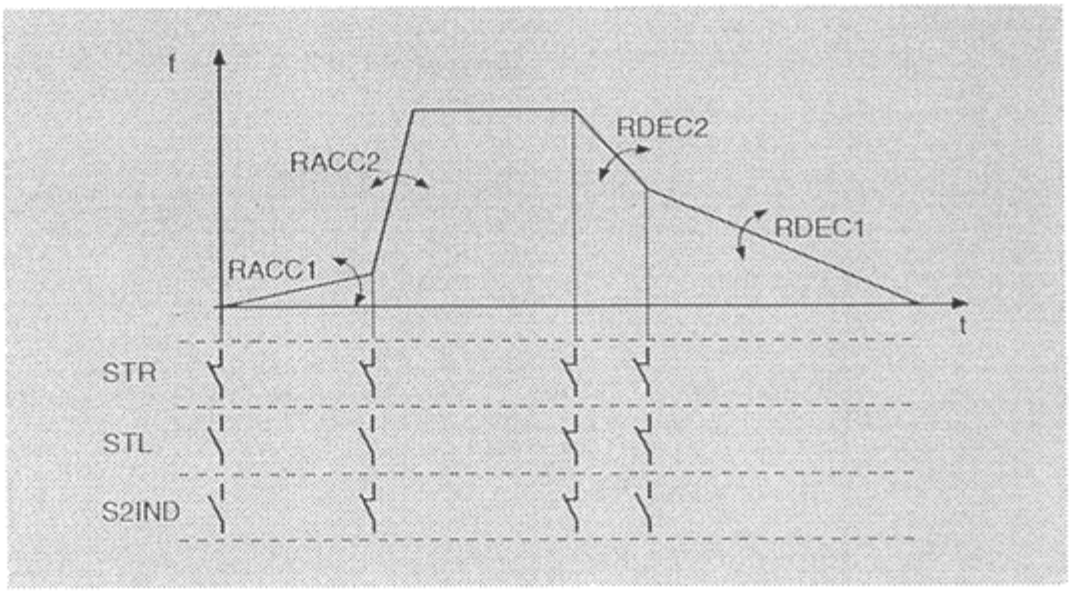
Example: Frequency Reversal (KSEL ≠ 2)

6.4.8 TABLE OF CONTROL FUNCTIONS 'U/F CURVE REVERSAL' AND 'RAMP REVERSAL'

PRECONDITION	ACTION / ACTUATION	REACTION / PROCESS
U/F Curve Reversal in 'Stop' Mode		
• Main Switch ON • No Malfunction • KSEL = 2 • STL and STR OFF (End Stages closed)	• Enter S2IND	• The Frequency Inverter reverses from U/F Curve set 1 to U/F Curve set 2.
Ramp Reversal in 'Stop' Mode or in 'Run' Mode		
• Main Switch ON • No Malfunction • KSEL = 2 • FN1 = FN2 • STR or STL ON	• Enter S2IND	• The Frequency Inverter reverses from the ramp pair selected in U/F Curve set 1 to the pamp pair selected in U/F Curve set 2 (ref. to example below).

ATTENTION:
U/F Curve reversal during operation is not permitted.
Direct reversal from Ramp pair 1 to ramp pair 2 during operation is permissible only if parameters FN1 and FN2 are set identically.

U/F Curve set 1	U/F Curve set 2
RACC1	RACC2
RDEC1	RDEC2
VB1	VB2
FN1	FN2



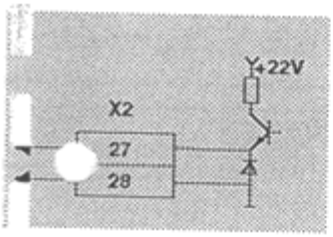
Example: Ramp Reversal (KSEL = 2)

6.5 PROGRAMMABLE DIGITAL CONTROL OUTPUTS (S1OUT-S3OUT)

6.5.1 CONTROL OUTPUT 1 S1OUT:

Specification:
- Short Circuit-Proof
- Max. Current Load: 80mA
- Output Voltage: 20V
- HIGH activated
- Internal recovery diode for relay control

- Basic Setting:
  S1OUT = 1
  Failure Summary Message



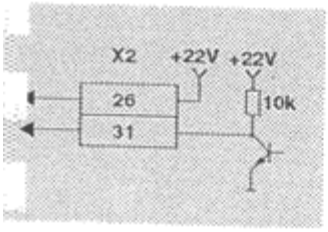
Explanation:
The cable- break-proof signal output is deactivated if the rotational field's frequency has surpassed the value programmed in 'Fixed Frequency' FF5 (F > FF5).

6.5.2 CONTROL OUTPUT 2 AND 3 S2OUT, S3OUT:

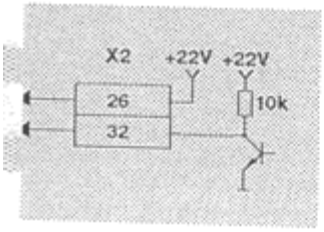
ATTENTION :
Signal outputs 2 and 3 (S2OUT/S3OUT) are NOT short circuit-proof; max. current load: 50mA

Specification:
- NOT Short Circuit-proof
- Max. Current Load: 50mA
- Output Voltage: 22V
- LOW activated (< 1,5V)

- Basic Setting:
  S2OUT = 7
  Operation Message
  S3OUT = 6
  Nominal Frequency Value reached



Explanation S2OUT:
Signal output 2 is activated,
- if main power supply is disconnected, or
- if the Inverter is switched OFF with Failure Display



Explanation S3OUT:
Signal output 3 is activated, if the rotational field's frequency has reached the preselected nominal value (FS).
(F = FS ± 0,5Hz)

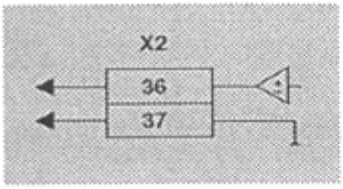
Programming Options:

S1OUT S2OUT S3OUT	MEANING	EXPLANATION
0	-	Output deactivated
1 (S1OUT)*	Failure Summary Message	Deactivated if Frequ. Inv. is de-energized due to a failure
2	Motor Output activated	Activated if motor is exited
3	Ct-Clockw. (LH) Direction	Activated if STL and nominal value or stop torque is entered
4	Clockw. (RH) Direction	Activated if STR and nominal value or stop torque is entered
5	Motor Stop	Activated if rotational field's frequency is 0Hz (Stop Torque)
6 (S3OUT)*	Nominal Frequency Value reached	Activated if nominal speed (RPM) is reached (F = FS ±0,5Hz)
7 (S2OUT)*	Frequency Boundary Value	Activated if rotational field's frequency has surpassed the fixed frequency programmed in FF5 (F > FF5)
8	Current Boundary reached	Activated if actual current boundary value is exceeded (IW > ILIM)
9	Brake chopper activated	Activated if brake chopper on
10	Failure Stop	Activated if Frequency Inverter is de-energized due to a failure

* Basic Setting

6.6 PROGRAMMABLE ANALOGOUS OUTPUT (SOUTA)

ATTENTION:
The programmable output SOUTA is NOT short circuit-proof; max. current load: 1mA



Specification:
- NOT Short Circuit-Proof
- Max. Current Load: 1mA
- Output Voltage: 10V + 50% Overvoltage (max.15V)
- Programmable via DBE
- Tolerance ± 5%
- Solution 7 BIT

- Basic Setting: SOUTA = 1 Display of rot.field's frequency (50Hz = 10V)

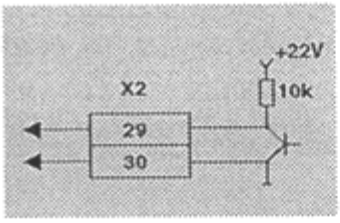
Explanation:
The 15V are output corresponding to the 7 BIT in 126 increments of 120mV per increment.

PROGRAMMING POSSIBILITIES

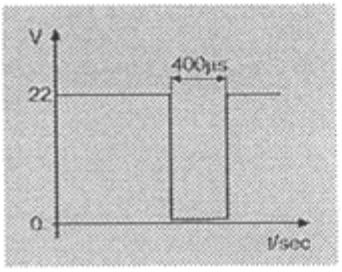
SOUTA	Function	Ratio	max. Value
0	Deactivated	–	–
1	Rot. Field Frequ.	50Hz ≙ 10V	75Hz
2	Rot. Field Frequ.	100Hz ≙ 10V	150Hz
3	Rot. Field Frequ.	500Hz ≙ 10V	400Hz
4	Motor Voltage	100% ≙ 10V	150%

6.7 FREQUENCY OUTPUT (FOUTF)

ATTENTION:
The Frequency Output FOUTF is NOT short circuit-proof; max. current load: 50mA



Specification:
- NOT Short-Circuit-Proof
- Max. Current Load 50mA
- Output Voltage (HIGH level) 22V
- 6-fold Rot.Field Frequency
- Open Collector (LOW activated)
- LOW pulse constant 400µs



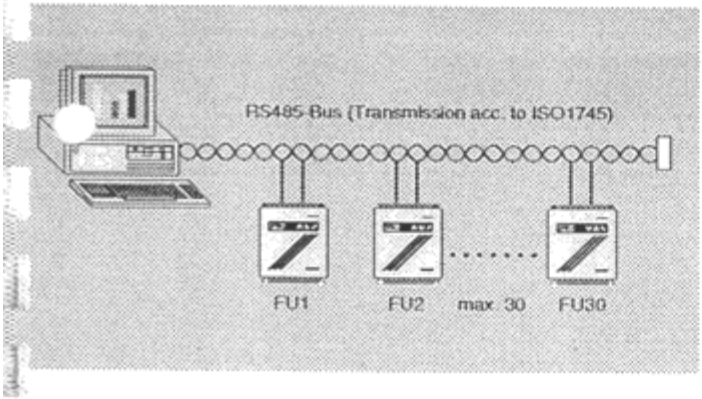
Explanation:
6 LOW pulses are output on the frequncy output for each 1Hz frequency of the rot. field.

Note:
The frequency output is prepared for connection of DF40/56.

6.8 SERIAL INTERFACE RS485

ATTENTION:
The serial interface RS485 is active only with the FU2000-RT!

Frequency Inverters are subjected to communication with primary control and monitoring systems at an ever increasing rate.
Serial interfaces transmit data, free of interference, without detouring via Digital/Analogous conversion (D/A Inverter). Up to 30 Frequency Inverters can be controlled, monitored and supplied with parameter entries by ONE Central Master Computer. Digital data transmission performs bi-directionally.
Data transmitted to the frequency inverter are confirmed, or automatically repeated if transmission errors take place. Operational mode, e.g. RH or LH drive, or data such as motor current, motor voltage, frequency etc., can be scanned continuously. The frequency inverter's parameters can be monitored and altered, and failure messages can be put on display.



6.8.1 ATTRIBUTES OF THE BUS SYSTEM

Transmission Medium	RS485: 2-wire cable twisted and shielded, with end resistance
Bus Access	Linear, centrally controlled by Master
Transmission Speed	9600 Bits/Second
Transmission Format	8 Bits asynchronous with Start/Stop Bits
Transmission Distance	max. 1000m
Participants	30 Frequency Inverters 1 Master
Failure Recognitionm	Length and Cross parity, Reasonability
Data Print-out	Based upon ISO Standard 1745
Broadcast Message	The Broadcast Message is directed to all frequency inverters and facilitates synchronized signal transmission.

NOTE:
Detailed information in regard to data print-out is available from

LUST electronic systeme

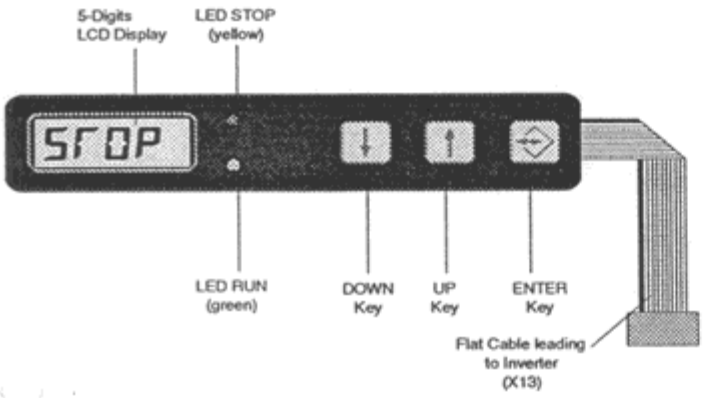
LUST Electronic-Systeme GmbH
Gewerbestraße 5-9
D-6335 Lahnau 1

Phone 0 64 41 / 6 02-0
Telefax 0 64 41 / 6 02-37

or from foreign sales agencies.

7 ENTRY OF PARAMETERS VIA DIGITAL CONTROL UNIT (DBE)

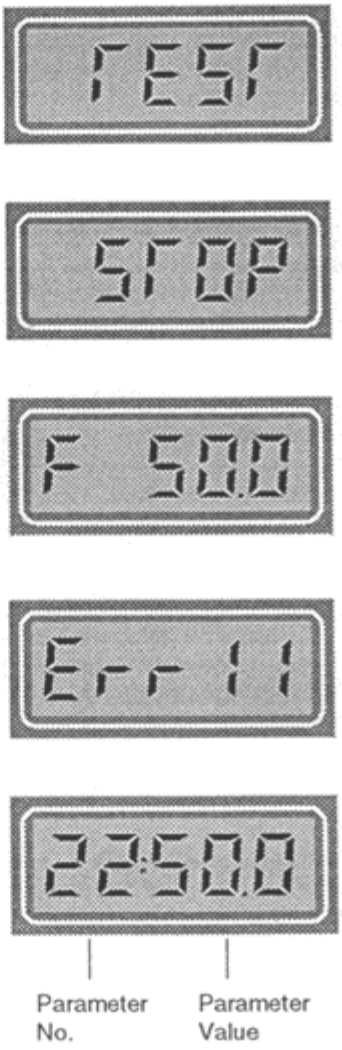
7.1 FUNCTIONAL DESCRIPTION



Entry of parameters takes place via the Digital Control (Bedien) Unit (abbr.'DBE'), which is integrated in the Inverter. Integration of 'DBE' resulted in the following advantages:

1. Continuous availabilty of the Inverter (use of potentiometers discontinued)
2. Ease of Operation
3. Simplified handling
4. High-degree reproducibility of parameter setting due to digital control structure.

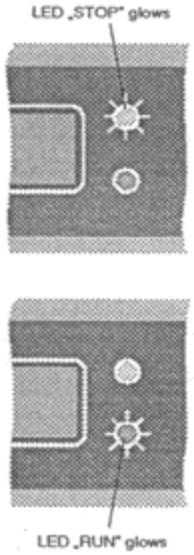
7.1.1 LCD DISPLAY



The 5-Digits LCD Display used can signal the following inverter modes:

1. **Self-Test**
   Upon connecting the inverter to the power supply source the display reads 'TEST' for the duration of appr. 2-3 seconds.
2. **Ready to Operate**
   Upon completed self-test the inverter assumes 'READY' mode.
3. **Inverter ON**
   Via RH or LH Start (STR/STL) the inverter accelerates to the selected nominal frequency value (e.g. 50 Hz).
4. **Failure Mode**
   Failure Messages are shown in coded fashion, e.g. 'ERR 11' = Switched OFF due to overload.
5. **Parameter Display**
   The inverter's parameters are displayed in coded fashion, showing first the parameter number, and following the colon(:) the parameter's value (ref.to listing of parameters in chapter 10.2).

7.1.2 FUNCTION OF LEDs



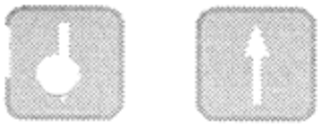
OPERATION

- LED 'STOP' glows: Power Supply is ON, inverter in Stop mode (Ready for operation).
- LED 'RUN' glows: Inverter in Operation (Output to motor activated).

MALFUNCTION (FAILURE)

- LED 'STOP', or LED 'RUN' flashing: Ref. to Evaluation of LED Display (Chapter 9.3).
- Display indicates Failure Code.
- Failure has been registered.

7.1.3 CONTROL COMPONENTS FOR PARAMETER ENTRY



'DOWN' KEY / 'UP' KEY

- The 'UP' and 'DOWN' keys are used to select menu points within one menu level, via up and down 'scrolling'.
- They also alter numeric values, again via up and down 'scrolling'.
- When actuated simultaneously, these keys are used to scan basic settings.

'TRANSFER'('ENTER') KEY

- Via first actuation of the 'Transfer' key the system is placed in 'Alteration' mode, i.e. the mode for alteration of parameters.
- Via second actuation of this key the altered parameter is 'Entered' into storage.

7.2 STRUCTURE OF MENU

Conception of Control Levels

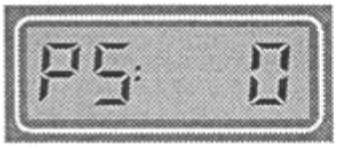
The menu provides 3 control levels.

Parameters essential for Start-up are noted in level 1. This level is of the single-stage type for 'direct' alteration of parameter values.

In addition to the possibility of parameter alteration in level 1, additional parameters and some 'special' functions are provided in level 2, such as 'slippage compensation'. This control level is of the multi-stage type. Selection of the desired parameter block is made on stage 1; the actual entry of the individual parameter alteration is made on stage 2 (ref.to diagram of menu structure of level 2 , shown at the end of this manual).
Level 3 is provided exclusively for interface operation, e.g. entry of the 'Slave' address, surveillance of bit combinations, etc.).

7.2.1 PASSWORD

In order to prevent manipulation and possible alteration of parameters by unauthorized personnel, a three-digit password must be entered after initial entry of the alteration mode.



Password prompting takes place prior to initial entry of parameters (Display Colon (:) flashes).

Depress and hold 'UP' key until the required password number is on display.

Actuate ENTER key to confirm password.

Upon correct entry of the password, parameter entry is permitted for the duration of 10 minutes. After expiration, or when depressing and holding the ENTER key for 3 seconds, the alteration mode is again interlocked.

Upon accepting the password the last previous parameter selected appears on display (e.g. 'Fmax' = maximum frequency).

If the password is not accepted (wrong password or wrongly entered), an ERRor message is displayed.

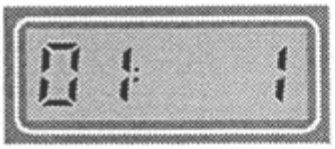
ATTENTION:
The Standard Password (Factory-set) is indicated at the end of this manual (ref. to chapter 10).

7.2.2 ENTRY OF PARAMETERS

Example of parameter entry for alteration of maximum frequency from 60Hz to 50Hz:

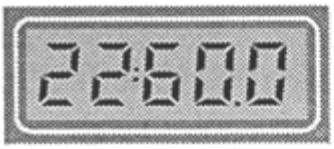
1 Power ON; LCD Display indicates STOP.

2 Briefly actuate UP key.



3 Parameter No.1 is displayed.

4 Briefly actuate UP key twice.



5 Actual value of parameter No.22 „Max.Frequency" is displayed.

6 Briefly actuate ENTER key; colon (:) following '22' flashes - prompting for password prior to attempting to alter this parameter.

7 Depress and hold DOWN key until

8 „50,0" Hz is displayed.

9 Briefly actuate ENTER key. Display disappears for an instant, to return after appr. 1 second with the colon (:) no longer flashing.

10 The Inverter can be switched ON when entry of the parameter is completed. Display changes automatically to the 'Actual' frequency of the Inverter's rotational field.

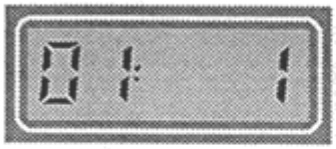
ATTENTION:
The display remains on minimum or maximum boundaries if these values are exceeded during parameter setting.

NOTE:
Alteration of parameter values should be performed while the Inverter is in STOP mode.

7.3 CONTROL LEVEL 1 / MENU FOR INITIAL START-UP

7.3.1 SELECTION OF OPERATIONAL MODE

OPERATIONAL MODE
01 - MODE



Possible Entries:

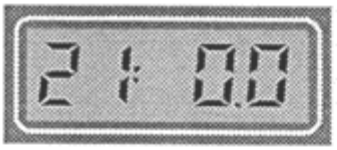
MODE	CONTROL	LEVEL
0	Terminal and SIO	3
1	Terminal	1
2	Terminal	2
3	Terminal	3

Basic Setting = 1

Explanation:
- Parameter MODE allows selection of Control type and access to other menu levels.

7.3.2 FREQUENCIES

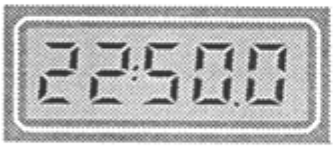
MINIMUM FREQUENCY
21 - FMIN



Setting Range:
- FMIN min = 0,0Hz
- FMIN max = 400,0Hz
- Resolution* = 0,1Hz
- Basic Setting = 0,0Hz

Explanation:
- Entry of nominal value 'Zero' corresponds to output frequency FMIN.
- With analogous entry of nominal value the range corresponds, e.g., to 0 ... 10V, FMIN ... FMAX.

MAXIMUM FREQUENCY
22 - FMAX

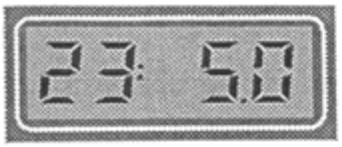


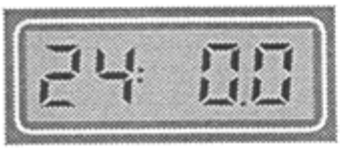
Setting Range:
- FMAX min = 4,0Hz
- FMAX max = 400,0Hz
- Resolution = 0,1Hz
- Basic Setting = 50,0Hz

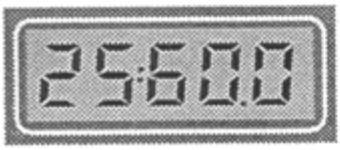
Explanation:
- Output frequency is limited to FMAX, i.e. maximum nominal value = FMAX.
- With analogous entry of nominal value the range corresponds, e.g., to 0 ... 10V, FMIN ... FMAX.

* Resolution of DBE (Digital Control Unit)

FIXED FREQUENCIES
23 - FF2
24 - FF3
25 - FF4





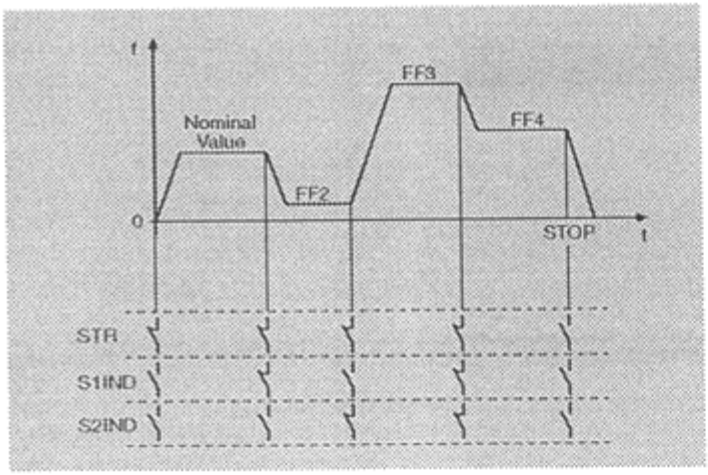


Setting Range:
- FFx min = 0,0Hz
- FFx max = 400,0Hz
- Resolution = 0,1Hz
- Basic Setting:
  FF2 = 5,0Hz
  FF3 = 0,0Hz
  FF4 = 60,0Hz

Explanation:

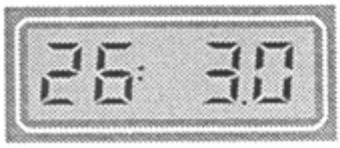
S2IND	S1IND	Frequencies
0	0	Entry of Nom. Val. activated
0	1	FF2
1	0	FF3
1	1	FF4

(ref.to chapter 6.4.6)



*** Fixed Frequencies

CONTROL FREQUENCY
26 - FF5

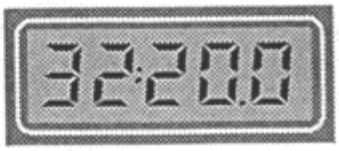


Setting Range:
- FF5 min = 0,0Hz
- FF5 max = 400,0Hz
- Resolution = 0,1Hz
- Basic Setting = 3,0Hz

Explanation:
- Programmable digital signal output is activated if the rotational field's frequency surpasses the fixed frequency programmed in FF5 (F > FF5).

7.3.3 RAMPS

ACCELERATION RAMP
32 - RACC1



Setting Range:
- RACC1 min = 0,1Hz/sec
- RACC1 max = 999,0Hz/sec
- Resolution = 0,1Hz/sec
- Basic Setting = 20,0Hz/sec

Explanation:
- Ref. to Diagram: Frequency/Ramp
- Acceleration Time from 0Hz to FMAX

Acceleration Time:

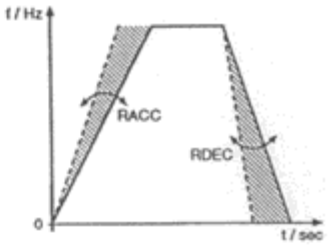
$$\frac{FMAX}{RACC} = \frac{50Hz}{999Hz/sec} = 0,05sec$$

Minimum acceleration time:

$$\frac{FMAX}{RACC} = \frac{50Hz}{0,1Hz/sec} = 500sec$$

Maximum acceleration time:

$$\frac{FMAX}{RACC} = \frac{50Hz}{20Hz/sec} = 2,5sec$$



DECELERATION RAMP
33 - RDEC1

Setting Range:
- RDEC1 min = 0,1Hz/sec
- RDEC1 max = 999,0Hz/sec
- Resolution = 0,1Hz/sec
- Basic Setting = 20,0Hz/sec

Explanation:
- Ref. to Diagram: Frequency/Ramp

Deceleration time:

$$\frac{FMAX}{RDEC} = \frac{50Hz}{20Hz/sec} = 2,5sec$$

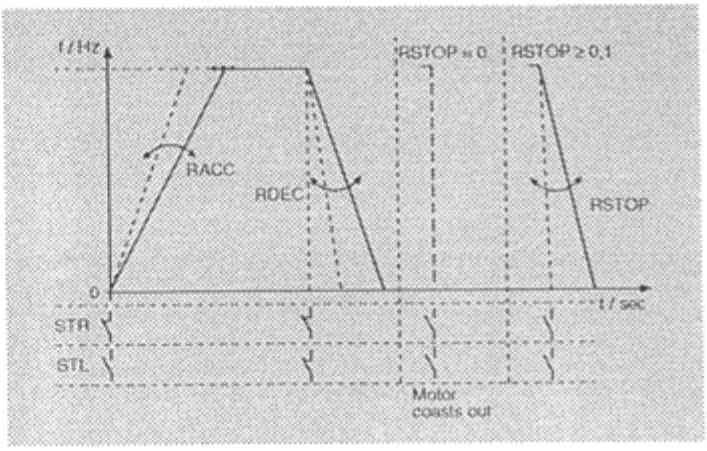
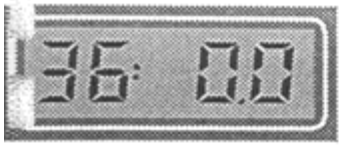


Diagram: Frequency/Ramp

ATTENTION:
The display remains on minimum or maximum boundaries if these values are exceeded during parameter setting.

STOP RAMP
36 - RSTOP



Setting Range:
- RSTOP min = 0,0Hz/sec
- RSTOP max = 999,0Hz/sec
- RSTOP ON = ≥ 0,1Hz/sec
- RSTOP OFF = 0,0Hz/sec
- Basic Setting = 0,0Hz/sec

Precondition	Action / Actuation	Reaction / Process
Stop via RSTOP = 0,0Hz/sec		
• "STR" or "STL" - ON • RSTOP = 0	• Cancellation of Entry "STR" and "STL"	1 Output stages locked. 2 Motor 'coasts' out uncontrolled.
Stop via RSTOP ≥ 0,1Hz/sec		
"STR" or "STL" - ON RSTOP ≥ 0,1Hz/sec	• Cancellation of Entry "STR" and "STL"	1 Inverter decelerates its output frequency along selected stop ramp to 0Hz. 2 Output stages locked.

Minimum theoretical Stop Time at 50Hz:

$$\frac{MAX}{RSTOP} = \frac{50Hz}{999Hz/sec} = 0,05sec$$

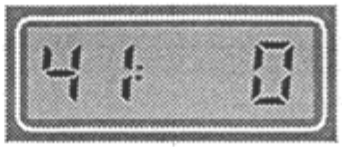
Explanation:
- Ref. to Diagram: Frequency/Ramp

ATTENTION:
Observe possible generator phenomena of motor: If required, provide brake chopper of adequate dimensioning (ref. to chapter 6.1.5).
Switch-OFF delay THTDC is disabled.

7.3.4

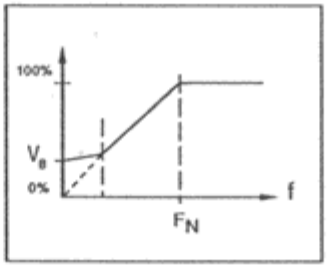
DIAGRAMS

CURVE CHARACTERISTICS
41 - V/F C

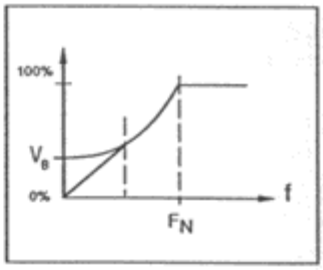


Setting Range:
- V/F C min = 0
- V/F C max = 5
- Basic Setting = 0

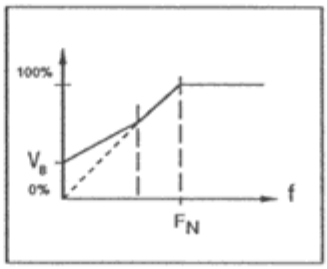
Explanation:
- ref. to illustrated diagrams



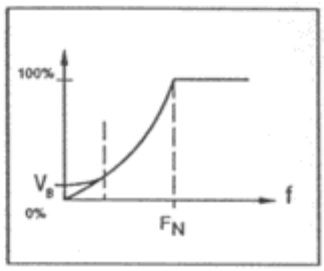
V/F C = 0 linear



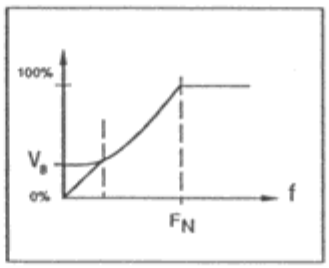
V/F C = 3 mixed raised



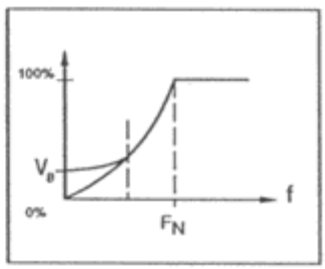
V /F C = 1 linear raised



V/F C = 4 square



V/F C = 2 mixed



V/F C = 5 square raised

Ill.: Diagram Characteristics

BOOST (START TORQUE)
42 - VB1

Setting Range:
- VB1 min = 0%
- VB1 max = 25%
- Resolution = 0%
- Basic Setting = 8%

Explanation:
- Selected %-value is always related to line power voltage.
- ref.to Ill. U/f Curve.

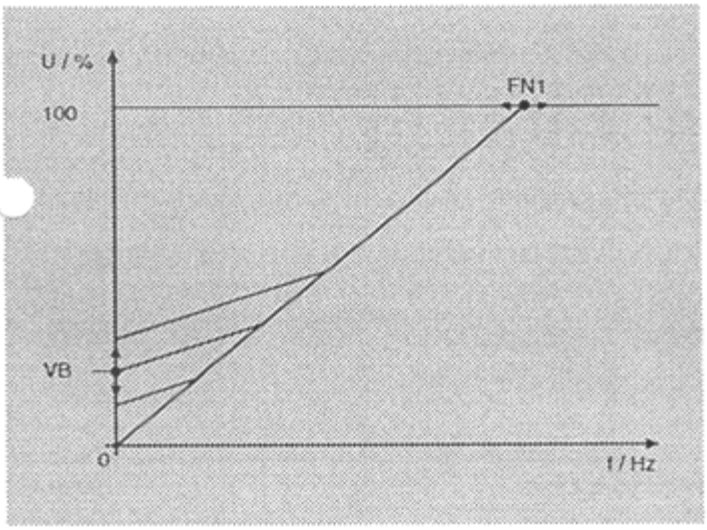
RATED FREQUENCY
43 - FN1

Setting Range:

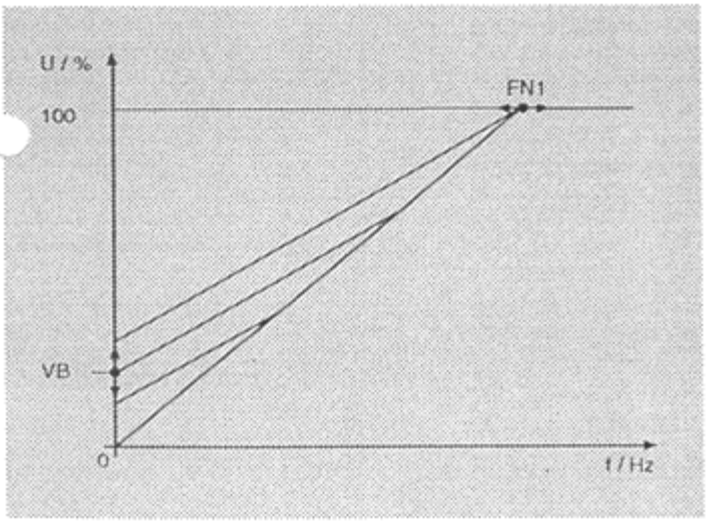
- FN1 min = 26,0Hz
- FN1 max = 960,0Hz
- Resolution = 0,1Hz
- Basic Setting = 50,0Hz

Explanation:

- 'Rated Frequency' indicates at which frequency the motor reaches 100% of the power supply's voltage.
- Ref. to ill. 'U/f Curve'.



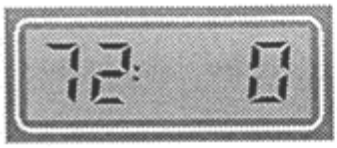
Ill.: U/f Curve (linear) V/F C = 0



Ill.: U/f Curve (linear raised) V/F C = 1

7.3.5

START OPTIONS
72 - START



Setting Possibilities:

START	OPTION
0	Standard
1	Autostart
4 ≙ 0	Standard with LH direction locked-out
5 ≙ 1	Autostart with LH direction locked-out

Basic Setting = 0

Explanation:

Autostart
For safety reason the inverter does not re-start automatically upon power restoration after a power failure. This safety feature, however, can be disabled when activating AUTOSTART (ref. to 6.4). causing automatic re-start upon power restoration.

ATTENTION:
Your attention is drawn to VDE rules 0100, part 227 and rule 0113, especially paragraph 5.4, concerning protection against undesired automatic re-start after power failure and restoration of voltage, as well as paragraph 5.5, concerning protection against sub-voltage. Jeopardizing personnel, machines and/or production goods must be avoided.
Other rules and regulations pertaining to the specific operation must also be followed.

Lock-out of LH Rot.Direction
For certain drives (e.g.knitting machines) it is of utmost importance that no directional reversal can occur, even in case of faulty manipulation. This can be ascertained through ulilization of parameters 4, 5, 6, and 7. The description of control functions STL and STR remains valid except for function START LH (ANTI-CLOCKWISE).

7.4 CONTROL LEVEL 2/ ENTRY OF PARAMETERS FOR OTHER FUNCTIONS

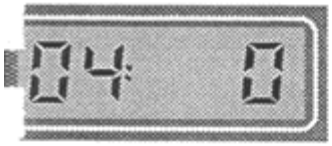
In addition to the parameters for initial start-up in control level 1 more functions can be called up in control level 2 and their parameters can be entered.

Initially a Primary term (Parameter Block) is selected, followed by alterations of parameters in the lower menu level.

As most of the following parameters serve to make settings of complex functions, they are not described individually, they are explained in conjunction with their respective functions.

7.4.1 ENTRY OF NOMINAL VALUE INPUT FSINA(F)

SELECTOR FOR NOMINAL FREQUENCY VALUE 04 - FSSEL



Setting Range:

- FSSEL min = 0
- FSSEL max = 5
- Basic Setting = 0

FSSEL	Nominal Value	Scaling
0	FSINA	0(2)V, 0(4)mA = FMIN (2)10V, 20mA = FMAX
1	FSINA	(2)10V, 20mA = FMIN 0(2)V, 0(4)mA = FMAX
4	FSINF	0kHz = FMIN 1kHz = FMAX
5	FSINF	0kHz = FMIN 10kHz = FMAX

* Depending on Jumper position X11 (ref.to chapter 6.4.2).

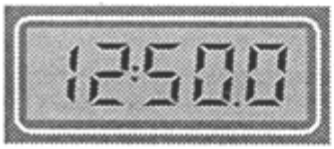
Other settings are not permitted.

7.4.2 ENTRY OF ACTUAL VALUE DISPLAY

NOTE:

- The following parameters are for 'READ' only; they facilitate monitoring of the operation via serial interface.

OUTPUT FREQUENCY 12 - F



Explanation:

- Displays actual output frequency.

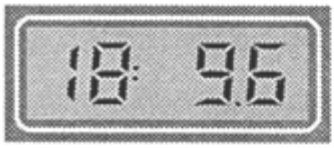
OUTPUT VOLTAGE 13 - U

Explanation:

- Displays actual output voltage in % of the power supply voltage.

7.4.3 OPERATING TIME

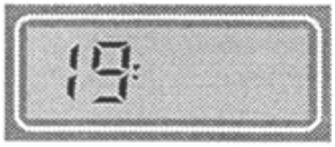
OPERATING HOURS 18 - TIME



Explanation:

- Displays number of operating hours since last switch-ON of system.

TOTAL OPERATION TIME 19 - TOP



Explanation:

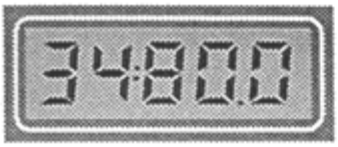
- Displays total hours of operation since initial start-up of the equipment (Time clock reading).
- Indicated value remains in memory (EEPROM) after switch-OFF.
- Overflow after 65000 hours.

NOTE:

- Upon selection of parameter No.19 the display changes to operation hours.

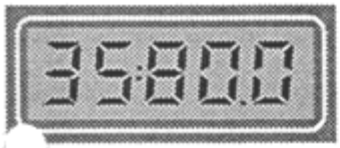
7.4.4 ENTRY OF U/f CURVE SETS AND RAMP REVERSAL

ACCELERATION RAMP 2
34 - RACC2



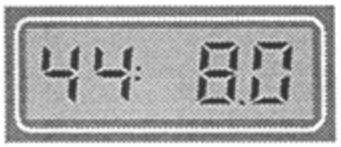
Setting Range:
- RACC2 min = 0,1Hz/sec
- RACC2 max = 999,0Hz/sec
- Resolution = 0,1Hz/sec
- Basic Setting = 80,0Hz/sec

DECELERATION RAMP 2
35 - RDEC2



Setting Range:
- RDEC2 min = 0,1Hz/sec
- RDEC2 max = 999,0Hz/sec
- Resolution = 0,1Hz/sec
- Basic Setting = 80,0Hz/sec

START VOLTAGE 2
44 - VB2



Setting Range:
- VB2 min = 0,0%
- VB2 max = 25,0%
- Resolution = 0,1%
- Basic Setting = 8,0%

NOMINAL FREQUENCY POINT 2
45 - FN2

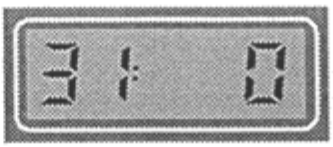
Setting Range:
- FN2 min = 26,0Hz
- FN2 max = 960,0Hz
- Resolution = 0,1Hz
- Basic Setting = 50,0Hz

CONTROL FREQUENCY
27 - FF6

Setting Range:
- FF6 min = 0,0Hz
- FF6 max = 400,0Hz
- Resolution = 0,1Hz
- Basic Setting = 0,0Hz

Explanation:
- If parameter KSEL is set on 1, and the output frequency (control frequency selected via FF6) is surpassed, automatic reversal to U/f curve set 2 takes place (ref.to table and chapter 6.4.8).

SELECTION OF U/F CURVE SET
31 - KSEL



Setting Range:
- KSEL min = 0
- KSEL max = 3
- Basic Setting = 0

Explanation:
- Ref. to table below

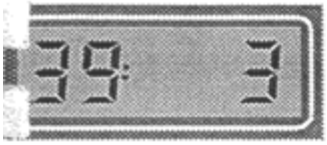
KSEL	U/F Curve Set 1 activated if	U/F Curve Set 2 activated if
0	No Reversal (U/F Curve Set 1 activated)	No Reversal (U/F Curve Set 2 activated)
1	F ≤ FF6	F > FF6
2	S2IND = LOW	S2IND = HIGH
3	RH Rotat. Field	LH Rotat. Field

NOTE:
The following table shows which parameters are allocated to U/F Curve Set 1 or 2.

U/F Curve Set1	U/F Curve Set 2
RACC1	RACC2
RDEC1	RDEC2
VB1	VB2
FN1	FN2

7.4.5 ENTRY OF DC STOP TORQUE

DC VOLTAGE
39 - VHTDC



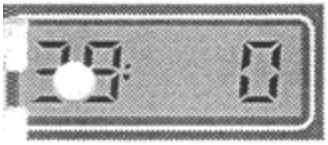
Setting Range:

- VHTDC min = 1,0%
- VHTDC max = 15,0%
- Resolution = 0,1%
- Basic Setting = 3,0%

Explanation:

- This percentage value is based on power supply voltage.

DC STOP DELAY TIME
38 - THTDC



Setting Range:

- THTDC min = 0,0sec
- THTDC max = 5,0sec
- THTDC ON = ≥ 0,1sec
- THTDC cont'ly. ON = 5sec
- THTDC OFF = 0,0sec
- Resolution = 0,1sec
- Basic Setting = 0,0sec

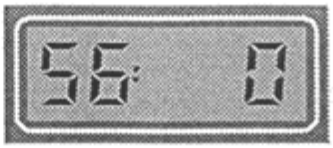
Explanation:

- Ref. to table below

Precondition	Action / Actuation	Reaction / Process
DC STOP TORQUE with Stop Delay		
0 < THTDC < 5sec "STL" and/or "STR" ON	• Frequency Reference "Zero" or • Braking: "STR" and "STL" ON	1 After falling short of output frequency FS < FMAX / 128 the motor is subjected to a DC current corresponding to parameter entry VHTDC. 2 The output stage is deactivated upon expiration of the delay time selected with parameter THTDC.
DC STOP TORQUE without Stop Delay		
THTDC = 5sec "STL" and/or "STR" ON	• Frequency Reference "Zero" or • Braking: "STR" and "STL" ON	1 After falling short of output frequency FS < FMAX / 128 the motor is subjected to a DC current corresponding to parameter entry VHTDC. 2 The Stop torque remains in effect until the output frequency returns to FS < FMAX / 128, or until the Inverter is set on STOP (STR and STL OFF).

7.4.6 ENTRY OF OVERLOAD PROTECTION

56 - TRIP

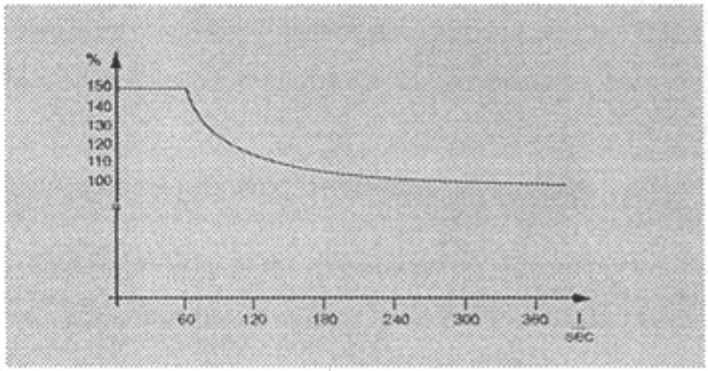


Setting Range:

- TRIP min = 0
- TRIP max = 3
- TRIP ON > 0
- TRIP OFF = 0
- Basic Setting = 0

Explanation:

- At TRIP = 0
  no switch-OFF takes place when overload occurs; instead, the output frequency is altered in correspondence to the load.
- At TRIP = 1
  quick switch-OFF takes place within appr. 10sec.
- At TRIP = 2
  medium switch-OFF takes place within appr. 30sec.
- At TRIP = 3
  delayed switch-OFF takes place within appr. 100sec.

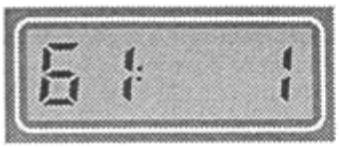


Ill.: Max. permissible Overload Surface for 1,5-fold Overload

7.4.7

SPECIFICATION OF SPECIAL OUTPUTS

ANALOGOUS OUTPUT 61 - SOUTA

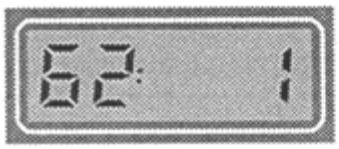


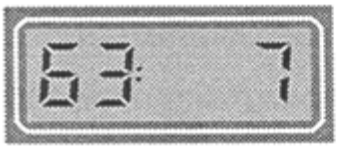
Setting Range:
- Basic Setting = 1

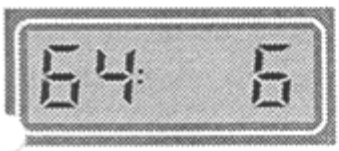
Possible Settings:

SOUTA	SPECIFICATION
0	non-active
1	F 50Hz ≙ 10V
2	F 100Hz ≙ 10V
3	F 500Hz ≙ 10V

CONTROL OUTPUTS 62 - S1OUT 63 - S2OUT 64 - S3OUT







Setting Range: 0 ... 10
- Basic Setting
  - S1OUT = 1
  - S2OUT = 7
  - S3OUT = 6

Programming Possibilities:

S1OUT S2OUT S3OUT	MEANING	EXPLANATION
0	—	Output deactivated
1 (S1OUT)*	Failure Summary	Deactivated if Inverter is in 'Failure Stop'
2	Motor output activated	Activated if Motor is exited
3	LH Rotat. Direction	Activated if STL and Nom. Value or Stop Value are entered
4	RH Rotat. Direction	Activated if STR and Nom. Value or Stop Value are entered
5	Motor Stop	Activated if Rotational Field's frequ. is 0Hz (Stop Torque)
6 (S3OUT)*	Nominal Frequency Value reached	Activated if Operational RPM is reached (F = FS ±0,5Hz)
7 (S2OUT)*	Frequency Boundary Value	Activated if the Rotational Field's Frequ. has exceeded the Fixed Frequ. programmed in (F > FF5)
8	Current Boundary reached	Activated if actual current boundary value is exceeded IW > ILIM
9	Brake Chopper activated	Activated if brake chopper on
10	Failure Stop	Activated if Frequ. Conv. is OFF due to Failure

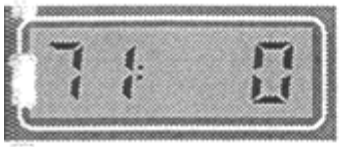
* Basic Setting

Explanation:

- **S1OUT**
  Special output S1OUT is a HIGH-activated output (20V DC). It furnishes a current of 80mA if activated (short circuit-proof).

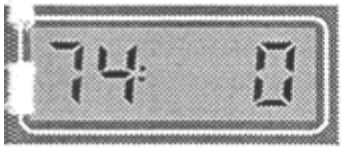
- **S2/3OUT**
  Special outputs S2/3OUT are LOW-activated outputs (< 1,5 V DC) with 'Open-Collector' Circuit and 'Pull-Up' resistor 10kΩ to +22V.

7.4.8 PROGRAM NUMBER 71 - PROG



PROG	PROGRAM
0	Standard
1	Reset of Parameter Block to Basic Settings
2, 3	Internal Utilization
4 ... 9999	Programs for Special Applications

7.4.9 MODULATION FREQUENCY 74 - PWM

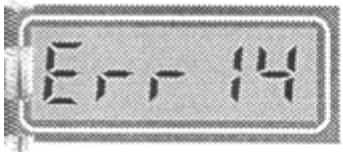


Programming Possibilities:

PWM	MEANING
0	7,2kHz Mod. Frequency to FMAX 270Hz
1	14,4kHz Mod. Frequency to FMAX 400Hz

7.4.10 CONVERTER DATA

95 - ERR1 (last failure)
96 - ERR2 (next to last failure)
97 - ERR3 (second to last fail.)
98 - ERR4 (third to last failure)



This data contains Inverter information possibly useful for remote monitoring or for repairs. It includes a failure memory capable of storing up to 4 failure occurences. Each entry contains the failure code (Octal code) and duration to register the failure in 1/10 of an hour.

7.5 FU2000-RT FREQUENCY INVERTER

The development of frequency inverters is now at the stage of fine tuning to suit the specific motor and its application.

Further development on the microprocessor card for the FU2000 LUMIDRIVE Frequency Inverter has fine tuned it for pulse and positioning applications. To operate pulse and positioning drives dynamically and precisely positioned with real time response and defined reaction times, a frequency inverter must have the following characteristics:

7.5.1 REAL TIME SIGNAL PROCESSING

Real time signal processing makes possible a constant reaction time to the external control commands: start clockwise, start anti-clockwise, brake, reverse and fixed frequency default (FF2).

Constant reaction time is equivalent to a maximum positive time error of 100 µs. The real time software structure implemented in the FU2000-RT increases positional accuracy compared with standard frequency inverters by a factor of between 10 and 100.

7.5.2 PARAMETRIC FILTER TIME CONSTANTS 67 - FST

Range:

- FST min = 0
- FST max = 4
- Basic setting = 4

FST	FILTER
0	off
1	2,9ms
2	8,7ms
3	20,3ms
4	43,5ms

Explanation:

Using this function the filter time constant can be pre-selected for the analogue frequency setpoint default in five stages. When using position regulators or positioning modules it is possible to optimise the reaction time of the inverter and therefore the control dynamics of the complete drive design.

7.5.3 SELF-OPTIMISING DYNAMIC CHOPPING PROTECTION

The TRIP parameter (overload protection - see Section 7.4.6.) has been extended as follows:

TRIP	MEANING
0	No cutout
1	Cutout at overload current after approx 10 seconds
2	Cutout at overload current after approx 30 seconds
3	Cutout at overload current after approx 100 seconds
4	No cutout and acceleration stop
5	Cutout on overload after approx 10 seconds and acceleration stop
6	Cutout on overload after approx 30 seconds and acceleration stop
7	Cutout on overload after approx 100 seconds and acceleration stop

Explanation:
Dynamic trip protection is active during the acceleration phase. It is designed for extremely dynamic reaction and works effectively even with acceleration times of 50 - 100ms.
This function is especially suitable for pulse and positioning drives. It carries out an automatic self-optimisation of the acceleration ramp according to the load and the sluggishness of the drive system.

7.5.4 AUTOMATIC MOMENT INCREASE DURING ACCELERATION

47 - KFN1
51 - KNF2
48 - MKFN1
53 - MKFN2

Range:

- KFN1(2) min = 0%
- KFN1(2) max = 25%
- Basic Setting = 0%

- MKFN1(2) = 0%
- MKFN1(2) = 6%
- Basic Setting = 0%

MKFN1(2)	MEANING
0	off
1	add on acceleration
2	subtract on hesitation
3	1 + 2
4	add on clock-wise operation
5	subtract on anti-clockwise operation
6	4 + 5

Explanation:

- The value programmed in KFN1(2) is added to or subtracted from the complete U/f characteristic depending on parameter MKFN1(2).
- The set value as a percentage always relates to the supply input voltage.
- When these parameters are activated there is an automatic torque increase (voltage increase). After completion of acceleration or hesitation the increase is reduced again.

7.5.5 AUTOMATIC VOLTAGE INCREASE FOR SLIDING RING MOTORS

46 - KVB1
49 - KVB2

Range:

- KVB1(2) min = 0%
- KVB1(2) max = 25%
- Basic setting = 0%

Explanation:

- This function activates a short duration voltage increase. The increase is cancelled out after 1 second or at 3 phase frequency >5Hz.
- The set percentage always relates to the power supply input voltage.

7.5.6 MODULATION FREQUENCY

74 - PWM

PWM	MEANING
0	3,9kHz
1	5,2kHz
2	7,8kHz
3	15,6kHz

Caution:

- **PWM3 must not be operated without the LA2000 fan running.**
- **Exception:**
  In the FU2233-RT inverter the modulatioin frequency of 15,6kHz is permissible even without the LA2000 running.

7.5.7 CHARACTERISTICS CHANGEOVER

The set of characteristics has been extended and it is now possible to switch between travel and lifting mode easily.

KSEL	Characteristics set 1 active when	Characteristics set 2 active when
0	no switchover (characteris. set 1 active)	no switchover (characteris. set 2 active)
1	F ≤ FF6	F > FF6
2	S2IND = LOW	S2IND = HIGH
3	rotating field clockwise	rotating field anti-clockwise

FU2000:

Characteristics 1	Characteristics 2
RACC1	RACC2
RDEC1	RDEC2
VB1	VB2
FN1	FN2

FU2000-RT:

Characteristics 1	Characteristics 2
RACC1	RACC2
RDEC1	RDEC2
VB1	VB2
FN1	FN2
FMIN1	**FMIN2**
FMAX1	**FMAX2**
1FF2	**2FF2**
KVB1	**KVB2**
KFN1	**KFN2**
MKFN1	**MKFN2**

7.5.8 FU2000-RT PARAMETER LIST

Level No.1	Level No.2	Abbr.	Dim.	Parameter Name	Page	Setting Range	Factory Setting	Customer Setting
01	01	MODE	–	Operation Mode	28	1 ... 6	1	
	04	FSSEL	–	Selector for Nominal Frequency Value	32	0 ...23	0	
				Modes (Display only)				
	12	F	Hz	Output Frequency	32	0 ...400		
	13	V	%	Output Voltage	32	0 ...100, from U_{line}		
	18	TIME	h	Switch-ON after Reset	32	0 ...960	4	
	19	TOP	h	Operation Hours	32	0 ...65000	4	
				Frequencies				
21	**21**	**FMIN1**	**Hz**	**Minimum Frequency**	**28**	**0 ...400**	**0**	
22	**22**	**FMAX1**	**Hz**	**Maximum Frequency**	**28**	**4 ...400**	**50**	
23	**23**	**1FF2**	**Hz**	**Fixed Frequency**	**29**	**0 ...400**	**5**	
24	24	FF3	Hz	Fixed Frequency	29	0 ...400	0	
25	25	FF4	Hz	Fixed Frequency	29	0 ...400	60	
26	26	FF5	Hz	Reference Frequency for S2OUT	29	0 ...400	3	
	27	FF6	Hz	Control Frequency Selector for U/f Curve Set	33	0 ...400	0	
	28	FF7	Hz	Fixed Frequency (Program. via Option. Function)		0 ...400		
				Ramps				
	31	KSEL	–	U/f Curve Set Selector	33	0 ...3	0	
32	32	RACC1	Hz/sec	Acceleration Ramp 1*	29	0,1 ...999	20	
33	33	RDEC1	Hz/sec	Deceleration Ramp 1*	29	0,1 ...999	20	
	34	RACC2	Hz/sec	Acceleration Ramp 2*	33	0,1 ...999	80	
	35	RDEC2	Hz/sec	Deceleration Ramp 2*	33	0,1 ...999	80	
36	36	RSTOP	Hz/sec	STOP Deceleration Ramp	30	0 ...999	0 = OFF	
	38	THTDC	sec	OFF Delay of DC Stop Torque	34	0 ...5	0 = OFF	
	39	VHTDC	%	DC Stop Voltage	34	1,0 ...15	3	
				U/f Curve				
41	41	V/F C	–	U/f Curve Selector	30	0 ...5	0	
42	42	VB1	%	Start Torque 1 (Boost 1)*	30	0 ...25, from U_{line}	5	
43	43	FN1	Hz	Nominal Frequency Point 1*	31	26 ...960	50	
	44	VB2	%	Start Torque 2 (Boost 2)*	33	0 ...25, from U_{line}	5	
	45	FN2	Hz	Nominal Frequency Point 2*	33	26 ...960	50	
	46	**KVB1**	**%**	**Δ Boost to 5Hz**	**38**	**0 ...25**	**0**	
	47	**KFN1**	**%**	**Δ Boost U/f characteristics**	**37**	**0 ...25**	**0**	
	48	**MKFN1**		**Mode for KFN1**	**37**	**0 ...6**	**0**	
	49	**KVB2**	**%**	**Δ Boost to 5Hz**	**38**	**0 ...25**	**0**	
	51	**KFN2**	**%**	**Δ Boost U/f characteristics**	**37**	**0 ...25**	**0**	
	53	**MKFN2**		**Mode for KFN2**	**37**	**0 ...6**	**0**	
				Current Boundary Value				
	56	TRIP	%	Overload Protection	34	0 ...7	0	
	57	**2FF2**	**Hz**	**Fixed Frequency 2***		**0 ...400**	**0**	
				Control Circuit				
	61	SOUTA	–	Programming of Analogous Output	35	0 ...3	1	
	62	S1OUT	–	Programming of Control Output 1	35	0 ...10	1	
	63	S2OUT	–	Programming of Control Output 2	35	0 ...10	7	
	64	S3OUT	–	Programming of Control Output 3	35	0 ...10	6	
	67	**FST**	–	**Filter time constants**	**36**	**0 ...4**	**0**	
				Program				
	71	PROG	–	Program No.	36	0 ...9999	0	
72	72	START	–	Start Option	31	0 ...7	0	
	74	PWM	–	Modulation Frequency	36	0 ...3	2	
				Inverter Data				
	95	ERR 1	–	Last Failure	36	F00 ...99		
	96	ERR 2	–	Next to last Failure	36	F00 ...99		
	97	ERR 3	–	Second to last Failure	36	F00 ...99		
	98	ERR 4	–	Third to last Failure	36	F00 ...99		

* These parameters can be reserved in correlation to the U/f Curve Set Selector (Parameter No. 31).

7.5.9

CIRCUIT EXAMPLE FOR OPTIMUM TIME POSITIONING USING FU2000-RT

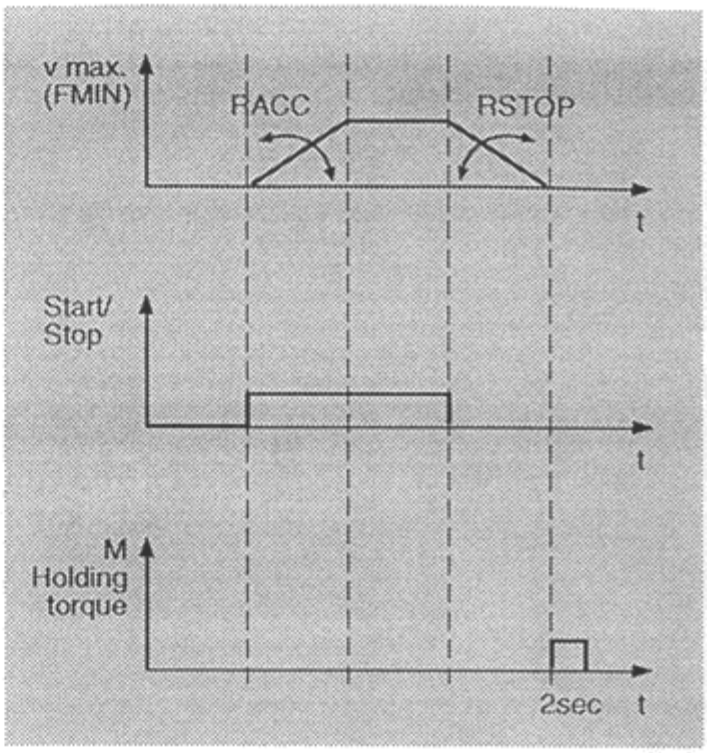
The following change from the factory setting can be made for pulse and positioning drives with acceleration times shorter than 0,5 seconds.

VB1 = 14% , FSSEL = 1
THTDC = 2sec
VHTDC = 15%
V/F C = 1

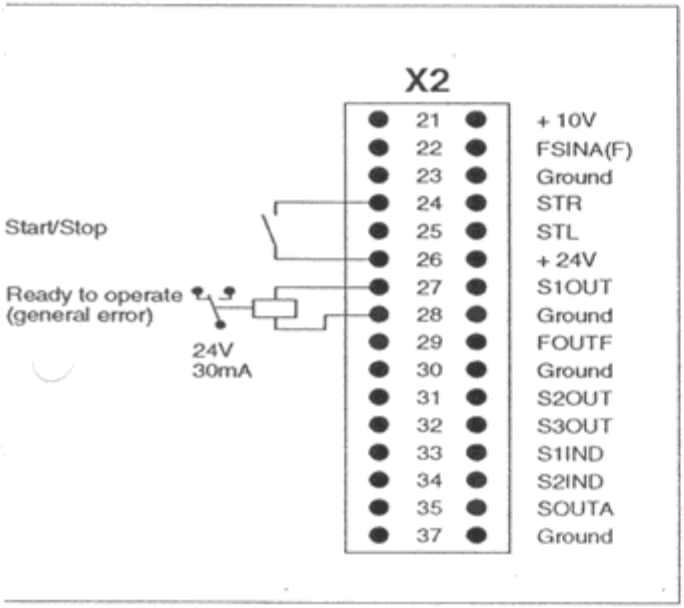
The maximum rotating field frequency and maximum speed is entered using parameter FMAX.

The acceleration ramp is entered using parameter RACC = ...Hz/sec.
The delay ramp (braking) is entered using parameter RSTOP = ...Hz/sec.

Signal diagram for connection example:



nnection example:



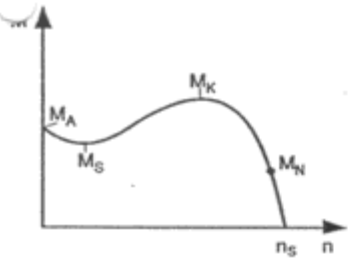
8 GENERAL INFO FOR THE OPERATION OF FREQUENCY INVERTERS

8.1 REMARKS CONCERNING RPM CONTROL OF AC MOTORS VIA FREQUENCY INVERTERS

AC machines are available as synchronous or as asynchronous motors. The stator coils are dimensioned in such fashion that when operated with power supply from an AC network a rotational field is generated in the motor, which pulls the rotor along. Rotational speed (RPM) is determined by the following formula:

$$n_s = \frac{f_1 \cdot 60}{p}$$

n_s = Synchronous RPM
p = Number of pole pairs
f_1 = Stator Frequency

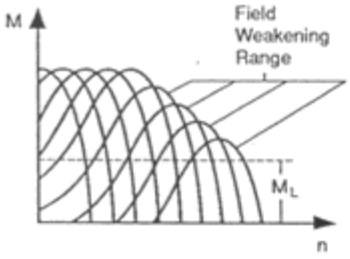


With known number of pole pairs and constant network frequency the motor's RPM are thus established. A stepless control carrying little loss is possible through frequency alteration with simultaneous alteration of voltage. Asynchronous motors, operated at constant network voltage and network frequency show the following ratio Torque/RPM behavoir (ref.to graph on the left). The following formula applies for Torque calculation:

$$M \sim \Phi_1 \cdot I_2 \qquad \Phi_1 \sim \frac{U_1}{f_1}$$

Φ_1 = Flow in Stator
I_2 = Rotor Current
U_1 = Stator Voltage
f_1 = Stator Frequency
M_A = Starting Torque
M_S = Pull-Up Torque
M_K = Breakdown Torque
M_N = Nominal Torque
n_N = Nominal RPM

In order to maintain constant motor torque M when altering RPM it is necessary that the magnetic flow Φ_1 remains constant. Voltage U_1 must thus be altered proportionally to to frequency f_1. Under these conditions, a frequency-controlled alteration of RPM via Frequency Inverter causes a parallel shifting of the M/n curve on the RPM axis (ref. to graph on the left).



If the stator frequency is boosted further after reaching nominal frequency and nominal voltage (with constant voltage), a field weakening occurs and thus a decrease of torque with increasing RPM.

Asynchronous motors show slight losses of RPM depending upon load, due to slippage.

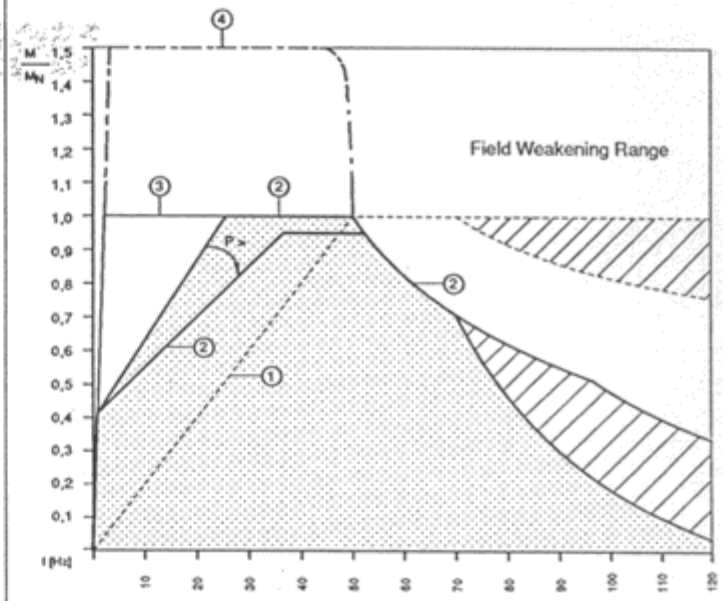
Operational RPM n_b is:

$$n_b = \frac{f_1 \cdot 60}{p} \cdot (1 - s)$$

n_b = Operational RPM
p = Number of pole pairs
f_1 = Stator Frequency
s = Slippage

NOTE:
This loss of RPM can be compensated through utilization of tacho-control or slippage compensation.

8.2 STANDARD GRAPHS FOR MOTOR LOADS



Graph 1
Output performance of a DS motor with FU2000 Frequency Inverter.

Graph 2
Permissible Torque curve of a self-venting DS motor.

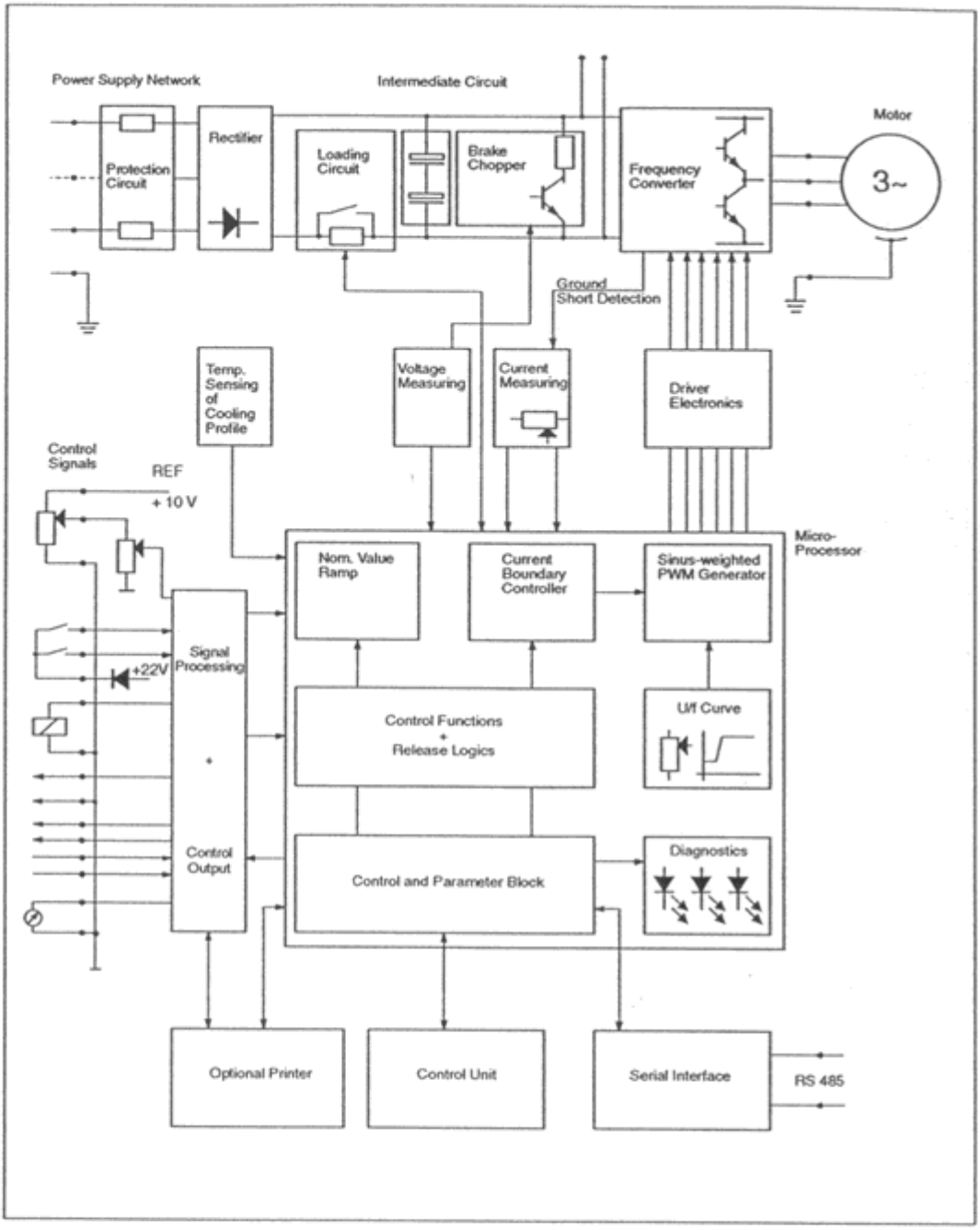
Graph 3
Permissible Torque curve of a DS motor with adequate ambient venting.
With large-size DS motors load must be reduced, as the motor heat cannot be dissipated sufficiently.

Graph 4
Maximum permissible torque for 120sec. according to DIN 57530.

The Frequency Inverter must be chosen for increased motor current.

ATTENTION:
This curve is of general validity only. Exact info concerning thermal loads must be requested from the motor manufacturer.

3.3 BLOCK DIAGRAM



8.4 ELECTRICAL DIMENSIONING OF MOTOR DRIVES

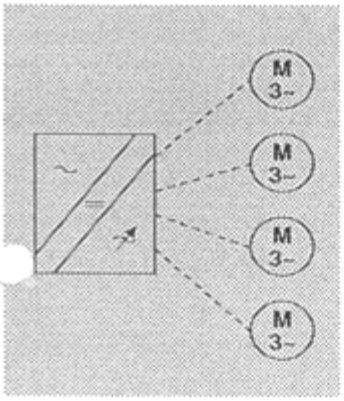
OPERATION WITH INSTANTANEOUS START

If extremely short acceleration times are required, or an increased break-off torque, the Frequency Inverter must be dimensioned according to start-up current, instead of nominal motor current.

OPERATION OF PUMPS AND VENTING DRIVES

If pump drives or venting drives with square torque progression are to be controlled and/or regulated via Frequency Inverter, a square U/f Curve can be selected for motor noise suppression and for energy saving purpose.

MULTI-MOTOR OPERATION WITH ONE FREQUENCY INVERTER



Several motors can be controlled simultaneously by one Frequency Inverter Model PM(B)L-230/400. For dimensioning it is of importance whether the motors are to be started simultaneously or successively.

- For simultaneous start the total of all motor nominal currents must not exceed the rated current of the Frequency Inverter.
- For successive start the Frequency Inverter must be dimensioned in such fashion that the additional start-up current of the motors is taken into account.

This means:
The total of all motor nominal currents, plus the total of current peaks at start-up of all motors (appr. 6-8 x I_N), must not exceed the Frequency Inverter's rated current.
Reason: Each motor is added to the Frequency Inverter's output already accelerated to operational condition, which, in respect to current, is equal to subjecting the motor directly to network power supply.
Further information can be obtained from

LUST electronic systeme

LUST Electronic-Systeme GmbH
Gewerbestraße 5-9
D-6335 Lahnau 1

Phone 0 64 41 / 6 02-0
Telefax 0 64 41 / 6 02-37

or an authorized foreign agency.

9 INITIAL START-UP

9.1 INITIAL INSTALLATION

Mechanical Installation

Double-Check:
- Venting, Mounting Orientation, Minmum Distance, Ambient Conditions

Electrical Installation:

- Cable Routing and Wiring
- Protective Leads
- Disconnected motor wiring

Switch Main Power Supply 'ON'

- LED 'STOP' (yellow) glows;
- LCD Display shows 'STOP';

If a failure is displayed, examine and remove reason.

NOTE:
Control function STL or STR is validated only if it has been activated AFTER completed self-test (Switching of pre-load relay).

Entry of Operational Data

Make entries via digital control unit (DBE).

Options
- All options not required for the particular operation must be deactivated, otherwise unwanted reactions of the drive may occur.

External Entry of Nominal Value (if equipped accordingly)

- Set jumper on pin strip X11 as required.

If possible, check rotational Direction of Drive

- Connect Rotary-Field Measuring Instrument to output terminals U, V, W, activate control function STR or STL, enter nominal value and examine rotational direction of drive.

Start-up of Drive without Motor

- Start Inverter and inspect frequency display for correct acceleration, maximum frequency, deceleration, and minimum frequency.
- After Start of system the LED 'RUN' must glow.
- If integrated potentiometer for nominal value is provided, inspect if scale settings of minimum and maximum frequency correspond to minimum and maximum frequency of the Inverter.

Switch-OFF Main Power Supply

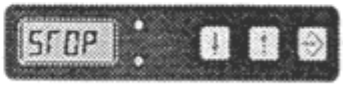
Wait 2 minutes!

ATTENTION:
Wait 2 minutes before proceeding with any activity (Time to fully discharge the capacitors) and check for absence of DC voltage on intermediate circuit terminals X1/- and X1/+, using a voltmeter set on DC.

Connect Motor Wiring
- Wire motor to X1/U, V, W, PE

Switch Main Power Supply 'ON'

- Self-test is completed after 2 to 3 seconds (Pre-load relay must activate after appr. 1 second)
- LED „STOP' on DBE Unit glows.
- DBE Displays the following message:



If a failure appears on display, examine and remove reason.

NOTE:
Control functions STL or STR are validated only if they have been activated AFTER completed self-test (Switching of pre-load relay).

Examine Rotational Direction of Motor

- Set nominal value at lowest magnitude possible and actuate START statement (STR or STL). If motor fails to turn over, increase nominal value accordingly.
- Direction can be changed when reversing from STR to STL or vice-versa.
- Operate Drive at nominal load.

Final Tuning of Operational Data

- Examine, throughout one work cycle, whether or not the drive performs as desired. If not so, re-tune entries.

9.2 REPAIRS

Each Frequency Inverter is subsected to rigorous quality testing prior to shipment, consisting of functional testing and endurance test over several hours.
This assures delivery of top-quality equipment.
No malfunctions are to be expected if all operational instructions are properly followed, and if dimensioning of the equipment is correct. Should problems arise in spite of all precautions, please return the Frequency Inverter to

LUST electronic systeme

LUST Electronic-Systeme GmbH
Gewerbestraße 5-9
D-6335 Lahnau 1

Phone 0 64 41 / 6 02-0
Telefax 0 64 41 / 6 02-37

or to an authorized foreign agency, accompanied by info in respect to

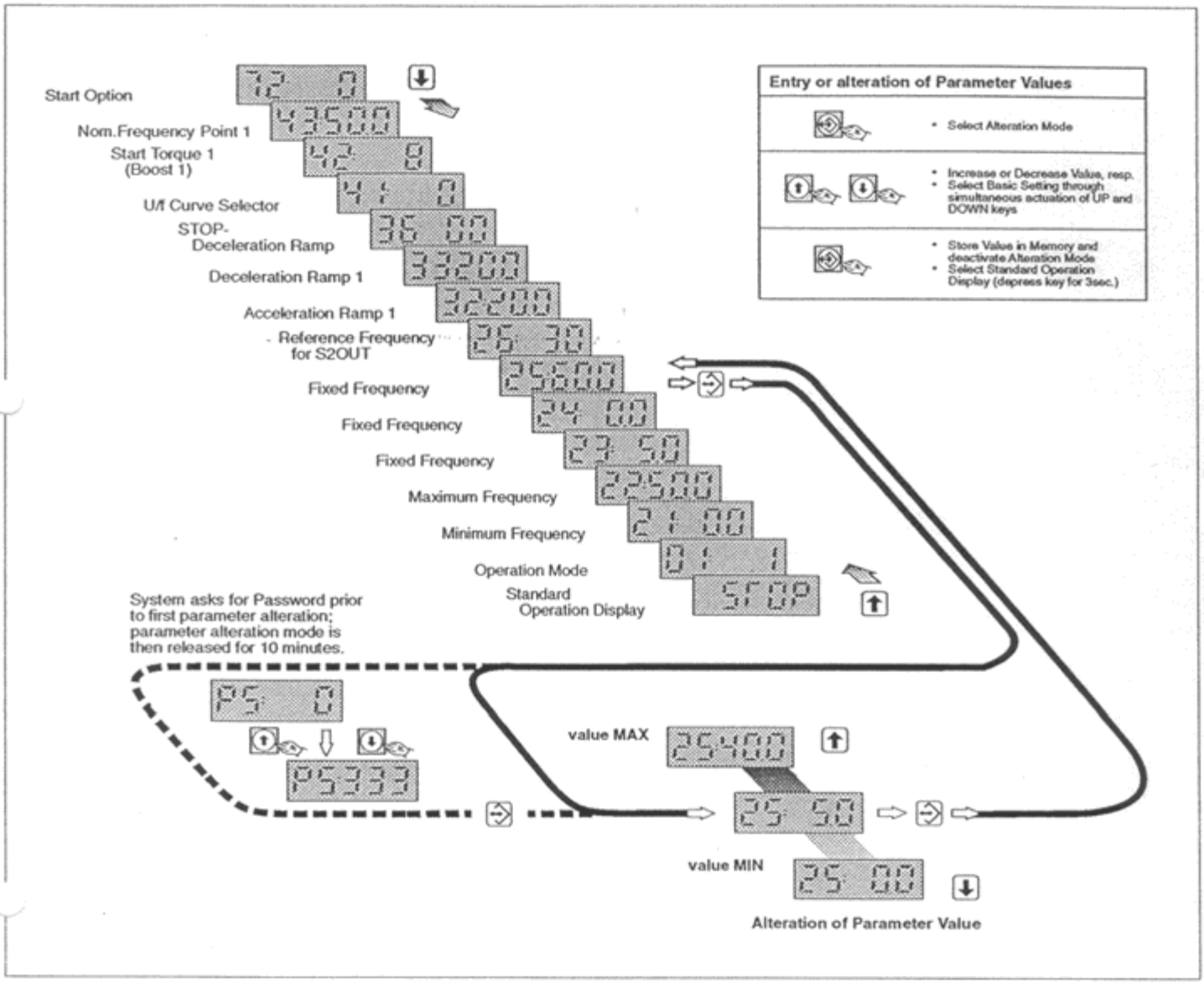
1. Description of Application
2. Failure message and description of malfunction
3. Copy of Parameter entries
4. Wiring Diagram

EVALUATION OF LED DISPLAYS

DBE DISPLAY	CONDITION / REASON	REMEDY
After Power "ON"		
	Power-OFF	• Check Power Supply • Check Fuses
TEST	Self-test, Pre-load on Int.Circuit	
STOP	Frequ. Inverter ready Output Stages not activated	
Green LED begins to flash after Self-Test and Switch-OFF		
Err 01	Malfunction in Computer Module	Exchange Microprocessor Module
Err 03	Short Circuit/Ground Short on Motor Output	Check Motor Wiring
Err 04	Short Circuit in Int.Circuit	Output Stage, or Brake Chopper Defective. Return Inverter to Supplier
Err 06	Parameter Block invalid	False Microprocessor Module; Exchange Print
Yellow LED flashes during Operation (Switch-OFF)		
Err 11	I • t Switch-OFF	Long-time Overload; Check Drive and Rating
Err 12	Overcurrent Switch-OFF	Overload >150%; Check Drive
Err 13	Over-/Undervoltage exceeding 10 seconds	Check Power Supply Voltage; use external Brake Chopper if large Fly-wheel Mass is to be driven.
Err 14	Temperature > 80°C	Utilize external Venting Provide Venting Attachment

10 STRUCTURE OF MENU

10.1 CONTROL LEVEL 1



Reset to Factory Settings

Within **one** parameter:
Press both keys and then enter.

For **all** parameters:
Set parameter 71 to 1 and press Enter.

Read-Only Protection

System prompts for password when attempting to alter a parameter.

P5 0 with ↑ to P533

Confirm with