FP160
Operator Manual

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Contents

1 General

1.1 Features and functions

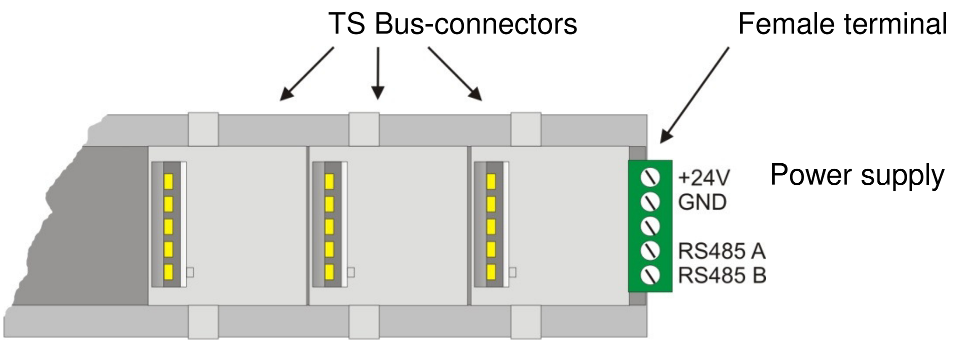
- Different calculation to set the output rate:
  * Manual determinable constant output rate
  * PID temperature controlling for heating/cooling
  * Copy of the output rate from a neighbor zone in case of a defective sensors
  * Comparator-function (see parameter 4, Xp)
  * Stable tripping limiter for safety function (see parameter 2, HI)
- Self-tuning of the zone if required
- FE3-Bus via RS485for parameters and visualization (e.g. Visual Fecon)
- Shorten resistant outputs for Solid state Relay control

2 Construction of the hardware

The temperature controller ***FP160*** is built in a module to snap on a mounting rail.

2.1 System for mounting rails

The power supply of the controller as well as the communication occurs via the 5-pole terminal system („TS Bus-connectors“, article-No. 90-00217), which may be fit to a standard rail by simple snap-in.



The TS Bus-connectors may be beaded to individual length to supply multiple controllers FP160 side by side on one single rail.

The number of required TS Bus-connectors depends on the width of the controllers:

Type of controller	**Number of connectors**
FP160C*x*08	1
FP160C*x*08E, FP160C*x*16	2
FP160C*x*16E	3

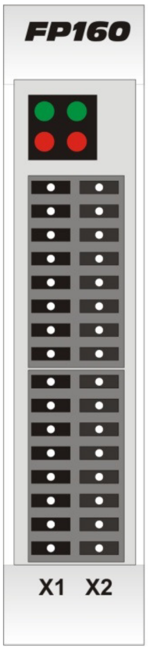
The 24V power supply and the connection of the interface RS485 occur by a 5-pole terminal-connector (article-No. 90-000216), which may be put laterally to the TS Bus-connectors.

The terminal assignment is posed in the upper picture.

2.2 FP160 Cx08

FRONT

TX: Busy
H1: System Fault, Overload
Sensor Input
Sensor 1(-) X1.1
Sensor 2(-) X1.2
Sensor 3(-) X1.3
Sensor 4(-) X1.4
Sensor 5(-) X1.5
Sensor 6(-) X1.6
Sensor 7(-) X1.7
Sensor 8(-) X1.8
24VDC Outputs
Heating Zone 1 X1.9
Heating Zone 2 X1.10
Heating Zone 3 X1.11
Heating Zone 4 X1.12
Heating Zone 5 X1.13
Heating Zone 6 X1.14
Heating Zone 7 X1.15
Heating Zone 8 X1.16

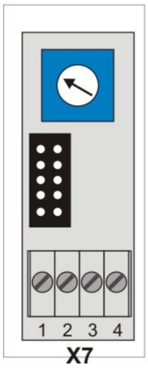


V+: Power
H2: Fault
Sensor Input
X2.1 Sensor 1(+)
X2.2 Sensor 2(+)
X2.3 Sensor 3(+)
X2.4 Sensor 4(+)
X2.5 Sensor 5(+)
X2.6 Sensor 6(+)
X2.7 Sensor 7(+)
X2.8 Sensor 8(+)
24VDC Outputs
X2.9 LO-Alarm *)
X2.10 Hi-Alarm *)
X2.11 DEV-Alarm *)
X2.12 SYS-Alarm *)
X2.13 Cooling Zone 5 *)
X2.14 Cooling Zone 5 *)
X2.15 Cooling Zone 5 *)
X2.16 Cooling Zone 5 *)

*) Output Cooling, if parameter No. 12 < „0“

BOTTOM SIDE

24VDC power supply for the outputs
+24V Input X7.1
NC X7.2



Addresse

Service
(behind cover)

X7.3 NC
X7.4 GND Input

2.3 FP160 Cx08E: 8Zone-controller with Option „Real Time Ethernet“

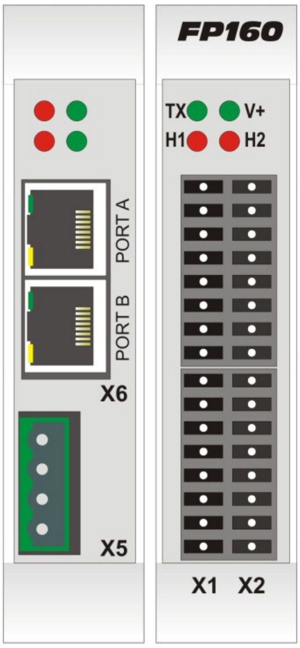
(Profinet or Sercos)

FRONT

ALM: Alarm | SYS OK
CRT: Bus Function | CGN

Real Time Ethernet
(ProfiNet, Sercos,...)

Dry contacts
X5.13
X5.14
X5.23
X5.24



TX: Busy | V+: Power
H1: System Fault | H2: Fault

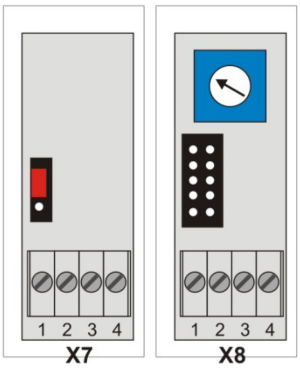
Sensor Inputs	**Sensor Inputs**
Sensor 1(-) X1.1	X2.1 Sensor 1(+)
Sensor 2(-) X1.2	X2.2 Sensor 2(+)
Sensor 3(-) X1.3	X2.3 Sensor 3(+)
Sensor 4(-) X1.4	X2.4 Sensor 4(+)
Sensor 5(-) X1.5	X2.5 Sensor 5(+)
Sensor 6(-) X1.6	X2.6 Sensor 6(+)
Sensor 7(-) X1.7	X2.7 Sensor 7(+)
Sensor 8(-) X1.8	X2.8 Sensor 8(+)
24VDC Outputs	**24VDC Outputs**
Heating Zone 1 X1.9	X2.9 LO-Alarm *)
Heating Zone 2 X1.10	X2.10 Hi-Alarm *)
Heating Zone 3 X1.11	X2.11 DEV-Alarm *)
Heating Zone 4 X1.12	X2.12 SYS-Alarm *)
Heating Zone 5 X1.13	X2.13 Cooling Zone 5 *)
Heating Zone 6 X1.14	X2.14 Cooling Zone 5 *)
Heating Zone 7 X1.15	X2.15 Cooling Zone 5 *)
Heating Zone 8 X1.16	X2.16 Cooling Zone 5 *)

*) Output Cooling, if parameter No. 12 < „0“

BOTTOM SIDE

Configuration-jumper

24V Control-inputs
+24V Input X7.1
NC X7.2
NC X7.3
GND Input X7.4



Addresse

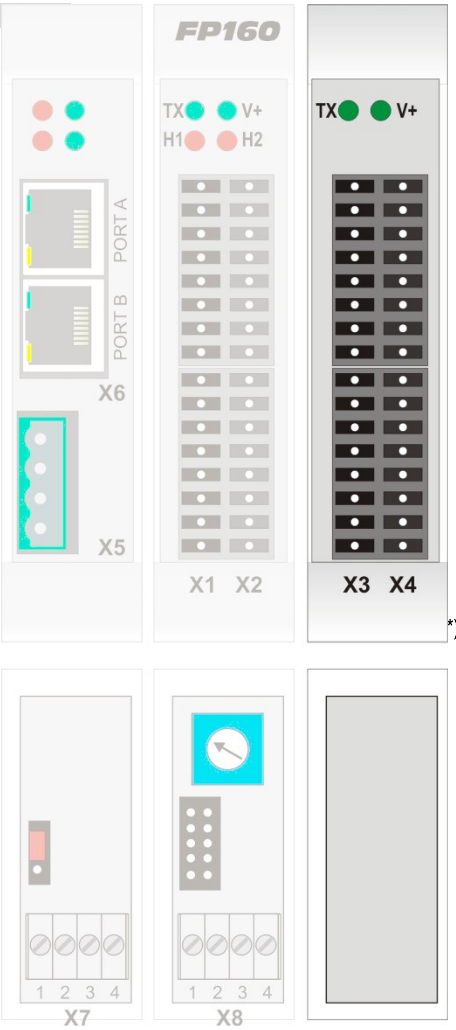
Service
(behind cover)

24VDC power supply for the outputs
X8.1 +24V Input
X8.2 NC
X8.3 NC
X8.4 GND Input

2.4 FP160 Cx16E: 16Zone-controller with Option „Real Time Ethernet“

(Profinet or Sercos)

<u>**Zones 1 – 8 as FP160 x08E**</u>



TX: Busy	V+: Power
Sensor Inputs	**Sensor Inputs**
Sensor 9(-) X3.1	X4.1 Sensor 9(+)
Sensor 10(-) X3.2	X4.2 Sensor 10(+)
Sensor 11(-) X3.3	X4.3 Sensor 11(+)
Sensor 12(-) X3.4	X4.4 Sensor 12(+)
Sensor 13(-) X3.5	X4.5 Sensor 13(+)
Sensor 14(-) X3.6	X4.6 Sensor 14(+)
Sensor 15(-) X3.7	X4.7 Sensor 15(+)
Sensor 16(-) X3.8	X4.8 Sensor 16(+)
24VDC Outputs	**24VDC Outputs**
Heating Zone 9 X3.9	X4.9 Cooling Zone 9 *)
Heating Zone 10 X3.10	X4.10 Cooling Zone 10 *)
Heating Zone 11 X3.11	X4.11 Cooling Zone 11 *)
Heating Zone 12 X3.12	X4.12 Cooling Zone 12 *)
Heating Zone 13 X3.13	X4.13 Cooling Zone 13 *)
Heating Zone 14 X3.14	X4.14 Cooling Zone 14 *)
Heating Zone 15 X3.15	X4.15 Cooling Zone 15 *)
Heating Zone 16 X3.16	X4.16 Cooling Zone 16 *)

*) Output Cooling, if parameter No. 12 < „0“

2.5 Functions oft he processor module

2.5.1 LED's

LED	Function
V+	Lights permanent with the power supply.
Tx	Flashes in cycles of 500ms
H1	The Led H1 lights in case of a great failure (internal hardware failure) or flashes in case of shorted outputs. In such a case the referring output switches continuously off. With the next start of the controller this alarm will be acknowledged.
H2	

Additional LEDs with the processor-variation FP160 Cxxx**E** (with Realtime Ethernet)

LED	Function
ALM	This LED „ALM“ indicates a detected a temperature-alarm (HI overridden). The contact 5.13 – 5.14 will be opened synchronously.
SYS OK	There is a hardware failure detected, if the green SYS OK turns off. The contact 5.23 – 5.24 opens synchronously.
CRT	Status of the Ethernet connection: LED off: No communication with the Bus-master LED flashes: Communication with the Bus-master in start-up. LED on: existing communication with the Bus-master
CGN	Actual without function

2.5.2 Alarm outputs

Die Alarm outputs LO-Alarm, HI-Alarm, DEV-Alarm and SYS-Fault supply 24V DC under normal conditions for external relays. If there is an alarm at one of the zones, the voltage at the referring alarm output drops to 0V. SYS-Fault refers to the integrated hardware supervision.

2.5.3 Alarm contacts

There are two dry contacts available with the version for mit Realtime Ethernet (FP160 C*xxx*E):

Contact	Function
5.13 – 5.14	Normally closed, Contact opens in case of temperature HI-Alarm
5.23 – 5.24	Normally closed, Contact opens in case of great hardware failure in the controller.

2.5.4 RS485

An interface RS485 is available by the Bus-terminal. This enables the connection to max. 30 units by a 2-wire Bus. The addresse has to be set by the BCD-switch at the bottom side of the unit.

2.5.5 Supply oft he outputs

There is a 4-pole connector-terminal (X8) at the bottom of the module. It has to be supplied by 24VDC to power the outputs. The controller will operate without this supply, but the outputs in the front for the Solid State Relays stay disabled.

2.5.6 Technical data

		FP160 C*x*08	**FP160 C*x*16**	**FP160 C*x*08E**	**FP160 C*x*16E**	
Range of temperature with version „Pt100“ (FP160C**P***xx*)	T_{in} max	0,0 … 500,0				°C
Range of temperature with version „FeCuNi Typ J“ (FP160C**T***xx*)	T_{in} max	0,0 … 700,0				°C
Resolution of temperature		0,1				°K
Outputs heating / cooling	I max	80				mA
		Inductive loads (e.g. relays) need a compensation diode!				
Max. capacity of the connected load	C max	100				nF
Current consumption (24V DC)	I b	100		200		mA
Ambient temperature	T max					°C
Weight		150	300	250	380	g
Max. load of the alarm contacts		-	-	4		A
Max. voltage at the alarm contacts		-	-	230		V AC

2.5.7 Max. cross section of wires for X1..X4 (spring type connection)

	min	**max**	
Cross section stiff	0,2	1,5	mm^2
Cross section flexible	0,2	1,5	mm^2
Cross section flexible with wire end ferrules without plastic tube	0,25	1,5	mm^2
Cross section flexibel with wire end ferrules with plastic tube	0,25	0,75	mm^2

3 Parameters

The default settings of the parameters are defined to solve general control-requirements. Specific conditions as setpoints, alarm-limits, operation mode a.s.o. have to be set individually. The reset via system-parameter **STD** returns all parameters to the default settings.

3.1 System-parameters

These general parameters may be necessary for operation or during commissioning of the ***FP160***. There is no relation to single zones.

3.1.1 HI-Value {HIW}

Limits:	0..900
Default value:	400
Unit	-
FE3-Protocol	G01**? HIW=**

Function This prameter limits the setting of setpouints.

3.1.2 Enable of all outputs {ENA}

Limits:	0..1
Default value:	0
Unit	-
FE3-Protocol	G01**?ENA**

Function

This parameter is used for genaral enable of all the outputs without single operation. It helps to prepare the controller for self-tuning or to set the parameters without direct reaction for the zones.

This way should be preferred instead of the main isolator. The controller "freezes" the zones and doen't increase the integral part (danger of overheat after turn on).

The start-up tuning should be started by this parameter.

Disable by „0“.
Wait until the zones are in a stable (cold) condition. Meanwhile the desired setpoints and the tuning may be set.
When the temperatures are in a stable condition enable heating by setting this parameter to (=1). Only now the internal tune procedure will be started. This is the best opportunity to reach a synchronous start of combined heaters.

3.1.3 Behaviour with broken sensor {APM}

Limits:	0..4
Default value:	0
Unit	-
FE3-Protocol	G01**? APM**

Function This system parameter chooses the behaviour in case of a broken sensor during controlled mode:

Setting „0“ (Default)

This way the power for this zone will be turned off in case of a broken sensor. The zone is kept in controlled mode. As soon as the sensor is available the previous setpoint is valid.

Setting „1“

The controller turns from controlled mode to manual mode and uses the previously calculated mean output rate of this zone for permanent output.

Setting „2“

In reason of compatibility this function is identic to „1“

Setting „3“

The controller turns from controlled mode to manual mode and uses the output rate of the setting of parameter No. 17 of this zone for permanent output.

Setting „4“

The controller turns from controlled mode to manual mode. The output rate of the leading zone, setting parameter No. 26, will be copied for the defective zone.

3.1.4 Standby-Mode {SBY}

Limits 0..1
Default value 0
Unit -
FE3-Protocol G01**? SBY=**

Function This system parameter is used to set all controlled zones to the standby mode. These zones will be controlled to reach the 2nd setpoint of parameter No. 11.

3.1.5 Alarm Delay {DLY}

Limits 0..60
Default value 0 (off)
Unit sec
FE3-Protocol G01**? DLY=**

Function This parameter is used to ignore short alarms. Only a zone alarm (e.g. LO, HI or DEV Alarm) which is longer than this time setting, will be notified by alarm contacts and via interface.

3.1.6 Reset to deafault parameters {STD}

Limits 0..60

Default value	0 (off)
Unit	sec
FE3-Protocol	G01**? STD=**
Function	A single transmission of the value “1” will reset all settings to the default values. This is the status of delivery of the controller.

3.1.7 Query of the type of software {AZ#}

Limits	read only
Default value	-
Unit	-
FE3-Protocol	G01? **AZ#**=
Function	This way the the type of software may be identified. The referring code is a value from 00001 … 99999. The standard FP160 notifies e.g. AZ-No. 310

3.1.8 Query of the number of control zones (channels) {KAN}

Limits	read only
Default value	-
Unit	-
FE3-Protocol	G01? **KAN**=
Function	Referring to the size of the unit there are 8 or 16 zones available to be checked by this parameter.

3.1.9 Query of the version of software {VER}

Limits	read only
Default value	-
Unit	-
FE3-Protocol	G01**? VER**=
Function	This information transmits the version of software oft he controller.

3.2 Parameters of the zones

Each zone has its own set of parameters.

3.2.1 P01: Lo-Alarm {LO_}

Limits	0...9999
Default value	0
Unit	1/10 °K
FE3-Protocol	G01K01**P01**=

Function Underpassing the value set for parameter 1 triggers the respective zone **LO**-alarm. The collective alarm “Low temperature” will be activated at X2.9. The required resolution is 1/10°. A setting of 200 accords to 20,0°.

3.2.2 P02: Hi-Alarm {HI_}

Limits	0...9999
Default value	4000 (=400,0 °)
Unit	1/10 °K
FE3-Protocol	G01K01**P02**=

Function

Exceeding the value set for parameter 2 triggers the respective zone **HI**-alarm. The collective alarm "High temperature" will be activated at X2.10. The required resolution is 1/10°. A setting of 4000 accords to 400,0°.

Special case: The Setting of HI=0 defines this zone for **limiter** . The power is fully activated till to the setpoint (=limiting value). Exceeding the setpoint will create a HI-alarm and the zone will stay switched off (=operation mode OFF). Beneath the setpoint the zone may be reactivated manually. This method may protect another zone of overheating by serial wiring of the output actuators. Additional safety is available, if controller and limiter are built by separate units (eah with its own processor).

3.2.3 P03: Deviation-Alarm {DEV}

Limits	1...9999
Default value	150
Unit	1/10 °K
FE3-Protocol	G01K01**P03**=

Function

As soon as the actual value of a zone deviates from the setpoint by more than the setting here the respective zone triggers deviation alarm. The collective alarm "Dev alarm" will be activated at X2.11. The required resolution is 1/10°. A setting of 150 accords to 15,0°.

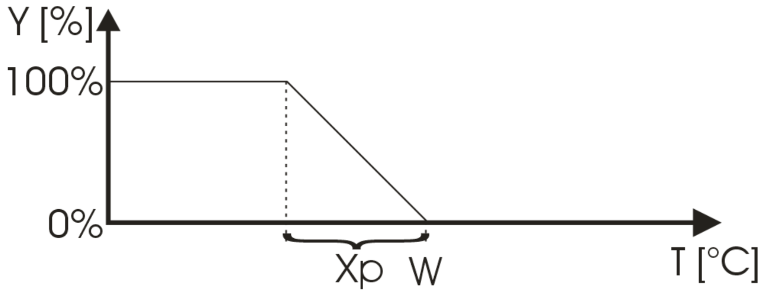
3.2.4 P04: Proportional range of the Heating {XPH}

Limits	1...100
Default value	5
Unit	% (of 500)
FE3-Protocol	G01K01**P04**=

Function

The P-part changes the output rate of the controller referring to the deviation between setpoint and actual value. The proportional range (xp) is the range of the process dimension, where this linear relation reaches from minimum to maximum:

.



The FP160 uses a fixed temperature range of 500°C (1% accords to 5K).
An overdimensioned proportional value results in a rather inert result.
A too small range will strongly react on small deviations and make the system oszillating.
Using a simple P-controller (without I- and D-part) the deviation to the setpoint will not be eliminated.
Special case: The setting of xP=0 turns the controller to c**omperato mode**. Overheating of 2° will disable the heating and beneath 2° the heating will retun fully. There is a hysteresis of +/-2°.

3.2.5 P05: Integral part of the Heating {TNH}

Limits	0...9999
Default value	800
Unit	1/10 s
FE3-Protocol	G01K01**P05** =

Function

The integral part avoids a remaining temperature deviation by continuous change of the output rate untill the deviation is zero. The speed of the changes depends on the setting of this time. Small values refer to fast as great values result in slower changes of the rates.

The setting „0“ disables the I-part completely.

3.2.6 P06: Differential part of the Heating {TVH}

Limits	0...9999
Default value	200
Unit	1/10 s
FE3-Protocol	G01K01**P06** =

Function

The differential part reacts on the speed of deviations of the temperature. This value “brakes” the output rate, if the temperature approaches too fast to the setpoint.
The setting „0“ disables the D-part completely.

3.2.7 P07: Proportional range of the Cooling {XPK}

Limits	0..100
Default value	5
Unit	% (of 500)
FE3-Protocol	G01K01**P07** =

Function

See → P04
This parameter works for negative calculated values for the cooling of the zone.

3.2.8 P08: Integral part of the Cooling {TNK}

Limits	0...9999
Default value	800
Unit	1/10 s
FE3-Protocol	G01K01**P08** =

Function

See → P05
This parameter works for negative calculated values for the cooling of the zone.

3.2.9 P09: Differential part of the Cooling {TVK}

Limits	0…9999
Default value	200
Unit	1/10 s
FE3-Protocol	G01K01**P09**=

Function

See → P06
This parameter works for negative calculated values for the cooling of the zone.

3.2.10 P10: Operation mode of the Zone {MOD}

Limits	0…3
Default value	2
Unit	-
FE3-Protocol	G01K01**P10**=

Function

3 different operation modes are available to be selected here.
0 = OFF
1 = Manual mode (constant output rate) (→ P17)
2 = Controlled mode (→P04..P09)
3 = Standby mode (→ P11)

3.2.11 P11: Standby-Setrpoint {SBY}

Limits	0…9999
Default value	0
Unit	°C
FE3-Protocol	G01K01**P11**=

Function This parameter sets the temperature for the standby mode (→ P10). It may be set during the controlled mode.

3.2.12 P12: Minimum Output Rate {YMI}

Limits	-100…0
Default value	0
Unit	%
FE3-Protocol	G01K01**P12**=

Function To enable the function for cooling, the minimum output rate has to be adapted (-100% refers to maximum cooling).

3.2.13 P13: Maximum Output Rate {YMA}

Limits	0…100
Default value	100
Unit	%
FE3-Protocol	G01K01**P13**=

Function This parameter limits the maximum output rate of the heaters.

3.2.14 P14: Output Rate setting {YST}

Limits	-100…100
Default value	0
Unit	%
FE3-Protocol	G01K01**P14**=

Function a) In manual mode (parameter P10 = 1) this value will be used for the constant output rate.

b) In controlled mode (parameter P10 = 2 or 3) a preset for a later change to manual mode (thrust selection) may be set here. Changes have no influence during the controlled mode.

3.2.15 P15: Cycle Time for the Heating {CYH}

Limits	1...20
Default value	1
Unit	s
FE3-Protocol	G01K01**P15**=

Function

To reduce the fast switching outputs to an acceptable speed for relays, the value of this parameter has to increase. A greater setting reduces the speed of the outputs. The cycle time is always the sum of ON- and OFF-periods. The shortest impuls is 1/100 of the cylcle time.

3.2.16 P16: Cycle Time for the Cooling {CYC}

Limits	1..20
Default value	1
Unit	s
FE3-Protocol	G01K01**P16**=

Function

To reduce the fast switching outputs to an acceptable speed for relays, the value of this parameter has to increase. A greater setting reduces the speed of the outputs. The cycle time is always the sum of ON- and OFF-periods. The shortest impuls is 1/100 of the cylcle time.

3.2.17 P17: Average Output Rate {YAV}

Limits	Read only
Default value	0
Unit	%
FE3-Protocol	G01K01**P17**=

Function

Thie parameter indicates the average output rate of a controlled zone. The referring calculation is only enabled, if the zone is OK and without deviation alarm. Settings are not possible (read only).
In cas eof a broken sensor the zone may be set to manual mode. The value of this parameter helps to select a constant output rate.

3.2.18 P18 Ramp up {RP+}

Limits	0..100
Default value	0
Unit	Sec / K
FE3-Protocol	G01K01**P18**=

Function

If a gradual heating up of the medium is required a heating ramp can be set via parameter 18. This is effective if:

- the device has just been activated
- the setpoint has been increased

The ramp effects gradual changing of the *INTERNAL* setpoint towards the set setpoint. As soon as the *INTERNAL* setpoint has reached the set setpoint the ramp becomes inactive until the next setpoint adjustment.

Controlling always applies to the *INTERNAL* setpoint!!

The ramp speed of the heating ramp is set in a unit of secs/°C , this means large values effect a slow ramp.

3.2.19 P19: Ramp down {RP-}

Limits	0..100
Default value	0
Unit	sec / K
FE3-Protocol	G01K01**P19**=

Function In contrast to parameter 18 (ramp up) a down ramp can be programmed here. This means the ramp is only effective after decreasing the setpoint.

3.2.20 P20: Diagnosis Time: Heater- and Sensorsupervision {DIA}

Limits	0…9999
Default value	0
Unit	sec
FE3-Protocol	G01K01**P20**=

Function In controlled mode the temperature of this zone should increase by 5K within this time.

Otherwise this zone will be turned off permanent to be on the safe side. The following reasons are possible:

- Shorted temperature sensor
- Temperature sensor without connection to the heater
- Defective fuse or
- Defective heater

Only the reset of the referring setpoint of this zone may reactivate it.

The setting of the value „0“ disables the plausibility check of this zone.

3.2.21 P21: Reserve

Limits	
Default value	
Unit	
FE3-Protocol	G01K01**P21**=

Function

3.2.22 P22: Temperature Offset {OFS}

Limits	-999…999
Default value	0
Unit	1/10 °K
FE3-Protocol	G01K01**P22**=
Function	The indicated value for the temperature may be adapted by this parameter. The adaption in steps of 1/10K allows the adaption of the length oft he cables for Pt100 sensors.

3.2.23 P23: Type of sensor {SEN}

Limits	2, 3, 7 depending on the hardware of the **FP160** (see below)
Default value	3, 7 (see below)
Unit	
FE3-Protocol	G01K01**P23**=
	This parameter is available from version 1.08.
Function	2 = NiCrNi available with make for thermocouples 3 = FeCuNi available with make for thermocouples 7 = Pt100 available with make for Pt100

Maximum values 900°C for Pt100 !

4 FE3-Protocol

The communication via FE3-Bus between a PC (Master) and a controller (Slave) follows the principle of Masster/Slave by questioning and answering the data. The Master controls the data transfer, the Slaves just answer. They are to identify by their unit-adresse.

The FE3-protocol enables the complete operation and questioning.

The protocol is based on pure ASCII. The telegrams start with „G“ and finish by the sign *etx*. The checksum enables the detection of failures during the transmission. The referring data will be sent in blocs of 5 characters.

4.1 Format of protocol:

Query from master:

G	0	1	xxxxx	cs	cs	*{etx}*
0x47	0x30	0x31				0x03
Beginner	Address of the unit (e.g. 1)		Data	Checksum HI-Nibble	Checksum LO-Nibble	Final sign

Answer from slave:

G	0	1	=	xxxxx	cs	cs	*{etx}*
0x47	0x30	0x31					0x03
Beginner	Address of the unit (e.g. 1)			Data	Checksum HI-Nibble	Checksum LO-Nibble	Final sign

4.2 Calculation of the checksum:

The checksum is calculated by adding the ASCII-values of all previous characters in the telegram. Starting with „G“ and excluding the checksum itself and the sign *etx*. After the addition the checksum will be added by 0xFF to get shortened to 1byte. The checksum will be changed to a hexadecimal value and the resulting signs transferred by ASCII.

Example for calculation of the checksum:

G	1	0	K	0	5	P	0	0	=	0	0	0	5	0	3	A	{etx}
0x47	0x31	0x030	0x4B	0x30	0x35	0x50	0x30	0x30	0x3D	0x30	0x30	0x30	0x35	0x30	0x33	0x41	0x03

a) 0x47+0x31+0x030+0x4B+0x30+0x35+0x50+0x30+0x30+0x3D+0x30+0x30+0x30+0x35+0x30 = 0x33A
b) 0x33A & 0xFF = 0x3A
c) transmitted checksum = „3“ and „A“

4.3 Zone- specific values

Single values will be called by a 2-character zone-No. and the 2-character parameter-No. (see description of the parameters). The zone-no. follows after a **„K“**, the parameter-No. followes after a **“P”**.

G 0 1 K *0 5* P *0 1* = ... calls the unit with address No.1 of zone No. 5 for LO-Alarm (parameter 1).

4.3.1 Setting single Values for a Zone

A value will be set and transmitted by the 5-character ASCII-code <u>beginning with Zero</u>. The value must follow **"="**. To set the above mentioned value to 20 the telegram is:

`G01K05P01=0002038{etx}` *(This checksum is 38)*

The controller answers thereafter

`G01{ack}` if the value was accepted

or

`G01{nak}` if the value was cancelled by the controller.

☛ Negative values need to start with „-047" "-". So -47 has to be transmitted as **„-0047"**; not „0-47" and not „-047"!!!

4.3.2 Calling single Values from a Zone

To call for a value from the controller, the „**=**" has to be directly followed by the checksum and the *{etx}*.

`G01K05P01=46{etx}` *(This checksum is 46)*

The controller answers thereafter

`G01=00020D7{etx}` to notify, that the LO-Alarm (parameter 1) of zone No. 5 was set to 20.

or

`G01{nak}` if the question was unvalid.

4.3.3 Calling a Parameter-value from all the Zones

If „**AL**" was sent instead of the 2-character zone No., the controller answers with all these values from all the zones by a single telegram.

`G01KALP01=6E{etx}` *(This checksum is 6E)*

The controller answers thereafter

`G01=00020000200002000020000200002000020000200002000020000200002059{etx}`

The values of the zones are sent by 5-character ASCII-numbers. The length of the telegram depends on the total number of zones in the controller.

☛ Setting of values for multiple zones is not possible within a single telegram.

4.3.4 Calling Process-values (actual values, alarms...) from Zones

Changing process-values can only be called, never set. The parameter <u>No.</u> has to be replaced by the following code:

PII to call for actual value
PYY to call fort he actual output rate
PSS to call fort he status of the zone
PIX to call for the heater current oft he zone

G01KALPII= calls all actual values from the controller.

4.3.5 Status of the zone

The status of the zone notifies the information of different warnings, alarms and modes of a zone. The status will be queried via decimal number like all other values and has to be explicated bit by bit.

Bit 0	0 = A zone-alarm occurs, 1 = zone OK							
Bit 1	1 = LO-Alarm							
Bit 2	1 = HI-Alarm							
Bit 3	1 = Broken sensor							
Bit 4	1 = Shorted sensor							
Bit 5	0	Mode OFF	1	Mode MAN	0	Mode AUTO (PID)	1	Mode STANDBY
Bit 6	0		0		1		1	
Bit 7	1 = Self-tuning failed							
Bit 8	1 = Tuning aktive							
Bit 9	1 = Negative temperature deviation (-DEV)							
Bit 10	1 = Positive temperature deviation (+DEV)							
Bit 11	1 = Alarm in reason of change of setpoint							
Bit 12	1 = Heater current alarm							
Bit 13	1 = HIHI-Alarm overridden							
Bit 14	-							
Bit 15	-							

Examples:

Queried status of zone = 00065 (dez) = 0000 0000 0100 0001 (bin)

bit 0 is set → Zone OK,

bit 5=0 and bit 6=1 → Mode AUTO

Queried status of zone = 0068 (dez) = 0000 0000 0100 0100 (bin)

bit 0=0 → Zone with ALARM,

bit 2=1 → HI-Alarm

bit 5=0 and bit 6=1 → Mode AUTO

4.4 System parameters

There are also global parameters referring tot o the complete controller, not just a single zone.

The calling and setting of these unit-referring parameters occurs this way:

4.4.1 Calling of System-parameters

Question from the Master:

G	0	1	?	x	x	x	=	cs	cs	{etx}
0x47	0x30	0x31	0x3F				0x3D			0x03
Beginner	Address of the unit (e.g. 1)			Code of the system-parameter				Checksum HI-Nibble	Checksum LO-Nibble	Final sign

„x x x“ muss ersetzt werden durch das 3 Zeichen lange Kürzel des globalen Parameters. Dieses Kürzel wird bei der Beschreibung des Parameters im jeweiligen Kapitel angegeben.

Answer from the Slave:

G	0	1	=	w	w	w	w	w	cs	cs	{etx}
0x47	0x30	0x31	0x3D								0x03
Beginner	Address of the unit (e.g. 1)			Value of the parameter					Checksum HI-Nibble	Checksum LO-Nibble	Final sign

4.4.2 Setting of System-parameters

Question from the Master:

G	0	1	?	x	x	x	=	w	w	w	w	w	cs	cs	{etx}
0x47	0x30	0x31	0x3F				0x3D								0x03
Beginner	Address of the unit (e.g. 1)			Code of the system-parameter				Value of the parameter					Checksum HI-Nibble	Checksum LO-Nibble	Final sign

„x x x“ has to be replaced by the 3-character code of the system parameter. This code is metioned with each parameter in the referring manual.

The controller answers by

`G01{ack}` if the value was accepted

oder

`G01{nak}` if the value was cancelled by the controller.

Example: Enable all outputs fort he unit with address 5: `G05?ENA=00001`

5 Realtime Ethernet (ProfiNet / Sercos)

5.1 Technical Details

5.1.1 GSDML-File (ProfiNet)

The required GSDML file to project the Bus for the Master is available via homepage www.fellereng.de for download.

5.1.2 SDDML-File (Sercos)

The required SDDML file to project the Bus for the Master is available via enquiry.

5.2 Exchange of Utility Data

The unit keeps a certain number of settings per zone e.g. setpoint, alarm-limits and different control-parameters. There are additional informations about the actual status oft he zones (actual values, alarn notes, output rates) as well as sytem settings for the complete unite.

The Bus-profil of Feller Engineering enables the access to all these settings and values to make the controller as clear as possible.

It is not possible and makes no sense to transfer all these data by a single telegram. So the respective desired data need to be querried by the Bus-Master.

The data transfer to and from the controller occurs by sections of 20 bytes for input and output.

Each section is composed of 4 bytes „header“ and 16 bytes „utility data“.

The Bus-Master defines the output-section and queries certain data from the controller this way. The controller will put these to the input section of the Master.

This way the projecting of the interface of the controller is more complex than for “smaller” partners e.g. scales and valves. These may keep all available data in just one section.

The programmer has to respect some important items
while tooling the steps for transferring:

5.3 Protection of the Consistence

During the first step of the program, before the output section will be created, the consistence-byte must be set to”0”. All transferred telegrams will be declared “invalid” this way.

After the complete description of the output section the consistence-byte has to be set, to declare this set of data “valid”.

This is required as lots of Masters do not transfer the data synchronous with the utility program. So there will be transferred sets of data, which are not yet completed (as the user is just executing his program).

These failures in transmission appear seldom and accidentally and are very difficult to locate. So it is very important to keep the sequence.

5.4 Check after the query of the required Data in the Input Section

The input section is not fit with the required data just after demand, as the slave has to collect these before sending an answer. That is why the program of the master has to wait for the required data by checking byte 1 and byte 2 of the input section.

5.5 Attention to the Format of the Utility Data

All utility data will be stored in integer format according to the "INTEL-FORMAT". The LO-byte is always followed by the HI-byte.

Some Profibus-master (e.g. Siemens) use the "MOTOROLA-FORMAT" which sets the HI-byte before the LO-byte.
In this case the programmer has to change the bytes before transfer.

5.6 Transfer settings only after changes

To reduce the load of processor and bus the settings should only be transferred with changes. There is no sense to transfer continuously the same identical data to the controller. The controller stores these values durable in its EEPROM independently of the power supply.

5.7 Definition of the Profinet/Sercos Ranges of Inputs and Outputs

5.7.1 The range of outputs at the Bus-Master (sent from the Master to the Slave)

Byte No..	Name	Function (contents)	
0	*oAction*	**1** = read values from slave **2** = send values to slave	HEADER
1	*0Group*	A group includes a series of 8 zones. **1** = zones 1..8 **2** = zones 9..16 special group: **0** = global settings (see below)	HEADER
2	*aSignification*	The number of the referring parameter will be set here. **0** = setpoint **1** = parameter 1 (referring to the manual of the controller) **2** = parameter 2 (referring to the manual of the controller) ... a.s.o. ... **252** = heater current (not for all controllers) **253** = output rate **254** = actual value **255** = zone status (description see below)	HEADER
3	*oConsistency*	According to the above description the Consistency-byte has to be set to **0** before any further change of the output section. Only after the setting all data of the output section, the Consistence-byte has to be set with the last action. The consistence-byte consists of 8 bit. These sign the validity of the following datawords 1..8. Each bit signs a valid dataword (bit0 for dataword 1, bit7 for dataword 8). This allows to enable the orders for single or more zones.	HEADER
4 5	*oDataword 1*	Value for the 1st zone of a group. In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
6 7	*oDataword 2*	Value for the 2nd zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
8 9	*oDataword 3*	Value for the 3rd zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
10 11	*oDataword 4*	Value for the 4th zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
12 13	*oDataword 5*	Value for the 5th zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
14 15	*oDataword 6*	Value for the 6th zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
16 17	*oDataword 7*	Value for the 7th zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
18 19	*oDataword 8*	Value for the 8th zone of a group In case of calling (Byte 0 = 1) the contents is not valid.	UTILITY-DATA

5.7.2 The range of outputs at the Bus-Master (sent from the Slave to the Master)

Byte No.	Name	Function (contents)	
0	*iAction*	**3** = values accepted by the slave **4** = slave reports exceeded range, one or more values are not set	**HEADER**
1	*iGroup*	The slave sets the number of the group that was called by the master. Only if the group-number of the input and output section are identical, the received utility-data should be used.	
2	*iSignification*	The slave sets the signification as it was demanded in the output section of the master. Only if the signification of the input and output section are identical, the received utility-data should be used.	
3	*iConsistency*	Only if Bit0 of the consistence was set, the following utility-data shall be used. Bit 1 togles in the transmission-cycle of the slave from 0 to 1.	
4	*iDataword 1*	Transferred value of the 1st zone within the group	**NUTZDATEN**
5			
6	*iDataword 2*	Transferred value of the 2nd zone within the group	
7			
8	*iDataword 3*	Transferred value of the 3rd zone within the group	
9			
10	*iDataword 4*	Transferred value of the 4th zone within the group	
11			
12	*iDataword 5*	Transferred value of the 5th zone within the group	
13			
14	*iDataword 6*	Transferred value of the 6th zone within the group	
15			
16	*iDatenwort 7*	Transferred value of the 7th zone within the group	
17			
18	*iDataword 8*	Transferred value of the 8th zone within the group	
19			

5.8 Status of the zone

The status of a zone is built bit-wise. 16 bit are transferred for each zone with the following signification:

BIT	Signification			
0	1=Zone ok 0=zone failed			
1	0=O.K. 1=LO-Alarm			
2	0=O.K. 1=HI-Alarm			
3	0=O.K. 1=broken sensor / override			
4	0=O.K. 1=shorted sensor			
5 6	0 zone off 0	1 manual mode 0	0 control mode 1	1 drop 1
7	0=O.K. 1=optimising failed			
8	1=optimising demanded			
9	0=O.K. 1= neg. deviation alarm			
10	0=O.K. 1= pos. deviation alarm			
11	0=O.K. 1=alarm after change of setpoint			
12	0=O.K. 1=heater current failure			
13 14 15	always 0 always 0 always 0			

The self-optimising of the zone will be enabled or disabled by setting bit no.8 of the status (sole accepted order). The descriptions referring to the process are to find in the operator manual.

5.9 Global Values

Global values for the complete unit will be transferred instead of zone-specific data as soon as the master sets a “0” to the 1st byte (group). The different parameters are to send in READONLY or READ/WRITE mode (see column R /RW). The 2nd byte (contents of telegram) indicates which global values are transferred.

Byte 1 „Group“	Byte 2 „Signific. contents“	Byte 6..19 „Values“	R / RW
0	0	Firmware-Ident-number (AZ-number)	R
		Firmware-version	R
		Firmware-Date (Day)	R
		Firmware-Date (Month)	R
		Firmware-Date (Year)	R
		Serial number	R
		Position of internal DIP-switch	R
		Number of zones in the controller	R
0	1	Heater current supervision (1=enabled, 0=disabled)	R
		Profile-version	R
		*Status of the digital inputs of the AF140 **)*	R
		Reserve	R
		Reserve	R
		Reserve	R
		Reserve	R
		Reserve	R
0	2	Controller outputs (0=disable, 1=enable)	RW
		Alarm-Delay in seconds (0=no delay)	RW
		Net frequency (0=50cps, 1=60cps)	RW
		Max. temperature setpoint (HI-value)	RW
		Drop mode (0=normal, 1=drop)	RW
		Setpoint program (1 or 2)	RW
		Function of plc-input (from firmware V6.2)	RW
		*Digital outputs of the AF140 **)*	RW
0	3	*Spare*	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
0	4	0=no reaction 1=Load default settings *) 2=Reset oft he unit *) (Warm start of the controller)	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W

*) Special routines may be run via group „0“, signification „4“. The activation of these routines may interrupt the communication for some seconds.
**) actually only available with AZ932 (status 11/2006)

5.9.1 Examples:

The master of the bus demands the actual values of the zones 9..16:

1. ***oConsistence*** set to 0
2. ***oAction*** set to 1 (to read out)
3. ***oGroup*** set to 2 (demand for zones 9..16)
4. ***oSignification*** set to 254 (demand actual values)
5. ***oConsistence*** set to 255 (all 8 bits = 1)
6. wait for ***iGroup*** = ***oGroup*** = 2
7. wait for ***iSignification*** = ***oSignification*** = 254
8. wait for setting bit0 of ***iConsistence***
9. Now the required values may be read from ***iDataword1*** .. ***iDataword8*** for zones 9..16.

The master of the bus sets the setpoint of zone 20 to 300°C. All other zones have to keep the values stable.

1. ***oConsistence*** set to 0
2. ***oAction*** set to 2 (to write)
3. ***oGroup*** set to 3 (zone 20 the 4th zone within group 3)
4. ***oSignification*** set to 0 (parameter 0=setpoint)
5. ***oDataword4*** set to 300 (byte 10= 44, byte 11 = 1. Attention: LO-byte first!)
6. ***oConsistence*** set to binary *00000010* = 8. This way only Dataword 2 is valid.
7. wait for ***iGroup*** = ***oGroup*** = 3
8. wait for ***iSignification*** = ***oSignification*** = 0
9. wait for setting bit0 of ***iConsistence***.
10. If ***iAction*** = 3, the value was accepted.
    If ***iAction***=4, the section had exceeded.
11. The new setpoint can be taken from ***iDataword2*** for check.