>pDRIVE<

Description of functions

>pDRIVE< *MX* **eco** 4V

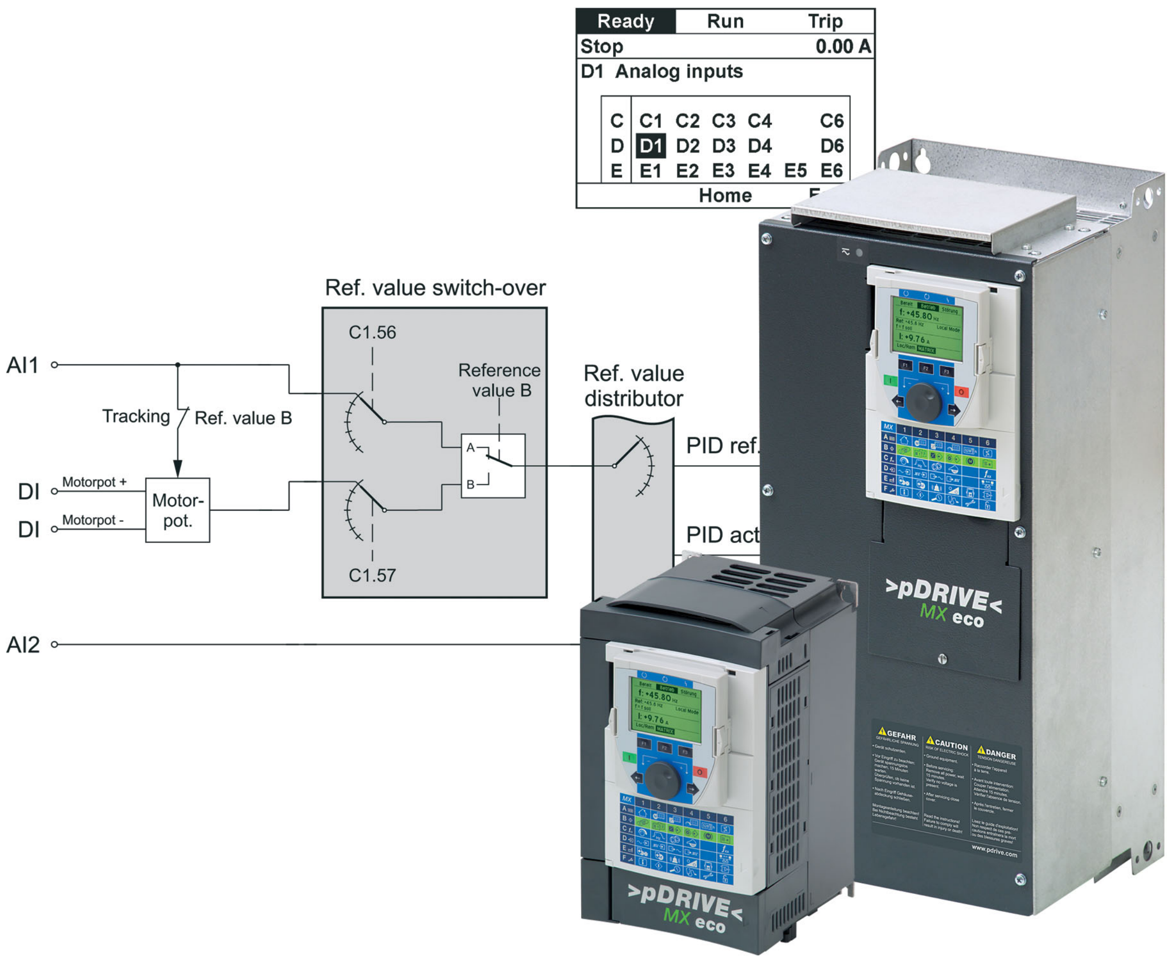
>pDRIVE< *MX* **pro** 4V

>pDRIVE< *MX* **pro** 6V

>pDRIVE< *MX* **multi-eco**

>pDRIVE< *MX* **multi-pro**

Software APSeco_B04 and higher



General remarks

The following symbols should assist you in handling the instructions:

Advice, tip !

General information, note exactly !

The requirements for successful commissioning are correct selection of the device, proper planning and installation. If you have any further questions, please contact the supplier of the device.

Capacitor discharge !

Before performing any work on or in the device, disconnect it from the mains and wait at least 15 minutes until the capacitors have been fully discharged to ensure that there is no voltage on the device.

Automatic restart !

With certain parameter settings it may happen that the frequency inverter restarts automatically when the mains supply returns after a power failure. Make sure that in this case neither persons nor equipment is in danger.

Commissioning and service !

Work on or in the device must be done only by duly qualified staff and in full compliance with the appropriate instructions and pertinent regulations. In case of a fault contacts which are normally potential-free and/or PCBs may carry dangerous voltages. To avoid any risk to humans, obey the regulations concerning "Work on Live Equipment" explicitly.

Terms of delivery

The latest edition "General Terms of Delivery of the Austrian Electrical and Electronics Industry Association" form the basis of our deliveries and services.

Specifications in this document

We are always anxious to improve our products and adapt them to the latest state of the art. Therefore, we reserve the right to modify the specifications given in this document at any time, particular those referring to weights and dimensions. All planning recommendations and connection examples are non-binding suggestions for which we cannot assume liability, particularly because the regulations to be complied depend on the type and place of installation and on the use of the devices.

All foreign-language translations result from the German or English version. Please consider those in case of unclarity.

Basis of contract

The specifications in text and drawings of this document are no subject of contract in the legal sense without explicit confirmation.

Regulations

The user is responsible to ensure that the device and its components are used in compliance with the applicable regulations. It is not permitted to use these devices in residential environments without special measures to suppress radio frequency interferences.

Trademark rights

Please note that we do not guarantee that the connections, devices and processes described herein are free from patent or trademark rights of third parties.

Copyright

Description of functions for the frequency inverters
>pDRIVE< MX eco

Parameters and their settings refer to software version APSeco_B04_05 and higher

Theme	Page
Basic concept of the ***>pDRIVE< MX***	3
Basic concept of the reference sources	5
Basic concept of the reference value distributor	11
Operation of the ***>pDRIVE< MX eco*** inverters	17
A Display	41
A1 Home	41
A2 Motor values	51
A3 Inverter values	56
A4 Reference values	57
A5 Counter	62
A6 Display configuration	64
B Start-Up	67
B1 Language selection	67
B2 Macro configuration	69
B3 Inverter data	84
B4 Motor data	93
B5 Brake function	98
B6 Short menu	101
C Functions	105
C1 Int. reference	105
C2 Ramp / frequency	120
C3 Cascade control	125
C4 PID configuration	139
C6 Special functions	148

Theme	Page
D Input / Output	159
D1 Analog inputs	159
D2 Digital inputs	169
D3 Analog outputs	177
D4 Digital outputs	188
D6 Fieldbus	193
E System	195
E1 Process protection	195
E2 Motor protection	206
E3 Fault configuration	219
E4 Control configuration	235
E5 Keypad	239
E6 Function blocks	243
F Service	261
F1 Info	261
F2 Test routines	262
F3 Fault memory	267
F4 Diagnosis	270
F5 Service	275
F6 Code	276
Index	279

HTIU

8 P01 023 EN.04/04

The instructions in hand cover the topics operation and parameterization. Moreover, the basic concept of the *>pDRIVE< MX eco* frequency inverters as well as their functions are explained in detail.

Use this instructions additionally to the device documentation "Operating instructions" and "Mounting instructions".

The parameter description of the different fieldbuses is given in the respective fieldbus documentation.

HTIU

8 P01 023 EN.04/04

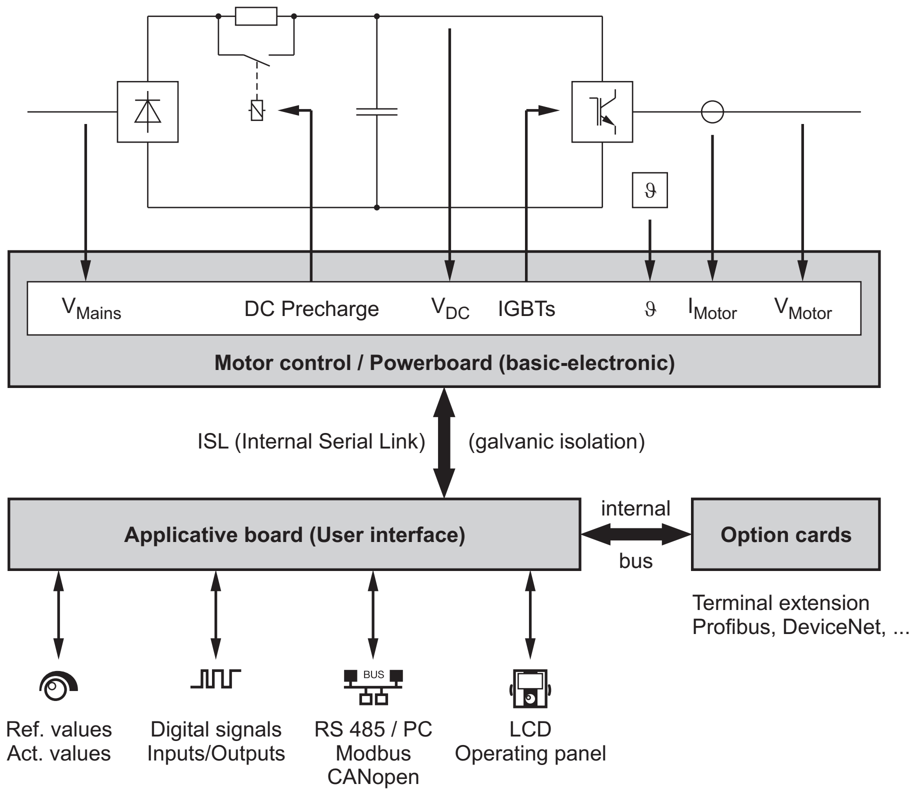
Basic concept of the >*pDRIVE*< *MX*

The frequency inverters >*pDRIVE*< *MX eco* are intended for use with three-phase induction motors. They are connected in series between the power supply and the asynchronous motor which should be operated with variable speed.

By means of power electronic components (diodes, thyristors, IGBTs, …) the frequency inverter converts the energy of the three-phase or alternating voltage system with a preset voltage and frequency (e.g. 400 V / 50 Hz) into a frequency and voltage variable three-phase current system.

Conversion is done in two steps.

1. Rectification via a 6-pulse uncontrolled diode rectifier (uncoupling from the mains frequency)
2. Conversion of the DC voltage stored in the DC link into a frequency and voltage variable three-phase system with an external controlled 6-pulse IGBT-bridge by using a sinus-rated pulse width modulation



The basis for the functionality of a frequency inverter is its power part which performs the frequency and voltage conversion. In addition to the power electronic components a control electronics is required for the numerous open and closed loop and protection functions of the inverter.

The control electronics of the >*pDRIVE*< *MX eco* are structured into three basic units.

Basic electronics (Motor control / Power board)

This part covers the basic functions of the frequency inverter.

- Voltage supply for the control electronics
- Measurement electronics for the control and protection of the power part, measurement of the voltages, the motor current, the temperature of the heat sink etc.
- Open/close loop model of the motor with modulation procedure
- Processing of the IGBT-control commands (amplification, electrical isolation)
- Control of the DC link pre-charging

Applicative electronics

The application-specific functions are realized in this part.

- Parameterization via LED 7-segment display or optional Matrix operating panel >*pDRIVE*< *BE11*
- Reference value processing (different types of reference values, scaling,...)
- Control commands (Start/Stop, FWD/REV, Reset, different operating modes,...)
- Functions (ramp formation for reference values, PID process controller, fault and alarm management,...)
- Type of communication (24 V control commands / reference values performed with analog standard signals, fieldbus systems, PC-connection, …)

Option cards

A maximum of two different option cards can be added to the basic device for extending the functionalities of the >*pDRIVE*< *MX eco*. The option cards are mounted directly at the control block and are connected to the basic electronics via an internal serial bus.

The following option cards are available:

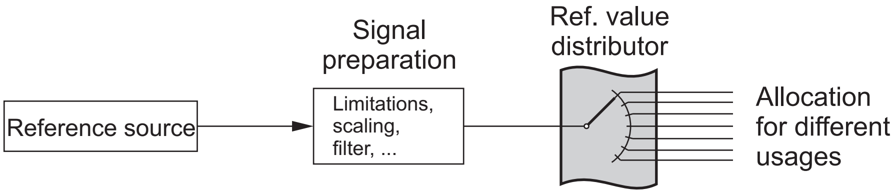
- Digital terminal extension option >*pDRIVE*< *IO11*
- Analog / digital terminal extension option >*pDRIVE*< *IO12*
- Fieldbus connections (Profibus DP, DeviceNet, Interbus, ...)

HTIU
8 P01 023 EN.04/04

Basic concept of the reference sources

The frequency inverters *>pDRIVE< MX eco* can process reference values of different forms. In addition to the established standard signals such as voltage [V] or current [mA], digital selectable pre-set reference values, a scalable frequency input, an electronic motor potentiometer, serial fieldbus reference values as well as different internal reference sources are also available.

All reference sources can be influenced via corresponding parameterization in their activity and finally can be further used via the reference value distributor.

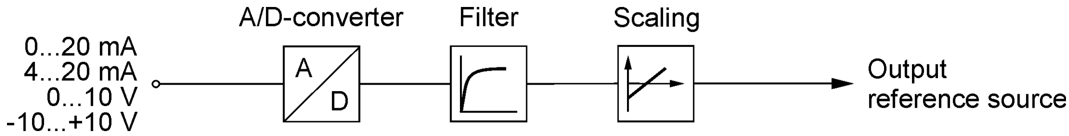


Reference source			Position	Matrix field
AI1	Analog input	0...10 V / -10...+10 V	Basic device *>pDRIVE< MX eco*	D1
AI2	Analog input	4...20 mA / 0...20 mA 0...10 V	Basic device *>pDRIVE< MX eco*	D1
AI3	Analog input	4...20 mA / 0...20 mA	Option *>pDRIVE< IO12*	D1
AI4	Analog input	4...20 mA / 0...20 mA 0...10 V	Option *>pDRIVE< IO12*	D1
FP	Frequency input	0...30 kHz	Option *>pDRIVE< IO12*	D1
Pre-set	Pre-set references	max. 16 with binary encoded selection	Digital reference source	C1, D2
MP	Motor potentiometer		Digital reference source	C1, D2
Bus	References from serial communication source		Basic device *>pDRIVE< MX eco* / Bus option	D6
MX-wheel	Matrix wheel / ↓↑ keys		Matrix operating panel BE11 / basic device	C1
CALC	Analog calculator		Internal function	C1
IW	Actual value selection		Internal function	C1
KB	Curve generator		Internal function	C1
XY graph	XY graph		Internal function	C1
LFP	Frequency input via digital input		Basic device *>pDRIVE< MX eco*	C1

See also hardware specification in the *>pDRIVE< MX eco* mounting instructions.

HTIU
8 P01 023 EN.04/04

Analog inputs AI1...AI4

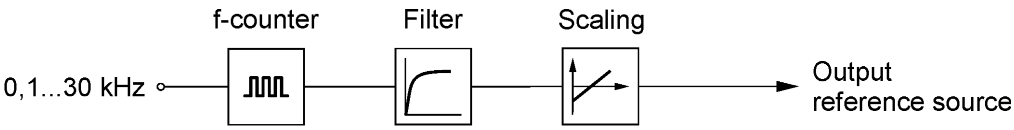


For analog inputs the reference values are provided by means of standardized signals. The signal connected to the respective terminals is transferred to the inverter electronics via an A/D-converter where the signal is then processed. The type of signal that is finally used, its scaling as well as the option of a filter can be set by means of parameterization.

All 4...20 mA reference sources can be monitored for reference failure (signal < 2 mA) if required.

The analog inputs AI3 and AI4 require the hardware option >*pDRIVE*< *IO12*.

Frequency input FP

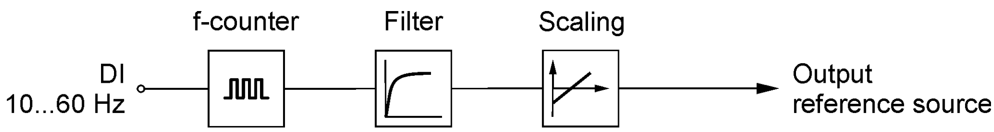


The frequency input FP uses a voltage pulse sequence in the frequency range 0.1...30 kHz as reference signal. After the frequency count the resulting reference value is transferred to the inverter electronics for further signal processing. The frequency range of the reference value signal, its scaling as well as the option of a filter can be adjusted by means of parameterization.

If required the frequency input can be monitored for reference failure (< 50 % of the min. frequency scaling).

Frequency input FP requires the hardware option >*pDRIVE*< *IO12*.

Frequency input LFP (Low Frequency Pulse Input)

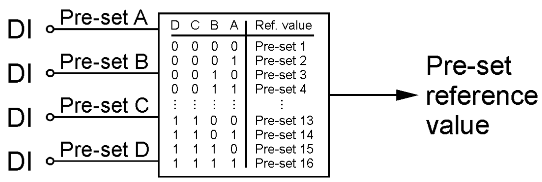


The frequency input LFP uses a voltage pulse sequence at a free selectable digital input in the frequency range 10...60 kHz as reference signal. After the frequency count the resulting reference value is transferred to the inverter electronics for further signal processing. The frequency range of the reference value signal, its scaling as well as the option of a filter can be adjusted by means of parameterization.

If required the frequency input can be monitored for reference failure (< 50 % of the min. frequency scaling).

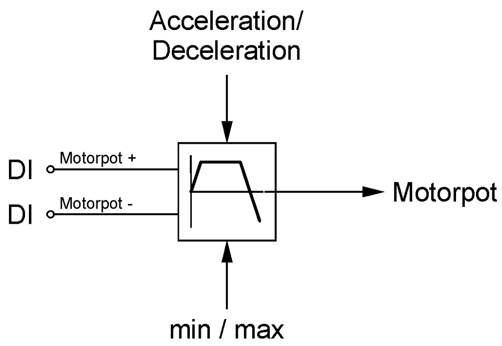
HTIU
8 P01 023 EN.04/04

Pre-set references 1...16



The pre-set reference source contains up to 16 freely programmable references in Hz or %. Depending on the binary encoded digital input commands (Pre-set A, Pre-set B, Pre-set C and Pre-set D) these commands can be connected to the output of the reference source. The number of required digital inputs depends on the number of required reference values.

Electronic motor potentiometer



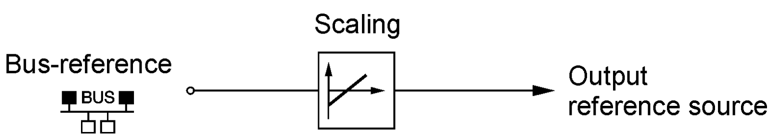
The electronic motor potentiometer represents an integrator whose output value is to be controlled in Hz or % by means of two digital input commands. The output value will change linear within the set min-/max limits if the input is activated.

If neither of the two input commands is active, the electronic motor potentiometer will remain at its last value. Negative frequencies correspond with a left turning rotary field at the frequency inverter output.

The desired setting range, the acceleration/deceleration times as well as the storage behaviour of the motor potentiometer at shut-down can be influenced through the parameterization.

Instead of the digital input commands, the matrix wheel can be also used to set the reference value.

Reference values from serial communication

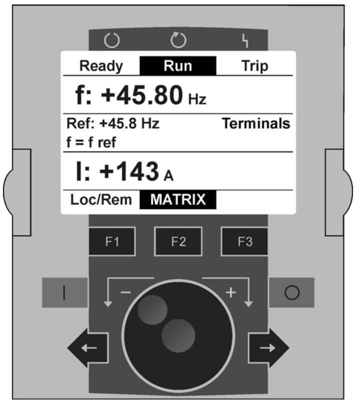


The serial transmitted reference values (Profibus, ModBus, CANopen, …) provide the frequency inverter with references in digital form. The necessary scaling as well as a possible filter can be adjusted by means of parameterization.

ModBus and CANopen are available at the basic device, while other field bus connections require the respective option card.

8 P01 023 EN.04/04 HTIU

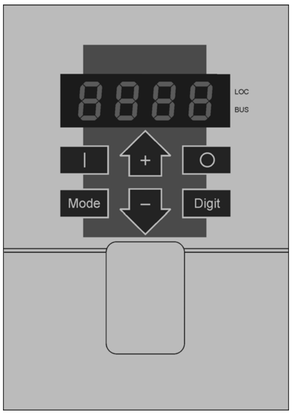
Reference value Matrix-wheel (panel operation)



The Matrix wheel is located as central element at the removable Matrix operating panel of the *>pDRIVE< MX eco* and represents an easy-to-use frequency reference source for the panel operating mode besides its functionalities for parameterization.

The output value of the Matrix wheel is changed by turning the thumb wheel. Turning right leads to an increasing reference value, turning left leads to a decreasing reference value..

The arithmetical sign of the reference value (direction of rotation) is chosen via the arrow keys at the keypad. The required setting range, the reaction dynamic, the single step size as well as the behaviour regarding the changes of operating states can be adjusted by means of the parameterization.



If the removable Matrix operating panel is not used, the two arrow keys at the keypad of the basic device will provide the function of the panel reference sources.

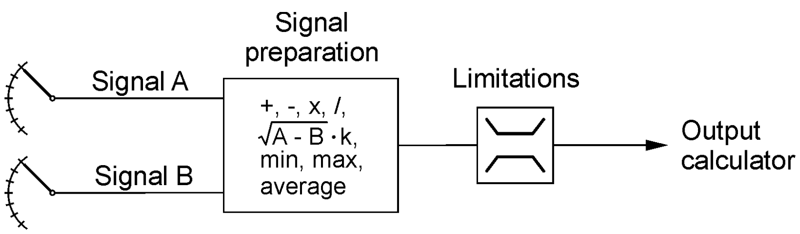
They represent the control commands for a bipolar acting motor potentiometer, with which the direction of rotation can also be selected.

Press shortly:	Single step (C1.34 MX-wheel single step)
Press continuously:	Quickens the change to reference value

The switching to reverse rotation occurs by means of a negative reference value.

To avoid desired changes of the rotational direction, the reference value will remain at zero crossing. By pressing the corresponding arrow key again the arithmetical sign of the reference value changes and thus also the direction of rotation changes.

Calculator

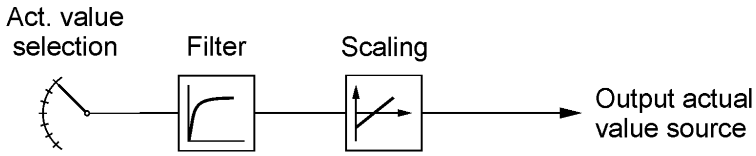


The calculator can be used for the algebraic connection of two signals. All reference sources and actual values as well as a constant can be used as signals. Besides the four basic arithmetical operations it is also possible to operate with sum, inversion, root, rounding and statistic functions.

The calculator is particularly used for PID-controller functions such as differential pressure control, flow rate control etc.

HTIU
8 P01 023 EN.04/04

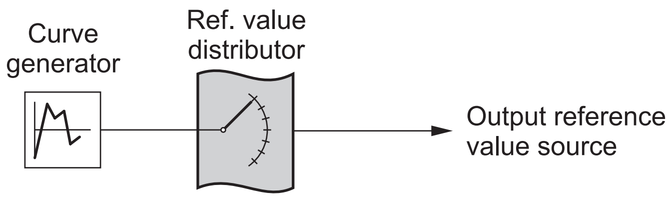
Actual value selection



The actual value selection gives the reference value distributor access to the actual values measured or calculated by the frequency inverter.

The feedback of the actual values is particularly used for PID control applications and/or in conjunction with the calculator.

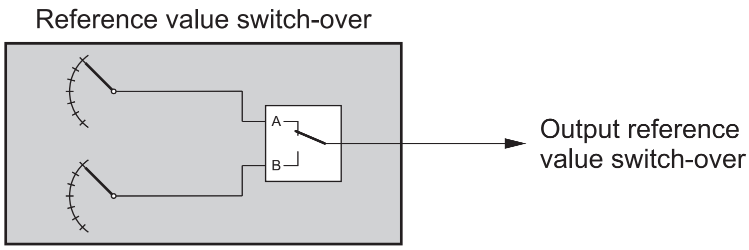
Curve generator



The curve generator provides a cyclically processed reference curve that is to be configured by setting seven value pairs (reference value and time).

The curve generator is often used in combination with the correction reference value and the comparator functions (e.g. in case of automatic wash-up systems, irrigation plants, vibration movements, winding and coiling applications,...).

Switch-over of reference values

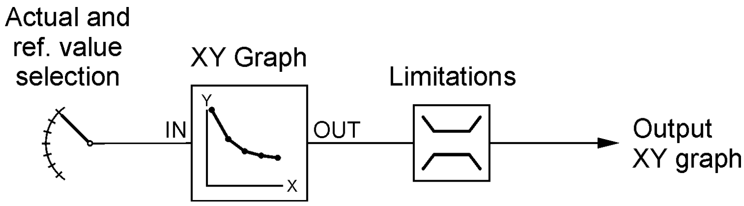


The reference source "Ref. value switch-over" enables the selection of two reference sources for one reference use. It is possible to switch between these two sources by means of parameterization or a digital input.

This function additionally offers the possibility to transmit a reference source which is already used for further use at the reference value distributor (double use of a reference source).

HTIU
8 P01 023 EN.04/04

XY graph



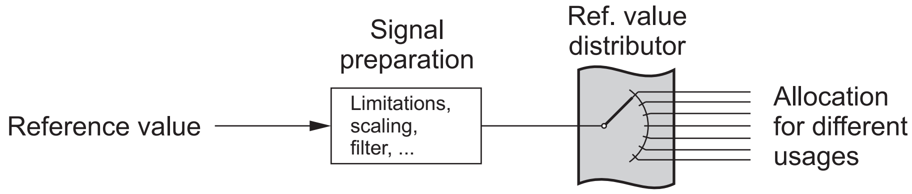
The XY graph represents a reference source whose output is defined by the given input signal and a line shape that can be set using six points.

The output of the XY graph can be used as a general reference source or as a variable limitation for the PID controller. For example, the XY graph can be used to realize the maximum speed for compressors depending on the pressure (PID limitation), a speed-dependent torque limitation (simulation of combustion engines),...

Basic concept of the reference value distributor

The reference value distributor is the interface between the reference sources and the reference use. In addition to the control source selection and the Matrix parameter concept it represents the main functional principle of the *>pDRIVE< MX eco*.

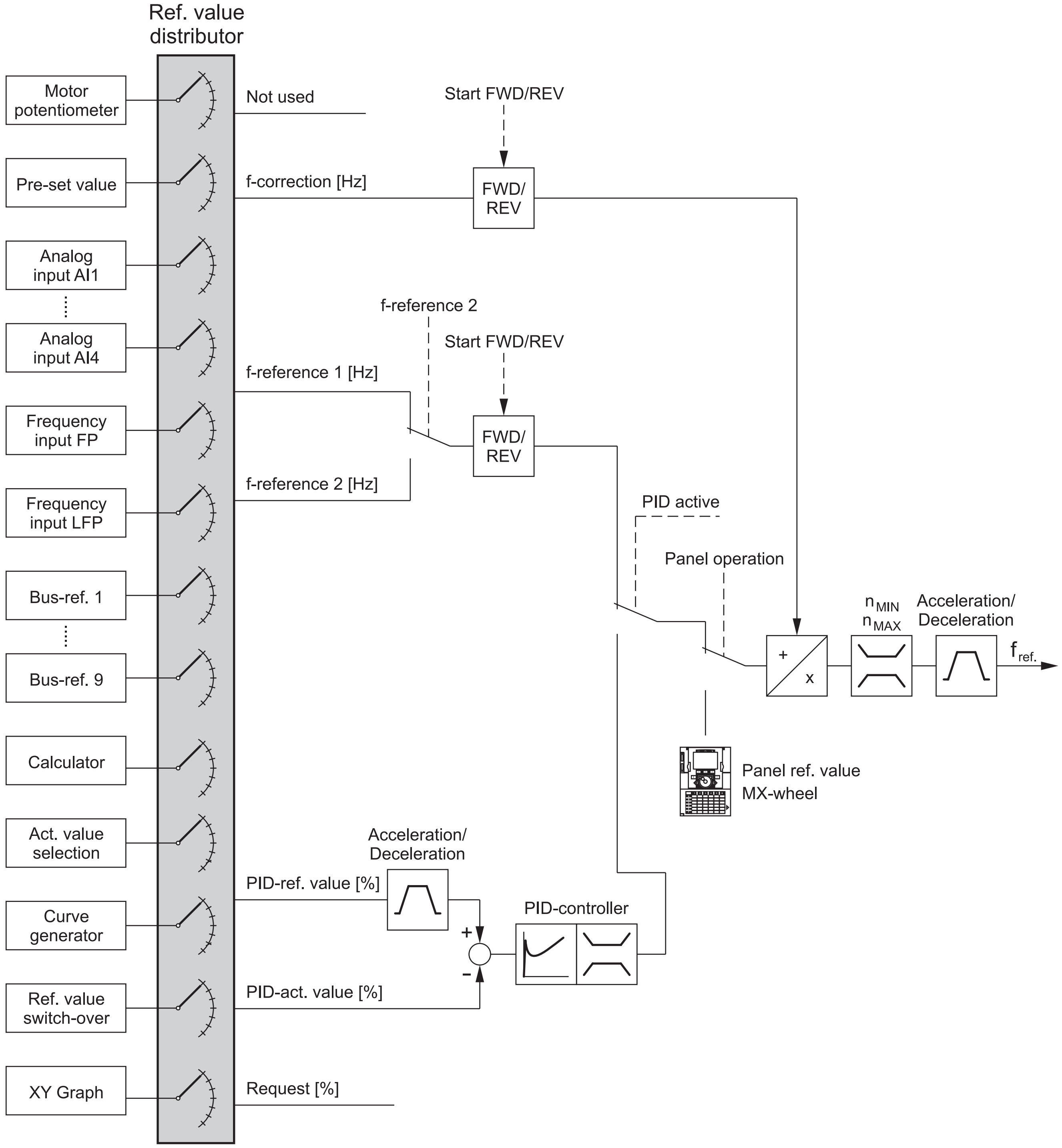
The processed and scaled reference values from the various reference sources end in the reference value distributor. The reference value distributor now has the task to transmit the given reference value to the reference use which suits the application.



A reference use can only ever be assigned to one reference source. If you try to assign a second reference source to the same use, the message "Multiple use of inputs not possible" is displayed.

8 P01 023 EN.04/04 HTIU

>pDRIVE< MX eco **Reference value distributor with all objectives**



HTIU
8 P01 023 EN.04/04

The following reference uses are available:

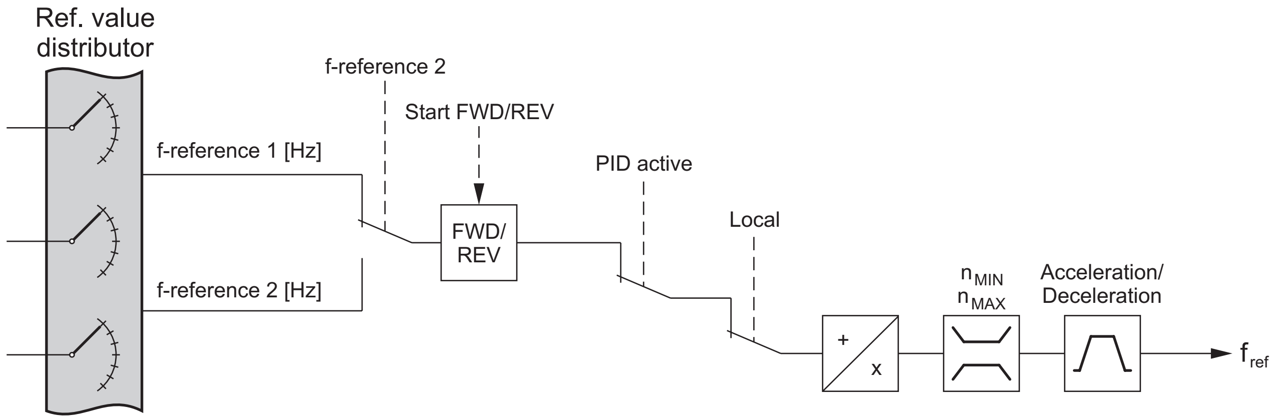
Setting	Use
Not used	The reference source is not used.
f-reference 1 [Hz]	Frequency reference value (selectable / switchable)
f-reference 2 [Hz]	
f-correction [Hz]	Additive or multiplicative correction of the frequency reference value
PID-reference val. [%]	PID process controller
PID-actual value [%]	
Request [%]	This setting should be selected if the reference source is used for a comparator, an internal limitation or at an analog output.

Frequency reference path

Any two reference sources can be connected to the mixing points f-reference 1 [Hz] and f-reference 2 [Hz]. By means of the digital input f-reference 2 [Hz] one of the two connected reference values are directly applied for setting the frequency of the drive motor.

If the digital input f-reference 2 [Hz] is not parameterized, the selection will refer to f-reference 1 [Hz].

The reference value is scaled in Hertz.



Once the reference value has been selected the signal is provided with an algebraic sign to achieve the required rotary field at the inverter output (forward / reverse rotation). A positive frequency reference value corresponds with forward direction, while a negative frequency reference value corresponds with reverse direction at the inverter output.

The inversion of the reference value is derived from the digital input commands Start FWD / Start REV.

If the direction of rotation is already taken into account during scaling of the reference source (e.g. at ±10 V signal), only the command Start FWD is valid, as the drive could not follow the required direction of rotation otherwise due to the double inversion of the reference value.

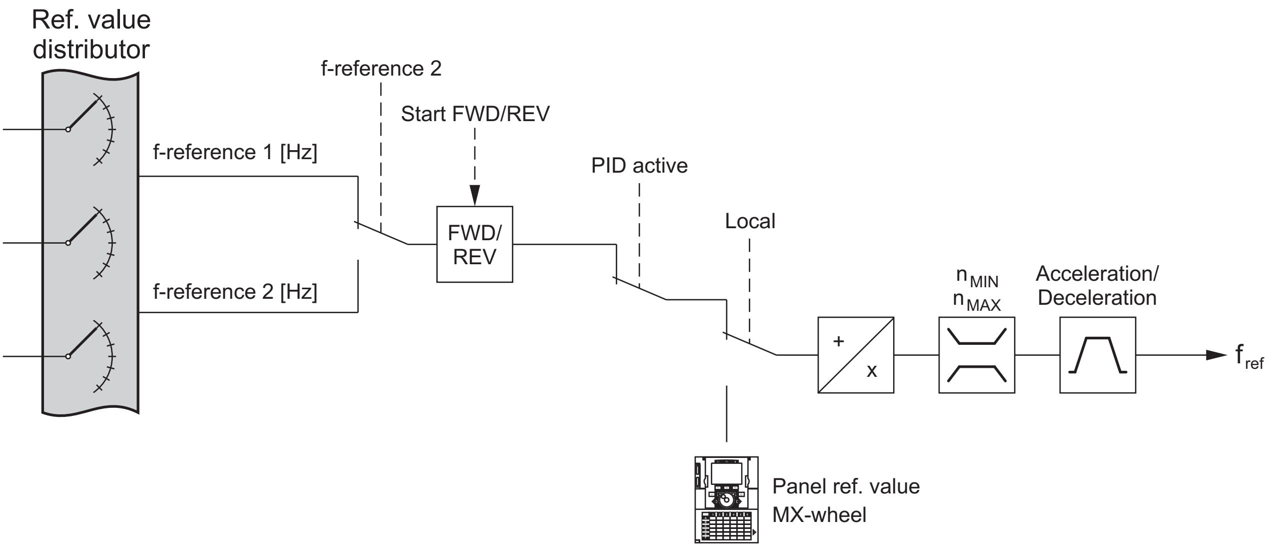
The prepared frequency reference value is restricted to the frequency limitation, which overlies the reference sources. Afterwards the frequency reference value is transferred to the acceleration/deceleration ramps.

Panel reference source "Matrix wheel"

If the *>pDRIVE< MX eco* is switched from remote operation into panel operation, the Matrix wheel at the keypad of the device serves as easy-to-handle reference source along with its functionalities during parameterization.

The switch-over from remote to panel operation is shock-free. This means that the present operating state as well as the frequency reference are assumed into panel operation at switch-over.

The reference value is scaled in Hertz the same way as with the remote sources.



As all other references the reference value of the Matrix wheel is subject to the shared acceleration and deceleration ramp as well as the superior frequency limitation.

If the removable Matrix-operating panel is not used the two arrow keys at the LED keypad will take over the functionality of the Matrix-wheel.

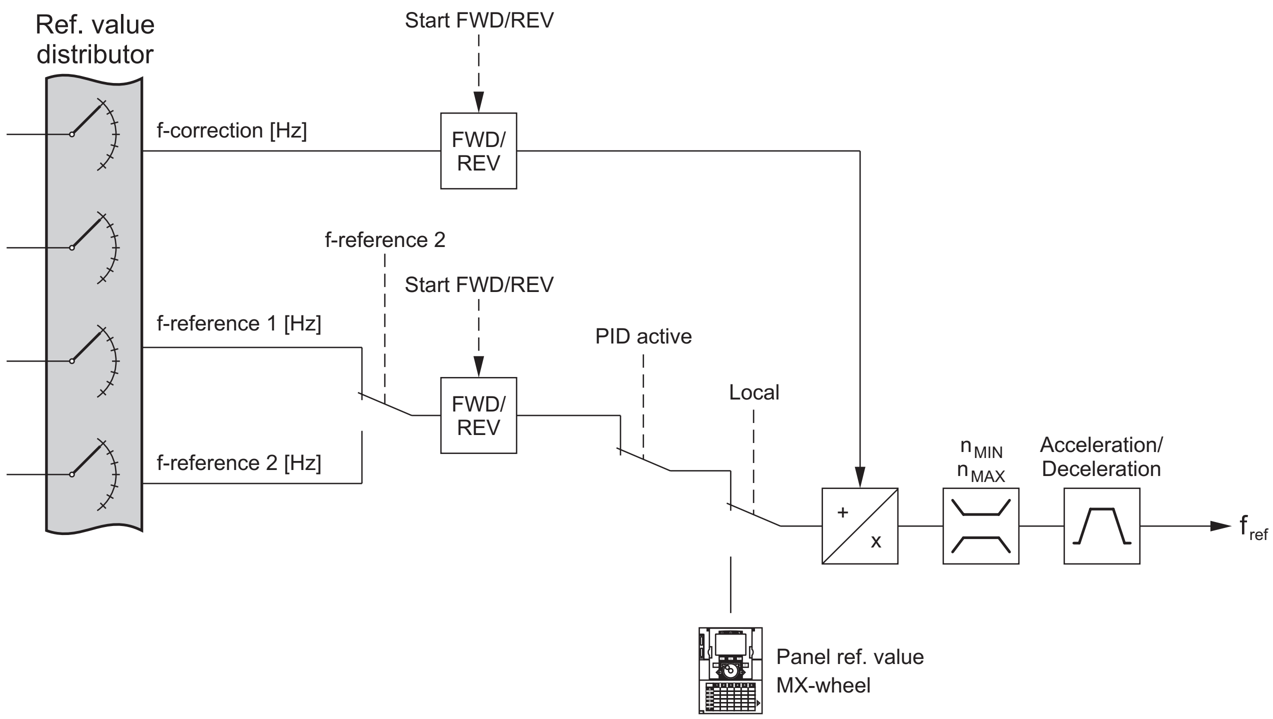
HTIU

8 P01 023 EN.04/04

Frequency correction

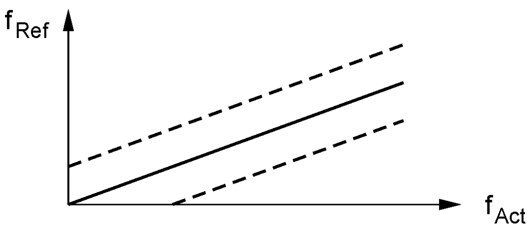
Both, the frequency reference from the remote sources as well as the Matrix-wheel can be manipulated by means of a frequency correction.

The f-correction signal is scaled in Hz for additive correction and in % for multiplicative correction.



Depending on the parameter C6.26 f-correction a distinction is made between two different types of correction.

Additive correction

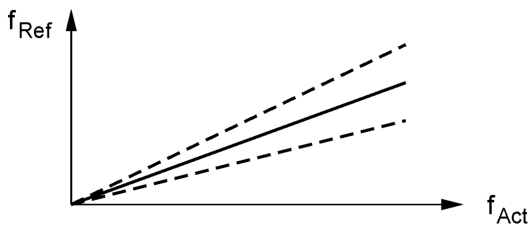


For this a correction frequency is added (offset) with correct algebraic sign to the frequency reference.

Example:

Reference value: 20 Hz
Correction signal: 5 Hz
Forward: 25 Hz
Reverse: 25 Hz

Multiplicative correction



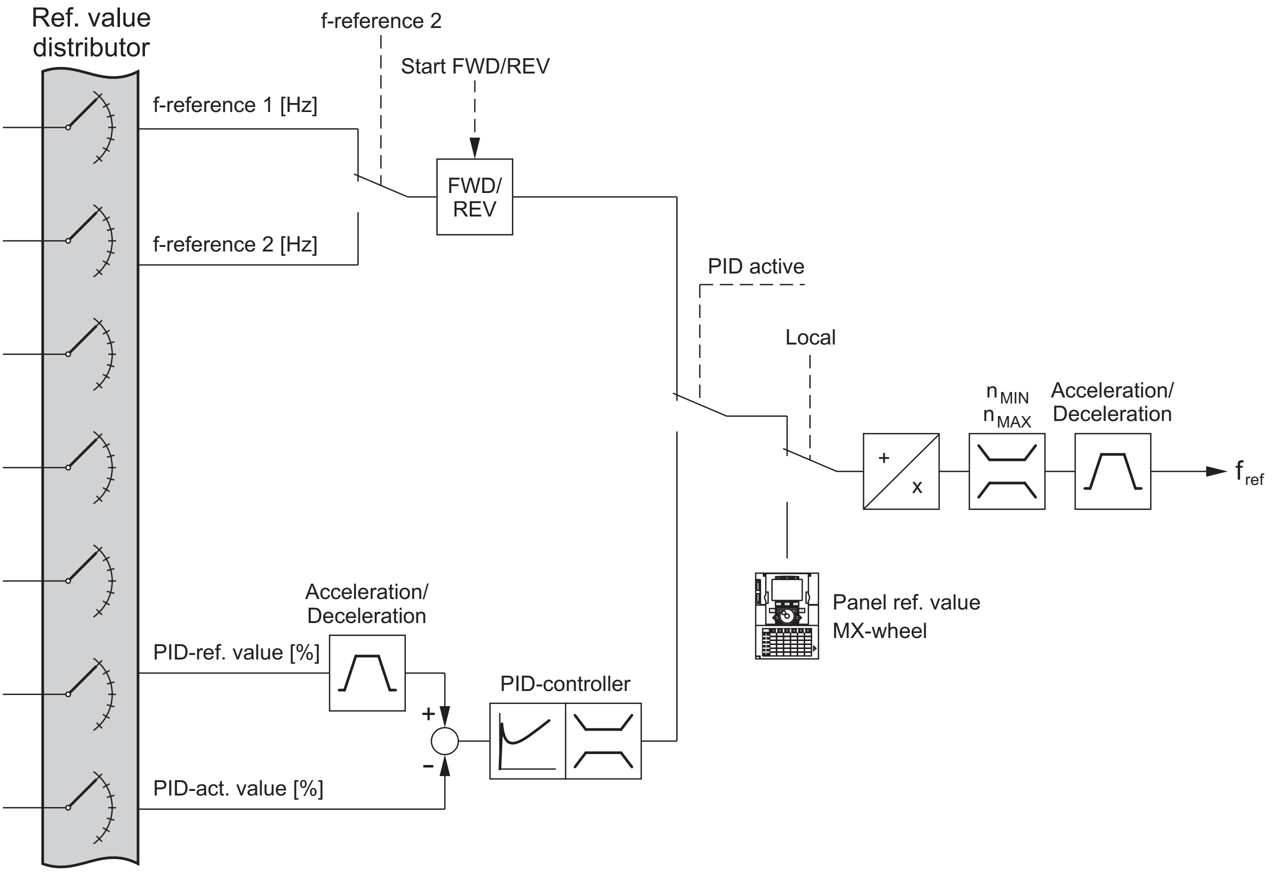
For the multiplicative correction the frequency reference signal is multiplied (amplification) by the correction signal.

f-correction: 100 % ... signal unchanged
> 100 % ... magnification
< 100 % ... weakening

PID process controller

The PID-controller has been designed as a process controller with adjustable proportional gain, integration- and derive-time with a PID-output in Hertz. If the PID process controller is used the output frequency is influenced not directly by the frequency reference but by the manipulated variable of the controller output. The controller will try to regulate the difference between the PID-reference and actual value to zero and to keep it.

The two signals are scaled in% independent of their original unit.



HTIU

8 P01 023 EN.04/04

The PID-control circuit can be activated permanent or dependent on the digital input "PID-active".

When using the XY graph the PID controller output can be changed depending on a variable size (e.g. limitation of the flow rate dependent on the chosen pressure reference value of a compressor control).

Further settings options for the controller are:

PID reference ramps, energy saving mode, keeping the PID-output, adjustable limitation, wind-up behaviour, shock-free switching between closed and open loop control, usage as master for cascade control of pumps or compressors.

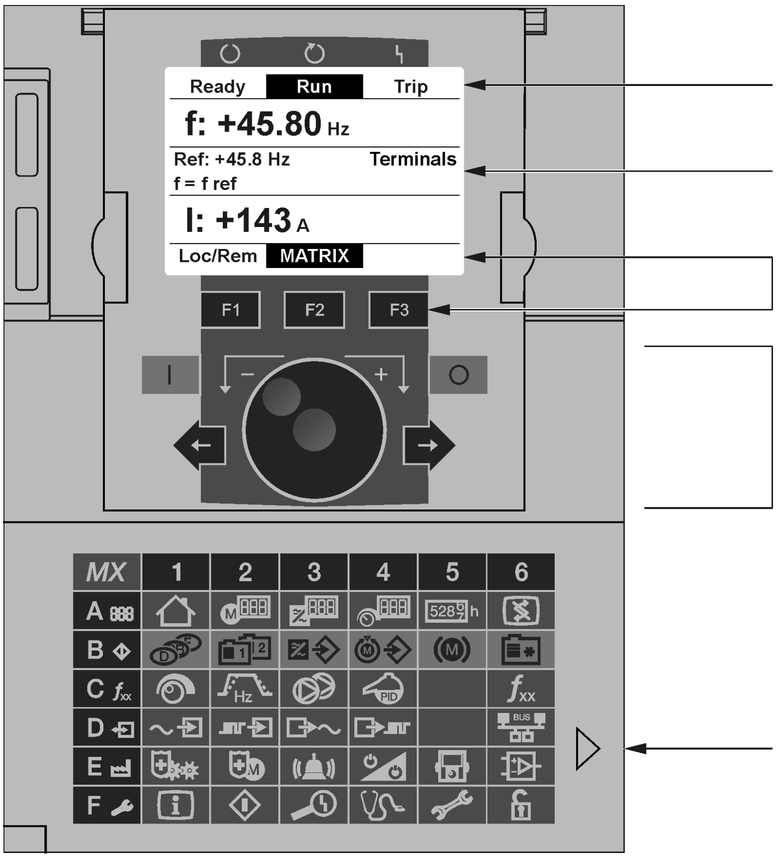
Operation of the *>pDRIVE< MX eco* inverters

Matrix operating panel

The keypad of the *>pDRIVE< MX eco* combines function and design and thereby fulfils multiple different tasks:

- **Display function:**
  A good readable, large LCD displays the latest status of the inverter in plain text, three selectable actual values and the currently active control variant.
  All displayed texts are changed according to the selected language.
- **Manual operation (panel operation):**
  The function button F1 enables the shock free switch-over to manual operation. The control is carried out via 4 buttons and the practical Matrix wheel presets the desired reference value.
  Manual operation can also be locked, if it is not permitted for safety reasons.
- **Parameterization**:
  The desired functions and device characteristics can be set quickly and without any problems due to the well-structured Matrix surface and the parameter descriptions in clear text which are displayed at the same time. The parameterization is started with the "MATRIX" function button and can be abort at any time with just one press of the F2 function button "HOME".

Display function of the keypad in automatic and in manual operation



Status display

Three selectable actual value displays as well as the latest control source

Three function buttons with display of the available functions

Control commands and Matrix wheel for reference assignment in manual operation

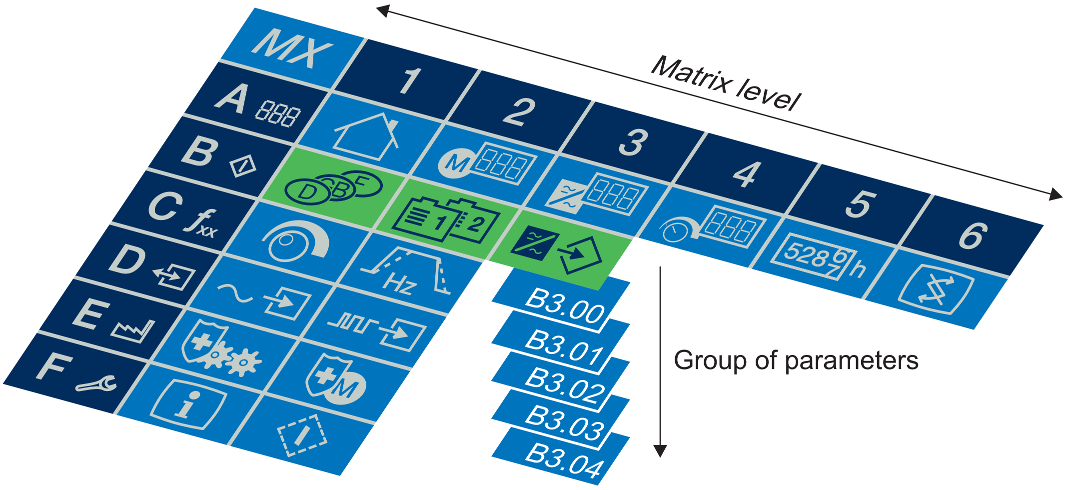
The *>pDRIVE< MX eco* Matrix enables the user to locate the required parameters quickly and easily.

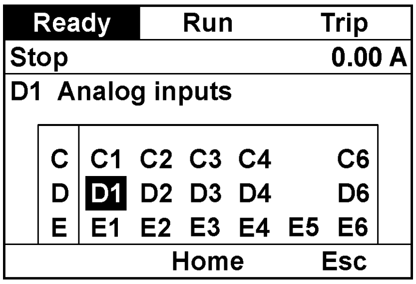
8 P01 023 EN.04/04 HTIU

Matrix philosophy

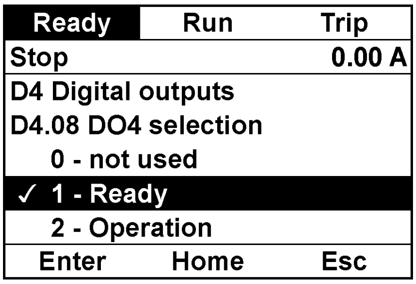
The secret of the simple and quick parameterization of the >*pDRIVE*< *MX eco* devices is not an endlessly long list or a many-branched tree structure but a clear Matrix with easy-to-recognize symbols.

The parameters themselves are therefore arranged in the third dimension.





Within the Matrix level first the desired Matrix line and then the function can be selected with the Matrix wheel (e.g. field D1). Subsequently the relevant parameter can be selected and adapted by pressing the Matrix wheel again.



With the arrow keys the position, which is to be changed, is selected and can be set with the Matrix wheel. Pressing of the Matrix wheel once more saves the changed value.

With the ESC function button F3 you can go back step-by-step to select the next parameter.

To abort parameterization immediately just one push of the functions button F2 "HOME" is necessary.

HTIU
8 P01 023 EN.04/04

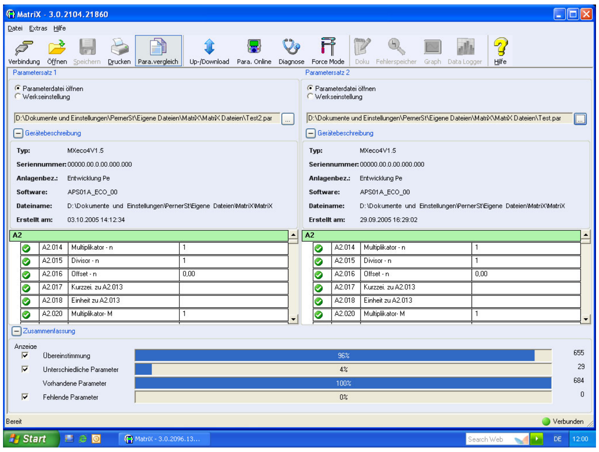
Further advantages of the Matrix philosophy of the >*pDRIVE*< *MX eco* inverters:

- The recognizing, assigning and accurate call-up of all functions and setting variances are made easier by the clear and easily identifiable pictograms.
- All parameters have a clear letter/number-code as well as a parameter name in several languages.
- The setting possibilities of the list parameters have in addition a numerical value in order to guarantee even quicker setting and checking.
- On request only each parameters, whose respective function is active, are displayed (e.g. motor protection) or whose respective option is plugged-in (e.g. terminal extension).

PC software Matrix 3

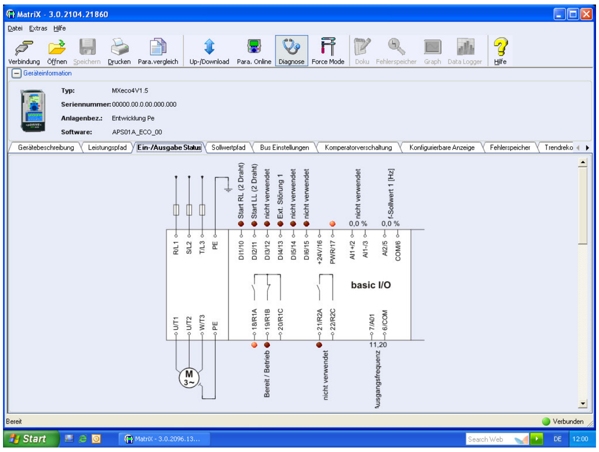
The easy to operate and powerful PC software Matrix 3 makes a further step towards the improvement of the user-friendliness of the >*pDRIVE*< *MX eco* devices. Based on the familiar Windows-surface and the well proven functions of the Matrix 2.0 PC software, it offers numerous tools for considerable quicker commissioning and for the safe archiving of the parameter settings. Special attention was paid to the clearly arranged display and the comparability of drive parameters.

The numerous representations of the control inputs and outputs as well as the whole drive chain are especially advantageous for the commissioning and trouble-shooting.



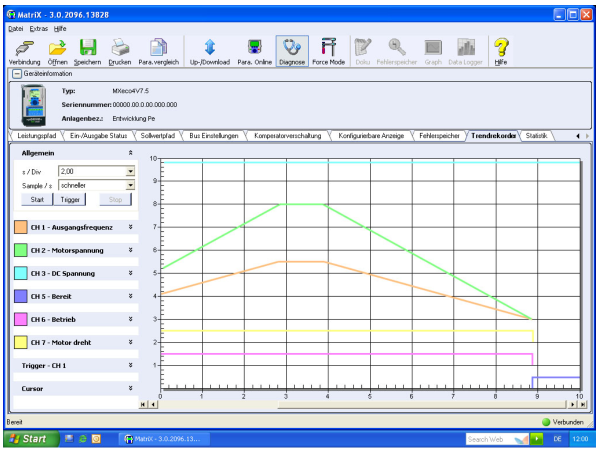
Our concise user interface is also available on the screen of your PC. All parameters can be queried online and changed if necessary. The display of the setting possibility and limits of each parameter make the adjustment easier. A detailed description of the function is available with F1.

By means of the Parameter-Upload and Download, the device settings can be archived or printed out as lists. For a quick recognition of the specific setting values, the parameter list can be compared with the factory setting or with other parameter lists.



The extensive setting possibilities are clearly presented in schematic diagrams which are created online. In this way you quickly obtain an overview of the active functions and control signals.

You also receive intelligent support in the event of a fault: >*pDRIVE*< *MX eco* inverters create a detailed record for each problem. With Matrix 3 the fault memory is evaluated and archived problem-free.



The built-in actual value recorder is the right tool for commissioning. In real time mode freely selectable analog and digital states can be recorded during operation and analysed at a later point in time. The built-in trigger is invaluable especially for the analysis of unplanned incidents.

The reading of the values from the "Data logger" (the records of three selectable sizes which are saved in the inverter) provides further possibilities for the analysis of the drive or the whole process (see function "Data logger", page 270).

HTIU
8 P01 023 EN.04/04

Operation by means of the Matrix operating panel

Status displays for Ready, Run and Trip

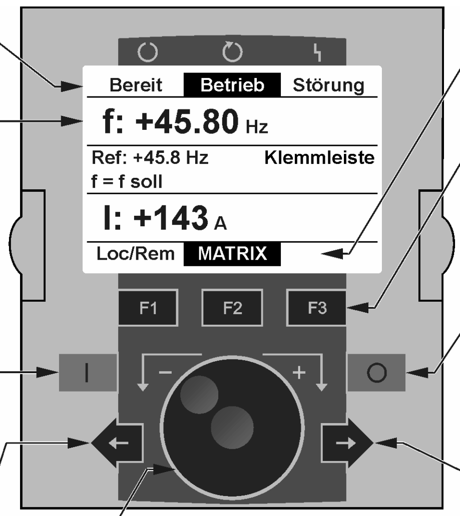
Configurable **LCD display** with indication in large characters

ON key

start command in panel operation

Left key

Navigation inside the Matrix level, moves the cursor to the left,
defines left-handed rotary field in panel operation



Description of the actual **function** of the keys **F1**, **F2** and **F3**

Function keys

Meaning corresponds to the shown description

OFF key

Stop command in panel operation and optionally in remote and bus operation, selectable reset function

Right key

Navigation inside the Matrix level, moves the cursor to the right,
defines right-handed rotary field in panel operation

Matrix wheel

Turning:
navigation inside the Matrix level,
scrolling of parameters inside a matrix field,
adjustment of the reference value in panel operation,
turning left decreases the value,
turning right increases the value

Pressing:
parameter selection,
selecting a parameter value,
enter key (confirmation of the input)

HTIU
8 P01 023 EN.04/04

Basic displays

Ready	Run	Trip
Stop		
Ref: 0.0 Hz		Terminals
I: 0 A		
Loc/Rem	MATRIX	

Display at Ready

	Ready	Run	Trip
A6.01 →	**f: +45.80** Hz		
A6.02 →	Ref: +45.8 Hz		Terminals
	f = f ref		
A6.03 →	**I: +143** A		
	Loc/Rem	MATRIX	

Display at Run (the actual values which are selected with parameter A6.01...03 are shown)

	Ready	Run	Trip
	f: +46.30 Hz		
	Ref: +46.3 Hz		Terminals
Alarm message →	Alarm		Reference fault AI2
	Q: +13.7 m^3/h		
	Loc/Rem	MATRIX	

Display at Run if an alarm occurs

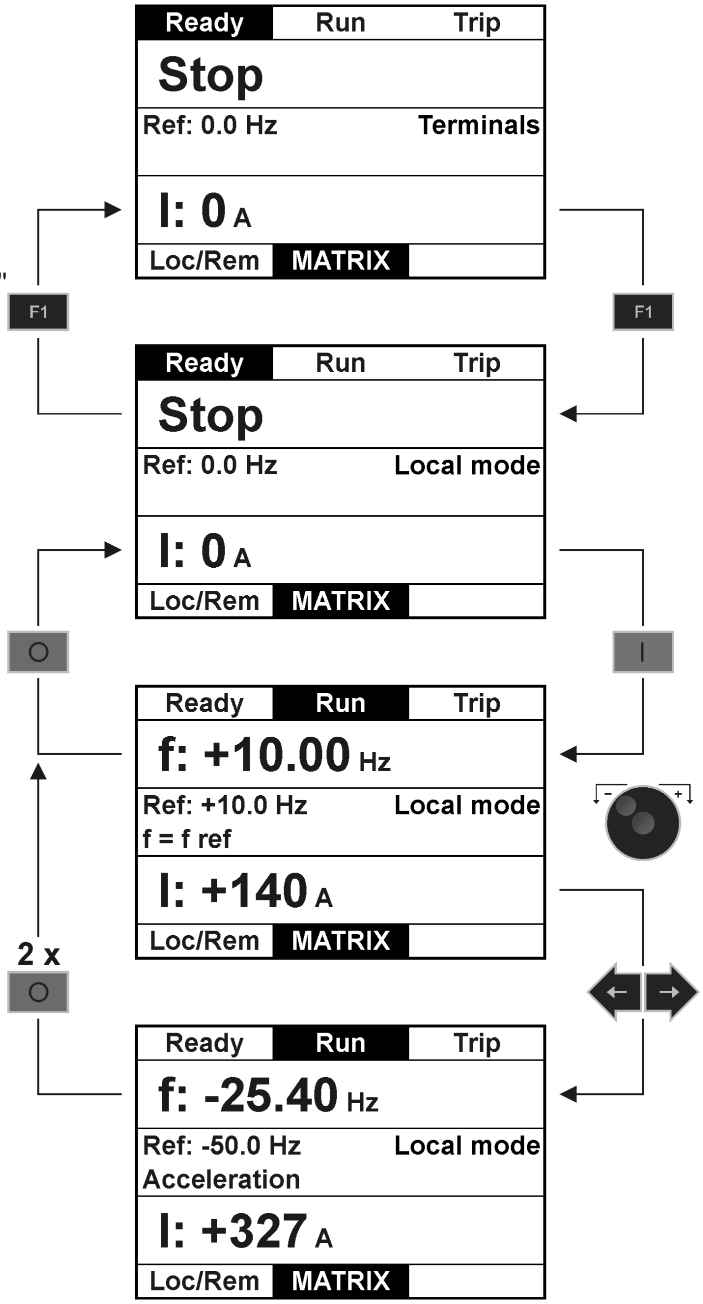
	Ready	Run	Trip
	Störung		
	Ref: +45.8 Hz		Terminals
Trip message →	External fault 1		
	I: 0 A		
	Loc/Rem	MATRIX	RESET

Display at Trip;
Press F3 "RESET" or Stop "O" button to reset

HTIU

8 P01 023 EN.04/04

Panel operation



Press F1 "Loc/Rem" button to switch to Remote mode

Press F1 "Loc/Rem" button to switch to the panel operation mode

Press Stop "O" button to shut down the drive along the set deceleration ramp

Press Start "I" button to start the drive

Turn the Matrix wheel to select the desired reference value

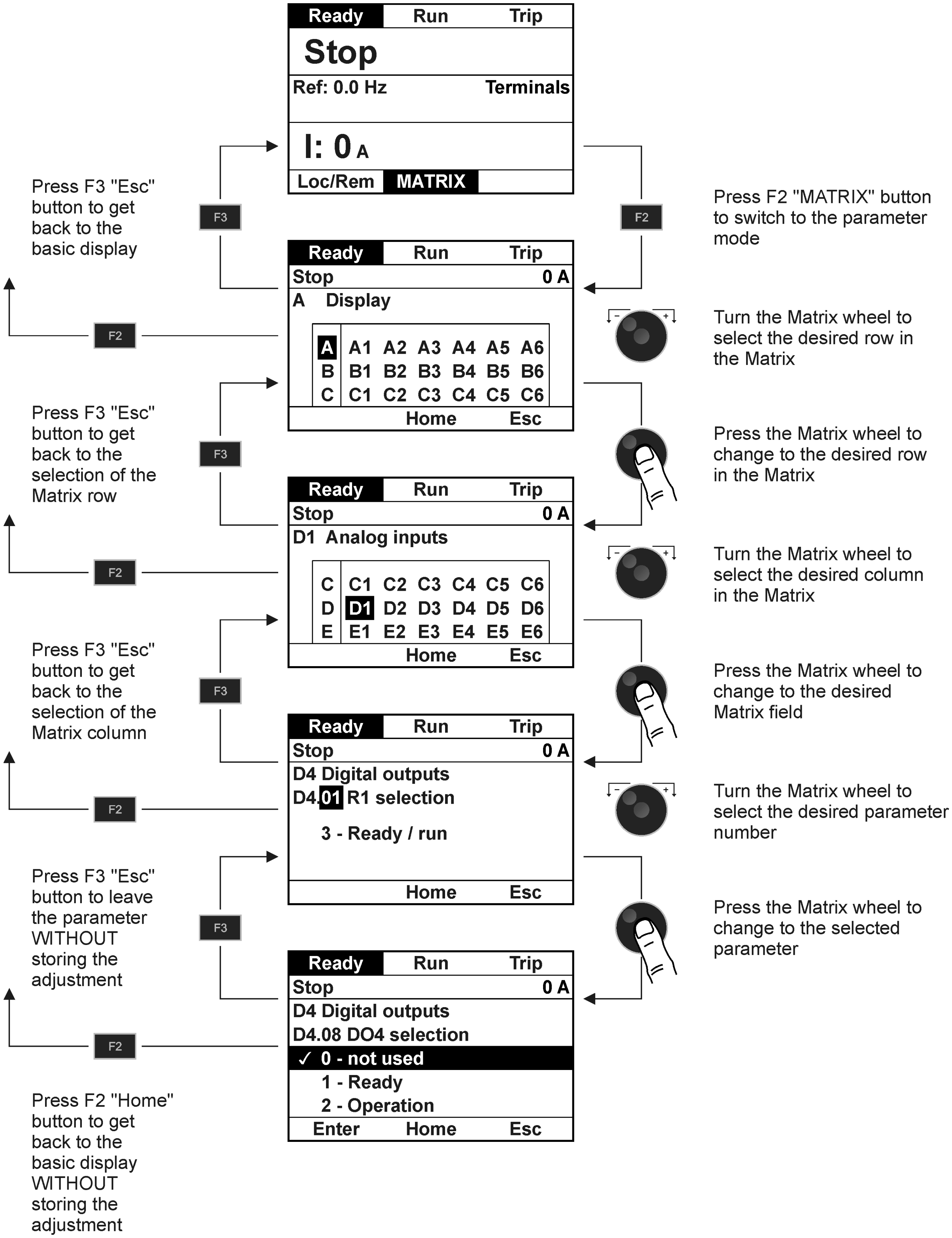
Press Stop "O" button twice to lock the inverter output (the motor runs in free wheel)

Press the arrow buttons to switch between FWD and REV direction

HTIU

8 P01 023 EN.04/04

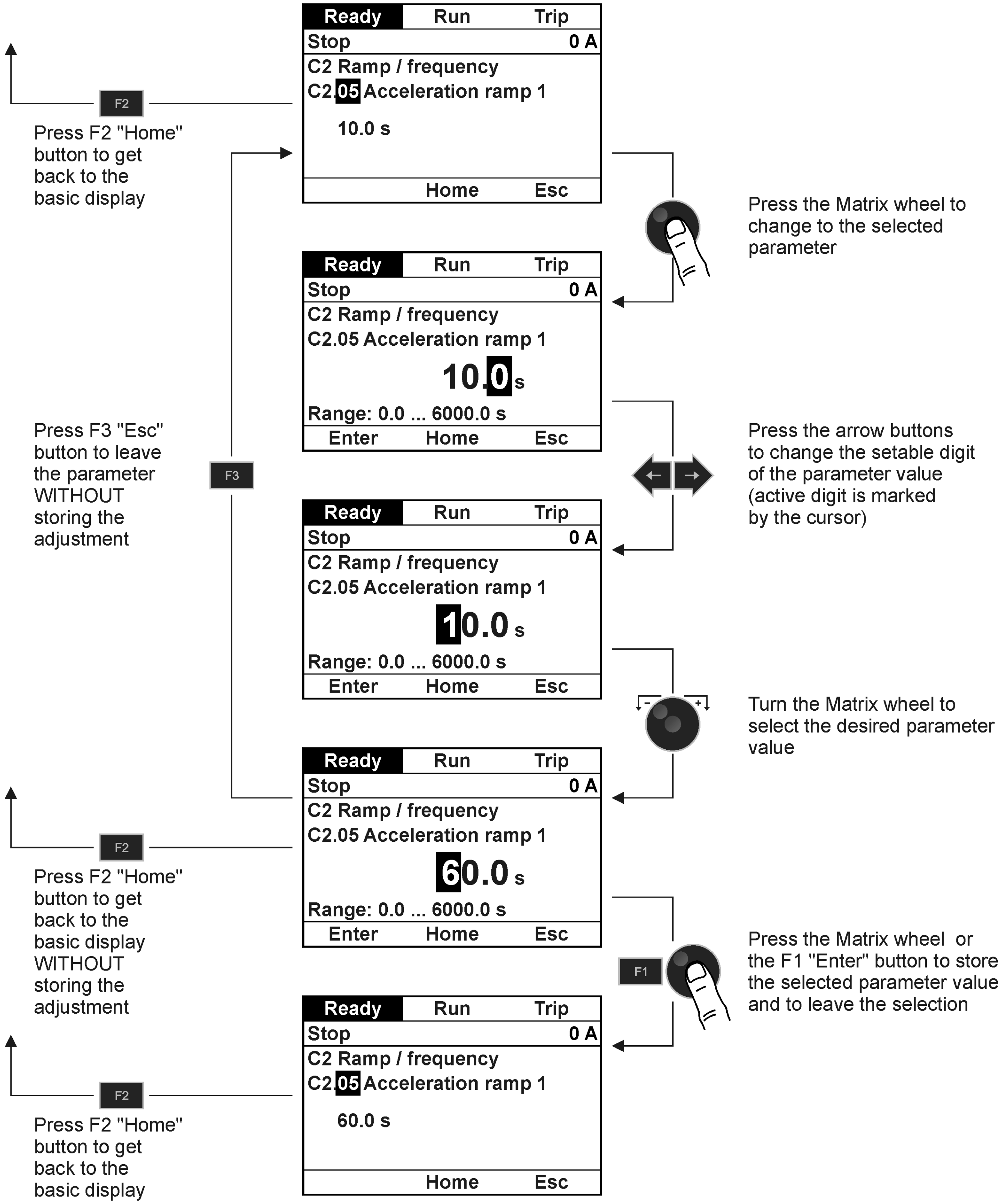
Navigation inside the Matrix



HTIU

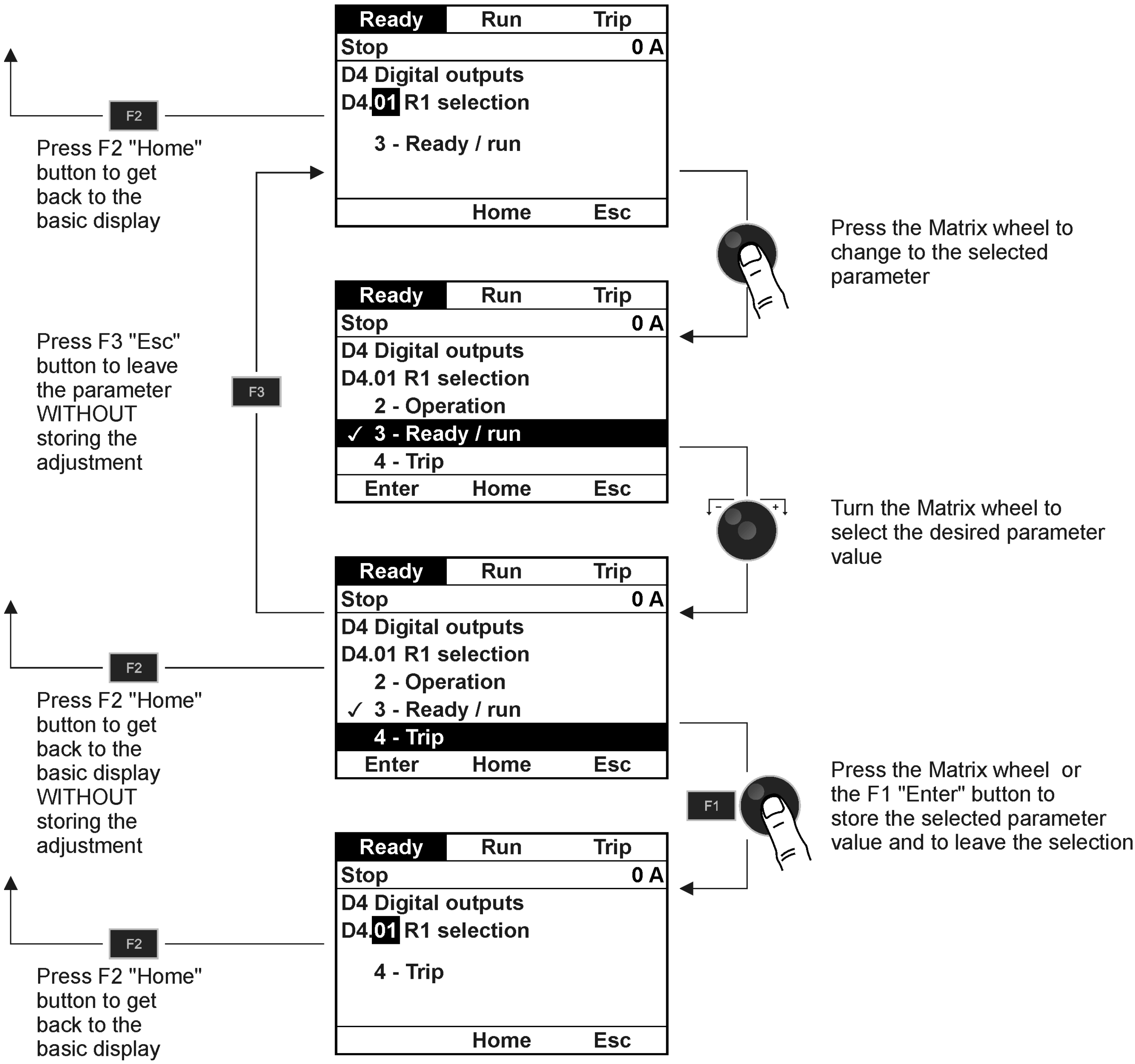
8 P01 023 EN.04/04

Adjusting a parameter of type "Variable"



HTIU 8 P01 023 EN.04/04

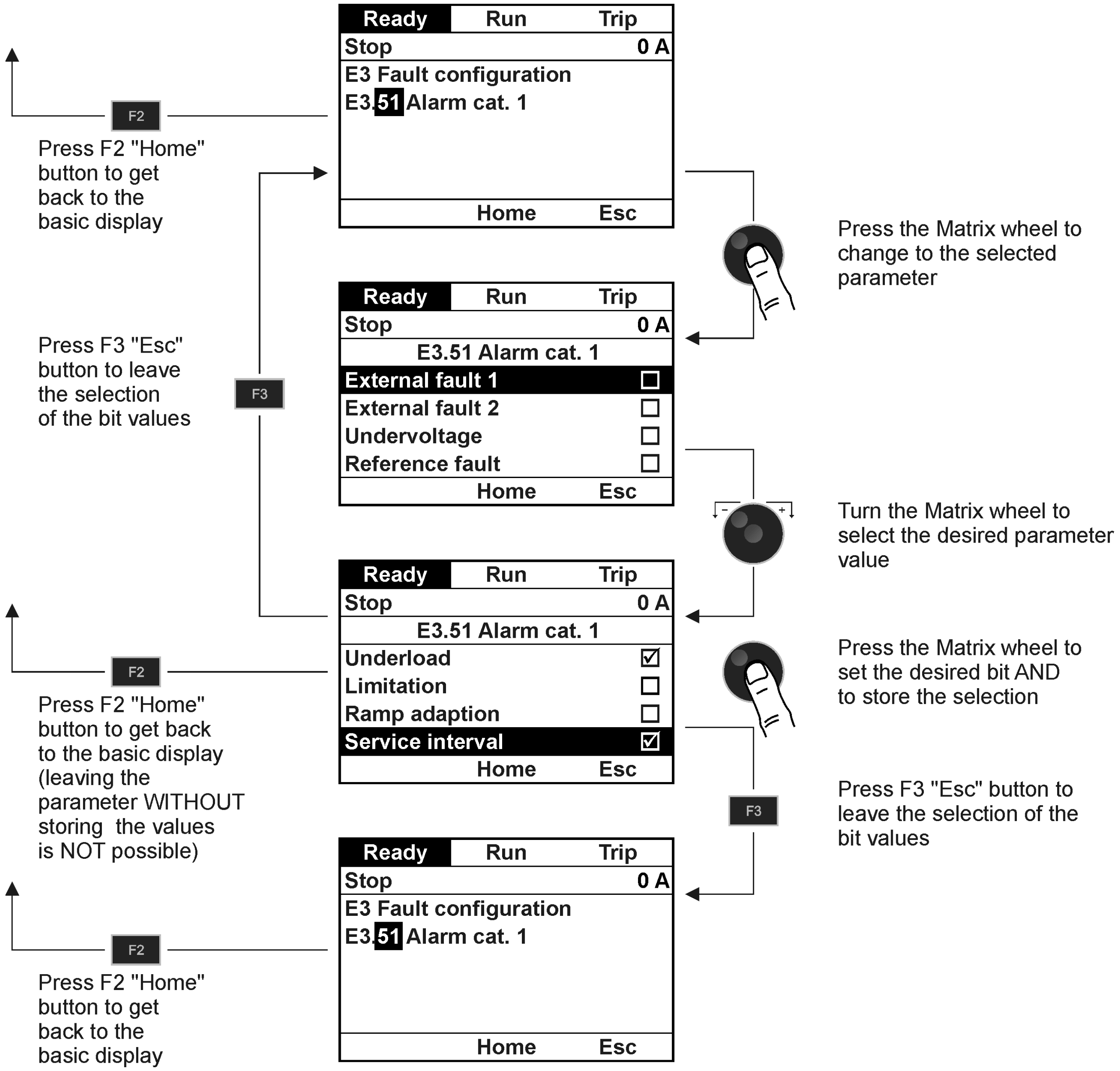
Adjusting a parameter of type "List"



HTIU

8 P01 023 EN.04/04

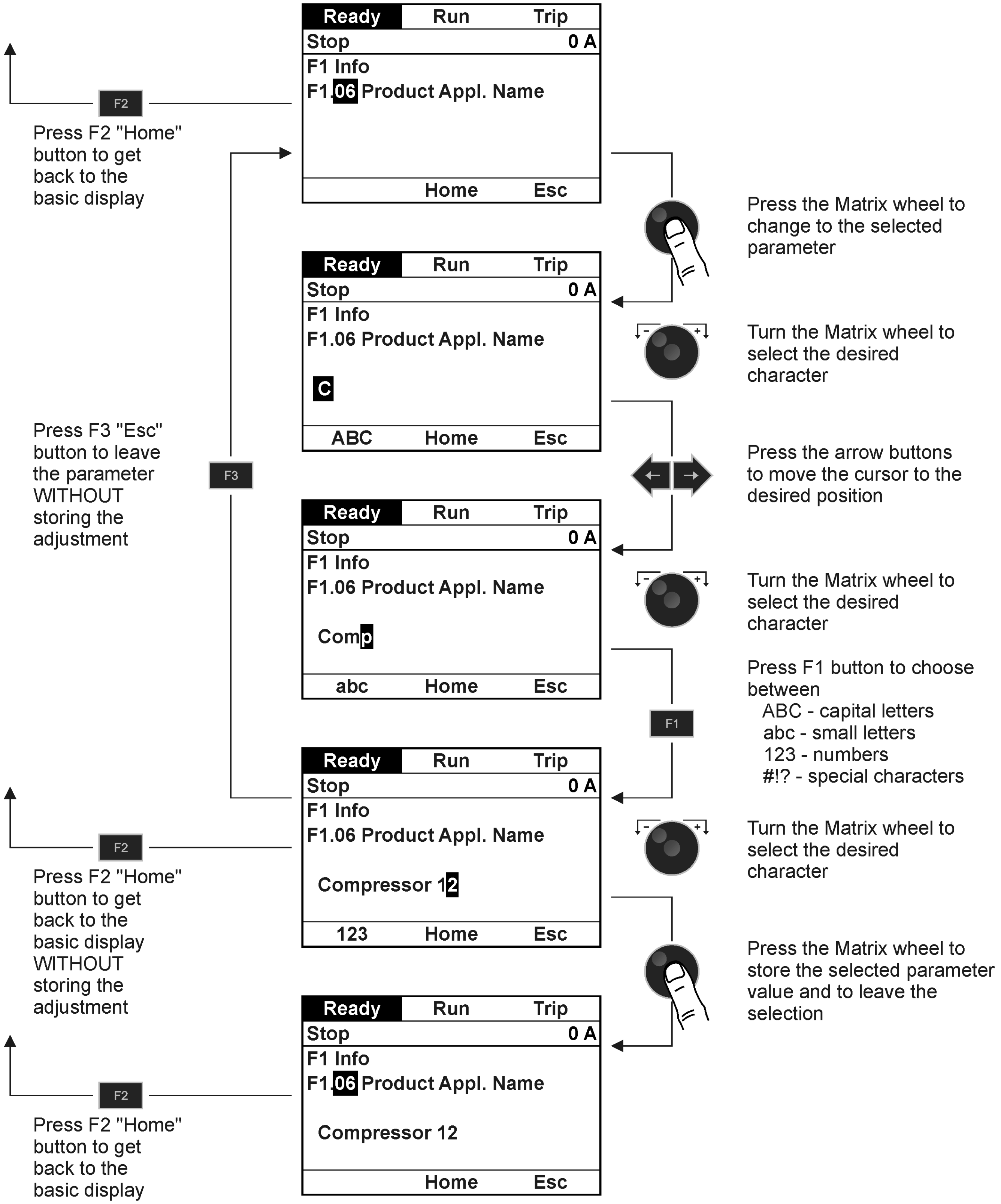
Adjusting a parameter of type "Bit field"



HTIU

8 P01 023 EN.04/04

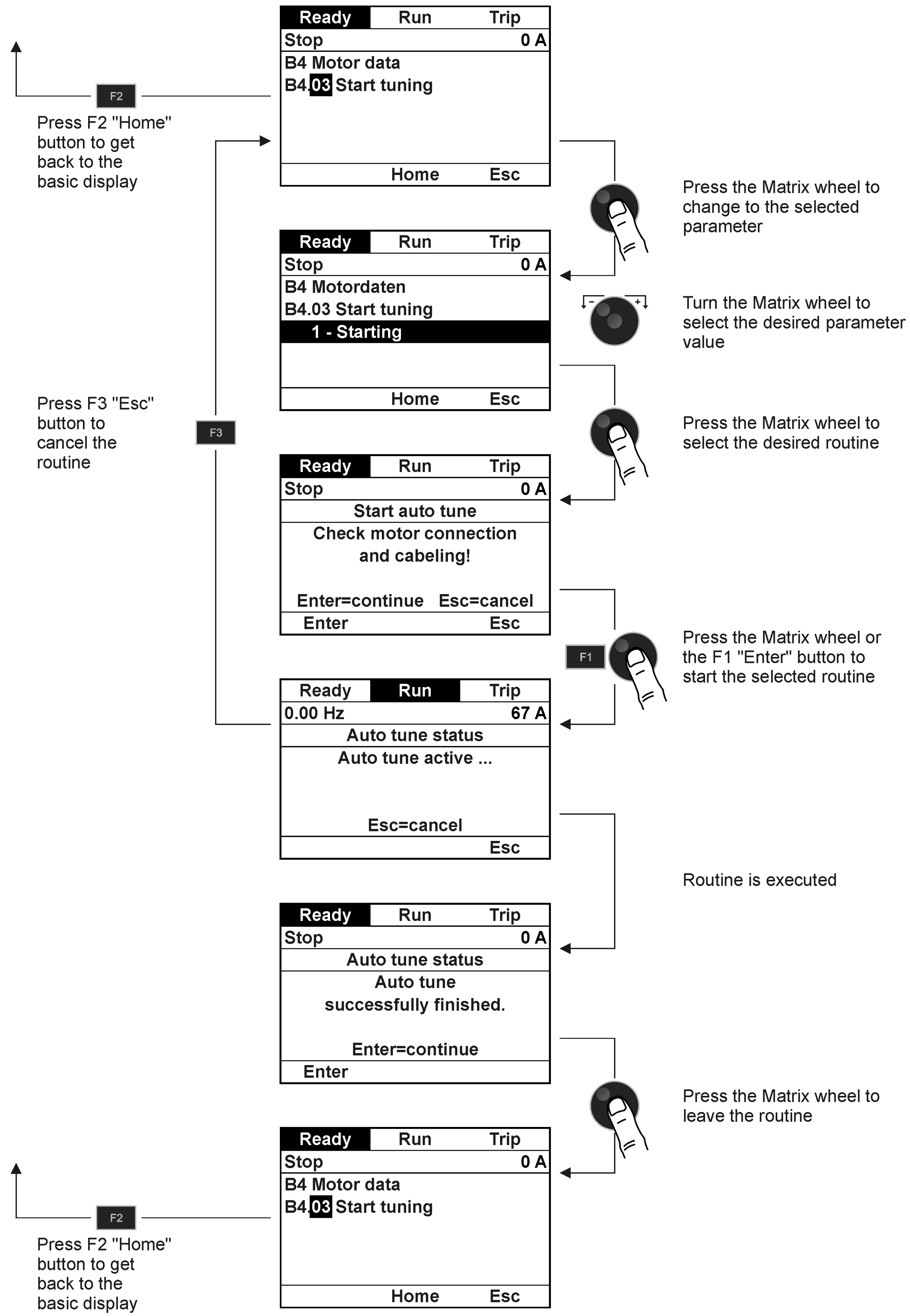
Adjusting a parameter of type "Text"



HTIU

8 P01 023 EN.04/04

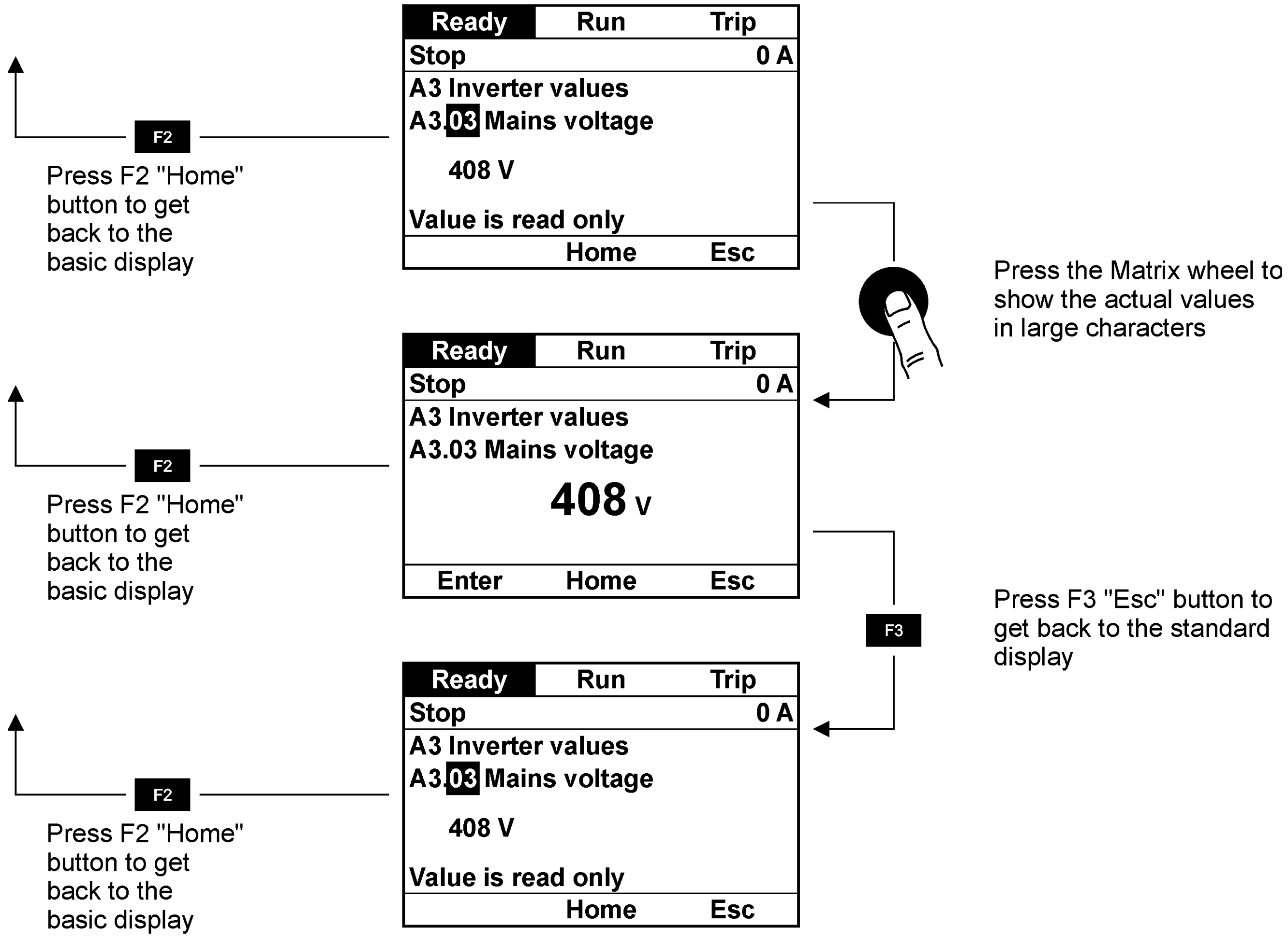
Adjusting a parameter of type "Routine"



HTIU

8 P01 023 EN.04/04

Display of an "actual value" parameter

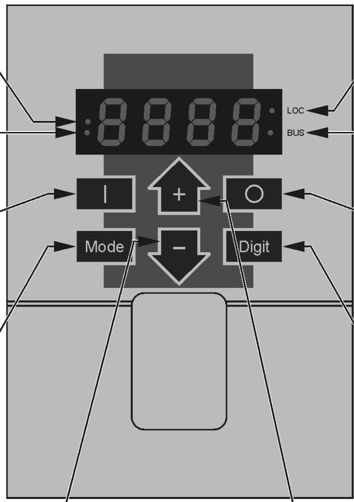


HTIU

8 P01 023 EN.04/04

Operation by means of the LED keypad

LED display



LED status display
for active Modbus communication

LED status display
for active CANopen communication

ON key
start command in panel operation

Mode key
Switching between basic display, matrix field, parameter no. and value; switching between panel/remote operation (press key at least 1.5 s)

LED status display
for active panel operation

LED status display
for active fieldbus operation

OFF key
Stop command in panel operation and optionally in remote and bus operation, selectable reset function

Digit key
Moves the adjustable digit to the left in case of parameters with analog value

Down key
Navigation inside the Matrix level,
scrolling of parameters inside a matrix field,
decreasing of numerical values,
decreasing of the reference value in panel operation

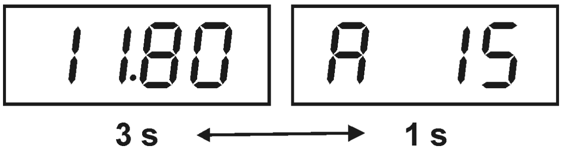
Up key
Navigation inside the Matrix level,
scrolling of parameters inside a matrix field,
increasing of numerical values,
increasing of the reference value in panel operation

HTIU
8 P01 023 EN.04/04

Basic displays

Display at Ready

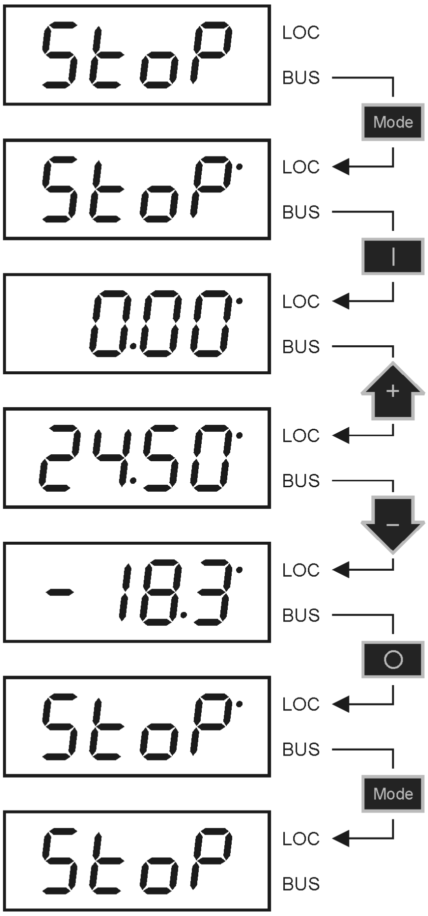
Display at Run (the actual value which is selected with parameter A6.01 is shown)



Display at Run if an alarm occurs (the actual value and the code of the alarm message is shown alternately)

Display at Trip (the code of the trip message is flashing);
Press Stop "O" button to reset

Panel operation



Press "Mode" button for 1.5 s to switch to the panel mode

Press Start "I" button to start the drive

Press Up "+" button to increase the reference value

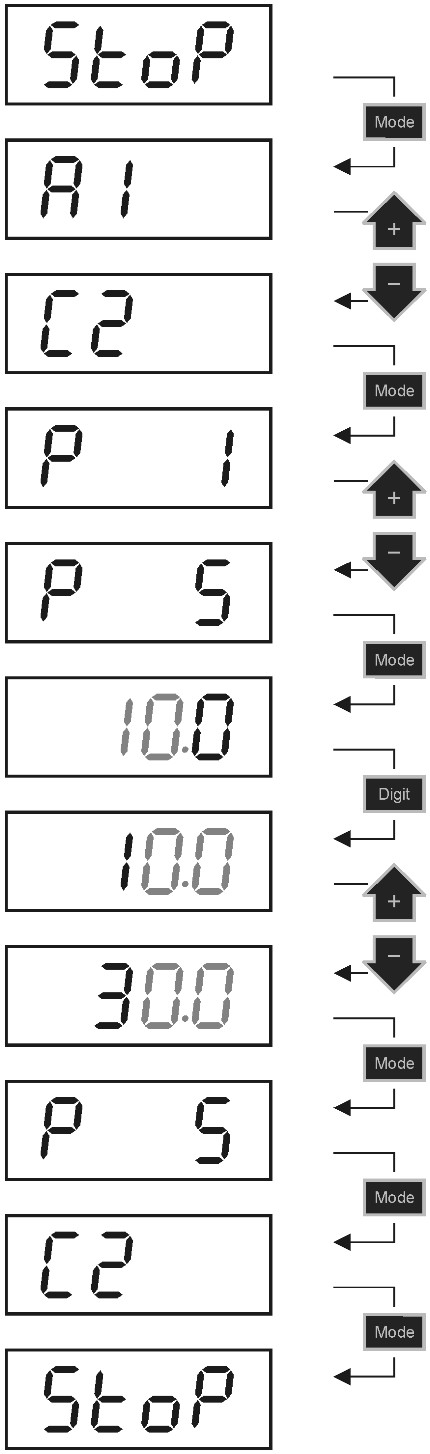
Press Down "-" button to decrease the reference value (negative reference value means REV operation)

Press Stop "O" button to shut down the drive along the set deceleration ramp (2 x Stop leads to pulse inhibit)

Press "Mode" button for 1.5 s to change to the remote mode

HTIU
8 P01 023 EN.04/04

Adjusting a parameter of type "Variable"



Press "Mode" button to switch to the parameter mode

Press arrow buttons to select the desired matrix field

Press "Mode" button to change to the desired matrix field

Press arrow buttons to select the desired parameter number

Press "Mode" button to change to the desired parameter number

Press "Digit" button to change the setable digit of the parameter value (active digit is brighter)

Press arrow buttons to select the desired parameter value

Press "Mode" button to get back to the parameter number

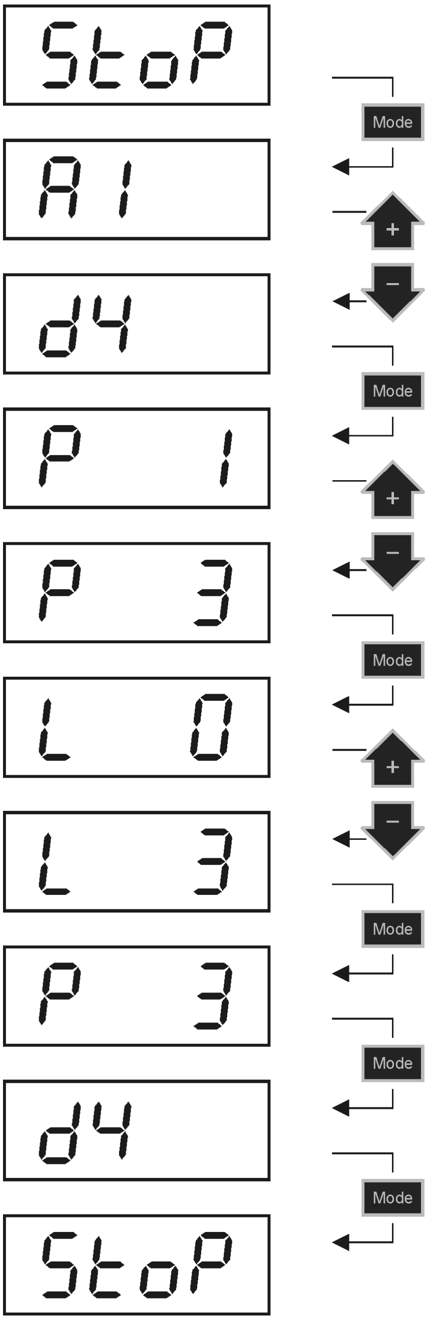
Press "Mode" button to get back to the matrix field

Press "Mode" button to get back to the basic display

HTIU

8 P01 023 EN.04/04

Adjusting a parameter of type "List"



Press "Mode" button to switch to the parameter mode

Press arrow buttons to select the desired matrix field

Press "Mode" button to change to the desired matrix field

Press arrow buttons to select the desired parameter number

Press "Mode" button to change to the desired parameter number

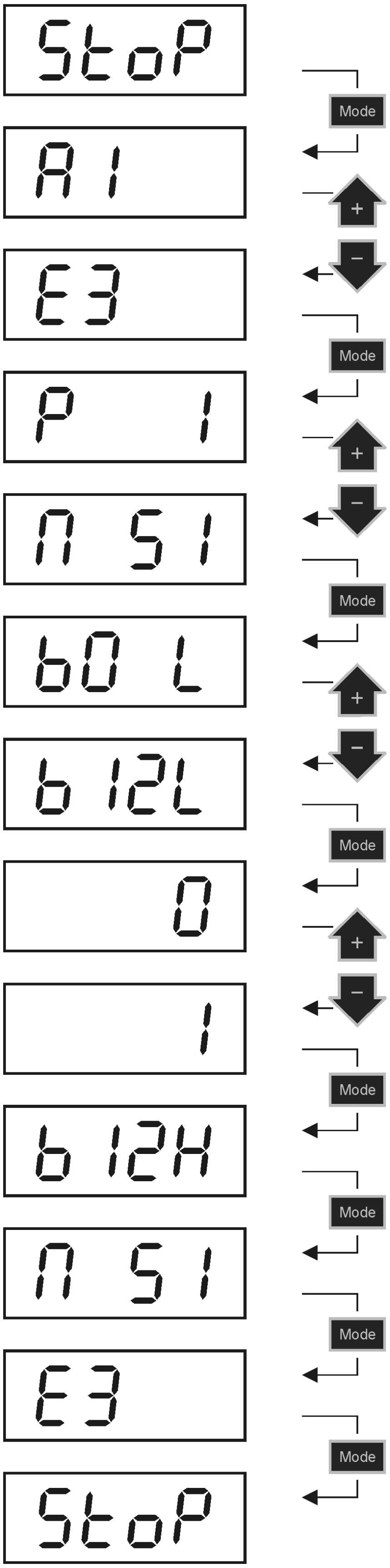
Press arrow buttons to select the desired parameter value

Press "Mode" button to get back to the parameter number

Press "Mode" button to get back to the matrix field

Press "Mode" button to get back to the basic display

Adjusting a parameter of type "Bit field"



Press "Mode" button to switch to the parameter mode

Press arrow buttons to select the desired matrix field

Press "Mode" button to change to the desired matrix field

Press arrow buttons to select the desired parameter number

Press "Mode" button to change to the desired parameter number

Press arrow buttons to select the desired bit of the bitfield

Press "Mode" button to change to the desired bit number

Press arrow buttons to set the desired bit to "1 = high" or "0 = low"

Press "Mode" button to get back to the bit number

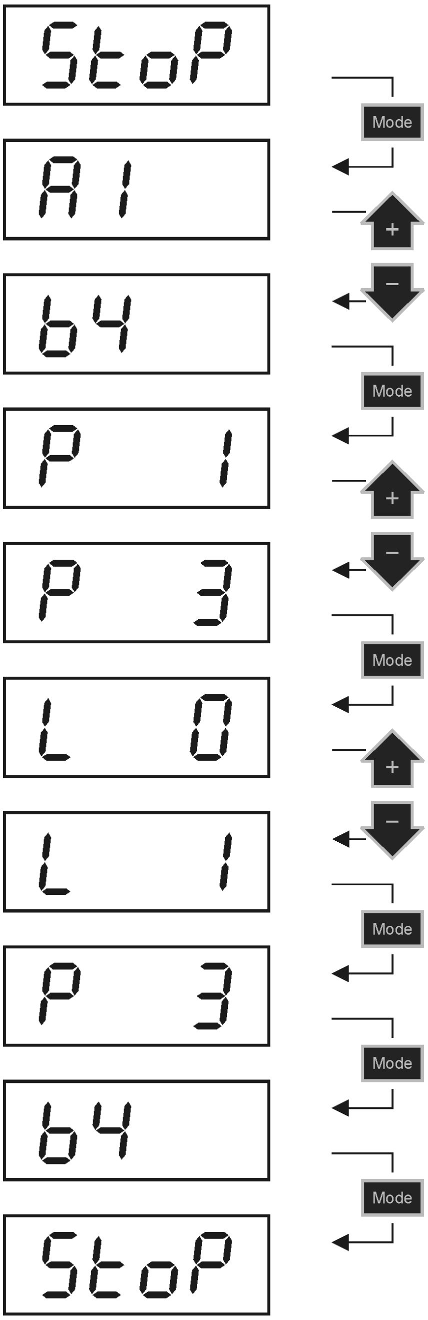
Press "Mode" button to get back to the parameter number

Press "Mode" button to get back to the matrix field

Press "Mode" button to get back to the basic display

HTIU
8 P01 023 EN.04/04

Adjusting a parameter of type "Routine"



Press "Mode" button to switch to the parameter mode

Press arrow buttons to select the desired matrix field

Press "Mode" button to change to the desired matrix field

Press arrow buttons to select the desired parameter number

Press "Mode" button to change to the desired parameter number

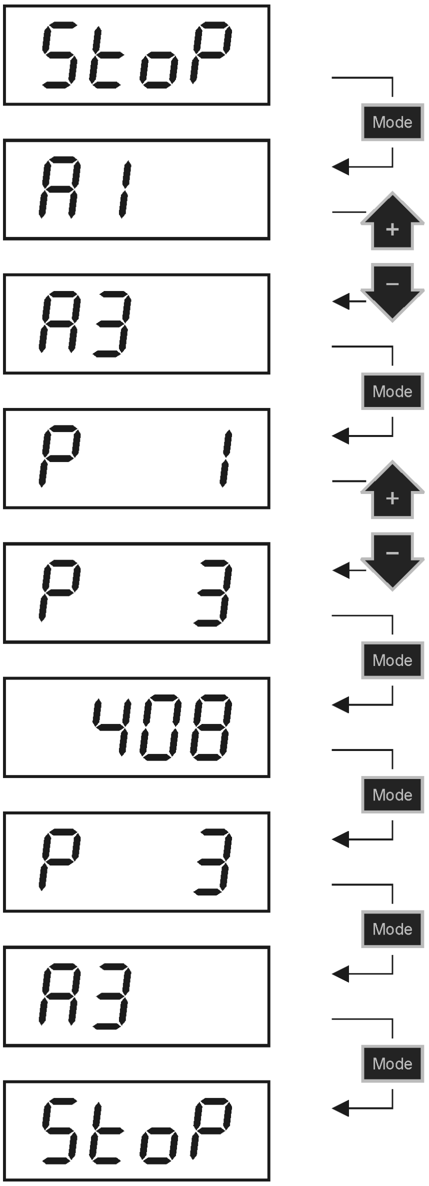
Press arrow buttons to select the desired routine

Press "Mode" button to start the routine, the display changes back to the parameter number

Press "Mode" button to get back to the matrix field

Press "Mode" button to get back to the basic display

Display of an "actual value" parameter



Press "Mode" button to switch to the parameter mode

Press arrow buttons to select the desired matrix field

Press "Mode" button to change to the desired matrix field

Press arrow buttons to select the desired parameter number

Press "Mode" button to change to the desired parameter number

Press "Mode" button to get back to the parameter number

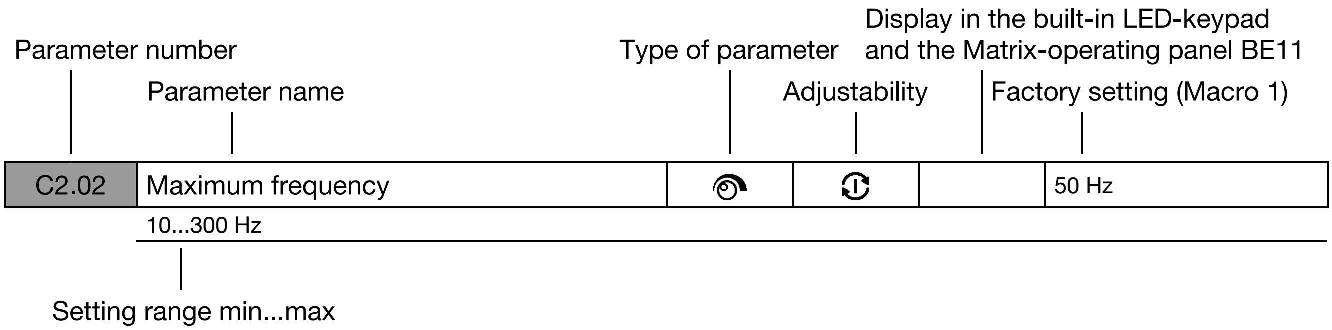
Press "Mode" button to get back to the matrix field

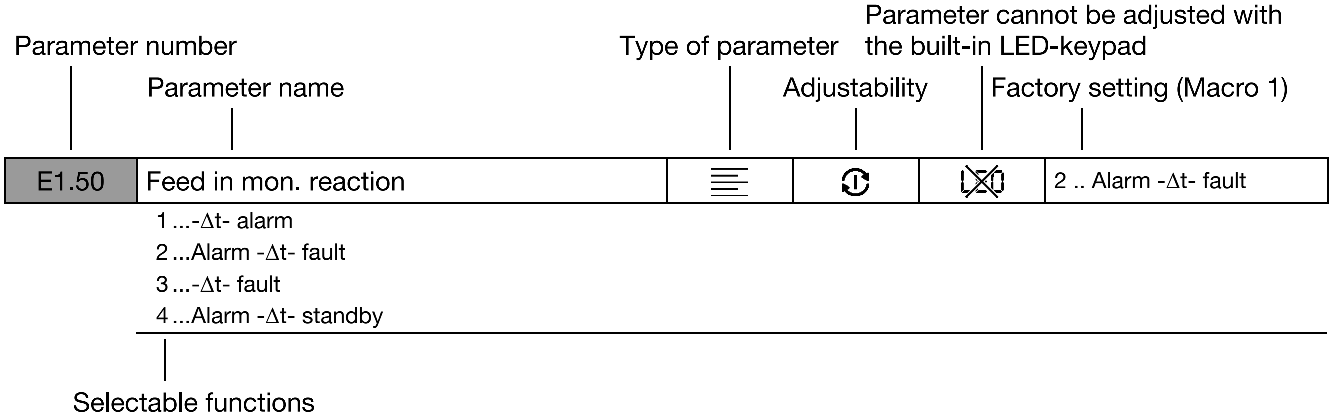
Press "Mode" button to get back to the basic display

HTIU
8 P01 023 EN.04/04

Parameter identification

All parameters described in this documentation are typically represented as follows:





All parameters are sub-divided into different parameter types according to their use and type of setting.

Parameter type	Symbol	Description
Variable		Variables are parameters whose value can be adjusted linear. The possible setting range is limited by a minimum and a maximum value. Typical representatives: C2.05 Acceleration ramp 1 [s], Setting range 0...6000 s
List		List parameters offer the user different selection choices in list form (one below the other). The required function can be selected from the displayed list. Each entry in the list is prefixed with a line number, which is required when the LED-keypad is used. Typical representatives: D3.09 AO2 level 1 .. 0 ... 10V 2 .. ± 10V 3 .. 0 ... 20 mA 4 .. 4 ... 20 mA

HTIU
8 P01 023 EN.04/04

Parameter type	Symbol	Description
Bit field	0110	Bit fields are a special type of list parameters, which allow multiple selection of settings. Typical representatives: E3.04 Autoreset selection 0 .. Line overvoltage ☐ / ☑ 1 .. FU overtemperature ☐ / ☑ ... ... 14 .. ON lock ☐ / ☑ 15 .. Overcurrent ☐ / ☑
Text	**txt**	Text parameters are freely editable or already prepared alpha-numerical texts of different length, which can be displayed in the removable Matrix operating panel BE11. These parameters are omitted when using the built-in LED keypad because they cannot be displayed on the LED display. Typical representatives: F1.06 Facility description Compressor #3

Different list parameters will cause an automatically processing function during their setting. This special form of list parameters is also called a routine (autotuning, loading of macros, creating a backup,...).

Independent of the parameter type a distinction is made between three different types of adjustability:

Adjustability	Symbol	Description
Always adjustable		Parameters with this symbol can be changed independent of the operating state of the frequency inverter.
Adjustable only in case of impulse inhibit		Parameters of this group cannot be adjusted during device state "Run". The drive must be stopped before adjustment (impulse inhibit).
Actual value (not adjustable)		Parameters with this symbol can only be read → Actual value parameters. Actual values can be different parameter types. Typical representatives: A2.03 |Torque| [Nm] (Variable) A2.02 Direction of rotation (List) 1 .. Forward 2 .. Reverse 3 .. Standstill F2.40 Start IGBT test (Bit field) 0 .. IGBT 1 short circuit Yes / No 1 .. IGBT 1 Interrupt. Yes / No ... ... 11 .. IGBT 6 Interrupt. Yes / No F1.07 APP software (Text) APS_eco_B03_04

Hiding parameters

For easy parameter adjustment within the Matrix structure the visibility of individual parameters or complete parameter groups can be adopted specifically to the respective situation.

Parameters that refer to missing hardware options or which belong to non-activated functions, can be automatically faded-out.

D1.01 AI1 selection to 1 .. f-reference 1 [Hz]

D1.02 AI1 level D1.03 AI1 min. value D1.04 AI1 max. value D1.05 AI1 filter-time	These parameters are only displayed, if D1.01 AI1 selection is not set to "0 .. Not used".

D1.08 AI2 selection to 0 .. Not used

D1.15 AI3 selection

This automatic function to hide parameters can be suppressed with parameter A6.04 "View all parameters".

Restriction of functions

The *>pDRIVE< MX eco* frequency inverters include a huge number of application-orientated functions.

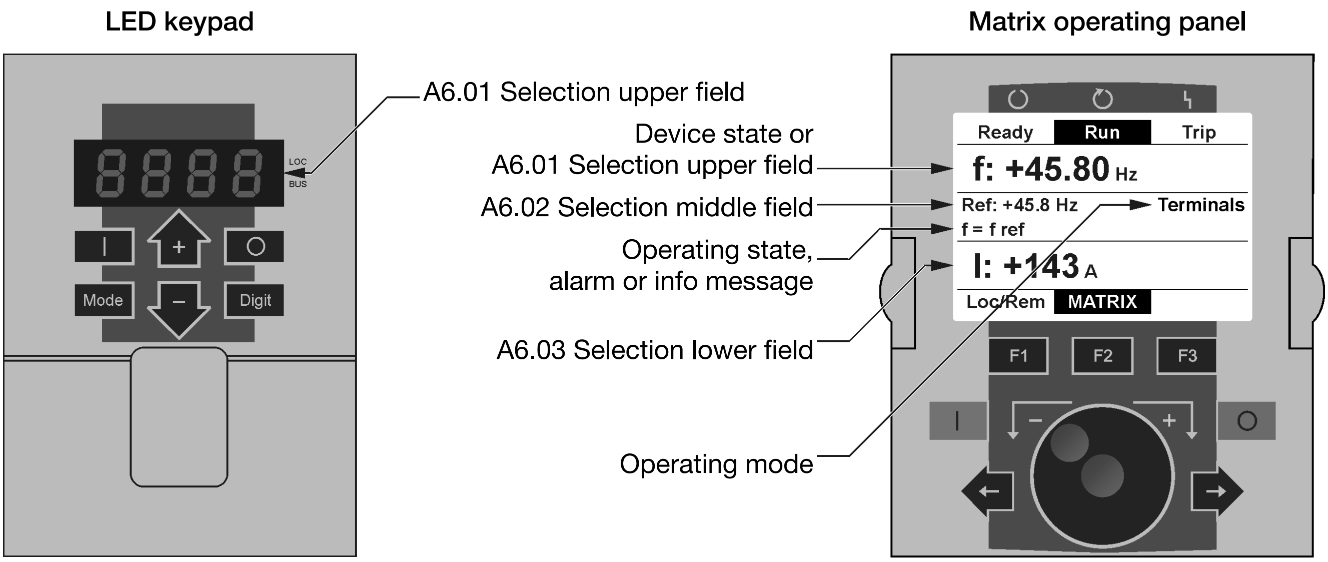
The following table points out which functions must not be used at the same time because malfunction of the inverter is not excluded or simultaneous use is simply ineffective.

	V/f Modi	VC Modi	Minimum frequency	FWD and REV enabled	2nd parameter set	Backup mode	T-limitation	P-limitation	Display torque	Motor heating	Line contactor control	Motor contactor control	Panel operation	Underload protection	Undervoltage ride through	Fast stop at V<	Simulation mode
V/f Modi		–	✓	✓	✓	✓	–	–	–	✓	✓	✓	✓	–	✓	✓	✓
VC Modi	–		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Minimum frequency	✓	✓		–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FWD and REV enabled	✓	✓	–		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2nd parameter set	✓	✓	✓	✓		–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Backup mode	✓	✓	✓	✓	–		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
T-limitation	–	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	–
P-limitation	–	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	–
Display torque	–	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	–
Motor heating	✓	✓	✓	✓	✓	✓	✓	✓	✓		–	–	–	✓	✓	✓	–
Line contactor control	✓	✓	✓	✓	✓	✓	✓	✓	✓	–		✓	✓	✓	✓	✓	–
Motor contactor control	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓		✓	✓	✓	✓	–
Panel operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓		✓	✓	✓	✓
Underload protection	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Undervoltage ride through	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	–
Fast stop at V<	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		–
Simulation mode	✓	✓	✓	✓	✓	✓	–	–	–	–	–	–	✓	✓	–	–	

A	888	**Display**	Display of reference and actual values, Configuration of the LCD display

A1	⌂	**Home**	Basic display, main diagnostic display, Presentation of operating modes, reference and actual values as well as the actual device state

Basic display



The basic display on the removable Matrix operating panel as well as on the built-in 7 segment LED keypad enables an easy, readable diagnostic of the actual operating state and operating mode of the >*pDRIVE*< *MX eco*.

The basic display appears automatically when the device is supplied with voltage. If the device is in parameterization mode, it can be changed to the basic display by pressing the function key F2 "Home" (LCD) or the key "Mode" (LED).

Device state

Matrix operating panel	LED keypad	Description
Trip	E88	The inverter is shut-down due to an occurring fault and there is no voltage on the motor. The cause of the fault is displayed in clear text on the Matrix operating panel, the LED display shows a fault code.
Lock (PWR)	LoCP	The inverter output is locked and there is no voltage on the motor. Locking takes place by means of the digital input PWR (safe standstill).
Lock	LoCI	The inverter output is locked and there is no voltage on the motor. The locking occurs by: – Digital input parameterized at "Enable" – Parameter F6.04 Impulse inhibit
Stop	StoP	The inverter is released, however no starting command is given (terminals or bus control word).
RUN (Display A6.01)	(Display A6.01)	If the inverter is in RUN state the actual value selected at parameter A6.01 "Selection upper field" is displayed instead of the message RUN.
Load	LoAd	The pre-charging of the DC link is active.
Mains off	OFF	The inverter is separated from the supplying mains by the function C6.07 "Line contactor control".
Mains missing	nI P	The supplying mains has broken down. According to the set undervoltage reaction (E3.29 V< response) this state is however not classified as a fault. When the voltage returns the drive automatically starts again.
Mains disconnect	LoFF	A safety mains cut-out is released by the digital command "Mains cut-off".
Locked	LoC2	The inverter electronics is locked for remote operation by the digital command "Locking". The panel operation via the Matrix operating panel or the LED keypad is still possible.
Motor heating	Mht	The function "Motor heating" is active.
DC missing	ndc	The frequency inverter is operated on the intelligent rectifier *>pDRIVE< LX* and the DC link voltage, made available by this rectifier, is cut off. According to the set undervoltage reaction (E3.29 V< response) this state is however not classified as a fault. When the voltage returns the drive automatically starts again.
Auto tune	tun	The function "Start auto tune" is called up and is active.
Standby mode	SI P	The inverter has switched to standby mode. An automatic starting of the drive is possible at any time. See function group C6.11 Standby mode or E1.50 Feed in mon. reaction.
Catch on the fly	CAt	The frequency inverter executes the catch on the fly function. As a result the inverter output synchronizes itself in frequency and phase position on the turning motor.
V<< ride through	dcMt	The undervoltage ride through function is active. As a result, the inverter reduces the output frequency automatically in the case of an occurring undervoltage. The motor is as a result operated as generator in order to supply the inverter electronics during the undervoltage situation. See E3.29 V< response.

HTIU
8 P01 023 EN.04/04

Matrix operating panel	LED keypad	Description
Fast stop	FASt	The command for a fast-stop was triggered and the drive has reached speed zero and is locked. A possibly given start command is ignored. The fast stop function can be triggered by: – Digital input function – B3.24 Stop mode = Fast stop – E3.01 Reaction at a trip = Fast stop
Motorfluxing	Flu	Before start the motor is pre-magnetized in order to optimize the starting behaviour.
DC-holdingbrake	dcbr	The DC holding brake is active.

Operating mode

Matrix operating panel	LED keypad	Description
Local mode	LED "Loc" ●	The control as well as the reference value of the device occur from the Matrix operating panel BE11 or the built in LED keypad.
Terminals	LED "Loc" ❍	The control of the device occurs with the digital command of the terminals. The following possibilities of the command logic are available: – 2-wire (edge rated) – 3-wire – 2-wire (level rated) See also E4.01 Control source 1.
Modbus	LED "Bus" ●	The control of the device occurs via the control word of the active modbus connection. See E4.01 Control source 1 and D6.01 Bus selection.
CANopen	LED "Bus" ●	The control of the device occurs via the control word of the active CANopen fieldbus connection. See E4.01 Control source 1 and D6.01 Bus selection.
Profibus	LED "Bus" ●	The control of the device occurs via the control word of the active Profibus fieldbus connection. See E4.01 Control source 1 and D6.01 Bus selection.

HTIU
8 P01 023 EN.04/04

Operating state

Matrix operating panel	LED keypad	Description
Alarm	–	There is a warning situation. See listing of the alarm and info messages.
Fast stop	–	The command for a fast stop function is triggered. Thereby the drive is in controlled deceleration. The fast stop function can be triggered by: – Digital input function – B3.24 Stop mode = Fast stop – E3.01 Reaction at a trip = Fast stop
Ramp adaption	–	The set acceleration or deceleration ramp cannot be maintained and is automatically extended.
I-limit active	–	A current limitation is active.
Shut down	–	The drive has reacted to a stop command and comes to standstill. After the motor has reached standstill the operating message is reset.
Acceleration	–	The drive accelerates according to the adjusted acceleration ramp. The reference frequency has not been reached yet ($f_{ref} > f_{act}$).
Deceleration	–	The drive decelerates according to the adjusted deceleration ramp. The reference frequency has not been reached yet ($f_{ref} < f_{act}$).
f = f ref	–	The drive has reached its preset speed reference value.
f min	–	The drive operates at the set Minimum frequency (C2.01).
f max	–	The drive operates at the set Maximum frequency (C2.02).

HTIU

8 P01 023 EN.04/04

Alarm/Info messages

Matrix operating panel	LED keypad	Description
Force active	A 01	The force mode is active (see F2.01 Force operation).
Emergency op. active	A 02	The inverter is switched over to the status "Emergency operation" via a digital input command. See parameter E3.10.
External fault 1 (or free editable text E3.38)	A 03	An external fault is signalized via a digital input command (see E3.34 to E3.38). It is processed as an alarm message corresponding to the setting of E3.35 Ext. fault 1 response.
External fault 2 (or free editable text E3.45)	A 04	An external fault is signalized via a digital input command (see E3.41 to E3.45). It is processed as an alarm message corresponding to the setting of E3.42 Ext. fault 2 response.
Undervoltage	A 05	There is an undervoltage situation. This leads to an alarm message corresponding to the setting of E3.29 V< response.
Reference fault AI2	A 06	At analog input AI2 the reference value fell below 2 mA. This leads to an alarm message corresponding to the setting of E3.13 AI2 - 4mA monitor and E3.14 AI2 - 4mA response. If the reference value exceeds 2.5 mA again, the alarm message will be reset.
Reference fault AI3	A 07	At the analog input AI3 the reference value fell below 2 mA. This leads to an alarm message corresponding to the setting of E3.16 AI3 - 4mA monitor and E3.17 AI3 - 4mA response. If the reference value exceeds 2.5 mA again, the alarm message will be reset.
Reference fault AI4	A 08	At the analog input AI4 the reference value fell below 2 mA. This leads to an alarm message corresponding to the setting of E3.19 AI4 - 4mA monitor and E3.20 AI4 - 4mA response. If the reference value exceeds 2.5 mA again, the alarm message will be reset.
Bus fault	A 09	According to the setting of D6.03 Bus error behaviour a bus fault caused by exceeded runtime or a loss of control leads to an alarm message.
Reference fault FP	A 11	At the frequency input FP the reference value fell short by 50 % of the setting f_{min}. This leads to an alarm message corresponding to the setting of E3.22 FP - f monitoring and E3.23 FP - monitoring resp..
Feed in <	A 12	According to the setting of E1.49 Feed-in monitoring and E1.50 Feed in mon. reaction the trigger of the feed-in monitoring leads to an alarm message.
ON-lock from DI	A 13	The digital input function ON lock (E3.48) signalizes a problem which leads to an alarm message corresponding to the setting of E3.49 ON lock response.
Speed check fault	A 14	The function n-monitoring (E1.38) leads to an alarm message corresponding to the setting of E1.45 n-monitoring response.
ϑ M1 >	A 15	The thermal mathematical motor model has reached the set alarm level for motor M1. See parameter E2.19 M1 - response.
ϑ M2 >	A 16	The thermal mathematical motor model has reached the set alarm level for motor M2. See parameter E2.31 M2 - response.
Overspeed	A 17	The overspeed protection (E2.48) has triggered and signalizes an alarm corresponding to the setting of the parameter E2.49 Overspeed response.

Matrix operating panel	LED keypad	Description
TH - ϑ M1 >	A 18	At least one of the thermistors (PTC) or thermal switches assigned to motor M1 (see motor assignment E2.01, E2.06, E2.11) has detected an overtemperature. An alarm message is as a result activated corresponding to the reaction setting for the respective thermistor.
TH - ϑ M2 >	A 19	At least one of the thermistors (PTC) or thermal switches assigned to motor M2 (see motor assignment E2.01, E2.06, E2.11) has detected an overtemperature. An alarm message is as a result activated corresponding to the reaction setting for the respective thermistor.
TH ϑ Ext >	A 20	At least one of the thermistors (PTC) or thermal switches, which are planned for the general use (see assignment E2.01, E2.06, E2.11) has detected an overtemperature. An alarm message is as a result activated corresponding to the reaction setting for the respective thermistor.
Underload	A 21	The underload function (E2.61) recognises a motor underload and activates an alarm message corresponding to the setting of E2.62 Underload response.
Ramp adaption	A 23	The set acceleration or deceleration ramp cannot be maintained and is automatically extended.
Service M1	A 24	The operating hours counter (A5.01) for motor M1 has exceeded the set time interval (A5.02).
Service M2	A 25	The operating hours counter (A5.04) for motor M2 has exceeded the set time interval (A5.05).
Service Power On	A 26	The operating hours counter (A5.07) for the power part of the device (device is supplied with mains voltage) has exceeded the set time interval (A5.08).
Service fan	A 27	The operating hours counter (A5.10) for the power part fan has exceeded the set time interval (A5.11).
Simulation active	A 28	The Simulation mode (F2.45) is activated.
Download active	A 29	The PC program Matrix 3 executes a parameter download. After transmission it is necessary to confirm the parameterization on the LED keypad with shortcut "Digit + ↑" (or shortcut "Digit + ↓" to deny parameterization) in order to return to the regular operating state. Alternatively confirmation is possibly by means of the service code F6.05 = 33. (When using the Matrix operating panel BE11 confirmation takes place by means of the function keys F1/F3.)
E6 incomplete	A 30	*Parameterization alarm* One or several function modules in parameter group E6 are parameterized incompletely or faulty.
XY Graph set faulty	A 31	*Parameterization alarm* The reference source XY graph is parameterized incompletely or faulty.
Change control mode !	A 32	*Parameterization alarm* The selected function cannot be combined with the actual control mode.
Param.set 1 fault	A 36	Faulty Eprom-zone for parameter set 1
Param.set 2 fault	A 37	Faulty Eprom-zone for parameter set 2
IGBT ϑ >	A 38	IGBT overtemperature, determined by the thermal mathematical inverter model
V/f 7 point set faulty	A 40	*Parameterization alarm* Incomplete or faulty parameterization of the V/f characteristic.

Matrix operating panel	LED keypad	Description
BE11 loss	A 45	The connection between matrix operating panel BE11 and inverter is cut off during active panel operation and a loss of BE11 control is detected (see parameter E5.12).
Control requ. missing	A 46	Control bit (b10) of the bus control word is low.
Parameter set 1	A 47	Displays the active parameter set when switch-over of parameter sets is selected (see parameter B2.03).
Parameter set 2	A 48	Displays the active parameter set when switch-over of parameter sets is selected (see parameter B2.03).
Test mode active	A 49	The drive operates in test mode (see parameter F2.49).
I-limit active	A 51	The actual motor current is higher than the actual allowed operating current. Current-limiting protective mechanisms are I_{max1} (E1.01), the thermal motor model (E2.18...E2.39) and the thermal mathematical inverter model (E1.03).
T-limitation active	A 52	The actual motor torque is higher than an effective limitation value. Torque-limiting protective mechanisms are the internal torque limitation (E1.05) and the power limitation (E1.13).
Process fault 1	A 53	A process fault is signalized via a digital input command (see E3.65...E3.69). It is processed as an alarm message corresponding to the setting of E3.66 Process fault 1 response.
Process fault 2	A 54	A process fault is signalized via a digital input command (see E3.72...E3.76). It is processed as an alarm message corresponding to the setting of E3.73 Process fault 2 response.
Process fault 3	A 55	A process fault is signalized via a digital input command (see E3.79...E3.83). It is processed as an alarm message corresponding to the setting of E3.80 Process fault 3 response.

Trip messages

Matrix operating panel	LED keypad	Description
Undervoltage	E01	There is an undervoltage situation. See parameter E3.29 V< response.
V>> at deceleration	E02	The DC link voltage has exceeded the hardware protection level of 825 V due to a deceleration. Extend deceleration ramps or activate motor brake B5.01 Brake mode.
Line overvoltage	E03	The DC link voltage has exceeded the protection level of 756 V. As the fault evaluation only occurs with impulse inhibit, a line overvoltage situation takes place !
MC not ready	E04	The motor control is not ready after the charging process.
DC missing	E05	The frequency inverter is operated at the intelligent rectifier >*pDRIVE*< *LX*. The DC link voltage, made available by this rectifier, has shut down.
Precharging fault	E06	Fault of the soft charge device (half controlled thyristor bridge). Only for devices larger than >*pDRIVE*< *MX eco* 4V18.
Line fault 1p	E08	Loss of one mains phase
Line fault 2-3p	E09	Loss of two or three mains phases
Overcurrent	E10	Overcurrent at the output
Motor earth fault	E11	Earth fault at the output Registration by means of the software (only with devices up to and including >*pDRIVE*< *MX eco* 4V75)
Insulation fault	E12	The differential current determined from the three motor phases is larger than 25 % of the nominal current of the inverter.
Overcurrent	E13	Overcurrent at the output Registration by means of the software (only with devices up to and including >*pDRIVE*< *MX eco* 4V75)
IGBT ϑ >>	E14	IGBT overtemperature, determined by the thermal mathematical inverter model
Motor phase fault 3p	E15	Loss of the three motor phases
Motor phase U lost	E16	Loss of motor phase U
Motor phase V lost	E17	Loss of motor phase V
Motor phase W lost	E18	Loss of motor phase W
Inverter overtemp.	E19	Inverter overtemperature (overload, cooling problem)
Unknown MC	E20	Unknown power part
PTC short circuit	E21	Short-circuit at a thermistor (PTC) sensor (TH1, TH2, TH3, TH heat sink)
PTC open circuit	E22	A thermistor (PTC) sensor is open (TH1, TH2, TH3, TH heat sink)
ASIC Init fault	E23	Asic on the motor control cannot be initialised.
IGBT fault	E25	The desaturation protection of an IGBT has triggered. The registration of this fault occurs only with devices larger than >*pDRIVE*< *MX eco* 4V75.
IGBT short circuit	E27	Electronically determined short circuit at one of the IGBTs.
Motor short circuit	E28	The automatically running test routine B3.43 Automatic SC test has detected a short circuit at the output.

Matrix operating panel	LED keypad	Description
Current measure fault	E30	Fault of the current transformer, its voltage supply or the evaluation electronics. The registration of this fault occurs only with devices larger than >*pDRIVE*< *MX eco* 4V75.
MC E^2 zones invalid	E32	Motor control EEProm defect
CPU fault	E33	Internal electronic fault
ISL fault	E34	Communication fault on the internal serial link
MTHA fault	E35	Asic for time measurement defect (undervoltage time determination)
Overspeed	E36	The motor has exceeded the maximum allowed Overspeed level (E2.50).
Safe Standstill	E37	There is a fault in the area of the internal monitoring for function "Safe Standstill" (PWR).
IO12 comm. fault	E38	Communication fault at option card >*pDRIVE*< *IO12*
Opt. comm. fault	E39	Communication fault at an option card
Wrong option board	E40	Defect or unknown option card used
Bus fault	E41	A bus fault occurred due to exceeded run time or loss of control.
Param. config. fault	E42	Parameter settings invalid
Reference fault AI2	E43	At the analog input AI2 the reference value fell below 2 mA.
Reference fault AI3	E44	At the analog input AI3 the reference value fell below 2 mA.
Reference fault AI4	E45	At the analog input AI4 the reference value fell below 2 mA.
Reference fault FP	E46	At the frequency input FP the reference value fell short by 50 % of the setting f_{min}.
TH ϑ M1 >>	E47	At least one of the thermistors (PTC) or thermal switches assigned to motor M1 (see motor assignment E2.01, E2.06, E2.11) has detected an overtemperature.
TH ϑ M2 >>	E48	At least one of the thermistors (PTC) or thermal switches assigned to motor M2 (see motor assignment E2.01, E2.06, E2.11) has detected an overtemperature.
TH ϑ Ext >>	E49	At least one of the thermistors (PTC) or thermal switches, which are planned for the general use (see assignment E2.01, E2.06, E2.11) has detected an overtemperature.
ϑ M1 >>	E50	The thermal mathematical motor model has reached the set trigger level for motor M1.
ϑ M2 >>	E51	The thermal mathematical motor model has reached the set trigger level for motor M2.
Stall protection	E52	The stall protection has triggered due to a rotor blockade or a highly overloaded starting. See parameter E2.42 to E2.45.
Underload	E53	The underload function (E2.61) has recognized a motor underload.
Speed check fault	E54	The function n-monitoring (E1.38) has recognized an overspeed.
Feed in <<	E55	The function Feed-in monitoring (E1.49) has triggered.
AT-fault 1	E56	Fault at the execution of the autotuning routine
Config. fault	E57	EEProm application software incompatible or changed power part
External fault 1	E58	An external fault is signalized via a digital input function (see E3.34 to E3.38).
External fault 2	E59	An external fault is signalized via a digital input function (see E3.41 to E3.45).

Matrix operating panel	LED keypad	Description
Line contactor fault	E60	Line contactor control defect (response monitoring)
Motor contactor error	E61	Feedback for motor contactor control faulty
ON lock	E63	The digital input function "ON lock" (E3.48) caused a protective shut-down.
Internal SW error	E64	Internal software bug
Power rating fault	E65	Unclear power part assignment
Incompatible MC	E66	Motor control is not compatible to the application software
Flash fault APP	E67	Flash Eprom on the applicative defect
Indus zone fault	E68	Value for calibration on the applicative defect
Eprom fault APP	E69	EEProm on the applicative defect
Limitation active	E71	A limitation function of the motor control (current or torque) was active and according to the setting of E1.17 Reaction at limitation a protective shut-down takes place.
Ramp adaption	E72	The set acceleration or deceleration ramp cannot be maintained and is automatically extended.
24V fault	E73	Problem with the external 24 V buffer voltage
BE11 loss	E80	The connection between matrix operating panel BE11 and inverter is cut off during active panel operation and a loss of BE11 control is detected (see parameter E5.12).
VSD overload	E81	Protective shut-down due to exceeding the maximum current/time specification.
I-limit active	E82	The actual motor current was higher than the actual allowed maximum current (E1.01 I_{max1}, thermal mathematical motor model E2.18...E2.39, thermal mathematical inverter model E1.03). This leads to a protective shut-down corresponding to the setting of E1.17 Reaction at limitation.
T-limitation active	E83	The actual motor torque was higher than an effective limitation value. Torque-limiting protective mechanisms are the internal torque limitation (E1.05) and the power limitation (E1.13). This leads to a protective shut-down corresponding to the setting of E1.17 Reaction at limitation.
Process fault 1	E87	A process fault is signalized via a digital input command (see E3.65...E3.69).
Process fault 2	E88	A process fault is signalized via a digital input command (see E3.72...E3.76).
Process fault 3	E89	A process fault is signalized via a digital input command (see E3.79...E3.83).

Motor values

A2.01	|Speed|				rpm

Display of the actual motor speed in rotations per minute. The presentation occurs in unipolar form. The motor speed is calculated from the inverter output frequency and the nominal motor data (to be entered into the Matrix field B4) considering the actual slip as a result of the load.

A2.02	Direction of rotation				

1 ...Forward
2 ...Reverse
3 ...Standstill

Display of the phase sequence of the current output rotating field.

The display "Standstill" occurs in the range of speed zero.

HTIU

A2.03	|Torque|				Nm

Display of the motor torque in Nm. The presentation occurs in unipolar form.

The torque is calculated from the internal motor values current and flow. Exact calculation is only possible if a vector-oriented motor control method (B3.02) is used.

8 P01 023 EN.04/04

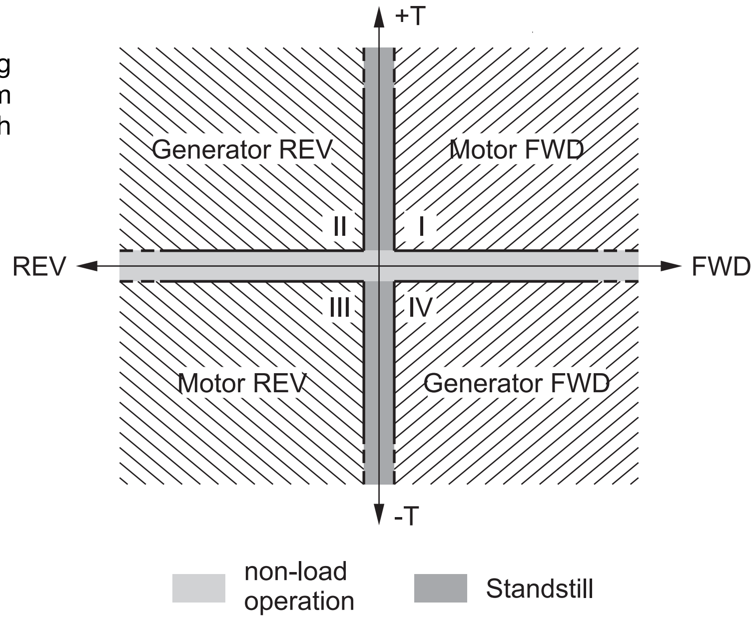
The entry of the motor nominal data (Matrix field B4) is essential for the correct determination of the torque.

Accuracy: V/f-variants: 15 % (10...50 Hz, related to nominal motor torque)
Vector control: 5 % (3...300 Hz, related to nominal motor torque)

A2.04	Operating quadrant				

0 ...Standstill
1 ...Motor FW
2 ...Generator REV
3 ...Motor REV
4 ...Generator FW
5 ...No-load operation

Display of the actual operating quadrant which is determined from the values of speed and torque with right algebraic sign.



In the range of torque precision the display "no-load operation" occurs, at speed zero the display "Standstill" occurs.

A2.05	Motor current in A				A

Display of the actual apparent motor current (effective value of the fundamental mode).

The measurement occurs up to >*pDRIVE*< *MX eco* 4V18 in two output phases, for bigger devices in all three output phases.

Accuracy: 3% (related to nominal inverter current)

A2.06	Motor current in %				%

Display of the actual motor current in % related to the parameterized nominal motor current (see Matrix field B4, page 93).

Accuracy: 3% (related to nominal inverter current)

A2.07	Shaft power in kW				kW

Display of the motor shaft power in kW. It is calculated from the characteristic values of torque and speed.

Accuracy:	>*pDRIVE*< *MX eco* 4V0,75...4V75:	10% (related to nominal inverter power)
	>*pDRIVE*< *MX eco* from 90 kW:	5% (related to nominal inverter power)

A2.08	Shaft power in HP				HP

Presentation of the actual output power in HP (NEC motors).

Accuracy: >*pDRIVE*< *MX eco* 4V0,75...4V75: 10% (related to nominal inverter power)
>*pDRIVE*< *MX eco* from 90 kW: 5% (related to nominal inverter power)

A2.09	Apparent power				kVA

Presentation of the actual apparent inverter output in kVA. For calculation the measuring values of output current and voltage are used.

Accuracy: >*pDRIVE*< *MX eco* 4V0,75...4V75: 10% (related to nominal inverter power)
>*pDRIVE*< *MX eco* from 90 kW: 5% (related to nominal inverter power)

A2.10	Motor voltage				V

Display of the actual motor voltage in V (effective value of the fundamental mode).

With devices up to and including 75 kW the motor voltage is calculated by the µP-control from the measured DC link voltage and the actual modulation pattern. In the power range from 90 kW the output voltage is measured directly.

Accuracy: >*pDRIVE*< *MX eco* 4V0,75...4V75: 10% (related to nominal voltage)
>*pDRIVE*< *MX eco* from 90 kW: 2% (related to nominal voltage)

HTIU

A2.11	Thermal load M1				%
A2.12	Thermal load M2				%

For the calculation of the thermal load of both possible motors two load adaptive mathematical models are available which determine the motor temperature without external sensors (setting see Matrix field E2, page 206).

100 % thermal load correspond with the maximum approved continuous heating corresponding insulation class B.

After mains disconnection the thermal motor state is tracked accordingly on the basis of the determined off period. A buffering with 24 V control voltage is therefore not necessary.

A2.13	Process speed				rpm

A2.14	Multiplier - n				1
	-1000...1000				

A2.15	Divisor - n				1
	1...1000				

A2.16	Offset - n				0
	-100...100				

A2.17	Symbol for A2.13	txt			

A2.18	Unit for A2.13	txt			

Edit unit	kWh	m/s
_	Hz	m³/h
%	kHz	s
mA	bar	min
A	mbar	h
mOhm	rpm	Nm
Ohm	mm	kg
V	m	°C
W	m³	°F
kW	ms	

By using the removable Matrix operating panel it is possible to display a value derived from the motor speed. In addition the value itself, its symbol and also the required unit can be user-specifically set by means of the functional module "Process speed". The unit can be selected from the list or can be freely adapted by alphanumerical entry.

Example: Display of the conveyor capability of a screw feeder in m³/h

Value adaptation: Display value = Speed (A2.01) x A2.14 / A2.15 + A2.16

Symbol: Selection from list "m³/h"

A2.19	Process torque				%

A2.20	Multiplier - T				1
	1...10000				

A2.21	Divisor - T				1
	1...1000				

A2.22	Offset - T				0
	-100...100				

A2.23	Symbol for A2.19	txt			

A2.24	Unit for A2.19	txt			

Edit unit	kWh	m/s
_	Hz	m³/h
%	kHz	s
mA	bar	min
A	mbar	h
mOhm	rpm	Nm
Ohm	mm	kg
V	m	°C
W	m³	°F
kW	ms	

By using the removable Matrix operating panel it is possible to display a value derived from the motor torque in the basic display. In addition the value itself, its symbol and also the required unit can be user-specifically set by means of the functional module "Process torque". The unit can be selected from the list or can be freely adapted by alphanumerical entry.

Example: Display of the drive load in % of a gear connected behind the motor.

Value adaptation: Display value = Motor torque (A2.03) x A2.20 / A2.21 + A2.22

Symbol: Selection from list "%"

A2.25	Active motor				

1 ...Motor 1
2 ...Motor 2

The frequency inverter can be operated independently of the application-sided parameterization with two different motors (see Matrix group B4, page 93).

Parameter A2.25 displays the respective active motor.

The switching over between both motors occurs by means of a free programmable digital output or by the parameterization.

Inverter values

A3.01	Output frequency				Hz

Display of the inverter output frequency in Hz.

Resolution: 0.01 Hz

A3.02	Inverter load				%

Display of the actual current loading of the frequency inverter in % of the nominal inverter current.

Accuracy: 3% (related to nominal inverter current)

A3.03	Mains voltage				V

The display of the actual mains voltage, which is determined from the measured DC link voltage and in consideration of the actual load status.

Accuracy: 8% (related to maximum DC link voltage)

A3.04	DC voltage				V

Display of the actual DC link voltage in V DC.

The value of the DC link voltage depends on the factors mains voltage, operating state (motor operation / braking) and the respective load situation.

Operating state	Typical value
No-load operation	Peak value of the mains-sided supplied AC voltage ($\sqrt{2}$ x V_{Mains})
Motor operation	1...3 % lower than the no-load voltage
Braking	DC link voltage is higher than the no-load voltage, max. 850 V

Accuracy: 3% (related to maximum DC link voltage)

A3.05	Thermal load VSD				%

Display of the actual thermal load of the frequency inverter.

100 % correspond with the maximum approved heat sink temperature of the respective inverter.

The thermal load is a dimension for the thermal balance which arises from the two factors load (current and time of load) and the cooling conditions (temperature of coolant, fan power).

A3.06	Active pulse frequency				kHz

Display of the actual pulse frequency.

Maybe the actual pulse frequency does not comply with the parameterized value because of too high thermal load or at active motor noise optimization (see Matrix group B3, page 84).

HTIU
8 P01 023 EN.04/04

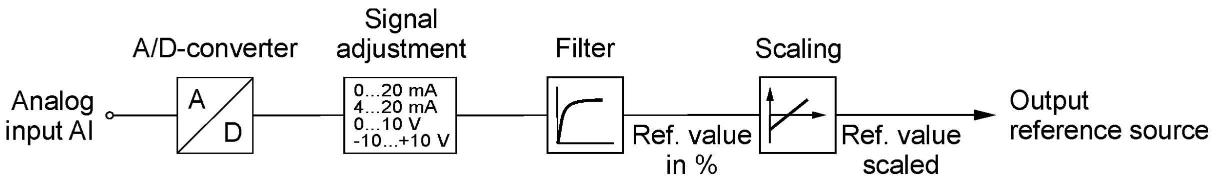
A4		**Reference values**	Display of inverter internal and external reference values

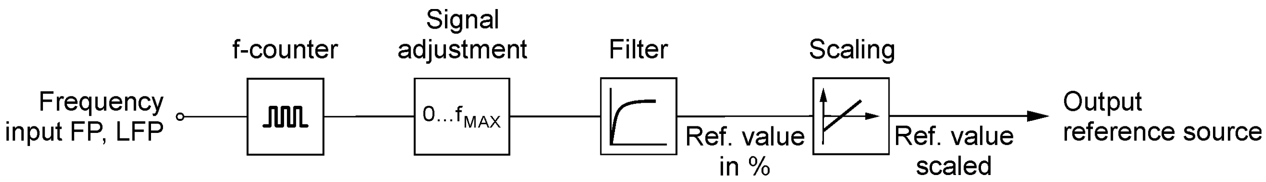
The Matrix field A4 offers the possibility to display all reference values which are internally available as well as the status of the digital inputs.

With the reference values, it is differentiated between analog, digital, internal and bus reference sources.

This possibility for diagnostics is a valuable help especially during commissioning and for clarifying possibly occurring faults.

Monitoring of analog inputs





HTIU
8 P01 023 EN.04/04

The following analog reference sources are available:

Basic card:	AI1	0...10 V / -10...+10 V
	AI2	0...10 V / 0...20 mA / 4...20 mA
	LFP (DIx)	24 V / 10...60 Hz
Option >*pDRIVE*< *IO12*:	AI3	0...20 mA / 4...20 mA
	AI4	0...10 V / 0...20 mA / 4...20 mA
	FP	0...30 kHz

A4.01	AI1 ref. value [%]				%

Available reference value on the analog input terminal AI1 (directly after the analog/digital conversion).

0 % = 0 V or -10 V (corresponding to D1.02 "AI1 level")
100 % = 10 V

A4.02	AI1 ref. value scaled				% or Hz

Output of the reference source AI1.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.03	AI2 ref. value [%]				%

Available reference value on the analog input terminal AI2 (directly after the analog/digital conversion).

0 % = 0 mA or 4 mA (corresponding to D1.09 "AI2 level")
100 % = 10 V or 20 mA

A4.04	AI2 ref. value scaled				% or Hz

Output of the reference source AI2.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.05	AI3 ref. value [%]				%

Available reference value on the analog input terminal AI3 on the option card >*pDRIVE*< *IO12* (directly after the analog/digital conversion).

0 % = 0 mA or 4 mA (corresponding to D1.16 "AI3 level")
100 % = 20 mA

A4.06	AI3 ref. value scaled				% or Hz

Output of the reference source AI3.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.07	AI4 ref. value [%]				%

Available reference value on the analog input terminal AI4 on the option card >*pDRIVE*< *IO12* (directly after the analog/digital conversion).

0 % = 0 mA or 4 mA (corresponding to D1.23 "AI4 level")
100 % = 10 V or 20 mA

A4.08	AI4 ref. value scaled				% or Hz

Output of the reference source AI4.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.09	FP ref. value in kHz				kHz

Available reference value on the frequency input FP on the option card >*pDRIVE*< *IO12* (directly after the frequency counter).

Resolution: 0.01 kHz

A4.10	FP ref. value scaled				% or Hz

Output of the reference source frequency input.

The value is displayed in % or Hz according to the use on the reference value distributor.

HTIU
8 P01 023 EN.04/04

Monitoring of digital reference sources

Digital reference sources create their output reference value as a result of digital input signals. With this type of reference source the scaled output value is available before the transmission on the reference value distributor as display value (see Matrix field C1, page 105).

A4.11	Motor pot. ref. value				% or Hz

Output of the reference source motor potentiometer.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.12	MX-wheel ref. value				Hz

Output of the panel reference source Matrix wheel in Hz.

A4.13	Pre-set reference				% or Hz

Output of the reference source pre-set reference values.

The value is displayed in % or Hz according to the use on the reference value distributor.

Monitoring of internal reference sources

Internal reference sources do not create their output value directly depending on external signals. The reference value is internally created by the selected function and the corresponding parameterization and is subsequently transferred to the reference value distributor (see Matrix field C1, page 105).

A4.14	Reference val. switch				% or Hz

Output of the reference source Reference val. switch.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.15	Calculator				% or Hz

Output of the reference source Calculator.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.16	Act. value selection				% or Hz

Output of the reference source Act. value selection.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.17	Curve generator				% or Hz

Output of the reference source Curve generator.

The value is displayed in % or Hz according to the use on the reference value distributor.

Monitoring of digital inputs

Digital inputs are used for integration of commands from a superior control into the frequency inverter.

The active inputs are presented as logical 1 in the corresponding monitor parameters independent of the selected signal type (sink / source).

The following digital inputs are available:

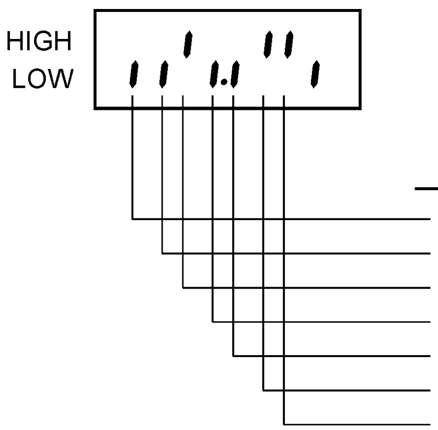
Basic card:	DI1...DI5	free programmable inputs
	DI6	free programmable input (hidden if it is used as TH1)
	PWR	Input for "Safe Standstill", cannot be parameterized
Option >*pDRIVE*< *IO11*:	DI7...DI10	free programmable inputs
Option >*pDRIVE*< *IO12*:	DI11...DI14	free programmable inputs

A4.18	DI state basic device	0110			
	0 .. DI 1	☐ / ☑	4 .. DI 5	☐ / ☑	
	1 .. DI 2	☐ / ☑	5 .. DI 6	☐ / ☑	
	2 .. DI 3	☐ / ☑	6 .. PWR	☐ / ☑	
	3 .. DI 4	☐ / ☑			

A4.19	DI state IO11	0110			
	0 .. DI 7	☐ / ☑			
	1 .. DI 8	☐ / ☑			
	2 .. DI 9	☐ / ☑			
	3 .. DI 10	☐ / ☑			

A4.20	DI state IO12	0110			
	0 .. DI 11	☐ / ☑			
	1 .. DI 12	☐ / ☑			
	2 .. DI 13	☐ / ☑			
	3 .. DI 14	☐ / ☑			

The state of the digital inputs is displayed on the built-in LED keypad as follows:



Basic device	Option IO11	Option IO12
DI 1	DI 7	DI 11
DI 2	DI 8	DI 12
DI 3	DI 9	DI 13
DI 4	DI10	DI 14
DI 5		
DI 6		
PWR		

Monitoring of bus reference sources

Irrespective of the selected fieldbus the maximum 9 possible bus reference values can be displayed before the transmission to the reference value distributor.

The value is displayed in % or Hz according to the use on the reference value distributor.

A4.21	Bus reference 1 scaled				% or Hz
A4.22	Bus reference 2 scaled				% or Hz
A4.23	Bus reference 3 scaled				% or Hz
A4.24	Bus reference 4 scaled				% or Hz
A4.25	Bus reference 5 scaled				% or Hz
A4.26	Bus reference 6 scaled				% or Hz
A4.27	Bus reference 7 scaled				% or Hz
A4.28	Bus reference 8 scaled				% or Hz
A4.29	Bus reference 9 scaled				% or Hz

Monitoring of analog inputs

A4.30	LFP ref. value in Hz				Hz

Available reference value on the frequency input LFP (signal via digital input, directly after the frequency counter).

A4.31	LFP ref. value scaled				% or Hz

Output of the reference source frequency input LFP.

The value is displayed in % or Hz according to the use on the reference value distributor.

A5	5289 h	**Counter**	Operating hours meter, service interval, alarms, energy meter

Operating hours

A5.01	Operating hours motor1				h

A5.02	Interval motor 1				0 h
	0...60000 h				

A5.03	Interval counter M1				h

A5.04	Operating hours motor2				h

A5.05	Interval motor 2				0 h
	0...60000 h				

A5.06	Interval counter M2				h

The operating hours meter registers the actual operation time of the active motor. Times as a result of active DC-brake, motor heating or standby mode are not valued as operation time. For this reason the operating hours meter can be used as interval for the bearing maintenance.

The evaluation occurs separately for both switchable motors.

If the operating hours meter reaches the parameter value "Interval motor" then the alarm message "Service M1" or "Service M2" occurs. The alarm can be reset by means of parameter A5.13 "Clear interval counter" whereby a new time interval is started. The already elapsed time of a running interval can be seen in parameter "Interval counter".

A5.07	Power on hours				h

A5.08	Interval power on				0 h
	0...60000 h				

A5.09	Interval count. PowerOn				h

The operating hours counter "Power On" registers that time in which the frequency inverter is operated at the mains or the DC link voltage. It indicates the operating time of the DC link capacitors, the drive-related control electronics components and the control part fan.

If the operating hours counter reaches the value of parameter A5.08 "Interval power on", then the alarm message "Service Power On" is set. The alarm can be reset by means of parameter A5.13 "Clear interval counter" whereby a new time interval is started. The already elapsed time of a running interval can be seen in parameter A5.09 "Interval count. PowerOn".

A5.10	Operating hours fan				h

A5.11	Interval fan				0 h
	0...60000 h				

A5.12	Interval counter fan				h

The operating hours meter "Fan" registers the operation time of the power part fan and can be evaluated for maintenance purposes.

If the operating hours meter reaches the parameter value "Interval fan" then the alarm message "Service fan" occurs. The alarm can be reset by means of parameter A5.13 "Clear interval counter" whereby a new time interval is started. The already elapsed time of a running interval can be seen in parameter A5.12 "Interval counter fan"

A5.13	Clear interval counter				0 .. No reset
	0 ...No reset 1 ...Reset motor 1 2 ...Reset motor 2 3 ...Reset Power On 4 ...Reset fan				

If an interval has elapsed, the corresponding alarm message is set. This alarm message can be reset by parameter A5.13 "Clear interval counter" separate for each counter.

With this resetting of the alarm, a further time interval is started.

If the counters of operating hours exceed 60.000 hours (approx. 7 years in case of 24 hour operation) the counters are automatically reset and start counting again from zero hours.

HTIU
8 P01 023 EN.04/04

Energy meter

A5.14	MWh meter mot.				MWh

A5.15	kWh meter mot.				kWh

A5.16	MWh meter gen.				MWh

A5.17	kWh meter gen.				kWh

The supplied or absorbed electrical energy on the frequency inverter output is registered in separated counters and can be presented by means of two parameters.

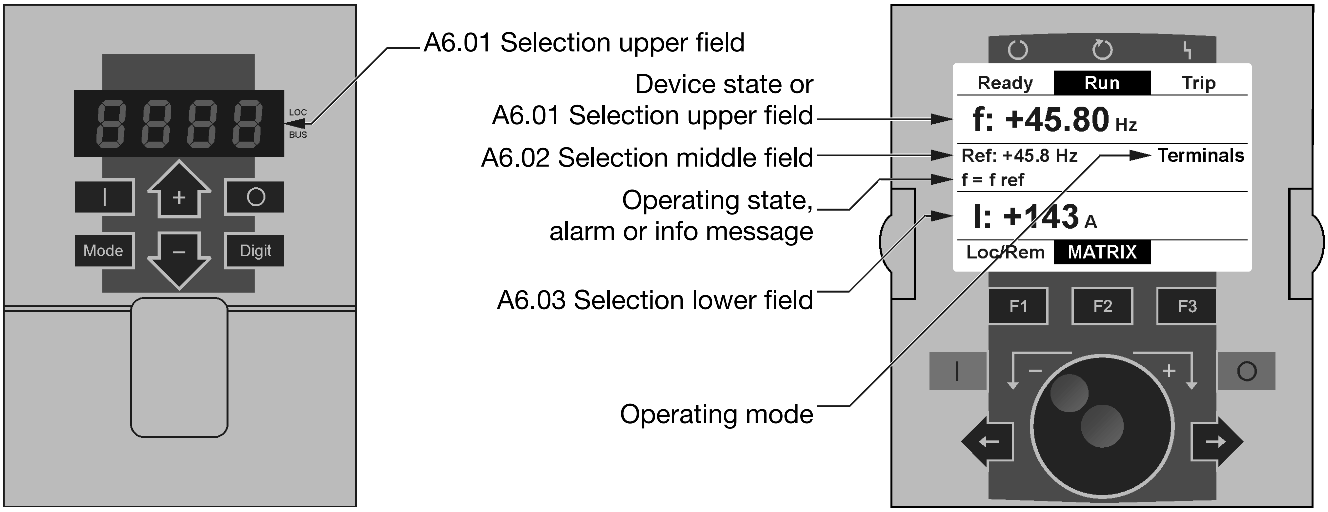
The kWh counter operates from 0.0...999.9 kW. If the counter exceeds the MW-limit, the kWh counter begins to count from zero again and the MWh counter is incremented accordingly.

Accuracy:	*>pDRIVE< MX eco* 4V0,75...4V75:	10 % (related to nominal inverter power)
	>pDRIVE< MX eco from 90 kW:	5 % (related to nominal inverter power)

Configuration of the display

LED keypad

Matrix operating panel



The basic display on the removable Matrix operating panel serves to visualise the actual operating state of the >pDRIVE< *MX eco*. The actual device- and operating state as well as three analog actual values can be displayed on it. All 3 presentable actual values can be selected by means of the parameters A6.01...A6.03 corresponding to the user-sided requirements.

A6.01	Selection upper field				1 .. Actual frequency
A6.02	Selection middle field				9 .. f-ref. before ramp
A6.03	Selection lower field				2 .. Motor current in A

- 1 ...Actual frequency
- 2 ...Motor current in A
- 3 ...|Torque|
- 4 ...Process torque
- 5 ...Process speed
- 6 ...Shaft power in kW
- 7 ...Motor voltage
- 8 ...|Speed|
- 9 ... f-ref. before ramp
- 10 .. PID reference value
- 11 .. PID actual value
- 12 .. PID deviation
- 13 .. Counter (average)
- 14 .. Total counter
- 15 .. DC voltage
- 19 .. Thermal load M1
- 20 .. Thermal load M2
- 22 .. Thermal load VSD
- 23 .. MWh meter mot.
- 24 .. kWh meter mot.
- 25 .. MWh meter gen.
- 26 .. kWh meter gen.

When using the LED display on the built-in keypad the value set with parameter A6.01 "Selection upper field" is displayed.

HTIU

8 P01 023 EN.04/04

A6.04	View all parameters				0 .. No

0 ...No
1 ...Yes

For easy parameter adjustment within the Matrix structure the visibility of individual parameters or complete parameter groups can be adopted specifically to the respective situation.

Parameters that refer to missing hardware options or which belong to non-activated functions, can be automatically faded-out.

This automatic function to hide parameters can be suppressed with parameter A6.04 "View all parameters".

A6.05	Limitations				0 .. hidden

0 ...hidden
1 ...visible

If parameter A6.05 is set to "1 .. visible" the active limitation interventions are displayed on the removable Matrix keypad. The display occurs as long as the limitation is active, but at least 1 second.

The display of limitations is beneficial especially for commissioning and service.

B1		Language selection	Selection of the desired language

Language selection

B1.01	Language selection				

All language-dependent texts in the *>pDRIVE< MX eco* are stored in the removable Matrix operating panel.

Corresponding to the used language package, different national languages are selectable. When an inverter with connected matrix operating panel is switched on first-time, all languages that are available in the BE11 are displayed for selection.

The chosen language is kept when the matrix operating panel is connected to another inverter.

Language	Languages contained in the matrix operating panel					
	BE11/A	BE11/B	BE11/C	BE11/D	BE11/E	BE11/G
German	✓	–	–	✓	–	–
English	✓	✓	✓	✓	✓	✓
Bosnian	–	–	–	✓	–	–
Bulgarian	–	–	–	–	✓	–
Chinese	–	–	–	–	–	●
Estonian	–	–	●	–	–	–
French	✓	–	–	–	–	–
Greek	–	–	–	–	●	–
Italian	✓	–	–	–	–	–
Korean	–	–	–	–	–	✓
Croatian	–	–	–	✓	–	–
Latvian	–	–	●	–	–	–
Lithuanian	–	–	✓	–	–	–
Polish	–	✓	–	–	–	–
Russian	–	–	✓	–	✓	–
Serbian	–	–	–	✓	–	–
Slovak	–	✓	–	–	–	–
Spanish	✓	–	–	–	–	–
Czech	–	✓	–	–	–	–
Turkish	–	–	–	–	✓	–
Hungarian	–	✓	–	–	–	–

✓... available ●... in process

The set language can be changed later by means of parameter B1.01.

If the software versions do not correspond between device and operating panel, it can happen that individual parameter texts are missing. In this case the respective Matrix code or the line number is displayed.

Parameter management

The user can take settings and device adaptations by means of parameterization of the device. The varied functions of the *>pDRIVE< MX eco* need in the same way a multi-functional adjustability and therefore a high number of parameters.

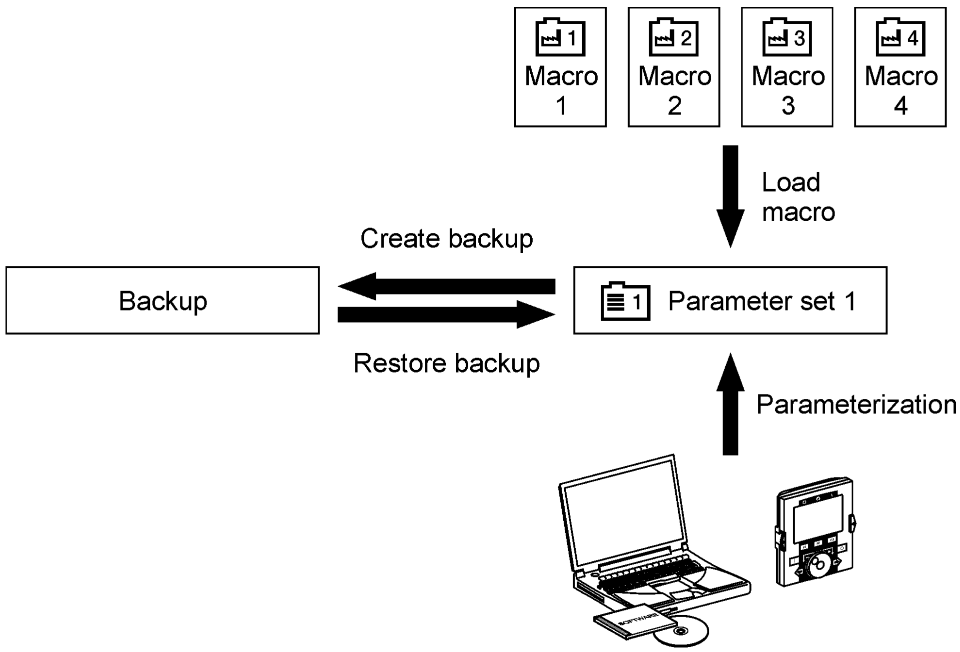
The structured parameter management with the Matrix philosophy enables itself a quick and easy access to all setting and display parameters. In addition further functions are provided in the device concept which makes working with the application-orientated functions and their settings easier.

The individual parameters are functionally organized in groups and are saved in different locations. By means of different automated or manually callable commands for storage and loading varying operation modes arise.

Backup mode

The backup mode is intended as standard. After loading of a macro compatible to the application and optimization of the setting by the user, all application parameters can be copied in a backup register by means of the command "Create backup". If required, the created safety copy can be recalled at any time by means of the command "Restore backup".

A simultaneous use of the backup mode and the switch-over of parameter sets is not possible. The use of the 2nd set of motor data (see Matrix field B4, page 93) is unconfined available in both function modes.



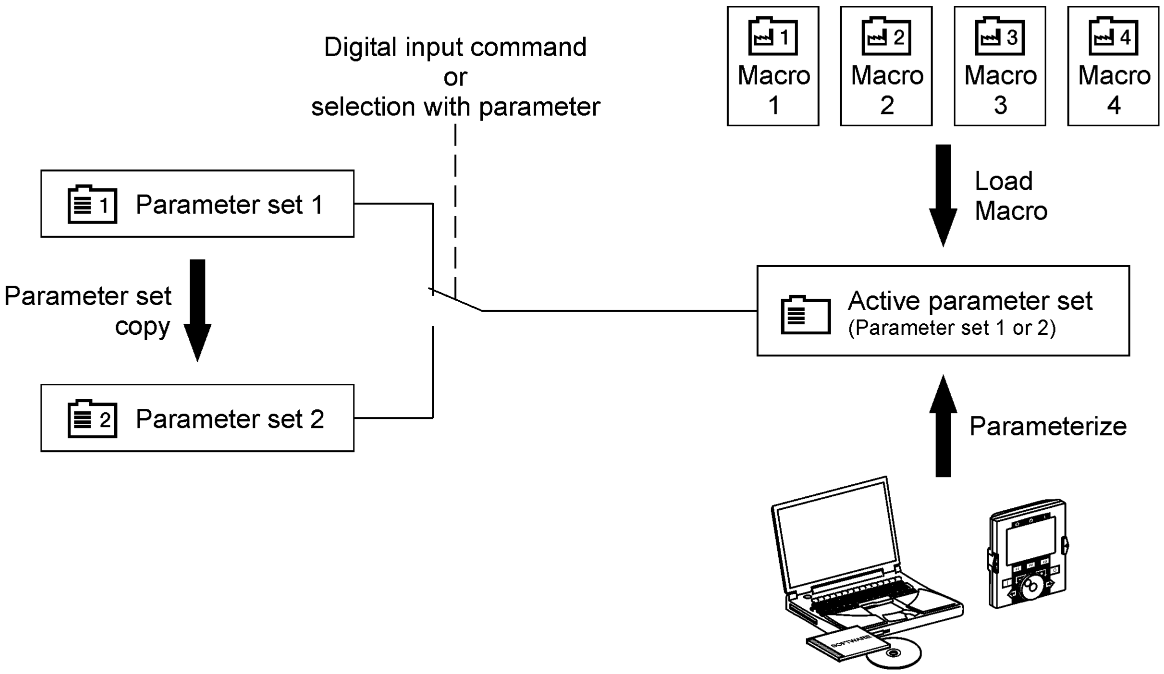
2nd set of parameters

If it is necessary to change the behaviour of the drive radically dependent from the process, two separate sets of parameters can be used.

These parameter sets can be switched over by parameterization or by means of a digital input signal. The switch-over always occurs in drive state "Ready". A switch-over command which appears during operation is carried out if the drive state changes to "Ready".

A digital output function is available for confirmation of the active set of parameters.

HTIU
8 P01 023 EN.04/04



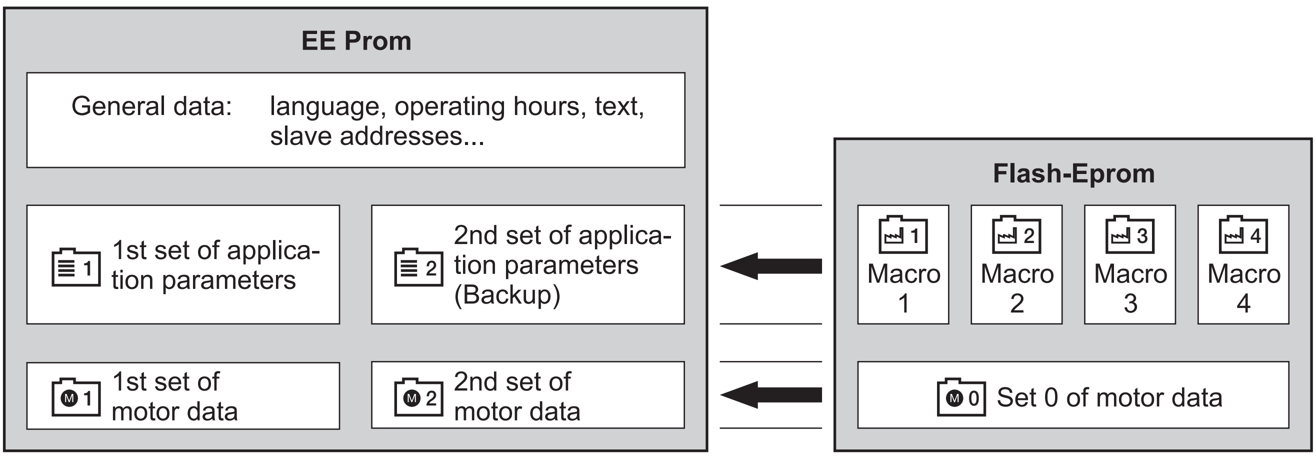
Application: Use of a frequency inverter for two different drives with different parameterization, creating of an emergency or service operation

The same setting of the digital input in both sets of parameters is required for a correct switching with digital input signals.

If a recognition of wire break of the signal outputs is necessary, two outputs are required instead of one.

Macros

Macros are factory presettings of the parameters for typical applications of the *>pDRIVE< MX eco*. When loading a macro, the application data in the EEprom are overwritten. Parameter groups such as motor data, language setting, fault memory, operating hours, texts and basic communication settings as well as the parameter settings stored in the "Backup" remain unchanged.



2nd set of motor data

Independent of both sets of parameters two switchable sets of motor data are available with whose help one frequency inverter can be used on two different motors.

The selection of the motor switches the nominal motor data, the data calculated by the autotuning function as well as the respective thermal motor model and the operating hours meter.

The use of the 2nd set of motor data (see Matrix field B4, page 93) is possible in addition to the switch-over of parameter sets.

B2.01	Macro selected				1 .. Macro 1

1 ...Macro 1
2 ...Macro 2
3 ...Macro 3
4 ...Macro 4

This parameter displays the macro selected with B2.02 last.

B2.02	Macro selection				

1 ...Load macro 1
2 ...Load macro 2
3 ...Load macro 3
4 ...Load macro 4

Loads the selected application macro into the active set of parameters.

When loading a macro, all existing application data in the active set of parameters are overwritten. Parameter groups such as motor data, language setting, fault memory, operating hours, texts and basic communication settings remain unchanged.

B2.03	Parameter mode				

1 ...Backup
2 ...Parameter set 1
3 ...Parameter set 2
4 ...Switch-over with DI

Defines the actual set of parameters.

In case of selection "4 .. Switch-over with DI", proceed as follows:

- Set parameter B2.03 to "2 .. Parameter set 1".
- Load the proper macro by means of parameter B2.02 and make further adjustments if necessary.
- Assign a digital input to the function "2nd parameter set".
- Create a copy of the parameter set by means of B2.06 if you want to adjust the second parameter set on the basis of the first parameter set.
- Set parameter B2.03 to "3 .. Parameter set 2".
- Adjust the parameters of the second parameter set.
- Activate the switch-over of parameter sets by setting B2.03 to "4 .. Switch-over with DI".

8 P01 023 EN.04/04 HTIU

B2.04	Create backup				

1 ...Create backup

B2.05	Restore backup				

1 ...Restore backup

B2.06	Copy parameter set				

1 ...Copy parameter set

If the function of the switchable parameter sets is used, it can be advantageous during parameterization of the 2nd set of parameters to have the 1st set available as base. In order to enable this, the contents of parameter set 1 is copied into parameter set 2. Therefore, parameter set 1 has to be activated !

B2.07	Name parameter set 1	txt			

B2.08	Name parameter set 2	txt			

The texts for parameter set 1 and 2 can be edited here alphanumerically. The edited text appears on the matrix operating panel during the boot phase of the device and in case of active parameter set switch-over.

"P15 menu" – Parameters switchable during operation

The 2nd set of parameters and motor data provide two possibilities to change the configuration of the drive basically. The switch-over between the individual data sets must always occur in operating state "Stop" or "Lock".

When individual parameters should be changed during operation of the drive, the P15 function can be used. Up to 15 parameters can be selected for the P15 menu and for each three values switchable during operation can be defined. The individual values are parameterized using the menu items "P15 edit Set A...C". Switching between these three P15 parameter sets is possible using two digital inputs or via parameterization.

B2.13	P15 activation				0 .. Deactivated

0 ...Deactivated
1 ...Set A
2 ...Set B
3 ...Set C
4 ...DI dependent

Using parameter B2.13 the functionality of switching the P15 parameters can be activated and the parameters selected with B2.17 "P15 parameter selection" can be switched between sets A, B or C.

In case of setting "4 .. DI dependent" switch-over is also possible via a superior automation concept using two digital inputs (P15-set B, P15-set C).

<table>
<tr><th>Setting</th><th>"P15" functionality</th></tr>
<tr><td>0 .. Deactivated</td><td>There are no parameters available for switch-over during operation.</td></tr>
<tr><td>1 .. Set A</td><td>All parameters added to the P15 menu are changed according to the setting of Set A.</td></tr>
<tr><td>2 .. Set B</td><td>All parameters added to the P15 menu are changed according to the setting of Set B.</td></tr>
<tr><td>3 .. Set C</td><td>All parameters added to the P15 menu are changed according to the setting of Set C.</td></tr>
<tr><td>4 .. DI dependent</td><td>The switch-over of the P15 parameter sets takes place depending on the two digital inputs:
<table>
<tr><th rowspan="2">Active P15 data set</th><th colspan="2">Signal at digital input</th></tr>
<tr><th>P15-set B</th><th>P15-set C</th></tr>
<tr><td>Set A active</td><td>0</td><td>0</td></tr>
<tr><td>Set B active</td><td>1</td><td>0</td></tr>
<tr><td>Set C active</td><td>x</td><td>1</td></tr>
</table></td></tr>
</table>

B2.14	P15 edit Set A				
B2.15	P15 edit Set B				
B2.16	P15 edit Set C				

For all parameters added to the P15 menu three parameter values are available for switchover during operation. These values are set during activated P15 function with the parameters of the respective P15 set.

If you try to adjust one of the P15 parameters during active P15 parameter switch-over using the matrix structure, the message "Parameterization locked, Parameter set 1/2 selection is active!" appears on the matrix operating panel.

B2.17	P15 parameter selection				

Parameter B2.17 "P15 parameter selection" contains an editing mode in which all parameters intended for switch-over can be selected by means of the matrix structure as usual. All parameters that are adjustable during operation are available for selection.

By means of the function key F1 a selected parameter is added to the P15 menu ((→ P15) or an included parameter is removed from the P15 menu (P15 →).

Macro M1: General use (factory macro)

By setting parameter B2.02 Macro selection to "1 .. Load macro 1" the parameter settings according to macro 1 are loaded into the device memory.

Existing parameters are overwritten when loading a macro !

Macro M1 represents a consciously simple kept setting variant which has all required functions ready for a huge number of applications. It is used typically for PLC-automatic systems with conventional wiring in which the frequency inverter is used as intelligent actuator.

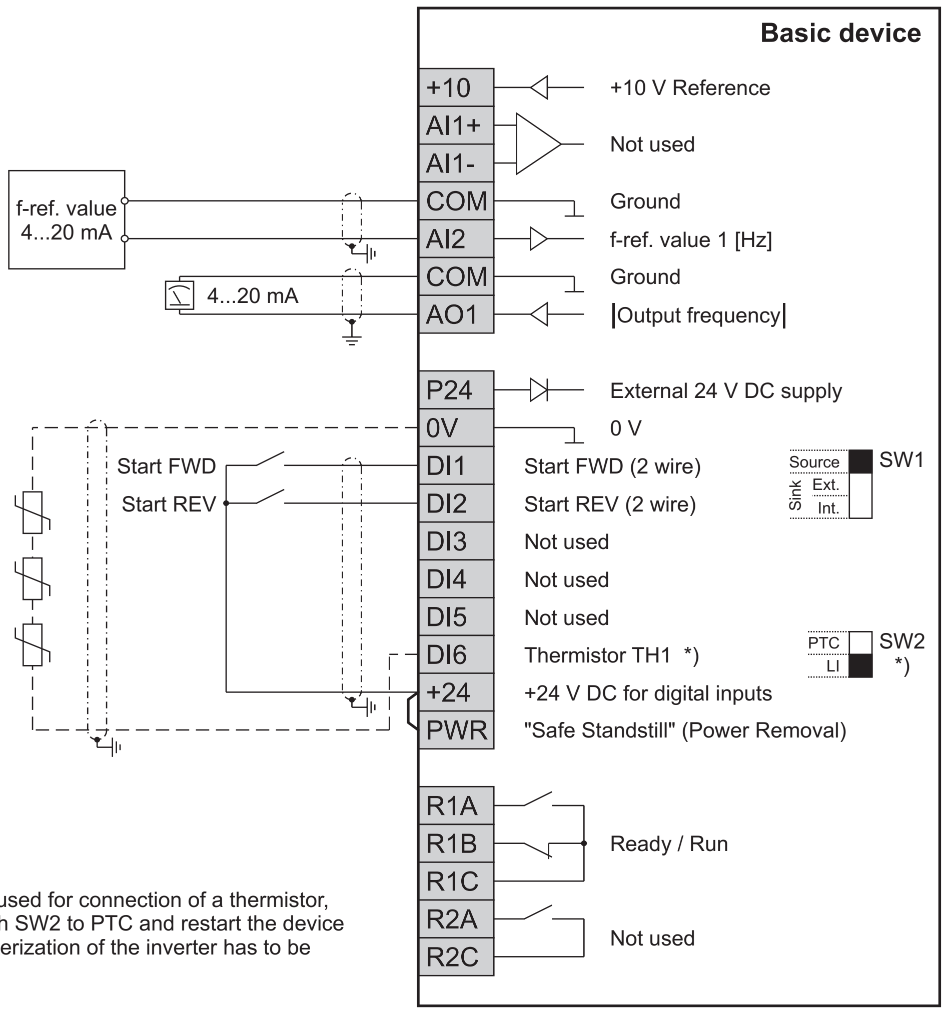
The control commands occur in 2-wire technology separate for both rotational directions via the terminals of the basic device. The reference value for the frequency is planned as 4...20 mA signal.

Panel control of the device is possible via the Matrix operating panel BE11 or the built-in LED-keypad.

The macro values represent a pre-parameterization of the frequency inverter. Unconfined and independent of the macro setting all functions are always available in the *>pDRIVE< MX eco*. These can be activated or changed according to requests of the application.

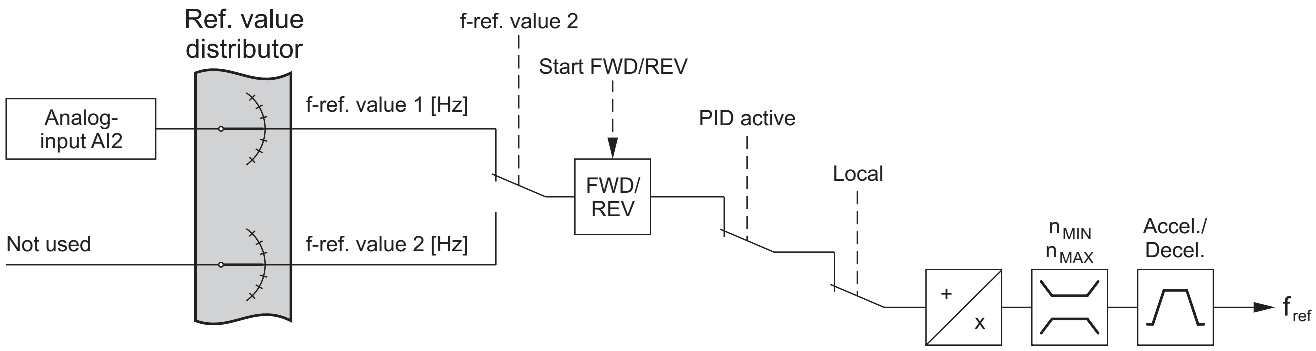
The macro M1 corresponds to the factory setting.

Allocation of terminals for macro M1



*) If the digital input DI6 is used for connection of a thermistor, switch the selector switch SW2 to PTC and restart the device afterwards. The parameterization of the inverter has to be adjusted appropriate.

Reference value path of macro M1



Parameter list of macro M1

Parameter		Presetting macro 1
A6.01	Selection upper field	1 .. Actual frequency
A6.02	Selection middle field	9 .. f-ref. before ramp
A6.03	Selection lower field	2 .. Motor current in A
B3.01	Mains voltage	2 .. 400 V - 50/60 Hz
B3.02	Control mode	1 .. VC standard
B3.17	R1 Compensation	80 %
B3.24	Stop mode	2 .. Deceleration ramp
C2.01	Minimum frequency	0 Hz
C2.02	Maximum frequency	50 Hz
C2.03	Direction enable	3 .. Forward & reverse
C2.05	Acceleration ramp 1	10 s
C2.06	Deceleration ramp 1	10 s
C2.11	Start ramp	0 s
D1.08	AI2 selection	1 .. f-reference 1 [Hz]
D1.09	AI2 level	4 .. 4 ... 20 mA
D1.10	AI2 min. value	0 Hz
D1.11	AI2 max. value	50 Hz
D2.01	DI1 selection	1 .. Start FW (2 wire)
D2.02	DI2 selection	2 .. Start REV (2 wire)
D3.01	AO1 selection	3 .. Actual frequency
D3.02	AO1 level	4 .. 4 ... 20 mA
D3.03	AO1 min. value	0 Hz
D3.04	AO1 max. value	50 Hz

Parameter			Presetting macro 1
D3.05	AO1 filter-time		0.1 s
D4.01	R1 selection		3 .. Ready / run
E1.01	I max 1	MX eco:	135 %
		MX pro:	depending on the device (135 or 165 %)
E1.05	T limit motor		300 %
E1.17	Reaction at limitation		1 .. Limitation allowed
E1.21	Reaction at deceleration		1 .. Ramp adaption
E2.01	TH1 motor allocation		0 .. Not used
E2.02	TH1 activation		2 .. Ready and run
E2.03	TH1 response		3 .. -Δt- fault
E2.04	TH1 Time Δt		0 s
E2.05	TH1 verification		1 .. Active
E2.18	M1 - overl. monitoring		1 .. Standard
E2.19	M1 - response		3 .. Alarm-trip
E2.20	M1 - Imax at 0Hz		50 %
E2.21	M1 - Imax at f nom.		100 %
E2.22	M1 - therm. f-limitation		35 Hz
E2.23	M1 - motor-time		5 min
E2.25	M1 - alarm level		100%
E2.26	M1 - trigger level		110 %
E2.42	Stall protection		1 .. Active

Macro M2: Drives with PID process control

By setting parameter B2.02 Macro selection to "2 .. Load macro 2" the parameter settings according to macro 2 are loaded into the device memory.

Existing parameters are overwritten when loading a macro !

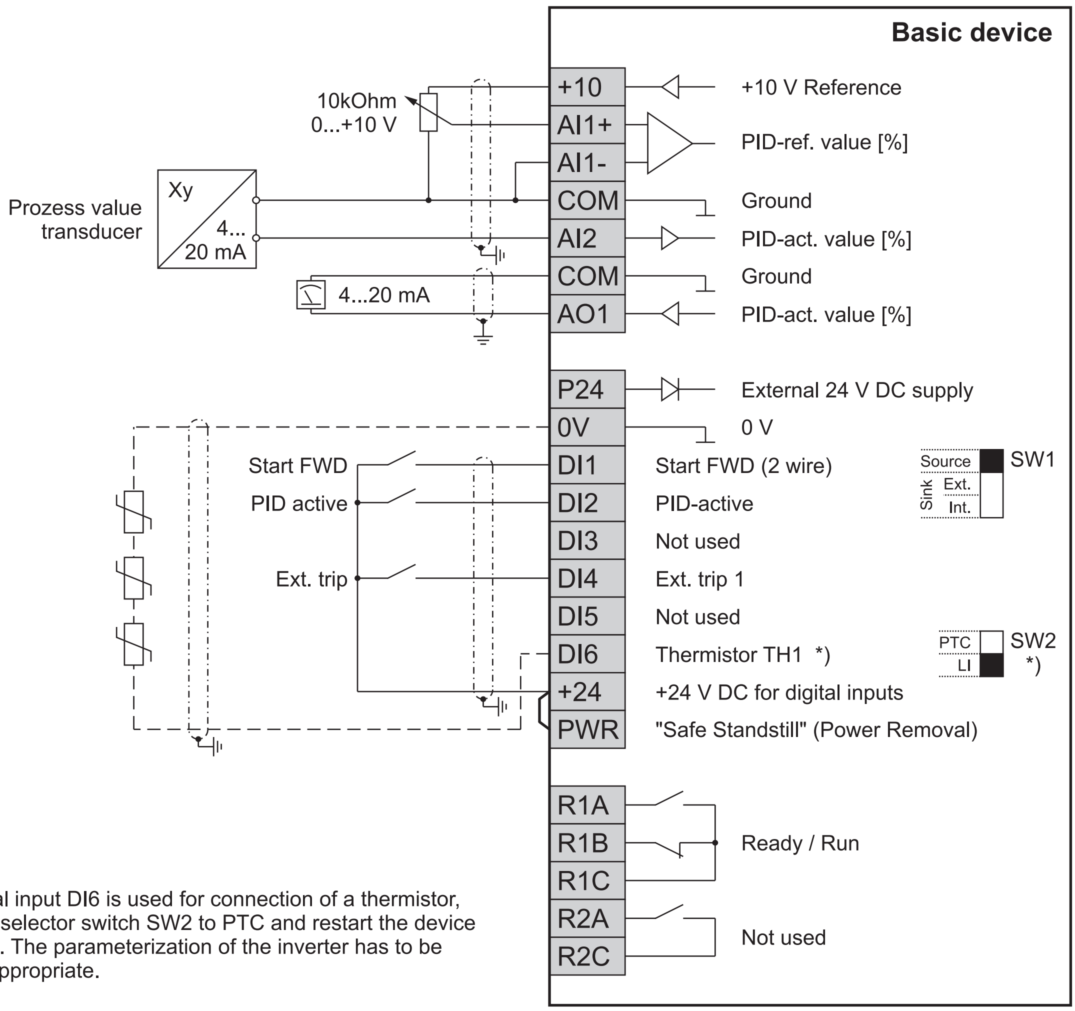
The macro M2 is a typical presetting for drives with PID-controller such as those which are used for pumps, fans, compressors etc.

The control commands occur in 2-wire technology for forward via the terminals of the basic device, the PID reference value is assigned to the analog input AI1 (0...10 V) and the PID actual value to AI2 (0...10 V or 4...20 mA). Switching-over from closed-loop control to open-loop control can be carried out by means of a digital input whereas in this case the reference value at AI1 can also be used as the frequency reference value.

In addition to the closed-loop and open-loop control (via the terminals) a panel control of the device is possible via the Matrix operating panel BE11 or the built-in LED keypad.

The macro values represent a pre-parameterization of the frequency inverter. Unconfined and independent of the macro setting all functions are always available in the *>pDRIVE< MX eco*. These can be activated or changed according to requests of the application.

>pDRIVE< MX eco allocation of terminals for macro M2

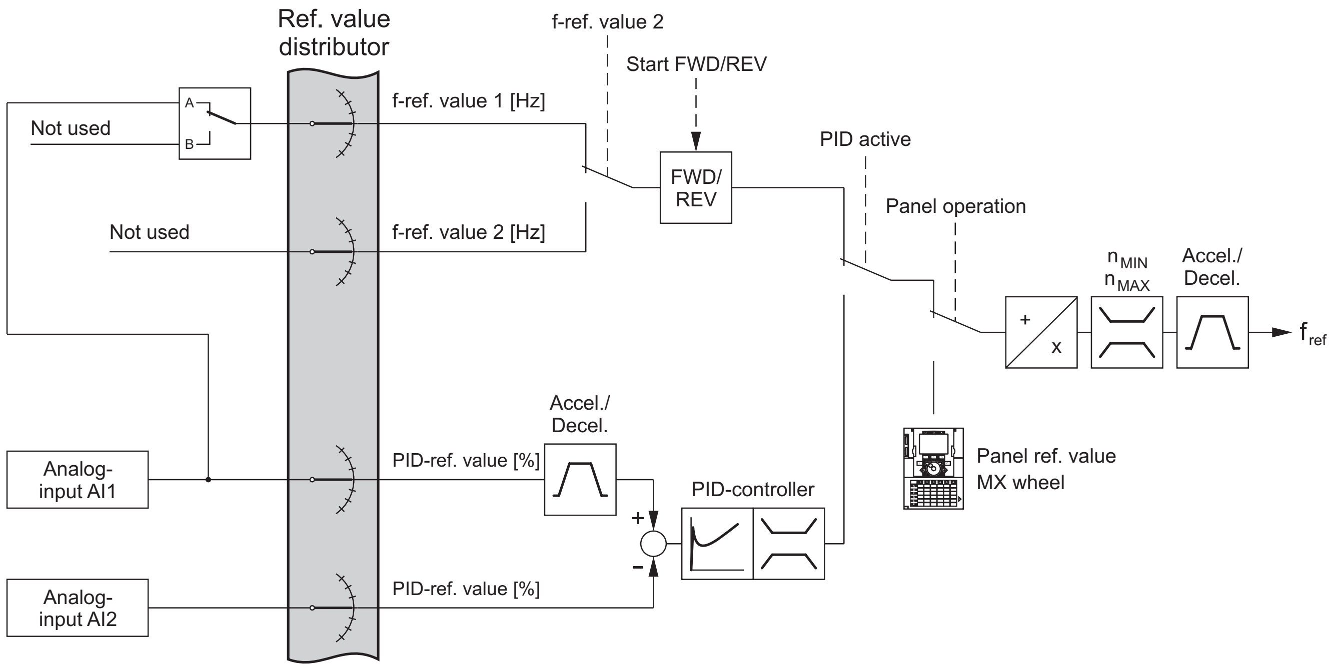


*) If the digital input DI6 is used for connection of a thermistor, switch the selector switch SW2 to PTC and restart the device afterwards. The parameterization of the inverter has to be adjusted appropriate.

HTIU

8 P01 023 EN.04/04

>pDRIVE< MX eco reference value path of macro M2



Parameter list of macro M2

Parameter		Presetting macro 2
A6.01	Selection upper field	10 .. PID reference value
A6.02	Selection middle field	9 .. f-ref. before ramp
A6.03	Selection lower field	11 .. PID actual value
B3.01	Mains voltage	2 .. 400 V - 50/60 Hz
B3.02	Control mode	1 .. VC standard
C1.54	Ref. val. switch usage	1 .. f-reference 1 [Hz]
C1.55	Ref. val. switch selec.	1 .. Value A
C1.56	Ref. val. switch input A	1 .. AI 1
C1.57	Ref. val. switch input B	0 .. Not used
C2.01	Minimum frequency	15 Hz
C2.02	Maximum frequency	50 Hz
C2.03	Direction enable	1 .. Forward
C2.05	Acceleration ramp 1	1.5 s
C2.06	Deceleration ramp 1	1.5 s
C2.11	Start ramp	5 s
C4.07	Control mode	2 .. PID - n / DI depend
C4.08	Control sense	1 .. Normal
C4.09	Proportional gain	0.2
C4.10	Integration time	0.8 s
C4.11	Derive time	0 s
C4.12	Max. D-part	50 Hz
C4.13	Output level min.	15 Hz
C4.14	Output level max.	50 Hz
C4.18	Ref. value acceleration	10 s
C4.19	Ref. value deceleration	10 s
C4.34	PID multiplier	1
C4.35	PID divisor	1
C4.36	PID offset	0
D1.01	AI1 selection	6 .. PID-reference val. [%]
D1.02	AI1 level	1 .. 0 ... 10V
D1.03	AI1 min. value	0 %
D1.04	AI1 max. value	100 %
D1.08	AI2 selection	7 .. PID-actual value [%]
D1.09	AI2 level	4 .. 4 ... 20 mA

Parameter		Presetting macro 2
D1.10	AI2 min. value	0 %
D1.11	AI2 max. value	150 %
D2.01	DI1 selection	1 .. Start FW (2 wire)
D2.02	DI2 selection	35 .. PID-active
D2.04	DI4 selection	29 .. External fault 1
D3.01	AO1 selection	27 .. PID-actual value [%]
D3.02	AO1 level	4 .. 4 ... 20 mA
D3.03	AO1 min. value	0 %
D3.04	AO1 max. value	100 %
D3.05	AO1 filter-time	0 s
D4.01	R1 selection	3 .. Ready / run
E1.01	I max 1	135 %
E1.05	T limit motor	300 %
E1.17	Reaction at limitation	1 .. Limitation allowed
E1.21	Reaction at deceleration	1 .. Ramp adaption
E2.01	TH1 motor allocation	0 .. Not used
E2.02	TH1 activation	2 .. Ready and run
E2.03	TH1 response	3 .. -Δt- fault
E2.04	TH1 Time Δt	0 s
E2.05	TH1 verification	1 .. Active
E2.18	M1 - overl. monitoring	1 .. Standard
E2.19	M1 - response	3 .. Alarm-trip
E2.20	M1 - Imax at 0Hz	50 %
E2.21	M1 - Imax at f nom.	100 %
E2.22	M1 - therm. f-limitation	35 Hz
E2.23	M1 - motor-time	5 min
E2.25	M1 - alarm level	100%
E2.26	M1 - trigger level	110 %
E2.42	Stall protection	1 .. Active
E3.34	Ext. fault 1 monitor	2 .. N.O. ready / run
E3.35	Ext. fault 1 response	3 .. -Δt- fault
E3.36	Start delay time	0 s
E3.37	Time Δt	0 s

Macro M3: Drives with PID process control and cascade operation

By setting parameter B2.02 Macro selection to "3 .. Load macro 3" the parameter settings according to macro 3 are loaded into the device memory.

Existing parameters are overwritten when loading a macro !

The macro M3 is a typical presetting for drives with cascade control and active PID control circuit such as those which are used in booster stations, waterworks etc.

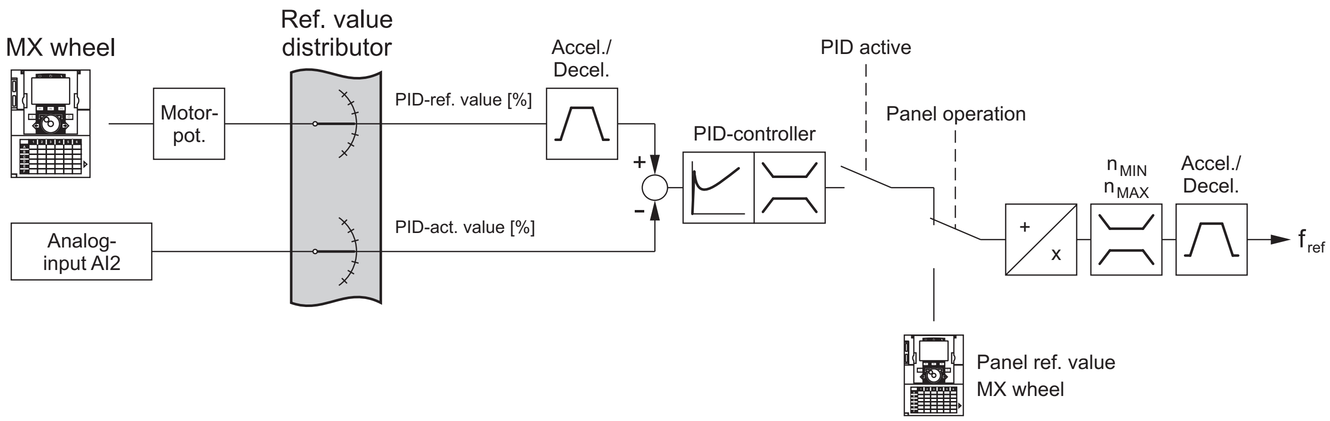
The device is configured according to the design of the "Mains cascade 1" with a speed-controlled master drive and two slave drives. The control of the slave drives occurs through the interpretation of the control deviation of the PID control circuit on the master drive which connects and disconnects the slave drives by means of two output relays.

The control commands occur in 2-wire technology for forward via the terminals of the basic device, the PID reference value is directly given on the inverter by means of the thumb wheel on the Matrix operating panel BE11 or with the arrow buttons on the built-in LED keypad. The PID actual value is assigned the analog input A12 (0...10 V or 4...20 mA). To recognize whether the slave drives are ready to run, for each of both slave drives a digital input has to be provided on the master drive. Based on the balancing of operating hours the slave drives are connected and disconnected by means of two relay outputs.

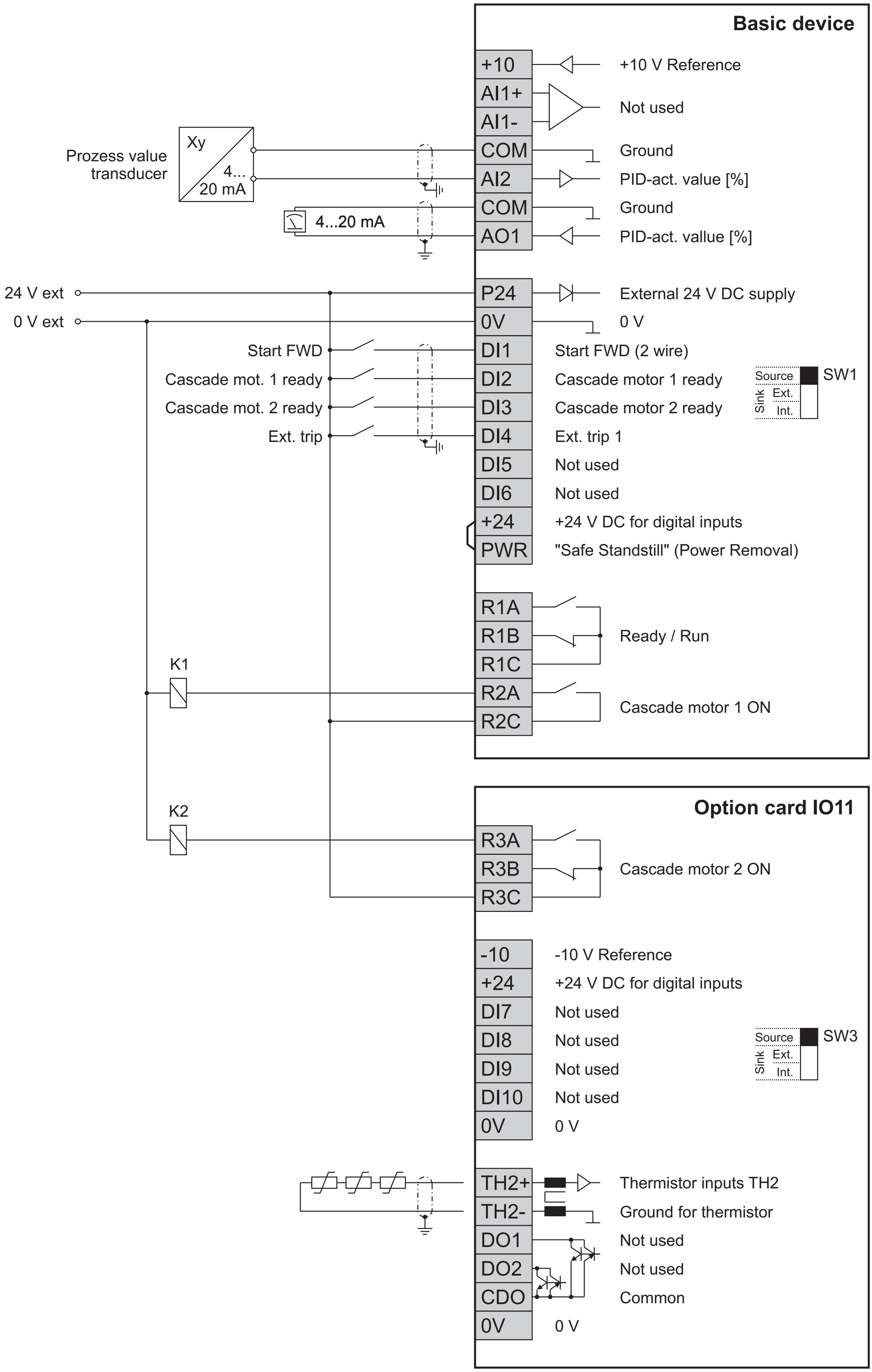
In addition to the closed-loop and open-loop control (via the terminals) a panel control of the device is possible via the Matrix operating panel BE11 or the built-in LED keypad.

The macro values represent a pre-parameterization of the frequency inverter. Unconfined and independent of the macro setting all functions are always available in the *>pDRIVE< MX eco*. These can be activated or changed according to requests of the application.

>pDRIVE< MX eco reference value path of macro M3



>pDRIVE< MX eco allocation of terminals for macro M3



8 P01 023 EN.04/04 HTIU

Parameter list of macro M3

Parameter		Presetting macro 3
A6.01	Selection upper field	10 .. PID reference value
A6.02	Selection middle field	9 .. f-ref. before ramp
A6.03	Selection lower field	11 .. PID actual value
B3.01	Mains voltage	2 .. 400 V - 50/60 Hz
B3.02	Control mode	1 .. VC standard
C1.18	Motor pot. selection	6 .. PID-reference val. [%]
C1.19	Motor pot. control	2 .. MX-wheel
C1.20	Motor pot. min. value	0 %
C1.21	Motor pot. max. value	100 %
C1.22	Motor pot. accel. time	5 s
C1.23	Motor pot. decel. time	10 s
C1.24	Motor pot. ref. storage	1 .. always
C2.01	Minimum frequency	15 Hz
C2.02	Maximum frequency	50 Hz
C2.03	Direction enable	1 .. Forward
C2.05	Acceleration ramp 1	1.5 s
C2.06	Deceleration ramp 1	1.5 s
C2.11	Start ramp	5 s
C3.01	Cascade mode	1 .. Mains cascade 1
C3.09	No. of cascade pumps	2
C3.10	Manual / auto switch	1 .. Used
C3.11	Oper. mode C.Mot1	1 .. AUTO
C3.12	Oper. mode C.Mot2	1 .. AUTO
C3.15	Switching mode	1 .. Pressure analysis
C3.18	Max. PID-deviation	10 %
C3.19	Overdrive limit	30 %
C3.32	Switch on delay	30 s
C3.33	Turn-off delay	30 s
C3.34	Overdrive time	10 s
C3.35	Min. switch-over time	10 s
C3.38	Motor change	2 .. Optimised cycle
C3.39	Change master drive	1 .. at stop
C3.40	Time-frame	72 h
C3.41	Time master drive	24 h
C4.07	Control mode	1 .. PID - n
C4.08	Control sense	1 .. Normal
C4.09	Proportional gain	0.2
C4.10	Integration time	0.8 s
C4.11	Derive time	0 s
C4.12	Max. D-part	50 Hz
C4.13	Output level min.	15 Hz
C4.14	Output level max.	50 Hz
C4.18	Ref. value acceleration	10 s

Parameter		Presetting macro 3
C4.19	Ref. value deceleration	10 s
C4.34	PID multiplier	1
C4.35	PID divisor	1
C4.36	PID offset	0
D1.08	AI2 selection	7 .. PID-actual value [%]
D1.09	AI2 level	4 .. 4 ... 20 mA
D1.10	AI2 min. value	0 %
D1.11	AI2 max. value	150 %
D2.01	DI1 selection	1 .. Start FW (2 wire)
D2.02	DI2 selection	50 .. C. motor 1 ready
D2.03	DI3 selection	51 .. C. motor 2 ready
D2.04	DI4 selection	29 .. External fault 1
D3.01	AO1 selection	27 .. PID-actual value [%]
D3.02	AO1 level	4 .. 4 ... 20 mA
D3.03	AO1 min. value	0 %
D3.04	AO1 max. value	100 %
D3.05	AO1 filter-time	0 s
D4.01	R1 selection	3 .. Ready / run
D4.02	R2 selection	30 .. C. motor 1 ON
D4.03	R3 selection	31 .. C. motor 2 ON
E1.01	I max 1	135 %
E1.05	T limit motor	300 %
E1.17	Reaction at limitation	1 .. Limitation allowed
E1.21	Reaction at deceleration	1 .. Ramp adaption
E2.06	TH2 motor allocation	0 .. Not used
E2.07	TH2 activation	2 .. Ready and run
E2.08	TH2 response	3 .. -Δt- fault
E2.09	TH2 Time Δt	0 s
E2.10	TH2 verification	0 .. Not active
E2.18	M1 - overl. monitoring	1 .. Standard
E2.19	M1 - response	3 .. Alarm-trip
E2.20	M1 - Imax at 0Hz	50 %
E2.21	M1 - Imax at f nom.	100 %
E2.22	M1 - therm. f-limitation	35 Hz
E2.23	M1 - motor-time	5 min
E2.25	M1 - alarm level	100%
E2.26	M1 - trigger level	110 %
E2.42	Stall protection	1 .. Active
E3.34	Ext. fault 1 monitor	2 .. N.O. ready / run
E3.35	Ext. fault 1 response	3 .. -Δt- fault
E3.36	Start delay time	0 s
E3.37	Time Δt	0 s

Macro M4: General use with field bus

By setting parameter B2.02 Macro selection to "4 .. Load macro 4" the parameter settings according to macro 4 are loaded into the device memory.

Existing parameters are overwritten when loading a macro !

Macro M4 represents a consciously simple kept setting variant which is intended for a hugh number of industrial applications. The macro is used typically for PLC-automatic systems with Profibus connection in which the frequency inverter is used as intelligent actuator.

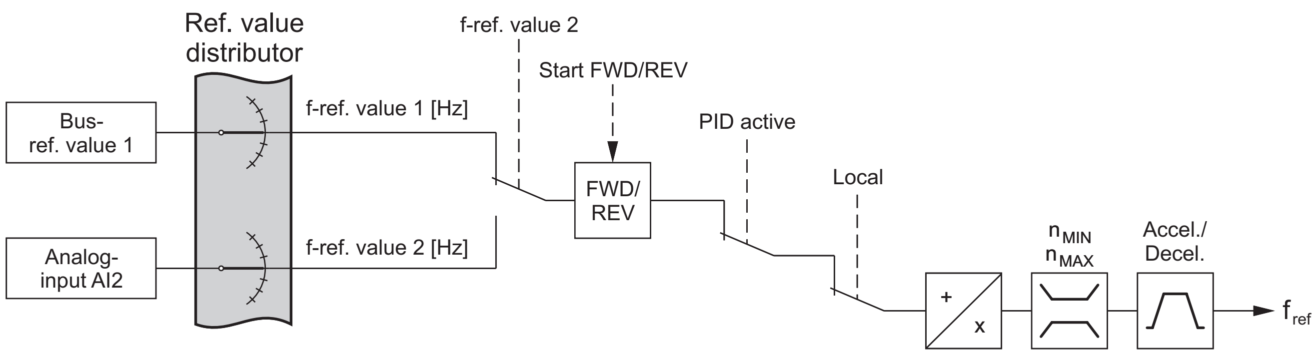
The control commands as well as the reference-/actual value transmission occurs according to the Profidrive-Profile to PPO4. To realize a switching of the control source also the conventional terminal operation with 2-wire control commands and a reference value at analog input AI2 must be parameterized in addition to the fieldbus connection.

It is possible to switch between bus- and terminal operation by means of a digital input.

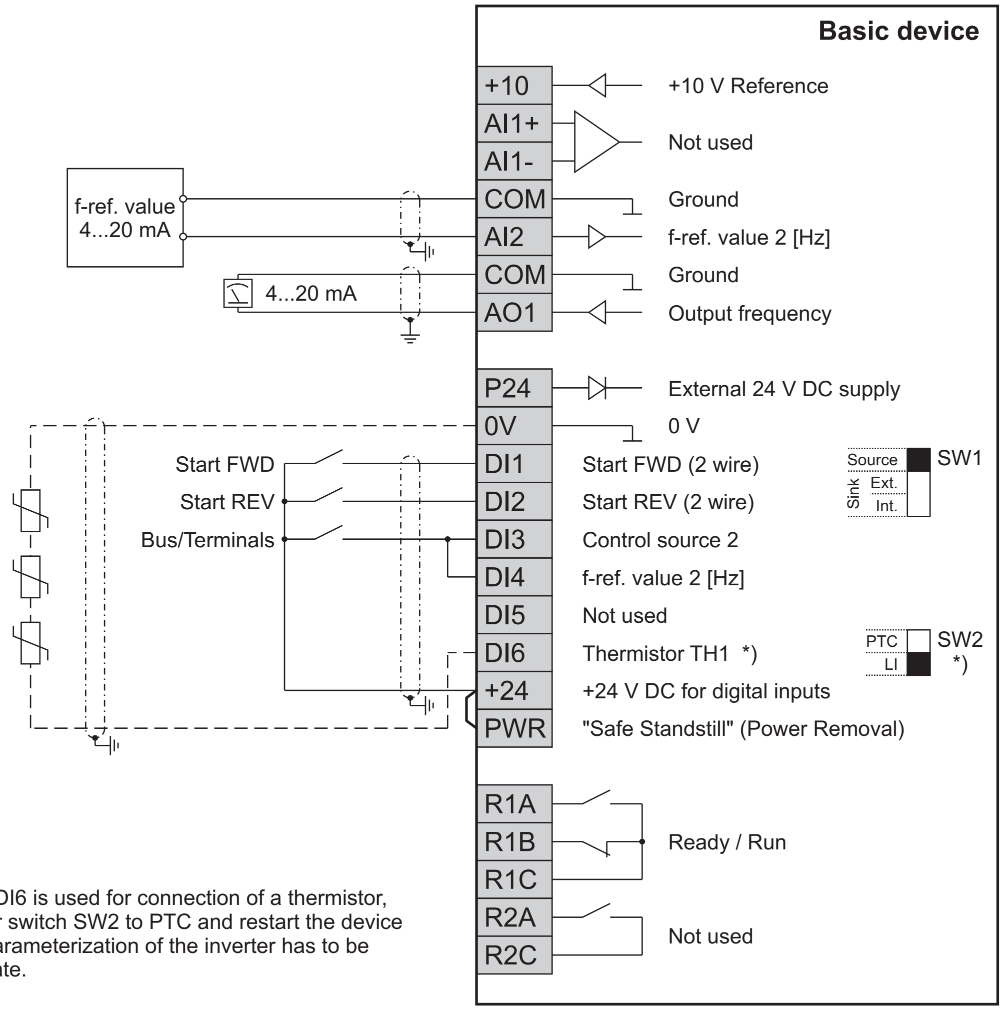
Controlling the device is possible via the Matrix operating panel BE11 or the built-in LED keypad independent of the control source (bus / terminals).

The macro values represent a pre-parameterization of the frequency inverter. Unconfined and independent of the macro setting all functions are always available in the >*pDRIVE*< *MX eco*. These can be activated or changed according to requests of the application.

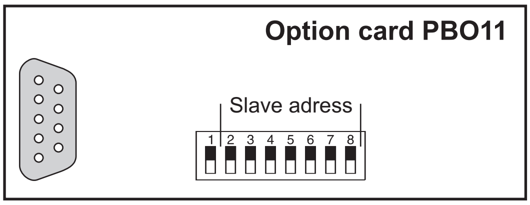
Reference value path of macro M4



Allocation of terminals for macro M4



*) If the digital input DI6 is used for connection of a thermistor, switch the selector switch SW2 to PTC and restart the device afterwards. The parameterization of the inverter has to be adjusted appropriate.



HTIU

8 P01 023 EN.04/04

Parameter list of macro M4

Parameter		Presetting macro 4
A6.01	Selection upper field	1 .. Actual frequency
A6.02	Selection middle field	9 .. f-ref. before ramp
A6.03	Selection lower field	2 .. Motor current in A
B3.01	Mains voltage	2 .. 400 V - 50/60 Hz
B3.02	Control mode	1 .. VC standard
B3.17	R1 Compensation	80 %
B3.24	Stop mode	2 .. Deceleration ramp
C2.01	Minimum frequency	0 Hz
C2.02	Maximum frequency	50 Hz
C2.03	Direction enable	3 .. Forward & reverse
C2.05	Acceleration ramp 1	10 s
C2.06	Deceleration ramp 1	10 s
D1.08	AI2 selection	2 .. f-reference 2 [Hz]
D1.09	AI2 level	4 .. 4 ... 20 mA
D1.10	AI2 min. value	0 %
D1.11	AI2 max. value	50 %
D2.01	DI1 selection	1 .. Start FW (2 wire)
D2.02	DI2 selection	2 .. Start REV (2 wire)
D2.03	DI3 selection	23 .. Control source 2
D2.04	DI4 selection	22 .. f-reference 2 [Hz]
D3.01	AO1 selection	3 .. Actual frequency
D3.02	AO1 level	4 .. 4 ... 20 mA
D3.03	AO1 min. value	0 Hz
D3.04	AO1 max. value	50 Hz
D4.01	R1 selection	3 .. Ready / run
D6.01	Bus selection	3 .. Profibus
D6.02	Control requested	1 .. Active
D6.03	Bus error behaviour	1 .. Trip
D6.04	Bus error delay time	0.5 s
D6.33	On after off 1	1 .. Active
D6.100	No. of Bus-ref. values	5 .. 1 STW + 5 SW
D6.101	Ref. value1 selection	1 .. f-reference 1 [Hz]
D6.102	Ref. value1 min. value	0 Hz
D6.103	Ref. value1 max. value	50 Hz
D6.137	Number actual values	5 .. 1 ZTW + 5 IW
D6.138	Act. value1 selection	1 .. Actual frequency
D6.139	Act. value1 min. value	0 Hz
D6.140	Act. value1 max. value	50 Hz
D6.141	Act. value1 filter-time	0.1 s

Parameter		Presetting macro 4
D6.142	Act. value2 selection	3 .. Motor current
D6.143	Act. value2 min. value	0 %
D6.144	Act. value2 max. value	100 %
D6.145	Act. value2 filter-time	0.1 s
D6.146	Act. value3 selection	4 .. Torque
D6.147	Act. value3 min. value	0 %
D6.148	Act. value3 max. value	100 %
D6.149	Act. value3 filter-time	0.1 s
D6.150	Act. value4 selection	8 .. Power
D6.151	Act. value4 min. value	0 %
D6.152	Act. value4 max. value	100 %
D6.153	Act. value4 filter-time	0.1 s
D6.154	Act. value5 selection	58 .. Act. Error Code
D6.155	Act. value5 min. value	0 %
D6.156	Act. value5 max. value	100 %
D6.157	Act. value5 filter-time	0.0 s
E1.01	I max 1 MX eco: MX pro:	135 % depending on the device (135 or 165 %)
E1.05	T limit motor	300 %
E1.17	Reaction at limitation	1 .. Limitation allowed
E1.21	Reaction at deceleration	1 .. Ramp adaption
E2.01	TH1 motor allocation	0 .. Not used
E2.02	TH1 activation	2 .. Ready and run
E2.03	TH1 response	3 .. -Δt- fault
E2.04	TH1 Time Δt	0 s
E2.05	TH1 verification	1 .. Active
E2.18	M1 - overl. monitoring	1 .. Standard
E2.19	M1 - response	3 .. Alarm-trip
E2.20	M1 - Imax at 0Hz	50 %
E2.21	M1 - Imax at f nom.	100 %
E2.22	M1 - therm. f-limitation	35 Hz
E2.23	M1 - motor-time	5 min
E2.25	M1 - alarm level	100%
E2.26	M1 - trigger level	110 %
E2.42	Stall protection	1 .. Active
E4.01	Control source 1	4 .. Bus
E4.02	Control source 2	1 .. 2-wire (edge rated)

Mains voltage

B3.01	Mains voltage				2 .. 400 V - 50/60 Hz

1 ...380 V - 50/60 Hz
2 ...400 V - 50/60 Hz
3 ...440 V - 50/60 Hz
4 ...480 V - 60 Hz

The frequency inverters >*pDRIVE*< *MX eco* are designed as wide voltage range devices and can be operated in the voltage range of 380...480 V AC.

The correct setting of the mains voltage is absolutely necessary for the adaptation of the internal voltage alarm levels and protection levels. Maladjustment can lead to damage of the device !

Motor control

For the optimal adaptation of the used motor to the respective application, the input of the corresponding motor name plate data, the execution of the autotuning routine as well as the selection of an appropriate motor control method are necessary.

B3.02	Control mode				1 .. VC standard

1 ...VC standard
2 ...VC enhanced
3 ...VC economy
5 ...V/f 2 point
6 ...V/f economy
7 ...V/f 7 point

The >*pDRIVE*< *MX eco* provides a range of different motor control methods:
Select the method according to the table below:

Control method	Brief description	Possible adjustments	Typical applications
V/f 2 point	Simple V/f-characteristic control	Nominal motor data Starting voltage	Standard applications, multimotor drives, special motors, special windings
V/f economy	V/f characteristic control, optimized for quadratic loads	Nominal motor data Starting voltage Flux reduction	Simple applications in the range of pumps and blowers
V/f 7 point	In 7 points free configurable V/f-characteristic	Nominal motor data V1/f1...V5/f5	Special motors and windings, damping of resonance problems

Control method	Brief description	Possible adjustments	Typical applications
VC standard	Field orientated control without speed feedback	Nominal motor data Starting torque Slip compensation V_{max} field weakening Autotuning	Factory setting, all-purpose field orientated control with very good dynamics
VC enhanced	Optimized field orientated control without speed feedback	Nominal motor data Starting torque Slip compensation V_{max} field weakening Autotuning	Applications with special requests concerning dynamic and starting torque performances, only for single drives e.g. compressor, extruder, conveyor belt,...
VC economy	Field orientated control without speed feedback optimized for quadratic load	Nominal motor data Starting torque Slip compensation V_{max} field weakening Autotuning Flux reduction	Drives with quadratic loads such as centrifugal pumps and fans. The energy consumption is optimized by means of a load dependent decrease of the magnetizing current vector.

Individual functions of the inverter are only possible when using an appropriate motor control method. When functions are activated which do not correspond with the selected motor control method the alarm message "Change control mode !" occurs.

HTIU

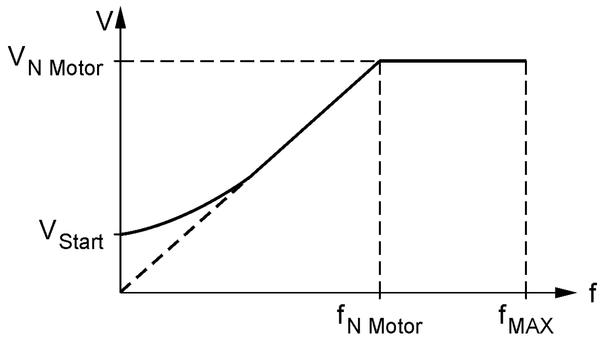
Settings for V/f mode (V/f 2 point and V/f 7 point)

B3.03	Starting voltage				0 V
	0...100 V				

8 P01 023 EN.04/04

If a V/f control variant is used, the starting torque can be adjusted to the respective load request by means of this setting. The V/f characteristic is as a result raised during start in order to compensate the voltage loss caused by the stator resistance.

The voltage increase occurs independently of the actual load. A longer operation in the frequency range with voltage increase or a too high setting leads to increased motor temperature and is therefore to be avoided.



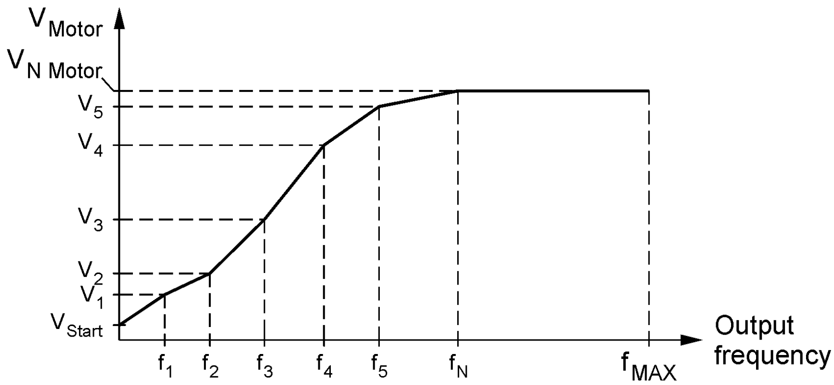
V_{N_Motor} and f_{N_Motor} can be adjusted in matrix field B4.

Settings for V/f mode (V/f 7 point)

B3.04	V/f - V1				40 V
B3.06	V/f - V2				120 V
B3.08	V/f - V3				200 V
B3.10	V/f - V4				280 V
B3.12	V/f - V5				360 V
	0...1000 V				

B3.05	V/f - f1				5 Hz
B3.07	V/f - f2				15 Hz
B3.09	V/f - f3				25 Hz
B3.11	V/f - f4				35 Hz
B3.13	V/f - f5				45 Hz
	0...300 Hz				

If the control variant "V/f 7 point" is used, the V/f-characteristic is not linear defined by the points V_{Start} / 0 Hz and V_N / f_N. They can be defined by means of 5 further free-selectable value pairs for voltage and frequency. As a result a universal adjustable V/f-characteristic is available especially for special motors and also for the damping of magnetic resonance problems in the motor.



V_{N_Motor} and f_{N_Motor} can be set in matrix field B4.

Choose the value pairs of the free programmable V/f-characteristic in such a way that they are parameterized with upward trend ($f_1 < f_2 < ... < f_5 < f_{NOM}$).

If individual points are parameterized incompletely or faulty ($f > f_{NOM}$, $V > 1.5 \times V_{NOM}$) the alarm message "V/f 7 point set faulty" is set.

Settings for Vector Control Mode

B3.17	R1 Compensation				80 %
	50...100 %				

If a field-orientated control variant (VC standard, VC enhanced or VC economy) is used, the effect of the stator resistor, that is determined by the autotuning routine, can be modified.

At setting 100 % the determined stator resistor (B4.12) is used for control. Lower values reduce the resistor in percentage.

Overcompensation (measured value greater than the real value of R1 and cable resistance) leads to instability and must be prevented !

B3.18	Slip compensation				100 %
	0...300 %				

The control tries to keep the motor speed constant also for varying load situations.

The nominal slip calculated from the motor nominal motor data is used as a measure of the speed deviation. By means of the slip compensation the accuracy of the load-dependent correction can be adjusted. Values smaller than 100 % lead to lower compensation, values larger than 100 % lead to stronger compensation.

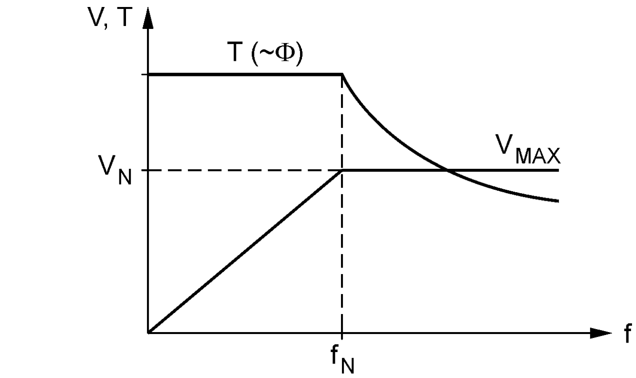
The function is only available by using a field-orientated control variant (VC standard, VC enhanced or VC economy).

B3.19	Vmax field weakening				110 %
	100...200 %				

The speed control of the motor via the frequency inverter provides a proportional change of the motor voltage depending on the output frequency.

The frequency as well as the voltage increase proportionally from zero up to nominal point of the motor V_N / f_N. If the frequency increases further above this point, the voltage remains constant and the motor is operated in the so-called field weakening.

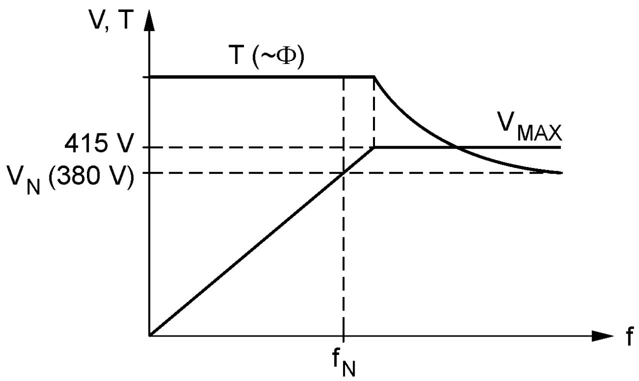
When a field-oriented control variant (VC standard, VC enhanced or VC economy) is used, the maximum permissible motor voltage within the field weakening range can be set.



Setting B3.19 = 100 %

Field-weakening point = nominal frequency / nominal motor voltage

V_{MAX} = 100 % = $V_{N\ Motor}$



Setting B3.19 > 100 %

The maximum allowed voltage within the field weakening range is higher than the nominal motor voltage. For this reason the field weakening point is displaced to higher frequencies.

This is however only possible if the level of the DC link voltage is high enough for the selected voltage e.g. using a 380 V motor at a mains voltage of 415 V.

V_{MAX} = 415 / 380 * 100 = 109 %

B3.20	Dynamic 1				0.67
	0...25				

B3.21	Dynamic 2				1
	0...10				

If a field-orientated control variant (VC standard, VC enhanced or VC economy) is used, the dynamic speed characteristics for load impulses can be adjusted with both of these settings. The settings act directly on the internal control circuit and are preset by factory default.

The presetting is related on a total centrifugal mass (motor and load) of the drive system that is typically when an IEC motor suitable for the inverter power is used (J_{Total} = approx. 2 x J_{Motor}).

If the total centrifugal mass (motor, drive elements like coupling, brake, gear and load) extremely differs from the presetting, a manual correction of parameter B3.20 Dynamic 1 is necessary.

large total centrifugal mass → increase B3.20
small total centrifugal mass → reduce B3.20

An optimisation is only required in exceptional cases.

The occurrence of vibrations in the middle speed range (20...40 Hz) can be compensated by lowering B3.20 Dynamic 1 (typical for small motors at big frequency inverters).

General settings

B3.24	Stop mode				2 .. Deceleration ramp
	1 ...Free wheel 2 ...Deceleration ramp 3 ...Dec. with persistant 4 ...Fast stop				

B3.25	decel. persistant freq.				0 Hz
	0...50 Hz				

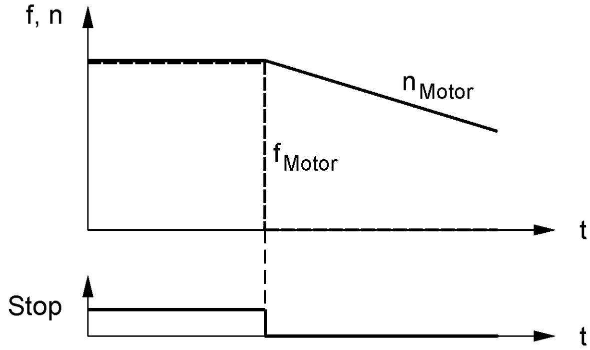
B3.26	decel. persistant time				0 s
	0...3600 s				

The behaviour of the frequency inverter when the stop command takes effect can be defined by parameter B3.24...B3.26. Therefore it is of no importance from which control source the stop command comes (see Matrix field E4, page 235).

In all cases a further start command leads to a restart of the drive.

Free wheel

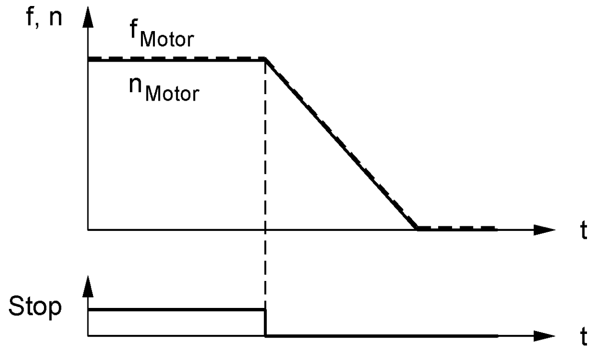
A stop command leads to immediate locking of the output-sided transistor bridge. The motor runs in free wheel without current.



Deceleration ramp (factory setting)

The stop command initiates a controlled stop. The motor is therefore delayed at the active deceleration ramp.

After reaching standstill, current to the motor is switched off.

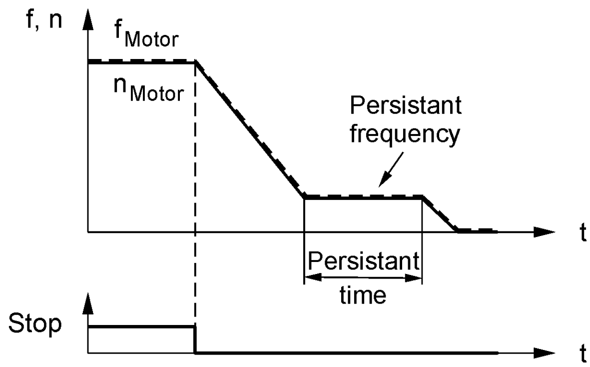


Deceleration with persistence

The stop command initiates a controlled stop with the deceleration ramp. This, however, does not lead directly to a standstill of the motor, but instead to keeping the adjustable persistence frequency for the period of the persistence time. The final switching-off occurs after the end of the persistence time.

The persistence function is mainly used for hydraulic systems in which a direct switching-off would lead to undesired pressure fluctuations or also cavitation effects.

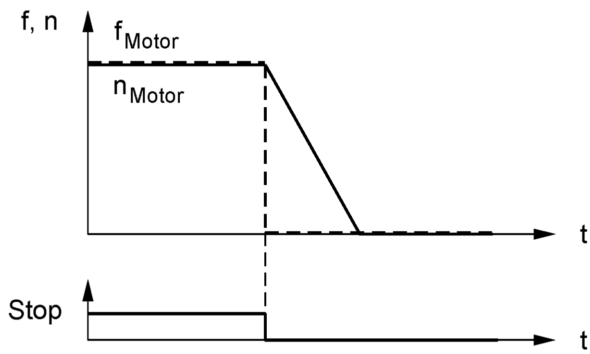
The persistence frequency can also be set below the allowed minimum frequency.



Fast stop

The stop command leads to a fastest possible standstill. The internal ramp time is therefore 0.1 seconds.

The real time until standstill depends on the centrifugal mass, the load and on possible active braking functions (see matrix field B5, page 98).



B3.27	Motor fluxing				1 .. At start

0 ...Not active
1 ...At start
2 ...Always active

By means of parameter B3.27 a prefluxing can be initiated at the start of the motor. This is only necessary for drives where high starting torque is requested.

HTIU
8 P01 023 EN.04/04

B3.30	Switch. frequency				kHz
	2...16 kHz				

The output voltage of the inverter is produced by means of a loss-optimised PW modulation of the transistors on the output side. The underlying pulse frequency of the modulation is limited by means of this parameter.

High pulse frequencies lead to small current ripples and reduce the typical noise emission. High pulse frequencies however also cause heavily increased electrical high-frequency emissions (EMC) and additional losses in the IGBTs and the DC link capacitors (see product catalogue, chapter "Power decrease"). High pulse frequencies lead therefore to a shortening of the allowable motor cable length.

Therefore the pulse frequency should not be set unnecessarily high.

Type of device	Factory setting B3.30	Max. pulse frequency		
		Standard	B3.40 = Sinusfilter	B3.32 = 6, 8 or 10 µs
>pDRIVE< MX eco 4V0,75...4V30	4 kHz	16 kHz	4 kHz	4 kHz
>pDRIVE< MX eco 4V37...4V75	4 kHz	16 kHz	4 kHz	2.5 kHz
from *>pDRIVE< MX eco* 4V90/110	2.5 kHz	8 kHz	4 kHz	2.5 kHz

In most cases the relevant factory setting is a good compromise between noise- and EMC strain. The effective setting range depends on the size of the device.

At high heat sink temperature the pulse frequency is automatically decreased in order to reduce the thermal load (see also Matrix field A3, page 56).

When calling the function Load default motor (B4.40) the pulse frequency (B3.30) is reset to factory default.

B3.31	Noise reduction				0 .. Not active
	0 ...Not active 1 ...Active				

When using frequency inverters a very characteristic motor noise occurs due to the pulsed output voltage that depends on the set pulse frequency. In industrial environments the motor noise is no problem but in low-noise environments the use of frequency inverters may cause inadmissible high noise emission.

The function "Noise reduction" changes the modulation pattern so that pronounced single tones do not disturb any longer.

HTIU
8 P01 023 EN.04/04

B3.32	Min. length of pulses				0 .. Not active

0 ...Not active
6 ...6 µs
8 ...8 µs
10...10 µs

In case of long motor cables excessive voltages arise due to reflections and as a result the motor insulation can be strained.

With the help of the parameter B3.32 "Min. length of pulses" the minimum width of a pulse can be extended whereby the reflection conditional overvoltage can be reduced.

The slew rate as well as the EMC load are not influenced by changing this parameter.

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.

B3.35	Catch on the fly				1 .. Active

0 ...Not active
1 ...Active

B3.36	Allowed catch direction				3 .. Forward & reverse

1 ...Forward
2 ...Reverse
3 ...Forward & reverse

B3.37	Remanence level				0.4

0.4...12

The frequency inverters of the >*pDRIVE*< *MX eco* range are designed to be able to catch on the fly a free wheeling but still energized motor. The inverter is connected speed and voltage synchronous to the free wheeling motor.

With parameter B3.37 Remanence level a remanence limit can be set. When the voltage measured at the motor terminals is lower than the set value, no catch on the fly takes place. Thereby the accuracy of measurement can be adapted to the existing operating conditions (e.g. interspersions of parallel motor cables).

If parameter B3.37 is set too high a free wheeling motor cannot be catched on the fly !

B3.40	Output filter				1 .. No filter / AMF

1 ...No filter / AMF
2 ...Sinus filter

If filters are installed on the inverter output, set the type of used filters on the >*pDRIVE*< *MX eco*.

A fault or non-setting can lead to damage of the filter components !

HTIU
8 P01 023 EN.04/04

B3.41	Fan control				1 .. Automatic

1 ...Automatic
2 ...Continuous

All >*pDRIVE*< *MX eco* inverters are equipped with a configurable control of the power part fans. Switching off the fan when cooling is not required increases the life of the fans and reduces its energy consumption as well as the noise load.

Depending on the size of the device the function differs as following:

- >*pDRIVE MX eco 4V0,75...4V75*
  The fan is switched on at a thermal load of > 70 % and switched off again at < 60 %.
- >*pDRIVE MX eco from 90 kW*
  The fan runs as soon as the inverter is in operation. After a stop command the fan continues running until the thermal load drops to < 60 %.

If setting "2 .. Continuous" is selected, the fan is always in operation.

Select setting "2 .. Continuous" if the devices are operated on a common DC link. A failure to comply leads to excessive heating of the DC link capacitors and therefore to a reduction in the life cycle !

B3.42	Auto tune at power on				0 .. Not active

0 ...Not active
1 ...Active

In case of setting "1 .. Active" an autotuning routine is carried out at each voltage connection. Execution of the routine lasts about 1...10 s for devices up to 75 kW and up to 3 minutes from 90 kW.

This function should be used if the ambient temperature strongly fluctuates during operation and in case of high starting torques.

In case of active fieldbus connection the function must not be carried out during operating state "Lock switching on" !

B3.43	Automatic SC test				0 .. Not active

0 ...Not active
1 ...Active

If this function is activated, a short test routine checks the connected motor and the cabling on the output side for a possible short-circuit at each start command.

The execution of the routine lasts about 200 ms.

B3.44	Operation with IR				0 .. No

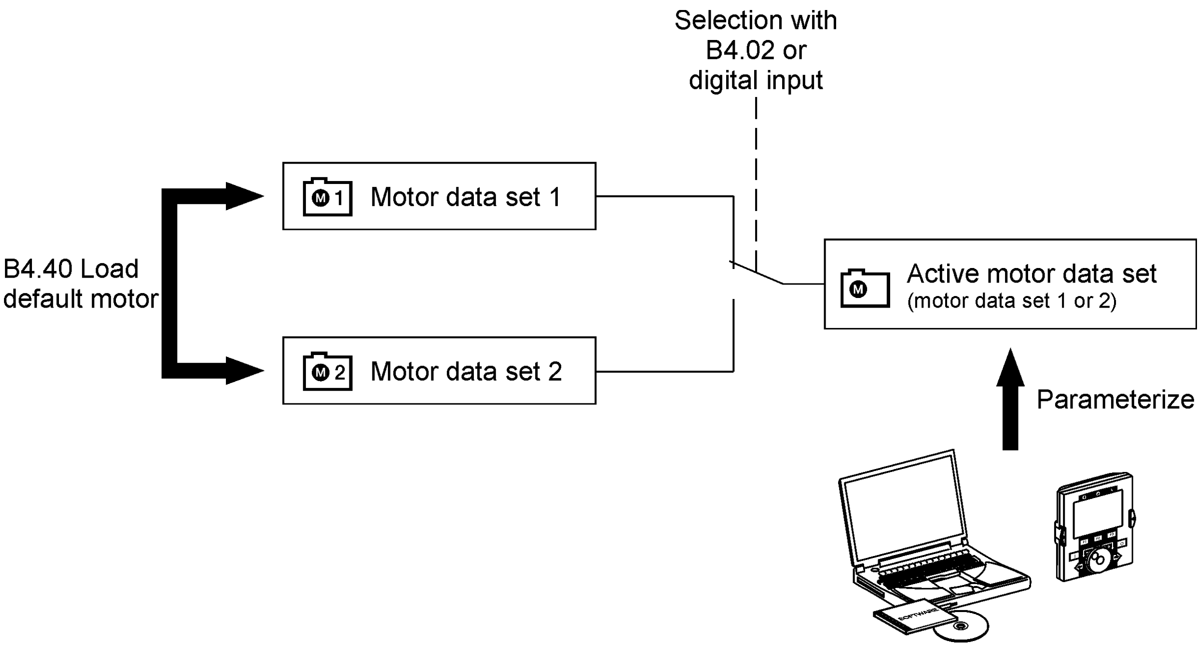
0 ...No
1 ...Yes

This parameter determines whether the inverter is supplied by the mains or by an intelligent rectifier >*pDRIVE*< *LX*. Thereby the internal acting levels of the voltage monitoring are adapted.

B4		**Motor data**	Adjustment of nominal motor data, autotuning function, switchable sets of motor data

For the optimal operation and protection of the motor via the frequency inverter, it is absolutely necessary for all motor control variants to have knowledge of the motor to be operated. The electrical definition of the motor occurs by the entry of the name plate data as well as via the starting of the autotuning function by which further electrical characteristics are registered.

All motor data are pooled together in a set of motor data. In order to be able to operate the *>pDRIVE< MX eco* on two different motors, two independent sets of motor data are available which can be switched over by means of parameterization or a digital input.



The switchable sets of motor data are carried out completely independent from the two sets of parameters.

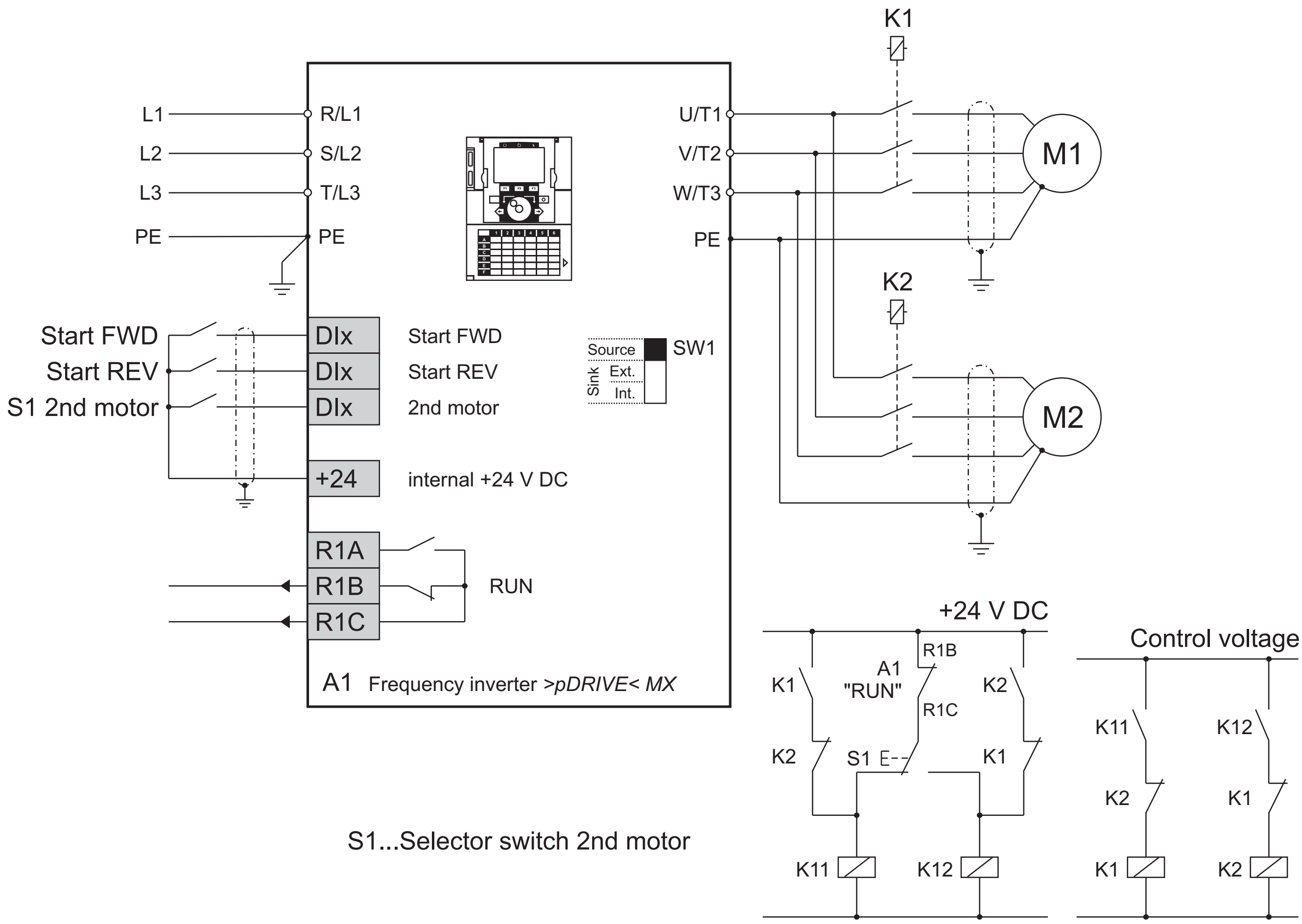
A motor switching does not urgently need a changed parameterization, nor does the use of 2nd set of application parameters need two different motors.

In addition to the motor data, the thermal motor model and the operating hours meter are also switched over.

The switching occurs always in drive state "Ready". A switch-over command which is given during device state "Run", is carried out if the drive state changes to "Ready".

A digital output function is available for confirmation of the active motor.

If a recognition of wire break of the signal outputs is necessary, two outputs are required instead of one.



S1...Selector switch 2nd motor

Motor selection

B4.01	Motor type				0 .. IEC (Europe)

0 ...IEC (Europe)
1 ...NEC (US)

The settings of the motor type "IEC (Europe)" or "NEC (US)" is used for the selection of the factory motor data to be loaded (see parameter B4.40 "Load default motor").

B4.02	Motor selection				1 .. Motor 1

1 ...Motor 1
2 ...Motor 2
3 ...DI dependent

The parameter determines the used set of motor data.

If "3 .. DI dependent" is selected, a digital input with the function "2nd motor" is necessary (see Matrix field D2, page 169).

B4.03	Start auto tune				

1 ...Starting

The autotuning routine carries out a static measurement of electrical characteristics whereby the motor is not turned. The measurement lasts up to 3 minutes depending on the size of the motor and the inverter and is only required when using a vector control mode (see parameter B3.02).

HTIU
8 P01 023 EN.04/04

Before calling the autotuning routine, check the following points:

- Correct entry of the nominal motor data M1 or M2
- Correctly connected and available mains voltage
- Motor connected, switching devices in the motor line are switched on
- Correctly selected motor (if both sets of motor data are used)
- Inverter is in operating state "ready"
- Motor is in stillstand and in cold operating state

During carrying out the autotuning function the motor is supplied with voltage !

Motor data M1

B4.05	Nominal power M1				kW
	0.2...3500 kW				

B4.06	Nominal current M1				A
	0...4000 A				

B4.07	Nominal voltage M1				V
	0...1000 V				

B4.08	Nominal frequency M1				Hz
	0...300 Hz				

B4.09	Nominal speed M1				rpm
	0...65000 rpm				

Enter the name plate data for the 1st set of ASM motor data (factory setting).

When a parameter from the group of motor name plate data is changed, the autotuning parameters B4.12...B4.15 are recalculated.

Thereby, existing autotuning values are overwritten !

B4.10	Nominal slip M1				Hz

B4.11	No. of pole pairs M1				

Values calculated from the nominal motor data (read only).

B4.12	Stator resistor M1				mOhm
	0...65000 mOhm				

B4.13	Rotortime constant M1				ms
	0...10000 ms				

B4.14	Fluxing current M1				A
	0...4000 A				

B4.15	Stray reactance M1				mH
	0...655.35 mH				

Values for the 1st set of motor data which are calculated from the motor name plate data or measured by the autotuning routine.

Motor data M2

B4.17	Nominal power M2				kW
	0.2...3500 kW				

B4.18	Nominal current M2				A
	0...4000 A				

B4.19	Nominal voltage M2				V
	0...1000 V				

B4.20	Nominal frequency M2				Hz
	0...300 Hz				

B4.21	Nominal speed M2				rpm
	0...65000 rpm				

Enter the name plate data for the 2nd set of ASM motor data.

When a parameter from the group of motor name plate data is changed, the autotuning parameters B4.24...B4.27 are recalculated.

Thereby, existing autotuning values are overwritten !

B4.22	Nominal slip M2				Hz

B4.23	No. of pole pairs M2				

Values calculated from the nominal motor data (read only).

B4.24	Stator resistor M2				mOhm
	0...65000 mOhm				

B4.25	Rotortime constant M2				ms
	0...10000 ms				

B4.26	Fluxing current M2				A
	0...4000 A				

B4.27	Stray reactance M2				mH
	0...655.35 mH				

Values for the 2nd set of motor data which are calculated from the motor name plate data or measured by the autotuning routine.

Motor data M0

B4.29	Nominal power M0				kW
B4.30	Nominal current M0				A
B4.31	Nominal voltage M0				V
B4.32	Nominal frequency M0				Hz
B4.33	Nominal speed M0				rpm
B4.34	Nominal slip M0				Hz
B4.35	No. of pole pairs M0				
B4.36	Stator resistor M0				mOhm
B4.37	Rotortime constant M0				ms
B4.38	Fluxing current M0				A
B4.39	Stray reactance M0				mH

Factory motor data for an IEC or NEC asynchronous three-phase motor suitable for inverter power. By means of parameter B4.40 "Load default motor" these values are automatically copied into the data sets M1 and M2 and as a result existing settings are reset.

B4.40	Load default motor				
	1 ...Load default motor				

With selection "1 .. Load default motor" the set of data M0, M1 and M2 are overwritten by the factory motor data deposited in the inverter.

The factory data are values of a 4-pole motor suited for the inverter nominal power. According to the setting of parameter B4.01 Motor type to IEC (Europe) or NEC (US), the data relate to 400 V/50 Hz or 480 V/60 Hz.

When loading the factory motor data, the existing parameterization is overwritten and is lost !

When calling the function Load default motor (B4.40) the pulse frequency (B3.30) is reset to factory default.

Brake mode

B5.01	Brake mode				0 .. No braking function

0 ...No braking function
1 ...Motor braking A
2 ...Motor braking B
3 ...Motor braking C
5 ...External braking unit

Motor brake

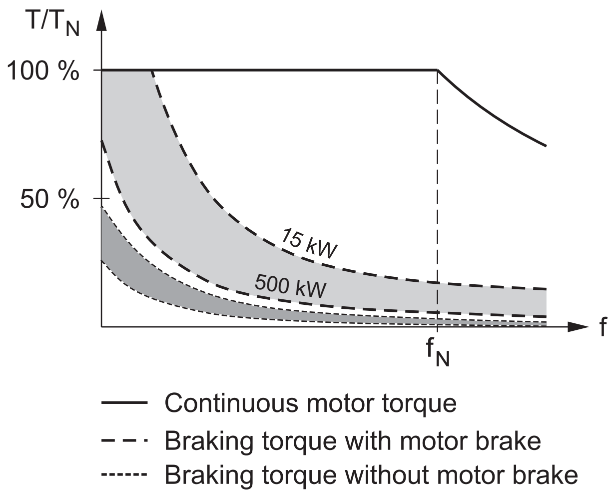
The motor brake is an utmost economical alternative to the use of a braking unit device with external braking resistor. The braking action is achieved by using a specially tuned modulation pattern which produces losses in the system of the stator windings, the motor cable, the IGBTs and the DC link capacitors. The occurring losses are in the range of the respective nominal losses and are directly covered by the load. During braking no energy consumption from the supplying mains takes place !

The achievable braking power depends on the type of motor winding and the speed range or field weakening range and is around 8...12 % of the nominal device power. As the braking torque increases with decreasing speed, the achievable deceleration is not constant.

By means of the three possible settings motor braking A-B-C, the braking action for the respective operating case can be empirically optimised.

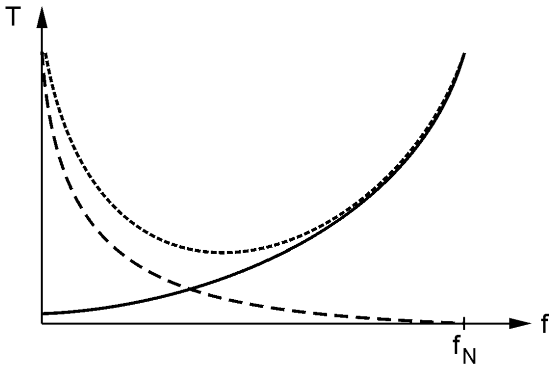
The activation of the motor braking occurs automatically with increasing DC link voltage.

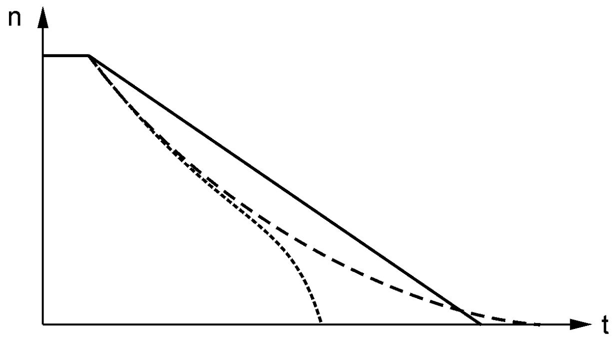
The use of the motor braking is only permitted in case of field oriented motor control variants.



At the shutdown of fan drives the quadratic decreasing load torque acts in addition to the motor braking torque. The deceleration time can be typically reduced to 1/4 of the deceleration time with free wheeling.

When considering both torques the following behaviours arise:





——	Load torque
– – ·	Braking torque
------	Resulting braking torque

——	Deceleration corresponding to the set ramp
– – ·	Free-wheeling
------	Deceleration with motor braking

External braking unit

If the *>pDRIVE< MX eco* is operated in combination with *>pDRIVE< MX pro* devices, which are coupled by the DC link and whose internal braking unit is active, set B5.01 Brake mode of the *>pDRIVE< MX eco* to "5 .. External braking unit" in order to adapt the internal levels for voltage limitation to operation with the braking unit.

DC-Holdingbrake

The DC holding brake is used to keep a rotor shaft that has just come to a standstill stopped for a short time. For this purpose, a magnetic DC field is built up in the stator which leads to a braking torque when the rotor is turning. The holding brake must not be understood as a fixing brake. On the contrary, the braking action does not come into force until the rotor is slightly turning, whereby acceleration is prevented, however.

The braking torque depends on the set braking current and the winding data. The speed required for braking is about 0.5...3 times the nominal motor slip.

Typical applications are holding unbalanced machine parts, protection of mechanical parking brakes (long-travel), keeping pressure of pumps for a short time,...

B5.20	DC-holdingbrake				0 .. Inactive
	0 ...Inactive 1 ...Time limited 2 ...Continuous				

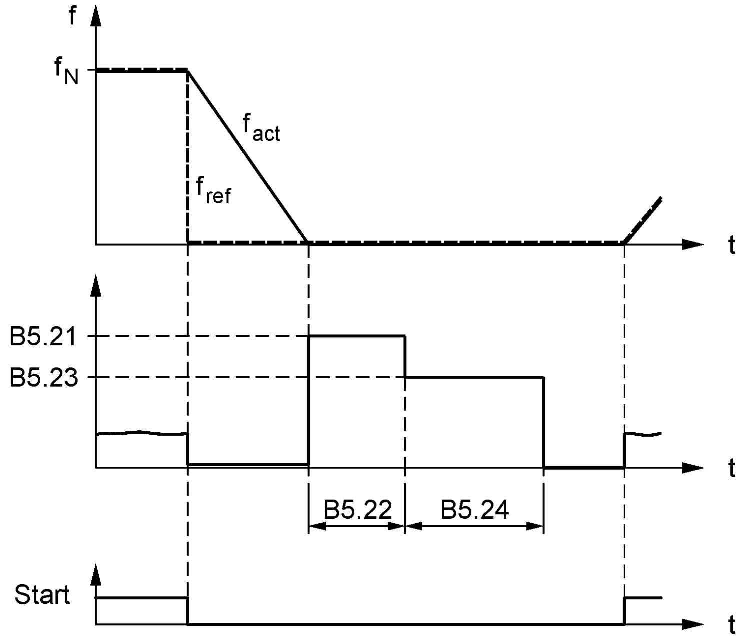
B5.21	DC-holdingbrake I-start				100 %
	0...100 %				

B5.22	DC-holdingbrake t-start				0 s
	0...100 s				

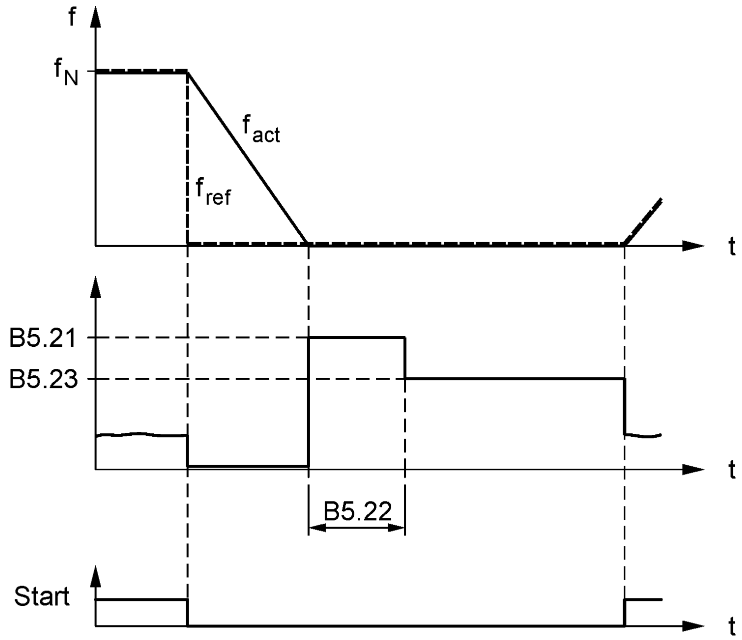
B5.23	DC-holdingbrake I-cont.				50 %
	0...100 %				

B5.24	DC-holdingbrake t-cont.				0 s
	0...100 s				

Setting "1 .. Time limited"



Setting "2 .. Continuous"



HTIU

8 P01 023 EN.04/04

B6		Short menu	Compilation of a user-specific short-menu

Short menu

The short menu offers the possibility of storing parameters selected from the entire range of the matrix structure as a copy in matrix field B6 "Short menu". In this way, parameters frequently used in operation for optimization or monitoring can be summarized for the user for adjustment or indication.

In addition, it is possible to except all parameters listed in the short menu from the generally applicable parameter lock in order to generate a freely editable security range.

The factory presetting of the short menu depends on the loaded macro. Essentially, the parameters used for the optimization of the drive during operation (e.g. acceleration / deceleration time, PID settings,...) are noted here.

B6.01	Edit parameters				

By means of parameter B6.01 "Edit parameters" you can access the parameter list of the short menu. These parameters can be read, adjusted or removed from the short menu there.

B6.02	Add parameters				

Parameter B6.02 "Add parameters" contains an editing mode by which the parameters can be selected which should be added to the short menu. The parameters are selected using the usual matrix structure.

By means of the function key F1 a selected parameter is added to the short menu (→ B6) or an included parameter is removed from the short menu (B6 →).

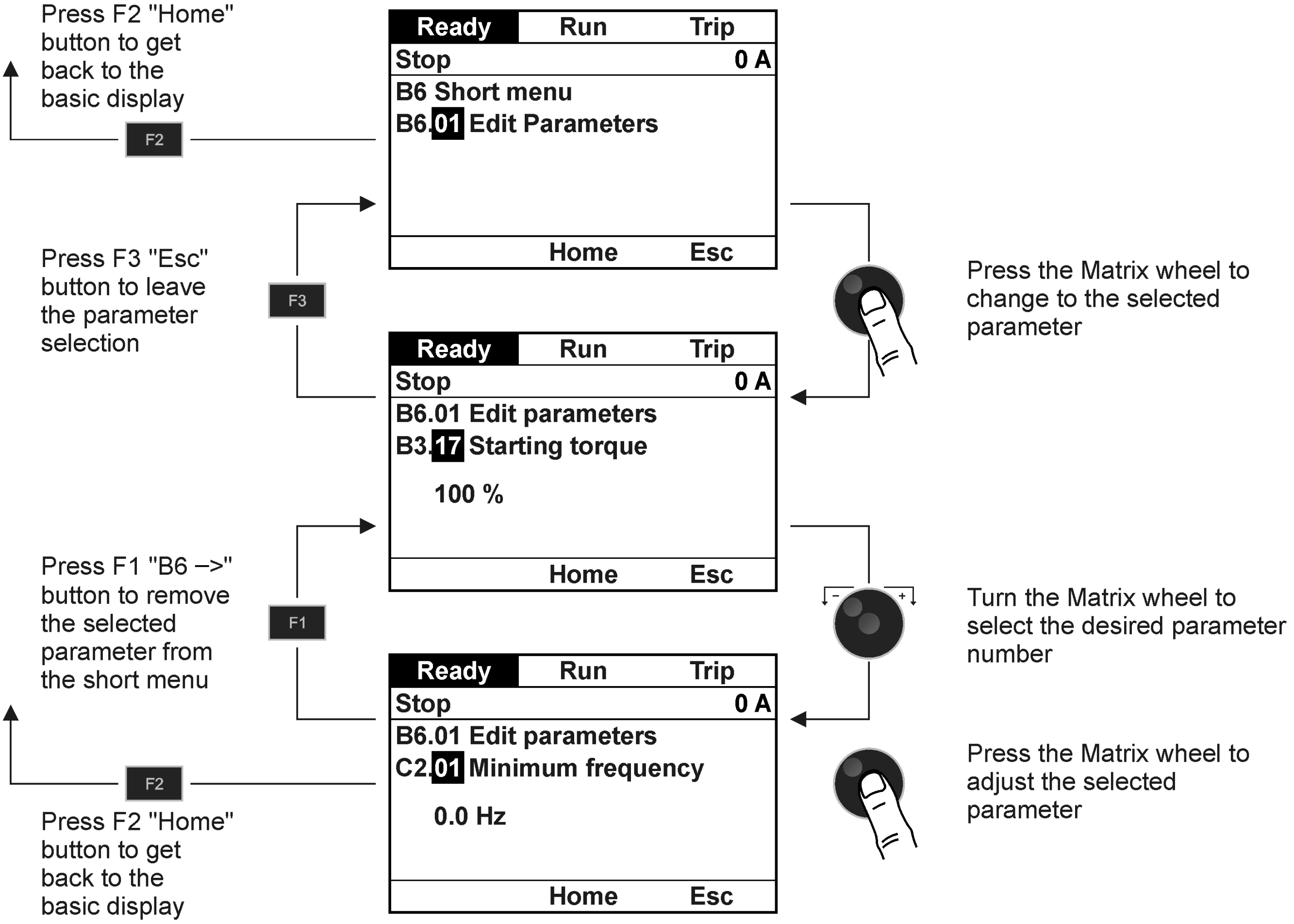
A maximum of 60 parameters can be added to the short menu.

B6.03	Last modified parameter				

This parameter enables quick access to the last ten modified parameters.

Parameters that are modified via fieldbus connection are excluded from the listing.

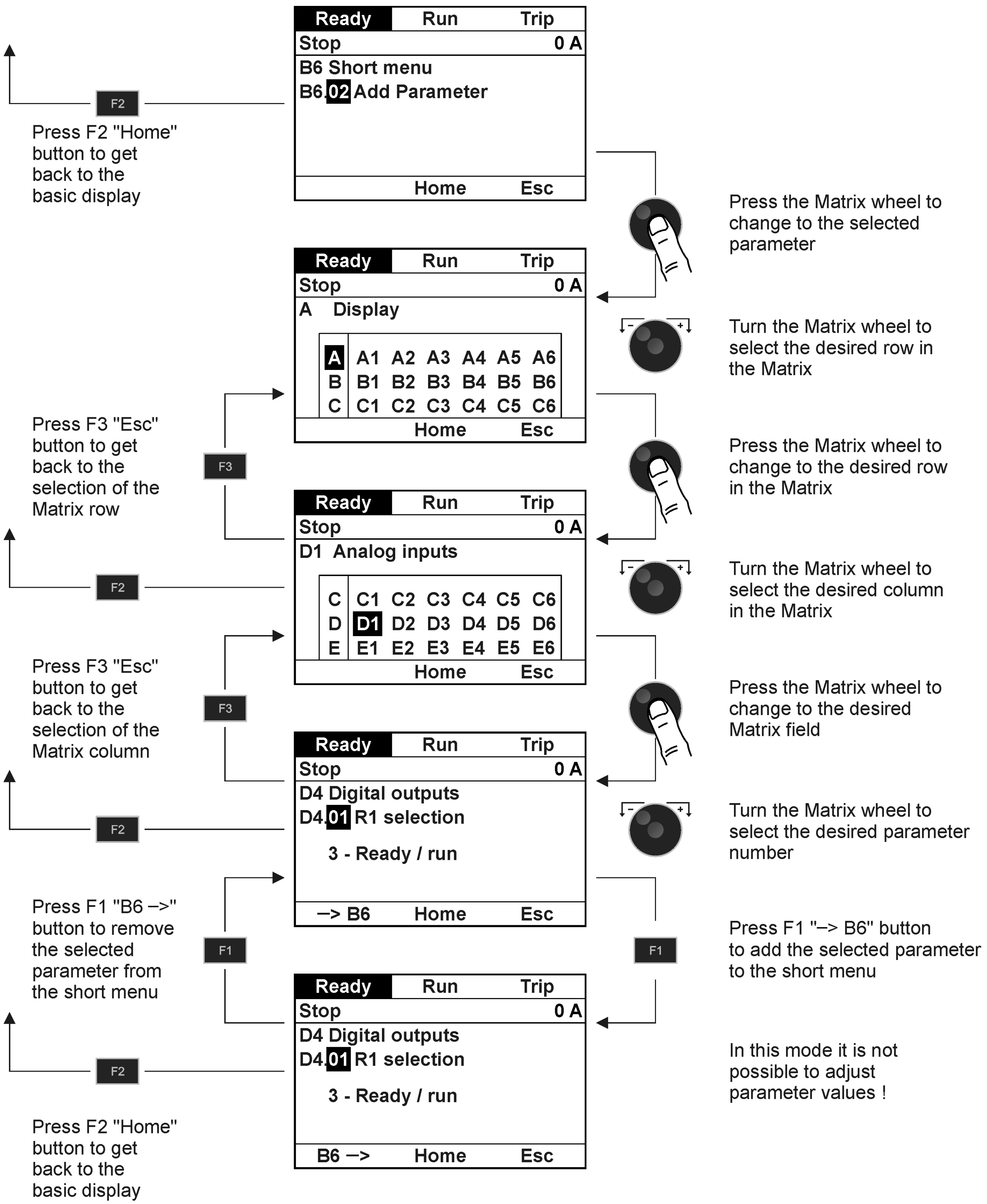
Edit parameters of the short menu



HTIU

8 P01 023 EN.04/04

Add parameters to the short menu



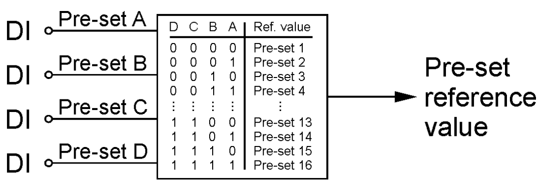
HTIU
8 P01 023 EN.04/04

HTIU

8 P01 023 EN.04/04

C1		Int. reference	Configuration and scaling of the internal reference value sources, signal assignment via reference value distributor

Preset reference values



The pre-set reference block contains up to 16 freely programmable references in Hz or %. Depending on the binary encoded digital input commands (Pre-set A, Pre-set B, Pre-set C and Pre-set D) these commands can be connected to the output of the reference source.

Additionally to their functionality as reference source the pre-set references can be also used as switchable limitation for the PID controller output and speed.

The number of necessary digital inputs depends on the necessary number of reference values. The selection of a pre-set reference represents a pure reference value selection. The necessary start/stop commands must be realised via further digital inputs or the bus control word.

C1.01	Pre-set ref. selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the pre-set reference value block can be set corresponding to the reference value distributor as source for different uses. Parameter C1.01 assigns the pre-set reference value source to the desired use. See also chapter "Reference sources" and "Reference value distributor".

The pre-set references are scaled in Hz or % according to the set use.

If the pre-set reference values should be used as switchable limitation of the PID controller or the acceleration integrator, set parameter C1.01 to "15 .. Request [%]" and the corresponding function to "FIX-xy".

HTIU
8 P01 023 EN.04/04

C1.02	Pre-set reference 1				0 % or Hz
C1.03	Pre-set reference 2				0 % or Hz
C1.04	Pre-set reference 3				0 % or Hz
C1.05	Pre-set reference 4				0 % or Hz
C1.06	Pre-set reference 5				0 % or Hz
C1.07	Pre-set reference 6				0 % or Hz
C1.08	Pre-set reference 7				0 % or Hz
C1.09	Pre-set reference 8				0 % or Hz
C1.10	Pre-set reference 9				0 % or Hz
C1.11	Pre-set reference 10				0 % or Hz
C1.12	Pre-set reference 11				0 % or Hz
C1.13	Pre-set reference 12				0 % or Hz
C1.14	Pre-set reference 13				0 % or Hz
C1.15	Pre-set reference 14				0 % or Hz
C1.16	Pre-set reference 15				0 % or Hz
C1.17	Pre-set reference 16				0 % or Hz
	-300...300 % or Hz				

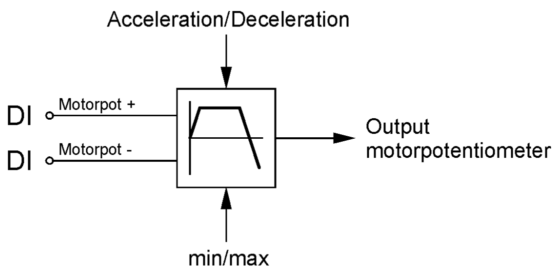
Entry of the individual pre-set references in Hz or %

Negative frequencies correspond to a reverse rotating field on the output of the frequency inverter.

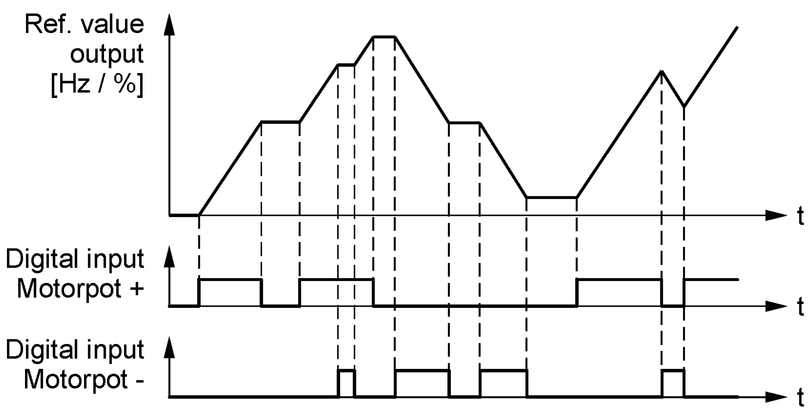
HTIU

8 P01 023 EN.04/04

Motor potentiometer



The electronic motor potentiometer presents an integrator whose output value is to be controlled by means of two digital input commands in Hz or %. The output value changes time linear during active input within the set min/max limits.



If neither of the two input commands is active (or both simultaneously), the electronic motor potentiometer remains at its last value.

Negative frequencies correspond to a reverse rotating field on the output of the frequency inverter.

Instead of the digital input commands, the matrix wheel can be also used to set the reference value.

C1.18	Motor pot. selection				0 .. Not used

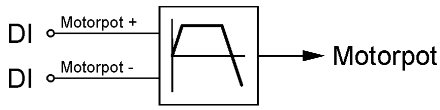
0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the motor potentiometer can be set corresponding to the reference value distributor as source for different uses. Parameter C1.18 assigns the desired use to the motor potentiometer.

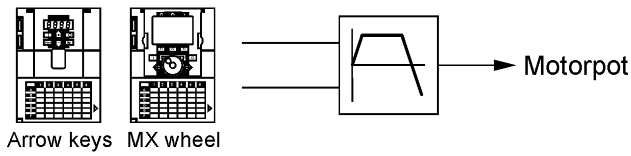
C1.19	Motor pot. control				1 .. Terminals

1 ...Terminals
2 ...MX-wheel

The motor potentiometer is controlled from the terminals with the help of both digital inputs "Motor pot. +" and "Motor pot. -" as standard.



By switching parameter C1.19 to "2 .. MX-wheel" the adjustment of the motor potentiometer can also occur by means of the thumb wheel on the removable Matrix operating panel or with both of the arrow keys on the built-in LED keypad.



Especially if the internal PID process controller is used a reference value which is performed external can be renounced. Desired adjustments of the reference value can be carried out directly on the device without having to operate the device in panel mode.

The behaviour of the motor potentiometer itself is not influenced by changing parameter C1.19.

C1.20	Motor pot. min. value				0 % or Hz

-300...300 % or Hz

C1.21	Motor pot. max. value				50 % or Hz

-300...300 % or Hz

C1.22	Motor pot. accel. time				10 s

0...6500 s

C1.23	Motor pot. decel. time				10 s

0...6500 s

The scaling of the motor potentiometer output occurs via the parameters C1.20 and C1.21. The increase/decrease, which is controlled by means of the both digital inputs "Motor pot. +" and "Motor pot. -", occurs within set limits.

8 P01 023 EN.04/04 HTIU

The motor potentiometer can be used as uni- or bipolar reference source. The setting should occur in such a way that parameter C1.21 "Motor pot. max. value" corresponds to the positive value.

The time, which the motor potentiometer needs for integration within the min/max limits, is defined as the acceleration and deceleration time of the motorpotentiometer.

C1.24	Motor pot. ref. storage				0 .. No

0 ...No
1 ...always
2 ...at stop

Parameter C1.24 determines the behaviour of the electronic motor potentiometer if the frequency inverter is switched off.

If "0 .. No" is selected, the reference value of the motor potentiometer is deleted after each stop command and each switching-off of the device.

Selection "1 .. always" simulates a "mechanical" motor potentiometer, i.e. the actual reference value remains saved after a switch-off.

In case of setting "2 .. at stop" the reference value of the motor potentiometer remains stored as long as the frequency inverter is not disconnected from the mains (and a possibly existing 24 V buffer voltage). When the control electronics is rebooted the reference value is canceled.

C1.25	Motor pot. tracking				0 .. Not active

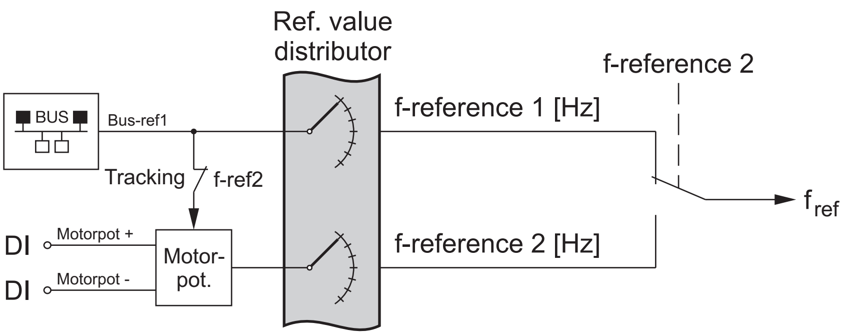
0 ...Not active
1 ...Active

In order to enable a shock free switch-over of the reference values of any reference source to the motor potentiometer, the function "Motor pot. tracking" can be activated.

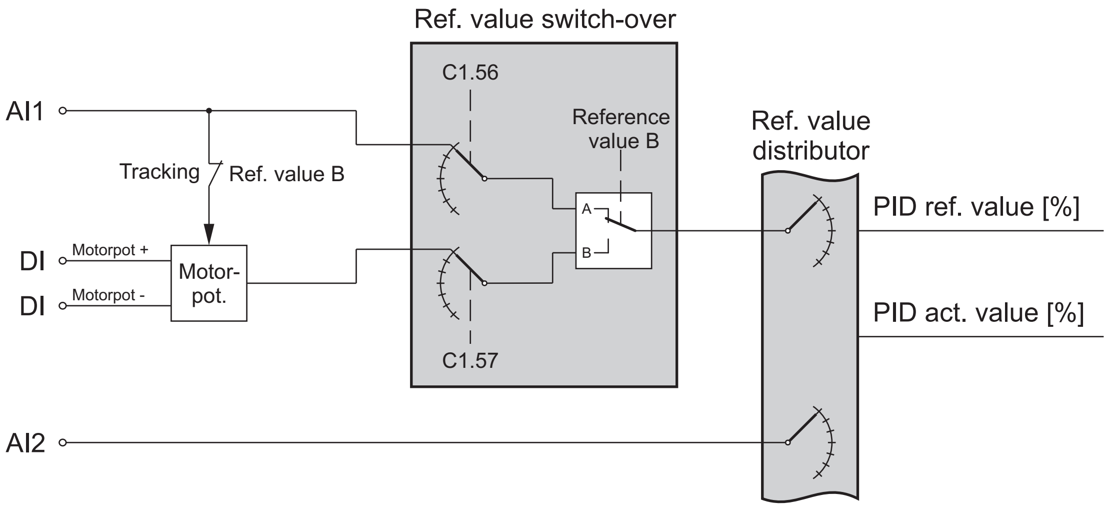
Thereby the motorpotentiometer automatically assumes the actual reference value as long as the motor potentiometer is not active.

The switch-over for the frequency path can be realized by using the reference values "f-reference 1 [Hz]" and "f-reference 2 [Hz]" or by using the function Reference value switch in general.

Tracking of the frequency path with the digital command "f-reference 2 [Hz]"

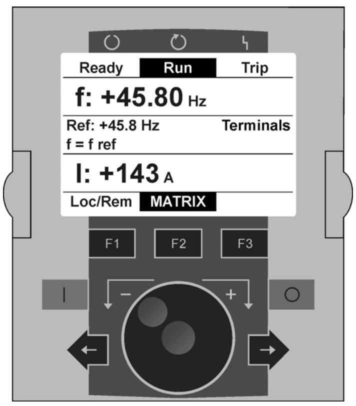


Tracking by using the reference value switch-over with digital command "Reference value B"

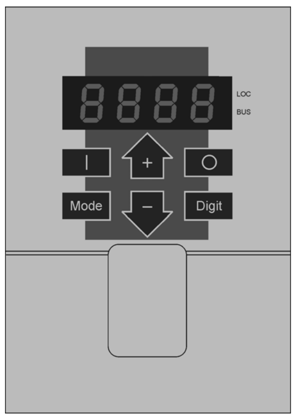


Panel reference sources

Matrix operating panel



LED keypad



The output value of the local reference source MX-wheel is changed by turning the thumb wheel.

Turning right leads to an increasing reference value, turning left leads to a decreasing reference value.

The rotational direction is selected with the arrow keys on the keypad.

If the removable Matrix operating panel of the *>pDRIVE< MX eco* is not used, the local reference source is not controlled by the MX-wheel but by both arrow keys on the built-in LED-keypad of the basic device.

The arrow keys act as control commands for the changing of the reference value as well as for a change of rotation.

To avoid desired changes of the rotational direction, the reference value will remain at zero crossing. By pressing the corresponding arrow key again the arithmetical sign of the reference value changes and thus also the direction of rotation changes.

As a simultaneous use of the LED- and LCD-keypads is excluded, the settings of the local reference source for both variants occur with the same parameters.

C1.29	MX-wheel selection				1 .. f reference

0 ...Not used
1 ...f reference

C1.30	MX-wheel f min. value				0 Hz

0...300 Hz

C1.31	MX-wheel f max. value				50 Hz

0...300 Hz

Setting of the minimum and maximum limits of the frequency reference value. The entry occurs unipolar and is valid for both rotational directions.

When using the built-in LED keypad the minimum reference value limit C1.30 is not active if both rotational directions are enabled.

C1.34	MX-wheel single step				0.1

0...50

The single step for the local reference source can be adapted for easily reference source setting.

Matrix operating panel: incremented value per step on the MX-wheel
LED-keypad: incremented value per key press (arrow keys)

The increment for the reference value changes with the rotational speed of the MX-wheel.

C1.35	Store MX-wheel ref.				0 .. No

0 ...No
1 ...always
2 ...at stop

Parameter C1.35 determines the behaviour of the panel reference source if the frequency inverter is switched off.

If "0 .. No" is selected, the reference value of the MX-wheel is deleted after each stop command and each switching-off of the device.

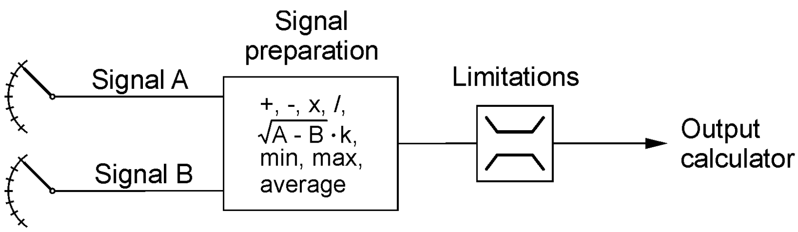
If "1 .. always" is selected, the reference value remains stored after a switch-off.

In case of setting "2 .. at stop" the reference value of the Matrix wheel remains stored as long as the frequency inverter is not disconnected from the mains (and a possibly existing 24 V buffer voltage). When the control electronics is rebooted the reference value is canceled.

HTIU

8 P01 023 EN.04/04

Calculator



The calculator can be used for the algebraic connection of two signals. All reference sources and actual values as well as a constant can be used as signals. Besides the four basic arithmetical operations it is also possible to operate with sum, inversion, root, rounding and statistic function.

The calculator is particularly used for PID-controller functions such as differential pressure control, flow rate control etc.

C1.38	Calculator selection				0 .. Not used

0 ...Not used	6... PID-reference val. [%]
1 ...f-reference 1 [Hz]	7... PID-actual value [%]
2 ...f-reference 2 [Hz]	15 .. Request [%]
3 ...f-correction [Hz]	

The output of the calculator can be set corresponding to the reference value distributor as source for different uses. Parameter C1.38 assigns the desired use to the calculator.

C1.39	Calculator input A				0 .. Not used
C1.40	Calculator input B				0 .. Not used

0 ...Not used	21 .. Int. ref. switch-over	45...Bus SW 4
1 ...0%	22 .. Calculator	46...Bus SW 5
2 ...100%	23 .. Curve generator	47...Bus SW 6
3 ...Actual frequency	26 .. PID-reference val. [%]	48...Bus SW 7
4 ...|Actual frequency|	27 .. PID-actual value [%]	49...Bus SW 8
5 ...Motor current	28 .. PID-deviation [%]	50...Bus SW 9
6 ...Torque	29 .. PID-output	58...AI 1
7 ...|Torque|	32 .. Thermal load M1	59...AI 2
8 ...Power	33 .. Thermal load M2	60...AI 3
9 ...|Power|	34 .. Thermal load VSD	61...AI 4
10...Speed	35 .. Counter (average)	62...Frequency input
11...|Speed|	36 .. Total counter	63...Motor potentiometer
12...Motor voltage	37 .. Speed machine	64...Pre-set reference
13...DC voltage	42 .. Bus SW 1	65...MX-wheel
16...Int. f-ref. before ramp	43 .. Bus SW 2	66...LFP input
17...Int. f-ref. after ramp	44 .. Bus SW 3	

Parameters C1.39 "Calculator input A" and C1.40 "Calculator input B" define both signals which are used for calculation.

If input B is set to "0 .. Not used" a constant is used for calculation instead of signal B. This constant is created with parameters C1.42...C1.44.

C1.41	Calculator function				2 .. A - B

1 ...A + B	7... A - (-B)	13...A / |B|
2 ...A - B	8... A x (-B)	14...min (A, B)
3 ...A x B	9... A / (-B)	15...max (A, B)
4 ...A / B	10 .. A + |B|	16...Average value (A, B)
5 ...√|A-B| x k	11 .. A - |B|	17...Round (A, k)
6 ...A + (-B)	12 .. A x |B|	

Parameter "Calculator function" defines the arithmetic operation which is applied to the two input signals.

Available are the four basic arithmetical operations, the term $\sqrt{|A-B|}\cdot k$ as well as three statistic functions. Input B can be used inverted or as absolute value for all arithmetic operations.

The function $\sqrt{|A-B|}\cdot k$ is particularly used to calculate the flow from an actual value of a pressure sensor $(\text{Flow} = \sqrt{\text{Differential pressure}}\cdot\text{System constant})$. This determined signal can be integrated in the PID controller as an actual value of a flow control.

The selection "14 .. min (A, B)" compares both input signals and provides the smaller value to the output of the calculator. Setting "15 .. max (A, B)" provides the bigger value and setting "16 .. Average value (A, B)" provides the average value (A+B)/2 to the output of the calculator.

The function "17 .. Round (A, k)" rounds the signal of input A to a multiple of the reference value k (C1.42).

e.g.: A = 13.71 k = 1.0 → 14.00
k = 0.1 → 13.70
k = 0.2 → 13.80
k = 0.5 → 13.50

C1.42	Reference value				1
	-300...300				

C1.43	Multiplier				1
	1...30000				

C1.44	Divisor				1
	1...1000				

By means of this group of parameters a constant can be defined by the user which is available for static arithmetic operations of the calculator like e.g. adding an offset value, defining an amplification (multiplication), use as a system constant, rounding value a.s.o.

It replaces the input signal B as long as signal B is set to "0 .. Not used" by means of parameter C1.40.

The constant $k = \text{Reference value} \cdot \frac{\text{Multiplier}}{\text{Divisor}}$ is always available for the arithmetic operation $\sqrt{|A - B|} \cdot k$.

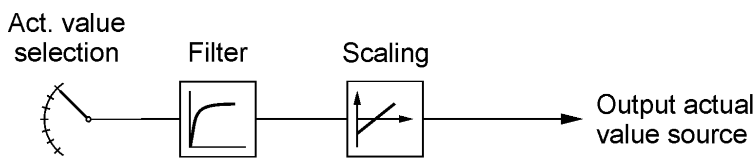
C1.45	Calculator min. value				0 % or Hz
	-300...300 % or Hz				

C1.46	Calculator max. value				150 % or Hz
	-300...300 % or Hz				

Parameters C1.45 and C1.46 limit the result of the calculation before it is supplied to the reference value distributor finally.

The scaling of the two signal inputs occurs at the used reference sources.

Actual value selection



The actual value selection enables that actual values, which are measured or calculated from the frequency inverter, are available for the reference value distributor. The feedback of the actual values is particularly used for applications with PID controller and the calculator.

C1.49	Actual value usage				0 .. Not used

0 ...Not used	6... PID-reference val. [%]
1 ...f-reference 1 [Hz]	7... PID-actual value [%]
2 ...f-reference 2 [Hz]	15 .. Request [%]
3 ...f-correction [Hz]	

The output of the actual value selection can be set corresponding to the reference value distributor as source for different uses. Parameter C1.49 assigns the actual value selection to the desired use.

C1.50	Actual value selection				0 .. Not used

0 ...Not used	18 .. PID-actual value [%]	49...Bus SW 3
1 ...Actual frequency	19 .. PID-deviation [%]	50...Bus SW 4
2 ...|Actual frequency|	20 .. PID-output	51...Bus SW 5
3 ...Motor current	23 .. Int. ref. switch-over	52...Bus SW 6
4 ...Torque	24 .. Calculator	53...Bus SW 7
5 ...|Torque|	25 .. Curve generator	54...Bus SW 8
8 ...Power	26 .. Counter (average)	55...Bus SW 9
9 ...|Power|	27 .. Total counter	66...Ref. value C. motor 1
10...Motor voltage	33 .. DC voltage	67...Ref. value C. motor 2
11...Speed	36 .. Thermal load M1	68...Ref. value C. motor 3
12...|Speed|	37 .. Thermal load M2	69...Ref. value C. motor 4
15...Int. f-ref. before ramp	39 .. Thermal load VSD	
16...Int. f-ref. after ramp	47 .. Bus SW 1	
17...PID-reference val. [%]	48 .. Bus SW 2	

Parameter "Actual value selection" selects the desired actual value signal which should be supplied to the reference value distributor.

C1.51	Actual value filter time				0.1 s

0...20 s

By adjusting a filter time unwanted fluctuations of the actual value can be suppressed (e.g. current or torque signals).

C1.52	Value at 0 Hz/%				0 % or Hz

-300...300 % or Hz

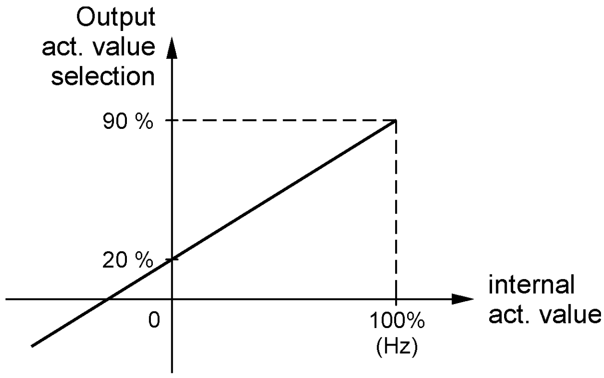
C1.53	Value at 100 Hz/%				100 % or Hz

-300...300 % or Hz

By means of the parameters C1.52 and C1.53 the output signal can be scaled before it is transmitted to the reference value distributor.

"Value at 0 Hz/%" defines the output value in case of an incoming actual value signal of 0 Hz or 0 %.

"Value at 100 Hz/%" defines the output value in case of an incoming actual value signal of 100 Hz or 100 %.



Value 0 % = 20 %
Value 100 % = 90 %

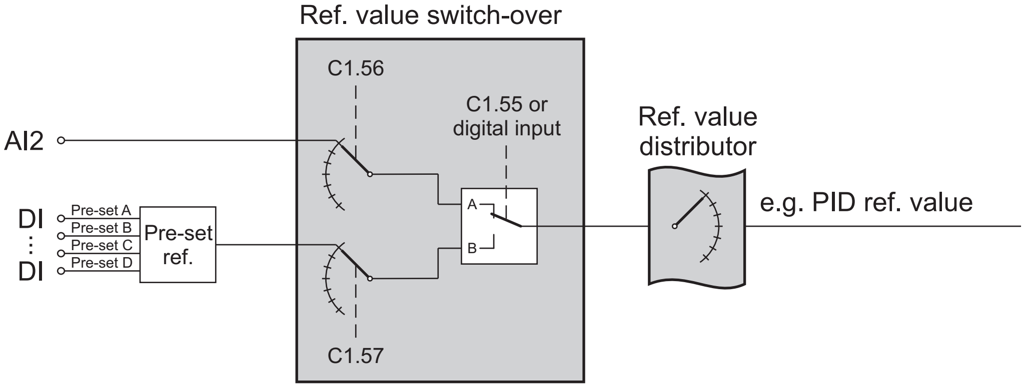
HTIU
8 P01 023 EN.04/04

Frequency-related values are scaled in Hz, all other signals are scaled in %. The assignment of 100 % is given in the listing in Matrix field D3. Values are presentable to max. 300 Hz / %.

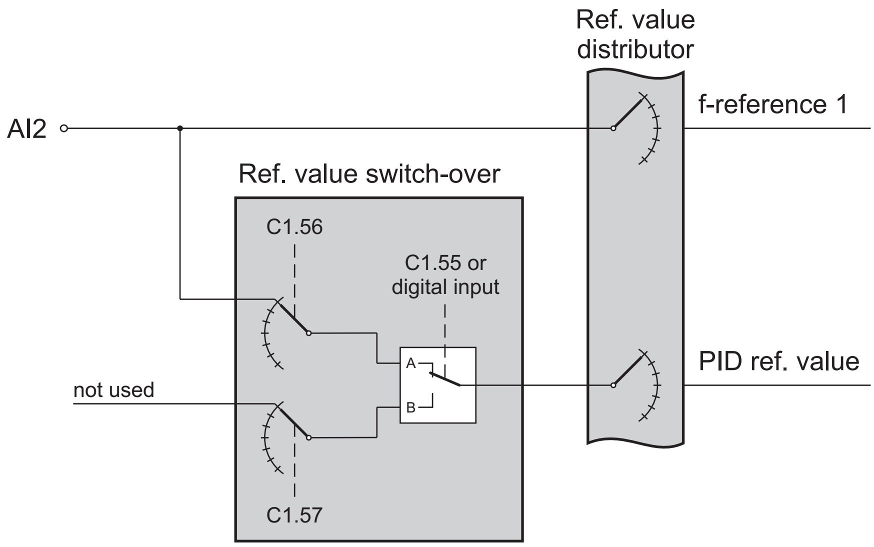
Reference value switch

The internal reference source "Reference value switch-over" acts in front of the reference value distributor and thus enables to select between two different reference sources for one reference use.

So this function is like the switching of f-reference 1 [Hz] / f-reference 2 [Hz] but it can be used generally for all reference values (e.g. PID-reference val. [%]).



Additionally, this function enables that an already used reference source is available for the reference value distributor again.



C1.54	Ref. val. switch usage				0 .. Not used

0 ...Not used	6... PID-reference val. [%]
1 ...f-reference 1 [Hz]	7... PID-actual value [%]
2 ...f-reference 2 [Hz]	15 .. Request [%]
3 ...f-correction [Hz]	

The output of the reference value switch-over can be set corresponding to the reference value distributor as source for different uses. Parameter C1.54 assigns the actual value selection to the desired use.

HTIU

8 P01 023 EN.04/04

C1.55	Ref. val. switch selec.				1 .. Value A

1 ...Value A
2 ...Value B
3 ...DI dependent

The choice between the two signals of the reference value switch-over is taken by means of parameter C1.55 definitely to one of the both values (Value A or Value B).

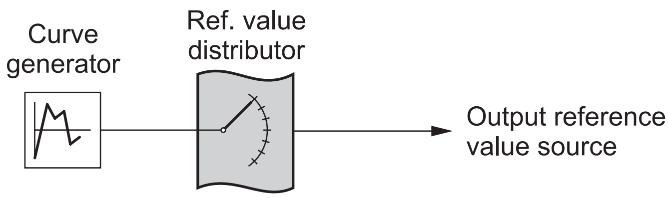
Furthermore there is the possibility to switch the reference values by means of a digital input signal from an external source.

C1.56	Ref. val. switch input A				0 .. Not used
C1.57	Ref. val. switch input B				0 .. Not used

0 ...Not used
1 ...AI 1
2 ...AI 2
3 ...AI 3
4 ...AI 4
5 ...Frequency input
6 ...LFP input
8 ...Motor potentiometer
9... Pre-set reference
10 .. Calculator
11 .. Output act. val. sel.
12 .. Int. ref. switch-over
13 .. Curve generator
16 .. Bus SW 1
17 .. Bus SW 2
18 .. Bus SW 3
19...Bus SW 4
20...Bus SW 5
21...Bus SW 6
22...Bus SW 7
23...Bus SW 8
24...Bus SW 9

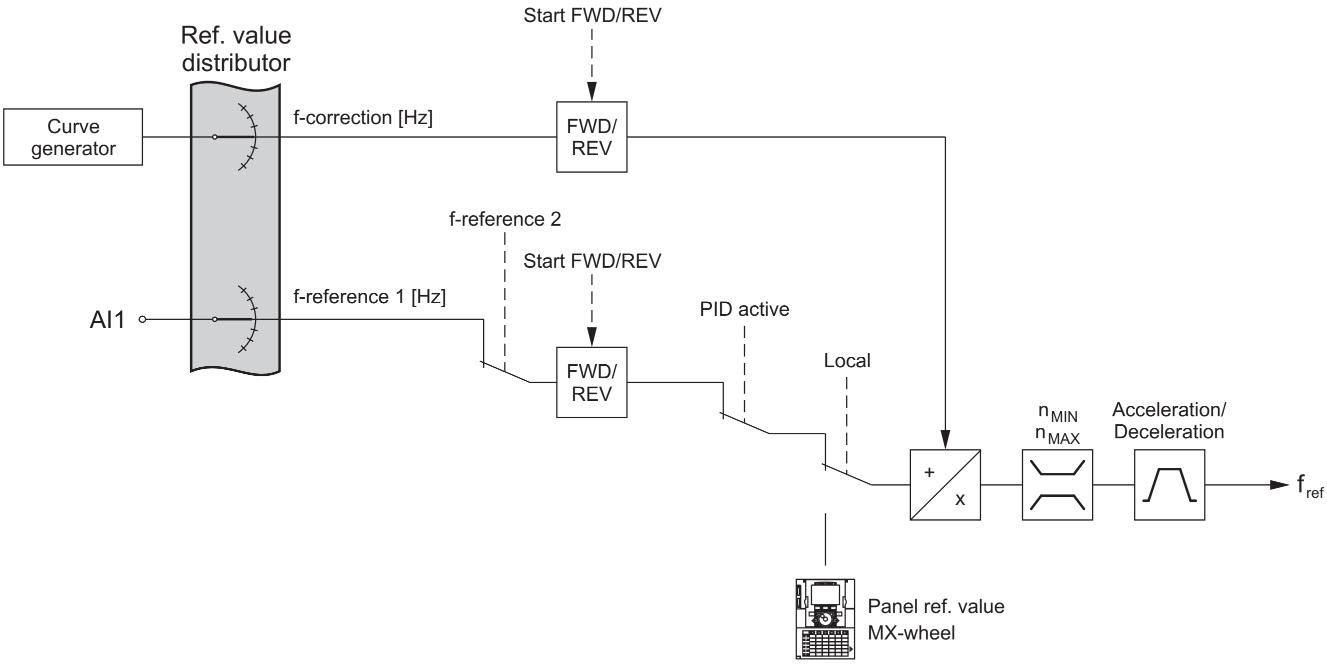
The reference sources which are provided for the reference value switch-over can be assigned by means of parameters C1.56 and C1.57. Thereby already used reference sources can be assigned twice.

Curve generator



The curve generator provides a cyclically processed reference curve that is to be configured by setting seven value pairs (reference value and time).

The curve generator is often used in combination with the correction reference value and the comparator functions (e.g. in case of automatic wash-up systems, irrigation plants, vibration movements, winding and coiling applications,...).



C1.61	Curve generator selec.				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the curve generator can be set corresponding to the reference value distributor as source for different uses. Parameter C1.61 assigns the desired use to the actual value selection.

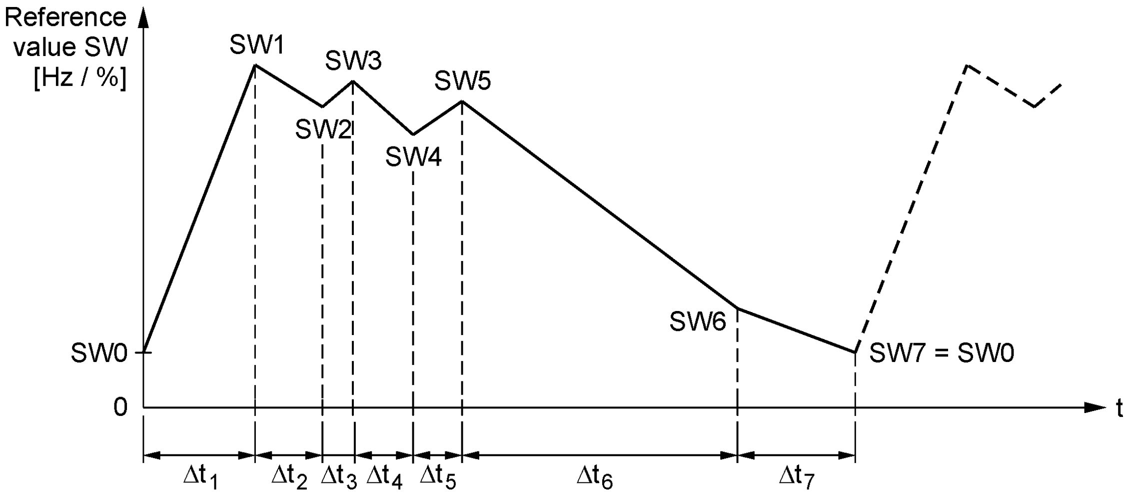
C1.63	Ref. value 0				0 % or Hz
C1.65	Ref. value 1				0 % or Hz
C1.67	Ref. value 2				0 % or Hz
C1.69	Ref. value 3				0 % or Hz
C1.71	Ref. value 4				0 % or Hz
C1.73	Ref. value 5				0 % or Hz
C1.75	Ref. value 6				0 % or Hz

-300...300 % or Hz

C1.64	Time - Δt1				0 s
C1.66	Time - Δt2				0 s
C1.68	Time - Δt3				0 s
C1.70	Time - Δt4				0 s
C1.72	Time - Δt5				0 s
C1.74	Time - Δt6				0 s
C1.76	Time - Δt7				0 s

0...650 s

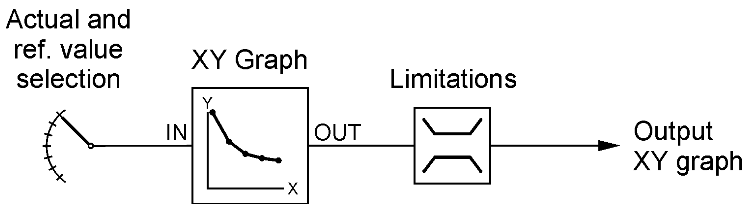
The points defined by means of parameters C1.63...C1.76 are connected to each other linearly and are executed cyclically.



After reaching the reference value point SW6 the reference value runs to the reference value point SW0 within the Δt_7 time and starts with a new cycle there.

If less than 7 value pairs are needed to illustrate the cyclical reference value sequence, the remaining time points are to be set to zero seconds and the rest of the reference points equal to the reference value SW0.

XY Graph



The XY graph represents a reference source whose output is defined by the given input signal and a line shape that can be set using six points.

The output of the XY graph can be used as a general reference source or as a variable limitation for the PID controller. For example, the XY graph can be used to realize the maximum speed for compressors depending on the pressure (PID limitation), a speed-dependent torque limitation (simulation of combustion engines),...

C1.90	XY graph selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6 ...PID-reference val. [%]
7 ...PID-actual value [%]
8... T-ref. in %
9... T-limitation in %
14 .. Load measurement
15 .. Request [%]

The output of the XY graph can be set as source for different uses according to the reference value distributor. Parameter C1.90 assigns the desired use to the XY graph.

If the XY graph should be used as a variable limitation of the PID controller, the T-reference value or the acceleration integrator, C1.90 has to be set to "15 .. Request [%]" and the corresponding function to "XY Graph".

C1.91	XY graph input selection				0 .. Not used

0 ...Not used	21 .. Int. ref. switch-over	45.. Bus SW 4
1 ...0%	22 .. Calculator	46.. Bus SW 5
2 ...100%	23 .. Curve generator	47.. Bus SW 6
3 ...Actual frequency	26 .. PID-reference val. [%]	48.. Bus SW 7
4 ...|Actual frequency|	27 .. PID-actual value [%]	49.. Bus SW 8
5 ...Motor current	28 .. PID-deviation [%]	50.. Bus SW 9
6 ...Torque	29 .. PID-output	58.. AI 1
7 ...|Torque|	32 .. Thermal load M1	59.. AI 2
8 ...Power	33 .. Thermal load M2	60.. AI 3
9 ...|Power|	34 .. Thermal load VSD	61.. AI 4
10...Speed	35 .. Counter (average)	62.. Frequency input
11...|Speed|	36 .. Total counter	63.. Motor potentiometer
12...Motor voltage	37 .. Speed machine	64.. Pre-set reference
13...DC voltage	42 .. Bus SW 1	65.. MX-wheel
16...Int. f-ref. before ramp	43 .. Bus SW 2	66.. LFP input
17...Int. f-ref. after ramp	44 .. Bus SW 3	

Parameter C1.91 assigns an input to the XY graph. The output signal of the XY graph is created from the input signal depending on the set line shape.

C1.92	No. of value pairs				2

2...6

Setting of the required number of points to create the desired characteristic.

Each point is defined with an IN/OUT value pair.

C1.93	XY Graph min				0 % or Hz

-300...300 % or Hz

C1.94	XY Graph max				0 % or Hz

-300...300 % or Hz

Limitation of the reference source XY graph at the output side. Depending on the use the adjusted value is scaled in Hz or %.

C1.95	XY Graph - IN 1				0 % or Hz
C1.96	XY Graph - OUT 1				0 % or Hz
C1.97	XY Graph - IN 2				0 % or Hz
C1.98	XY Graph - OUT 2				0 % or Hz
C1.99	XY Graph - IN 3				0 % or Hz
C1.100	XY Graph - OUT 3				0 % or Hz
C1.101	XY Graph - IN 4				0 % or Hz
C1.102	XY Graph - OUT 4				0 % or Hz
C1.103	XY Graph - IN 5				0 % or Hz
C1.104	XY Graph - OUT 5				0 % or Hz
C1.105	XY Graph - IN 6				0 % or Hz
C1.106	XY Graph - OUT 6				0 % or Hz

-300...300 % or Hz

8 P01 023 EN.04/04

The line shape of the XY graph is set by means of 6 value pairs. Parameters for IN values refer to the x-axis of the representation. For each IN value an appropriate parameter with the designation OUT is available. It defines the output of the XY graph at the appropriate IN value.

The line shape is created between the set points by means of linear interpolation.

Choose the value pairs in such a way that the X values are parameterized with increasing order (IN 1 < IN 2 < ... < IN 6).

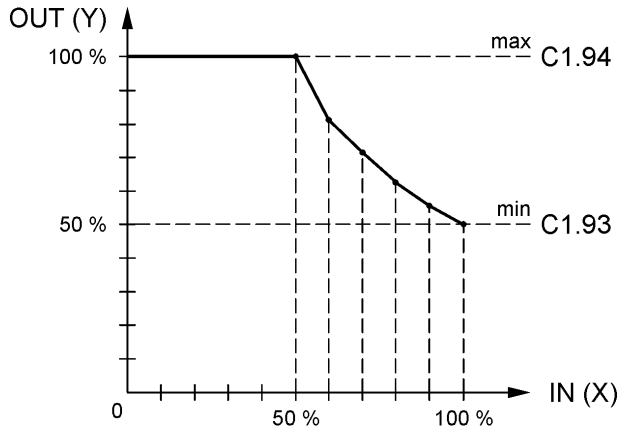
The values of the parameters XY graph - OUT can be outside of the min/max limits.

If the parameterization of the XY graph is incompletely or improperly, the alarm message "XY Graph set faulty" is set.

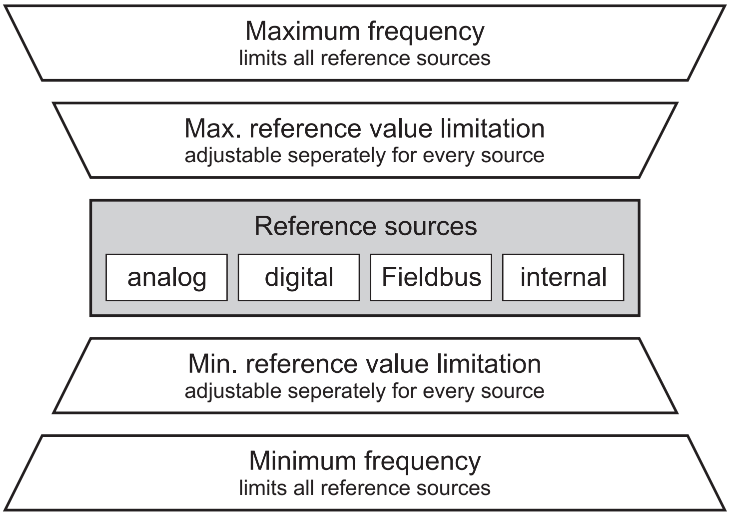
Setting example for the line shape

X (IN)	Y (OUT)
50 %	100.00 %
60 %	83.33 %
70 %	71.43 %
80 %	62.5 0%
90 %	55.56 %
100 %	50.00 %
XY graph MIN	50.00 %
XY graph MAX	100.00 %

0...50 % constant, 50...100 % with 1/x falling function



Frequency range



Each reference source has an individual limit (min. and max.). In addition a limitation of the frequency reference value is available with the parameters C2.01 and C2.02 which acts on all reference sources.

If reversing the drive is required, both rotational directions must be enabled. With this setting the minimum frequency limit C2.01 is automatically deactivated. The individual reference value limitations are further unconfined active !

Limitation by the maximum frequency must not be mixed up with an overspeed protection of the motor. Parameter C2.02 Maximum frequency only acts on the frequency reference value. Because of limitation interventions or during torque-controlled operation also higher speeds may occur at the motor (also see "Overspeed protection" E2.48) !

C2.01	Minimum frequency				0 Hz
	0...300 Hz				

C2.02	Maximum frequency				50 Hz
	10...300 Hz				

If the maximum frequency is set lower than the minimum frequency the drive operates with minimum frequency.

Using the XY graph or the pre-set references as variable limitation is also possible by means of parameter C2.14 Limitation.

HTIU
8 P01 023 EN.04/04

Direction of rotation

By means of selecting the transistor pulsing the frequency inverter is able to change the rotating field in addition to a frequency change.

If a reverse of the rotational direction is not desired, this is to be set via restriction of the allowed rotational direction.

The mechanical rotational direction of the motor shaft depends also on the connection of the three phases on the corresponding motor windings in addition to the rotational direction of the output field. A check of the actual rotational direction is therefore to be carried out during commissioning !

C2.03	Direction enable				3 .. Forward & reverse

1 ...Forward
2 ...Reverse
3 ...Forward & reverse

C2.04	Phase rotation				1 .. U-V-W

1 ...U-V-W
2 ...U-W-V

If the rotational direction of the motor does not correspond to the planned direction, the following possibilities to change the direction are available after the checking of the reference value:

Method	Position	Note
Interchange two motor phases	Motor terminal box	Changing of the cable plan and the documentation, accessibility and space in the terminal box is very limited especially for large motors
Interchange two motor phases	Inverter output	Easier accessibility, change of the cable layout plan and the documentation
Change of the output rotating field on the inverter	Parameter C2.04 U-V-W → U-W-V	Easy variant without adaptation of the electrical wiring, changing of the cable layout plan and the documentation

The specification of the rotational direction on the motor is related on a view to the shaft !

HTIU

8 P01 023 EN.04/04

Acceleration/deceleration ramps

The prepared frequency reference value, which can be selected from different sources, is rated with adjustable ramps. Two separate sets of acceleration and deceleration ramps are available which can be switched over automatically or by means of a digital input signal.

Furthermore there is the possibility to activate various S-ramps additionally to the acceleration/deceleration ramps.

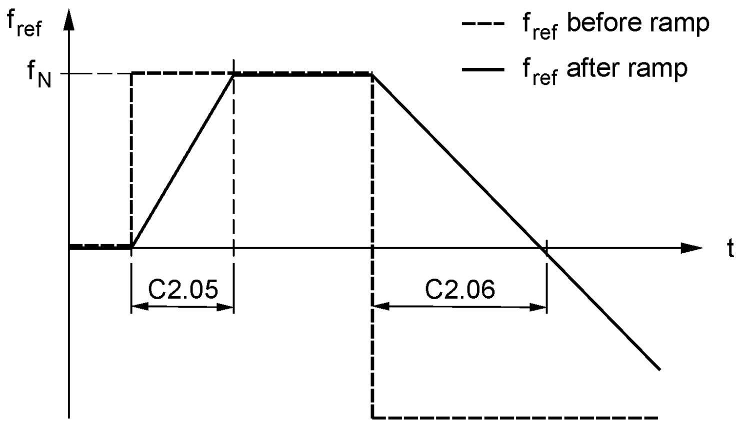
C2.05	Acceleration ramp 1				10 s
	0...6000 s				

C2.06	Deceleration ramp 1				10 s
	0...6000 s				

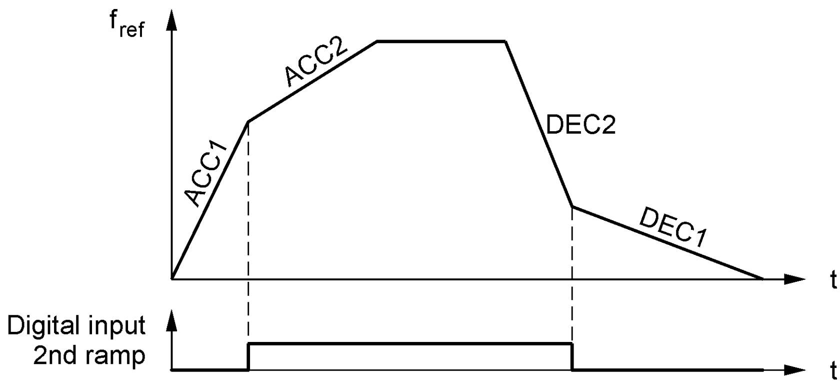
C2.07	Acceleration ramp 2				10 s
	0...6000 s				

C2.08	Deceleration ramp 2				10 s
	0...6000 s				

The acceleration and deceleration time set with parameters C2.05...C2.08 describes the period of time which is necessary for reaching the nominal frequency of the motor starting from zero.



In order to switch between the two acceleration/deceleration times by means of a digital signal, a digital input with the function "2nd ramp" is necessary. See also Matrix field D2, page 169. If the digital input is active the acceleration integrator switches to the 2nd set of ramps.

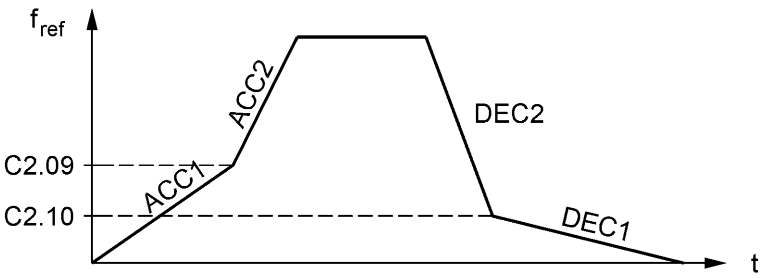


HTIU
8 P01 023 EN.04/04

C2.09	Switch 1st/2nd accel.				0 Hz
	0...300 Hz				

C2.10	Switch 2nd/1st decel.				0 Hz
	0...300 Hz				

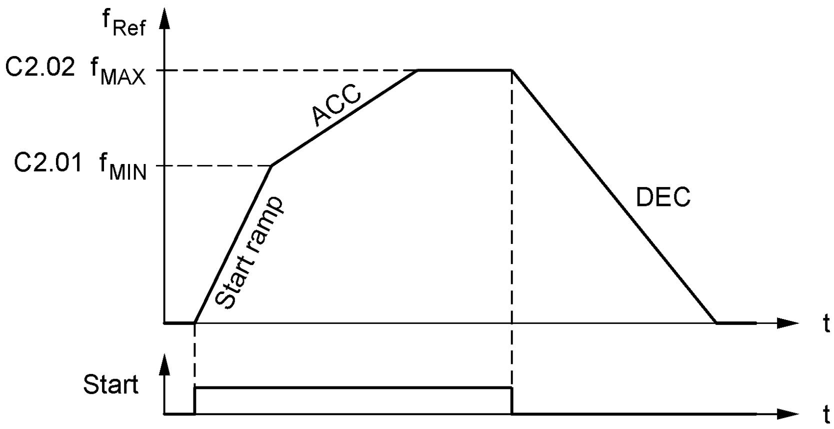
By means of parameters C2.09 and C2.10 the ramp switching can occur automatically depending on the output frequency. The functionality of the manual switching via digital input is still available and can be combined if necessary.



At setting zero Hz the respective switching function is not active.

C2.11	Start ramp				0 s
	0...6000 s				

If the drive should not start with the standard acceleration/deceleration ramps, the start ramp can be used till the minimum frequency is reached. It is activated by setting C2.11 greater than zero.



Typical uses are applications with active PID-controller or applications with limited rotational speed range and long acceleration/deceleration ramps.

By enabling both rotational directions by means of C2.03 or by setting C2.11 to 0 seconds, the function is not active.

C2.12	S-ramp mode				0 .. Not active

0 ...Not active
1 ...Round start
2 ...Round end
3 ...S-rounding

C2.13	S-ramp				1 %

1...100 %

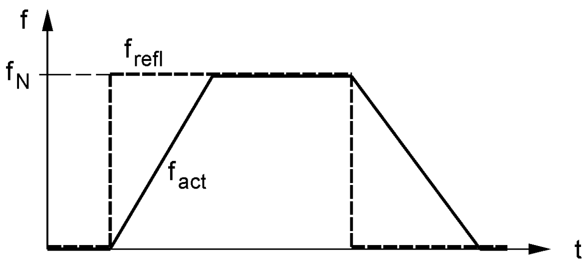
If the acceleration/deceleration ramps are set short, an increased stress load of the mechanical system (shock in the gear, rope, girder,...) occurs due to the sudden change of acceleration.

The use of the function "S-ramps" leads to a smooth acceleration and therefore to a load reducing of the mechanical load (durability, ease,...). For an optimal adaptation to the process a start-, end-, and S-ramp are available for selection.

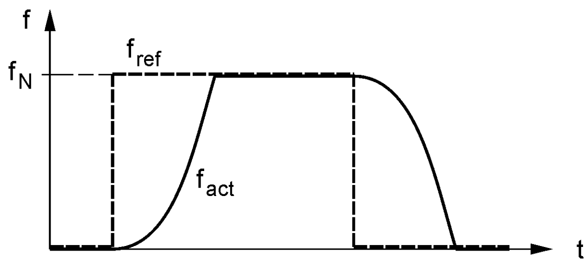
The S-ramp degree can be set in %. In case of rounded start or rounded end, 100 % correspond to an extension of 50 %, in case of S-ramp 100 % correspond to a doubling of the selected acceleration/deceleration time.

With a stop- or fast stop command, the S-ramp function is interrupted in order to prevent an unwanted "tracking" of the frequency.

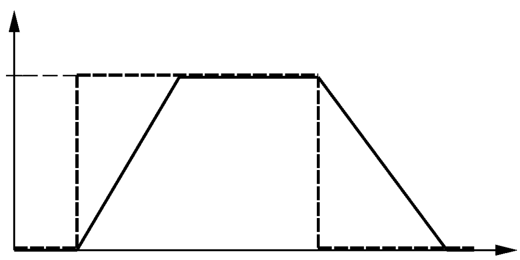
Without rounding



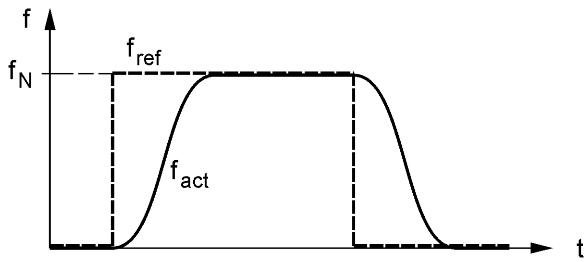
Rounded start



Rounded end



S-ramp



C2.14	Limitation				0 .. Reference values

0 ...Reference values	5... -XY -> min/XY -> max	13.. -Pre -> max
1 ...XY -> min	6... XY -> min/-XY -> max	14.. -Pre -> min/Pre -> max
2 ...-XY -> min	10 .. Pre -> min	15.. Pre -> min/-Pre -> max
3 ...XY -> max	11 .. -Pre -> min	
4 ...-XY -> max	12 .. Pre -> max	

Depending on the setting of parameter C2.14 the internal acting frequency reference value can be limited either permanently to both reference values C2.01 Minimum frequency and C2.02 Maximum frequency or variably using the XY graph or the pre-set references.

When using the XY graph, several settings with various effects on the speed limitation are available under parameter C2.14.

HTIU
8 P01 023 EN.04/04

If big flow differences occur due to the process, consider the use of several smaller pumps in cascade connection instead of a big speed-controlled pump system. Thus several pumps are connected in parallel on the draw- and pressure-side and controlled or connected/disconnected depending on the process load.

The individual pumps and drives are always operated in their optimal control- or efficiency range. In addition to the lower operating costs (energy saving), an additional reduction of costs arises by using smaller system units at simultaneous increased reliability !

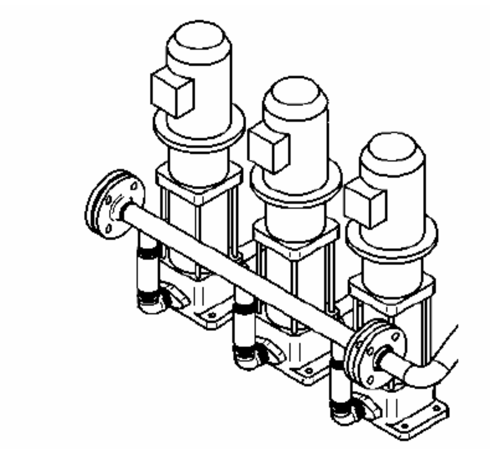
The required functions for cascade operation such as the switching point determination for tailor-made connection and disconnection of individual cascade drives, permanent monitoring of operation up to recording occur by means of the standard function in the *>pDRIVE< MX eco*.

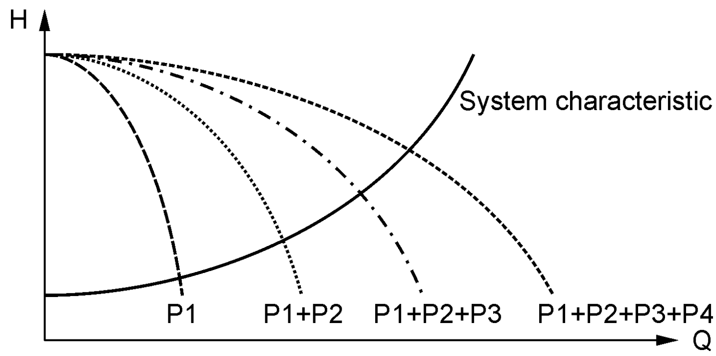
No external open-loop- and closed-loop controlled systems are necessary for the cascade operation.

Cascade connections are mainly used for pump systems in industry and also communities. Typical application ranges are water supply plants, booster station or irrigation plants, fire water supply, process pumps etc.

The range of applications is principally not only limited to pumps. Compressors, air conditioning and refrigerating devices can also be operated in this way.

8 P01 023 EN.04/04 HTIU





Cascade control - activation

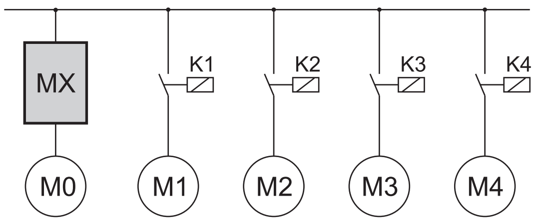
C3.01	Cascade mode				0 .. Not active

0 ...Not active
1 ...Mains cascade 1
2 ...Mains cascade 2
3 ...VSD cascade

The principal conception of the electrical design of the cascade occurs according to system-relevant factors.

The >*pDRIVE*< *MX eco* can be used for the control of three typical configurations:

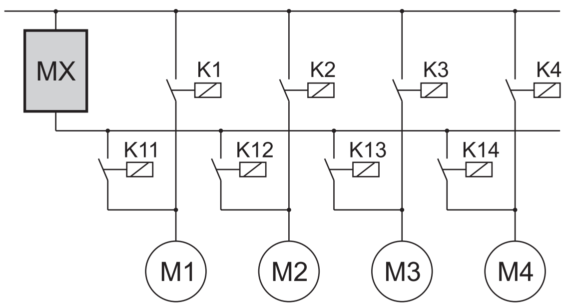
Setting "1 .. Mains cascade 1"



Master drive + max. 4 slave drives

One pump serves as master drive and is operated speed-controlled on the >*pDRIVE*< *MX eco*. The remaining drives work directly or via softstarters on the supplying mains, controlled by the frequency inverter of the master drive. By using the process control (typical pressure or flow control) in connection with the speed-controlled drive the unsteadiness due to the stepwise connection is avoided. The connection and disconnection of the individual pumps can be carried out periodically or depending on the operating hours.

Setting "2 .. Mains cascade 2"



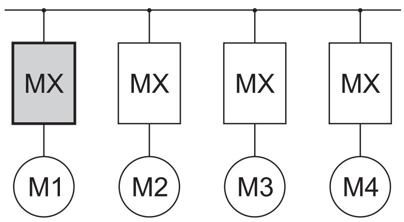
max. 4 drives (incl. master drive)

Function such as "Mains cascade 1", however with this connection the master drive can also participate in the automatic pump change with balancing of operating hours.

HTIU

8 P01 023 EN.04/04

Setting "3 .. VSD cascade"



max. 4 inverter-controlled drives
(incl. master drive)

All cascade drives are carried out speed-controlled with >*pDRIVE< MX eco* frequency inverters and are controlled by the master drive (with activated function "VSD cascade"). Because of the frequency inverter the connection to the mains occurs without encumbering starting currents.

Typical for low-power drives (< 15 kW).

The inverter of the master drive determines the switching point for connection and disconnection of the respective slave drives by means of the evaluation and dynamic rating of the pressure (PID control operation) or the actual frequency of the master drive. The switching commands are available on the output relays or the digital outputs of the master drive.

Depending on the number of pumps the use of an optional terminal extension (Option >*pDRIVE< IO11* or >*pDRIVE< IO12*) can be required.

Corresponding to the selected type of cascade, hardware locking of the drive contactors is required. See the following control suggestions.

HTIU

Control suggestions

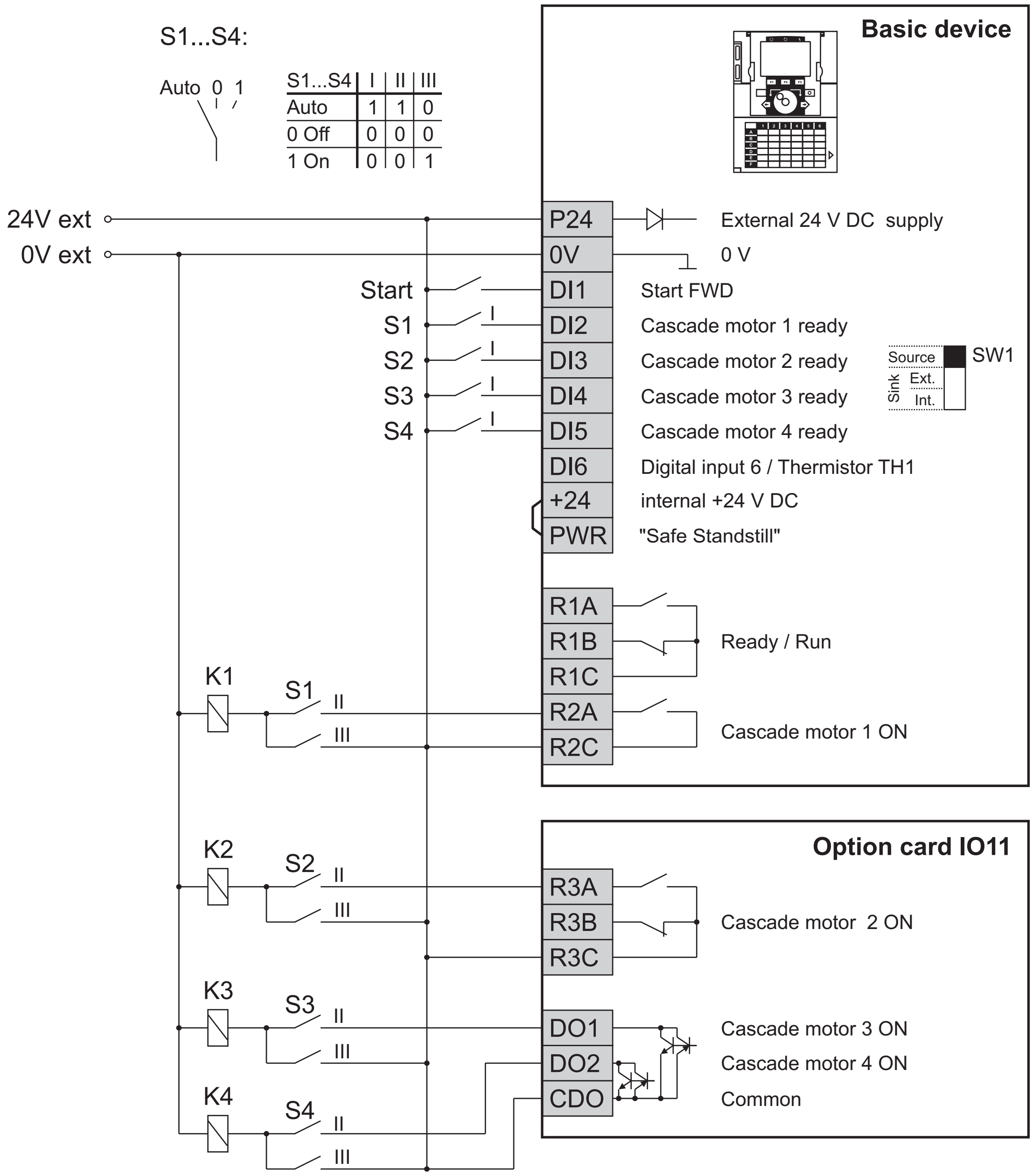
8 P01 023 EN.04/04

Subsequent control suggestions contain an operating mode switch which enables the switching between:

- *Automatic*
  Cascade motors are connected and disconnected by the automatic cascade control
- *Off*
  Drive switched off
- *Manual on*
  Drive is manually connected independent of the cascade control

For each slave drive a digital input has to be planned to recognize the Ready state of the drive on the control process.

Mains cascade 1



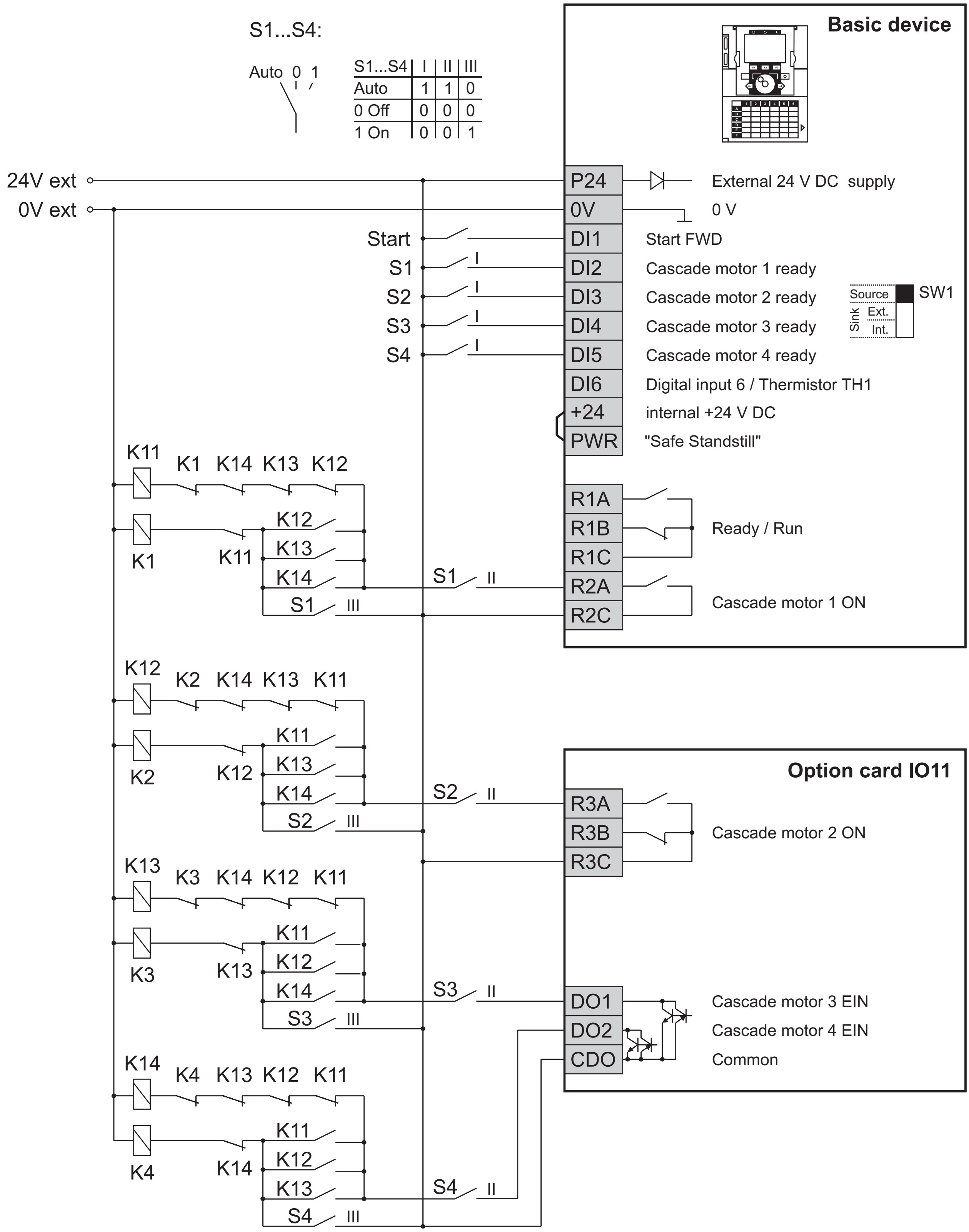
HTIU

8 P01 023 EN.04/04

Schematic diagram!

Typically, the switching of the motor contactors cannot occur directly via the inverter output relay or digital outputs. Appropriate auxiliary contactors are to be planned corresponding to the used contactors !

Mains cascade 2

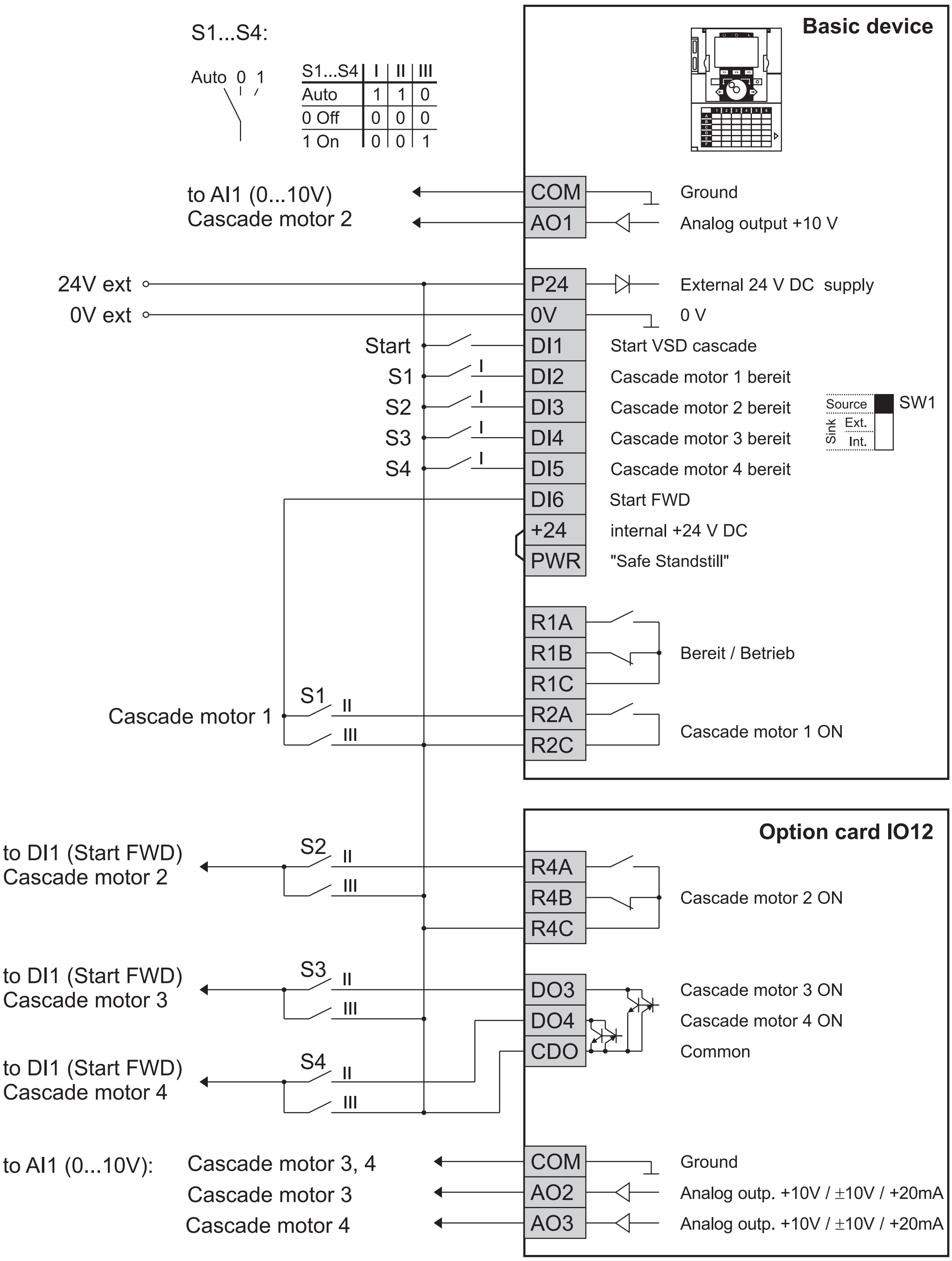


As above mentioned, the mains and motor contactors are locked against each other so that the first motor selection of the master drive activates an inverter output contactor. All following switching commands refer however to the line contactors.

Schematic diagram!

Typically, the switching of the motor contactors cannot occur directly via the inverter output relay or digital outputs. Appropriate auxiliary contactors are to be planned corresponding to the used contactors !

VSD cascade



HTIU

8 P01 023 EN.04/04

The advantage of this connection is the simple control-sided design without using of line or auxiliary contactors. The connection and disconnection of the individual motors occur via digital signals on the respective inverter. In addition to the switching commands also the frequency reference value for each cascade drive is provided by the master drive. The inverter of cascade motor 1 assumes the functionality of the master drive.

The mains-sided current load at connection of a pump is in this way the least, so that it is especially suitable for drives in mains-weakened systems.

Alternatively to conventional reference values provided by the analog outputs (like described above) also the Modbus master function can be used (details see Modbus operating instructions).

Cascade state

C3.02	Cascade state	0110			

0 ...C. Mot 1 - Master	☐ / ☑	8 .. C. Mot 3 - Master	☐ / ☑
1 ...C. Mot 1 - ON	☐ / ☑	9 .. C. Mot 3 - ON	☐ / ☑
2 ...C. Mot 1 - auto	☐ / ☑	10.. C. Mot 3 - auto	☐ / ☑
3 ...C. Mot 1 - ready	☐ / ☑	11.. C. Mot 3 - ready	☐ / ☑
4 ...C. Mot 2 - Master	☐ / ☑	12.. C. Mot 4 - Master	☐ / ☑
5 ...C. Mot 2 - ON	☐ / ☑	13.. C. Mot 4 - ON	☐ / ☑
6 ...C. Mot 2 - auto	☐ / ☑	14.. C. Mot 4 - auto	☐ / ☑
7 ...C. Mot 2 - ready	☐ / ☑	15.. C. Mot 4 - ready	☐ / ☑

The cascade state serves as visualisation of the actual operating state of all cascade drives. The display occurs in list presentation which includes the operating states of all cascade drives.

Entry		Meaning
Control	☑	The drive operates as master drive at the moment. A change of the master drive is only possible in case of switching variant "Mains cascade 2".
On	☑	The drive was connected by the automatism of the cascade control.
Auto	☑	The operating mode for this drive was set to automatic by the parameters C3.11...C3.14. The state "2 .. Auto" gives no information about the actual operating state of the drive.
Ready	☑	The drive was registered as "Ready" by means of a digital input on the master drive (C3.10 "Manual / auto switch").

C3.03	Oper. hours C.Mot1				h
C3.04	Oper. hours C.Mot2				h
C3.05	Oper. hours C.Mot3				h
C3.06	Oper. hours C.Mot4				h

The operating hours meter register the actual operating time of the individual cascade drives (pumps and motor) if the drive is controlled by the cascade automatic system (C3.11...C3.14 = "1 .. AUTO")

Basic settings

C3.09	No. of cascade pumps				1

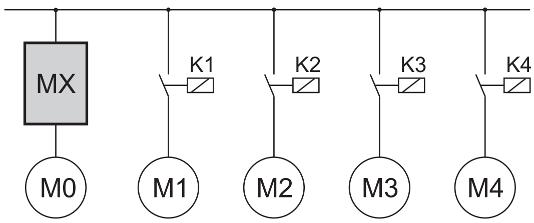
1...4

Number of installed cascade drives.

By using "Mains cascade 1" the master drive does not participate in the motor change and only the number of slave pumps is to be set.

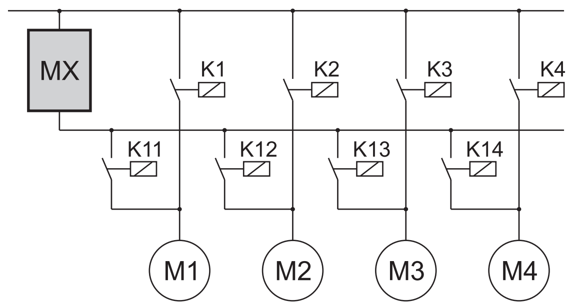
By using "Mains cascade 2" or "VSD cascade" the master pump is selected by the inverter depending on the operating hours. Here the total number of pumps is to be set.

Mains cascade 1



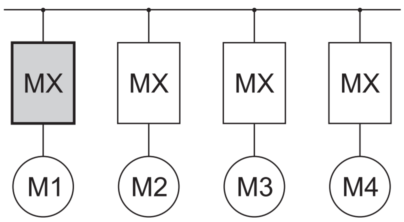
C3.09 "No. of cascade pumps" = 4

Mains cascade 2



C3.09 "No. of cascade pumps" = 4

VSD cascade



C3.09 "No. of cascade pumps" = 4

C3.10	Manual / auto switch				0 .. Not used

0 ...Not used
1 ...Used

The integration of an operating mode switch Manual/Automatic enables a manual intervention in the automatic cascade pump operation. Thereby a cascade motor ready for operation is registered on the master drive via a digital input "Cascade mot. 1...4 ready" (see Matrix field D2, page 169).

Only cascade drives registered as ready are taken into account by the control for connection and disconnection.

If the operating mode-switch is not used, a cascade motor which is not ready can first be recognised by means of an unusually long correction time.

Switch position	Meaning
Automatic	The respective cascade motor is connected and disconnected by the automatic cascade control.
Manual (Off)	The drive is disconnected manually. The drive is recognised as not ready by the cascade control and is not taken into account for connection.
Manual (On)	The drive is connected manually. The drive is recognised as not ready by the cascade control and is therefore left out for connection. The operating hours are not considered in this mode.

C3.11	Oper. mode C.Mot1				1 .. AUTO
C3.12	Oper. mode C.Mot2				1 .. AUTO
C3.13	Oper. mode C.Mot3				1 .. AUTO
C3.14	Oper. mode C.Mot4				1 .. AUTO

1 ...AUTO
2 ...ON
3 ...OFF

By means of the parameters C3.11...C3.14 individual cascade drives can be connected and disconnected manually but be controlled automatically by the cascade control.

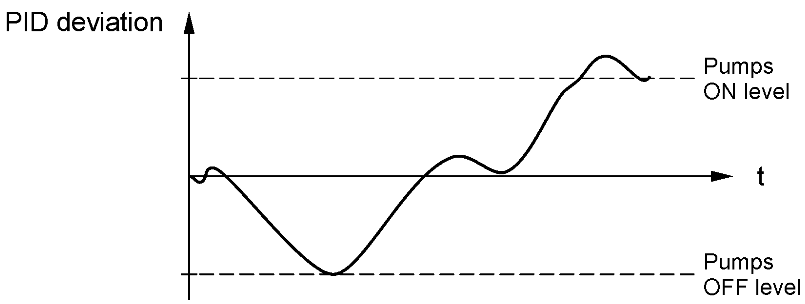
The parameters are identical to the functionality of the operating mode-switch. They can however only be set by personnel with knowledge of parameterization.

C3.15	Switching mode				1 .. Pressure analysis

1 ...Pressure analysis
2 ...Efficiency optimised

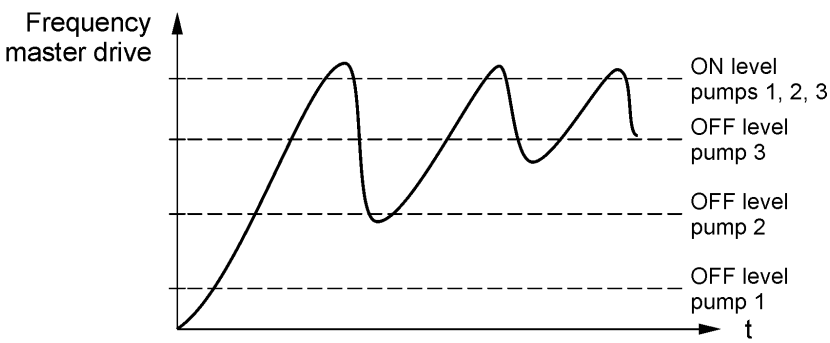
Two different switching modes are available for the tailor-made connection and disconnection of the individual cascade drives. The selection occurs according to process and control technical aspects.

Switching mode "1 .. Pressure analysis"



The commands for connection and disconnection of the individual cascade drives are generated depending on the PID deviation of the internal process controller (pressure or flow rate). The evaluation is easy to be carried out and requires only a few settings concerning the dynamics for connection and disconnection.

Switching mode "2 .. Efficiency optimised"



For each cascade pump a single frequency level is provided for connection and disconnection. This is useful if the PID deviation is unknown (external PID control circuit), the individual cascade pumps have unequal nominal outputs or the cascade pumps should be operated efficiency-optimized to the respective cascade level.

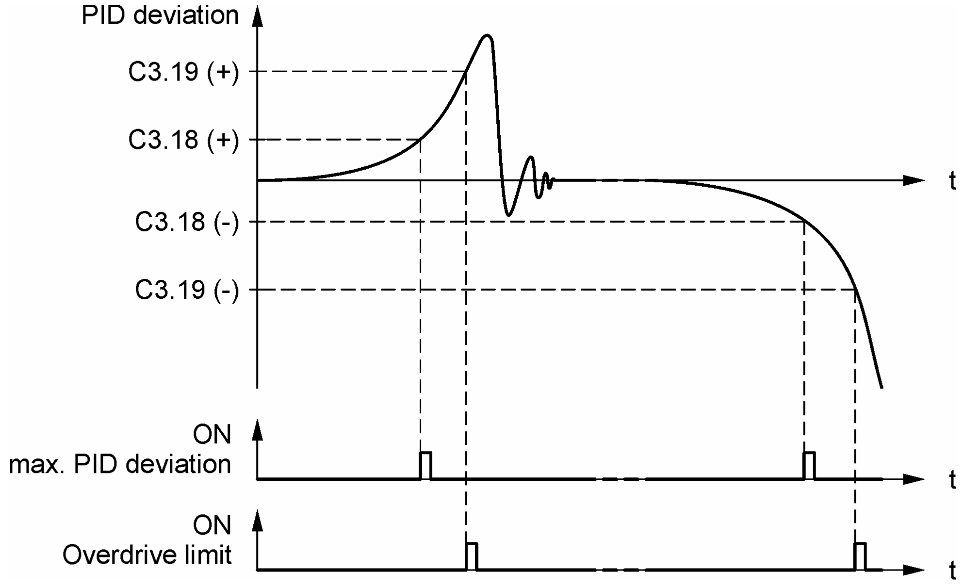
The switching commands are to be delayed to adapt the connection and disconnection to the allowed pressure or flow tolerances as well as the size of the plant-sided pressure accumulator. As a result unnecessary dynamic-conditioned connection or disconnection of individual cascade drives is avoided in case of short pressure fluctuations.

Switching points pressure evaluation

With this switching mode the PID deviation of the PID controller is monitored at the value "Max. PID-deviation". If the system pressure decreases and the control circuit can no longer be balanced by the increase of speed, the PID deviation increases. When the max. PID deviation C3.18 has been reached, the request to connect a slave drive appears.

In reverse, if the system pressure is too high, the negative threshold of the PID deviation is reached, whereby the disconnection of a slave drive is initiated.

In order to be able to react more quickly at intense pressure fluctuations, the parameter C3.18 "Max. PID-deviation" is overlapped by a further threshold "Overdrive limit".



The exceeding or falling short of the allowed limits does not lead directly to a connection or disconnection of a drive. The temporal switching dynamics can be optimized by means of parameter C3.32...C3.35.

C3.18	Max. PID-deviation				10 %
	0...100 %				

C3.19	Overdrive limit				30 %
	0...100 %				

HTIU

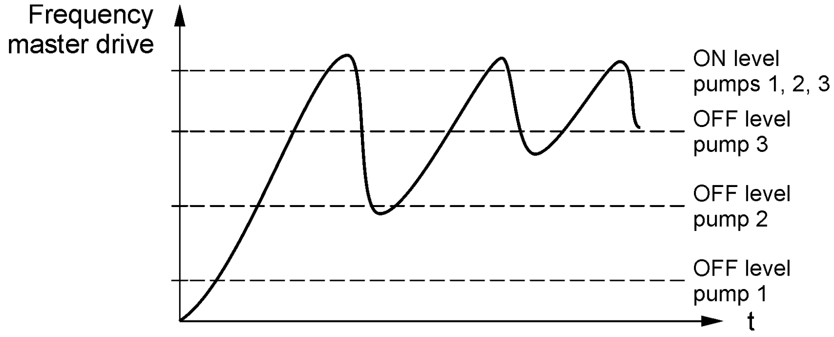
8 P01 023 EN.04/04

Switching points efficiency-optimized

For the switching mode "Efficiency optimised" the commands for the connection and disconnection of the cascade drives occur depending on the frequency. An individual point for connection and disconnection is selectable for each cascade drive.

The monitoring occurs by means of the internal frequency reference, whereby the operation is possible with the internal PID controller as well as with an external control circuit.

Set the switching levels in such a manner that the pumps are operated in their ideal efficiency range according to the number of running motors. The determined requests for connection and disconnection can be optimized by means of the parameters C3.32...C3.35 in their time switching dynamics.



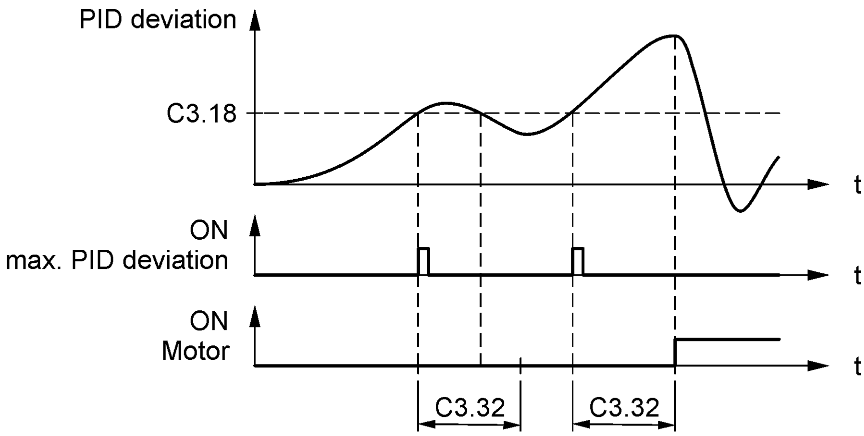
C3.22	Frequency C.Mot1 on				0 Hz
C3.23	Frequency C.Mot1 off				0 Hz
C3.24	Frequency C.Mot2 on				0 Hz
C3.25	Frequency C.Mot2 off				0 Hz
C3.26	Frequency C.Mot3 on				0 Hz
C3.27	Frequency C.Mot3 off				0 Hz
C3.28	Frequency C.Mot4 on				0 Hz
C3.29	Frequency C.Mot4 off				0 Hz
	0...300 Hz				

HTIU
8 P01 023 EN.04/04

Switching dynamic

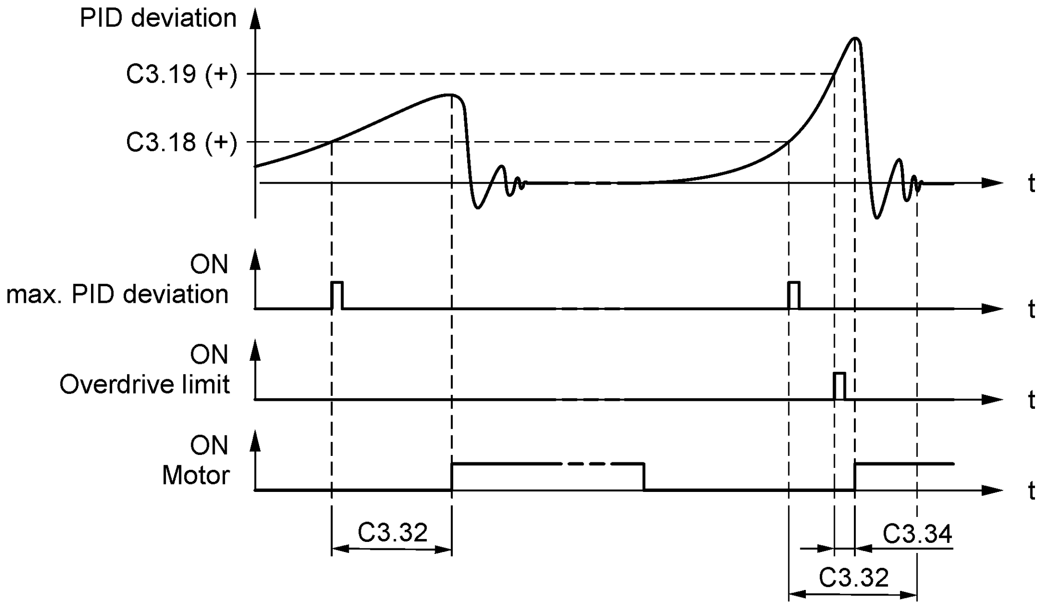
In order to reach a sufficiently fast and exact but nevertheless smooth-acting control, the requests for connection and disconnection, which result from the monitoring of the PID deviation or the output frequency, are assessed by means of adjustable delay times before they are carried out.

After a request to connect a slave drive, the time C3.32 "Switch on delay" is started. After this time is over the slave drive is connected. If the PID deviation gets however below C3.18 during the time interval, the time is reset and the slave drive is not connected.



With switching mode "Pressure analysis" the "Overdrive limit" is reached in case of a great pressure drop. This starts the time C3.34 "Overdrive time". After this time is over, the slave drive is connected although the ON delay time C3.32 is not over.

The overdrive time is not active at switching mode "Efficiency optimised".



HTIU

The disconnection of a slave drive occurs equivalent to the connection, however by means of the parameter C3.33 "Turn-off delay".

C3.35"Min. switch-over time" prevents a too early switching-back as a result of control-conditioned processes. If a drive is connected, no drive can be disconnected for the period of the minimum switch-over time. A further connection is however possible.

If it is tried to connect a drive that is not available or not ready, this is recognised by means of the PID deviation and the next drive is connected when the switch on delay is over.

8 P01 023 EN.04/04

By using the operating mode switch (digital input "Cascade mot. 1...4 ready") the switch on delay can be avoided.

C3.32	Switch on delay				30 s
C3.33	Turn-off delay				30 s
C3.34	Overdrive time				10 s
C3.35	Min. switch-over time				10 s
	0...500 s				

Change of motor

The principle of the cascade connection is the tailor-made connection and disconnection of the individual cascade steps. This however leads automatically to the fact that the basic load drive (= master drive) is more often in operation than the peak load drive. Thus, for a pump plant the operating hours of the individual cascade drives act proportionally to the necessary flow according to the daily operation of the plant.

According to the dimensioning, the peak load pump can e.g. only be used in emergency situations (fire water provision). In order to avoid problems or damages to each pump that is not used regularly (gasket problems, steadfast rust,...) and to balance the operating hours of all the cascade drives, it is a good idea to provide an automatic motor change.

C3.38	Motor change				2 .. Optimised cycle

1 ...Fixed cycle
2 ...Optimised cycle

Setting	Meaning
1 .. Fixed cycle	The motors are connected and disconnected one after the other. The motor, which was connected last is the first to be disconnected. This leads to a fixed definition of the basic load (= master drive) and drives for peak load (= slave drive).
2 .. Optimised cycle	The selection of the pumps occurs in such a way that the operating hours of the cascade drives are balanced. As a result a continuous change of the pump assignment between basic and peak load drive is guaranteed (evenly distributed stress, avoidance of damages on the peak load drive due to long standstill). When connecting a further motor, the motor with the shortest operating time is selected. When disconnecting a motor, the motor with the longest operating time is selected.

C3.39	Change master drive				1 .. at stop

1 ...at stop
2 ...at operation

The automatic motor change selects the drives that are to be switched depending on their operating time. However it would be unwise to use the operating hour meter as time base. In case of a standstill of a drive for maintenance purposes the function would try to regain the lost operating time when the drive is connected again.

The purpose of the motor change is to balance the operating hours of all available drives within a time-frame. The time-frame can be set by means of parameter C3.39. Select this time-frame in such a way that at least one cyclic sequence (e.g. daily process) is registered.

Setting	Change of the master drive at...
1 .. at stop	...the next impulse inhibit of the master drive (OFF or standby mode active)
2 .. at operation	...frequency reaches the minimum frequency

HTIU
8 P01 023 EN.04/04

C3.40	Time-frame				72 h

0...1000 h

C3.41	Time master drive				24 h

0...10000 h

The function of the automatic change of motors can be used only for the slave drive if cascade type "Mains cascade 1" is selected. The master drive itself is always active.

Should the master drive also take part at the automatic change of motor, the cascade is to be carried out according to the design of "Mains cascade 2" or "VSD cascade". In case of "Mains cascade 2" the change of the master drive is initiated after an adjustable time interval C3.41 "Time master drive". The actual switching occurs depending on the parameter C3.39 "Change master drive". In case of "VSD cascade" a "smooth change-over" to the next available drive is initiated after the time interval C3.41 "Time master drive".

C3.42	C.mot at trip				0 .. OFF

0 ...OFF
1 ...continue operation

Parameter C3.42 defines the behaviour of the inverter when a trip occurs (e.g. ɜ M1 >>, ...).

It can be chosen from following possibilities:

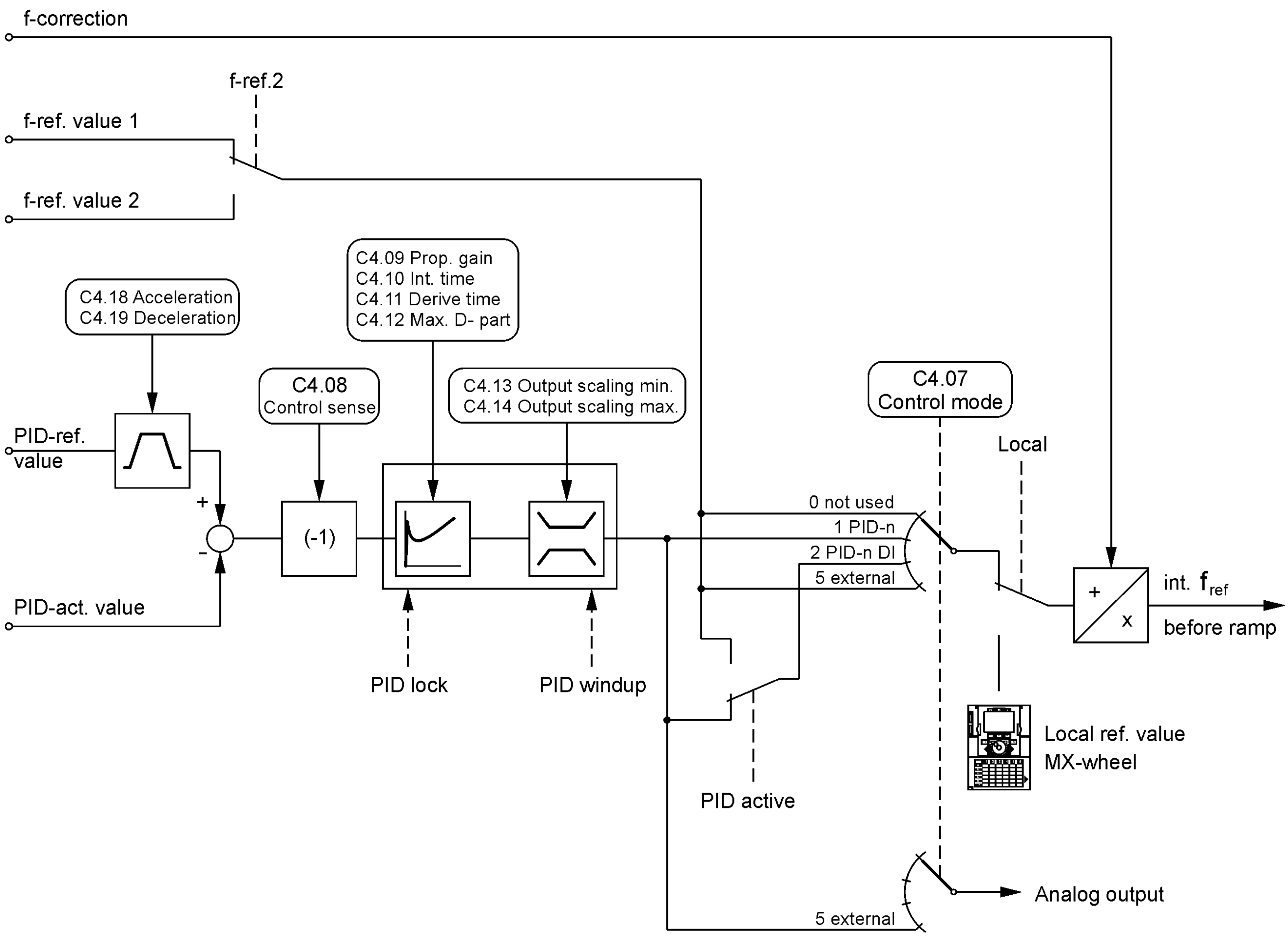
Setting	Behaviour when a fault occurs
0 .. OFF	The drive stops and also the control of the cascade is stopped. Operation can be continued with the remaining pumps by means of the AUTO/MANUAL-switch (controlled operation).
1 .. continue operation	The respective cascade motor is stopped but the cascade control continues operation (used for "Mains cascade 2" and "VSD cascade").

The PID controller which is integrated in the >*pDRIVE*< *MX eco* is used in applications where a process-technical control is required but however where the required control circuit cannot or should not occur in a superposed open-loop/closed-loop control unit.

Typical application areas are controls for pressure, flow, power, speed, band tension and quantities.

The control circuit is designed with µP-based technology as discrete-acting control circuit with adjustable PID characteristics. It acts on the manipulated variable of the speed and is worked off in 1.5 ms task. It can therefore be used also for controlled systems which require a very dynamic reaction of the manipulated variable.

As reference value for the PID controller not only all remote-reference sources can be used but also the Matrix rotating wheel on the removable Matrix operating panel or the up/down keys on the built-in LED keypad. The control actual signal is always connected with an analog source (or via Fieldbus) to the inverter. Reference as well as actual values can be scaled and displayed with a free editable unit on the removable Matrix operating panel.



PID activation

The PID controller is activated using parameter C4.07 "Control mode". Thereby it can be defined whether the controller is not active or always active, whether it can be activated using a digital input to be parameterized, or used for external purposes.

The controller output has an effect on the frequency reference value of the inverter and is normalised in Hz.

In case of setting "5 .. External" the control circuit can be used for external purposes. In this case, the output scaling is defined in %.

PID reference value

The following values can be used as reference sources:

– Pre-set references	see matrix field C1, page 105
– Motor potentiometer	see matrix field C1, page 105
– Analog inputs AI1...AI4	see matrix field D1, page 159
– Pulse inputs FP, LFP	see matrix field D1, page 159
– Bus reference values	see matrix field D6, page 193
– Analog calculator	see matrix field C1, page 105
– Matrix wheel / keypad	see matrix field C1, page 105

In order to optimize the behaviour of the control circuit with regards to disturbances it is advisable to set short acceleration and deceleration ramps (see matrix field C2, page 120) to enable a fast reaction of the inverter to the controller output.

For the PID reference value a separate acceleration and deceleration ramp is adjustable.

If the reference value of the controller should not be adjustable external then the setting occurs either via parameterization (pre-set references) or by means of the Matrix-wheel or the up/down keys of the LED keypad (motor potentiometer). The allowed reference value range is adjustable via the scaling of the motor potentiometer (see matrix field C1, page 105).

By means of the analog calculator it is possible to process the reference value of the controller before it is transmitted to the control circuit:

- algebraic (+, -, x, /), e.g. creating a differential signal
- statistical (max/min-selection, average)

PID actual value

If the PID actual value is available as analog standard signal, this can be directly processed on all analog inputs (AI1...AI4), the pulse inputs (FP, LFP) or by means of a serial bus reference value.

By means of the analog calculator (see Matrix field C1, page 105) it is possible to process the actual value of the controller before it is transmitted to the control circuit:

- algebraic (+, -, x, /), e.g. creating a differential signal
- statistical (max/min-selection, average)
- root extraction $\sqrt{p_1 - p_2} \cdot k$, $\sqrt{\Delta p} \cdot k$ (flow calculation from pressure measurement)

For the measurement of non-electrical values also the pulse counter can be used (see Matrix field C6, page 148). The pulse counter creates from a frequency signal a scaleable analog signal which can be used as actual value of the controller (e.g. flow measurement with turbine wheel instrument or metering with quantity meter).

Scaling

The signals for the reference and actual value are scaled in percent. Please take into account that the scaling of the actual value is selected in such a way that the reference value can be exceeded at maximum signal output of the sensor (e.g. reference value 0...10 bar = 0...100 %, actual value 0...15 bar = 0...150 %).

PID deviation

The PID deviation represents the difference between the reference and actual value signal. It can be inverted in order to change the control sense of the control circuit.

Example:

- Pressure control with sensor on the high-pressure side
  A positive PID deviation leads to speed increase (blowers).
- If the pressure sensor is however fixed in the low pressure area (control on low pressure), the speed must be reduced at increasing PID deviation (low pressure is too high).

8 P01 023 EN.04/04

Displays

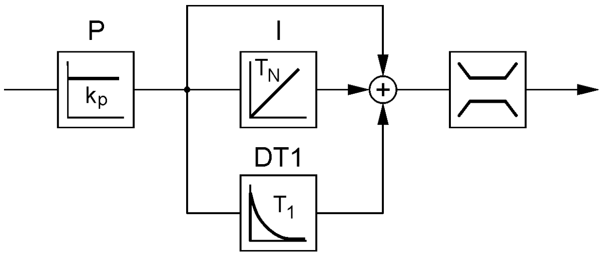
All control-specific values (reference value, actual value, PID deviation and PID output) are available as analog actual values and can be indicated in the basic display of the inverter (see Matrix A6, page 64).

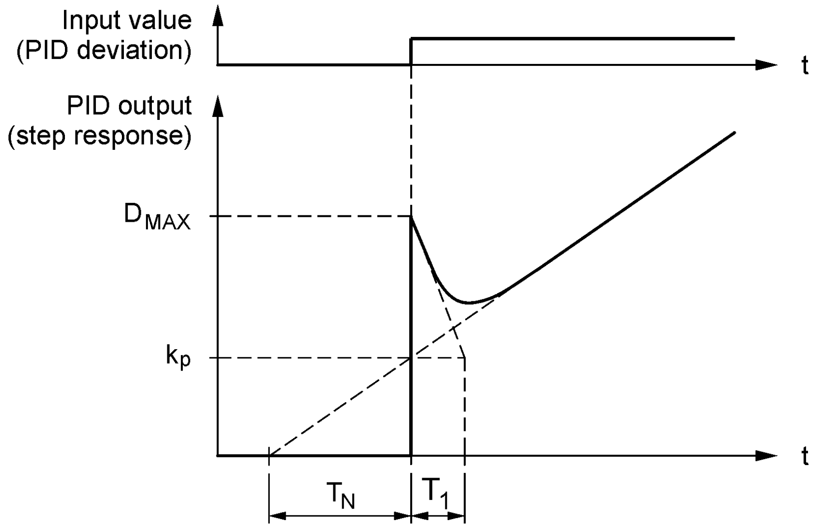
The values of the controller can be indicated on the Matrix operating panel in process-correct form by adjusting the respective display factor and the desired process unit. In addition the process unit can be freely edited.

PID output

The output of the control circuit is the frequency reference value of the motor in Hz. It is limited by means of the output levels.

PID control circuit





The design of the process controller corresponds to a PIDT1 control structure. It is characterised by the following factors:

Designation	Symbol	Unit	Function
Proportional gain	k_P [1]	1	Proportional gain
Integration time	T_N	s	Integration time Time which the integrator needs to reach the value of the control difference at k_P=1. Response time of 0 seconds deactivates the integration time of the controller.
Derive time	T_1	s	Decay time After this time the derive time is decayed to 37 % of the original amount (exponential function). Response time of 0 seconds deactivates the derive time of the controller.
	D_{MAX}	1	Maximum amount which should be attained by a "D-step".

8 P01 023 EN.04/04 HTIU

Limits

The controller output is limited by means of the output levels. Parameters C4.13 Output level min. and C4.14 Output level max. (C4.15 Limitation = "0 .. Reference values)" can be used for limitation or it can be derived from the XY graph or the pre-set reference source. Therewith it is possible to limit the controller output depending on a curve which can be influenced externally (e.g. flow control depending on pressure or power).

Switch-over panel/remote

The switching from remote control to panel mode (Matrix operating panel or LED keypad) occurs by pressing the key Loc/Rem on the keypad. After the switching has been carried out, the motor speed can be directly adjusted by the Matrix-wheel or the arrow key on the keypad. The PID controller is therefore not active in panel mode.

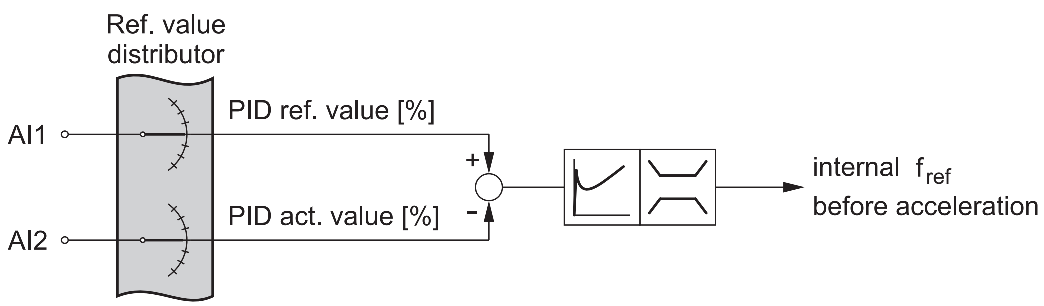
The switching in both directions occurs shock-free with tracking of the local reference value or of the controller output.

Control signals

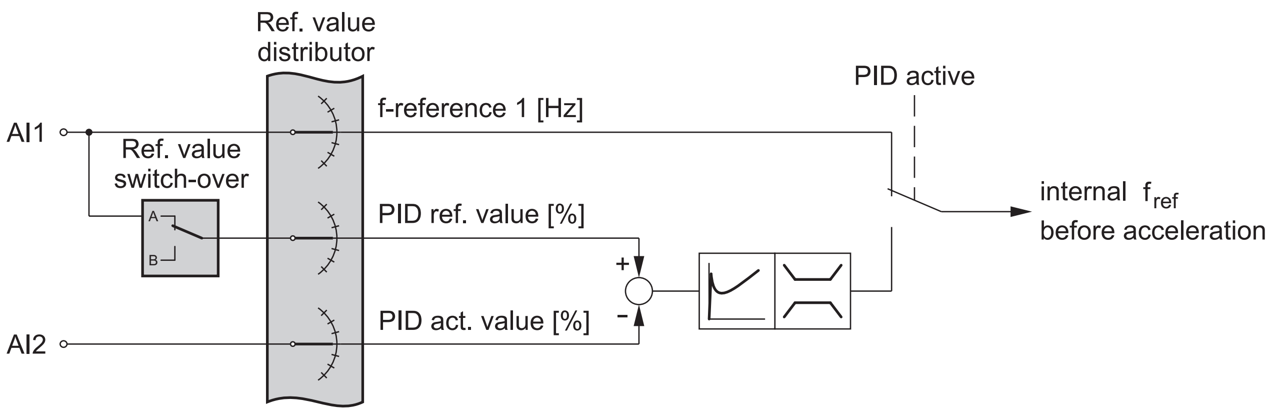
PID-active	Switches between open-loop and closed-loop control
PID-lock	Keeps the controller output at its last value or sets this to zero (C4.32 "PID-lock")
PID-wind up	Activates the anti-windup-behaviour (see C4.33)

The open design of the PID controller within the scope of the analog value processing enables the use of the control circuit in different structures. Thereby the universal function modules "Calculator" (see Matrix field C1, page 105), "pulse counter" (C6, page 148) or the comparator or logic blocks (E6, page 243) can also be integrated.

Simple PID control circuit

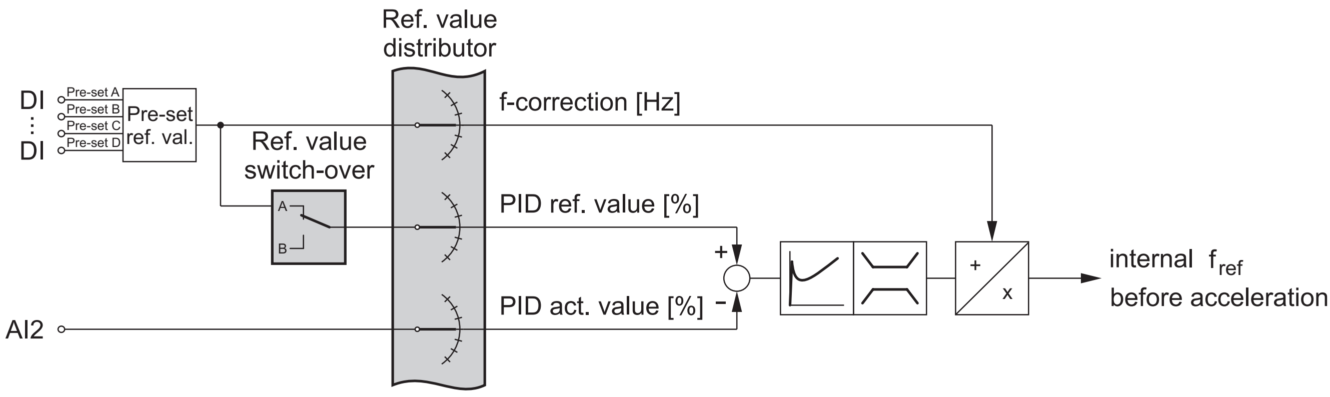


PID controller with switching closed-/open-loop control

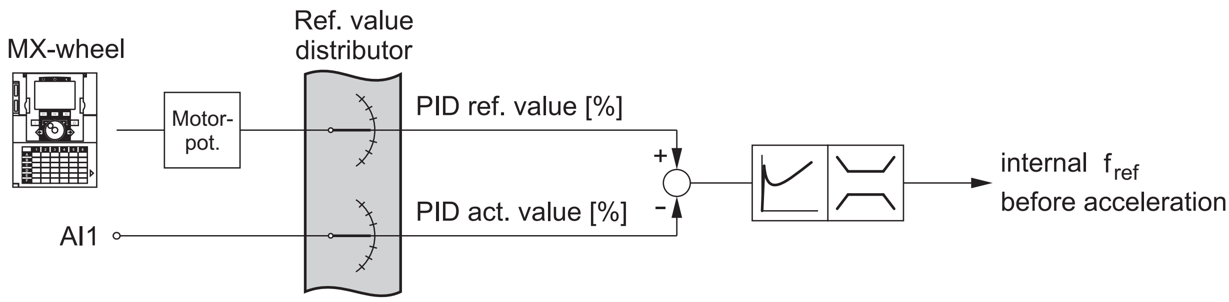


HTIU
8 P01 023 EN.04/04

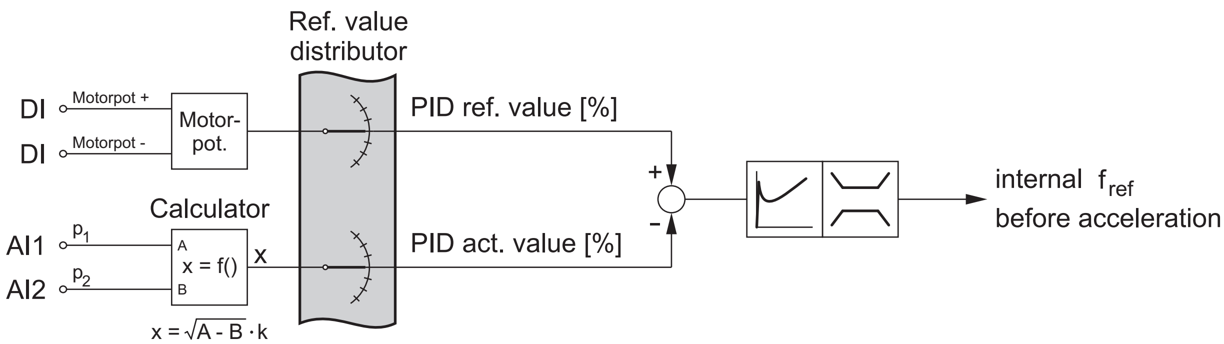
PID correction controller



Control circuit with reference values from the inverter keypad

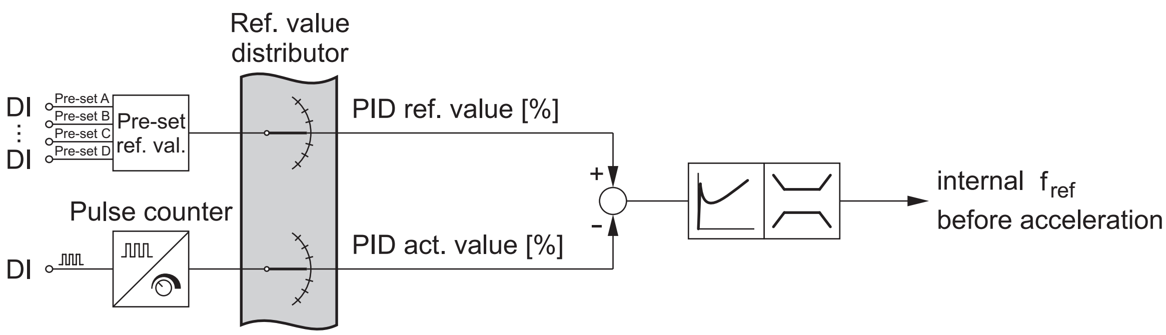


Flow control with differential pressure measurement



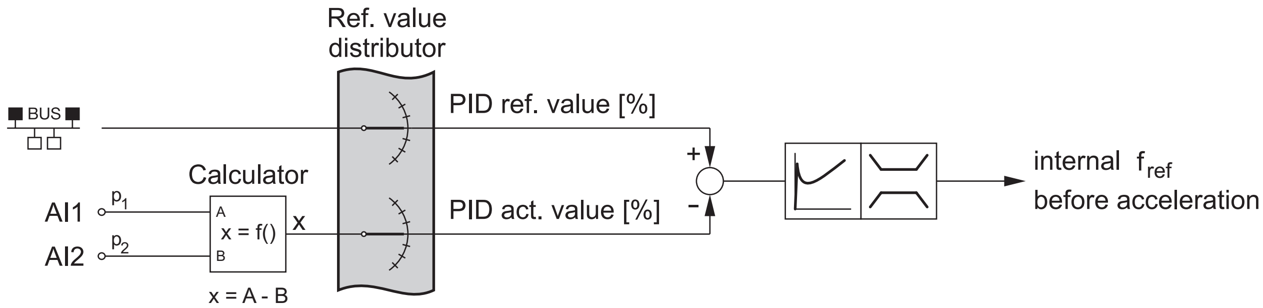
As an alternative to the evaluation of the differential pressure via the calculator, the differential signal can be directly integrated by using a differential pressure sensor. Therefor the input B on the analog calculator must be set to 0 %.

Flow control with turbine wheel instrument



HTIU
8 P01 023 EN.04/04

Differential pressure controller



Monitoring of PID values

C4.01	PID reference value				%
C4.02	PID actual value				%
C4.03	PID deviation				%
C4.04	PID output				Hz

The signals of the controller can be presented in % or in process-correct form. For a process-correct presentation the entry of the parameters C4.34...C4.37 is necessary.

Basic setting

C4.07	Control mode				0 .. Not active

0 ...Not active
1 ...PID - n
2 ...PID - n / DI depend
5 ...External

Setting	Behaviour at setting control mode
0 .. Not active	PID-controller not active
1 .. PID - n	PID-controller active Controller output (PID output) is equal to the frequency reference value scaled in Hz
2 .. PID - n / DI depend	PID-controller can be activated by means of the digital input command "PID-active". Controller output (PID output) is equal to the frequency reference value (scaled in Hz)
5 .. External	PID-controller active Controller output (PID output) can be used via analog output for external uses. Scaling in %

C4.08	Control sense				1 .. Normal

1 ...Normal
2 ...Inverse

C4.09	Proportional gain				0.2

0...30

C4.10	Integration time				0.8 s
	0...600 s				

C4.11	Derive time				0 s
	0...600 s				

C4.12	Max. D-part				50
	0...300				

C4.13	Output level min.				0 Hz
	-300...300 Hz				

C4.14	Output level max.				50 Hz
	-300...300 Hz				

C4.15	Limitation				0 .. Reference values

0 ...Reference values	5... -XY -> min/XY -> max	13...-Pre -> max
1 ...XY -> min	6... XY -> min/-XY -> max	14...-Pre -> min/Pre -> max
2 ...-XY -> min	10 .. Pre -> min	15...Pre -> min/-Pre -> max
3 ...XY -> max	11 .. -Pre -> min	
4 ...-XY -> max	12 .. Pre -> max	

Depending on the setting of parameter C4.15 the output of the PID controller can be limited either permanently to both reference values C4.13 Output level min. and C4.14 Output level max. or variably using the XY graph or the pre-set references.

C4.17	Frequency tracking				1 .. Active

0 ...Not active
1 ...Active

If the frequency tracking for the closed-loop circuit is activated, the switching between local and remote operation (closed-loop control) occurs shock-free. If this response is not desired (e.g. for external uses) the tracking is deactivated.

C4.18	Ref. value acceleration				10 s
	0...6000 s				

C4.19	Ref. value deceleration				10 s
	0...6000 s				

Compensation of pressure drop

In case of pump applications the pressure drop in the pipes and the installed components increases quadratic to the flow. These losses affect the pipes from the pump to the load or the next pump station (at booster applications) in form of pressure drop.

In order to compensate this pressure drop without having to install a pressure measurement at the end of the pipe, the pressure drop can be considered by the inverter. In doing so the PID reference value is raised with increasing frequency up to the value C4.22 "Pressure drop". The start of the compensation occurs by reaching the frequency C4.23 "Start compensation".

In order to avoid an intervention of the compensation at brief pressure surges, the dynamics of the compensating circuit can be adapted by the parameter C4.24.

C4.22	Pressure drop				0 %

0...300 %

C4.22 describes the pressure drop in the pipes at maximum rotational speed (maximum flow), the scaling corresponds to that of the PID reference value.

If cascade control is activated, the parameter C4.22 relates to the resulting pressure loss at max. flow. During operation the parameter is automatically adjusted to the active number of pumps at present.

C4.23	Start compensation				15 Hz

0...300 Hz

C4.24	Compensation dynamic				2 s

0...300 s

Advanced functions

C4.32	PID-lock				2 .. Last value

1 ...Zero
2 ...Last value

According to the use of the PID controller different behaviours can be required if the closed loop control circuit is locked.

Setting	Behaviour at locked PID controller
1 .. Zero	PID control algorithm stops, the controller output (PID output) is held on zero (e.g. when using as correction controller).
2 .. Last value	PID control algorithm stops, the controller output (PID output) is frozen on the last value.

C4.33	Wind-up behaviour				1 .. Limitation active

0 ...Not active
1 ...Limitation active
2 ...Digital input
3 ...Limitation or DI

The wind-up behaviour determines the behaviour of the PID-controller if an inverter limitation is triggered. According to the usage of the PID-controller different reactions can be required.

Setting	Behaviour at locked PID controller
0 .. Not active	The controller output is only determined by the control algorithm. If a PID deviation of zero cannot be reached, the PID output operates with the set integration behaviour up to its internal limit.
1 .. Limitation active	If a limitation function of the inverter is active which makes an adjustment impossible, the integration of the PID controller is stopped. Therefore, the integration time of the controller cannot negatively influence the output.
2 .. Digital input	The wind-up behaviour can be changed by means of a digital input. As a result plant-sided limits can be integrated in the control circuit.
3 .. Limitation or DI	The integration can be stopped by means of a limitation or a digital input.

C4.34	PID multiplier				1
	-1000...1000				

C4.35	PID divisor				1
	1...1000				

C4.36	PID offset				0
	-100...100				

C4.37	Process unit	txt			

Edit unit	kWh	m/s
_	Hz	m^3/h
%	kHz	s
mA	bar	min
A	mbar	h
mOhm	rpm	Nm
Ohm	mm	kg
V	m	°C
W	m^3	°F
kW	ms	

In order to present the display of the control values (PID reference value, PID actual value and PID deviation) on the LCD display in process-correct form, a mathematical adaptation can be carried out by means of parameters C4.34...C4.37.

$$\text{Display} = \text{Input value} \cdot \frac{C4.34}{C4.35} + C4.36 \quad [\text{Unit } C4.37]$$

HTIU
8 P01 023 EN.04/04

Economy mode

The frequency inverter control maintains the magnetic motor flux constant within the speed range of zero to the nominal frequency of the motor in order to be able to react dynamically to load requirements. For applications with quadratic load torque, such as e.g. centrifugal pumps or fan drives, the motor flux must however not be maintained constant as the load decreases quadratic with the speed.

The function economy mode lowers the flux systematic depending on the speed and the actual load. In this way, the magnetizing current decreases without causing losses to the availability of the drive. The resulting energy saving effect is especially great with drives that are often operated in partial-load operational range.

Depending on the process demands two different variants of the economy mode can be selected. Setting B3.02 Control mode = "VC economy" leads to a load-adaptive power factor control which can be also used for non-quadratic loads.

If B3.02 Control mode = "V/f economy" is selected, a specific voltage reduction according to a quadratic takes place.

In this context, it should also always be checked if the drive cannot be completely switched off in low load situations by using the standby mode (see function "Standby Mode", page 152).

C6.01	Economy mode				

0 ...Not active
1 ...Active

Parameter C6.01 displays the actual operation state of the economy function. The setting of the economy mode occurs by selecting a suitable motor control mode in the Matrix field B3.

The economy mode requires the setting of a suitable motor control mode with parameter B3.02 "Control mode". The variant "V/f economy" as well as "VC economy" is suitable for the economy mode.

C6.02	Max. fluxing reduction				30 %

25...100 %

If the economy mode function is active and motor control mode "VC economy" is used, the allowed decrease of the motor flow can be limited by means of the parameter "Max. fluxing reduction" (load adaptive power factor control).

C6.03	V/f level				30 %

0...100 %

If the economy mode function is active and motor control mode "V/f economy" is used, the allowed decrease of the V/f-ratios can be limited by means of the parameter "V/f level" (voltage decrease for quadratic loads).

Motor heating

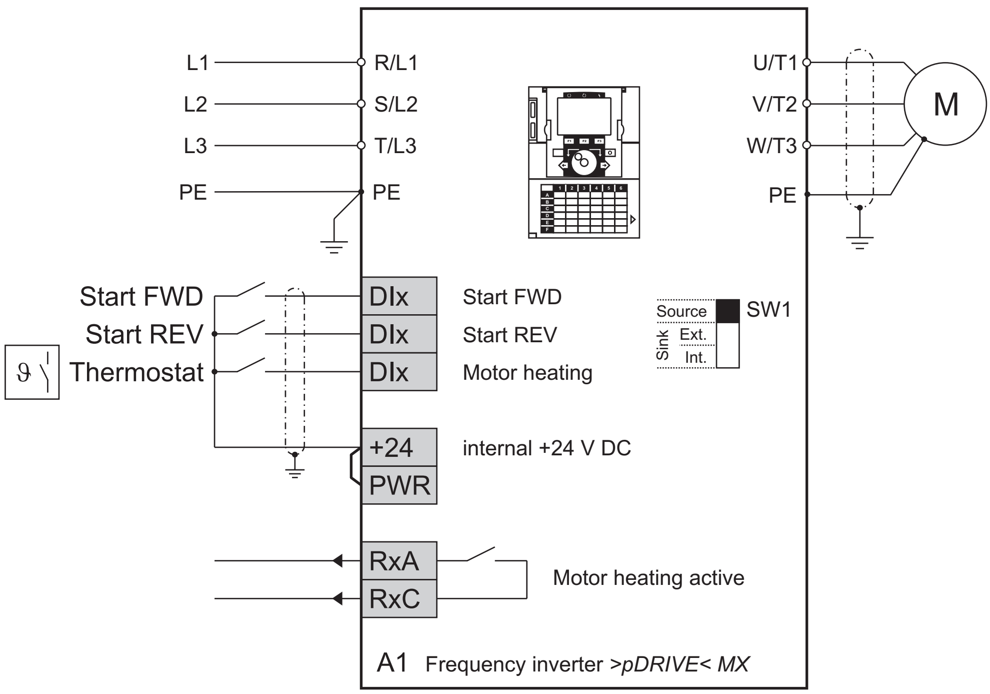
When using motors in disadvantageous ambient conditions such as high humidity and / or severe temperature fluctuations, there is a danger of condensation in the motor. In order to prevent resulting damages to the motor the function "Motor heating" can be activated. In contrast to externally mounted motor heating systems, the heating occurs directly in the motor windings by means of a direct current which is applied from the inverter.

C6.05	Motor heating				0 .. Not used
	0 ...Not used 1 ...Active 2 ...DI dependent				

C6.06	Heating current				15 %
	0...50 %				

The activation of the heating operation occurs by means of the setting C6.05 Motor heating "Active". As a result the heating operation is automatically initiated if the frequency inverter changes to operating state "Run" or to "Release operation" in case of bus operation.

A start command interrupts the heating function also when heating is still requested with a digital input (C6.05 or digital input).



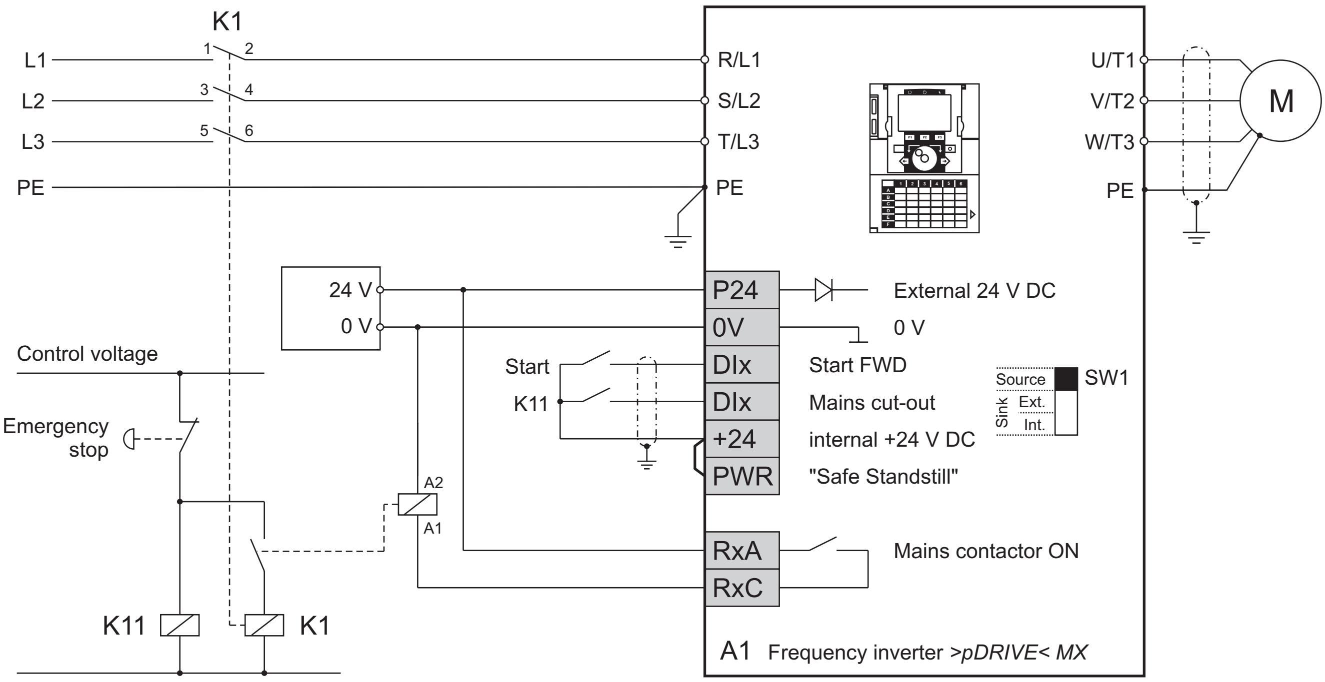
If heating should occur depending on an external sensor such as a hygro- or thermometer, select setting "2 .. DI dependent" and provide a corresponding configured digital input.

Line contactor control

C6.07	Line contactor control				0 .. Not active

0 ...Not active
1 ...Active

By using the function "Line contactor control" the frequency inverter is itself able connect and disconnect the mains by means of a contactor upstream. Therefore, a selectable digital output is activated with each start command (via keypad, terminals or bus) through which the line contactor is activated. The termination of the line contactor occurs with a stop command after a deceleration process has taken place, in the case of an occurring fault or if a lock signal is given, the line contactor releases immediately.



If the mains voltage (DC link voltage) does not reach its nominal value within 3 seconds, a fault shut-down with the message "Line contactor fault" occurs.

An external 24 V buffer voltage is required for the supply of the inverter electronics.

In order to guarantee a safe switching-off of the line contactor when using an emergency STOP control, a digital input with the function "Mains cut-off" must be integrated.

HTIU

8 P01 023 EN.04/04

Motor contactor control

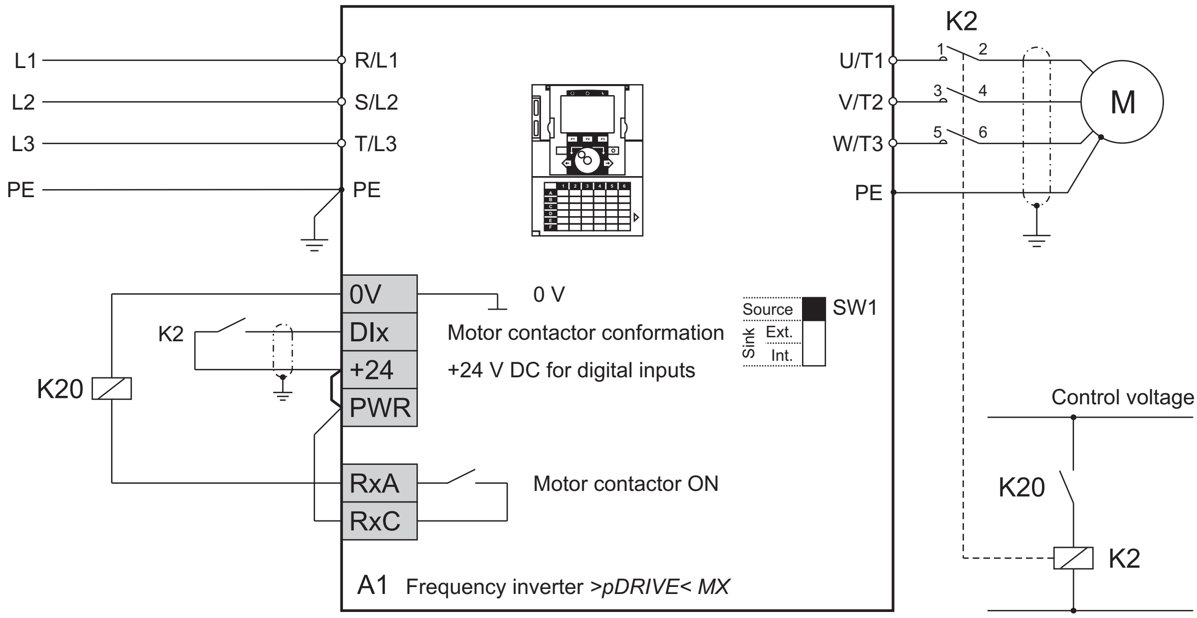
C6.08	Motor contactor control				0 .. Not active

0 ...Not active
1 ...VSD controlled
2 ...External control

The motor contactor control is functionally divided into two different groups.

Setting "VSD controlled"

If setting "VSD controlled" is activated, the motor contactor is switched on and of by means of a digital output. This digital input has to be configured with the function "Motor contactor ON". The motor contactor is closed with every start command and opens after completion of deceleration.



The function of the motor contactor can be monitored by connecting an auxiliary contact to a digital input.

If the motor contactor does not close or open within a period of 1 second after the inverter-internal request, a fault shut-down occurs with the message "Motor contactor error".

Setting "External control"

If setting "External control" is activated, the motor circuit is opened with an externally controlled motor contactor or by means of a manually operated switch. The frequency inverter recognizes the disconnection of the motor circuit due to its output phase monitoring and activates a routine which identifies the reclosing of the motor circuit. If the motor is connected again, the inverter synchronizes itself automatically to the motor speed and continues operation.

Standby Mode

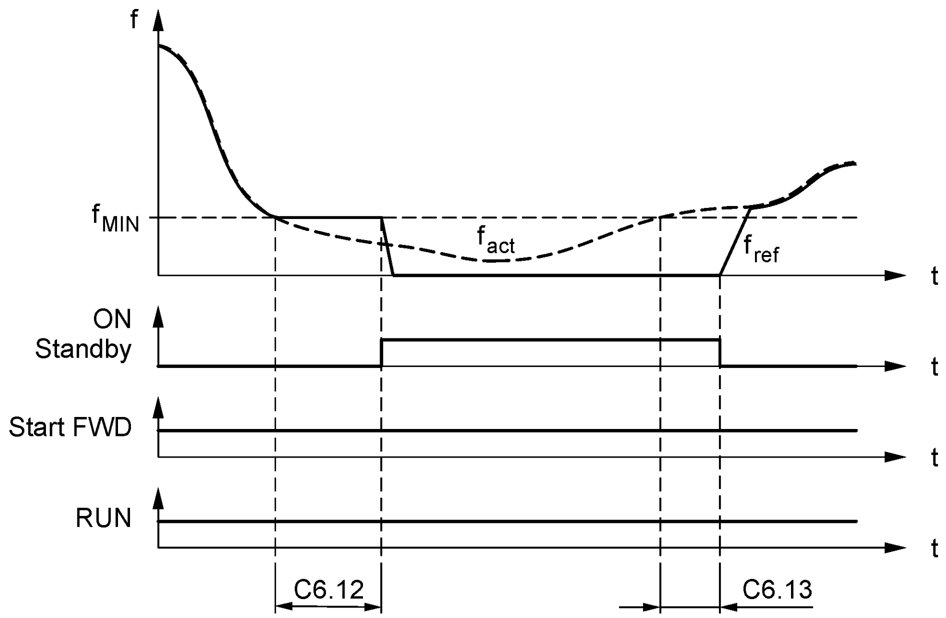
Like the economy mode the standby function affects an energy-efficient operating method of a system. It is a measure especially for applications with quadratic load performances and PID control. An internal PID controller as well as an external control system can be used.

If the standby function is active, the signals frequency actual value, frequency reference value and possibly available PID actual value are evaluated in order to check if the system is operated in an "expedient" range. If it is possible to disconnect the drive without interfering with the processing procedure, the drive is stopped and the frequency inverter changes into standby mode. The Run message remains in standby mode, the internal PID controller active. The standby mode is automatically ended as soon as the control circuit registers a corresponding need.

The end of the standby mode leads to an automatic restart of the drive.

C6.11	Standby mode				0 .. Not active
	0 ...Not active 1 ...f min 2 ...f min and p max				
C6.12	Off delay time				20 s
	1...3000 s				
C6.13	On delay time				5 s
	1...100 s				
C6.14	Max. level				0 %
	0...300 %				
C6.15	Min. level				0 %
	0...300 %				

Setting standby mode "f min"

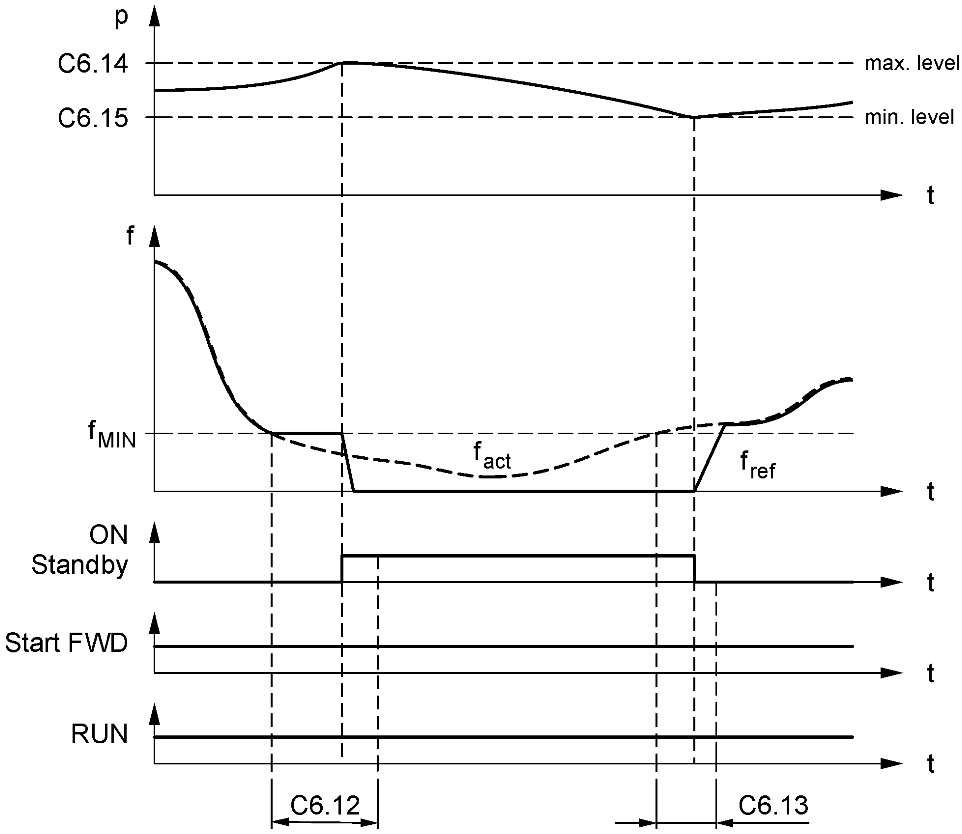


In operating situations with very low medium output (low load situation) the control circuit arrives its minimum output limitation. A further reduction of speed is not possible due to the minimum allowed operating speed of the pump.

HTIU
8 P01 023 EN.04/04

If the drive now remains at the minimum frequency limit C2.01 for the adjustable time "Off delay time", the motor is disconnected and the drive changes into standby mode. If the actual value of the controller decreases or if the reference value increases, this leads to an increase of the frequency reference value which, on the other hand, results in connecting the motor. This variant can be used for an external or the internal process controller. By using the internal PID controller, the minimum output limitation C4.13 is to be set 0.5 Hz lower than the minimum frequency C2.01.

Setting standby mode "f min and p max"



If the internal process controller is used for pressure control, the activation of the standby function depends on the minimum frequency as well as the actual pressure value which is recognised by the controller. As a result the device can be switched into standby mode at increasing pressure already before the release delay has been reached, whereby inadmissible high pressures in the system are avoided. When the pressure falls below the minimum level, the drive is switched on after the switch-on delay. Both of the pressure levels correspond to the PID actual value scaling in %.

Pulse counter

The pulse counter evaluates a pulse train from a digital input in different variants.

The counter can be used as follows:

- Pedometer for the joint usage of comparators and logic modules (see matrix field E6, page 243)
- Total counter with adjustable scaling and reset input for control tasks (filling level, position, weight,…)
- Determination of the average from the pulse count (leads to a scaleable size and can be used as PID-actual value feedback or as indicated value)

Push-buttons, initiators, measuring devices for electrical and non-electrical values with pulse output (water meter, turbine wheel instrument, energy meter,...) etc. can be used as signal sources for the counting input. The maximum allowed input frequency is 100 Hz.

The determined value is scaleable and can be performed with a free editable abbreviation and a unit for the display on the Matrix operating panel.

C6.18	Pulse counter				0 .. Not active

0 ...Not active
1 ...Active

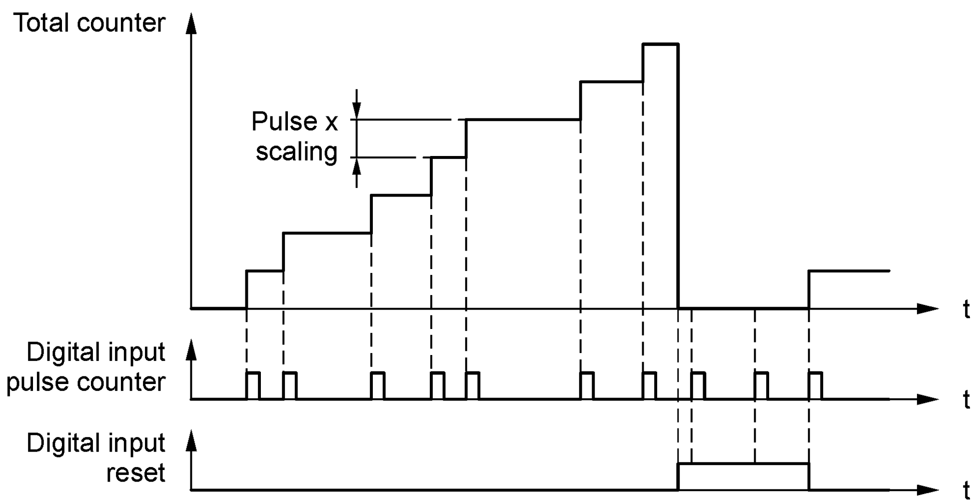
C6.19	Total counter				

The total counter is incremented by the value of the scaling with each pulse received by the digital input. The maximum representable value is limited to 6553.5.

The display of the count can be performed with a freely selectable abbreviation and a unit by means of parameters C6.24 and C6.25. The counter can also be displayed in one of the three configurable fields (see matrix field A6, page 64).

By means of the digital input "Pulse counter reset" (configurable in matrix field D2, page 169), the count can be set to or kept at zero.

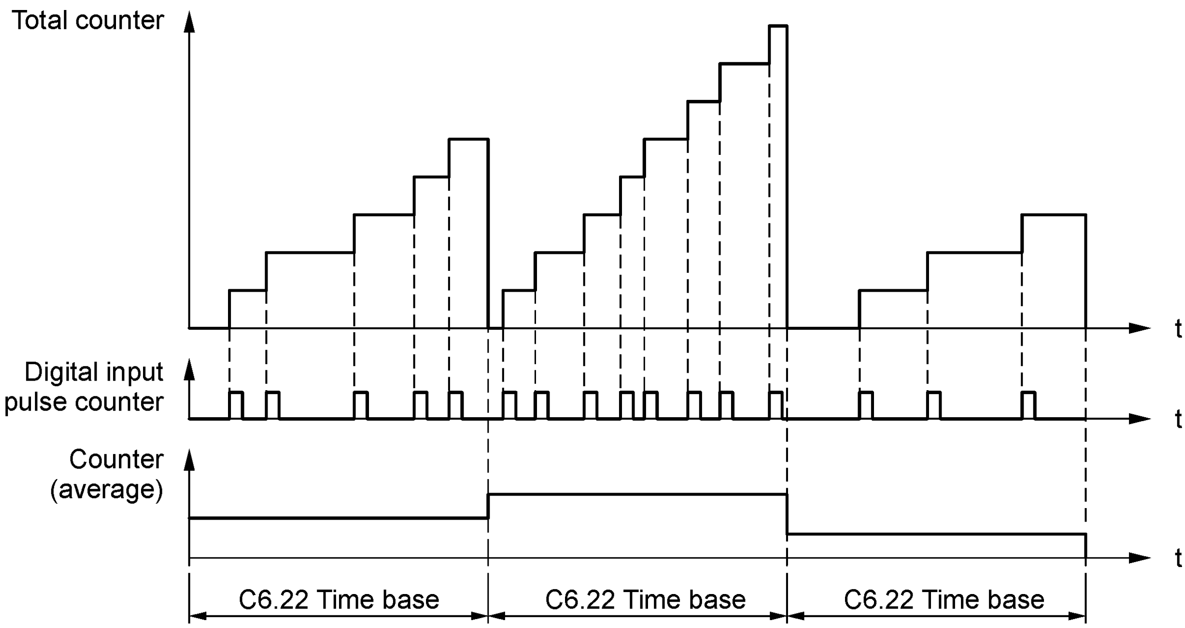
$$X = \Sigma \text{ Pulses} \times \text{Scaling}$$



C6.20	Counter (average)				

The given value corresponds to the time linear average of the pulse counter during a free selectable time base.

$$\overline{X} = \frac{\Sigma \text{ pulses} \times \text{scaling (during time base)}}{\text{time base}}$$



C6.21	Scaling				1

0...65

Multiplication factor for the total determination or average determination. Per incoming pulse on the digital input the counter is incremented by the value of the set scaling.

Use	Setting
Step counter	Setting 1
Total counter or measured value counter	Setting according to sensor e.g. Distance measurement in m (counter): 2 pulses/meter → scaling factor = 2 Flow in l/min: 40 Hz / 300 l/min → 300 / 40 = 7.5 l/min per pulse → scaling factor = 7.5

C6.22	Time base pulse counter				2 s

0...3600 s

The time base determines the period of the summation and forms therefore a time filter for the measuring value. It can be adapted depending on the temporal number of pulses as well as the dynamic change of the measuring value.

C6.23	Pulse type				1 .. Positive edge

1 ...Positive edge
2 ...Neg. edge
3 ...Pos. + neg. edge

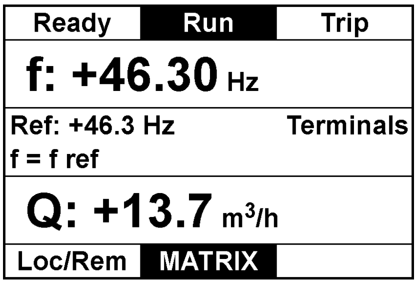
The pulse count can occur on the positive, negative or both signal ramps according to the used sensor and application.

C6.24	Symbol pulse counter	txt			

Free editable abbreviation. It is prefixed to the measuring- and total value in the LCD display.

C6.25	Pulse counter unit	txt			

Edit unit	kWh	m/s
	Hz	m^3/h
%	kHz	s
mA	bar	min
A	mbar	h
mOhm	rpm	Nm
Ohm	mm	kg
V	m	°C
W	m^3	°F
kW	ms	



Unit which is selectable from a list or free editable. It is added to the measuring- and total value in the Matrix operating panel.

Correction reference value

C6.26	f-correction				1 .. Additive

1 ...Additive
2 ...Multiplicative

The reference value for frequency correction offers the possibility to influence the internal frequency reference value before the acceleration/deceleration ramps act. The correction value can act as Offset (additive) or as magnification (multiplicative).

The correction reference value is used at automatic or manual positioning tasks, creating chained-up reference values and in the correction control structure of the internal PID process controller. See also chapter "Reference sources" and "Reference value distributor".

Setting	Note
1 .. Additive	Addition of the reference value for frequency correction with correct algebraic sign in Hz
2 .. Multiplicative	The signal of the reference path "frequency correction in Hz" acts as multiplicative factor. In this case the signal is scaled in % and not in Hz (100 Hz corresponds with factor 1).

DC-supply

The function "DC-supply" enables the supply of the inverter via the DC link with an existing DC voltage. The DC voltage source must keep the specification (voltage, power, fuse protection) and has to be connected to the DC link terminals of the inverter with a suitable pre-charging unit.

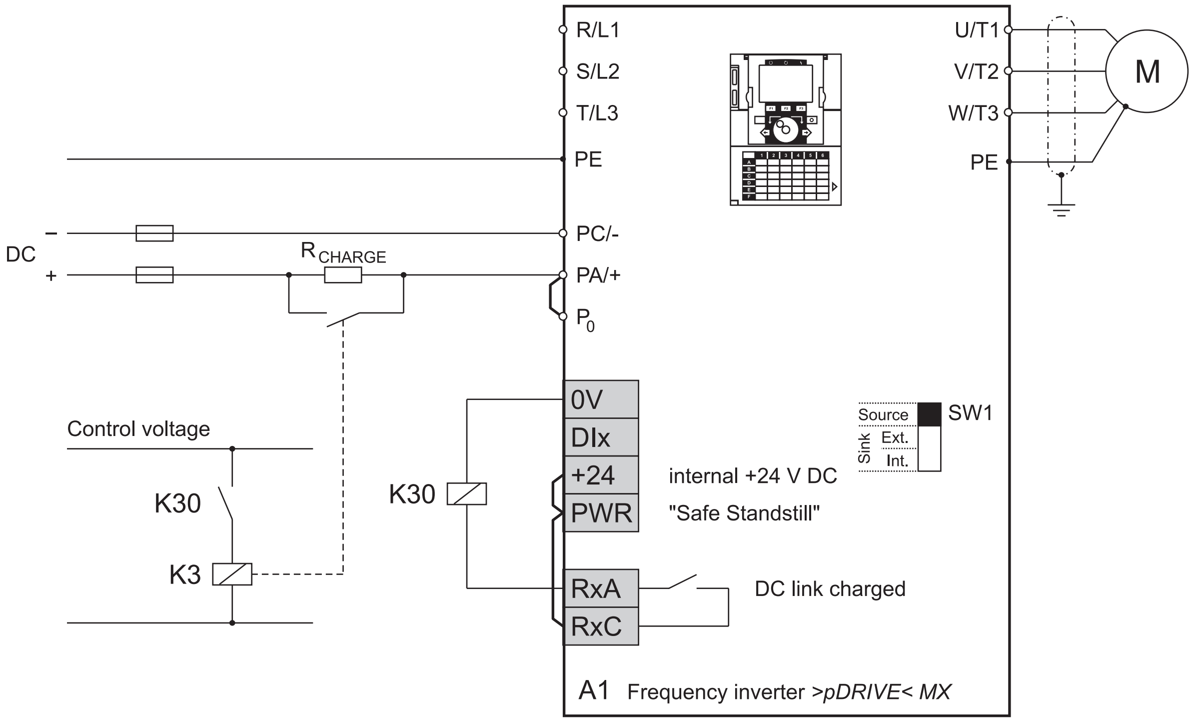
When using an external DC supply or an external rectifier in order to achieve 12-pulse ore 18-pulse input rectification, parameter C6.65 has to be set accordingly. The external pre-charging contactor must be actuated by means of the digital output function "DC link charged". The additional switching delay of the external charging contactor has to be set with parameter C6.66.

C6.65	DC - charging				0 .. Standard (AC)

0 ...Standard (AC)
1 ...External (DC)
2 ...Ext 12/18 Pulse Supp

C6.66	DC - charging time				0.5 s

0...15 s



8 P01 023 EN.04/04

HTIU

D		**Input / Output**	Configuration of the inputs/outputs as well as the fieldbus connection

D1		**Analog inputs**	Selection and scaling of analog acting reference sources

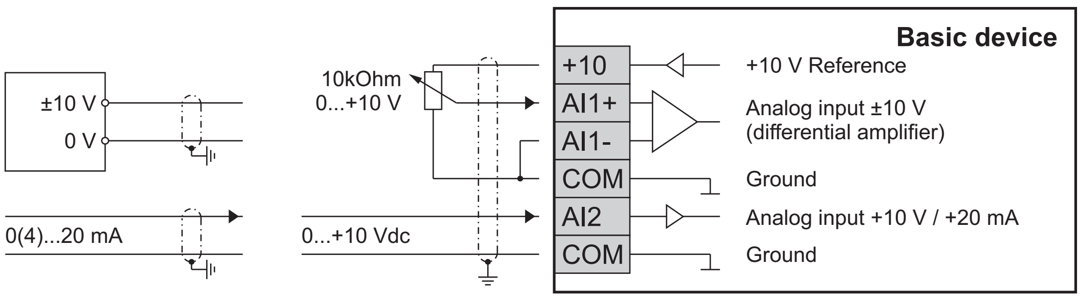
The references for the different functions of the *>pDRIVE< MX eco* can be provided in different ways (see chapters on reference sources /reference value distributor).

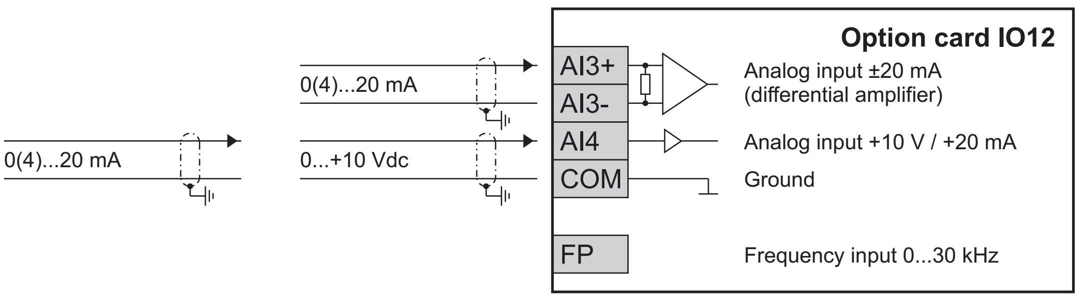
One way is the usage of analog inputs. Thereby the reference values are provided by means of standardized voltage or current signals.

The following analog outputs are available at the *>pDRIVE< MX eco*:

Input	Standardized signal	Type of input	Position	Terminal marking
AI1	0...+10 V or -10...+10 V	Voltage differential amplifier	Basic device	AI1+ AI1-
AI2	0...+10 V, 0...20 mA or 4...20 mA	Universal	Basic device	AI2 COM
AI3	0...20 mA or 4...20 mA	Current differential amplifier	Option *>pDRIVE< IO12*	AI3 + AI3 -
AI4	0...+10 V, 0...20 mA or 4...20 mA	Universal	Option *>pDRIVE< IO12*	AI4 COM
FP	0.1…30 kHz	1:1 frequency signal 5…30 V	Option *>pDRIVE< IO12*	FP COM
LFP	10…60 Hz	1:1 frequency signal 24 V	Basic device	DIx

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.





It is not possible to assign reference paths twice. If you try to assign a second reference source to a use which is already allocated in the reference value distributor, the parameterization will prevent this and the alarm message " Multiple usage of inputs not possible !" will be shown in the display.

Analog input AI1

D1.01	AI1 selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the reference source AI1 can be set as source for different uses according to the reference value distributor. Parameter "D1.01 "AI1 selection" assigns the reference value to the desired use (see also chapter reference sources, reference value distributor).

D1.02	AI1 level				1 .. 0 ... 10V

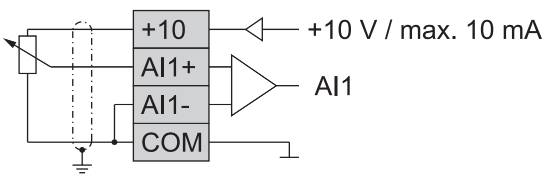
1 ...0 ... 10V
2 ...± 10V

The analog input AI1 can be configured for unipolar or bipolar voltage reference values.

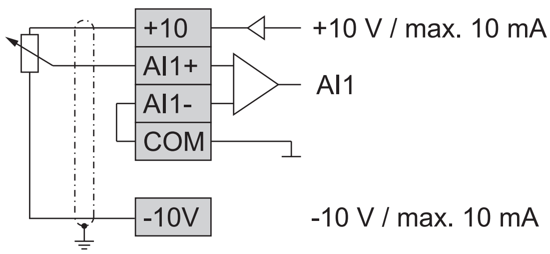
Available reference voltages are +10 V at the basic device and -10 V at the two terminal extension cards option >*pDRIVE*< *IO11* and >*pDRIVE*< *IO12*.

The analog input is built as differential amplifier, so reference signals from external reference sources can also be used without any problems.

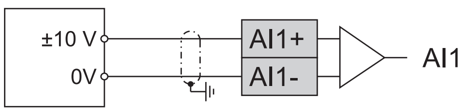
AI1 wiring unipolar



AI1 wiring bipolar



AI1 wiring external



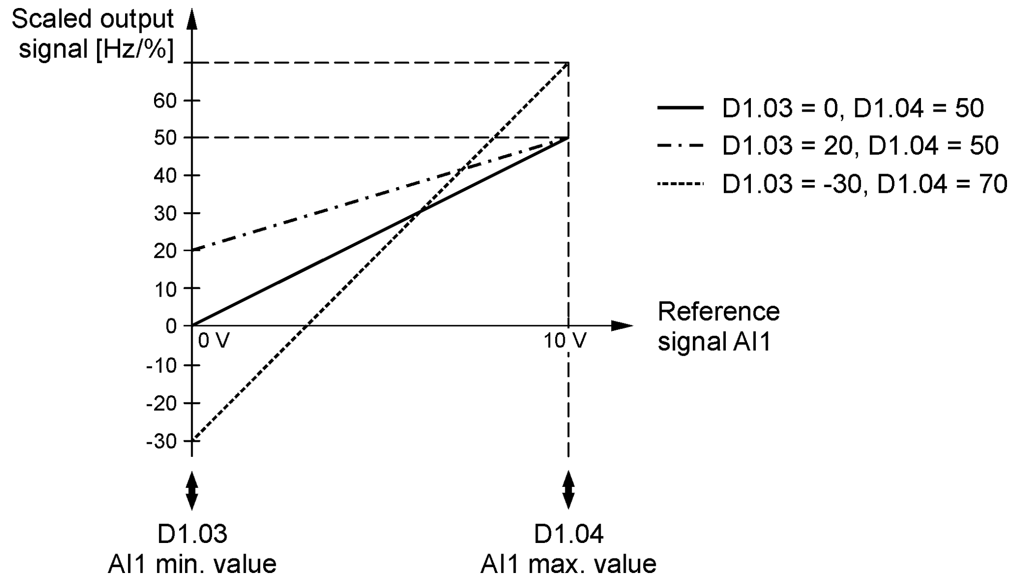
D1.03	AI1 min. value				0 % or Hz
	-300...300 % or Hz				

D1.04	AI1 max. value				50 % or Hz
	-300...300 % or Hz				

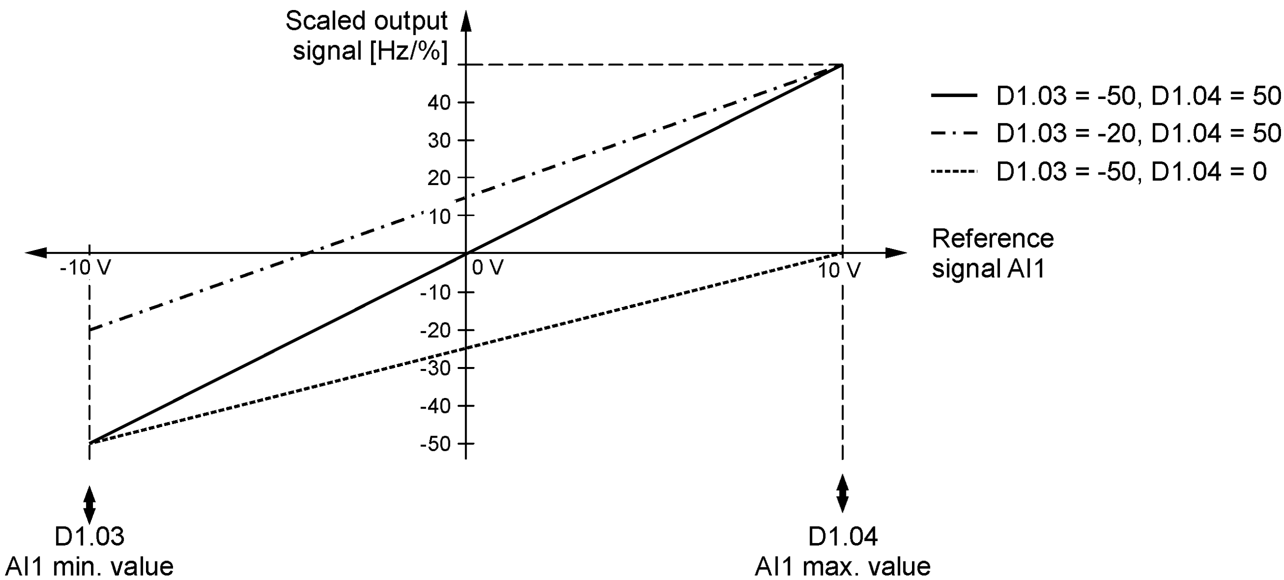
The two parameters D1.03 "AI1 min. value" and D1.04 "AI1 max. value" are used for linear scaling of the reference value. D1.03 defines the minimum reference point (0 V or -10 V), D1.04 the maximum reference point (+10 V).

The unit of the reference value is scaled according to the reference use D1.01 "AI1 selection" for all frequency values in Hz, while the remaining signals are scaled in %.

AI1 scaling unipolar



AI1 scaling bipolar



D1.05	AI1 filter-time				0.1 s
	0...30 s				

To prevent unwanted interspersions or high-frequency interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

Analog input AI2

D1.08	AI2 selection				1 .. f-reference 1 [Hz]

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the reference source AI2 can be set as source for different uses according to the reference value distributor. Parameter D1.08 "AI2 selection" assigns the reference value to the desired use (see also chapter reference sources, reference value distributor).

D1.09	AI2 level				4 .. 4 ... 20 mA

1 ...0 ... 10V
3 ...0 ... 20 mA
4 ...4 ... 20 mA

The analog input AI2 can be configured for voltage and current reference values.

If "4 .. 4 ... 20 mA" (Live Zero Signal) is selected, monitoring of the reference regarding failure is possible.

If the current signal falls below the level of 2 mA, one of the following reactions can be triggered:

Setting E3.14	Reaction
"1 .. Trip"	Fault shut-down
"2 .. Last ref. val & alarm"	Alarm and continuation of operations with the last valid reference value
"3 .. Emerg ref val & alarm"	Alarm and continuation of operations with an emergency reference value

The behaviour of the drive at loss of the reference value can be set separately for each relevant reference source (see Matrix field E3, page 219).

D1.10	AI2 min. value				0 % or Hz

-300...300 % or Hz

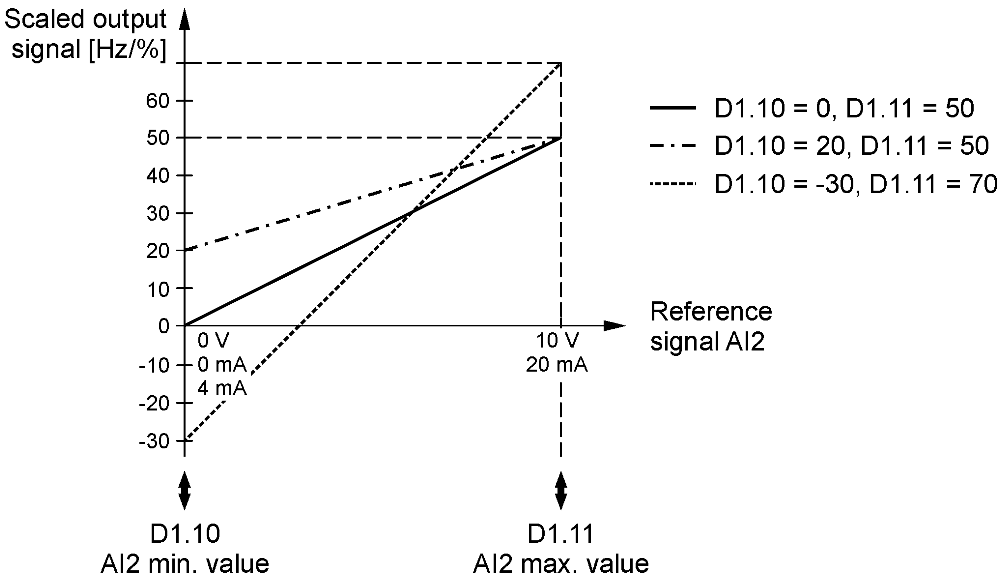
D1.11	AI2 max. value				50 % or Hz

-300...300 % or Hz

The two parameters D1.10 "AI2 min. value" and D1.11 "AI2 max. value" are used for linear scaling of the reference value. D1.10 defines the minimum reference (0 V, 0 mA or 4 mA), D1.11 the maximum reference (+10 V or 20 mA).

The unit of the reference value is scaled according to the reference use "D1.08 AI2 selection" for all frequency values in Hz, while the remaining signals are scaled in %

8 P01 023 EN.04/04



D1.12	AI2 filter-time				0.1 s

0...30 s

To prevent unwanted interspersions or high-frequency interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

HTIU

Analog input AI3

8 P01 023 EN.04/04

D1.15	AI3 selection				0 .. Not used

0 ...Not used	6... PID-reference val. [%]
1 ...f-reference 1 [Hz]	7... PID-actual value [%]
2 ...f-reference 2 [Hz]	15 .. Request [%]
3 ...f-correction [Hz]	

The output of the reference source AI3 can be set as source for different uses according to the reference value distributor. Parameter D1.15 "AI3 selection" assigns the reference value to the desired use (see also chapter reference sources, reference value distributor).

D1.16	AI3 level				4 .. 4 ... 20 mA

3 ...0 ... 20 mA
4 ...4 ... 20 mA

The analog input AI3 is designed as differential amplifier with current input.

If "4 .. 4 ... 20 mA" (Live Zero Signal) is selected, monitoring of the reference regarding failure is possible.

If the current signal falls below the level of 2 mA, one of the following reactions can be triggered:

Setting E3.17	Reaction
"1 .. Trip"	Fault shut-down
"2 .. Last ref. val & alarm"	Alarm and continuation of operations with the last valid reference value
"3 .. Emerg ref val & alarm"	Alarm and continuation of operations with an emergency reference value

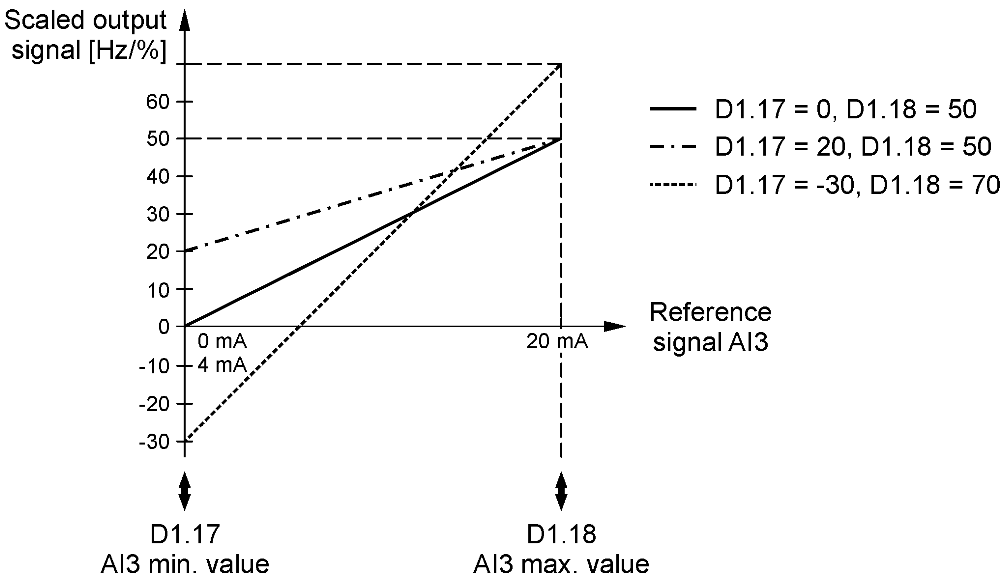
The behaviour of the drive at loss of the reference value can be set separately for each relevant reference source (see Matrix field E3, page 219).

D1.17	AI3 min. value				0 % or Hz
	-300...300 % or Hz				

D1.18	AI3 max. value				50 % or Hz
	-300...300 % or Hz				

The two parameters D1.17 "AI3 min. value" and D1.18 "AI3 max. value" are used for linear scaling of the reference value. D1.17 defines the minimum reference point (0 V or -10 V), D1.18 the maximum reference point (+10 V)

The unit of the reference value is scaled according to the reference use D1.15 "AI3 selection" for all frequency values in Hz, while the remaining signals are scaled in %.



D1.19	AI3 filter-time				0.1 s
	0...30 s				

To prevent unwanted interspersions or high-frequency interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

HTIU

8 P01 023 EN.04/04

Analog input AI4

D1.22	AI4 selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the reference source AI4 can be set as source for different uses according to the reference value distributor. Parameter D1.22 "AI4 selection" assigns the reference to the desired use (see also chapters reference sources, reference value distributor).

D1.23	AI4 level				4 .. 4 ... 20 mA

1 ...0 ... 10V
3 ...0 ... 20 mA
4 ...4 ... 20 mA

The analog input AI4 can be configured for voltage and current reference values.

If "4 .. 4 ... 20 mA" (Live Zero Signal) is selected, monitoring the reference regarding failure is possible.

If the current signal falls below the level of 2 mA, one of the following reactions can be triggered:

Setting E3.20	Reaction
"1 .. Trip"	Fault shut-down
"2 .. Last ref. val & alarm"	Alarm and continuation of operations with the last valid reference value
"3 .. Emerg ref val & alarm"	Alarm and continuation of operations with an emergency reference value

The behaviour of the drive at loss of the reference value can be set separately for each relevant reference source (see Matrix field E3, page 219).

D1.24	AI4 min. value				0 % or Hz

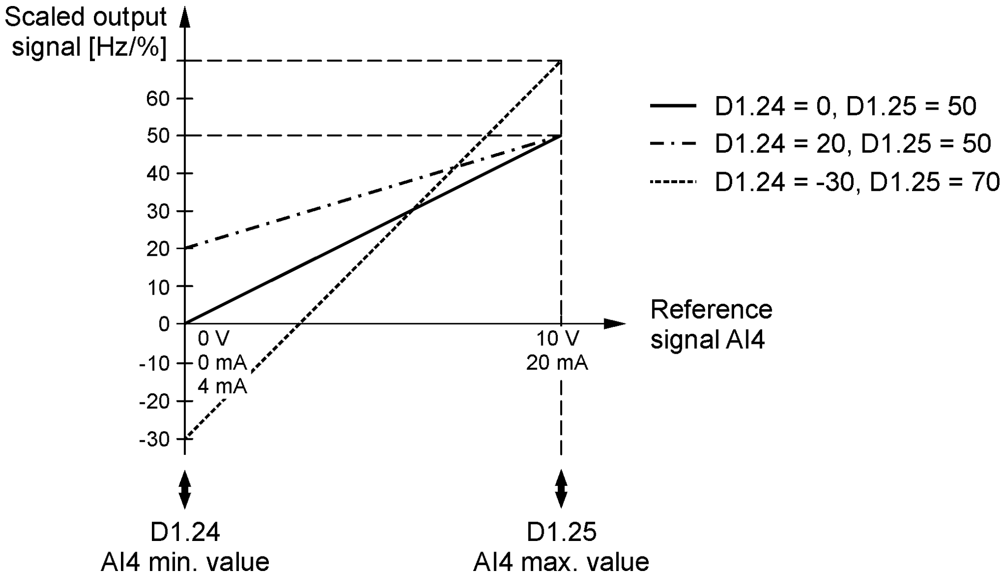
-300...300 % or Hz

D1.25	AI4 max. value				50 % or Hz

-300...300 % or Hz

The two parameters D1.24 "AI4 min. value" and D1.25 "AI4 max. value" are used for linear scaling of the reference value. D1.24 defines the minimum reference value (0 V, 0 mA or 4 mA), D1.25 the maximum reference value (+10 V or 20 mA).

The unit of the reference value is scaled according to the reference use D1.22 "AI4 selection" for all frequency values in Hz, while the remaining signals are scaled in %.



D1.26	AI4 filter-time				0.1 s

0...30 s

To prevent unwanted interspersions or high-frequency interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

HTIU

Frequency input FP

D1.29	FP selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

8 P01 023 EN.04/04

The output of the reference source frequency signal FP can be set as source for different uses according to the reference value distributor. Parameter D1.29 "FP selection" assigns the reference value to the desired use (see also chapter reference sources, reference value distributor).

D1.30	FP min.				0.1 kHz

0...30 kHz

D1.31	FP max.				30 kHz

0...30 kHz

D1.32	FP min. value				0 % or Hz

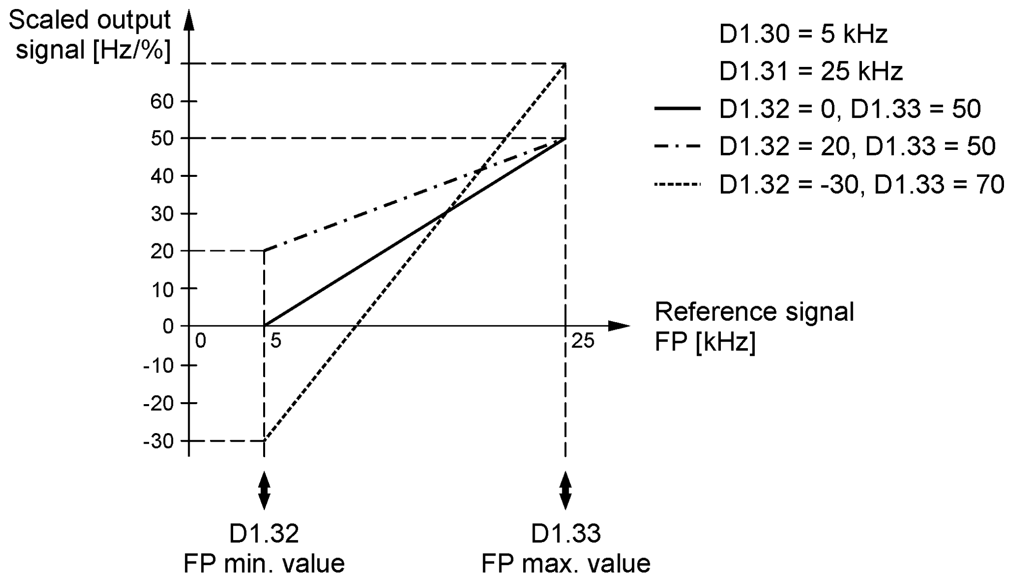
-300...300 % or Hz

D1.33	FP max. value				50 % or Hz

-300...300 % or Hz

Unlike the standardized signals for V and mA the frequency signal is not consistently standardized in its frequency range. The reference value is therefore scaled by the entry of two value pairs for signal frequency and output value. D1.32 defines the reference point at the minimum signal frequency D1.30, D1.33 the reference point at the maximum signal frequency D1.31.

The unit of the reference value is scaled according to the reference use D1.29 "FP selection" for all frequency values in Hz, while the remaining signals are scaled in %.



D1.34	FP filter-time				0.1 s
	0...30 s				

To prevent unwanted interspersions or interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

Frequency input LFP

The frequency input LFP uses a voltage pulse sequence at a free selectable digital input in the frequency range 10...60 kHz as reference signal. After the frequency count the resulting reference value is transferred to the inverter electronics for further signal processing.

D1.37	LFP selection				0 .. Not used

0 ...Not used
1 ...f-reference 1 [Hz]
2 ...f-reference 2 [Hz]
3 ...f-correction [Hz]
6... PID-reference val. [%]
7... PID-actual value [%]
15 .. Request [%]

The output of the reference source "frequency signal LFP" can be set as source for different uses according to the reference value distributor. Parameter D1.37 "LFP selection" assigns the reference value to the desired use (see also chapter reference sources, reference value distributor).

D1.38	LFP min.				10 Hz
	10...60 Hz				

D1.39	LFP max				60 Hz
	10...60 Hz				

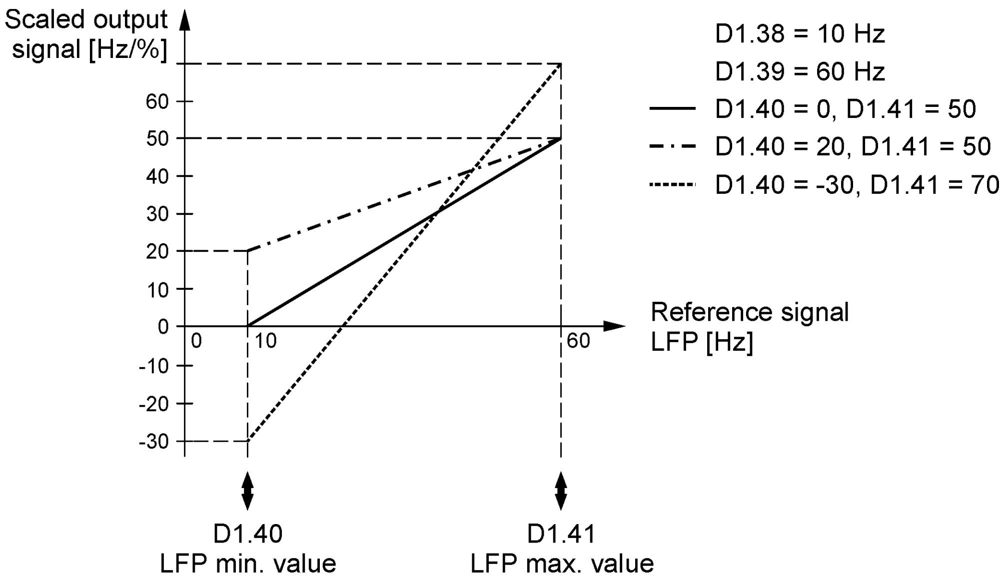
HTIU
8 P01 023 EN.04/04

D1.40	LFP min. value				0 % or Hz
	-300...300 % or Hz				

D1.41	LFP max. value				50 % or Hz
	-300...300 % or Hz				

Unlike the standardized signals for V and mA the frequency signal is not consistently standardized in its frequency range. The reference value is therefore scaled by the entry of two value pairs for signal frequency and output value. Parameter D1.40 defines the reference point at the minimum signal frequency D1.38, parameter D1.41 the reference point at the maximum signal frequency D1.39.

The unit of the reference value is scaled according to the reference use D1.37 "LFP selection" for all frequency values in Hz, while the remaining signals are scaled in %.



D1.42	LFP filter-time				0.5 s
	0...30 s				

To prevent unwanted interspersions or interferences, the reference value can be filtered by setting an appropriate filter time.

At setting 0.0 seconds the filter is deactivated.

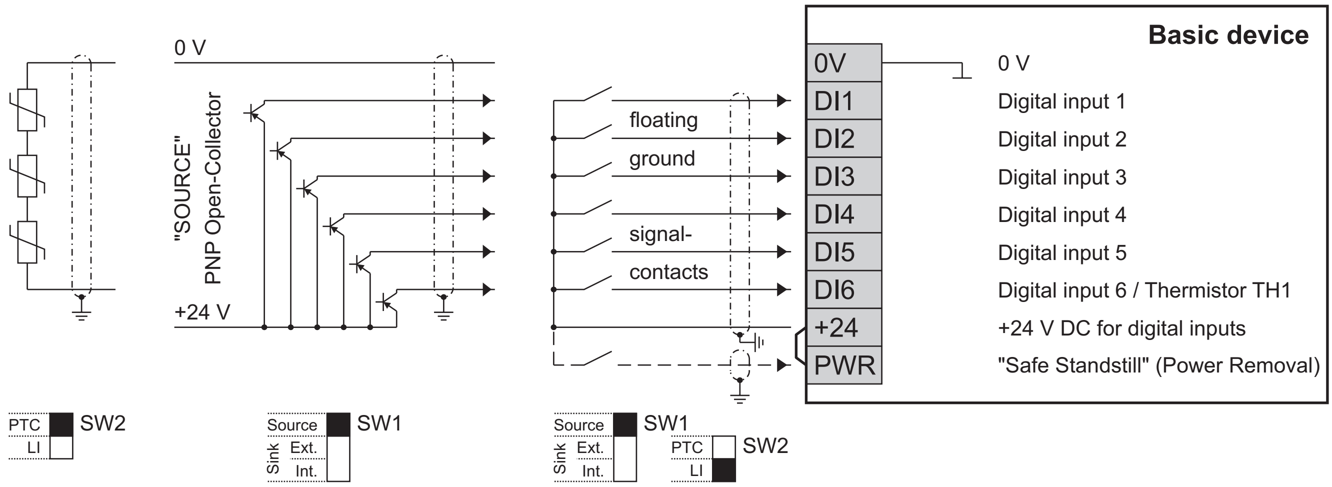
Digital inputs DI

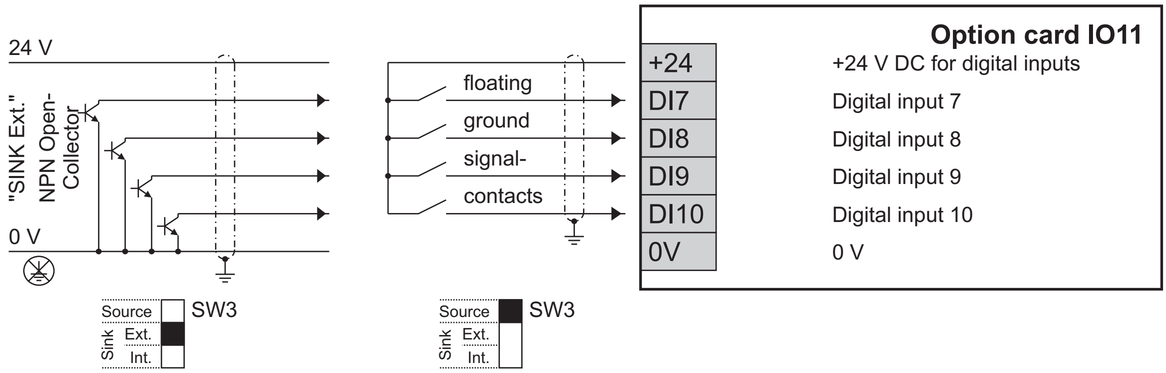
The digital inputs of the *>pDRIVE< MX eco* are used to adopt commands from upstream control systems. The commands can be executed by connecting +24 V or ground to the terminals. Depending on the desired type a print switch can be used to select between source and sink system.

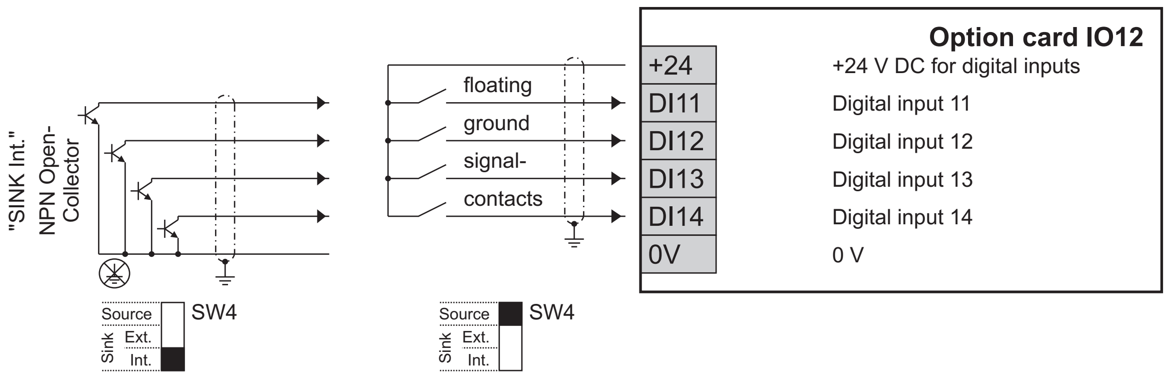
Input	Position	Comment
DI1	Basic device	Function freely programmable, signal level +24 V or 0 V
DI2	Basic device	Function freely programmable, signal level +24 V or 0 V
DI3	Basic device	Function freely programmable, signal level +24 V or 0 V
DI4	Basic device	Function freely programmable, signal level +24 V or 0 V
DI5	Basic device	Function freely programmable, signal level +24 V or 0 V
DI6	Basic device	Function freely programmable, signal level +24 V or 0 V or TH1
PWR	Basic device	"Safe Standstill", function not changeable, signal level +24 V
DI7	Option *>pDRIVE< IO11*	Function freely programmable, signal level +24 V or 0 V
DI8	Option *>pDRIVE< IO11*	Function freely programmable, signal level +24 V or 0 V
DI9	Option *>pDRIVE< IO11*	Function freely programmable, signal level +24 V or 0 V
DI10	Option *>pDRIVE< IO11*	Function freely programmable, signal level +24 V or 0 V
DI11	Option *>pDRIVE< IO12*	Function freely programmable, signal level +24 V or 0 V
DI12	Option *>pDRIVE< IO12*	Function freely programmable, signal level +24 V or 0 V
DI13	Option *>pDRIVE< IO12*	Function freely programmable, signal level +24 V or 0 V
DI14	Option *>pDRIVE< IO12*	Function freely programmable, signal level +24 V or 0 V

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.

HTIU
8 P01 023 EN.04/04







HTIU

8 P01 023 EN.04/04

All input functions can be used for digital inputs, freely usable bits in the control word (fieldbus) or for outputs of the time modules (see Matrix field E6 comparators, page 243).

It is not possible to assign functions twice. If you try to assign a second digital input to a function which is already used, the parameterization will prevent this and the alarm message "Multiple usage of inputs not possible !" will be shown in the display.

X = function selected, digital input not parameterized however
H = function selected and digital input is high
L = function selected and digital input is low

Digital input function	Signal level	Description	Reference Matrix field	Page
0 .. Not used	X	No effect	–	–
	L	No effect		
	H	No effect		
1 .. Start FW (2 wire)	X	No Start FWD command (2-wire) possible	E4	235
	L	Stop		
	H	Start / Forward		
2 .. Start REV (2 wire)	X	No Start REV command (2-wire) possible	E4	235
	L	Stop		
	H	Start / Reverse		
3 .. Start FW (3 wire)	X	No Start FWD command (3-wire) possible	E4	235
	L	No effect		
	H	Start forward (at positive signal edge)		
4 .. Start REV (3 wire)	X	No Start REV command (3-wire) possible	E4	235
	L	No effect		
	H	Start reverse (at positive signal edge)		
5 .. Stop (3 wire)	X	No operation with 3-wire control possible	E4	235
	L	Stop (at negative edge)		
	H	Required for operation		
6 .. Fast stop	X	Fast stop function not active	E4	235
	L	Start of the fast stop with negative edge		
	H	Required for operation		
7 .. Enable	X	No effect	E4	235
	L	Lock of the IGBTs on output side		
	H	Required for operation		
11 .. f-ref reverse	X	No effect	E4	235
	L	No effect		
	H	Internal frequency reference value is inverted → Change of rotational direction !		
14 .. Motor pot. +	X	Control of motor potentiometer not possible	C1	105
	L	No effect		
	H	Motor pot reference is increased		
15 .. Motor pot. -	X	Control of motor potentiometer not possible	C1	105
	L	No effect		
	H	Motor pot reference is decreased		
16 .. Pre-set A	X	Use of the input dependent on the required number of preset references	C1	105
	L	Binary encoded selection of a preset reference		
	H	Binary encoded selection of a preset reference		
17 .. Pre-set B	X	Use of the input dependent on the required number of preset references	C1	105
	L	Binary encoded selection of a preset reference		
	H	Binary encoded selection of a preset reference		
18 .. Pre-set C	X	Use of the input dependent on the required number of preset references	C1	105
	L	Binary encoded selection of a preset reference		
	H	Binary encoded selection of a preset reference		

Digital input function	Signal level	Description	Reference Matrix field	Reference Page
19 .. Pre-set D	X	Use of the input dependent on the required number of preset references	C1	105
	L	Binary encoded selection of a preset reference		
	H	Binary encoded selection of a preset reference		
22 .. f-reference 2 [Hz]	X	Reference source at f-reference 1 is active	Reference value distributor	11
	L	Reference source at f-reference 1 is active		
	H	Reference source at f-reference 2 is active		
23 .. Control source 2	X	Control source 1 active	E4	235
	L	Control source 1 active		
	H	Control source 2 active		
24 .. 2nd ramp	X	1st acceleration/deceleration ramp active	C2	120
	L	1st acceleration/deceleration ramp active		
	H	2nd acceleration/deceleration ramp active		
25 .. Reference value B	X	Input A of reference switch-over is active	C1	105
	L	Input A of reference switch-over is active		
	H	Input B of reference switch-over is active		
26 .. Panel operation [1)]	X	It is not possible to switch into the panel mode	E4	235
	L	Remote operation (2-wire, 3-wire, fieldbus) active		
	H	Panel operation via LED-keypad or Matrix operating panel		
29 .. External fault 1	X	Input is considered as low, behaviour according to setting of E3.35 "Ext. fault 1 response"	E3	219
	L	Behaviour according to setting of E3.35		
	H	Behaviour according to setting of E3.35		
30 .. External fault 2	X	Input is considered as low, behaviour according to setting of E3.42 "Ext. fault 2 response"	E3	219
	L	Behaviour according to setting of E3.42		
	H	Behaviour according to setting of E3.42		
31 .. Ext. reset [1)]	X	No effect	E3	219
	L	No effect		
	H	Reset at positive signal edge		
32 .. Emergency operation [1)]	X	No effect	E3	219
	L	No effect		
	H	Activation of emergency operation		
35 .. PID-active	X	f-reference is adjusted by reference source	C4	139
	L	f-reference is adjusted by reference source		
	H	PID controller output provides f-reference		
36 .. PID-lock	X	PID-algorithm active	C4	139
	L	PID-algorithm active		
	H	PID controller algorithm is kept or set to the value zero (adjustable behaviour)		
37 .. PID-wind up	X	Integration time of PID controller is independent of limitations that could occur at the inverter	C4	139
	L	Integration time of PID controller is independent of limitations that could occur at the inverter		
	H	Integration time of PID controller is stopped at limitations		

HTIU
8 P01 023 EN.04/04

Digital input function	Signal level	Description	Reference Matrix field	Page
40 .. Feed in pressure OK	X	The protection function feed-in monitoring always remains active and cannot be reset, depending on the setting switch-over into standby mode can also occur	E1	195
	L	The protection function feed-in monitoring is activated, depending on the setting switch-over into standby-mode can occur (used for pressure measurement with evaluation through comparator)		
	H	Active feed-in monitoring can be reset, automatic starting at activated standby-mode (used for pressure measurement with evaluation through comparator)		
41 .. Level OK	X	No effect (hysteresis behaviour with "Level <")	E1	195
	L	No effect (hysteresis behaviour with "Level <")		
	H	Active feed-in monitoring can be reset, automatic starting at activated standby-mode		
42 .. Level <	X	Protection function "Feed-in monitoring" becomes active, depending on the setting a switch-over into standby-mode can occur	E1	195
	L	Protection function "Feed-in monitoring" becomes active, depending on the setting a switch-over into standby-mode can occur		
	H	No effect (hysteresis behaviour with "Level OK")		
50 .. C. motor 1 ready	X	Drive is locked for cascade control	C3	125
	L	Drive is locked for cascade control		
	H	Drive is ready for cascade control		
51 .. C. motor 2 ready	X	Drive is locked for cascade control	C3	125
	L	Drive is locked for cascade control		
	H	Drive is ready for cascade control		
52 .. C. motor 3 ready	X	Drive is locked for cascade control	C3	125
	L	Drive is locked for cascade control		
	H	Drive is ready for cascade control		
53 .. C. motor 4 ready	X	Drive is locked for cascade control	C3	125
	L	Drive is locked for cascade control		
	H	Drive is ready for cascade control		
54 .. Start VSD cascade	X	No start command possible	C3	125
	L	Stop command for the whole VSD cascade		
	H	Start command for the whole VSD cascade		
56 .. Mains cut-off	X	No effect	E3	219
	L	Impulse inhibit and line contactor OFF		
	H	Required for operation		
57 .. ON lock	X	Drive is not ready	E3	219
	L	Drive is not ready		
	H	Required for operation		
58 .. Locking	X	Remote and panel operation released	–	–
	L	Drive is locked for all remote-control sources		
	H	Remote and panel operation released		
59 .. Feedb. motor cont.	X	Motor contactor open	C6	148
	L	Motor contactor open		
	H	Motor contactor closed		

Digital input function	Signal level	Description	Reference Matrix field	Reference Page
60 .. Motor heating	X	Motor heating not active	C6	148
	L	Motor heating not active		
	H	Motor is heated in status ready		
64 .. Pulse counter input	X	No counting possible	C6	148
	L	Counter input, signal type adjustable		
	H	Counter input, signal type adjustable		
65 .. Pulse counter reset	X	No effect	C6	148
	L	Sum counter is deleted and kept at 0		
	H	Sum counter released		
66 .. n-monitoring	X	No monitoring possible	E1	195
	L	Impulse input		
	H	Impulse input		
67 .. Parameter locked	X	Hardware parameter lock not active	F6	276
	L	Parameterization locked		
	H	Parameterization released		
75 .. 2nd motor	X	Motor 1 selected	B4	93
	L	Motor 1 selected		
	H	Motor 2 selected		
76 .. 2nd parameter set	X	1st parameter set selected	B2	69
	L	1st parameter set selected		
	H	2nd parameter set selected		
77 .. P15-set B	X	Use of the input dependent on B2.13 P15 activation	B2	69
	L	Selection corresponding to table P15 activation		
	H	Selection corresponding to table P15 activation		
78 .. P15-set C	X	Use of the input dependent on B2.13 P15 activation	B2	69
	L	Selection corresponding to table P15 activation		
	H	Selection corresponding to table P15 activation		
106 .. LFP input	X	LFP reference value is D1.40 "LFP min. value"	D1	159
	L	Frequency of the input signal is determined by LFP		
	H	Frequency of the input signal is determined by LFP		
107 .. Process fault 1	X	Input is considered as low, behaviour according to setting of E3.66 "Process fault 1 response"	E3	219
	L	Behaviour according to setting of E3.66		
	H	Behaviour according to setting of E3.66		
108 .. Process fault 2	X	Input is considered as low, behaviour according to setting of E3.73 "Process fault 2 response"	E3	219
	L	Behaviour according to setting of E3.73		
	H	Behaviour according to setting of E3.73		
109 .. Process fault 3	X	Input is considered as low, behaviour according to setting of E3.80 "Process fault 3 response"	E3	219
	L	Behaviour according to setting of E3.80		
	H	Behaviour according to setting of E3.80		

[1)] These signals are available on the terminals anyway even if it is switched over to bus operation.

D2.01	DI1 selection				1 .. Start FW (2 wire)
D2.02	DI2 selection				2 .. Start REV (2 wire)
D2.03	DI3 selection				0 .. Not used
D2.04	DI4 selection				0 .. Not used
D2.05	DI5 selection				0 .. Not used
D2.06	DI6 selection				0 .. Not used
D2.07	DI7 selection				0 .. Not used
D2.08	DI8 selection				0 .. Not used
D2.09	DI9 selection				0 .. Not used
D2.10	DI10 selection				0 .. Not used
D2.11	DI11 selection				0 .. Not used
D2.12	DI12 selection				0 .. Not used
D2.13	DI13 selection				0 .. Not used
D2.14	DI14 selection				0 .. Not used

0 ...Not used
1 ...Start FW (2 wire)
2 ...Start REV (2 wire)
3 ...Start FW (3 wire)
4 ...Start REV (3 wire)
5 ...Stop (3 wire)
6 ...Fast stop
7 ...Enable
11...f-ref reverse
14...Motor pot. +
15...Motor pot. -
16...Pre-set A
17...Pre-set B
18...Pre-set C
19...Pre-set D
22...f-reference 2 [Hz]
23...Control source 2
24...2nd ramp
25 .. Reference value B
26 .. Panel operation
29 .. External fault 1
30 .. External fault 2
31 .. Ext. reset
32 .. Emergency operation
35 .. PID-active
36 .. PID-lock
37 .. PID-wind up
40 .. Feed in pressure OK
41 .. Level OK
42 .. Level <
50 .. C. motor 1 ready
51 .. C. motor 2 ready
52 .. C. motor 3 ready
53 .. C. motor 4 ready
54 .. Start VSD cascade
56 .. Mains cut-off
57...ON lock
58...Locking
59...Feedb. motor cont.
60...Motor heating
64...Pulse counter input
65...Pulse counter reset
66...n-monitoring
67...Parameter locked
75...2nd motor
76...2nd parameter set
77...P15-set B
78...P15-set C
106.LFP input
107.Process fault 1
108.Process fault 2
109.Process fault 3

D2.15	DI at bus mode active	0110			0000

0 ...DI 1	☐ / ☑	7 .. DI 8	☐ / ☑
1 ...DI 2	☐ / ☑	8 .. DI 9	☐ / ☑
2 ...DI 3	☐ / ☑	9 .. DI 10	☐ / ☑
3 ...DI 4	☐ / ☑	10 .. DI 11	☐ / ☑
4 ...DI 5	☐ / ☑	11 .. DI 12	☐ / ☑
5 ...DI 6	☐ / ☑	12 .. DI 13	☐ / ☑
6 ...DI 7	☐ / ☑	13 .. DI 14	☐ / ☑

When the control source selection (see Matrix field E4, page 235) is used to switch between terminal and fieldbus operation it might be necessary to have individual digital input functions available on the terminals despite the fact that the control source has been switched to the field bus.

This exception from switch-over can be configured by the appropriate selection with parameter D2.15 "DI at bus mode active".

Example: control source switch-over

In this case the switch-over shall be made between the terminal and bus operation by means of the digital input DI4. Parameterization DI4: D2.04 "DI4 selection" = "23 .. Control source 2"

If the terminal operation is now switched to bus operation by means of digital input DI4 the terminal commands become ineffective !

This way, it will be impossible to switch into terminal operation with DI4 !

For this reason, the respective digital input in the parameter D2.15 "DI at bus mode active" must be marked for digital input commands that shall be effective both in the bus operation as well as the terminal operation.

If a free fieldbus Bit shall also be effective in terminal operation, it must be set by means of parameter D6.179 "STW1 at term.-mode act.".

If a control signal is configured both on a free bit at the bus as well as on the terminals which are active during bus operation, the bus command will be preferred.

The digital input signals "26 .. Panel operation", "31 .. Ext. reset" and "32 .. Emergency operation" are always active both in bus and in terminal operation and thus do not have to be added to the list D2.15 DI at bus mode active.

D2.18	DI invertation	0110			

0 .. DI 1	☐ / ☑	7 .. DI 8	☐ / ☑
1 .. DI 2	☐ / ☑	8 .. DI 9	☐ / ☑
2 .. DI 3	☐ / ☑	9 .. DI 10	☐ / ☑
3 .. DI 4	☐ / ☑	10 .. DI 11	☐ / ☑
4 .. DI 5	☐ / ☑	11 .. DI 12	☐ / ☑
5 .. DI 6	☐ / ☑	12 .. DI 13	☐ / ☑
6 .. DI 7	☐ / ☑	13 .. DI 14	☐ / ☑

With parameter D2.18 individual digital inputs can be inverted.

D3 Analog outputs

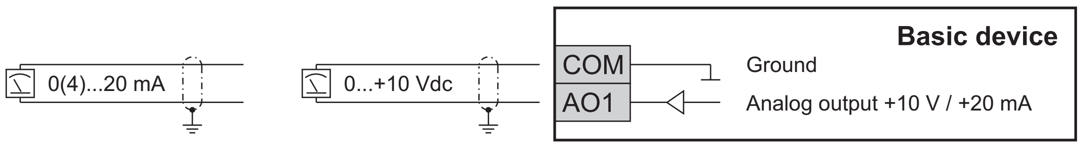
Configuration of the analog outputs and the pulse generator

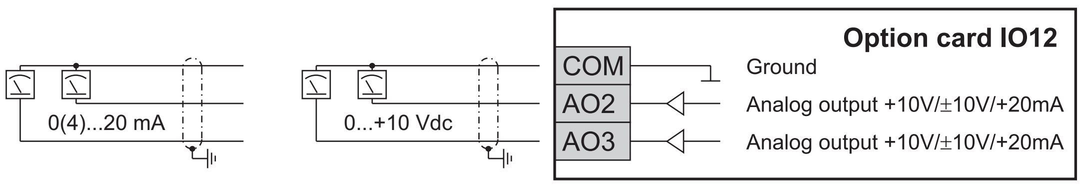
The >*pDRIVE*< *MX eco* provides three analog standardized signal outputs to forward analog information. The size to be issued, their scaling as well as the standardized signal to be used can be freely configured.

The following analog outputs are available at the >*pDRIVE*< *MX eco*:

Output	Standardized signal	Position	Terminal marking
AO1	0...+10 V, 0...20 mA or 4...20 mA	Basic device	AO1 COM
AO2	0...+10 V, -10...+10 V, 0...20 mA or 4...20 mA	Option >*pDRIVE*< *IO12*	AO2 COM
AO3	0...+10 V, -10...+10 V, 0...20 mA or 4...20 mA	Option >*pDRIVE*< *IO12*	AO3 COM

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.





Process size	Unit	Scaling
3 .. Actual frequency	Hz	–
4 .. |Actual frequency|	Hz	–
5 .. Motor current	%	100 % = Nominal motor current B4.06 (B4.18)
6 .. Torque	%	100 % = Nominal motor torque B4.05, B4.09 (B4.17, B4.21)
7 .. |Torque|	%	100 % = Nominal motor torque B4.05, B4.09 (B4.17, B4.21)
8 .. Power	%	100 % = Nominal motor power B4.05 (B4.17)
9 .. |Power|	%	100 % = Nominal motor power B4.05 (B4.17)
10 .. Speed	%	100 % = Nominal speed at f_{MAX} (C2.02)
11 .. |Speed|	%	100 % = Nominal speed at f_{MAX} (C2.02)
12 .. Motor voltage	%	100 % = Nominal voltage motor B4.07 (B4.19)
13 .. DC voltage	%	100 % = 1000 V DC
16 .. Int. f-ref. before ramp	Hz	–
17 .. Int. f-ref. after ramp	Hz	–
21 .. Int. ref. switch-over	% or Hz	–
22 .. Calculator	% or Hz	–
23 .. Curve generator	% or Hz	–
26 .. PID-reference val. [%]	%	–
27 .. PID-actual value [%]	%	–
28 .. PID-deviation [%]	%	–
29 .. PID-output	% or Hz	–
32 .. Thermal load M1	%	–
33 .. Thermal load M2	%	–
34 .. Thermal load VSD	%	–
35 .. Counter (average)	–	max. 6553.5 (counter value without unit)
36 .. Total counter	–	max. 6553.5 (counter value without unit)
37 .. Speed machine	rpm	–
42 .. Bus SW 1	% or Hz	–
43 .. Bus SW 2	% or Hz	–
44 .. Bus SW 3	% or Hz	–
45 .. Bus SW 4	% or Hz	–
46 .. Bus SW 5	% or Hz	–
47 .. Bus SW 6	% or Hz	–
48 .. Bus SW 7	% or Hz	–
49 .. Bus SW 8	% or Hz	–
50 .. Bus SW 9	% or Hz	–
58 .. AI 1	% or Hz	–
59 .. AI 2	% or Hz	–
60 .. AI 3	% or Hz	–
61 .. AI 4	% or Hz	–
62 .. Frequency input	% or Hz	–
63 .. Motor potentiometer	% or Hz	–
64 .. Pre-set reference	% or Hz	–
65 .. MX-wheel	% or Hz	–
66 .. LFP input	% or Hz	–

Analog output AO1

D3.01	AO1 selection				3 .. Actual frequency

0 ...Not used	16 .. Int. f-ref. before ramp	35...Counter (average)
3 ...Actual frequency	17 .. Int. f-ref. after ramp	36...Total counter
4 ...|Actual frequency|	21 .. Int. ref. switch-over	42...Bus SW 1
5 ...Motor current	22 .. Calculator	43...Bus SW 2
6 ...Torque	23 .. Curve generator	44...Bus SW 3
7 ...|Torque|	26 .. PID-reference val. [%]	45...Bus SW 4
8 ...Power	27 .. PID-actual value [%]	46...Bus SW 5
9 ...|Power|	28 .. PID-deviation [%]	47...Bus SW 6
10...Speed	29 .. PID-output	48...Bus SW 7
11...|Speed|	32 .. Thermal load M1	49...Bus SW 8
12...Motor voltage	33 .. Thermal load M2	50...Bus SW 9
13...DC voltage	34 .. Thermal load VSD	

Selection of the size to be displayed at the analog output.

Unlike the reference value distributor double assignments are possible here. If an analog signal is required twice (e.g. for display and acquisition of process data) two analog outputs can use the same selection.

D3.02	AO1 level				4 .. 4 ... 20 mA

1 ...0 ... 10V
3 ...0 ... 20 mA
4 ...4 ... 20 mA

D3.03	AO1 min. value				0 % or Hz

-300...300 % or Hz

D3.04	AO1 max. value				50 % or Hz

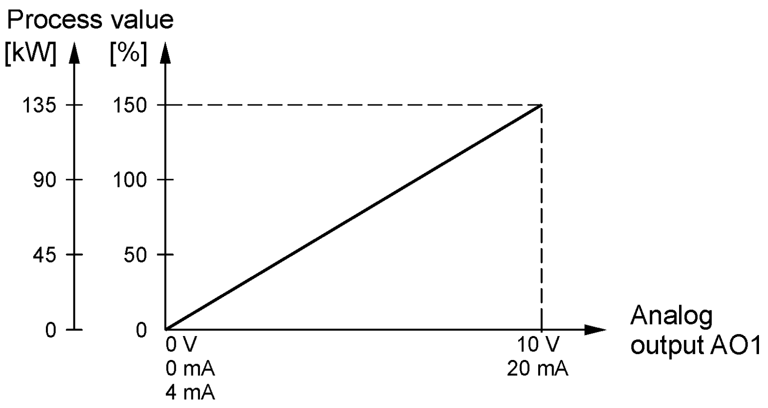
-300...300 % or Hz

The two parameters D3.03 "AO1 min. value" and D3.04 "AO1 max. value" are used for linear scaling of the analog output signal. D3.03 assigns according to the selection of the standardized signal D3.02 a process size to the minimum actual value signal (0 V, 0 mA or 4 mA), D3.04 assigns it to the maximum actual value signal (+10 V or 20 mA).

The scaling of the process size and their unit can be seen from the table analog outputs.

Setting example for a unipolar size at analog output AO1:

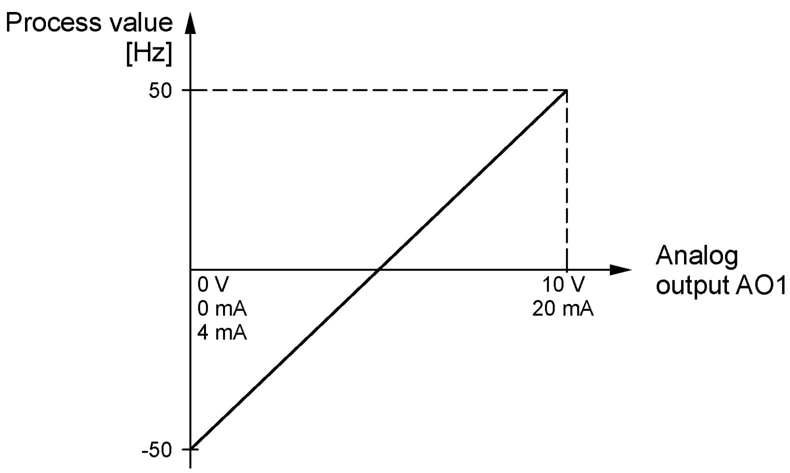
Process size	Scaling	D3.03 "AO1 min. value"	D3.04 "AO1 max. value"	Scaling of the output signal
9 .. |Power|	100 % = Nominal motor power (e.g. 90 kW)	0 %	150 %	20 mA at 150 % $P_{N\ Motor}$ = 135 kW



For process sizes with a possible overload such as power, torque etc. it is recommended to set AO1 max. value in such a way that a representation of the overload range is possible.

Settings example for a bipolar size at analog output AO1:

Process size	Scaling	D3.03 "AO1 min. value"	D3.04 "AO1 max. value"	Scaling of the output signal
3 .. Actual frequency	100 % = 100 Hz	-50 Hz	+50 Hz	4 mA at -50 Hz 20 mA at +50 Hz



D3.05	AO1 filter-time				0.1 s
	0...30 s				

During the measurement of dynamically changing values, such as current or torque, display problems may occur especially if digitally displaying instruments are used. The measured value can be stabilized by setting an appropriate filter time at the output filter.

At setting 0.0 seconds the filter is deactivated.

D3.06	AO1 value				V or mA

Display of the actual signal value of the analog output AO1 in V or mA.

Analog output AO2

D3.08	AO2 selection				0 .. Not used

0 ...Not used	16 .. Int. f-ref. before ramp	35...Counter (average)
3 ...Actual frequency	17 .. Int. f-ref. after ramp	36...Total counter
4 ...|Actual frequency|	21 .. Int. ref. switch-over	42...Bus SW 1
5 ...Motor current	22 .. Calculator	43...Bus SW 2
6 ...Torque	23 .. Curve generator	44...Bus SW 3
7 ...|Torque|	26 .. PID-reference val. [%]	45...Bus SW 4
8 ...Power	27 .. PID-actual value [%]	46...Bus SW 5
9 ...|Power|	28 .. PID-deviation [%]	47...Bus SW 6
10...Speed	29 .. PID-output	48...Bus SW 7
11...|Speed|	32 .. Thermal load M1	49...Bus SW 8
12...Motor voltage	33 .. Thermal load M2	50...Bus SW 9
13...DC voltage	34 .. Thermal load VSD	

Selection of the size to be displayed at the analog output.

Unlike the reference value distributor double assignments are possible here. If an analog signal is required twice (e.g. for display and acquisition of process data) two analog outputs can use the same selection.

D3.09	AO2 level				3 .. 0 ... 20 mA

1 ...0 ... 10V
2 ...± 10V
3 ...0 ... 20 mA
4 ...4 ... 20 mA

D3.10	AO2 min. value				0 % or Hz

-300...300 % or Hz

D3.11	AO2 max. value				100 % or Hz

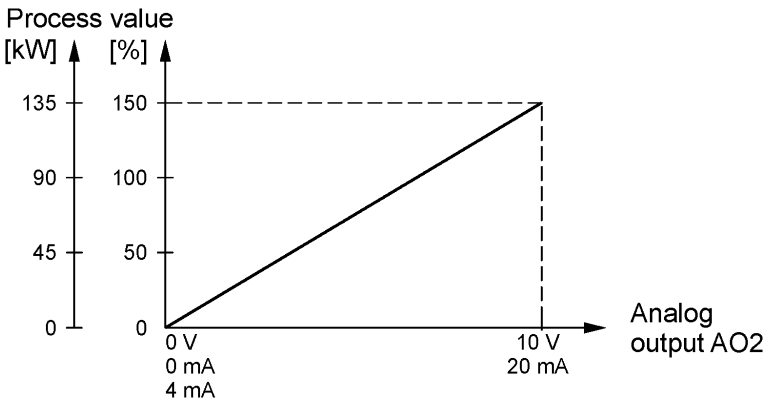
-300...300 % or Hz

The two parameters D3.10 "AO2 min. value" and D3.11 "AO2 max. value" are used for linear scaling of the analog output signal. D3.10 assigns according to the selection of the standardized signal D3.09 a process size to the minimum actual value signal (-10 V, 0 V, 0 mA or 4 mA), D3.11 assigns it to the maximum actual value signal (+10 V or 20 mA).

The scaling of the process size and their unit can be seen from the table analog outputs.

Setting example for a unipolar size at analog output AO2:

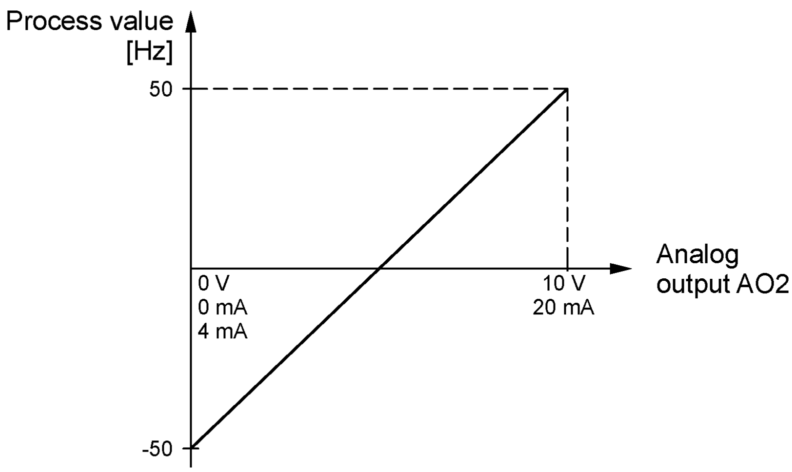
Process size	Scaling	D3.09 "AO2 level"	D3.10 "AO2 min. value"	D3.11 "AO2 max. value"	Scaling of the output signal
9 .. |Power|	100 % = Nominal motor power (e.g. 90 kW)	0 ... 10V, 0 ... 20 mA or 4 ... 20 mA	0 %	150 %	20 mA at 150 % $P_{N\ Motor}$ = 135 kW



For process sizes with a possible overload such as power, torque etc. it is recommended to set AO2 max. value in such a way that a representation of the overload range is possible.

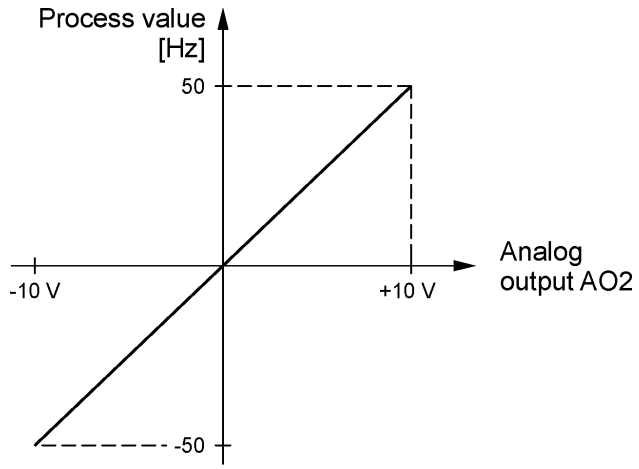
Settings example for a bipolar size at analog output AO2:

Process size	Scaling	D3.09 "AO2 level"	D3.10 "AO2 min. value"	D3.11 "AO2 max. value"	Scaling of the output signal
3 .. Actual frequency	100 % = 100 Hz	0 ... 10V, 0 ... 20 mA or 4 ... 20 mA	-50 Hz	+50 Hz	4 mA at -50 Hz 20 mA at +50 Hz



Settings example for a bipolar size at analog output AO2:

Process size	Scaling	D3.09 "AO2 level"	D3.10 "AO2 min. value"	D3.11 "AO2 max. value"	Scaling of the output signal
3 .. Actual frequency	100 % = 100 Hz	± 10V	-50 Hz	+50 Hz	-10V at - 50 Hz +10V at +50 Hz



D3.12	AO2 filter-time				0.1 s

0...30 s

During the measurement of dynamically changing values, such as current or torque, display problems may occur especially if digitally displaying instruments are used. The measured value can be stabilized by setting an appropriate filter time at the output filter.

At setting 0.0 seconds the filter is deactivated.

D3.13	AO2 value				V or mA

Display of the actual signal value of the analog output AO2 in V or mA.

Analog output AO3

D3.15	AO3 selection				0 .. Not used

0...Not used	16 .. Int. f-ref. before ramp	35...Counter (average)
3...Actual frequency	17 .. Int. f-ref. after ramp	36...Total counter
4...|Actual frequency|	21 .. Int. ref. switch-over	42...Bus SW 1
5...Motor current	22 .. Calculator	43...Bus SW 2
6...Torque	23 .. Curve generator	44...Bus SW 3
7...|Torque|	26 .. PID-reference val. [%]	45...Bus SW 4
8...Power	27 .. PID-actual value [%]	46...Bus SW 5
9...|Power|	28 .. PID-deviation [%]	47...Bus SW 6
10...Speed	29 .. PID-output	48...Bus SW 7
11...|Speed|	32 .. Thermal load M1	49...Bus SW 8
12...Motor voltage	33 .. Thermal load M2	50...Bus SW 9
13...DC voltage	34 .. Thermal load VSD	

Selection of the size to be displayed at the analog output.

Unlike the reference value distributor double assignments are possible here. If an analog signal is required twice (e.g. for display and acquisition of process data) two analog outputs can use the same selection.

D3.16	AO3 level				4 .. 4 ... 20 mA

1 ...0 ... 10V
2 ...± 10V
3 ...0 ... 20 mA
4 ...4 ... 20 mA

D3.17	AO3 min. value				0 % or Hz

-300...300 % or Hz

D3.18	AO3 max. value				100 % or Hz

-300...300 % or Hz

The two parameters D3.17 "AO3 min. value" and D3.18 "AO3 max. value" are used for lineal scaling of the analog output signal. D3.17 assigns according to the selection of the standardized signal D3.16 a process size to the actual value signal (-10 V, 0 V, 0 mA or 4 mA), D3.18 assigns it to the maximum actual value signal (+10 V or 20 mA).

The scaling of the process size and their unit can be seen from the table analog outputs.

Detailed setting examples can be found at the analog output AO2.

D3.19	AO3 filter-time				0.1 s

0...30 s

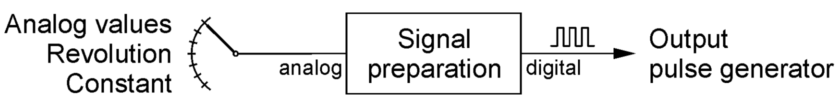
During the measurement of dynamically changing values, such as current or torque, display problems may occur especially if digitally displaying instruments are used. The measured value can be stabilized by setting an appropriate filter time at the output filter.

At setting 0.0 seconds the filter is deactivated.

D3.20	AO3 value				V or mA

Display of the actual signal value of the analog output AO3 in V or mA.

Pulse generator



The pulse generator (PG) creates a square-wave signal with a frequency that is proportional to an adjustable constant or a selectable analog value. Furthermore, it is possible to generate pulses depending on the current rotor position (rotational angle).

The output signal of the pulse generator can be further used by means of the function blocks or it is directly connected to further inverters or a superior PLC using the digital outputs DO1...DO4.

HTIU
8 P01 023 EN.04/04

D3.22	PG selection				0 .. Not active

0 ...Not active	17 .. Int. f-ref. after ramp	36...Total counter
1 ...Revolution	18 .. T reference value	42...Bus SW 1
2 ...Constant	19 .. T-limitation	43...Bus SW 2
3 ...Actual frequency	21 .. Int. ref. switch-over	44...Bus SW 3
4 ...|Actual frequency|	22 .. Calculator	45...Bus SW 4
5 ...Motor current	23 .. Curve generator	46...Bus SW 5
6 ...Torque	24 .. T ref. internal	47...Bus SW 6
7 ...|Torque|	26 .. PID-reference val. [%]	48...Bus SW 7
8 ...Power	27 .. PID-actual value [%]	49...Bus SW 8
9 ...|Power|	28 .. PID-deviation [%]	50...Bus SW 9
10...Speed	29 .. PID-output	55...Thermal load BR
11...|Speed|	32 .. Thermal load M1	56...T ref. after limitation
12...Motor voltage	33 .. Thermal load M2	
13...DC voltage	34 .. Thermal load VSD	
16...Int. f-ref. before ramp	35 .. Counter (average)	

Setting	Note
0 .. Not active	The pulse generator is not activated.
1 .. Revolution	The pulses are created depending on the adjustable rotational angle. The rotational angle is measured if an encoder exists. When there is no encoder is available, the encoder simulation (F2.51) can be used. $\text{PG output} = \frac{\text{D3.24}}{\text{D3.25}}$ pulses/revolution The pulse length is 20 % of the respective cycle duration, but at least 3 ms.
2 .. constant	The output frequency of the pulse generator is permanently defined by the two constants D3.24 and D3.25. $\text{Frequency PG output} = \frac{\text{D3.24}}{\text{D3.25}}\ [\text{Hz}]$ The pulse length is 20 % of the respective cycle duration, but at least 3 ms.
Settings 3...56 (analog values)	The output frequency of the pulse generator is determined proportionally to the chosen analog value considering the scaling set with parameters D3.26...D3.29. The pulse length can be set with parameters D3.24 and D3.25. The pulse length is $\frac{\text{D3.24}}{\text{D3.25}} \cdot \text{cycle duration}$ The factory presetting (D3.24 = 1, D3.25 = 2) leads to a pulse length of 50 % (duty cycle 1:1). The minimum pulse length is 3 ms, at most 90 % of the cycle duration.

D3.23	PG error correction				

0 ...Not active
1 ...Active

Because the output of pulses at the digital outputs is time limited with 1.5 ms, an error occurs depending on the value to be present (max. 8 % of the size to be present).

When parameter D3.23 is activated, the error is continuously added and corrected in one of the next pulses.

D3.24	PG const. value MUL				
	1...10000				

D3.25	PG const. value DIV				
	1...10000				

The two constants are used as factors for calculation of the rotational angle, the output frequency or the pulse length (see parameter D3.22).

D3.26	PG output min.				Hz
	0...100 Hz				

D3.27	PG output max.				Hz
	0...100 Hz				

Parameters D3.26 and D3.27 are only of importance when an analog value is selected under D3.22.

They define the output frequency range of the pulse generator. The minimum output value should not be set lower than 10 Hz because otherwise the time resolution is too low.

D3.28	PG input min.				
	-300...300 % or Hz				

D3.29	PG input max.				
	-300...300 % or Hz				

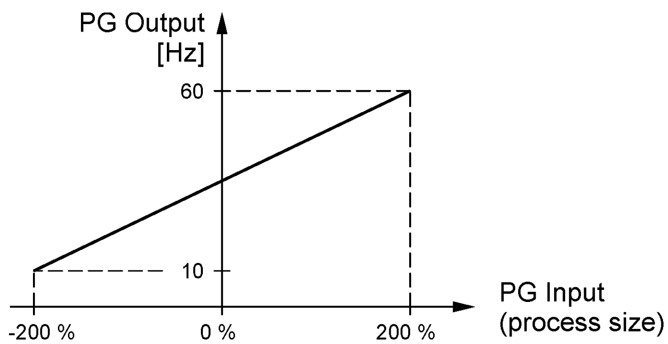
Parameters D3.28 and D3.29 are only of importance when an analog value is selected under D3.22.

By means of these two parameters the output frequency of the pulse generator is scaled linear depending on the selected input value.

D3.28 "PG input min." assigns a value to the minimum output frequency D3.26, D3.29 "PG input max." to the maximum output frequency D3.27.

Setting example for the pulse generator PG:

Process size	Scaling	Parameter setting	Scaling of the output signal
6 .. Torque	100 % = Nominal motor power (e.g. 90 kW)	D3.26 PG output min.= 10 Hz D3.27 PG output max. = 60 Hz D3.28 PG input min. = -200 % D3.29 PG input max. = 200 %	-200 % = 10 Hz, +200 % = 60 Hz



The function of the pulse generator has a multi-functional range of use such as:

- transmission of a second analog value without using the option card IO12 (also see frequency input LFP in chapter D1, page 159)
- instead of initiator pulses at the motor or gear shaft
- speed-dependent counting of piece goods in combination with the pulse counter

Digital outputs DO

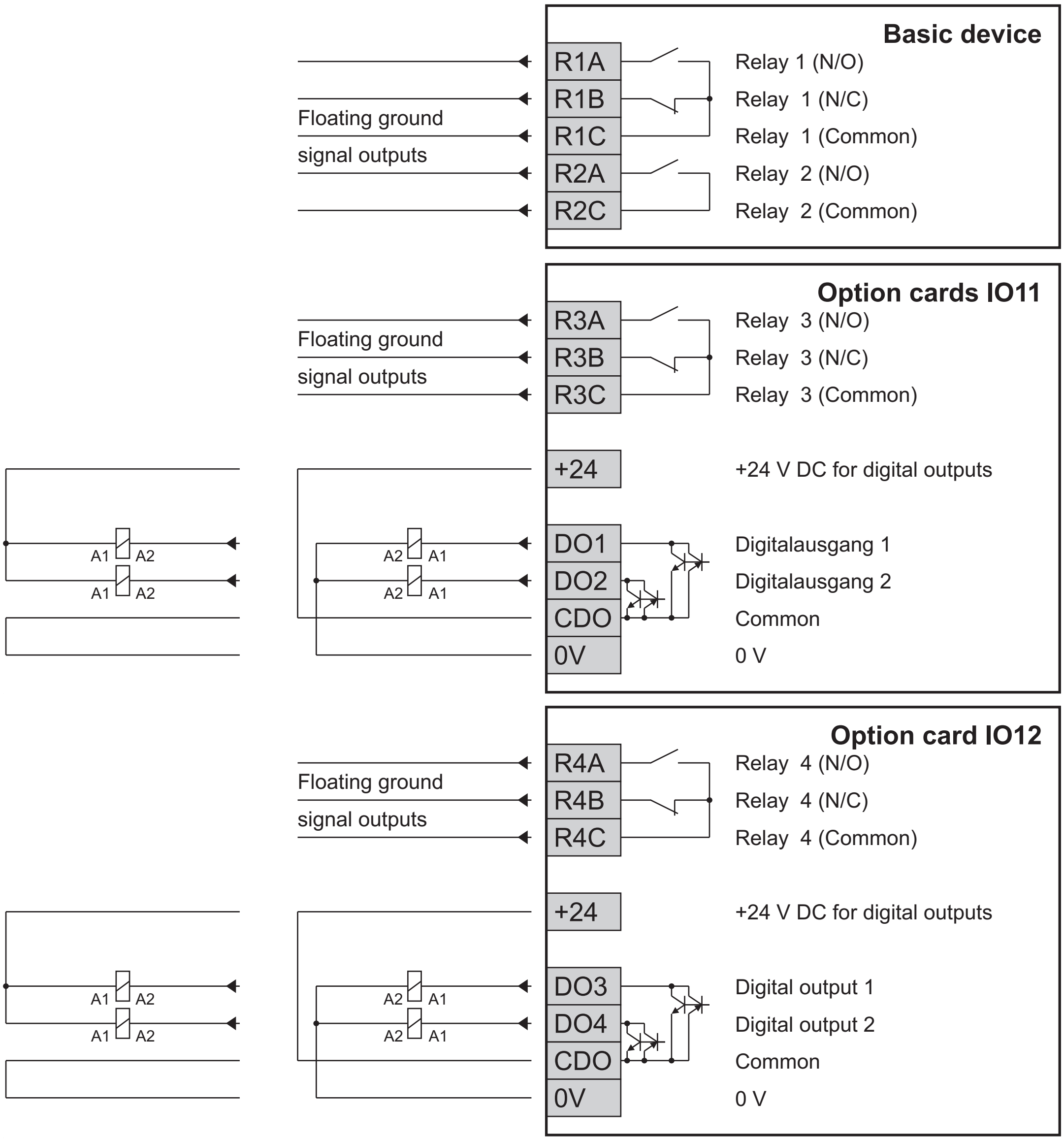
The digital status information on the inverter or the process that are available in the *>pDRIVE< MX eco* can be issued as messages by means of digital outputs. Floating ground relays and digital outputs with selectable sink/source-characteristics are available.

The signal assignment as well as an inversion of the individual outputs can be freely configured.

The following digital outputs are available at the *>pDRIVE< MX eco*:

Output	Type of output	Position	Terminal marking	Comment
R1	Floating ground relay (N.O./N.C.)	Basic device	R1A R1B R1C	
R2	Floating ground relay (N.O.)	Basic device	R2A R2B	
R3	Floating ground relay (N.O./N.C.)	Option *>pDRIVE< IO11*	R3A R2B R3C	
DO1	Open Collector output	Option *>pDRIVE< IO11*	DO1 CDO	Sink/Source selectable
DO2	Open Collector output	Option >pDRIVE< IO11	DO1 CDO	
R4	Floating ground relay (N.O./N.C.)	Option *>pDRIVE< IO12*	R3A R2B R3C	
DO3	Open Collector output	Option *>pDRIVE< IO12*	DO3 CDO	Sink/Source selectable
DO4	Open Collector output	Option *>pDRIVE< IO12*	DO4 CDO	

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.



The 24 V voltage from the frequency inverter has a maximum load of 200 mA.

Digital output function	Relay is active ... / digital output active	Reference	
		Matrix field	Page
0 .. Not used	...never	–	–
1 .. Ready	...if there is no failure, the DC link is charged, but the device is not in operation. At active line contactor control the status Ready applies already at available buffer voltage. There is no Ready state in case of: – active ON-lock – active 2-wire edge control and active ON command after trip reset – external motor contactor control without motor	–	–
2 .. Operation	...after the start command has been accepted, during controlled deceleration as well as during active standby mode (standby or feed-in monitoring). Active motor heating is not classified as status Run.	–	–
3 .. Ready / run	...in case of Ready or Run status.	–	–
4 .. Trip	...until an occurring fault is reset. No message is issued for faults that were reset by the Autoreset function.	–	–
5 .. Sum alarm	...as long as a parameterized alarm situation is given.	–	–
6 .. Motor turns	...if the output frequency exceeds 0.5 Hz and simultaneous current flow (> 20 % $I_{N\ Motor}$)	–	–
7 .. f = f ref	...as soon as the frequency actual value corresponds with the reference value. Hysteresis 0.5 Hz	–	–
8 .. Generator operation	...if the motor operates as a generator.	–	–
11 .. Shut down	...if the stop command has been accepted until the status Ready is reached.	–	–
12 .. Panel mode active	...as soon as the drive is in panel operating mode (operated via the LED-keypad or the removable Matrix operating panel).	E5	239
13 .. Motor 1 active	...as long as the 1st set of motor data is used.	B4	93
14 .. Motor 2 active	...as long as the 2nd set of motor data is used.	B4	93
15 .. Param.-set 1 active	...as long as the 1st set of application parameters is used.	B2	69
16 .. Param.-set 2 active	...as long as the 2nd set of application parameters is used.	B2	69
19 .. Safe standstill active	...if the status Safe Standstill has been reached.	–	–
20 .. Limitation active	...as long as a parameterized limitation function is active.	–	–
24 .. Motor heating active	... if the function motor heating is active.	C6	148
25 .. Motorfluxing active	...in case of active prefluxing phase.	B3	84
27 .. DC link charged	...if the charging process of the DC link is completed.	C6	148
28 .. Line Contactor ON	...if the line contactor shall be turned on by the activated contactor control.	C6	148
29 .. Motor contactor ON	...if the motor contactor shall be turned on by the activated motor contactor control.	C6	148
30 .. C. motor 1 ON	...if the cascade drive 1 shall be turned on by the cascade control.	C3	125

Digital output function	Relay is active ... / digital output active	Reference	
		Matrix field	Page
31 .. C. motor 2 ON	...if the cascade drive 2 shall be turned on by the cascade control.	C3	125
32 .. C. motor 3 ON	...if the cascade drive 3 shall be turned on by the cascade control.	C3	125
33 .. C. motor 4 ON	...if the cascade drive 4 shall be turned on by the cascade control.	C3	125
36 .. Alarm category 1	...as long as at least one alarm assigned to category 1 is active.	E3	219
37 .. Alarm category 2	...as long as at least one alarm assigned to category 2 is active.	E3	219
38 .. Alarm category 3	...as long as at least one alarm assigned to category 3 is active.	E3	219
41 .. Output T1	...if the output of the time module T1 becomes logical high.	E6	243
42 .. Output T2	...if the output of the time module T2 becomes logical high.	E6	243
43 .. Output T3	...if the output of the time module T3 becomes logical high.	E6	243
44 .. Output T4	...if the output of the time module T4 becomes logical high.	E6	243
45 .. Output T5	...if the output of the time module T5 becomes logical high.	E6	243
46 .. Output T6	...if the output of the time module T6 becomes logical high.	E6	243
54 .. Bus STW bit 11	...if the free bit 11 of the bus control word 1 is high.	D6	193
55 .. Bus STW bit 12	...if the free bit 12 of the bus control word 1 is high.	D6	193
56 .. Bus STW bit 13	...if the free bit 13 of the bus control word 1 is high.	D6	193
57 .. Bus STW bit 14	...if the free bit 14 of the bus control word 1 is high.	D6	193
58 .. Bus STW bit 15	...if the free bit 15 of the bus control word 1 is high.	D6	193
61 .. Digital input DI1	...if the digital input DI1 is active.	D2	169
62 .. Digital input DI2	...if the digital input DI2 is active.	D2	169
63 .. Digital input DI3	...if the digital input DI3 is active.	D2	169
64 .. Digital input DI4	...if the digital input DI4 is active.	D2	169
65 .. Digital input DI5	...if the digital input D5 is active.	D2	169
66 .. Digital input DI6	...if the digital input DI6 is active.	D2	169
67 .. Digital input DI7	...if the digital input DI7 is active.	D2	169
68 .. Digital input DI8	...if the digital input DI8 is active.	D2	169
69 .. Digital input DI9	...if the digital input DI9 is active.	D2	169
70 .. Digital input DI10	...if the digital input DI10 is active.	D2	169
71 .. Digital input DI11	...if the digital input DI11 is active.	D2	169
72 .. Digital input DI12	...if the digital input DI12 is active.	D2	169
73 .. Digital input DI13	...if the digital input DI13 is active.	D2	169
74 .. Digital input DI14	...if the digital input DI14 is active.	D2	169
76 .. Pulse generator	...according to the frequency of the output signal of the pulse generator.	D3	177

D4.01	R1 selection				3 .. Ready / run
D4.02	R2 selection				0 .. Not used
D4.03	R3 selection				0 .. Not used
D4.04	DO1 selection				0 .. Not used
D4.05	DO2 selection				0 .. Not used
D4.06	R4 selection				0 .. Not used
D4.07	DO3 selection				0 .. Not used
D4.08	DO4 selection				0 .. Not used

0 ...Not used	27 .. DC link charged	57.. Bus STW bit 14
1 ...Ready	28 .. Line Contactor ON	58.. Bus STW bit 15
2 ...Operation	29 .. Motor contactor ON	61.. Digital input DI1
3 ...Ready / run	30 .. C. motor 1 ON	62.. Digital input DI2
4 ...Trip	31 .. C. motor 2 ON	63.. Digital input DI3
5 ...Sum alarm	32 .. C. motor 3 ON	64.. Digital input DI4
6 ...Motor turns	33 .. C. motor 4 ON	65.. Digital input DI5
7 ...f = f ref	36 .. Alarm category 1	66.. Digital input DI6
8 ...Generator operation	37 .. Alarm category 2	67.. Digital input DI7
11...Shut down	38 .. Alarm category 3	68.. Digital input DI8
12...Panel mode active	41 .. Output T1	69.. Digital input DI9
13...Motor 1 active	42 .. Output T2	70.. Digital input DI10
14...Motor 2 active	43 .. Output T3	71.. Digital input DI11
15...Param.-set 1 active	44 .. Output T4	72.. Digital input DI12
16...Param.-set 2 active	45 .. Output T5	73.. Digital input DI13
19...Safe standstill active	46 .. Output T6	74.. Digital input DI14
20...Limitation active	54 .. Bus STW bit 11	76.. Pulse generator
24...Motor heating active	55 .. Bus STW bit 12	
25...Motorfluxing active	56 .. Bus STW bit 13	

D4.11	DO invertation	0110			

0 .. R 1	☐ / ☑	4 .. DO 2	☐ / ☑
1 .. R 2	☐ / ☑	5 .. R 4	☐ / ☑
2 .. R 3	☐ / ☑	6 .. DO 3	☐ / ☑
3 .. DO 1	☐ / ☑	7 .. DO 4	☐ / ☑

If a selected signal is required in inverted form it can be set with the parameter D4.11 "DO invertation" for every relay or digital output separately.

D6	BUS	Fieldbus	Settings of the serial communication properties

The parameter description of the different fieldbuses is given in the respective fieldbus documentation.

HTIU

8 P01 023 EN.04/04

E		System	Functions for limitation, protection and optimization of the system

E1		Process protection	Limitations, skip frequencies, speed monitoring, feed-in monitoring

Current limitation

E1.01	I max 1				135 %

10...135 %

This parameter defines the maximum current overload capacity in % of the nominal inverter current. The value is to be set to the maximum current desired/permitted by the user. The set value also limits the overload states permitted for a brief period of time.

Also see chapter "Technical data" in the product catalogue or the operating instructions.

E1.03	Inverter temp. model				1 .. Active

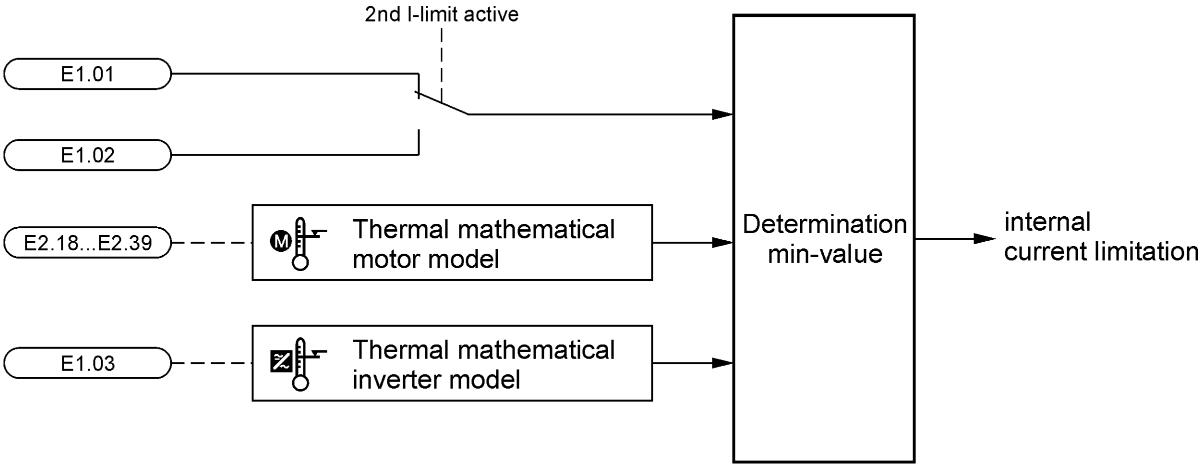
0 ...Not active
1 ...Active

In order to protect the inverter and all its electric components against thermal damage, the maximum permitted overload is time-limited. In case of an impermissibly long device overload, depending on the process requirements either a fault shut-down of the drive with "Inverter overtemp." takes place or the inverter current limitation is automatically reduced to 100 % (nominal inverter current).

Setting	Behaviour if the inverter overload model triggers
1 .. Not active	The drive shuts down with the trip message "Inverter overtemp.".
2 .. Active	The drive reduces (limits) the output current to the value of the inverter nominal current.

The use of a current limitation makes sense only in case of applications with quadratic load torque. Thereby the load reduces the motor speed if the current limitation triggers. If the load torque drops together with the speed (pumps, fan,...), the load is thus reduced and a new, more stable operating point is set. In case of constant counter-torques, on the other hand, a standstill of the motor takes place.

If the thermal capacity of the inverter continues to increase to 100 % despite a reduction in current (e.g. due to a high ambient/coolant temperature or defective power part fan), the drive reacts with a protective shut-down and the message "Inverter overtemp.".



Torque/Power limitation

The torque/power limitation protects the motor or its downstream components against high mechanical stress. The torque on which it is based is determined from the inverter-internal variables active current and magnetic flux.

The torque is not proportional to the motor current !

The limitation is entered in % of the nominal motor torque. If the maximum permissible torque is reached, the speed will deviate from its reference value according to the mechanical load. The behaviour of the drive in case of active limitation is adjustable (see E1.17 "Reaction at limitation").

If the torque limitation is used, no V/f control modes should be applied because the torque is only available with sufficient accuracy in case of field-orientated control methods.

E1.05	T limit motor				300 %
	10...300 %				

The torque limitation protects the motor or downstreamed components against too high mechanical loads. The torque which forms the basis for this function is determined from the internal values active current and magnetic flux.

The torque is not proportional to the motor current !

The entry of the limitation occurs in % of the nominal motor torque. If the maximum allowed torque is reached, the speed deviates from its reference value corresponding to the mechanical load. The behaviour of the drive in case of active limitation is adjustable (see E1.17 "Reaction at limitation").

If the torque limitation is used no V/f control modes should be applied because the torque is only available with sufficient accuracy in case of field-orientated control models

E1.13	P max. motor				300 %
	10...300 %				

The power of the drive results from the two variables speed and torque. If an application should be protected against too high power consumption, the power limitation can be used. The entry occurs in % of the nominal inverter power. If the power reaches the maximum allowed value, a corresponding correction by the torque takes place.

In connection with the V/f control models the function is only conditionally applicable !

Behaviour at limitations

E1.17	Reaction at limitation				1 .. Limitation allowed
	1 ...Limitation allowed 2 ...Limitation & alarm 3 ...Limit. & alarm/trip 4 ...Limitation & trip				

The events torque > T_{MAX}, current > I_{MAX} and motor temperature > level (calculator) can effect a limitation of the drive during running process. The operating behaviour of the drive in case of active limitation must be analysed.

Though the limitation prevents a protective shut-down of the drive, but mostly combined with a speed reduction. Either this can be a desired behaviour (e.g. abrupt pressure rise in a pumping station) or it can lead to problems in the further process (e.g. loss of oil at screw-type compressors).

Depending on the process demands one of the following behaviours in case of limitation can be selected:

Setting	Behaviour in case of limitation
1 .. Limitation allowed	Limitation allowed, no further reaction
2 .. Limitation & alarm	Limitation allowed, delayed alarm message
3 .. Limit. & alarm/trip	Limitation allowed, alarm message is set immediately, delayed trip shut-down is triggered (if limitation is still active)
4 .. Limitation & trip	Limitation allowed, delayed trip shut-down (if the delay time is set to 0 s the trip shut-down occurs immediately)

If limitations occur during acceleration, check if they can be prevented by adapting the acceleration/deceleration ramps (see Matrix field C2, page 120) or by releasing the motor brake (B5, page 98).

If a torque- or power-limited operation of the drive is planned, parameter E1.17 has to be set to "1 .. "Limitation allowed" !

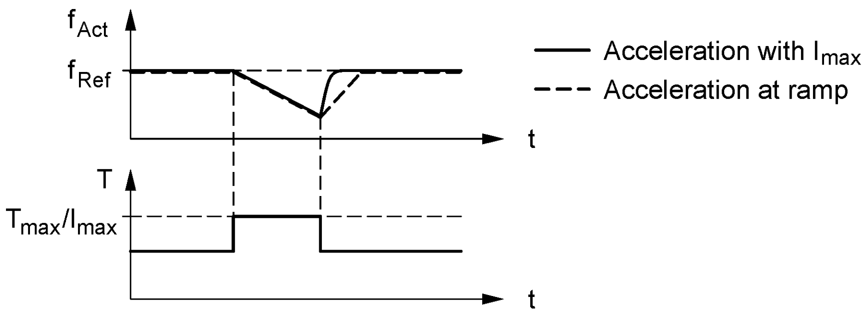
E1.18	Time Δt				0 s
	0...300 s				

Time adjustment of the desired reaction.

E1.19	Ref. after acc. extension				2 .. ACC with Imax

1 ...ACC at ramp
2 ...ACC with Imax

An active limitation leads to a deviation of the speed from its reference value. If the limitation ceases to apply the drive can resume the speed according to the reference value. Thereby you can choose between operation with the ramp or speed adjustment as quickly as possible (at the current limit).



E1.21	Reaction at deceleration				1 .. Ramp adaption

1 ...Ramp adaption
2 ...Extend & alarm
3 ...Extend & alarm/trip
4 ...Extend & trip

During deceleration of a drive the kinetic energy, which is stored in the inertias, is released and must be braked. The braking power depends primary on the desired deceleration time of the drive.

If the selected deceleration ramp is too short, the motor changes to generator operation and supplies energy to the DC link of the inverter. The deceleration time is automatically extended in order to avoid damage of the device due to too high DC link voltage. Therefore the actual deceleration time differs from the set deceleration ramp !

However, if an automatic extension of the deceleration time leads to problems (e.g. because of safety reasons) the drive must be switched off.

Depending on the process demands one of the following variants can be selected:

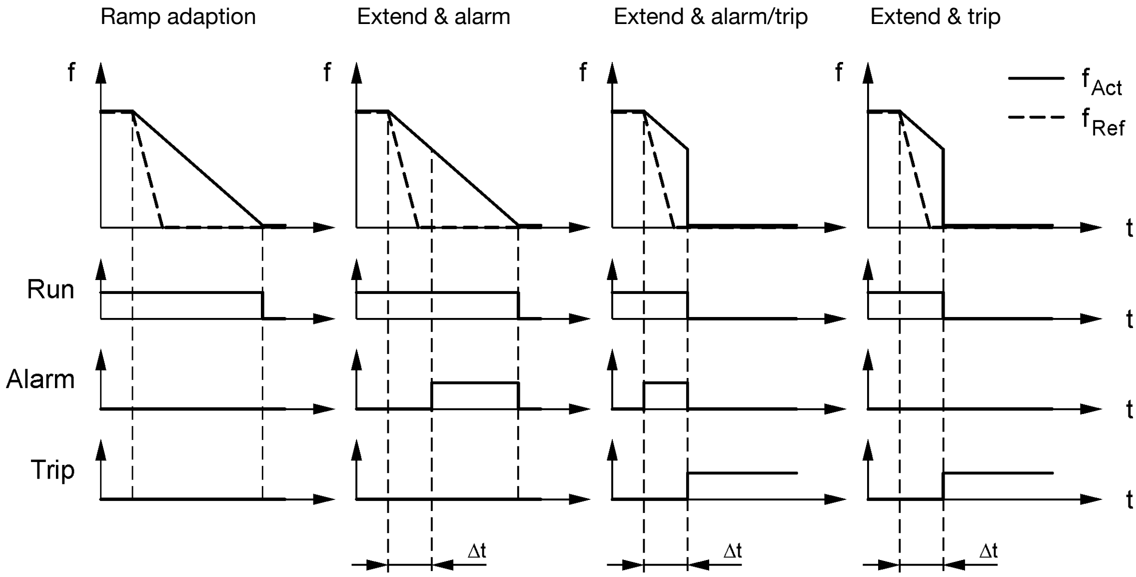
Setting	Behaviour if the deceleration ramp is too short
1 .. Ramp adaption	Extend deceleration ramp, no further reaction
2 .. Extend & alarm	Extend deceleration ramp and delayed alarm message occurs
3 .. Extend & alarm/trip	Extend deceleration ramp, alarm message is set immediately, delayed trip shut-down takes place (if the drive is still running)
4 .. Extend & trip	Extend deceleration ramp, delayed trip shut-down takes place (if the delay time is set to 0 s the trip shut-down occurs immediately)

The deceleration behaviour can be influenced by adjusting the deceleration ramp (see matrix field C2, page 120) and by enabling the motor brake (see matrix field B5, page 98).

E1.22	Time Δt				5 s

0...300 s

Time adjustment of the desired reaction.



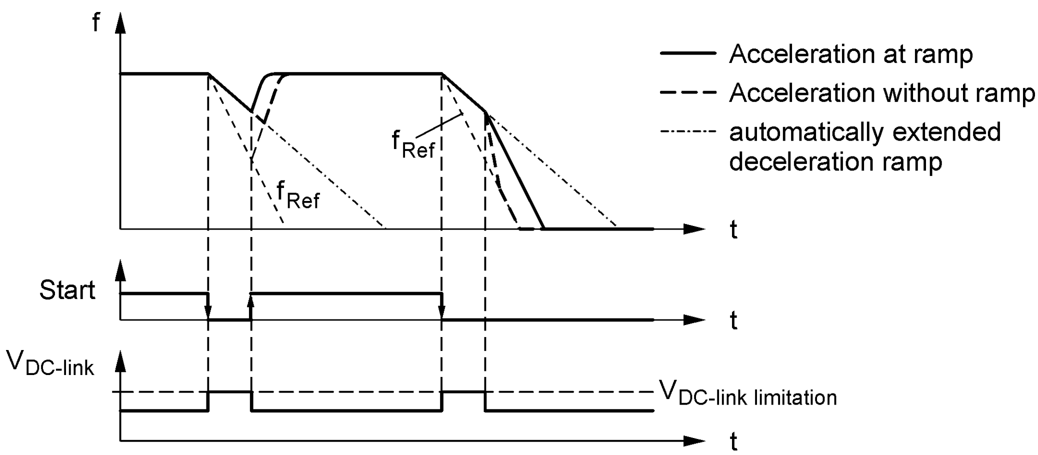
E1.23	Ref. after dec. extension				2 .. Dec. without ramp

1 ...Dec. at ramp
2 ...Dec. without ramp

Parameter E1.23 determines the behaviour of the frequency inverter if the limitation ceases during automatic extension of deceleration.

Depending on the process demands one of the following variants can be selected.

Setting	Behaviour after limitation
1 .. Dec. at ramp	The internal frequency reference value is tracked to the speed that is changed by the automatic ramp adaptation. After intervention of limitation the speed changes according to the set acceleration/deceleration ramps again.
2 .. Dec. without ramp	The internal frequency reference value is not tracked to the speed that is changed by the automatic ramp adaptation. After intervention of limitation the drive further decelerates at the voltage limit (without ramp). But if the drive changes to acceleration, it accelerates according to the ramp function generator after short time-delay.

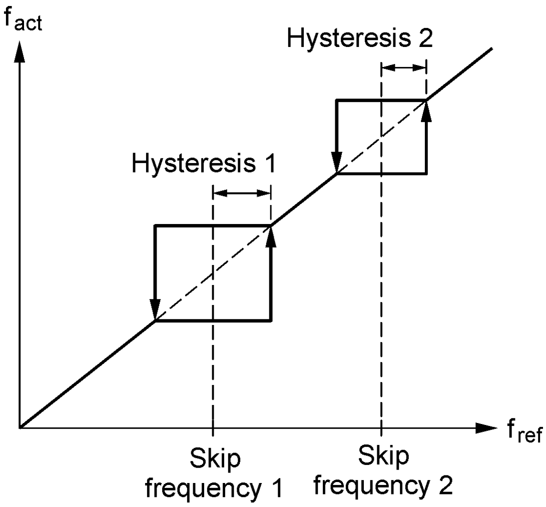


Skip frequencies

E1.25	Skip frequency 1				0 Hz
E1.27	Skip frequency 2				0 Hz
E1.29	Skip frequency 3				0 Hz
E1.31	Skip frequency 4				0 Hz
	-300...300 Hz				

E1.26	Hysteresis 1				0 Hz
E1.28	Hysteresis 2				0 Hz
E1.30	Hysteresis 3				0 Hz
E1.32	Hysteresis 4				0 Hz
	0...10 Hz				

For drives with speed-dependent resonance problems (e.g. noises in ventilation systems) the function "Skip frequency" prevents the static operation in relevant frequency range.



The skip frequency is set according to the frequency of the determined point of resonance. The hysteresis, which acts symmetrically to the skip frequency, has to be set according to the band width.

Up to four different skip areas can be defined for the operation of complex plants with multifarious configuration.

The skip frequencies have to be set separately for both rotational directions.

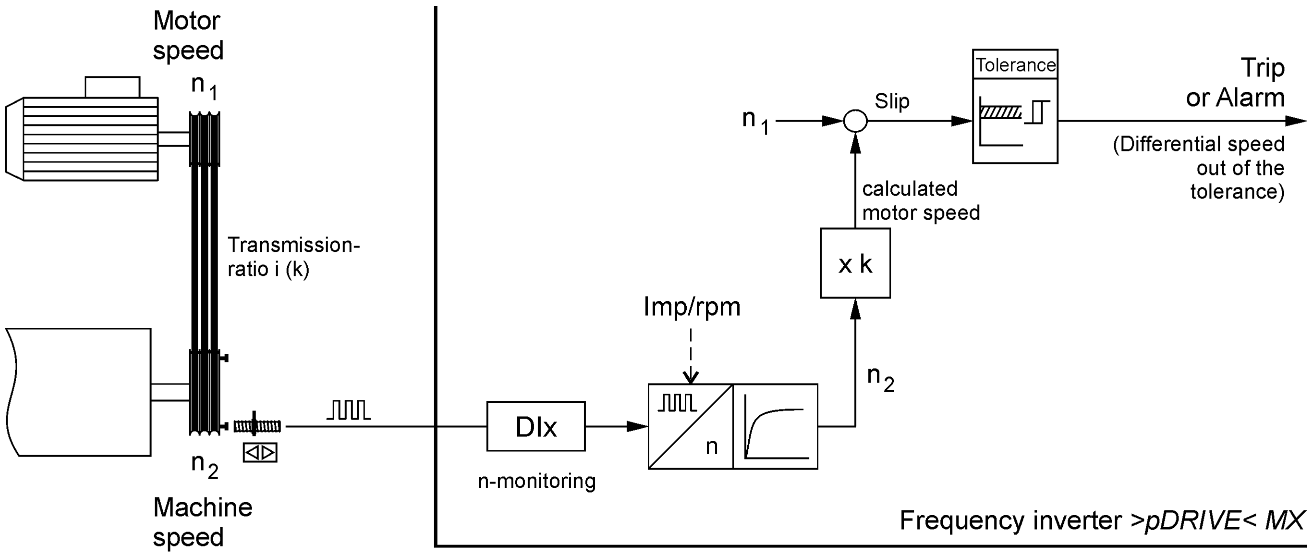
If a hysteresis is set to zero Hz it is not effective.

Speed monitoring

Between motor and machine varied mechanical transmission systems can be found. Gears, V-, flat- or toothed belts, drive shafts, different couplings etc. In many cases it is necessary to integrate these transmission elements into the monitoring and protection concept of the drive.

The speed check at the shaft of the gear box displays the usual method for this purpose. As a result the speed is determined with a simply mounted inductive pulse generator and a frequency meter downstream. These can, subject to possible transformation ratios, be compared with the speed of the motor.

The impulses of the inductive sensor can be conducted directly to a digital input of the *>pDRIVE< MX eco* with the function "n-monitoring".



E1.38	n-monitoring				0 .. Not active

0 ...Not active
1 ...Active

E1.39	Pulse / rotation				2

0...100

It is necessary to know the number of pulses per rotation to determine the speed. Typical are about 2...5 pulses/rotation.

The minimum pulse length is 2 ms.

Thereby the maximum input frequency of 250 Hz should not be exceeded.

E1.40	Filter-time				2 s

0...300 s

In case of slow rotating systems with low number of pulses time fluctuations of the actual value calculation occur. Adapting the filter time brings about remedy.

E1.41	Detected speed				rpm

Display of the determined output speed. The display repetition corresponds to the set filter time.

E1.42	Ratio factor				1

0...10

If the motor speed and the output speed are not identical, the transmission ratio has to be entered in parameter E1.42.

$$\text{Ratio factor} = \frac{\text{Motor speed}}{\text{Output speed}}$$

E1.43	Calculated slip				rpm

The speed difference between calculated motor speed and measured output speed is displayed. The determined slip value is used for further trip diagnostics.

E1.44	Tolerance				10 rpm

0...500 rpm

E1.45	n-monitoring response				2 .. Alarm -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E1.46	Time Δt				10 s

0...300 s

If the difference between the motor speed and the output speed which is determined by means of the initiator pulses (after evaluation with the correction factor) exceeds the allowed tolerance, a protective function must intervene to protect the drive.

Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour if the max. allowed slip is exceeded
1 .. -Δt- alarm	If the slip limit is exceeded, the alarm message "Speed check fault" occurs after an adjustable delay.
2 .. Alarm -Δt- fault	If the slip limit is exceeded, the alarm message occurs immediately. After an adjustable delay a fault shut-down with the message "Speed check fault" takes place if the state is still unchanged.
3 .. -Δt- fault	If the slip limit is exceeded a fault shut-down with the message "Speed check fault" takes place after an adjustable delay.

8 P01 023 EN.04/04

Feed-in monitoring

E1.49	Feed-in monitoring				0 .. Not active

0 ...Not active
1 ...Pressure monitoring
2 ...Level monitoring

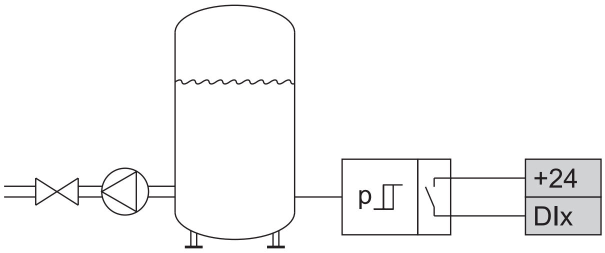
An inflow pressure that is too low can lead to cavitation problems up to dry running of centrifugal pumps. The protection function "Feed-in monitoring" recognises this risk and initiates a corresponding protection method.

The acquisition can occur in two different ways as described subsequently.

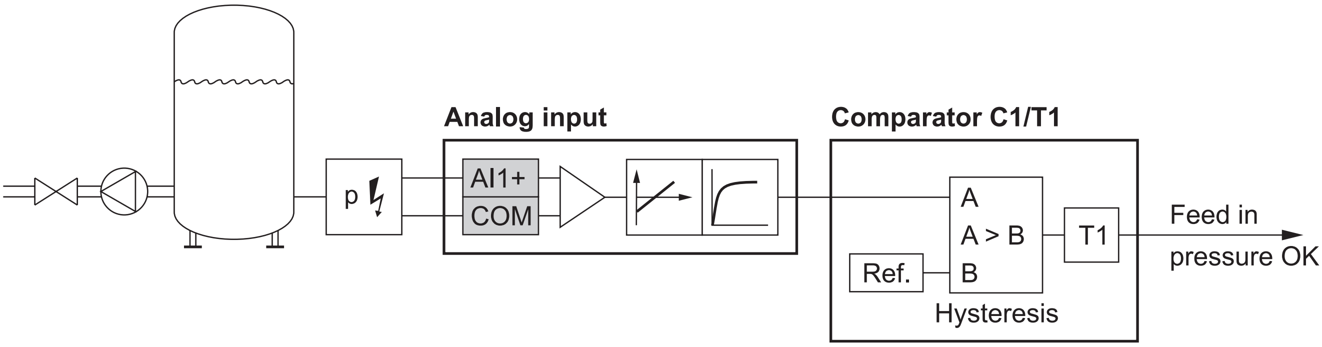
Pressure monitoring

With the pressure monitoring the feed-in pressure to the pump has to be registered with a suitable sensor. A pressure sensor with switching output and hysteresis function (link to the digital input "Feed in pressure OK") or an analog output signal of a pressure sensor (standard signal 0...10 V, 0(4)...20 mA) can be used.

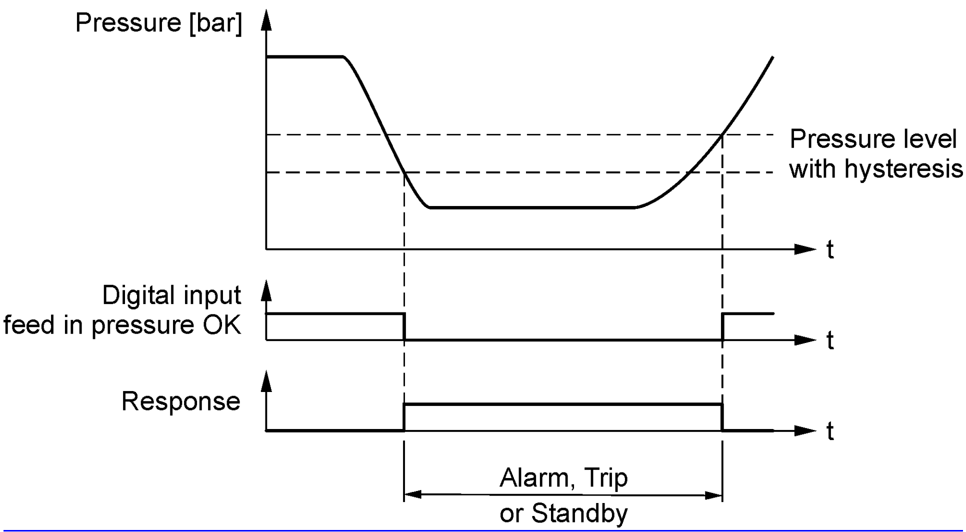
Pressure sensor with switching output



Pressure sensor with analog output signal



By using an analog measurement signal the switchpoint is generated by means of the comparator functions (see matrix field E6, page 243) and an analog input. If the minimum allowed feed-in pressure falls short, the protection function "Feed-in monitoring" is triggered.

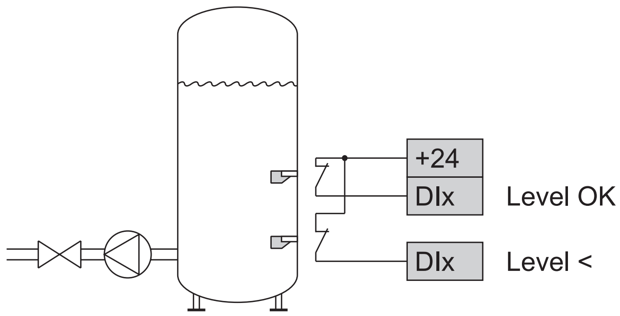


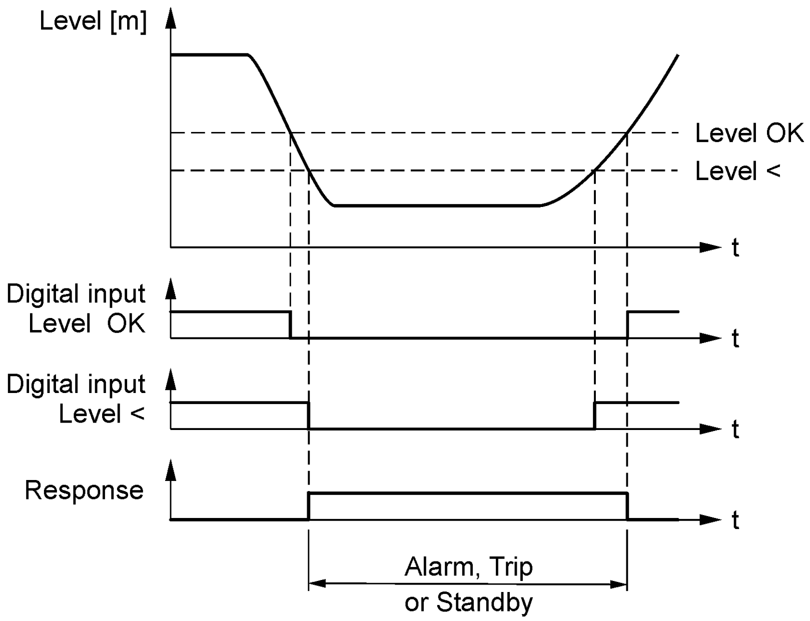
Example for adjusting a combination of comparators

Parameter		Setting
E6.01	Comparator C1	1 .. Active
E6.02	C1 signal A selection	59 .. AI 2
E6.03	C1 signal A filter-time	0.3 s
E6.04	C1 signal B selection	0 .. Ref. value
E6.05	C1 ref. value	30 %
E6.06	C1 signal B filter-time	0.3 s
E6.07	C1 function	1 .. A > B
E6.08	C1 hysteresis/band	10 %
E6.109	Time module 1	1 .. Active
E6.110	T1 signal A selection	80 .. Output C1
E6.111	T1 function	3 .. ON & OFF delayed
E6.112	T1 Time Δt	0.5 s
E6.114	T1 selection	40 .. Feed in pressure OK

Level monitoring

The level monitoring is selected if two levels are measured by means of pressure controllers, level switches, float switches and the like. The measured levels can be supplied to the inverters via the digital inputs "Level OK" and "Level <".





E1.50	Feed in mon. reaction				2 .. Alarm -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault
4 ...Alarm -Δt- standby

E1.51	Time Δt				30 s

0...300 s

The feed-in monitoring can be used as a protective function with adjustable alarm and trip behaviour or for automatic switch over of the drive to standby-mode.

Thereby the drive is automatically switched off if the pressure falls below a minimum value or the "Level <" is reached. If the feed-in pressure exceeds the hysteresis value or if the digital input "Level OK" is activated, the drive automatically restarts.

During standby-mode the inverter remains in "Run" state.

HTIU
8 P01 023 EN.04/04

Depending on the process demands one of the following reactions for triggered feed-in monitoring can be selected:

Setting	Behaviour after trigger of the function feed-in monitoring
1 .. -Δt- alarm	If the feed-in pressure falls below a minimum value or if the digital input "Level <" is low, the alarm message "Feed in <" occurs after an adjustable delay.
2 .. Alarm -Δt- fault	If the feed-in pressure falls below a minimum value or if the digital input "Level <" is low, the alarm message occurs immediately. After an adjustable delay a fault shut-down with the message "Feed in <<" takes place if the state is still unchanged.
3 .. -Δt- fault	If the feed-in pressure falls below a minimum value or if the digital input "Level <" is low, a fault shut-down with the message "Feed in <<" takes place after an adjustable delay.
4 .. Alarm -Δt- standby	If the feed-in pressure falls below a minimum value or if the digital input "Level <" is low, the alarm message "Feed in <" occurs immediately. The drive is switched over to standby-mode after an adjustable delay. Thus the motor is disconnected and restarts automatically if the feed-in pressure exceeds the minimum value (hysteresis) or if the digital input "Level OK" is high.

Thermistor control

Each motor must be protected against winding temperatures that are too high as a result of inadmissible high load.

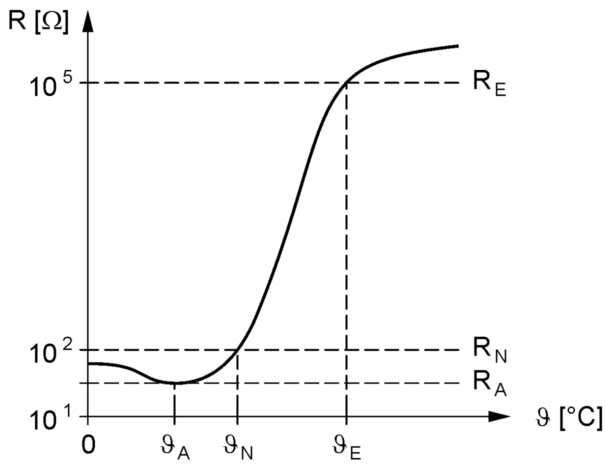
With motors without speed control this can be carried out with simple motor circuit breakers (I^2t protection). These determine an inadmissible load by registering the current and its residence time. The cooling of the motor is assumed as constant and is therefore not included in the registering of the load.

If a motor is operated at the output of an inverter, its speed can be changed. If the speed is smaller than its nominal value, the cooling effect of the motor is also reduced as with self-cooled motors the fan is driven directly by the motor shaft. Therefore the use of a motor circuit breaker is no sufficient overload protection in this case.

The most effective action of the motor protection is the measurement of the temperature in each of the three motor windings (complete motor protection). This takes place by integrating PTC thermistors in the end winding of the motor, whereby all three PTCs are connected in series and monitored together. The PTCs are monitored directly on the *>pDRIVE< MX eco* without an additional evaluation instrument.

Switching points:

Overtemperature trigger	$R_{PTC} > 3\ k\Omega$
Reset value	$R_{PTC} < 1.8\ k\Omega$
Short-circuit recognition	$R_{PTC} < 50\ \Omega$
Wire break recognition	$R_{PTC} > 100\ k\Omega$



Typical resistance behaviour of a PTC thermistor

The following monitoring inputs are available:

Input	Position	Terminal marking	Note
TH 1	Basic device	DI6 0V	Selection DI6: digital input / PTC sensor Switchover with SW2 = PTC Change does not become active until Mains OFF/ON.
TH 2	Option *>pDRIVE< IO11*	TH2+ TH2+	
TH 3	Option *>pDRIVE< IO12*	TH3+ TH3+	

Technical details on the control terminals can be found in the product catalogue and the mounting instructions.

If a thermal switch is used instead of a PTC thermistor (temperature dependent resistor), the respective thermistor monitoring has to be deactivated.

The used thermal switches must be capable for low-level signals.

HTIU
8 P01 023 EN.04/04

E2.01	TH1 motor allocation				0 .. Not used

0 ...Not used
1 ...Motor 1
2 ...Motor 2
3 ...General usage

Assignment of the sensor TH1 to the motor which should be protected. So if the function "Switch-over to 2nd set of motor data" is used, the inverter can always monitor the thermistor of the actual motor.

If "3 .. General usage" is selected, no motor assignment takes place and thus also external machine parts can be monitored (e.g. bearing temperature or gear temperature).

E2.02	TH1 activation				2 .. Ready and run

1 ...Always active
2 ...Ready and run
3 ...Operation only

Parameter TH1 activation determines the operating states during which a trigger of the thermistor monitoring is analysed.

Setting	Note
1 .. Always active	The thermistor is always monitored. This setting should be chosen if the thermistor is used external.
2 .. Ready and run	The thermistor is monitored as long as the inverter is in ready or run state. If a trip occurs, it cannot be reset in ready state as long as the motor is too hot.
3 .. Operation only	The thermistor is only monitored as long as the inverter is in run state.

E2.03	TH1 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E2.04	TH1 Time Δt				0 s

0...300 s

If a too high temperature is recognized by means of the thermistors which are connected in series on a measuring input, one of the following reactions can be selected depending on the process demands:

Setting	Behaviour in case of overtemperature, measured with TH1
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "TH - ϑ M1 >", "TH - ϑ M2 >" or "TH ϑ Ext >", which can be delayed, occurs.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message. After an adjustable delay a fault shut-down with the message "TH ϑ M1 >>", "TH ϑ M2 >>" or "TH ϑ Ext >>" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "TH ϑ M1 >>", "TH ϑ M2 >>" or "TH ϑ Ext >>" takes place.

The fault is only evaluated for the thermistors of the active motor as well as for thermistors which are planned for the general use.

The alarm message always occurs.

E2.05	TH1 verification				1 .. Active

0 ...Not active
1 ...Active

A thermistor sensor connected to an activated input is continuously monitored in regard to wire break and short-circuit during operation.

If a thermal switch is used for temperature measurement instead of a PTC sensor, the respective thermistor monitoring has to be deactivated.

Two or three PTCs can also be assigned to the same motor or for general use.

E2.06	TH2 motor allocation				0 .. Not used

0 ...Not used
1 ...Motor 1
2 ...Motor 2
3 ...General usage

Assignment of the sensor TH2 to the motor which should be protected. So if the function "Switch-over to 2nd set of motor data" is used, the inverter can always monitor the thermistor of the actual motor.

If "3 .. General usage" is selected, no motor assignment takes place and thus also external machine parts can be monitored (e.g. bearing temperature or gear temperature).

E2.07	TH2 activation				2 .. Ready and run

1 ...Always active
2 ...Ready and run
3 ...Operation only

Parameter TH2 activation determines the operating states during which a trigger of the thermistor monitoring is analysed.

Setting	Note
1 .. Always active	The thermistor is always monitored. This setting should be chosen if the thermistor is used external.
2 .. Ready and run	The thermistor is monitored as long as the inverter is in ready or run state. If a trip occurs, it cannot be reset in ready state as long as the motor is too hot.
3 .. Operation only	The thermistor is only monitored as long as the inverter is in run state.

E2.08	TH2 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E2.09	TH2 Time Δt				0 s

0...300 s

8 P01 023 EN.04/04

If a too high temperature is recognized by means of the thermistors which are connected in series on a measuring input, one of the following reactions can be selected depending on the process demands:

Setting	Behaviour in case of overtemperature, measured with TH2
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "TH - ϶ M1 >“, "TH - ϶ M2 >“ or "TH ϶ Ext >“, which can be delayed, occurs.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message. After an adjustable delay a fault shut-down with the message "TH ϶ M1 >>“, "TH ϶ M2 >>“ or "TH ϶ Ext >>“ takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "TH ϶ M1 >>“, "TH ϶ M2 >>“ or "TH ϶ Ext >>“ takes place.

The fault is only evaluated for the thermistors of the active motor as well as for thermistors which are planned for the general use.

The alarm message always occurs.

E2.10	TH2 verification				0 .. Not active

0 ...Not active
1 ...Active

A thermistor sensor connected to an activated input is continuously monitored in regard to wire break and short-circuit during operation.

If a thermal switch is used for temperature measurement instead of a PTC sensor, the respective thermistor monitoring has to be deactivated.

Two or three PTCs can also be assigned to the same motor or for general use.

E2.11	TH3 motor allocation				0 .. Not used

0 ...Not used
1 ...Motor 1
2 ...Motor 2
3 ...General usage

Assignment of the sensor TH3 to the motor which should be protected. So if the function "Switch-over to 2nd set of motor data" is used, the inverter can always monitor the thermistor of the actual motor.

If "3 .. General usage" is selected, no motor assignment takes place and thus also external machine parts can be monitored (e.g. bearing temperature or gear temperature).

E2.12	TH3 activation				2 .. Ready and run

1 ...Always active
2 ...Ready and run
3 ...Operation only

Parameter TH3 activation determines the operating states during which a trigger of the thermistor monitoring is analysed.

Setting	Note
1 .. Always active	The thermistor is always monitored. This setting should be chosen if the thermistor is used external.
2 .. Ready and run	The thermistor is monitored as long as the inverter is in ready or run state. If a trip occurs, it cannot be reset in ready state as long as the motor is too hot.
3 .. Operation only	The thermistor is only monitored as long as the inverter is in run state.

E2.13	TH3 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E2.14	TH3 Time Δt				0 s

0...300 s

If a too high temperature is recognized by means of the thermistors which are connected in series on a measuring input, one of the following reactions can be selected depending on the process demands:

Setting	Behaviour in case of overtemperature, measured with TH3
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "TH - ϑ M1 >", "TH - ϑ M2 >" or "TH ϑ Ext >", which can be delayed, occurs.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message. After an adjustable delay a fault shut-down with the message "TH ϑ M1 >>", "TH ϑ M2 >>" or "TH ϑ Ext >>" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "TH ϑ M1 >>", "TH ϑ M2 >>" or "TH ϑ Ext >>" takes place.

The fault is only evaluated for the thermistors of the active motor as well as for thermistors which are planned for the general use.

The alarm message always occurs.

E2.15	TH3 verification				0 .. Not active

0 ...Not active
1 ...Active

A thermistor sensor connected to an activated input is continuously monitored in regard to wire break and short-circuit during operation.

If a thermal switch is used for temperature measurement instead of a PTC sensor, the respective thermistor monitoring has to be deactivated.

Two or three PTCs can also be assigned to the same motor or for general use.

Thermal mathematical motor model

The thermal motor model is a complex arithmetic algorithm which determines the actual temperature of the motor windings. The specification of the motor model occurs by entering the current behaviour with regard to the speed (cooling conditions) and the thermal storage properties of the motor (motor time constant). If the maximum ambient temperature at the location of the motor is known then this can also be taken into account.

The motor temperature results from the time rated balance of the supplied current heat losses and the emitted heat due to the cooling or self-convection of the motor. The determined thermal state of the motor can be used for protection-, alarm- or limitation functions.

If the switchable 2nd set of motor data is used, the motor model can calculate simultaneously both motors even if they are different.

The information of the thermal motor states remains available, also when the inverter is in a dead state, therefore no external buffer voltage is needed.

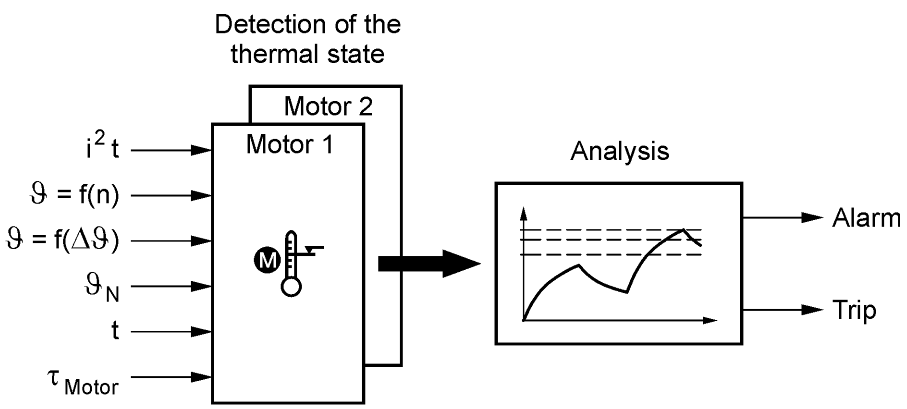
E2.18	M1 - overl. monitoring				1 .. Standard

0 ...Not active
1 ...Standard
2 ...UL

The thermal motor protection is designed for IEC standard motors. If UL motors are used, setting "2 .. UL" activates a motor protection according to UL standards. That means a switchover to an overcurrent time model. It depends on the allowed maximum current at nominal frequency (parameter E2.21, E2.33) related to the nominal motor current. All further adjustable parameters are only used for the calculation according to the IEC protective variant.

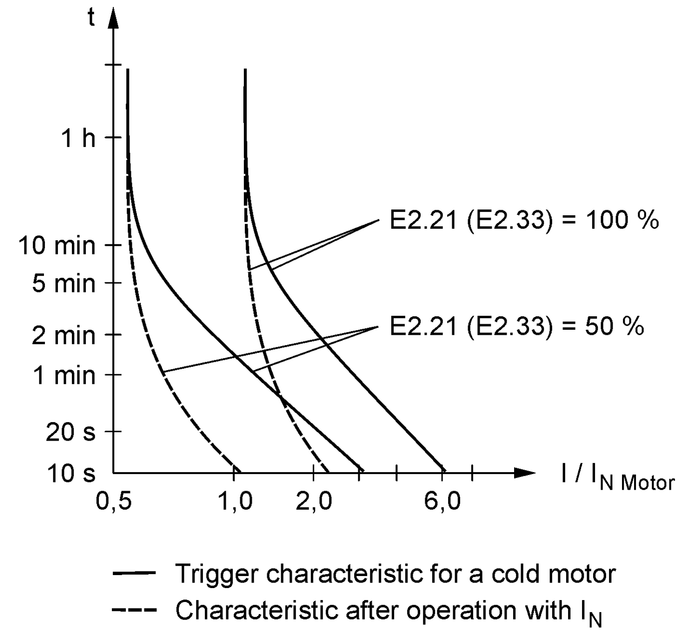
If the current/time area is exceeded, a fault shut-down with the message "ϑ M1 >>" takes place.

Thermal motor protection model for IEC standard motors



HTIU
8 P01 023 EN.04/04

Thermal motor protection model for UL motors



If setting UL is active, no limitation function is carried out!

E2.19	M1 - response				3 .. Alarm-trip

1 ...Alarm
2 ...Alarm-limitation
3 ...Alarm-trip

Parameter E2.19 defines the behaviour of the inverter in case of too high thermal load of the motor.

Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour in case of too high thermal load of the motor, thermal mathematical motor model
1 .. Alarm	If the load exceeds the alarm level E2.25, the alarm message "ɜ M1 >" occurs. It does not cause a limitation or a fault shut-down !
2 .. Alarm-limitation	If the load exceeds the alarm level E2.25, the alarm message "ɜ M1 >" occurs. If the thermal load of the motor still rises up to the trigger level E2.26 the limitation intervenes by means of a current reduction from the time when the level is exceeded. The current limitation is reduced to a value according to the current curve set with parameters E2.20...E2.22 (depending on the actual speed).
3 .. Alarm-trip	If the load exceeds the alarm level E2.25, the alarm message "ɜ M1 >" occurs. If the thermal load of the motor reaches the trigger level E2.26, a fault shut-down with the message "ɜ M1 >>" takes place.

8 P01 023 EN.04/04

E2.20	M1 - Imax at 0Hz				50 %

0...300 %

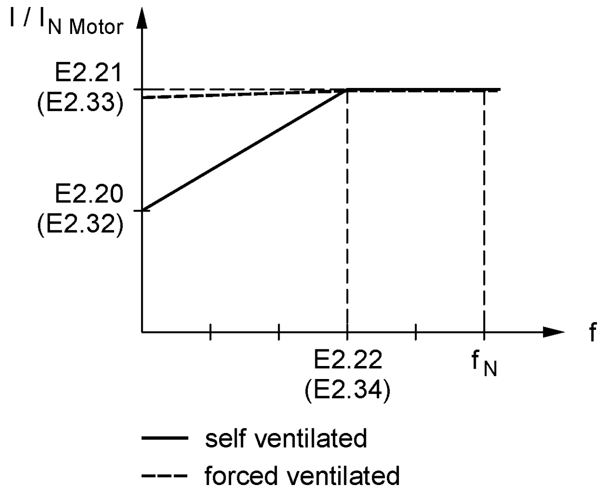
E2.21	M1 - Imax at f nom.				100 %

0...150 %

E2.22	M1 - therm. f-limitation				35 Hz

0...300 Hz

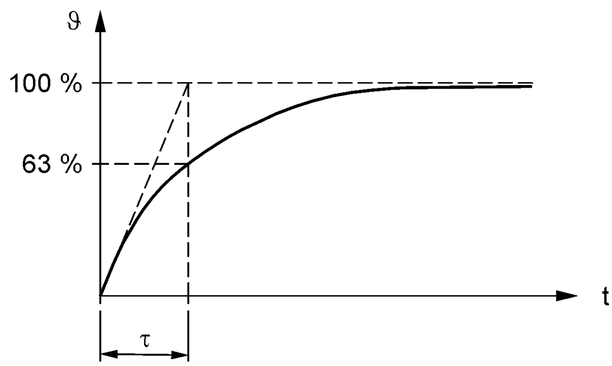
By means of these three parameters the allowed curve for continuous load is set. It is defined in % of the nominal motor current and considers the changing cooling at speed reduction. A continuous current of 50 % of the nominal current leads to 25 % of the nominal losses at the motor ($P_V = I^2 \times t$) and normally for standard motors it can also exist continuous at speed zero (unhindered free convection).



E2.23	M1 - motor-time				5 min

0...500 min

The motor time constant specifies the heat accumulation behaviour of the motor. During 4...5 time constants and nominal operation (nominal current and nominal frequency) the persistence temperature is reached.



The following tables include recommended values for motor time constants of IEC standard motors. Ask the motor supplier for this value, if required.

Number of poles	τ at motor size		
	160...200	225...280	315...400
2, 4	45 min	50 min	60 min
6, 8	60 min	80 min	100 min

E2.24	M1 - cooling temp.				40 °C

-10...80 °C

According to IEC 34-1 a maximum coolant temperature of 40°C forms the basis of the thermal mathematical motor model. If the expected maximum coolant temperature of the motor differs from this specification, the mathematical model can be adapted by means of parameter M1 - cooling temp..

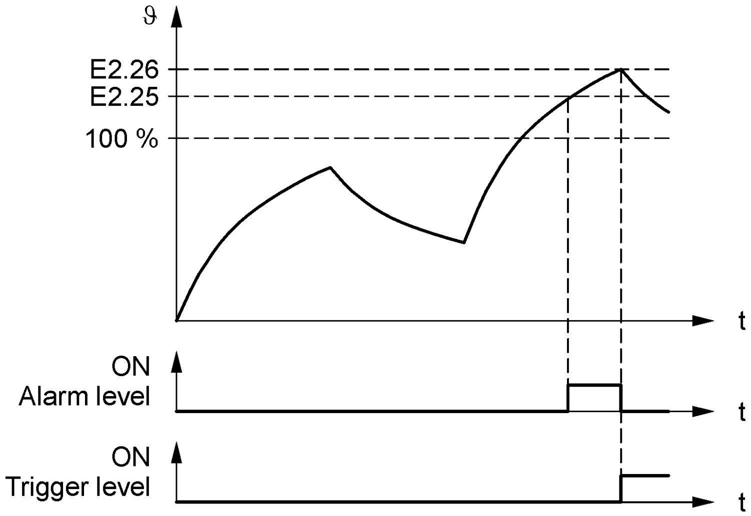
E2.25	M1 - alarm level				100 %

0...300 %

E2.26	M1 - trigger level				110 %

0...300 %

Parameters E2.25 and E2.26 define the levels for alarm, limitation and shut-down of the thermal mathematical motor model. 100 % correspond to a maximum allowed winding temperature of 120 C (thermal class B).



E2.27	Thermal load M1				%

Displays the thermal state of the mathematical motor model. 100 % correspond to the maximum allowed winding temperature of 120 C (thermal class B).

The thermal motor load is also available as an analog actual value, which can be processed by the comparator and it can be displayed in the basic display.

E2.30	M2 - overl. monitoring				0 .. Not active

0 ...Not active
1 ...Standard
2 ...UL

E2.31	M2 - response				3 .. Alarm-trip

1 ...Alarm
2 ...Alarm-limitation
3 ...Alarm-trip

E2.32	M2 - Imax at 0Hz				50 %

0...300 %

E2.33	M2 - Imax at f nom.				100 %

0...150 %

E2.34	M2 - therm. f-limitation				35 Hz

0...300 Hz

HTIU

8 P01 023 EN.04/04

E2.35	M2 - motor-time				5 min

0...500 min

E2.36	M2 - cooling temp.				40 °C

-10...80 °C

E2.37	M2 - alarm level				100 %

0...300 %

E2.38	M2 - trigger level				110 %

0...300 %

E2.39	Thermal load M2				%

If the function of the switchable 2nd set of motor data is used, the parameters E2.30...E2.39 must be parameterized according to motor M2.

Both mathematical models are handled at the same time, because when one motor is in operation (temperature rise by means of current heat losses) the inactive motor cools. For correct temperature determination the mathematical model takes this cooling phase into account.

Displayed alarm or trip messages always relate to the actual selected motor.

Stall protection

E2.42	Stall protection				1 .. Active

0 ...Not active
1 ...Active

E2.43	Stalling time				60 s

0...200 s

E2.44	Stalling frequency				5 Hz

0...20 Hz

E2.45	Stalling current				60 %

0...150 %

A blocked or much overloaded motor is recognised by monitoring of the output current and the speed rise time. If the inverter is in a time longer than the set stalling time E2.43 with a frequency smaller than the stalling frequency E2.44 and an output current larger than the set stalling current E2.45, a fault shut-down with the message "Stall protection" takes place.

The stalling current relates to % of the set nominal motor current (see Matrix field B4, page 93).

In case of planned brake emergency operation the stall protection monitoring must be set to "Not active" (see matrix field C3, page 125).

HTIU
8 P01 023 EN.04/04

Overspeed protection

E2.48	Overspeed monitoring				0 .. Not active

0 ...Not active
1 ...Active

The overspeed protection monitors the speed of the motor with respect to a set maximum value. If the value is exceeded, a tripping of the overspeed protection occurs.

The monitoring occurs independently of the rotational direction. The alarm message has a backslide hysteresis of 100 rpm.

E2.49	Overspeed response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E2.49 defines the behaviour of the inverter if the overspeed protection triggers. Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour after trigger of the overspeed protection
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "Overspeed", which can be delayed, is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "Overspeed". After an adjustable delay a fault shut-down with the message "Overspeed" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "Overspeed" takes place.

E2.50	Overspeed level				3200 rpm

0...20000 rpm

E2.51	Time Δt				0 s

0...300 s

Loss of motor phase

E2.54	Motor phase monitor				1 .. Active

0 ...Not active
1 ...Active

If one phase on the motor side is lost, the motor continues operation at low load with a strong distorted rotary field. If the monitoring of the motor phases is activated, the motor is monitored with respect to unsymmetry at the output side and is switched off with a trip message in case of a phase failure.

The display of the trip differentiates between loss of one phase and of all three phases.

Underload protection

E2.61	Underload monitor				0 .. Not active

0 ...Not active
1 ...Quadratic
2 ...Linear

The function underload monitoring checks the mechanical load (torque) with respect to a characteristics in relation to the speed. If a load reduction occurs which is untypical for the speed range, this situation can be process-technically evaluated (e.g. checking the V-belt of a fan, output of a pump, ...).

The reference torque used for monitoring can be switched between quadratic and linear characteristics.

E2.62	Underload response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E2.62 defines the behaviour of the inverter if the underload monitoring triggers. Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour after trigger of the underload protection
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "Underload", which can be delayed, is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "Underload". After an adjustable delay a fault shut-down with the message "Underload" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "Underload" takes place.

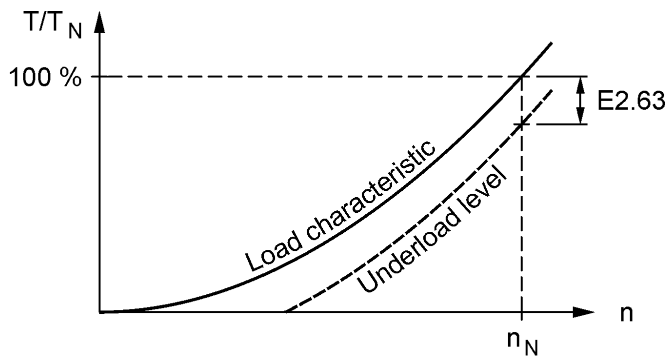
E2.63	Underload level n^2				20 %

0...100 %

Depending on the setting of parameter E2.61 the reference torque, which is used for monitoring, is quadratic valued.

Parameter E2.63 is used to set the quadratic reference torque. It defines an offset of the load torque which quadratic decreases from the motor nominal point (nominal torque / nominal speed).

If the actual torque falls below this reference curve, an underload situation is triggered.



See also time rating E2.66...E2.68.

E2.64	Underload level ½ fn				15 %
	0...100 %				

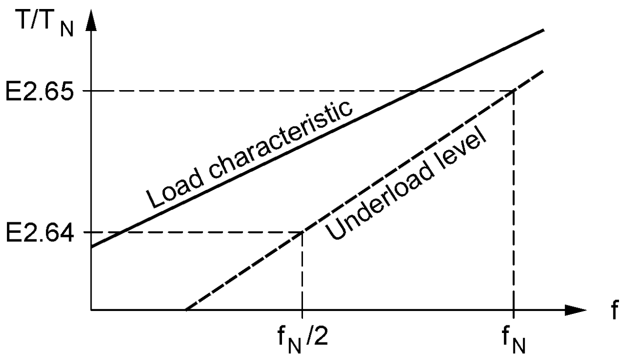
E2.65	Underload level fn				80 %
	0...100 %				

Depending on the setting of parameter E2.61 the reference torque, which is used for monitoring, is linear valued.

Parameters E2.64 and E2.65 are used to set a linear reference torque. It is defined by means of the two value pairs consisting of the torque at half nominal frequency (E2.64) and torque at nominal frequency (E2.65).

The entry occurs in % to the nominal motor torque.

If the actual torque falls below this reference curve, an underload situation is triggered.



A time rating of the underload behaviour can be set with the parameters E2.66...E2.68.

E2.66	Underload start time				60 s
	0...300 s				

E2.67	Time Δt				10 s
	0...300 s				

E2.68	Filter-time				5 s
	0...300 s				

Parameters E2.66... E2.68 make a temporal rating of the underload behaviour possible.

If the process which should be monitored needs a certain time period after starting to proceed steady, it might be useful to activate the underload monitoring delayed to the start in order to avoid incorrect triggering. Parameter E2.66 defines the start delay time.

If short-term load fluctuations due to the process exist, the load torque which should be monitored can be filtered before evaluation by means of the underload filter time E2.68. Thereby undesired incorrect triggering due to load fluctuations can be avoided.

A delay time for the underload reaction can be set with parameter E2.67.

Behaviour in case of faults

E3.01	Reaction at a trip				1 .. Free wheel

1 ...Free wheel
2 ...Deceleration
3 ...Fast stop

The behaviour after the recognition of a fault can be adapted to the respective process demands by means of parameter E3.01. In general it can be differentiated between inverter faults recognized by the inverter (e.g. Overcurrent) and process faults generated by the software (e.g. Overspeed).

In order to protect the power part of the device against destruction, faults recognized by the hardware lead to an immediate lock of the output-side transistors and also to a free-wheeling of the motor, independent of the parameter setting.

When a process fault occurs the inverter reacts according to the set fault behaviour.

Setting	Behaviour when a process fault occurs
1 .. Free wheel	Immediate locking of the transistors and change to drive state "Trip". In the removable matrix operating panel the name of the occurring fault is displayed, the LED-keypad shows a trip code.
2 .. Deceleration	The occurrence of a fault initiates a deceleration along the deceleration ramp. After reaching speed zero the device changes to the operating state "Trip". A given start command is inhibited.
3 .. Fast stop	A deceleration occurs with very short ramp time. After reaching speed zero the device changes to the operating state "Trip". A given start command is inhibited. By activating the motor brake (see B5.01 "Brake mode") the deceleration time is clearly shortened.

The occurrence of a fault leads to the following actions:

– automatic entry of the fault in the fault memory (see Matrix field F3, page 267)
– For control with 2-wire-ramp, 3-wire, fieldbus or control in panel mode, the start command is deleted. (see Matrix field E4, page 235)
– For control with 2-wire-level the start command is inhibited. (see Matrix field E4, page 235)
– Display of the trip message on the LCD- and LED-Display
– Message of the fault via relay, digital output or fieldbus

The fault state can only be canceled by means of a manual reset (keypad, digital input "Ext. reset" or fieldbus) or by means of a voltage disconnection of the inverter (incl. possibly existing 24 V buffer voltage). If the cause of the fault still exists at the time of the reset, the reset is not accepted (e.g. "ɜ M1 >>").

E3.03	Auto reset				0 .. Not active

0 ...Not active
1 ...Active

E3.04	Autoreset selection	0110			

0 .. Line overvoltage	☐ / ☑	9 .. Underload	☐ / ☑
1 .. Inverter overtemp.	☐ / ☑	10 .. Speed check	☐ / ☑
3 .. Com fault option	☐ / ☑	11 .. Feed in <<	☐ / ☑
4 .. Bus fault	☐ / ☑	12 .. External fault 2	☐ / ☑
5 .. Reference fault AI2	☐ / ☑	13 .. External fault 1	☐ / ☑
6 .. Reference fault AI3	☐ / ☑	14 .. ON lock	☐ / ☑
7 .. Reference fault AI4	☐ / ☑	15 .. Overcurrent	☐ / ☑
8 .. Reference fault FP	☐ / ☑		

E3.05	Autoreset selection 2	0110			

0 ...Process fault 1	☐ / ☑
1 ...Process fault 2	☐ / ☑
2 ...Process fault 3	☐ / ☑

E3.06	Auto reset trials				3

1...20

E3.07	Period				300 s

60...600 s

If autoreset is activated, the inverter tries to start the system by automatic reset when a fault occurs.

Those faults, which should be reset automatically by the device, can be selected by means of parameter E3.04. Moreover, the number of the autoreset attempts as well as the time span within which the autoreset attempts should be carried out, is adjustable. The time between two autoreset attempts is one second.

In case of an inadmissible high number of reset attempts within the set time span or for faults, which are not selected for the autoresetting, the normal fault shut-down and message is initiated.

The auto-reset function should only be selected in special cases (e.g. unmanned locations). The reset can lead to an automatic restart of the plant !

The autoreset function should be used only in combination with the control source selection E4.01 "2-wire (edge rated)" or "2-wire (level rated)".

HTIU
8 P01 023 EN.04/04

Emergency operation

E3.09	Enable emergency op.				0 .. Disable

0 ...Disable
1 ...Enable

E3.10	Emergency op. active				

0 ...Disable
1 ...Enable

The function "Emergency operation" enables the operation of the inverter with deactivated device protection. This is necessary for plants in which all functions are primarily directed to personal protection in case of an emergency (e.g. tunnel ventilating systems).

The function is activated by a digital input which is parameterized at the function "Emergency operation". As a result all limitations of the inverter are switched off, process faults detected by the software are treated as alarms and the autoreset function is approved unlimited.

By means of the function "Emergency operation" the operation of the inverter and the motor can also occur outside the specifications. The warranty claim expires in this case !

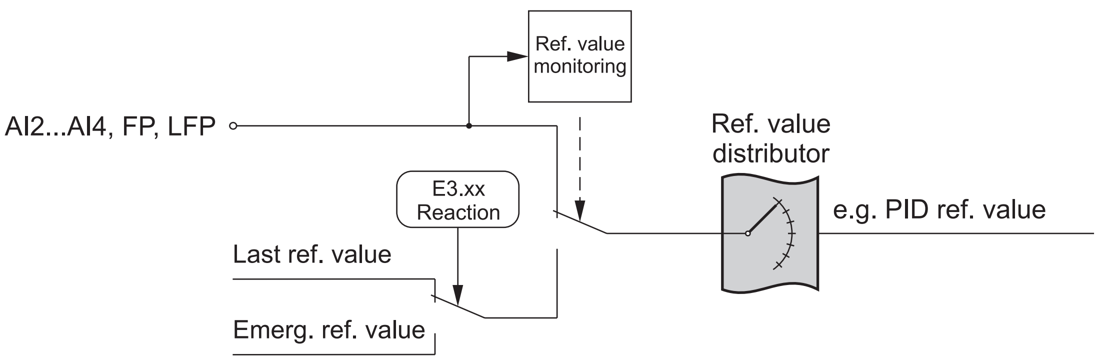
In order to prevent an unintentional selection of this function, the one-off entry of a service code is necessary before the activation of the function via parameter F6.05 Service code. The service code is mentioned in the service documentation or can be asked for from the manufacturer.

If E3.09 is set to "0 .. Disable," the function is deactivated. For reactivation, the service code must be entered again.

Loss of reference value

If a 4...20 mA standardized signal is used, the reference sources AI2, AI3 and AI4 can be monitored for reference failure. In this way the reference value is monitored at falling below 3 mA.

By using the pulse inputs FP or LFP the same method can be roughly used, whereby the signal is checked with respect to a decrease of the signal frequency smaller than 50 % of the set minimum value.



When a reference failure occurs, an appropriate behaviour for each reference value can be determined. By selecting "Last ref. val & alarm" or "Emerg ref val & alarm" the respective value is supplied as replacement for the reference source at the input of the reference value distributor. As a result the full functionality remains also when using the alternative reference path (e.g. PID controller, f-correction,...).

E3.13	AI2 - 4mA monitor				0 .. Not active

0 ...Not active
1 ...Active

Activation of the 4 mA monitoring for the analog input AI2. If the reference value is not activated (see Matrix field D1, page 159), the function group Reference failure AI2 is hidden.

E3.14	AI2 - 4mA response				1 .. Trip

1 ...Trip
2 ...Last ref. val & alarm
3 ...Emerg ref val & alarm

Parameter E3.14 defines the behaviour of the inverter if the 4 mA monitoring triggers. Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour if the reference value is lost
1 .. Trip	Fault shut-down with the message "Reference fault AI2".
2 .. Last ref. val & alarm	The alarm message "Reference fault AI2" is set. The drive still remains in operation and uses the last valid reference value instead of the missing analog reference value. If the reference value is available again, it is used and the alarm message is reset.
3 .. Emerg ref val & alarm	The alarm message "Reference fault AI2" is set. The drive still remains in operation and uses the value according to setting "AI2 - emergency val." instead of the missing analog reference value. If the reference value is available again, it is used and the alarm message is reset.

E3.15	AI2 - emergency val.				4 mA

4...20 mA

If an emergency reference value is set with parameter E3.15, this reference value is used during loss of the reference value. The unit of the emergency reference value is scaled according to the reference use "D1.08 "AI2 selection" for all frequency values in Hz, while the remaining signals are scaled in %.

E3.16	AI3 - 4mA monitor				0 .. Not active

0 ...Not active
1 ...Active

E3.17	AI3 - 4mA response				1 .. Trip

1 ...Trip
2 ...Last ref. val & alarm
3 ...Emerg ref val & alarm

E3.18	AI3- emergency val.				4 mA

4...20 mA

E3.19	AI4 - 4mA monitor				0 .. Not active

0 ...Not active
1 ...Active

E3.20	AI4 - 4mA response				1 .. Trip

1 ...Trip
2 ...Last ref. val & alarm
3 ...Emerg ref val & alarm

E3.21	AI4 - emergency val.				4 mA

4...20 mA

E3.22	FP - f monitoring				0 .. Not active

0 ...Not active
1 ...Active

E3.23	FP - monitoring resp.				1 .. Trip

1 ...Trip
2 ...Last ref. val & alarm
3 ...Emerg ref val & alarm

E3.24	FP - emergency val.				0 kHz

0...30 kHz

The functions of the parameters E3.16...E3.24 (analog input AI3, analog input AI4 and pulse input FP) have identical setting possibilities as those for AI2. Setting possibilities see E3.13...E3.15.

Loss of line phase

E3.27	Mains phase monitoring				1 .. Active

0 ...Not active
1 ...Active

8 P01 023 EN.04/04

Monitoring of the inverter regarding loss of a mains phase. If a mains phase fails during operation, the trip message "Line fault 1p" occurs.

If the device is used with DC bus or a 2-phase mains, the monitoring must be set to "0 .. Not active".

Behaviour at undervoltage

Depending on the set mains voltage B3.01 the inverter electronics continuously monitors the DC link voltage. The signals for the under- and overvoltage protection and also the control of the undervoltage ride through function and fast stop function are derived from this monitoring.

E3.29	V< response				3 .. Alarm only -Δt- Off

0 ...Not active
1 ...-Δt- fault
2 ...Alarm -Δt- fault
3 ...Alarm only -Δt- Off
4 ...V<< ride through
5 ...Fast stop

If the DC link voltage drops below a value which depends on the mains voltage, the inverter recognises an acute undervoltage situation. Parameter E3.29 defines the behaviour of the inverter in this situation.

E3.30	Allowed V< time				2 s

0...300 s

Parameter E3.30 defines the maximum permitted undervoltage time after which an automatic start-up of the drive is allowed again. During this time the Run message remains.

E3.31	Max. V< time				30 s

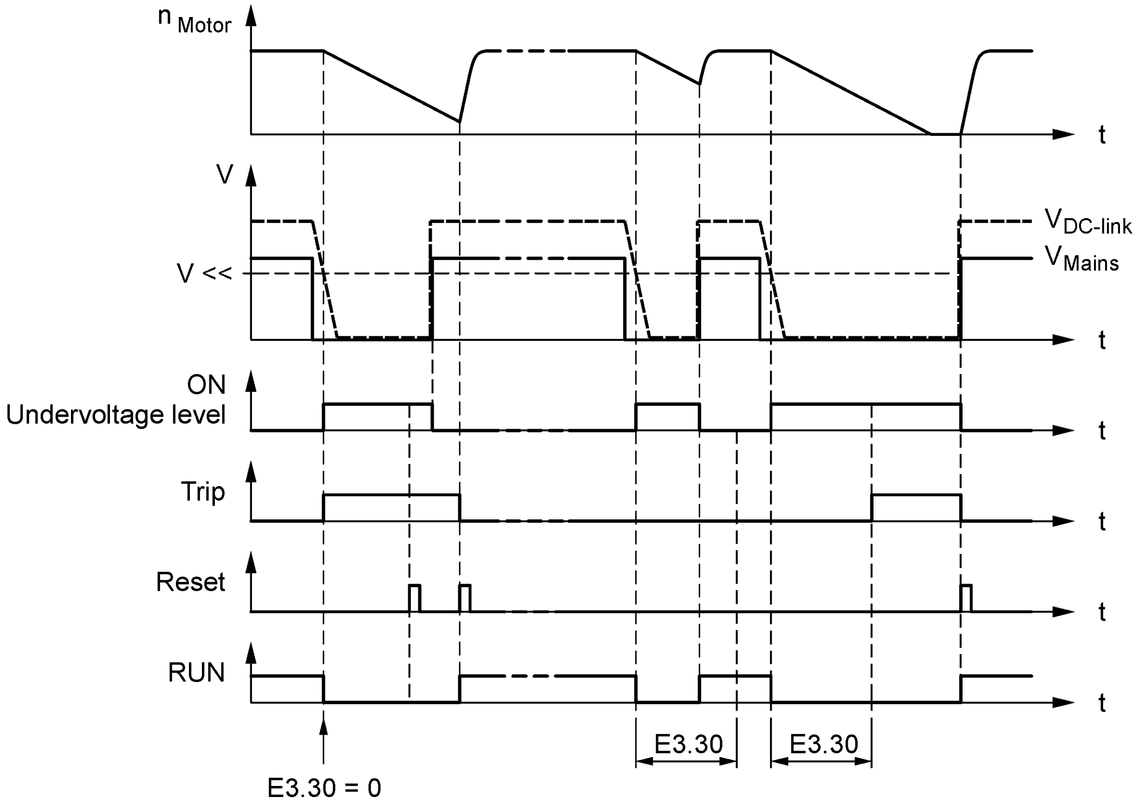
0...3000 s

When the reaction in case of undervoltage is set to "V<< ride through" or "Fast stop", the drive remains in operation with active "Run" message despite a recognized undervoltage situation (generator operation provided by the centrifugal mass). It is possible to limit this state with parameter E3.31.

HTIU
8 P01 023 EN.04/04

Depending on the process demands one of the following reactions in case of an undervoltage situation can be selected (see parameter E3.29):

Setting "-Δ*t*- *fault*"



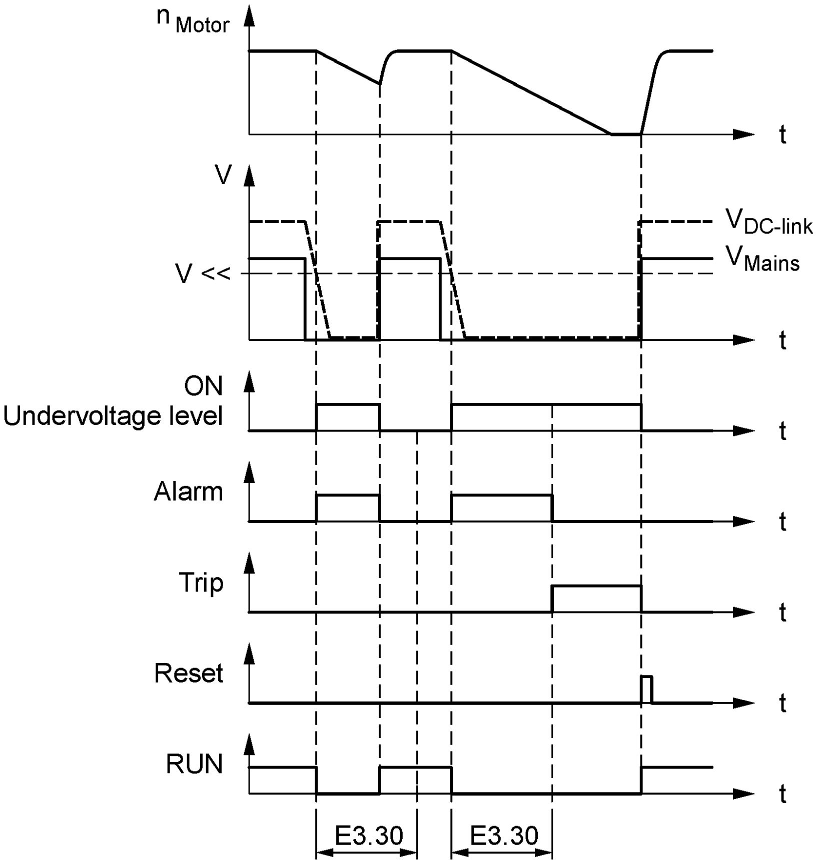
An undervoltage leads to an immediate lock of the inverter and therefore to a free-wheeling of the motor. If the voltage returns within the tolerated undervoltage time E3.30, the motor restarts automatically.

If the undervoltage time is exceeded, a fault shut-down occurs with the message "Undervoltage" (external 24 V buffer voltage required).

In order to avoid an automatic restart of the drive if the voltage returns, the control variant 2-wire level-rated (see matrix field E4, page 235) must not be used.

Setting "Alarm -Δt- fault"

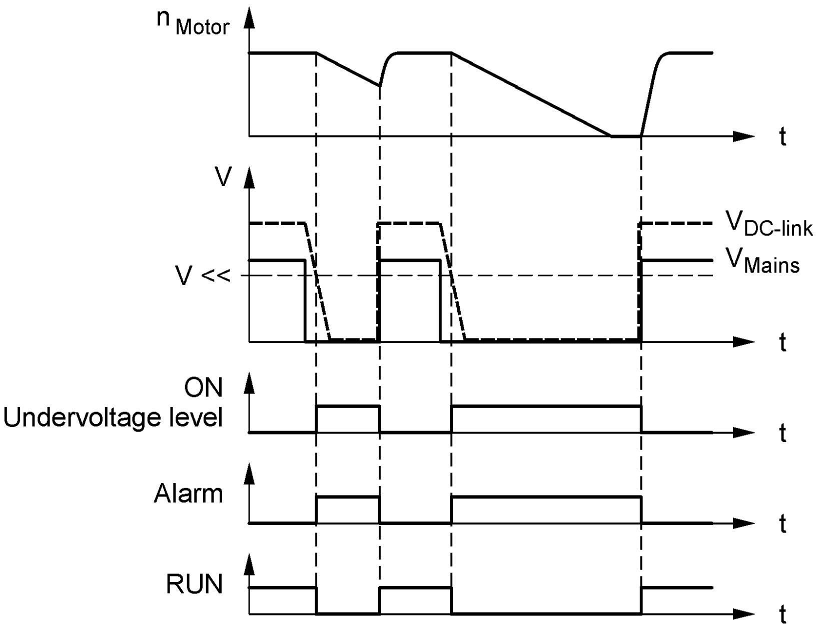
An undervoltage leads to an immediate lock of the output transistors and therefore to a free-wheeling of the motor. The alarm message "Undervoltage" is set. If the voltage returns within the tolerated undervoltage time E3.30, the motor restarts automatically, the alarm message is reset. If the undervoltage time is exceeded, a fault shut-down occurs with the message "Undervoltage" (external 24 V buffer voltage required).



HTIU

Setting "Alarm only -Δt- Off"

An undervoltage leads to an immediate lock of the output transistors and therefore to a free-wheeling of the motor. The alarm message "Undervoltage" is set. If the voltage returns, the motor restarts automatically and the alarm message is reset (external 24 V buffer voltage required).

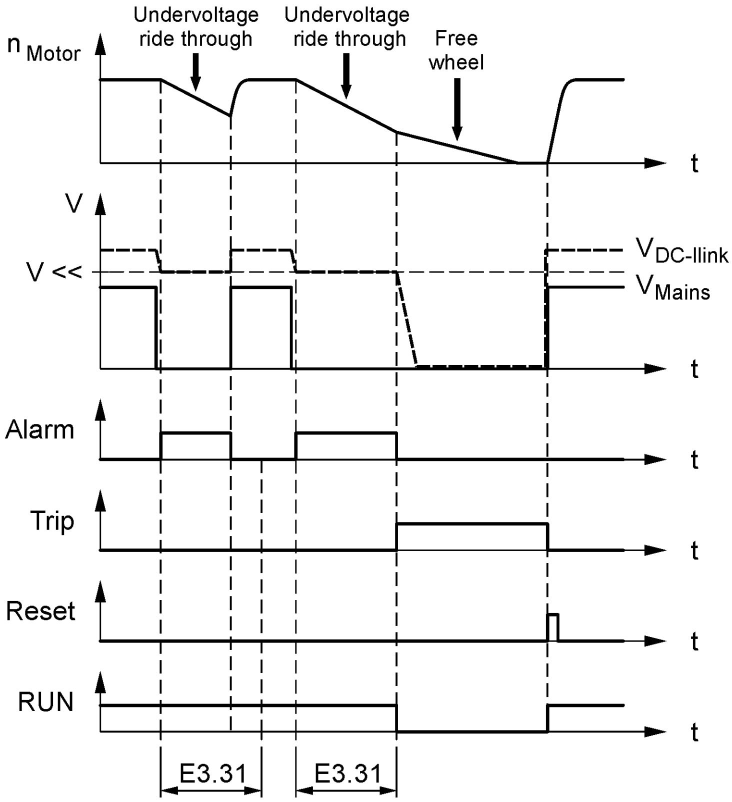


8 P01 023 EN.04/04

Setting "V<< ride through"

An undervoltage leads to slow reduction of the frequency reference value, whereby the motor changes to generator operation. In order to keep the DC link voltage constant (undervoltage ride through), energy is absorbed from the mechanical system (centrifugal mass of the motor and of the load) through braking. During the undervoltage ride through operation, the alarm message "Undervoltage" is set.

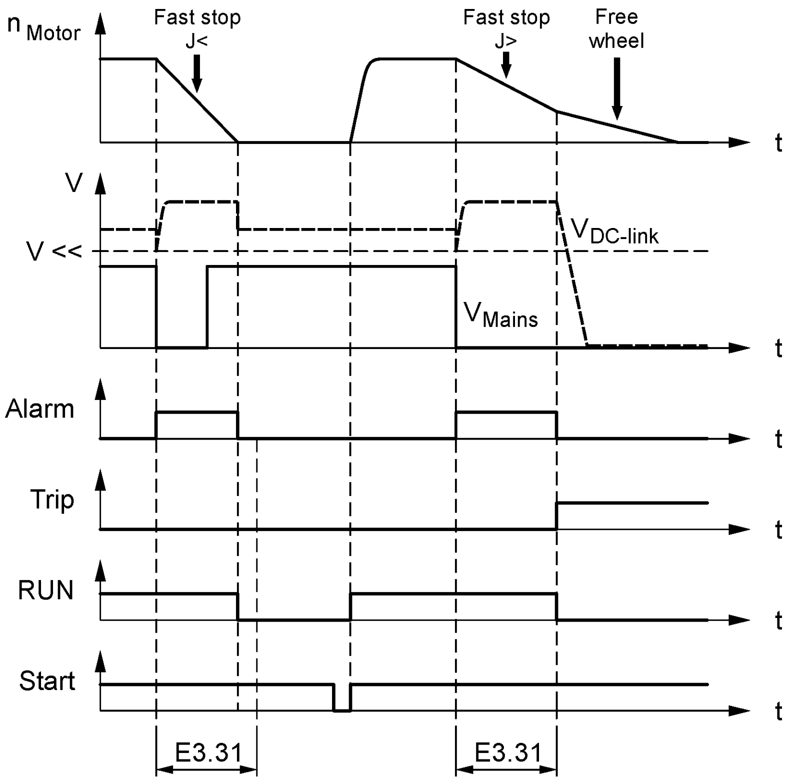
If the voltage returns within the maximum undervoltage time E3.31, the motor continues to run in normal operation and the alarm is reset. If the undervoltage time is exceeded, a fault shut-down occurs with the message "Undervoltage" (external 24 V buffer voltage required).



Setting "Fast stop"

An undervoltage leads to quick reduction of the frequency reference value, whereby the motor changes to generator operation. The DC link voltage increases and a possible activated motor braking will intervene (see matrix field B5, page 98). During the fast stop process, the alarm message "Undervoltage" is set.

If the rotational speed stands still within the maximum undervoltage time E3.31, the alarm message is reset. An existing start command from the sources 2-wire-edge, 3-wire or bus is deleted. If the undervoltage time is exceeded, a fault shut-down occurs with the message "Undervoltage" (external 24 V buffer voltage required).

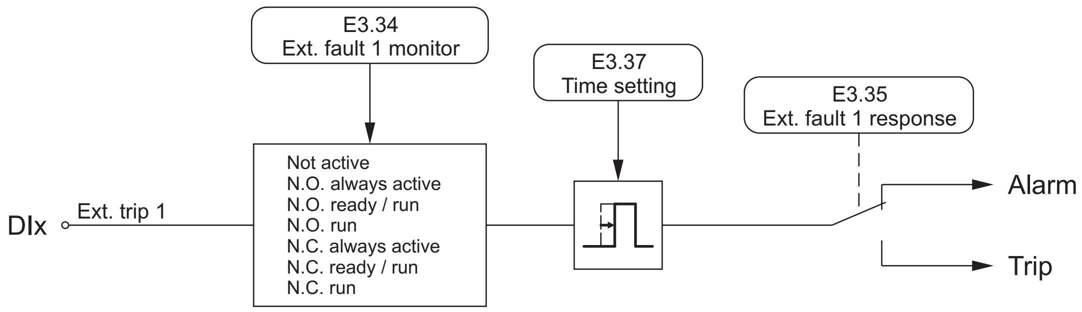


8 P01 023 EN.04/04

External fault

Should signals of the drive or the process be integrated in the inverter protection concept then this occurs with the digital input "External fault 1" or "External fault 2". The tripping behaviour and the temporal trigger performance are therefore adjustable to the demands of the system.

For easy user guidance the fault message text displayed on the removable Matrix operating panel can be freely edited.



E3.34	Ext. fault 1 monitor				2 .. N.O. ready / run

0 ...Not active
1 ...N.O. always active
2 ...N.O. ready / run
3 ...N.O. run
4... N.C.always active
5... N.C. ready / run
6... N.C. run

Parameter E3.34 defines the tripping behaviour of the digital input "External fault 1" which is to be configured in the Matrix field D2.

As a result it can be differentiated as follows:

Setting	Digital input external fault initiates fault shut-down when...
0 .. Not active	... never
1 .. N.O. always active	... at closed input, independent from the operating state
2 .. N.O. ready / run	... at closed input, only with Ready or Run state
3 .. N.O. run	... at closed input in Run state
4 .. N.C.always active	... at open input, independent from operating state
5 .. N.C. ready / run	... at open input, only with Ready or Run state
6 .. N.C. run	... at open input in Run state

E3.35	Ext. fault 1 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E3.35 defines the behaviour of the inverter if the digital input "External fault 1" triggers.

8 P01 023 EN.04/04

Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour after trigger of the external fault
1 .. -Δt- alarm	No shut-down of the inverter takes place. A time-delay alarm message "External fault 1" with free-editable text display (E3.38) is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "External fault 1". After the adjustable delay a fault shut-down with a free editable text message (E3.38) takes place if the state is still unchanged.
3 .. -Δt- fault	After the adjustable delay a fault shut-down with a free editable text message (E3.38) takes place.

E3.36	Start delay time				0 s

0...600 s

The start delay time delays the monitoring of the digital input "External fault 1" after a start command. As a result process-related instabilities can be blanked out after starting.

The Start delay time is only active when selecting E3.34 "N.O. run" or "N.C. run".

E3.37	Time Δt				0 s

0...300 s

Delay time for the reaction E3.35 after the occurrence of an "External fault 1".

E3.38	Ext. fault 1 name	txt			

When an "External fault 1" occurs, the edited text of parameter E3.38 is displayed in the Matrix operating panel.

E3.41	Ext. fault 2 monitor				0 .. Not active

0 ...Not active
1 ...N.O. always active
2 ...N.O. ready / run
3 ...N.O. run
4... N.C.always active
5... N.C. ready / run
6... N.C. run

E3.42	Ext. fault 2 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E3.43	Start delay time				0 s

0...600 s

E3.44	Time Δt				0 s

0...300 s

E3.45	Ext. fault 2 name	txt			

The functions of the parameters E3.41...E3.45 for "External fault 2" have identical setting possibilities as those for "External fault 1". See therefore parameters E3.34...E3.38.

ON lock

E3.48	ON lock activation				0 .. Not active

0 ...Not active
1 ...Active

The ON-lock is used in order to integrate drive-related components such as e.g. external auxiliary and control voltages, cubicle fans, door contacts etc. into the inverter control concept. All auxiliary contacts (N.C.) of the external components, which are to be monitored, are as a result connected in series to the digital input "ON lock" (the digital input is to be configured in the Matrix field D2).

If the drive is not in operation, all integrated contacts of the monitoring loop must be on in order to reach the ready status of the inverter. If one of the devices to be monitored of the integrated loop fails during operation, this leads to the trip message "ON lock" with adjustable reaction response.

E3.49	ON lock response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E3.49 defines the behaviour of the inverter if the ON lock triggers in operation.

Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour if the ON-lock triggers
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "ON-lock from DI", which can be delayed, occurs.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "ON-lock from DI". After an adjustable delay a fault shut-down with the message "ON lock" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "ON lock" takes place.

E3.50	Time Δt				0 s

0...300 s

Delay time for the reaction (E3.49) after the occurrence of an ON-lock during Run state.

Alarm categories

With the monitoring and protection concept of the >*pDRIVE*< *MX eco* it is possible to transfer drive or process faults to the superposed control as fault messages, advance warning with delayed fault message or only as alarm message.

These can be divided into up to 3 alarm category groups for the assessment of arriving alarm messages.

Mark the desired alarm messages for each alarm category there.

E3.51	Alarm category 1	0110			
	0 ...External fault 1	☐ / ☑	8 .. Motor model	☐ / ☑	
	1 ...External fault 2	☐ / ☑	9 .. Overspeed	☐ / ☑	
	2 ...Undervoltage	☐ / ☑	10.. TH ϑM >	☐ / ☑	
	3 ...Reference fault	☐ / ☑	11.. TH ϑExt >	☐ / ☑	
	4 ...Bus fault	☐ / ☑	12.. Underload	☐ / ☑	
	5 ...Feed in <	☐ / ☑	13.. Limitation	☐ / ☑	
	6 ...ON lock	☐ / ☑	14.. Ramp adaption	☐ / ☑	
	7 ...Speed check	☐ / ☑	15.. Service interval	☐ / ☑	

E3.52	Alarm category 1.2	0110		
	0 ...Process fault 1	☐ / ☑		
	1 ...Process fault 2	☐ / ☑		
	2 ...Process fault 3	☐ / ☑		

E3.54	Alarm category 2	0110			
	0 ...External fault 1	☐ / ☑	8 .. Motor model	☐ / ☑	
	1 ...External fault 2	☐ / ☑	9 .. Overspeed	☐ / ☑	
	2 ...Undervoltage	☐ / ☑	10.. TH ϑM >	☐ / ☑	
	3 ...Reference fault	☐ / ☑	11.. TH ϑExt >	☐ / ☑	
	4 ...Bus fault	☐ / ☑	12.. Underload	☐ / ☑	
	5 ...Feed in <	☐ / ☑	13.. Limitation	☐ / ☑	
	6 ...ON lock	☐ / ☑	14.. Ramp adaption	☐ / ☑	
	7 ...Speed check	☐ / ☑	15.. Service interval	☐ / ☑	

E3.55	Alarm category 2.2	0110		
	0 ...Process fault 1	☐ / ☑		
	1 ...Process fault 2	☐ / ☑		
	2 ...Process fault 3	☐ / ☑		

E3.57	Alarm category 3	0110			
	0 ...External fault 1	☐ / ☑	8 .. Motor model	☐ / ☑	
	1 ...External fault 2	☐ / ☑	9 .. Overspeed	☐ / ☑	
	2 ...Undervoltage	☐ / ☑	10.. TH ϑM >	☐ / ☑	
	3 ...Reference fault	☐ / ☑	11.. TH ϑExt >	☐ / ☑	
	4 ...Bus fault	☐ / ☑	12.. Underload	☐ / ☑	
	5 ...Feed in <	☐ / ☑	13.. Limitation	☐ / ☑	
	6 ...ON lock	☐ / ☑	14.. Ramp adaption	☐ / ☑	
	7 ...Speed check	☐ / ☑	15.. Service interval	☐ / ☑	

E3.58	Alarm category 3.2	0110		
	0 ...Process fault 1	☐ / ☑		
	1 ...Process fault 2	☐ / ☑		
	2 ...Process fault 3	☐ / ☑		

8 P01 023 EN.04/04 HTIU

Loss of reference value

E3.60	LFP - f monitoring				0 .. Not active

0 ...Not active
1 ...Active

E3.61	LFP - monitoring resp.				1 .. Trip

1 ...Trip
2 ...Last ref. val & alarm
3 ...Emerg ref val & alarm

E3.62	LFP - emergency val.				0 Hz

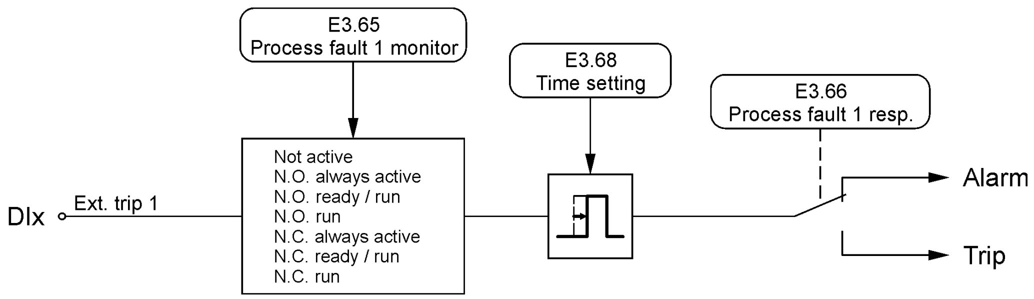
0...30 Hz

The functions of the parameters E3.60...E3.62 have identical setting possibilities as those for AI2. Setting possibilities see E3.13...E3.15.

Process fault

Should signals of the drive or the process be integrated in the inverter protection concept then this occurs with the digital inputs "Process fault 1" to "Process fault 3". The tripping behaviour and the temporal trigger performance are therefore adjustable to the demands of the system.

For easy user guidance the fault message text displayed on the removable Matrix operating panel can be freely edited.



E3.65	Process fault 1 monitor				0 .. Not active

0 ...Not active
1 ...N.O. always active
2 ...N.O. ready / run
3 ...N.O. run
4... N.C.always active
5... N.C. ready / run
6... N.C. run

Parameter E3.65 defines the tripping behaviour of the digital input "Process fault 1" which is to be configured in the Matrix field D2.

As a result it can be differentiated as follows:

Setting	Digital input external fault initiates fault shut-down when...
0 .. Not active	... never
1 .. N.O. always active	... at closed input, independent from the operating state
2 .. N.O. ready / run	... at closed input, only with Ready or Run state
3 .. N.O. run	... at closed input in Run state
4 .. N.C.always active	... at open input, independent from operating state
5 .. N.C. ready / run	... at open input, only with Ready or Run state
6 .. N.C. run	... at open input in Run state

HTIU
8 P01 023 EN.04/04

E3.66	Process fault 1 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E3.66 defines the behaviour of the inverter if the digital input "Process fault 1" triggers.
Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour after trigger of the external fault
1 .. -Δt- alarm	No shut-down of the inverter takes place. An alarm message "Process fault 1" with free editable text display (E3.69), which can be delayed, is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "Process fault 1". After the adjustable delay a fault shut-down with a free editable text message (E3.69) takes place if the state is still unchanged.
3 .. -Δt- fault	After the adjustable delay a fault shut-down with a free editable text message (E3.69) takes place.

E3.67	Start delay time				0 s

0...600 s

The start delay time delays the monitoring of the digital input "Process fault 1" after a start command. As a result process-related instabilities can be blanked out after starting.

The Start delay time is only active when selecting E3.65 "N.O. run" or "N.C. run".

E3.68	Time Δt				0 s

0...300 s

Delay time for the reaction E3.66 after the occurrence of a "Process fault 1".

E3.69	Process fault 1 name	**txt**			

When a "Process fault 1" occurs, the edited text of parameter E3.69 is displayed in the removable Matrix operating panel.

E3.72	Process fault 2 monitor				0 .. Not active

0 ...Not active
1 ...N.O. always active
2 ...N.O. ready / run
3 ...N.O. run
4... N.C.always active
5... N.C. ready / run
6... N.C. run

E3.73	Process fault 2 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E3.74	Start delay time				0 s

0...600 s

HTIU

8 P01 023 EN.04/04

E3.75	Time Δt				0 s
	0...300 s				

E3.76	Process fault 2 name	txt			

The functions of the parameters E3.72...E3.76 for "Prz. Störung 2" have identical setting possibilities as those for "Prz. Störung 1". Therefore see setting possibilities of E3.65...E3.69.

E3.79	Process fault 3 monitor				0 .. Not active

0 ...Not active
1 ...N.O. always active
2 ...N.O. ready / run
3 ...N.O. run
4... N.C.always active
5... N.C. ready / run
6... N.C. run

E3.80	Process fault 3 response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

E3.81	Start delay time				0 s
	0...600 s				

E3.82	Time Δt				0 s
	0...300 s				

E3.83	Process fault 3 name	txt			

The functions of the parameters E3.79...E3.83 for "Prz. Störung 3" have identical setting possibilities as those for "Prz. Störung 1". Therefore see setting possibilities of E3.65...E3.69.

Control logic

The signals to connect and disconnect the inverter as well as to select the rotational direction can occur in different ways.

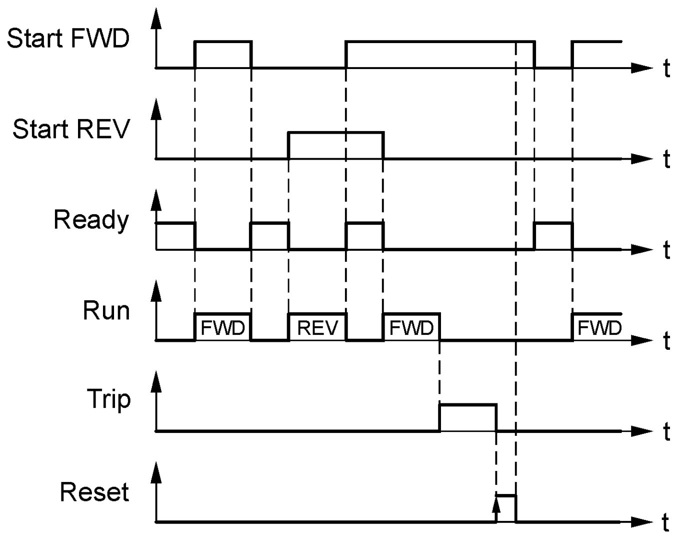
Basically you can differentiate between the panel control with the built-in LED-keypad or the removable Matrix operating panel and the remote control via the terminals or an integrated or optional fieldbus connection.

2-wire control (edge rated)

This control variant represents the factory-made basic setting. For control, both digital inputs "Start FW (2 wire)" and "Start REV (2 wire)" are to be configured.

A closed input leads to a start command of the corresponding direction, an open contact or the simultaneous selection of "Start FW (2 wire)" and "Start REV (2 wire)" leads to a stop command.

If the on command is given, the inverter changes by means of the reset command from an existing fault to the state "Not Ready", which remains until the start signal is opened. In this way, an automatic restart of the inverter after resetting the fault is prevented in case of a given start command.



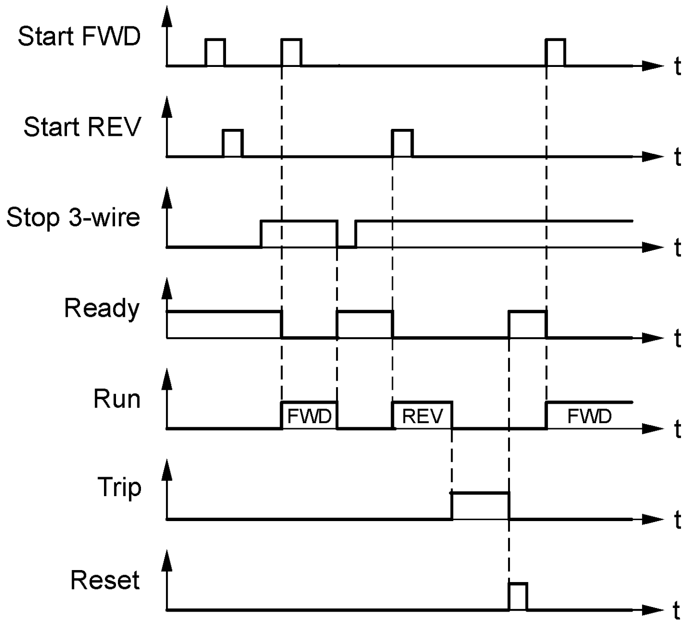
3-wire control

The three wire control is used for the processing of pulse commands. For control, the three digital inputs "Start FW (3 wire)", "Start REV (3 wire)" and "Stop (3 wire)" are to be configured.

A start command for the corresponding direction is triggered by switching-on the input "Start FW (3 wire)" for a short time (minimum pulse length 2 ms), if the input "Stop (3 wire)" is closed.

The stop command occurs by opening the stop input for a short time. If both signals "Start FW (3 wire)" and "Stop (3 wire)" are given simultaneous, this also leads to a stop command.

The autoreset function must not be used in case of 3-wire control.

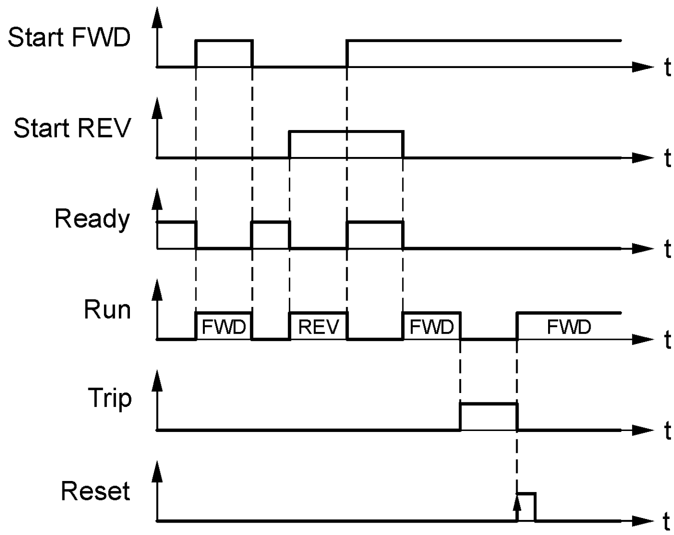


2-wire control (level rated)

The level rated 2-wire-control is used when replacing devices of the range *>pDRIVE< MX basic* or *>pDRIVE< MX plus* by a *>pDRIVE< MX eco*. With this control variant, only the signal levels of both digital inputs "Start FW (2 wire)" and "Start REV (2 wire)" are evaluated.

A closed input leads to a start command of the corresponding direction, an open contact or the simultaneous selection of "Start FW (2 wire)" and "Start REV (2 wire)" leads to a stop command.

The signal states of the terminal signals have top priority so that resetting of an existing fault or connection to the mains leads to an automatic starting of the motor if a start command is given.



Fieldbus

By using the fieldbuses Modbus or CANopen, which are standard integrated, or an optional fieldbus card (e.g. Profibus PBO11) the control of the inverter occurs by means of a control word which serves an inverter internal state machine.

The autoreset function must not be used in case of fieldbus control.

Details of the respective fieldbuses can be found in the belonging documentation.

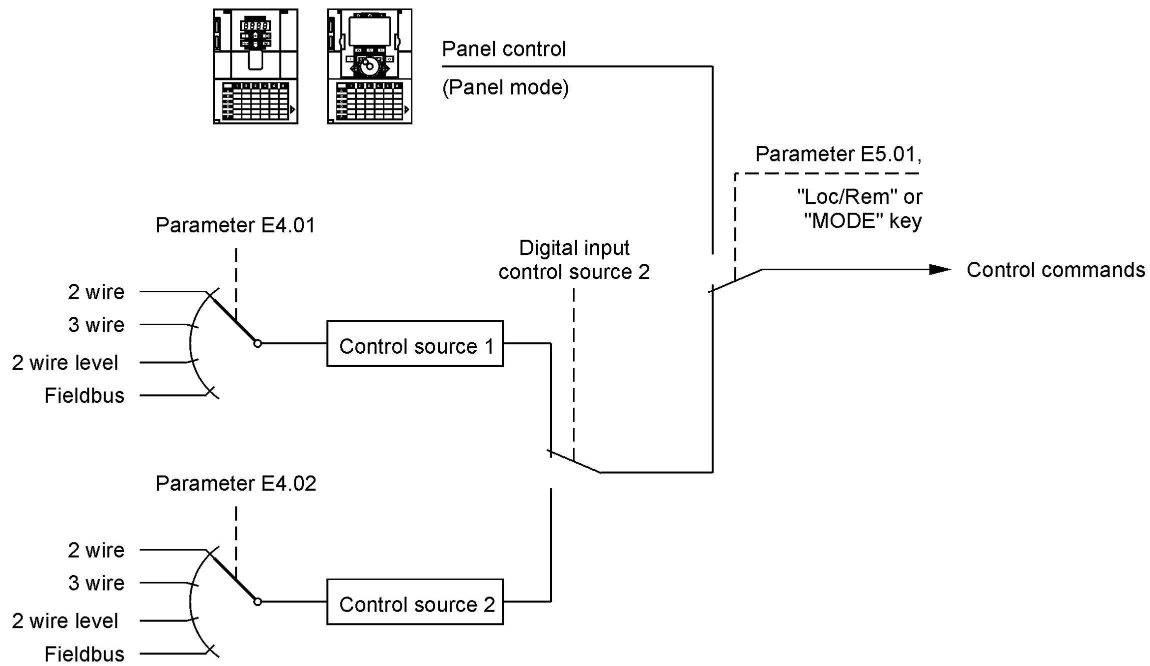
Panel control

The panel control of the device occurs by means of the keys on the built-in LED-keypad or the removable Matrix operating panel. The switching between panel mode and remote mode (terminals or bus) can also occur by means of a key on the keypad or via a terminal command.

The autoreset function must not be used in case of panel control.

Selection of the control source:

The internal design of the control path is structured in such a way that it can be switched between two configurable remote control sources and the panel mode. As a result you can switch between two different control sources or locations without losing the panel control on the inverter keypad.



If a switching of the control source from the fieldbus to the terminals is necessary, the actual operating state of the fieldbus can be assumed shock-free in case of switching by means of a tracking 3-wire-control.

E4.01	Control source 1				1 .. 2-wire (edge rated)

0 ...Not used
1 ...2-wire (edge rated)
2 ...3-wire
3 ...2-wire (level rated)
4 ...Bus

E4.02	Control source 2				0 .. Not used

0 ...Not used
1 ...2-wire (edge rated)
2 ...3-wire
3 ...2-wire (level rated)
4 ...Bus

E4.03	3-wire-control				0 .. No tracking

0 ...No tracking
1 ...Tracking

HTIU 8 P01 023 EN.04/04

Parameters E4.01 and E4.02 allocate a control variant to the control source 1 and 2. It is possible to switch between both control sources by means of a digital input with the function "Control source 2" (see Matrix field D2, page 169).

The switching of the control source can occur at any time. After the switching the commands of the selected source apply.

If no input is parameterized or the parameterized input is not closed, the signal of the control source 1 applies.

By switching to a control source with 3-wire control, the actual operation state can be assumed. Set parameter E4.03 to "1 .. Tracking" therefore.

If the reference value tracking of the motor potentiometer is used (see C1.25) a shock-free switching of fieldbus to terminal operation is possible.

E5		Keypad	Functionalities of the operating panel, copy function

Panel operation

E5.01	Local mode				1 .. Button at the keypad

1 ...Button at the keypad
2 ...Locked
3 ...Activated by DI
4 ...Always active

Parameter E5.01 defines the behaviour of the inverter if panel operation is selected.

Depending on the process demands one of the following reactions can be selected:

Setting	Switching between panel and remote mode occurs by...
0 .. Button at the keypad	Button at the LED keypad or the Matrix operating panel LED keypad: Push the button MODE until the LED "LOC" indicates the desired state. Matrix operating panel: Press the function key F1 Loc/Rem. The active mode is shown In the field operating mode.
1 .. Locked	No switching to panel mode is possible.
2 .. Activated by DI	Switch-over by means of the digital input function "Panel operation" (setting in Matrix field D2).
3 .. Always active	Panel mode is always active. There is no switch-over to remote mode possible.

E5.02	Local reset				1 .. Possible

0 ...Not possible
1 ...Possible

The setting of parameter E5.02 determines whether a resetting by means of the stop key on the LCD keypad or the Matrix operating panel is possible.

If this is not allowed the reset occurs via a positive edge of the digital input function "Ext. reset" (configuration in Matrix field D2) or via an active fieldbus coupling.

E5.03	Keypad stop button				1 .. Local mode

1 ...Local mode
2 ...always

Parameter E5.03 determines whether the stop key on the LCD keypad or on the Matrix operating panel is also active in remote operation.

At setting "2 .. always" a stop command can be initiated also during control of the inverter via the terminals or with field bus.

The function is not to be used when using the 2-wire control (level-rated) !

HTIU
8 P01 023 EN.04/04

Parameter transfer with Matrix operating panel *>pDRIVE< BE11*

The removable Matrix operating panel *>pDRIVE< BE11* provides also a parameter copy function in addition to the simple clear text parameterization in a multitude of languages. In one operating panel up to four different parameter settings can be saved.

By selecting E5.04 "Copy: MX -> Keypad" all adjustable parameters are loaded from the inverter into a free file on the keypad and are saved there.

A file which is saved in the operating panel is written back in an inverter by means of the parameter E5.05 "Copy: Keypad -> MX", whereby the transference in this direction can only be carried out by compliance with specific rules.

Before starting the parameter transfer, the file saved in the operating panel is compared with the actual frequency inverter type, its software status and the nominal power (scaling) by means of an automatic running test routine in order to guarantee a successful transference.

Depending on the inspection results the following restrictions are given for the transfer:

Inspection result			Parameter transfer Operating panel → *>pDRIVE< MX eco*
Inverter type	Index software	Scaling	
=	=	=	No restriction at all All parameters saved in the operating panel can be transmitted into the target device.
=	=	≠	The saved file derives from an inverter with varying scaling. A transfer of scaled parameter values would lead to a misinterpretation in the target device. For this reason the following parameters are not transmitted (motor data): B4.05 "Nominal power M1", B4.06 "Nominal current M1", B4.12 "Stator resistor M1", B4.17 "Nominal power M2", B4.18 "Nominal current M2", B4.24 "Stator resistor M2" A manual check or correction is necessary.
=	≠	x	The saved file derives from an inverter with varying family index of the applicative software. The parameters saved in the operating panel do not correspond to those in the frequency inverter. No transmission is possible.
≠	x	x	The saved file derives from an inverter of different type. A parameter transfer between the frequency inverters of type *>pDRIVE< MX eco*, *>pDRIVE< MX pro* or *>pDRIVE< LX* is not possible.

E5.04	Copy: MX -> Keypad

1 ...File 1	Available / used
2 ...File 2	Available / used
3 ...File 3	Available / used
4 ...File 4	Available / used

The copy function from the inverter to the keypad automatically transmits all parameters that are proper and required into one of four possible files. If a file is selected that is already used, its content is overwritten.

When the files (1...4) should be individually labelled, the desired name can be adjusted with parameters E5.06...E5.09 before the parameter transfer is started.

HTIU
8 P01 023 EN.04/04

E5.05	Copy: Keypad -> MX				

1 ...File 1
2 ...File 2
3 ...File 3
4 ...File 4

With the function "Copy: Keypad -> MX" the following areas can be selected:

Selection	Function
0 .. abort	Parameter transfer is not started.
1 .. all parameters	All available parameter groups (application parameters, motor data, calibration values of the system, texts) are transferred from the matrix operating panel into the inverter.
2 .. all para. excl. motor	The parameter groups application parameters, calibration values of the system and texts are transferred from the matrix operating panel into the inverter.
3 .. Application parameters	Only the application parameters are transferred from the matrix operating panel into the inverter (macro values).
4 .. Motor data	Only the group of motor data is transferred from the matrix operating panel into the inverter (motor data and autotuning values).
5 .. System values	Only the calibration values of the system are transferred from the matrix operating panel into the inverter (e.g. position values of the slowdown function or SFB positioning).
6 .. Texts	Only the group of texts is transferred from the matrix operating panel into the inverter (free editable texts, e.g. Ext. fault 1 name).

Parameters such as actual values, meters, routines, service parameters, release of emergency operation as well as scaling and calibration values are generally taken out of the copy function of the *>pDRIVE< BE11*.

E5.06	Label for file 1	**txt**			
E5.07	Label for file 2	**txt**			
E5.08	Label for file 3	**txt**			
E5.09	Label for file 4	**txt**			

Parameters E5.06...E5.09 enable to rename the preset texts "File 1"..."File 4".

The desired file name must be entered already before copying the data by means of parameter E5.04 Copy: MX -> Keypad.

BE11 monitoring

The removable matrix operating panel >*pDRIVE*< *BE11* can be used as an easy-to-use reference source.

When the matrix operating panel is plugged at the inverter, it is no safety risk to remove the BE11 even during active panel control because its function is taken over from the integrated LED keypad.

But when the operating panel is connected to the inverter by means of the door mounting kit >*pDRIVE*< *DMK11*, removing the BE11 may lead to loss of control. For this case, the function "BE11 monitoring" must be activated.

E5.12	BE11 monitoring				0 .. Not active

0 ...Not active
1 ...Active

E5.13	BE11 monitor. response				3 .. -Δt- fault

1 ...-Δt- alarm
2 ...Alarm -Δt- fault
3 ...-Δt- fault

Parameter E5.13 defines the behaviour of the inverter if the BE11 monitoring triggers.

Depending on the accessibility of the matrix operating panel and the integrated LED keypad, one of the following reactions can be selected:

Setting	Behaviour if the BE11 monitoring triggers
1 .. -Δt- alarm	No shut-down of the inverter takes place. The alarm message "BE11 loss", which can be delayed, is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "BE11 loss". After an adjustable delay a fault shut-down with the message "BE11 loss" takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down with the message "BE11 loss" takes place.

E5.14	Time Δt				0 s

0...3200 s

Delay time for the reaction after trigger of the BE11 monitoring.

The *>pDRIVE< MX eco* includes a multitude of PLC functions such as comparators, logic blocks, storage elements (Flip/Flop) and time modules which are free for use. In this way the multiple functions of the *>pDRIVE< MX eco* can be additionally adapted to the requirements of the application without installing an external control logic.

In addition to external components, extensive planning, mounting, checking and documentation are also omitted as they are covered by the inverter electronics and the parameter documentation.

The usability ranges from the adaptation of the software functions when exchanging devices from other companies up to small self-sufficient controls, which for example monitor process sequences and which can be used for messages as well as for autonomous intervention in the inverter operation.

The biggest advantage is the simple handling by means of the inverter parameterization. Required functions are simply described and programmed by means of only few basic modules and usage of the standard available analog and digital in- and outputs in the inverter, processing of the reference value, computing functions, counters etc.

Following functional units are available:

Function	Quantity	Description	Additional functions
Comparator	4	Module for comparison of two analog values All actual values known in the inverter as well as all reference value inputs are available as values.	– Comparison "A > B", "A < B", "A = B" and "A <> B" – Adjustable hysteresis or band width – Adjustable filter for both input signals – Comparison with fixed reference value or analog size
Logic module	6	Module with logical operation of maximum 3 digital signals. All digital states known in the inverter as well as digital inputs, free bits in the fieldbus, comparator outputs, flip-flops and time modules are available as signals.	– Logical functions "and", "Or", "equal" and "unequal" – Negation of the input possible – Inverting the function – Automatic adaptation of functions when using only 2 inputs
Storage element	2	Flip-flop storage element with set- and reset- input Control inputs like for logic modules	– Prioritized setting or deleting selectable
Time module	6	Freely connectable time modules Control inputs like for logic modules Outputs for connecting to internal objects (inverter functions) or to a digital output / relay	– Selectable time functions "ON delayed", "OFF delayed", "ON & OFF delayed" and pulse output – Extensible adjustable time range
Alarm logic module	1	Allows a logical operation of up to 6 free selectable alarm messages for free further use within the function blocks.	– Logical functions "and", "Or"
Trip logic module	1	Allows a logical operation of up to 6 free selectable trip messages for free further use within the function blocks.	– Logical functions "and", "Or"

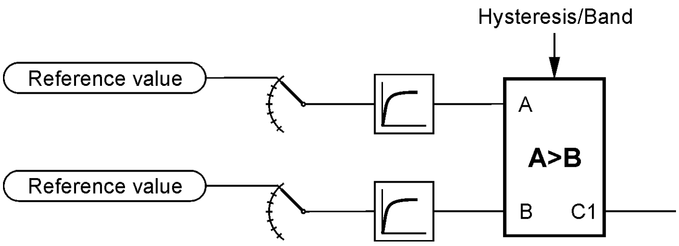
All function blocks are freely combinable with the in- and outputs of the inverters as well as among each other. The end of a logical linkage must however always represent a timing element.

For simple signal tracking each function block is equipped with a monitor parameter which displays the logical state of the output.

If individual function blocks are parameterized incompletely or improperly, the alarm message "E6 incomplete" is set. This message also appears if more than ten modules are linked to each other.

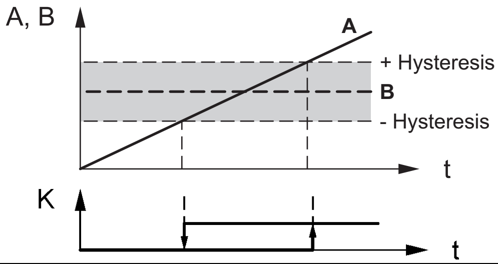
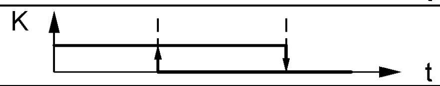
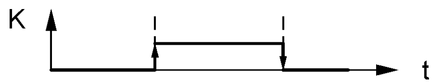
As long as the alarm message "E6 incomplete" is present, the function blocks are not active !

Comparator C1 - C4



The comparators are used for comparison of two analog values. All inverter-internal actual and reference values as well as an adjustable reference value can be used as signal.

The following operations for comparison are available:

Comparison operations	Output C changes to HIGH, when...	Output C changes to LOW, when...	Example
A > B	Signal A greater than signal B + hysteresis	Signal A less than signal B - hysteresis	
A < B	Signal A less than signal B - hysteresis	Signal A greater than signal B + hysteresis	
A = B	Signal A greater than signal B - hysteresis but less than signal B + hysteresis	Signal A less than signal B - hysteresis or greater than signal B + hysteresis	
A <> B	Signal A less than signal B - hysteresis or greater than signal B + hysteresis	Signal A greater than signal B - hysteresis but less than signal B + hysteresis	

E6.01	Comparator C1				0 .. Not active

0 ...Not active
1 ...Active

E6.02	C1 signal A selection				0 .. Ref. value

0 ...Ref. value	21 .. Int. ref. switch-over	45...Bus SW 4
1 ...0%	22 .. Calculator	46...Bus SW 5
2 ...100%	23 .. Curve generator	47...Bus SW 6
3 ...Actual frequency	26 .. PID-reference val. [%]	48...Bus SW 7
4 ...|Actual frequency|	27 .. PID-actual value [%]	49...Bus SW 8
5 ...Motor current	28 .. PID-deviation [%]	50...Bus SW 9
6 ...Torque	29 .. PID-output	58...AI 1
7 ...|Torque|	32 .. Thermal load M1	59...AI 2
8 ...Power	33 .. Thermal load M2	60...AI 3
9 ...|Power|	34 .. Thermal load VSD	61...AI 4
10...Speed	35 .. Counter (average)	62...Frequency input
11...|Speed|	36 .. Total counter	63...Motor potentiometer
12...Motor voltage	37 .. Speed machine	64...Pre-set reference
13...DC voltage	42 .. Bus SW 1	65...MX-wheel
16...Int. f-ref. before ramp	43 .. Bus SW 2	66...LFP input
17...Int. f-ref. after ramp	44 .. Bus SW 3	

E6.03	C1 signal A filter-time				0 s

0...300 s

E6.04	C1 signal B selection				0 .. Ref. value

0 ...Ref. value	21 .. Int. ref. switch-over	45...Bus SW 4
1 ...0%	22 .. Calculator	46...Bus SW 5
2 ...100%	23 .. Curve generator	47...Bus SW 6
3 ...Actual frequency	26 .. PID-reference val. [%]	48...Bus SW 7
4 ...|Actual frequency|	27 .. PID-actual value [%]	49...Bus SW 8
5 ...Motor current	28 .. PID-deviation [%]	50...Bus SW 9
6 ...Torque	29 .. PID-output	58...AI 1
7 ...|Torque|	32 .. Thermal load M1	59...AI 2
8 ...Power	33 .. Thermal load M2	60...AI 3
9 ...|Power|	34 .. Thermal load VSD	61...AI 4
10...Speed	35 .. Counter (average)	62...Frequency input
11...|Speed|	36 .. Total counter	63...Motor potentiometer
12...Motor voltage	37 .. Speed machine	64...Pre-set reference
13...DC voltage	42 .. Bus SW 1	65...MX-wheel
16...Int. f-ref. before ramp	43 .. Bus SW 2	66...LFP input
17...Int. f-ref. after ramp	44 .. Bus SW 3	

E6.05	C1 ref. value				0

-300...300

E6.06	C1 signal B filter-time				0 s

0...300 s

E6.07	C1 function				1 .. A > B

1 ...A > B
2 ...A < B
3 ...A = B
4 ...A <> B

E6.08	C1 hysteresis/band				5

0...650

E6.09	C1 output				

0 ...OFF
1 ...ON

HTIU
8 P01 023 EN.04/04

E6.10	Comparator C2				0 .. Not active
E6.11	C2 signal A selection				0 .. Ref. value
E6.12	C2 signal A filter-time				0 s
E6.13	C2 signal B selection				0 .. Ref. value
E6.14	C2 ref. value				0
E6.15	C2 signal B filter-time				0 s
E6.16	C2 function				1 .. A > B
E6.17	C2 hysteresis/band				5
E6.18	C2 output				

E6.19	Comparator C3				0 .. Not active
E6.20	C3 signal A selection				0 .. Ref. value
E6.21	C3 signal A filter-time				0 s
E6.22	C3 signal B selection				0 .. Ref. value
E6.23	C3 ref. value				0
E6.24	C3 signal B filter-time				0 s
E6.25	C3 function				1 .. A > B
E6.26	C3 hysteresis/band				5
E6.27	C3 output				

E6.28	Comparator C4				0 .. Not active
E6.29	C4 signal A selection				0 .. Ref. value
E6.30	C4 signal A filter-time				0 s
E6.31	C4 signal B selection				0 .. Ref. value
E6.32	C4 ref. value				0
E6.33	C4 signal B filter-time				0 s
E6.34	C4 function				1 .. A > B
E6.35	C4 hysteresis/band				5
E6.36	C4 output				

HTIU
8 P01 023 EN.04/04

When "Cx Signal B Selection" is set to "0 .. Ref. value," the corresponding reference value is used automatically.

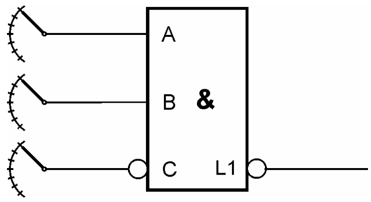
The alarm message "E6 incomplete" appears in case of an activated comparator if:

– Input A is not used.

Scaling of the available comparator signals

Process size	Unit	Scaling
3 .. Actual frequency	Hz	–
4 .. |Actual frequency|	Hz	–
5 .. Motor current	%	100 % = Nominal motor current B4.06 (B4.18)
6 .. Torque	%	100 % = Nominal motor torque B4.05, B4.09 (B4.17, B4.21)
7 .. |Torque|	%	100 % = Nominal motor torque B4.05, B4.09 (B4.17, B4.21)
8 .. Power	%	100 % = Nominal motor power B4.05 (B4.17)
9 .. |Power|	%	100 % = Nominal motor power B4.05 (B4.17)
10 .. Speed	%	100 % = Nominal speed at f_{MAX} (C2.02)
11 .. |Speed|	%	100 % = Nominal speed at f_{MAX} (C2.02)
12 .. Motor voltage	%	100 % = Nominal voltage motor B4.07 (B4.19)
13 .. DC voltage	%	100 % = 1000 V DC
16 .. Int. f-ref. before ramp	Hz	–
17 .. Int. f-ref. after ramp	Hz	–
21 .. Int. ref. switch-over	% or Hz	–
22 .. Calculator	% or Hz	–
23 .. Curve generator	% or Hz	–
26 .. PID-reference val. [%]	%	–
27 .. PID-actual value [%]	%	–
28 .. PID-deviation [%]	%	–
29 .. PID-output	% or Hz	–
32 .. Thermal load M1	%	–
33 .. Thermal load M2	%	–
34 .. Thermal load VSD	%	–
35 .. Counter (average)	–	max. 6553.5 (counter value without unit)
36 .. Total counter	–	max. 6553.5 (counter value without unit)
37 .. Speed machine	rpm	–
42 .. Bus SW 1	% or Hz	–
43 .. Bus SW 2	% or Hz	–
44 .. Bus SW 3	% or Hz	–
45 .. Bus SW 4	% or Hz	–
46 .. Bus SW 5	% or Hz	–
47 .. Bus SW 6	% or Hz	–
48 .. Bus SW 7	% or Hz	–
49 .. Bus SW 8	% or Hz	–
50 .. Bus SW 9	% or Hz	–
58 .. AI 1	% or Hz	–
59 .. AI 2	% or Hz	–
60 .. AI 3	% or Hz	–
61 .. AI 4	% or Hz	–
62 .. Frequency input	% or Hz	–
63 .. Motor potentiometer	% or Hz	–
64 .. Pre-set reference	% or Hz	–
65 .. MX-wheel	% or Hz	–
66 .. LFP input	% or Hz	–

Logic module L1 - L6



The logic modules are used for logical operation with up to three digital signals. All signal states known in the inverter as well as digital inputs and the outputs of the function blocks can be used.

The following logical operations are available:

Logical operation	Output L is HIGH, when...	Output L is LOW, when...	Function table
and	all used inputs are high	one of the used inputs is low	C B A | L 0 0 0 | 0 0 0 1 | 0 0 1 0 | 0 0 1 1 | 0 1 0 0 | 0 1 0 1 | 0 1 1 0 | 0 1 1 1 | 1 B A | L 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
Or	one of the used inputs is high	all used inputs are low	C B A | L 0 0 0 | 0 0 0 1 | 1 0 1 0 | 1 0 1 1 | 1 1 0 0 | 1 1 0 1 | 1 1 1 0 | 1 1 1 1 | 1 B A | L 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1
equal	all used inputs are either high or low	not all used inputs are either high or low	C B A | L 0 0 0 | 1 0 0 1 | 0 0 1 0 | 0 0 1 1 | 0 1 0 0 | 0 1 0 1 | 0 1 1 0 | 0 1 1 1 | 1 B A | L 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 1
unequal	not all used inputs are either high or low	all used inputs are either high or low	C B A | L 0 0 0 | 0 0 0 1 | 1 0 1 0 | 1 0 1 1 | 1 1 0 0 | 1 1 0 1 | 1 1 1 0 | 1 1 1 1 | 0 B A | L 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 0

HTIU
8 P01 023 EN.04/04

Logical operation	Output L is HIGH, when...	Output L is LOW, when...	Function table
and (C inverted)	Like setting "and", but input C acts inverted.		
Or (C inverted)	Like setting "Or", but input C acts inverted.		
equal (C inverted)	Like setting "equal", but input C acts inverted.		
unequal (C inverted)	Like setting "unequal", but input C acts inverted.		

E6.46	Logic 1				0 .. Not active

0 ...Not active
1 ...Active

E6.47	LM1 signal A selection				0 .. Not used
E6.48	LM1 signal B selection				0 .. Not used
E6.49	LM1 signal C selection				0 .. Not used

0 ...Not used
1 ...Logic 0
2 ...Logic 1
3 ...Ready
4 ...Operation
5 ...Trip
7 ...Ready / run
8 ...Sum alarm
9 ...Generator operation
10...Motor turns
11...Panel mode active
12...f = f ref
15...PID-active
16...PID-lock
17...PID-wind up
20...Motor heating
21...Standby mode active
22...Force active
25...DC link charged
26...Mains voltage OK
27...Safe standstill active
28...Line Contactor ON
30...Motor contactor open
33...External fault 1
34...External fault 2
35...Process fault 1
36 .. Process fault 2
37 .. Process fault 3
38 .. Alarm category 1
39 .. Alarm category 2
40 .. Alarm category 3
41 .. Alarm ϑ M1 >
42 .. Alarm ϑ M2 >
43 .. Alarm ϑ ext. >
44 .. Bus alarm
47 .. 4mA loss
48 .. Alarm V<
54 .. Limitation active
57 .. Motor 1 active
58 .. Motor 2 active
59 .. Param.-set 1 active
60 .. Param.-set 2 active
63 .. Digital input DI1
64 .. Digital input DI2
65 .. Digital input DI3
66 .. Digital input DI4
67 .. Digital input DI5
80 .. Output C1
81 .. Output C2
82 .. Output C3
83 .. Output C4
86 .. Output LM1
87...Output LM2
88...Output LM3
89...Output LM4
90...Output LM5
91...Output LM6
94...Output SR1
95...Output SR2
96...Output alarm module
97...Trip logic output
98...Output T1
99...Output T2
100.Output T3
101.Output T4
102.Output T5
103.Output T6
106.Bus STW bit 11
107.Bus STW bit 12
108.Bus STW bit 13
109.Bus STW bit 14
110.Bus STW bit 15
111.Output Zone 1
112.Output Zone 2
113.Output Zone 3
114.Output Zone 4
117.Pulse generator

E6.50	LM1 function				1 .. and

1 ...and
2 ...Or
3 ...equal
4 ...unequal
5 ...and (C inverted)
6... Or (C inverted)
7... equal (C inverted)
8... unequal (C inverted)

E6.51	LM1 output reverse				0 .. No

0 ...No
1 ...Yes

E6.52	LM1 output				

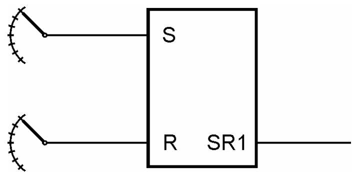
0 ...OFF
1 ...ON

E6.53	Logic 2				0 .. Not active
E6.54	LM2 signal A selection				0 .. Not used
E6.55	LM2 signal B selection				0 .. Not used
E6.56	LM2 signal C selection				0 .. Not used
E6.57	LM2 function				1 .. and
E6.58	LM2 output reverse				0 .. No
E6.59	LM2 output				
E6.60	Logic 3				0 .. Not active
E6.61	LM3 signal A selection				0 .. Not used
E6.62	LM3 signal B selection				0 .. Not used
E6.63	LM3 signal C selection				0 .. Not used
E6.64	LM3 function				1 .. and
E6.65	LM3 output reverse				0 .. No
E6.66	LM3 output				
E6.67	Logic 4				0 .. Not active
E6.68	LM4 signal A selection				0 .. Not used
E6.69	LM4 signal B selection				0 .. Not used
E6.70	LM4 signal C selection				0 .. Not used
E6.71	LM4 function				1 .. and
E6.72	LM4 output reverse				0 .. No
E6.73	LM4 output				
E6.74	Logic 5				0 .. Not active
E6.75	LM5 signal A selection				0 .. Not used
E6.76	LM5 signal B selection				0 .. Not used
E6.77	LM5 signal C selection				0 .. Not used
E6.78	LM5 function				1 .. and
E6.79	LM5 output reverse				0 .. No
E6.80	LM5 output				
E6.81	Logic 6				0 .. Not active
E6.82	LM6 signal A selection				0 .. Not used
E6.83	LM6 signal B selection				0 .. Not used
E6.84	LM6 signal C selection				0 .. Not used
E6.85	LM6 function				1 .. and
E6.86	LM6 output reverse				0 .. No
E6.87	LM6 output				

The alarm message "E6 incomplete" appears in case of activated logic modules if:

- Input A is not used.
- Inputs B and C are not used.
- Input C is not used and setting "C inverted" is selected at the same time.

Flip Flop



The output of the storage element (FlipFlop) can be set or reset by means of a short impulse at both inputs. All signal states known in the inverter as well as digital inputs and the outputs of the function blocks can be used. They have no remanence in case of voltage loss.

The following function variants are available:

<table>
<tr><th>Logical operation</th><th>Output SR is HIGH</th><th>Output SR is LOW</th><th>Function table</th></tr>
<tr><td>S(et) dominant</td><td>in case of positive signal edge at input S(et), even when input R(eset) is high simultaneously</td><td>after positive signal edge at input R(eset), if input S(et) is not high</td><td><table><tr><th>R</th><th>S</th><th>SR</th></tr><tr><td>0</td><td>0</td><td>x</td></tr><tr><td>0</td><td></td><td>1</td></tr><tr><td>1</td><td></td><td>1</td></tr><tr><td></td><td>0</td><td>0</td></tr><tr><td></td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>x</td></tr></table></td></tr>
<tr><td>R(eset) dominant</td><td>in case of positive signal edge at input S(et), if input R(eset) is not high</td><td>after positive signal edge at input R(eset), even when input S(et) is high simultaneously.</td><td><table><tr><th>R</th><th>S</th><th>SR</th></tr><tr><td>0</td><td>0</td><td>x</td></tr><tr><td>0</td><td></td><td>1</td></tr><tr><td>1</td><td></td><td>0</td></tr><tr><td></td><td>0</td><td>0</td></tr><tr><td></td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>x</td></tr></table></td></tr>
</table>

E6.94	SR module 1				0 .. Not active

0 ...Not active
1 ...Active

E6.95	SR1 signal S selection				0 .. Not used
E6.96	SR1 signal R selection				0 .. Not used

0 ...Not used	36 .. Process fault 2	87.. Output LM2
1 ...Logic 0	37 .. Process fault 3	88.. Output LM3
2 ...Logic 1	38 .. Alarm category 1	89.. Output LM4
3 ...Ready	39 .. Alarm category 2	90.. Output LM5
4 ...Operation	40 .. Alarm category 3	91.. Output LM6
5 ...Trip	41 .. Alarm ϑ M1 >	94.. Output SR1
7 ...Ready / run	42 .. Alarm ϑ M2 >	95.. Output SR2
8 ...Sum alarm	43 .. Alarm ϑ ext. >	96.. Output alarm module
9 ...Generator operation	44 .. Bus alarm	97.. Trip logic output
10...Motor turns	47 .. 4mA loss	98.. Output T1
11...Panel mode active	48 .. Alarm V<	99.. Output T2
12...f = f ref	54 .. Limitation active	100 Output T3
15...PID-active	57 .. Motor 1 active	101 Output T4
16...PID-lock	58 .. Motor 2 active	102 Output T5
17...PID-wind up	59 .. Param.-set 1 active	103 Output T6
20...Motor heating	60 .. Param.-set 2 active	106 Bus STW bit 11
21...Standby mode active	63 .. Digital input DI1	107 Bus STW bit 12
22...Force active	64 .. Digital input DI2	108 Bus STW bit 13
25...DC link charged	65 .. Digital input DI3	109 Bus STW bit 14
26...Mains voltage OK	66 .. Digital input DI4	110 Bus STW bit 15
27...Safe standstill active	67 .. Digital input DI5	111 Output Zone 1
28...Line Contactor ON	80 .. Output C1	112 Output Zone 2
30...Motor contactor open	81 .. Output C2	113 Output Zone 3
33...External fault 1	82 .. Output C3	114 Output Zone 4
34...External fault 2	83 .. Output C4	117 Pulse generator
35...Process fault 1	86 .. Output LM1	

E6.97	SR1 function				1 .. S(et) dominant

1 ...S(et) dominant
2 ...R(eset) dominant

E6.98	SR1 output				

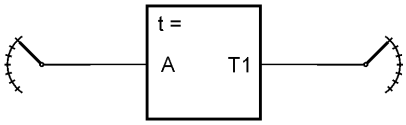
0 ...OFF
1 ...ON

E6.99	SR module 2				0 .. Not active
E6.100	SR2 signal S selection				0 .. Not used
E6.101	SR2 signal R selection				0 .. Not used
E6.102	SR2 function				1 .. S(et) dominant
E6.103	SR2 output				

The alarm message "E6 incomplete" appears in case of activated storage elements if:

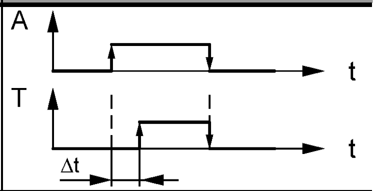
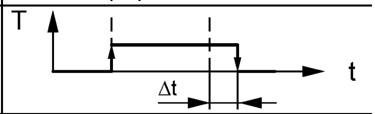
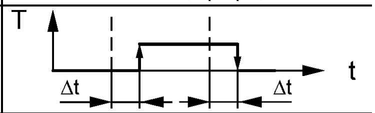
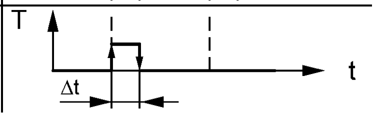
- Input S is not used.
- Input R is not used.

Time device



The time modules are used for completion of a functional network. The network is not ready for use until the time module is parameterized. All signal states known in the inverter as well as digital inputs and the outputs of the function blocks can be used as input signals.

The following time functions are available:

Logical operation	Output T is HIGH, when...	Output T is LOW, when...	Example
ON delayed	Input signal high and time Δt has elapsed	Input signal low	
OFF delayed	Input signal high	Input signal low and time Δt has elapsed	
ON & OFF delayed	Input signal high and time Δt has elapsed	Input signal low and time Δt has elapsed	
Impulse	during Δt after a positive signal edge at the input	no impulse given	

E6.109	Time module 1				0 .. Not active

0 ...Not active
1 ...Active

E6.110	T1 signal A selection				0 .. Not used

0 ...Not used
1 ...Logic 0
2 ...Logic 1
3 ...Ready
4 ...Operation
5 ...Trip
7 ...Ready / run
8 ...Sum alarm
9 ...Generator operation
10...Motor turns
11...Panel mode active
12...f = f ref
15...PID-active
16...PID-lock
17...PID-wind up
20...Motor heating
21...Standby mode active
22...Force active
25...DC link charged
26...Mains voltage OK
27...Safe standstill active
28...Line Contactor ON
30...Motor contactor open
33...External fault 1
34...External fault 2
35...Process fault 1
36 ..Process fault 2
37 ..Process fault 3
38 ..Alarm category 1
39 ..Alarm category 2
40 ..Alarm category 3
41 ..Alarm ϑ M1 >
42 ..Alarm ϑ M2 >
43 ..Alarm ϑ ext. >
44 ..Bus alarm
47 ..4mA loss
48 ..Alarm V<
54 ..Limitation active
57 ..Motor 1 active
58 ..Motor 2 active
59 ..Param.-set 1 active
60 ..Param.-set 2 active
63 ..Digital input DI1
64 ..Digital input DI2
65 ..Digital input DI3
66 ..Digital input DI4
67 ..Digital input DI5
80 ..Output C1
81 ..Output C2
82 ..Output C3
83 ..Output C4
86 ..Output LM1
87.. Output LM2
88.. Output LM3
89.. Output LM4
90.. Output LM5
91.. Output LM6
94.. Output SR1
95.. Output SR2
96.. Output alarm module
97.. Trip logic output
98.. Output T1
99.. Output T2
100 Output T3
101 Output T4
102 Output T5
103 Output T6
106 Bus STW bit 11
107 Bus STW bit 12
108 Bus STW bit 13
109 Bus STW bit 14
110 Bus STW bit 15
111 Output Zone 1
112 Output Zone 2
113 Output Zone 3
114 Output Zone 4
117 Pulse generator

E6.111	T1 function				1 .. ON delayed

1 ...ON delayed
2 ...OFF delayed
3 ...ON & OFF delayed
4 ...Impulse

E6.112	T1 Time Δt				0 s

0...6500 s

E6.113	T1 output				

0 ...OFF
1 ...ON

E6.114	T1 selection				0 .. Not used

0 ...Not used
1 ...Start FW (2 wire)
2 ...Start REV (2 wire)
3 ...Start FW (3 wire)
4 ...Start REV (3 wire)
5 ...Stop (3 wire)
6 ...Fast stop
7 ...Enable
11...f-ref reverse
14...Motor pot. +
15...Motor pot. -
16...Pre-set A
17...Pre-set B
18...Pre-set C
19...Pre-set D
22...f-reference 2 [Hz]
23...Control source 2
24...2nd ramp
25 .. Reference value B
26 .. Panel operation
29 .. External fault 1
30 .. External fault 2
31 .. Ext. reset
32 .. Emergency operation
35 .. PID-active
36 .. PID-lock
37 .. PID-wind up
40 .. Feed in pressure OK
41 .. Level OK
42 .. Level <
50 .. C. motor 1 ready
51 .. C. motor 2 ready
52 .. C. motor 3 ready
53 .. C. motor 4 ready
54 .. Start VSD cascade
56 .. Mains cut-off
57...ON lock
58...Locking
59...Feedb. motor cont.
60...Motor heating
64...Pulse counter input
65...Pulse counter reset
66...n-monitoring
67...Parameter locked
75...2nd motor
76...2nd parameter set
77...P15-set B
78...P15-set C
106.LFP input
107.Process fault 1
108.Process fault 2
109.Process fault 3

E6.115	Time module 2				0 .. Not active
E6.116	T2 signal A selection				0 .. Not used
E6.117	T2 function				1 .. ON delayed
E6.118	T2 Time Δt				0 s
E6.119	T2 output				
E6.120	T2 selection				0 .. Not used

E6.121	Time module 3				0 .. Not active
E6.122	T3 signal A selection				0 .. Not used
E6.123	T3 function				1 .. ON delayed
E6.124	T3 Time Δt				0 s
E6.125	T3 output				
E6.126	T3 selection				0 .. Not used

E6.127	Time module 4				0 .. Not active
E6.128	T4 signal A selection				0 .. Not used
E6.129	T4 function				1 .. ON delayed
E6.130	T4 Time Δt				0 s
E6.131	T4 output				
E6.132	T4 selection				0 .. Not used

E6.133	Time module 5				0 .. Not active
E6.134	T5 signal A selection				0 .. Not used
E6.135	T5 function				1 .. ON delayed
E6.136	T5 Time Δt				0 s
E6.137	T5 output				
E6.138	T5 selection				0 .. Not used

E6.139	Time module 6				0 .. Not active
E6.140	T6 signal A selection				0 .. Not used
E6.141	T6 function				1 .. ON delayed
E6.142	T6 Time Δt				0 s
E6.143	T6 output				
E6.144	T6 selection				0 .. Not used

The alarm message "E6 incomplete" appears in case of activated time modules if:

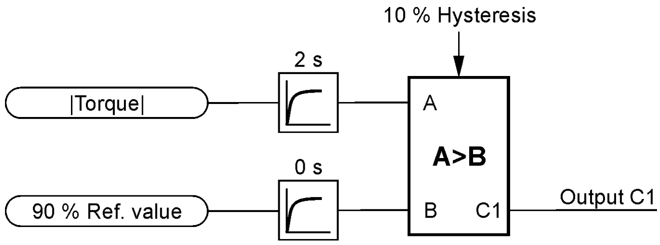
– Input A is not used.

Application example of function blocks

The load of a hydraulic pump of a centrifugal application should be monitored as follows:

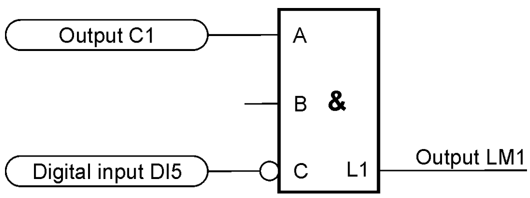
- When the torque (proportional to pressure) exceeds 100 %, a relay is activated that stops the feed-in of material and opens a flushing valve.
- When the torque falls below a value less than 80 %, the relay is terminated again in order to resume normal operation.
- This functionality has to be locked for test operation.
- Short-term pressure fluctuations must not lead to incorrect triggering.

Comparator C1



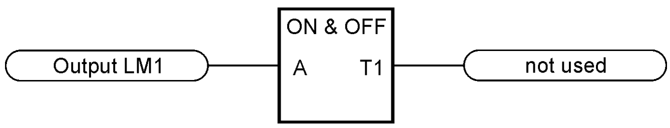
Parameter	Setting
E6.01 Comparator C1	Active
E6.02 C1 signal A selection	|Torque|
E6.03 C1 signal A filter-time	2 s
E6.04 C1 signal B selection	Ref. value
E6.05 C1 ref. value	90 %
E6.06 C1 signal B filter-time	0 s
E6.07 C1 function	A > B
E6.08 C1 hysteresis/band	10 %

Logic module LM1



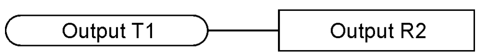
Parameter	Setting
E6.46 Logic 1	Active
E6.47 LM1 signal A selection	Output C1
E6.48 LM1 signal B selection	Not used
E6.49 LM1 signal C selection	Digital input DI5
E6.50 LM1 function	and (C inverted)
E6.51 LM1 output reverse	No

Time module T1



Parameter	Setting
E6.109 Time module 1	Active
E6.110 T1 signal A selection	Output LM1
E6.111 T1 function	ON & OFF delayed
E6.112 T1 Time Δt	2 s
E6.114 T1 selection	Not used

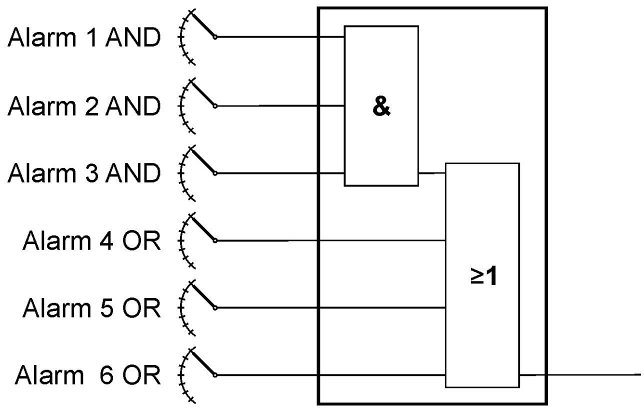
Relay R2



Parameter	Setting
D4.02 R2 selection	Output T1

HTIU
8 P01 023 EN.04/04

Alarm logic module



The alarm logic module allows to combine alarm messages that occur at the same time by the logical operations AND and OR and thus a further use in the function blocks is possible.

E6.151	Alarm Logic module				0 .. Not active

0 ...Not active
1 ...Active

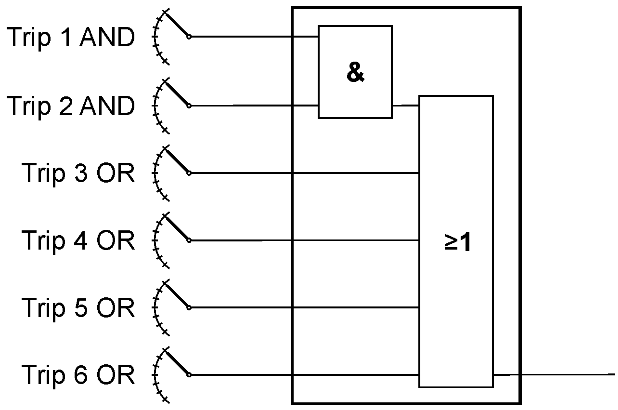
E6.152	Alarm 1 AND				0 .. No alarm
E6.153	Alarm 2 AND				0 .. No alarm
E6.154	Alarm 3 AND				0 .. No alarm
E6.155	Alarm 4 OR				0 .. No alarm
E6.156	Alarm 5 OR				0 .. No alarm
E6.157	Alarm 6 OR				0 .. No alarm

0 ...No alarm
1 ...Force active
2 ...Emergency op. active
3 ...External fault 1
4 ...External fault 2
5 ...Undervoltage
6 ...Reference fault AI2
7 ...Reference fault AI3
8 ...Reference fault AI4
9 ...Bus fault
11...Reference fault FP
12...Feed in <
13...ON-lock from DI
14...Speed check fault
15...ϑ M1 >
16...ϑ M2 >
17 ..Overspeed
18 ..TH - ϑ M1 >
19 ..TH - ϑ M2 >
20 ..TH ϑ Ext >
21 ..Underload
23 ..Ramp adaption
24 ..Service M1
25 ..Service M2
26 ..Service Power On
27 ..Service fan
28 ..Simulation active
29 ..Download active
30 ..E6 incomplete
31 ..XY Graph set faulty
32 ..Change control mode !
36 ..Param.set 1 fault
37.. Param.set 2 fault
38.. IGBT ϑ >
40.. V/f 7 point set faulty
45.. BE11 loss
46.. Control requ. missing
47.. Parameter set 1
48.. Parameter set 2
49.. Test mode active
51.. I-limit active
52.. T-limitation active
53.. Process fault 1
54.. Process fault 2
55.. Process fault 3

E6.160	Output alarm module				

0 ...OFF
1 ...ON

Trip logic module



The trip logic module allows further specific use of trip situations by means of the function blocks. Therefore selectable trip messages can be combined with the logical operation OR.

E6.161	Trip logic module				0 .. Not active

0 ...Not active
1 ...Active

E6.162	Trip 1 AND				0 .. No fault
E6.163	Trip 2 AND				0 .. No fault
E6.164	Trip 3 OR				0 .. No fault
E6.165	Trip 4 OR				0 .. No fault
E6.166	Trip 5 OR				0 .. No fault
E6.167	Trip 6 OR				0 .. No fault

0 ...No fault
1 ...Undervoltage
2 ...V>> at deceleration
3 ...Line overvoltage
4 ...MC not ready
5 ...DC missing
6 ...Precharging fault
8 ...Line fault 1p
9 ...Line fault 2-3p
10...Overcurrent
11...Motor earth fault
12...Insulation fault
13...Overcurrent
14...IGBT ϑ >>
15...Motor phase fault 3p
16...Motor phase U lost
17...Motor phase V lost
18...Motor phase W lost
19...Inverter overtemp.
20...Unknown MC
21...PTC short circuit
22...PTC open circuit
23...ASIC Init fault
25...IGBT fault
27...IGBT short circuit
28...Motor short circuit
30 .. Current measure fault
32 .. MC E² zones invalid
33 .. CPU fault
34 .. ISL fault
35 .. MTHA fault
36 .. Overspeed
37 .. Safe Standstill
38 .. IO12 comm. fault
39 .. Opt. comm. fault
40 .. Wrong option board
41 .. Bus fault
42 .. Param. config. fault
43 .. Reference fault AI2
44 .. Reference fault AI3
45 .. Reference fault AI4
46 .. Reference fault FP
47 .. TH ϑ M1 >>
48 .. TH ϑ M2 >>
49 .. TH ϑ Ext >>
50 .. ϑ M1 >>
51 .. ϑ M2 >>
52 .. Stall protection
53 .. Underload
54 .. Speed check fault
55 .. Feed in <<
56 .. AT-fault 1
57...Config. fault
58...External fault 1
59...External fault 2
60...Line contactor fault
61...Motor contactor error
62...Motor contactor error
63...ON lock
64...Internal SW error
65...Power rating fault
66...Incompatible MC
67...Flash fault APP
68...Indus zone fault
69...Eprom fault APP
71...Limitation active
72...Ramp adaption
73...24V fault
80...BE11 loss
81...VSD overload
82...I-limit active
83...T-limitation active
87...Process fault 1
88...Process fault 2
89...Process fault 3

E6.170	Output trip logic module				

0 ...OFF
1 ...ON

HTIU

8 P01 023 EN.04/04

F		**Service**	Service-orientated information and functions

F1		**Info**	Identification of the device, service notice

Identification of the device

Matrix field F1 contains information about the identification of the inverter (data of the rating plate). Additionally drive-specific texts like the facility description and a service notice of max. 4 lines can be adjusted by the user.

F1.01	Inverter type	txt			
F1.02	Nominal power				kW
F1.03	Nominal current				A
F1.04	Nominal voltage				

0 ...3x 220V
1 ...3x 380V-480V
2 ...3x 500V
3 ...3x 570V-690V

F1.05	Drive serial number				
F1.06	Facility description	txt			
F1.07	APP software	txt			

APSeco - A 02 - 11

- 11: Software version
- 02: Parameter version
- A: Parameter family
- APSeco: Type of program

F1.08	Service notice	txt			

HTIU
8 P01 023 EN.04/04

Force operation

By means of the force mode it is possible to simulate all inputs and outputs at the terminals. This is possible temporary for a signal check during commissioning or continuous, if necessary.

The signal level of digital inputs, relay outputs and digital outputs can be overwritten by ON or OFF independent of their actual state. For analog signals even the value for force mode can be set.

F2.01	Force operation				0 .. Force lock

0 ...Force lock
1 ...Force enable

Because the force operation overwrites chosen inputs and outputs software-internal, a reaction to incoming signals from superposed controls is not possible.

The force mode is a support for commissioning and it may be executed only if personal protection and protection of the drive is ensured.

To prevent unintended activation of force signals, a general release must be set before activating any force commands.

As long as the force mode is active, the info message "Force active" occurs on the LCD display.

F2.02	Force DI1				0 .. Not force
F2.03	Force DI2				0 .. Not force
F2.04	Force DI3				0 .. Not force
F2.05	Force DI4				0 .. Not force
F2.06	Force DI5				0 .. Not force
F2.07	Force DI6				0 .. Not force
F2.08	Force DI7				0 .. Not force
F2.09	Force DI8				0 .. Not force
F2.10	Force DI9				0 .. Not force
F2.11	Force DI10				0 .. Not force
F2.12	Force DI11				0 .. Not force
F2.13	Force DI12				0 .. Not force
F2.14	Force DI13				0 .. Not force
F2.15	Force DI14				0 .. Not force

0 ...Not force
1 ...Logic 1
2 ...Logic 0

F2.16	Force R1				0 .. Not force
F2.17	Force R2				0 .. Not force
F2.18	Force R3				0 .. Not force
F2.19	Force DO1				0 .. Not force
F2.20	Force DO2				0 .. Not force
F2.21	Force R4				0 .. Not force
F2.22	Force DO3				0 .. Not force
F2.23	Force DO4				0 .. Not force

0 ...Not force
1 ...Logic 1
2 ...Logic 0

F2.24	Force AI1				0 .. Not force

0 ...Not force
1 ...To force

F2.25	Force value AI1				10 V

-10...10 V

F2.26	Force AI2				0 .. Not force

0 ...Not force
1 ...To force

F2.27	Force value AI2				10 V or mA

0...20 V or mA

F2.28	Force AI3				0 .. Not force

0 ...Not force
1 ...To force

F2.29	Force value AI3				10 mA

0...20 mA

F2.30	Force AI4				0 .. Not force

0 ...Not force
1 ...To force

F2.31	Force value AI4				10 V or mA

0...20 V or mA

F2.32	Force FP				0 .. Not force

0 ...Not force
1 ...To force

F2.33	Force value FP				20 kHz

0...30 kHz

F2.34	Force AO1				0 .. Not force

0 ...Not force
1 ...To force

F2.35	Force value AO1				10 V or mA

0...20 V or mA

F2.36	Force AO2				0 .. Not force

0 ...Not force
1 ...To force

F2.37	Force value AO2				10 V or mA

-20...20 V or mA

F2.38	Force AO3				0 .. Not force

0 ...Not force
1 ...To force

F2.39	Force value AO3				10 V or mA

-20...20 V or mA

Test routines

F2.40	Start IGBT test	0110			

0 .. IGBT 1 sc	Yes / No	6 .. IGBT 4 sc	Yes / No
1 .. IGBT 1 oc	Yes / No	7 .. IGBT 4 oc	Yes / No
2 .. IGBT 2 sc	Yes / No	8 .. IGBT 5 sc	Yes / No
3 .. IGBT 2 oc	Yes / No	9 .. IGBT 5 oc	Yes / No
4 .. IGBT 3 sc	Yes / No	10 .. IGBT 6 sc	Yes / No
5 .. IGBT 3 oc	Yes / No	11 .. IGBT 6 oc	Yes / No

The state of the IGBTs on the output side can be checked by means of this test routine. The switching on as well as the switching off of each transistor is checked.

If one transistor has a short-circuit, the message "IGBT Short Circuit Yes" occurs. If the transistor does not react to an ON-signal, the message "IGBT failure Yes" occurs.

The test routine cannot be selected via the PC software Matrix 3 or a fieldbus connection. Furthermore, this parameter is excluded from the copy function of the matrix operating panel BE11.

F2.41	Test charging circuit	0110			

0 .. Thyristor 1	OK / Error
1 .. Thyristor 2	OK / Error
2 .. Thyristor 3	OK / Error

The charging of the DC link happens by means of a pre-charging resistor for devices up to and including *>pDRIVE< MX eco* 4V18, for bigger devices the DC link is charged by means of a half controlled thyristor. In case of the charging with thyristors, a check of the three semiconductors by means of the test routine "Test charging circuit" is possible.

The result of the tests is notified at the removable operating panel via the message "Thyristor OK" or "Thyristor Error".

F2.45	Simulation mode				0 .. Not active

0 ...Not active
1 ...Active

If the simulation mode is activated, the whole power part is disconnected from the control and its behaviour is simulated. As a result, a pre-commissioning of the device is possible without connected motor.

The simulation mode can be activated also without existing voltage supply by means of the 24 V buffer voltage.

In order to set the internal serial connection between power part and control part electronics to a valid state, a software reset (F2.46) or a restart of the device via switching off/on is necessary before final activation.

F2.46	Software reset				

1 ...Execute reset

The software reset aborts all running processes and reboots the control electronics. Therefore also the connection to all arithmetic processing units (motor control, IO12, BE11, fieldbus options,…) is cut off and reerected again.

The software reset is necessary to accept the slave address of a fieldbus option which has been changed as well as for the activation of the simulation mode.

F2.49	Test mode				

0 ...Not active
1 ...Test @ B3.01

If a field-orientated control variant is used, it is not possible to operate the inverter without a motor that is suitable for the inverter power. When a temporary operation without motor or with a significant smaller replacement motor is necessary for tests, parameter F2.49 has to be adjusted.

Setting	Note
0 .. Not active	Test mode not activated (common operating case).
1 .. Test @ B3.01	The required measuring values for field-orientated control are substituted by an internal switch-over to V/f 2 point control and the motor phase monitoring is deactivated, if it was activated. For the test mode the mains voltage set with parameter B3.01 is required.

If parameter F2.49 is reset to "0 .. Not active", the test mode is not deactivated yet !
For deactivation the device has to be switched off/on (booting) additionally.

Test operation cannot be selected via the PC software Matrix 3 or fieldbus connection. Furthermore, this parameter is excluded from the copy function of the matrix operating panel BE11.

After switching the device off/on (booting) parameter F2.49 Test mode is automatically reset to "0 .. Not active".

Force operation

F2.52	Force FP				0 .. Not force

0 ...Not force
1 ...To force

F2.53	Force value LFP				30 Hz

0...60 Hz

Forcing of the reference source LFP (Low Frequency Input). For details, see parameter F2.01.

Fault memory

The fault memory provides a protocol of the last eight fault shut-downs and therefore it supports you in detecting the cause of the fault. For each fault shut-down a number of operating states are stored and provided for manual evaluation.

The fault memory can be also read out automated when using the PC software Matrix 3.

F3.01	Number of faults			Last entry in the memory:	15
F3.02	Review		2 .. Event -2	1 .. Last event -1	0 .. Last event
F3.03	Fault number		13	14	15
F3.04	Fault cause		52 .. Stall protection	19 .. ϑ M1 >>	58 .. External fault 1
F3.05	Operating hours		1362h	1438h	1817h
F3.06	Min / sec		13.17 m:s	55.32 m:s	2.55 m:s
F3.07	Reference value [Hz]		+50.0 Hz	+22.0 Hz	+50.0 Hz
F3.08	Actual value [Hz]		+0.7 Hz	+22.0 Hz	+50.0 Hz
F3.09	Output current		60.2 A	47.8 A	34.2 A
F3.10	DC voltage		533 V	541 V	545 V
F3.11	Thermal load VSD		13 %	82 %	73 %
F3.12	Control mode		Terminals	Terminals	Terminals
F3.13	Operating status		Acceleration	f = f ref	f = f ref
F3.14	Alarm message		-	ϑM1 >	-
F3.15	Drive state		RUN	RUN	RUN
F3.16	Bus STW		007F	007F	007F
F3.17	Bus ZTW		007F	007F	007F

All diagnostic values correspond to the actual values 10 ms before fault shut-down.

F3.01	Number of faults				

F3.02	Review				0 .. Last event

0 ...Last event
1 ...Last event -1
2 ...Event -2
3 ...Event -3
4 ...Event -4
5... Event -5
6... Event -6
7... Event -7

F3.03	Fault number				

HTIU
8 P01 023 EN.04/04

F3.04	Fault cause				

0 ...No fault
1 ...Undervoltage
2 ...V>> at deceleration
3 ...Line overvoltage
4 ...MC not ready
5 ...DC missing
6 ...Precharging fault
8 ...Line fault 1p
9 ...Line fault 2-3p
10...Overcurrent
11...Motor earth fault
12...Insulation fault
13...Overcurrent
14...IGBT ϑ >>
15...Motor phase fault 3p
16...Motor phase U lost
17...Motor phase V lost
18...Motor phase W lost
19...Inverter overtemp.
20...Unknown MC
21...PTC short circuit
22...PTC open circuit
23...ASIC Init fault
25...IGBT fault
27...IGBT short circuit
28...Motor short circuit
30 .. Current measure fault
32 .. MC E² zones invalid
33 .. CPU fault
34 .. ISL fault
35 .. MTHA fault
36 .. Overspeed
37 .. Safe Standstill
38 .. IO12 comm. fault
39 .. Opt. comm. fault
40 .. Wrong option board
41 .. Bus fault
42 .. Param. config. fault
43 .. Reference fault AI2
44 .. Reference fault AI3
45 .. Reference fault AI4
46 .. Reference fault FP
47 .. TH ϑ M1 >>
48 .. TH ϑ M2 >>
49 .. TH ϑ Ext >>
50 .. ϑ M1 >>
51 .. ϑ M2 >>
52 .. Stall protection
53 .. Underload
54 .. Speed check fault
55 .. Feed in <<
56 .. AT-fault 1
57.. Config. fault
58.. External fault 1
59.. External fault 2
60.. Line contactor fault
61.. Motor contactor error
62.. Motor contactor error
63.. ON lock
64.. Internal SW error
65.. Power rating fault
66.. Incompatible MC
67.. Flash fault APP
68.. Indus zone fault
69.. Eprom fault APP
71.. Limitation active
72.. Ramp adaption
73.. 24V fault
80.. BE11 loss
81.. VSD overload
82.. I-limit active
83.. T-limitation active
87.. Process fault 1
88.. Process fault 2
89.. Process fault 3

F3.05	Operating hours				h
F3.06	Min / sec				m:s
F3.07	Reference value [Hz]				Hz
F3.08	Actual value [Hz]				Hz
F3.09	Output current				A
F3.10	DC voltage				V
F3.11	Thermal load VSD				%
F3.12	Control mode				

1 ...Local mode
2 ...Terminals
3 ...Modbus
4 ...CANopen
5 ...Profibus

F3.13	Operating status				

1 ...Alarm
2 ...I-limit active
3 ...Ramp adaption
4 ...Fast stop
5 ...Shut down
7 ...Acceleration
8... Deceleration
9... f = f ref
10 .. f min
11 .. f max

F3.14	Alarm message				

0 ...No alarm
1 ...Force active
2 ...Emergency op. active
3 ...External fault 1
4 ...External fault 2
5 ...Undervoltage
6 ...Reference fault AI2
7 ...Reference fault AI3
8 ...Reference fault AI4
9 ...Bus fault
11...Reference fault FP
12...Feed in <
13...ON-lock from DI
14...Speed check fault
15...ϑ M1 >
16...ϑ M2 >
17 .. Overspeed
18 .. TH - ϑ M1 >
19 .. TH - ϑ M2 >
20 .. TH ϑ Ext >
21 .. Underload
23 .. Ramp adaption
24 .. Service M1
25 .. Service M2
26 .. Service Power On
27 .. Service fan
28 .. Simulation active
29 .. Download active
30 .. E6 incomplete
31 .. XY Graph set faulty
32 .. Change control mode !
36 .. Param.set 1 fault
37...Param.set 2 fault
38...IGBT ϑ >
40...V/f 7 point set faulty
45...BE11 loss
46...Control requ. missing
47...Parameter set 1
48...Parameter set 2
49...Test mode active
51...I-limit active
52...T-limitation active
53...Process fault 1
54...Process fault 2
55...Process fault 3

F3.15	Drive state				

1 ...Lock (PWR)
2 ...Trip
3 ...Load
4 ...Mains off
5 ...Mains missing
6 ...Mains disconnect
7 ...Locked
8... Motor heating
9... Auto tune
10 .. Standby mode
11 .. Catch on the fly
12 .. DC missing
13 .. V<< ride through
14 .. Fast stop
15...RUN
16...Stop
17...Motorfluxing
19...Lock
20...DC-holdingbrake

F3.16	Bus STW	0110			

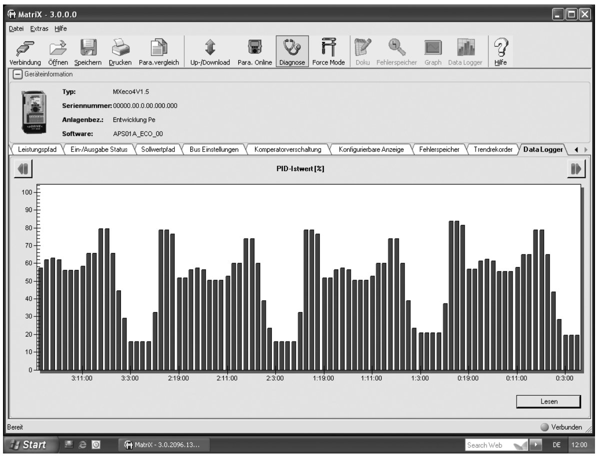
0 ...Switch on	☐ / ☑	6 .. Reference value lock	☐ / ☑
1 ...OFF 2 (pulse inhibit)	☐ / ☑	7 .. Reset	☐ / ☑
2 ...OFF 3 (fast stop)	☐ / ☑	8 .. Jog 1	☐ / ☑
3 ...Release operation	☐ / ☑	9 .. Jog 2	☐ / ☑
4 ...Ramp output release	☐ / ☑	10.. Control OK	☐ / ☑
5 ...Ramp integr. release	☐ / ☑		

F3.17	Bus ZTW	0110			

0 ...Ready to switch on	☐ / ☑	6 .. Lock switching-on	☐ / ☑
1 ...Ready to run	☐ / ☑	7 .. Alarm	☐ / ☑
2 ...Operation released	☐ / ☑	8 .. Ref. value reached	☐ / ☑
3 ...Trip	☐ / ☑	9 .. Control requested	☐ / ☑
4 ...No OFF 2	☐ / ☑	10.. f >= f level	☐ / ☑
5 ...No OFF 3	☐ / ☑		

HTIU
8 P01 023 EN.04/04

Data logger



The function of the Data logger offers the possibility to record up to three channels in time averaged form or as peak value. The recording serves as listing or as statistical evaluation of electrical values (e.g. energy) or known process values of the inverter (pressure, flow, speed, vibration). Therefore the number of channels, the value to be recorded and the time base can be set.

The selected values to be recorded are averaged during the set time base or the maximum value is determined and saved as data point. The data points are deposited in the *>pDRIVE< MX eco* in form of a ring buffer, from which they can be read and graphically represented by means of the PC program Matrix 3.

The maximum number of saveable data points depends on the number of channels to be recorded. If the maximum recording low is reached, the oldest data is automatically overwritten.

Number of channels	Data points per channel
1	90
2	45
3	30

F4.01	Data logger channel 1				0 .. Not used
F4.02	Data logger channel 2				0 .. Not used
F4.03	Data logger channel 3				0 .. Not used

0 ...Not used	21 .. Curve generator	44.. Bus SW 5
1 ...Actual frequency	24 .. PID-reference val. [%]	45.. Bus SW 6
2 ...|Actual frequency|	25 .. PID-actual value [%]	46.. Bus SW 7
3 ...Motor current	26 .. PID-deviation [%]	47.. Bus SW 8
4 ...Torque (%)	27 .. PID-output	48.. Bus SW 9
5 ...Torque (Nm)	30 .. Thermal load M1	56.. AI 1
6 ...Power	31 .. Thermal load M2	57.. AI 2
7 ...|Power|	32 .. Thermal load VSD	58.. AI 3
8 ...Speed	33 .. Counter (average)	59.. AI 4
9 ...|Speed|	34 .. Total counter	60.. Frequency input
10...Motor voltage	35 .. Speed machine	61.. Motor potentiometer
11...DC voltage	40 .. Bus SW 1	62.. Pre-set reference
14...Int. f-ref. before ramp	41 .. Bus SW 2	63.. MX-wheel
15...Int. f-ref. after ramp	42 .. Bus SW 3	64.. LFP input
19...Int. ref. switch-over	43 .. Bus SW 4	

F4.04	Time base				60 min

0...1500 min

F4.05	Rating channel 1				1 .. Average value
F4.06	Rating channel 2				1 .. Average value
F4.07	Rating channel 3				1 .. Average value

1 ...Average value
2 ...Max. value

If the selected channels or the time base are changed, the whole memory area has to be reconfigured and all existing data are deleted !

State digital inputs

F4.10	DI state basic device	0110			

0 ...DI 1	☐ / ☑	4 .. DI 5	☐ / ☑
1 ...DI 2	☐ / ☑	5 .. DI 6 *)	☐ / ☑
2 ...DI 3	☐ / ☑	6 .. PWR	☐ / ☑
3 ...DI 4	☐ / ☑		

*) When DI 6 is used as thermistor input TH1 the actual state is not displayed.

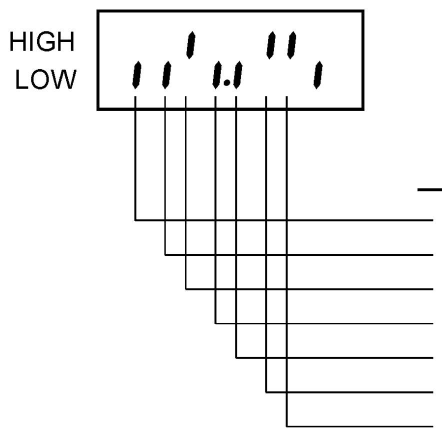
F4.11	DI state IO11	0110			

0 ...DI 7	☐ / ☑
1 ...DI 8	☐ / ☑
2 ...DI 9	☐ / ☑
3 ...DI 10	☐ / ☑

F4.12	DI state IO12	0110			

0 ...DI 11	☐ / ☑
1 ...DI 12	☐ / ☑
2 ...DI 13	☐ / ☑
3 ...DI 14	☐ / ☑

The state of the digital inputs is displayed on the built-in LED keypad as follows:



Basic device	Option IO11	Option IO12
DI 1	DI 7	DI 11
DI 2	DI 8	DI 12
DI 3	DI 9	DI 13
DI 4	DI10	DI 14
DI 5		
DI 6		
PWR		

State digital outputs

F4.13	DO state basic device	0110			
	0 .. RL 1	☐ / ☑			
	1 .. RL 2	☐ / ☑			

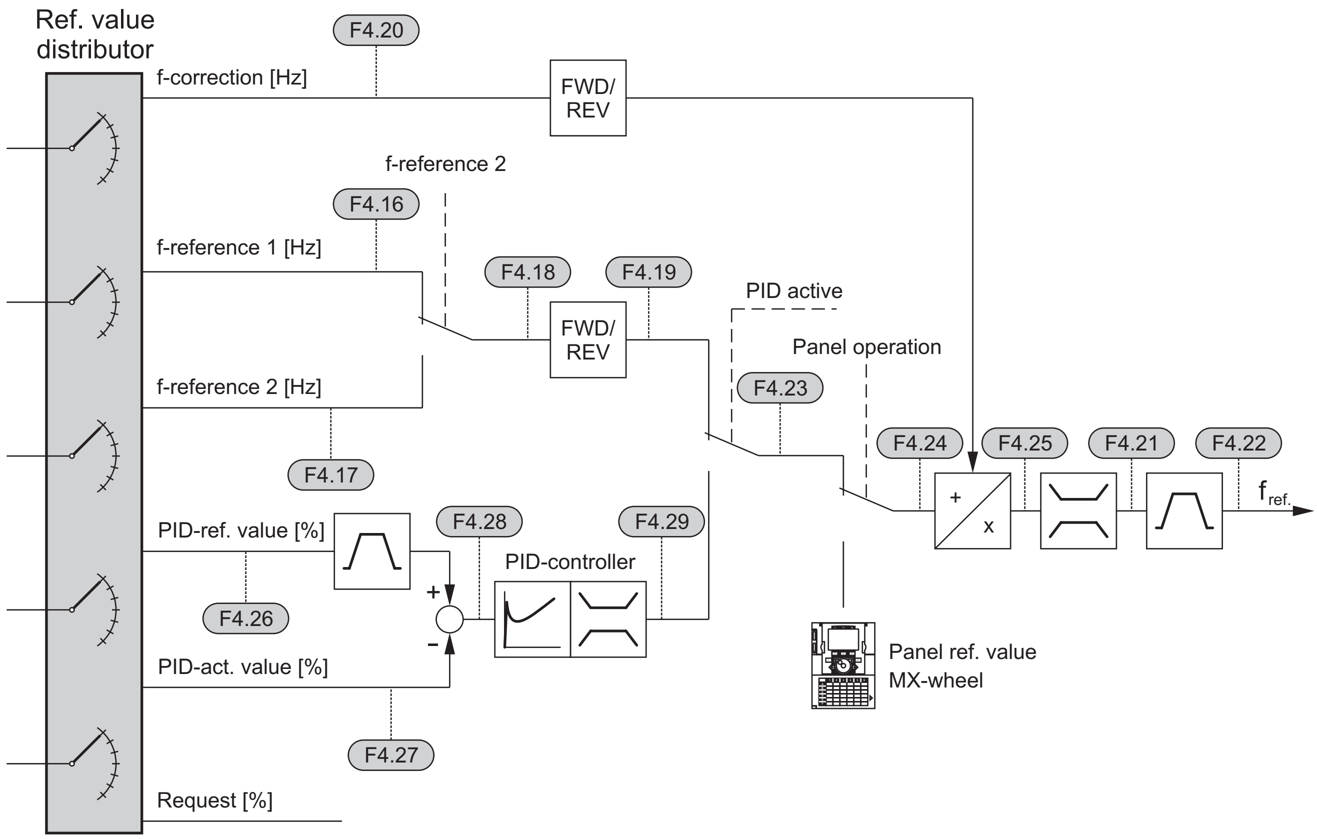
F4.14	DO state IO11	0110			
	0 .. RL 3	☐ / ☑			
	1 .. DO 1	☐ / ☑			
	2 .. DO 2	☐ / ☑			

F4.15	DO state IO12	0110			
	0 .. RL 4	☐ / ☑			
	1 .. DO 3	☐ / ☑			
	2 .. DO 4	☐ / ☑			

Analog checkpoints

F4.16	f-reference 1 [Hz]				Hz
F4.17	f-reference 2 [Hz]				Hz
F4.18	f-reference after sel.				Hz
F4.19	f-ref. after FW/REV				Hz
F4.20	f-correction				Hz
F4.21	f-ref. before ramp				Hz
F4.22	f-ref. after ramp				Hz
F4.23	f-ref. after PID act.				Hz
F4.24	f-ref. after loc/rem				Hz
F4.25	f-ref. after f-corr.				Hz
F4.26	PID reference value				%
F4.27	PID actual value				%
F4.28	PID deviation				%
F4.29	PID-output				Hz
F4.38	I limit				A

HTIU
8 P01 023 EN.04/04



Power part

F4.44	DC voltage				V
F4.45	IGBT overload time				s
F4.46	Thermal load VSD				%
F4.47	Thermal load M1				%
F4.48	Thermal load M2				%
F4.50	Fan status				

0 ...OFF
1 ...RUN

State option cards

F4.56	Option 1 type				

F4.57	Option 2 type				

F4.60	Status APP				

F4.61	Status MC				

F4.62	Status LCD-keypad				

Reference value linkage

F4.65	Source f-reference 1				
F4.66	Source f-reference 2				
F4.67	Source f-correction				
F4.68	Source PID-reference				
F4.69	Source PID-actual				
F4.70	Source T-reference				
F4.71	Source T-limit				

0 ...Not used
1 ...Motor potentiometer
2 ...Pre-set reference
3 ...Analog input AI1
4 ...Analog input AI2
5 ...Analog input AI3
6 ...Analog input AI4
7 ...Frequency input
8... Actual value selection
9... Reference val. switch
10 .. Calculator
11 .. Curve generator
12 .. Bus SW 1
13 .. Bus SW 2
14 .. Bus SW 3
15 .. Bus SW 4
16.. Bus SW 5
17.. Bus SW 6
18.. Bus SW 7
19.. Bus SW 8
20.. Bus SW 9
21.. LFP input

Analog checkpoints

F4.72	f-ref before MC				Hz

F4.78	Source STW1				

0 ...Not configurated
1 ...LED Keypad
2 ...BE 11
3 ...2-wire (edge rated)
4 ...3-wire
5... 2-wire (level rated)
6... Modbus
7... CANopen
8... Profibus

Service parameter

The parameters of this group are used for visualisation and adaptation of device-internal functions and are reserved for the service department.

F6		Code	Parameter lock, selection of the parameterization station

Security settings

The parameter lock serves as protection against unintentional or unauthorized parameter changes. If a parameter is tried to be changed during active parameter lock, the message "Parameterization locked" appears on the Matrix operating panel.

The parameters can be locked with the software by means of a code entry or hardware-wise by means of a digital input.

Reading the parameters is possible at any time irrespective of an active lock.

F6.01	Code				
	0...9999				

F6.02	Code value				
	0...9999				

The parameter lock is active as long as parameter F6.01 "Code" has another value than parameter F6.02 "Code value". The code value itself is readable so that the code cannot be forgotten.

For frequency inverters which have an OEM code, parameter F6.02 "Code value" is not readable. In this case, ask the respective service department for the code.

F6.03	Parametrising station				1 .. Keypad
	1 ...Keypad 2 ...Modbus 3 ...CANopen 4 ...Profibus				

The parameterization can be realized from different sources. If a parameterization source wants access to write to one parameter, this parameterization source must be selected first.

Access to read is possible from all sources.

F6.04	Impulse inhibit				0 .. Not active
	0 ...Not active 1 ...Active				

Parameter F6.04 represents an impulse inhibit which is activated by parameterization. With this function a start of the drive can be prevented (used in case of parameterization of the inverter by means of fieldbus connection).

F6.05	Service code				

0...59999

A four-digit service code authorises the service department to perform service activities like calibration and the like.

In case of inappropriate adjustment malfunctions of the device are possible. Therefore the code has to be changed only by the service department !

HTIU

8 P01 023 EN.04/04

Index

A
Acceleration 122, 198
Actual value 9
Alarm
- Category 231
- Logic block 258
- Message 45, 268

Analog
- Input 6, 57, 61, 159, 221, 263
- Output 177, 263

Auto reset 220
Autotuning 92

B
Backup mode 69
Behaviour at undervoltage 224
Brake function 98
Braking unit 99
Bus reference value 7, 61

C
Calculator 8, 59, 110
Cascade control 78, 125
Catch on the fly 91
Centrifugal mass 88
Control command 235
Control mode 84
Control source 237
Counter 62
Current limitation 195
Curve generator 9, 59, 115

D
Data-Logger 270
DC
- Holdingbrake 99

DC link supply 157
Deceleration 88, 122, 198, 219
Digital
- Input 60, 169, 262, 271
- Output 188, 272

Direction of rotation 51, 121
Drive state 42
Dynamic 88

E
Economy mode 148
Emergency operation 221

F
Factory setting 74
Fan 92
Fast stop 89, 219, 224
Fault
- Behaviour 219
- External 228
- Logic block 259
- Memory 267
- Message 48
- ON lock 230
- Process fault 232

Feed-in monitoring 202
Field weakening 87
Fieldbus 81, 193, 235
Filter
- Output filter 91

Force operation 262, 266
Frequency
- Correction 15
- Input 6, 58, 166, 223, 232, 263, 266
- Range 120
- Reference value 13
- Skip frequency 200

Function block 243

I
Info message 45, 268
Intelligent rectifier 92

L
Language selection 67
LED keypad 30
Limitation 65, 197
Line
- Voltage 56, 84

Line shape 10, 117
Loss of motor phase 216

M

Macro 70

Mains

- Contactor control 150
- Loss of line phase 223

Manual operation 8, 14, 17, 109, 235, 239

Matrix wheel 59

Matrix-wheel 8, 14, 17, 109, 235, 239

Motor

- Contactor control 151
- Data set 71, 93
- Heating 149
- Protection 206

Motor potentiometer 7, 59, 106

O

Operating mode 43, 267

Operating panel 17, 20, 64, 240, 242

Operating state 44

Output filter 91

Overspeed protection 216

P

Panel operation 8, 14, 17, 109, 235, 239

Parameter

- Hiding 39, 65
- Lock 276
- Parameter set switch-over 69
- Type 37

PC software 19

PID controller 16, 76, 139

Power 261

- Limitation 196

Pre-set reference 7, 59, 105

Presetting 70

Pulse counter 154

Pulse generator 184

R

Reference value

- Correction 156
- Distributor 11
- Loss 221, 232
- Source 5, 59, 274
- Switch-over 9, 59, 114

Reset 220, 239, 265

Rotational direction 51, 121

Rounding 124

S

Short menu 101

Skip frequency 56, 90

Slip compensation 87

Speed 51

- Monitoring 200

Square-wave signal 184

S-ramp 124

Stall protection 215

Standby Mode 152

Step counter 154

Stop behaviour 88

T

Test routine 92, 262, 265

Thermal mathematical motor model 211

Thermistor control 206

Torque 51

- Limitation 196

U

Underload protection 217

Undervoltage ride through 224

X

XY Graph 10, 117

>pDRIVE<

Schneider Electric Power Drives

a company of Schneider Electric

Schneider Electric Power Drives GmbH
Ruthnergasse 1
A-1210 Vienna
Phone: +43 (0)1 29191 0
Fax: +43 (0)1 29191 15
www.pdrive.com

MX	1	2	3	4	5	6
A Display	Home	Motor values	Inverter values	Reference values	Counter	Display configuration
B Start-Up	Language selection	Macro configuration	Inverter data	Motor data	Brake function	Short menu
C Functions	Internal reference	Ramp / frequency	Cascade control	PID configuration		Special functions
D In-/Output	Analog inputs	Digital inputs	Analog outputs	Digital outputs		Fieldbus
E System	Process protection	Motor protection	Fault configuration	Control configuration	Keypad	Function blocks
F Service	Info	Test routines	Fault memory	Diagnosis	Service	Code

8 P01 023 EN.04/04 HTIU