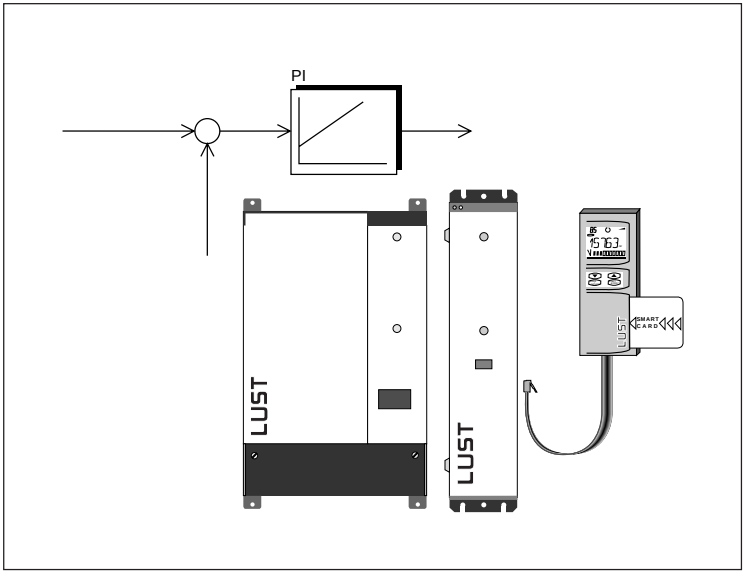
LUST
ANTRIEBSTECHNIK

SMARTDRIVE - VF1000M/VF1000L,TR/S58

EN

± 10 V Reference Input
Technical Controller



Important: This description does not replace the VF1000M and VF1000L Operation Manuals. In commissioning, and when performing other work on the inverter, be sure to follow the instructions, and in particular the safety instructions, given in the relevant manual.

1 Overview

± 10 V reference input (FSIN2):

- Analog input with automatic direction of rotation selection
- Additional offset input for 1st analog input (FSIN)
- High-resolution analog input (16-bit)

Technical controller:

- PI controller for process control, e.g. pressure, temperature, flow, winding drive, etc.

Note: All manufacturers' declarations and acceptances issued for the standard series are also applicable to the VF1000M, TR and VF1000L, TR frequency inverters.

When the **TR** version is selected the following additional versions are not possible:

VF1000M	C2 and C8
VF1000L	C1, C2, and OP1 ... OP10
VF1000L,HF	

The variant described here is based on the standard software:

V1.2 for VF1000M

V1.6 for VF1000L

Expanded functions in the standard software are not automatically adopted into the software of the TR version.

The current injection (55_ISEL = 3,4,5) is not selectable.

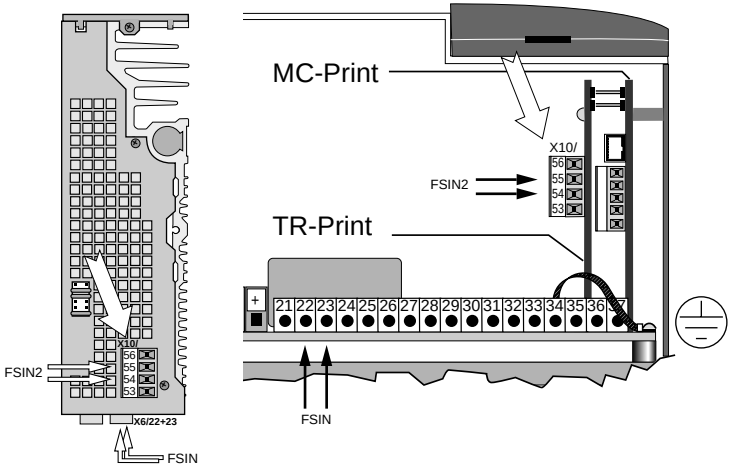
2 Electrical Connections

The type TR inverters are fitted with an additional terminal strip (X10). The terminal assignment and position sketches are shown below.

X10/	Label	Description
53	⏚	Termination point for protective earth
54	GND	Frame reference point for 10V reference
55	FSIN2	±10V input (2nd analog input)
56	UR	10V reference for reference input

Position sketches:

VF1000M,TR VF1000L,TR



3 Technical Specification

Connection	Spezification	
FSIN2	Input range	+ 10 V ... - 10 V (isolated)
	Resolution	16 Bit
	Input resistance	150 kΩ
	Dielectric strength	± 30 V
	Sampling time	8 ms
UR	Reference voltage	10 VDC ± 3 %
	Load capacity	15 mA max., short-circuit-proof
Terminal X10	Terminal cross-section	max. 2.5 mm²

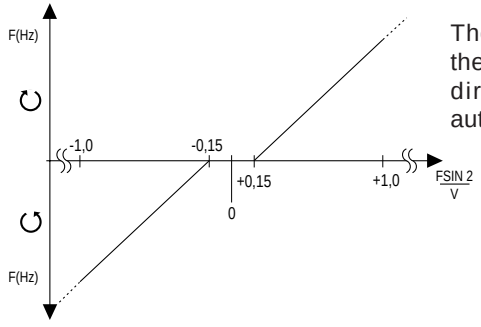
3.1 Input FSIN2

The FSIN2 can be used as an additional reference input with the following functions:

Parameter	Setting	Function
04-FSSEL	24	FSIN2 = ± 10 V reference input with automatic direction of rotation selection Hysteresis = ± 150 mV, STR input as hardware enable
04-FSSEL	25	FSIN2 = 0 ... 10 V reference input
04-FSSEL	26	FSIN2 = offset to FSIN (see example) + 10 V at FSIN2 => add $\frac{FMAX}{2}$ - 10 V at FSIN2 => subtract $\frac{FMAX}{2}$

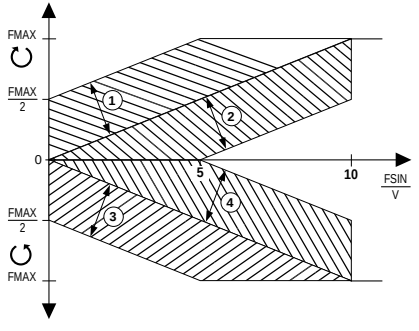
Example: FMAX = 50 Hz; FSIN = 5 V; FSIN2 = + 5 V
FOUT = 25 Hz (from FSIN) + 12.5 Hz (from FSIN2)
= 37.5 Hz

Setting: 04-FSSEL = 24



The control input STR is the hardware enable. The direction of rotation is automatically selected.

Setting: 04-FSSEL = 26



STR = active

STL = active

① FSIN 2 = 0 ... + 10 V

② FSIN 2 = 0 ... - 10 V

③ FSIN 2 = 0 ... + 10 V

④ FSIN 2 = 0 ... - 10 V

3.2 Technical Controller

The technical controller in the VF1000M and VF1000L controls process variables such as pressure, temperature, flow rate, jump, etc. It is not suitable for dynamic process variables such as rotational speed.

3.2.1 Actual Value Channel

76-CONFI	Function
0 VAL	Technical controller inactive, function of FSIN2 with 04-FSSEL = 24/25/26
1	Analog input FSIN (0 ... 10 V, 2 ... 10 V, 0 ... 20 mA, 4 ... 20 mA)
2	Analog input FSIN2 (± 10 V)
3	Frequency input (0 ... 1 kHz) via FSIN
4	Frequency input FSIN (0 ... 10 kHz) via FSIN
5	PWM input (0 ... 100%) via FSIN
6	Serial interface

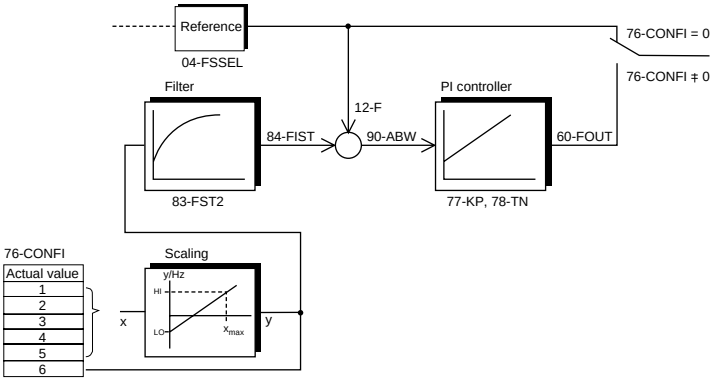
Note: Input FSIN can only be assigned once.

3.2.2 Reference Channel

04-FSSEL	Reference selector
0 VAL	Analog input, 0 ... 10 V, 2 ... 10 V, 0 ... 20 mA, 4 ... 20 mA
3	FSIN as frequency input 0 ... 1 kHz
4	FSIN as frequency input 0 ... 10 kHz
5	FSIN as PWM input 20 ... 100%
6	FSIN as PWM input 0 ... 100%
7	FSIN inactive, reference via KP100 (CTRL menu)
8	Reference via interface
9 to 16	Reference input via fixed frequencies (see Operation Manual)
17 to 22	Correction of analog reference via S1IND/S2IND (MOP function active)
23	Analog input, direction of action inverted
24	Analog input FSIN2, ± 10 V
25	Analog input FSIN2, 0 ... 10 V

Note: For more details concerning the functions of analog input FSIN refer to the relevant Operation Manual.

3.2.3 Block Diagram



3.2.4 Combination Options of the Reference and Actual Value Channels

Reference	Actual value 76-CONFI =						
04-FSSEL =	0	1	2	3	4	5	6
0	X		X				X
3	X		X				X
4	X		X				X
5	X		X				X
6	X		X				X
7	X	X	X	X	X	X	X
8	X	X	X	X	X	X	
9 - 16	X	X	X	X	X	X	X
17 - 22	X		X				X
23	X		X				X
24	X	X		X	X	X	X
25	X	X		X	X	X	X

X = permissible combination

Note: Parameter 30-FF7 cannot be selected as a reference.

Controller Parameters

The parameters set out below are available for setting and optimization of the controller:

Parameter	Manipulating Range	VAL	Function
77-KP	0.1 ... 10	0.5	Gain (P-component), adjustable online
78-TN	0 ... 65 [s]	0	Lag time (I-component), adjustable online
30-FF7	0 ... 999 [Hz]	0	Control start frequency
93-LEVHI	0 ... 400 [Hz]	50	Scaling of actual value signal, input optimizes manipulating range (upper limit)
88-LEVLO	0 ... 400 [Hz]	0	Scaling of actual value signal, input optimizes manipulating range (lower limit)

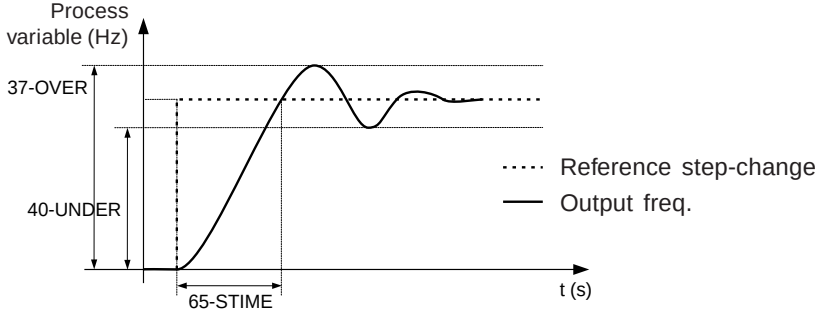
Note: Save 77-KP and 78-TN with 71-PROG = 5.

Important: With version TR parameters 93-KOMP, 88-PSW1, 83-SIOW and 84-SIOT are no longer required.

The following diagnostic parameters are available to check the optimum setting of the controller:

Parameter	Display value	Function
60-FOUT	Instantaneous [Hz]	Current output frequency (see block diagram)
84-FIST	Instantaneous [Hz]	Currently scaled actual value upstream of controller
37-OVER	Fixed [Hz]	Maximum output frequency after start
40-UNDER	Fixed [Hz]	Minimum output frequency after frequency maximum
65-STIME	Fixed [Hz]	Rise time to point where actual value is equal to reference for first time
90-ABW	Instantaneous [Hz]	Current amount of control difference

Diagnostic parameters graph (step response of a control loop):



Note: Parameter 65-SINT for ON delay of control inputs in VF1000M no longer required.

3.3 Commissioning the Controller

1) Connect the motor and control cables and set the motor characteristic as set out in the Operation Manual.

2) Connect the actual and reference value signals to inputs FSIN and FSIN2, observing the existing signal type.

Important: Only voltage signals can be fed in at input FSIN2. Current signals and digital signals can only be fed in at FSIN.

3) Set parameter 04-FSSEL to the available reference signals.

4) Set the desired actual value signal with parameter 76-CONFI.

5) Optimize the resolution of the actual value signal with parameters 93-LEVHI and 88-LEVLO.

6) As necessary, set the reference and actual value filters with parameters 67-FST and 83-FST2 (see “Optimizing the Controller”).

7) Set and optimize the control parameters 77-KP and 78-TN (see “Optimizing the Controller”).

3.4 Optimizing the Controller

If current or voltage ripple occurs on the actual and reference signals, it can be damped with the aid of low-pass filters. The time constants of the filters can be set as follows:

Parameter	Setting	VAL	Function
67_FST	0 ... 4	2	Reference filter
83_FST2	0 ... 9	2	Actual value filter

Setting:

67-FST	0	1	2	3	4					
83-FST2	0	1	2	3	4	5	6	7	8	9
Filter time	0	8.2	24.6	57.3	123	254	0.52	1.04	2.09	4.18
Dim.	ms						s			

Rough optimization of the control parameters:

In most processes the optimum control parameter values can be ascertained by the method set out below.

However, this does require that the application can be set to an unstable condition for a brief period.

Procedure:

1) Set parameter 77-KP to 0.3 and parameter 78-TN to 0 ms. Set a low reference value and start the motor.

Important: If the motor starts up in an uncontrolled manner stop the drive immediately and check the direction of action of the actual value signal. When the fault is eliminated restart the motor.

2) Slowly increase parameter 77-KP until the system begins to vibrate evenly. Then reduce the value until the system is just stabilized.

3) Lower the proportional gain 77-KP by 50% of the last set value and set the lag time 78-TN to 65 s (display = 65000 [ms]).

4) Reduce parameter 78-TN further until the system begins to vibrate. Then slowly increase parameter 78-TN again until the system is just stabilized.

5) Increase the current value of parameter 78-TN by 30%.

6) Stop the motor and save the values of 77-KP and 78-TN by setting parameter **71-PROG to 5**.

Fine adjustment of the control parameters:

The controller can be optimized still further with the aid of a step response.

This requires the use of a storage oscilloscope or graphical plotter to record the response of the actual value after a reference step-change.

Compare the resulting curve with the curves below and correct the setting of KP and TN in small increments.

When the optimum curve is attained, the values must be saved with the parameter setting **(71-PROG to 5)**.

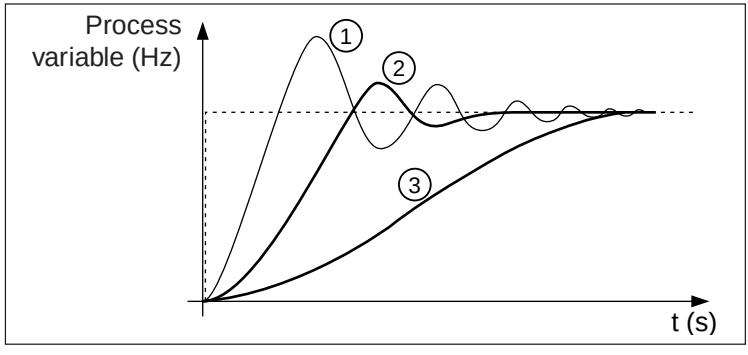


Figure A: Influence of the gain (77-KP) on the step response with optimum lag time (78-TN)

① KP too high

② Optimum setting if overshoot permitted

③ KP too low

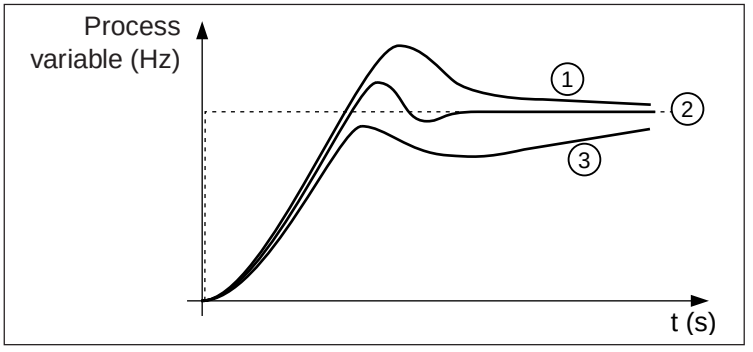


Figure B: Influence of the lag time (78-TN) on the step response with optimum gain (77-KP)

① TN too low

② Optimum setting if overshoot permitted

③ TN too high

3.5 Control Start Frequency

In some applications it is advantageous if the controller is activated only above a certain motor speed. The corresponding motor frequency can be set with parameter 30-FF7. After this frequency has been exceeded for the first time the controller remains active even when the frequency falls below 30-FF7.

1 Overview

Technical controller:

- PI controller for process control, e.g. pressure, temperature, flow, winding drive, etc.

Note: All manufacturers' declarations and acceptances issued for the standard series are also applicable to the VF1000M, S58 and VF1000L, S58 frequency inverters.

When the **S58** version is selected the following additional versions are not possible:

VF1000M C2 and C8

VF1000L C1 and C2

VF1000L,HF

The variant described here is based on the standard software:

V1.2 for VF1000M

V1.6 for VF1000L

Expanded functions in the standard software are not automatically adopted into the software of the S58 version.

The current injection (55_ISEL = 3,4,5) is not selectable.

2 Technical Controller

The technical controller in the VF1000M and VF1000L controls process variables such as pressure, temperature, flow rate, jump, etc. It is not suitable for dynamic process variables such as rotational speed.

2.1 Actual Value Channel

76-CONFI	Function
0 VAL	Technical controller inactive
1	Analog input FSIN (0 ... 10 V, 2 ... 10 V, 0 ... 20 mA, 4 ... 20 mA)
2	No function
3	Frequency input (0 ... 1 kHz) über FSIN
4	Frequency input (0 ... 10 kHz) über FSIN
5	PWM input (0 ... 100 %) über FSIN
6	Serial interface

Note: FSIN is available only once for the reference/actual value channel.

2.2 Reference Channel

04-FSSEL	Reference selector
0 VAL	Analog input, 0...10 V, 2...10 V, 0...20 mA, 4...20 mA
3	FSIN as frequency input 0...1 kHz
4	FSIN as frequency input 0...10 kHz
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6	FSIN as PWM input 0...100%
7	FSIN inactive, reference via KP100 (CTRL menu)
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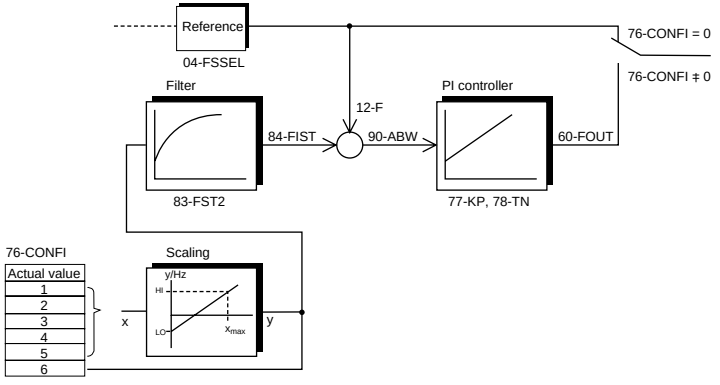
2.3 Block Diagram



2.4 Functions

Reference	Actual value 76-CONFI =						
04-FSSEL =	0	1	2	3	4	5	6
0	X						X
3	X						X
4	X						X
5	X						X
6	X						X
7	X	X		X	X	X	X
8	X	X		X	X	X	
9 - 16	X	X		X	X	X	X
17 - 22	X						X
23	X						X

X = possible combination

Note: Parameter 30-FF7 cannot be selected as a reference.

Controller Parameters

The parameters set out below are available for setting and optimization of the controller:

Parameter	Manipulating range	VAL	Function
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88-LEVLO	0 ... 400 [Hz]	0	Scaling of actual value signal, input optimizes manipulating range (lower limit)

Note: Save 77-KP and 78-TN with 71-PROG = 5.

Important: With the S58 special software, parameters 93-KOMP, 88-PSW1, 83-SIOW and 84-SIOT are no longer required.

The following diagnostic parameters are available to check the optimum setting of the controller:

Parameter	Display value	Function
60-FOUT	Instantaneous [Hz]	Current output frequency (see block diagram)
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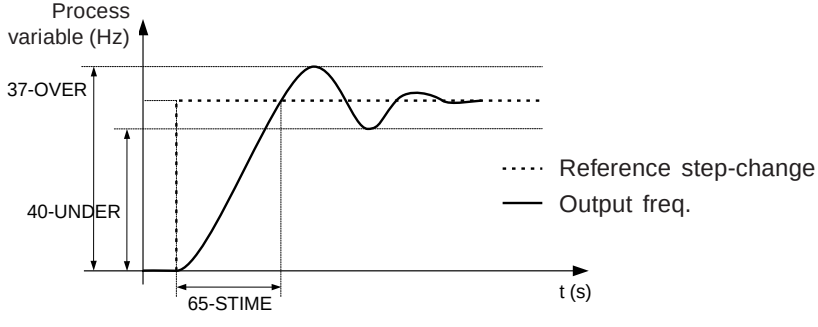

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6) As necessary, set the reference and actual value filters with parameters 67-FST and 83-FST2 (see “Optimizing the Controller”).
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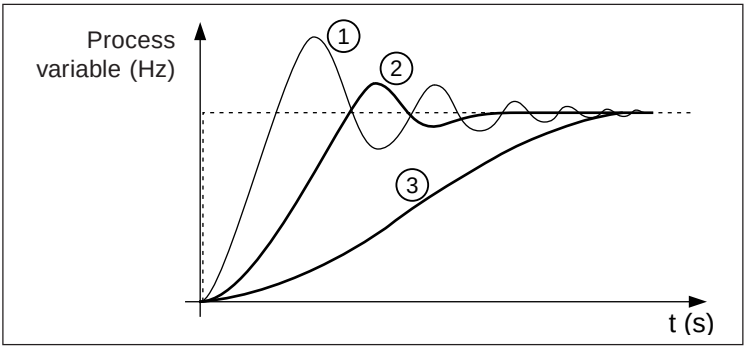

Figure A: Influence of the gain (77-KP) on the step response with optimum lag time (78-TN)

① KP too high

② Optimum setting if overshoot permitted

③ KP too low

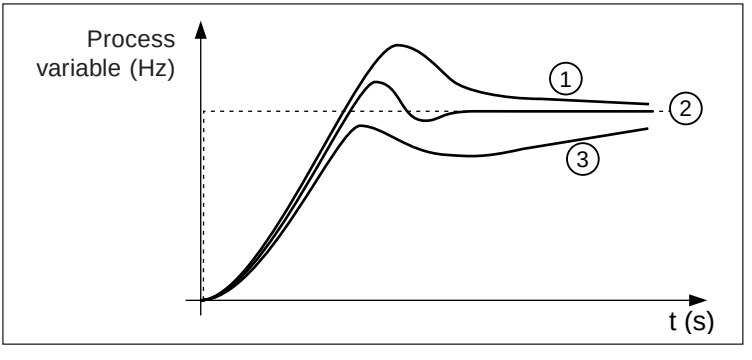

Figure B: Influence of the lag time (78-TN) on the step response with optimum gain (77-KP)

① TN too low

② Optimum setting if overshoot permitted

③ TN too high

3.5 Control Start Frequency

In some applications it is advantageous if the controller is activated only above a certain motor speed. The corresponding motor frequency can be set with parameter 30-FF7. After this frequency has been exceeded for the first time the controller remains active even when the frequency falls below 30-FF7.

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