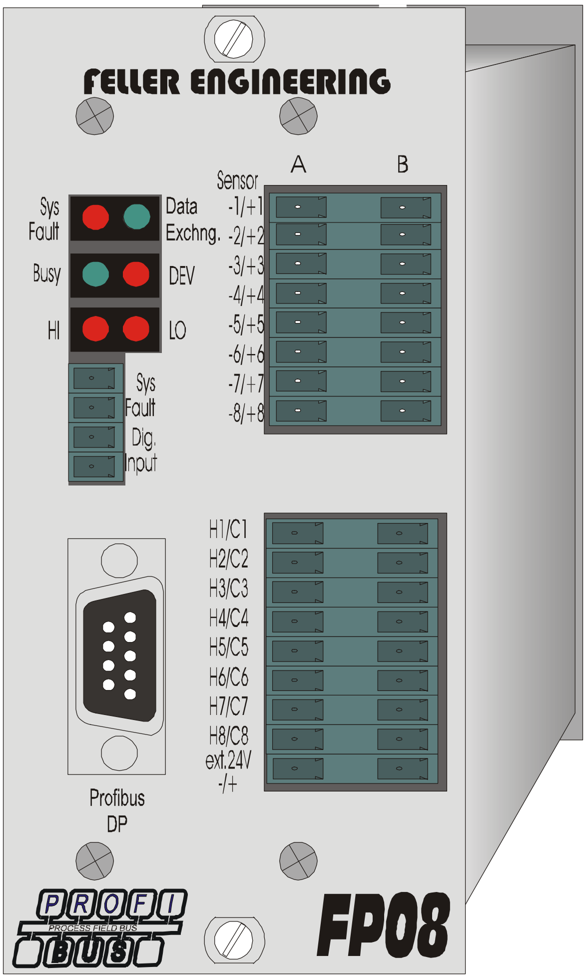
FP08

Operator Manual



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Version 6.2

Stand: 11/15-1106

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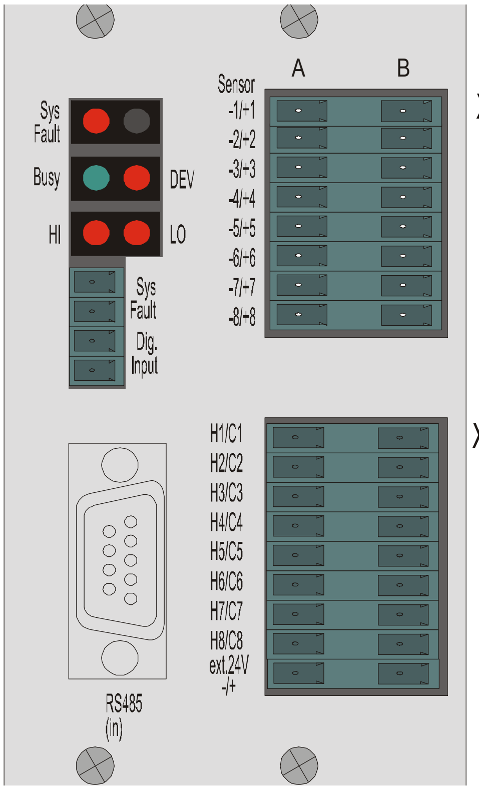
1 Basics of FP08

1.1 Features

- 8 zone temperature controller with pulsed heating/cooling outputs
- Refresh-cycle 1,5 seconds for all zones, suitable for fast controlled process
- FUZZY-based self- tuning of individual zones available
- Time cycles for heating and cooling separately adjustable to adapt to slower actuators (contactors)
- Selectable cooling medium: AIR or WATER INJECTION
- Inputs and outputs isolated
- All operation and settings via a bus facile, electrically isolated RS485 -interface.
- Potential free alarm outputs (dry relay contacts) for system faults (self-supervision of hardware)
- 24VDC supply

2 Controller Commissioning

2.1 Pin assignment



	A	B
X1	sensor input X1-A*n* = minus *n* =channel number	sensor input X1-B*n* = plus *n*=channel number
X2	X2-A*n* output heating for zone *n* ***X2-A9= (-) supply (24VDC)***	X2-B*n* output cooling for zone *n* ***X2-B9= (+) supply (24VDC)***

n in this table refers to the terminal and to the channel number

X3 = interface, BUS input (9pol. D-SUB female)
X3.3 = Profibus « B »
X3.4 = Profibus « RTS »
X3.5 = Profibus « GND »
X3.6 = Profibus « +5V »
X3.8 = Profibus « A »

X4 = 24Volt control input and system-fault contact
X4.1 = System-Fault (potential free contact output, open if system fault)
X4.2 = System-Fault (potential free contact output, open if system fault)
X4.3 = 24V DC plus (control input, application according to software)
X4.4 = 24V DC minus

2.2 Description of Contacts

2.2.1 Supply voltage

The supply voltage of 24V DC is to be connected to the terminals X2.9A (-) and X2.9B (+).

2.2.2 Sensor inputs

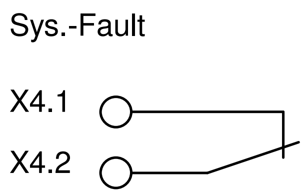
Different sensor types are available (also mixed) depending on the version. The sensors are connected to plug X1. In the case of thermocouples, the (-) pole is at the A-side (left) and the (+) pole at the B-side (right).

2.2.3 Controlled outputs

Controlled outputs have to be connected by the plug X2. Side-A (left) sets heating-outputs, side-B (right) sets cooling outputs. The output voltage is 24VDC, pulsed. This allows direct connections of Sold-State-Relays.
The maximum load of the outputs is limited to 25mA. These are protected by resistors inside. Only a long-term shorted circuit of all outputs may destroy internal components.
The outputs are designed isolated against the rest of the device. There is an internal hardware supervision, which disables all outputs in case of malfunction of the program or loss of net voltage.

2.2.4 System-Fault contakt

The "System-Fault Contact" is a supervisory function independent of the software. The contact opens as soon as the program doesn't run properly any longer, e.g. in case of hardware fault. It should lead to a general shut down of the device e.g. by switching off the main isolator.



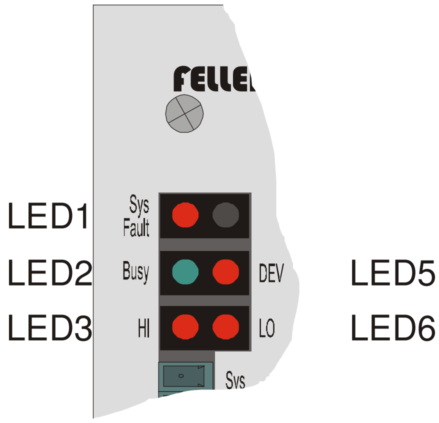
(normal condition shown!)

The contact is potential free and can be loaded up to 2 amps at 230 volts.

2.2.5 Digital control input

The digital control input (24V SPS-power level) is available via plugs X4.3 and X4.4. Depending on the supplied firmware, this input can have differing functions.

2.2.6 LED function



LED1 red SYSTEM FAULT - LED. When the LED is either permanently on or flashes irregularly, there is a defective hardware. Simultaneously all outputs are shut down and the SYS-FAULT relay switches off.
LED2 green BUSY-LED. This flashes quickly when starting up the device, and slows down during normal operation.
LED3 Hi-Alarm. This lights up red as soon as a zone indicates HI-Alarm (summary signal for all zones).
LED4 DATA EXCHANGE. This LED lights up green as soon as the Profibus was connected and the Bus is in a state of „Data Exchange“ (cycled data exchange).
LED5 DEV-Alarm. This lights up red as soon as one of the zones indicates deviation alarm (summary signal for all zones).
LED6 LO-Alarm. This lights up red as soon as one of the zones indicates LO-Alarm or broken sensor (summary signal for all zones).

2.3 Configuration

Internal DIP-switches on the processor card (device addressing, plausibility test, °C/°F selection)

There are two DIP switch blocks on the processor slide-in unit which enable basic settings of the devices:

5-fold DIP-switch-block on the plugged board (MAC-module), behind the EPROM:

	DIP1	DIP2	DIP3	DIP4	DIP5
ON	**sensor short circuit monitoring active**	**solid state-supervision active**	temperature in ° Celsius	thrust-free selection AUTO-MAN	No function
OFF	sensor short circuit monitoring passive	solid state- supervision passive	**temperature in ° Fahrenheit**	**thrust selection AUTO-MAN**	

6-fold DIP-switch-block on the main board

DIP-switch 1..5 to set the Bus-address binary for RS485-interface

DIP1	DIP2	DIP3	DIP4	DIP5	resulting address
ON	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	4
ON	OFF	ON	OFF	OFF	5
OFF	ON	ON	OFF	OFF	6

(The table can be continued to address 30)

3 Setting Parameters

3.1 Reset default parameters

This procedure effects a reset to the default parameters. It may be activated in two different ways:

- Remote via interface (see protocol description)

- By the following process:

1. Switch off the controller
2. Set the DIP-switch for device addressing to device address '0'
3. Switch on the controller
4. Wait, until the green BUSY-Led **slowly** flashes. The parameters are reset now
5. Switch off the controller
6. Re-set DIP-switch for device addressing to the desired address
7. Switch on the controller

Hint:
When loading the standard parameters, not only the parameters get reset, but all the reference values will return to 0 (zone off).

3.2 Device specific Parameters

Device specific parameters are all parameters which either effect all zones simultaneously or the device itself.

3.2.1 Highest temperature („HI-value“)

The Hi-value limits the temperature settings to a max. value.
This value has even a second function:
All control parameters refer to this Hi-value. E.g. the setting for x_p = 5% effects with a Hi-value of 350°C a P-band of 35°.
The manipulation of the HI-value effects all control loops.

Limits:	20.. 999
Default value	700

PROTOCOL:

G01?HIW=0400	400° HI-value

3.2.2 Selection of net Frequency

To suppress the influence of net frequency to the sensor wires most effective, the net frequency should be set here.

Limits:	0 (for 50cps) or 1 (for 60cps)
Default value	0

PROTOCOL:

G01?F60=0001	60cps net supply
G01?F60=0000	50cps net supply

3.2.3 Alarm delay

The controller may react with a certain delay to any alarm. This means, that the controller ignores the detected alarm for the time, set here (in seconds). Only thereafter the relay contacts and the interface will notify. This will be helpful during short time failures, also in connection with bad screened sensor wires.

Limits: 0 ... 90s
Default value 0 (no delay)
PROTOCOL: G01?DLY=....

3.2.4 Disable all Outputs

This parameter is used for general disable of all outputs without operation of the zones. It may be helpful to prepare the controller for the self-tuning without any disturbing heating.

This method has to be preferred instead of switching off the heating power. This would create an overheating after start in reason of "frozen" integral part.

The start-tuning should be started this way by using this parameter.

- Disable by „0"
- Wait until this zone is in a stable (cold) state
- During this time the required setpoints may be set. The tuning may be started as well.
- Enable the heating, when the zones are in a stable state, by setting this parameter to "1". The tuning will start only now. This is the best way to enable all zones together.

Limits: 0 or 1
Default value 1

PROTOCOL G01?ENA=0000 (disable all)
G01?ENA=0001 (enable all)

3.2.5 Standby for all zones (Temperature drop)

This parameter sets all zones to the standby mode without operation.

Limits: 0 or 1
Default value 1

PROTOCOL: G01?ABS =0000 (Standby off)
G01?ABS =0001 (Standby on

3.3 Zone-specific Parameters

There are different parameters available, that effect each zone individually:

3.3.1 PARAMETER 1-LO Alarm

Dropping below this value the referring zone indicates LO-Alarm.

Limits: 0...999
Default value 0

The LO-Alarm is not supervised at setpoint = 0!

3.3.2 PARAMETER 2-HI Alarm

Overriding this value the referring zone indicates HI-Alarm.

Limits: 0...999
Default value 400 °C

The HI-Alarm is even supervised at setpoint = 0! This prevents damage in case of shorted SSR in connection with disabled zones.

3.3.3 PARAMETER 3- Deviation-Alarm

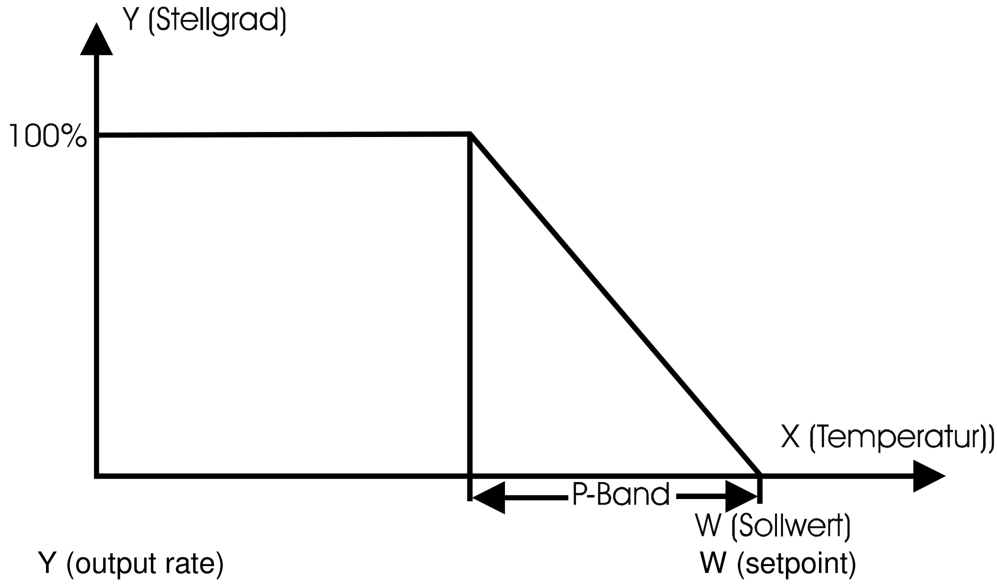
As soon as the actual value of a zone deviates from the setpoint by more than this value, the referring zone indicates deviation alarm.

Limits: 1...999
Default value 15

The deviation-alarm is not supervised in case of OFF-mode!

3.3.4 PARAMETER 4-x_p for heating control

Parameter 4 allows to set the **'xp'** of the controlled process in *Percent*. The resulting p-band derives from the set maximum value (default 400°C).
If, for example, a parameter value of 10% is set and the maximum value (adjustable at another position) is 500°C, the effective p-band is 50°C. For a simple P-controller this means, that the output rate is slowly reduced at 50° before reaching the setpoint. At SETPOINT = ACTUAL it has been reduced to 0%. This results in the following curve:



Limits: 0...999 % (0=2-point controller)
Default value 5 %

3.3.5 PARAMETER 5-t_n (Integral part for heating control)

Parameter 5 allows the setting of the integral part of the control system in seconds. In the event of deviations this control part modifies the controller output by a speed set here (up or down).

Limits : 0...999 s (0=I- part disabled)
Default value 80 s

3.3.6 PARAMETER 6-t_V (Differential part for heating control)

Parameter 6 allows the setting of the differential part in **1/10** seconds. This part 'brakes' the output rate for a time which can be set here, in the event of the actual value approaching the setpoint at too high speed.

Limits :	0...99,9 s (0=D-part disabled)
Default value	20,0 s

3.3.7 PARAMETER 7 – Ramp up

If a gradual heating up of the medium is required a heating ramp can be set via parameter 7. 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 that a larger value effects a slower ramp.

Limits :	0...999 sec/°C (0=Ramp disabled)
Default value	0

3.3.8 PARAMETER 8 – Ramp down

In contrast to parameter 7 (ramp up) a down ramp can be programmed here, this means the ramp is only effective when decreasing the setpoint.

Limits :	0...999 sec/° (0=Ramp disabled)
Default value	0

3.3.9 PARAMETER 9 - Cycle time for the heating

In order to reduce the speed of fast switching outputs to one which is suitable, for example, for contactors, parameter 9 is to be increased for the switching speed of the heating outputs. An increase in this parameter effects a slowing down of the outputs. The cycle time is always the sum of ON and OFF time. The shortest switching impulse results from a cycle time: 100!

Limits:	1...20 sec
Default value	1

3.3.10 PARAMETER 10 – Maximum output for heating

This parameter limits the maximum output of the heating.

Limits :	0...100 %
Default value	100%

3.3.11 PARAMETER 11 – Diagnosis time

For the plausibility check of the controller. (see below)

Limits:	0...999s
Default value	180s

Setting the value „0“ means, that the plausibility supervision is disabled for this zone.

3.3.12 PARAMETER 12 – Standby temperature

During normal control operations this parameter can be used to set the temperature drop. The value is recognised as setpoint during temperature drop operation.

Limits: 0...999
Default value 0

3.3.13 PARAMETER 13 - Cooling medium AIR / STEAM

This parameter allows to select the cooling medium (air or steam). The settings for air cooling (parameter 13 = 0) effects an equal output rate for ON and OFF according to the required cooling.
The steam cooling is always activated for the time set here. The variation of the cooling rate depends on different pauses between these pulses.
The parameter 13 sets cooling pulses in steps of 1/10sec (e.g. 4 = 40ms pulse).

Limits: 0 ... 60 [*10ms]
Default value 0 (AIR)

3.3.14 PARAMETER 14 - *xp* for cooling control

Similar to parameter 4 (xp for heating control) the p-band can be set here for the cooling performance.

Limits: 1...99%
Default value 5%

3.3.15 PARAMETER 15 - t_n for cooling control

Similar to parameter 5 (t_n for heating control) the I-part for cooling performance can be set here.

Limits: 0...999s
Default value 20s

3.3.16 PARAMETER 16 – Cycle time fort he cooling

Limits: 1...100
Default value 1

Function of the mode „AIR-cooling“

If the mode „AIR-cooling“ (Parameter 13=0) is selected for this zone, then the cycle time of the cooling may be set similar to parameter 9.

Function of the mode „STEAM-cooling“

If the mode „steam-cooling“ (Parameter 13>0) is selected for this zone, then the pause between the injections may be set. The dimension is 1/10sec: so 60 is equal to 6,0sec.

3.3.17 PARAMETER 17 – Maximum cooling performance

Similar to parameter 10 the maximum cooling performance can be set here.

Limits: 0...100%
Default value 0% (cooling disabled)

3.3.18 PARAMETER 18 – Mean output rate

Parameter 18 defines itself during normal control operations. The mean output rate is kept here during control operation. The controller restarts the control process with this output rate after a short net supply interruption. This avoids temperature deviations after interruptions of the power supply.

Limits:	0...100%
Default value	0%

3.3.19 PARAMETER 19 – Operation mode of the zone

Limits:	
	0 = Outputs OFF
	1 = Manual mode
	2 = Automatic, controlled mode
	3 = Standby mode
Default value	2

Note:

In the operation mode ‘0’ (outputs OFF) all supervisions of the zone are active (LO-, HI-alarms and plausibility check). To cancel these the diagnosis time has to be set to ‘0’.

Application of this mode: The zone is completely installed (sensor and heater) but actually not required. To turn off a zone generally, the setpoint should be set to ‘0’.

Behaviour during the change from Auto- (=control) mode to Manual- (= not controlled) mode

Depending on DIP switch 4 o the processor board a soft or thrust change of the operation is selected.
The **soft change** will go on with the mean output rate, which has been stored by the controller before. Another value may be set via interface later on. An order for setting the output rate will not be accepted in auto-mode.
The **thrust change** will use the value, which has been preset in parameter 20 for the output rate. This does not refer to the previous controlled output rate.

3.3.20 PARAMETER 20 – Preset output rate

Limits: -	100% ... +100%
Default value	0

A preset for a later change to manual mode (thrust selection) may be prepared here already during the controlled mode. There is no effect during the controlled mode.

3.3.21 PARAMETER 21 – Sensor type

Limits :	0...7

Depending on the input board used, the type of sensor and thus the linearisation can be selected here. The value set here must accord with the component parts on the input board. The following codes are possible:

0 = Compensation channel
1 = Pt100
2 = NiCrNi
3 = FeCuNi
4 = 0..10V
5 = not used
6 = 4..20mA
7 = Pt100 with 1/10° resolution
7 = Pt100 3- or 4-wire with 1/10° resolution

The compensation channel
is only necessary with mixed component parts and may only be defined once per device.

0...10 V input (from V5.42)
Parameter 22 enables the offset (indication at 0V), Parameter 23 adjusts the maximum indication at 10V.

4...20 mA input (from V5.42)
Parameter 22 enables the offset (indication at 4mA), Parameter 23 adjusts the maximum indication at 20mA. Dropping below 2mA, the controller sets ‘broken sensor’.

Pt100 with 1/10° C resolution (from V5.42)
This spreads the resolution of the connected Pt100 sensors to 1/10°. The range is limited to 200,0°C.
This is important for the interface protocol FE3-Bus: All transmitted temperature values are carried out with resolution 1/10°. E.g. „*G01K01P00=1234..*“ transmits the setpoint of 123,4°.
Attention: To reach the best quality of measurement, all open Pt100-inputs should be shorted by a wire. Parameter 22 enables a final offset adjustment.

3.3.22 PARAMETER 22 – Offset actual value

Limits:	+99 °K
Default value	0

The measured temperatures may be adjusted by displacing (parallel) of the curve.

3.3.23 PARAMETER 23 – Max. value

Limits: 1 ... 999

Adjusts the indication of final value from standard signals.

3.3.24 PARAMETER 24 - t_V for cooling control

Similar to parameter 6 (t_V of the heating) the D-part for the cooling may be set here.

Limits:	0...99,9s
Default value	0s

4 Plausibility check

The controller may be enabled by parameter 11 to check its activated zones for fails.

4.1 Recognition of shorted thermocouples

Sensor short circuit is signalled if:

- the actual value lies below the deviation-alarm limit and
- the controller for which parameter 11, the configured diagnosis time, requires 99% or 100% controller output and
- within this time the temperature does not increase by at least 5°C
- the zone is in controlled or drop-set operation
- the set diagnosis time for the zone > 0 sec.
- and the reference value is not set to '0'

This procedure also reports wrong poled sensors and defective heating !

The consequences of such an alarm are the shutdown of the heating and an activated BIT 4 in the status byte of the interface protocol. The LO-Alarm contact is activated simultaneously. Within FECON a flashing -S- is signalled in the respective zone.

As no sensor short circuit supervision is possible when the heating is inactive this alarm status can only be cancelled by external confirmation. This can be done by

- brief mains ON/OFF (collective confirmation)
- RESET-command via the interface (collective confirmation)
- Amending or resetting the old reference value for the disturbed zone, via the interface (selective confirmation)

The short circuit recognition can be deactivated by setting the internal DIP-switch 1 = OFF .

Achtung!

The sensor short circuit alarm can also occur in zones, where the heating can be shut down by means of a main switch. Attention must be paid that the controller receives a confirmation in one of the above forms when resetting the main switch.

The zone must have previously signalled DEV Alarm to avoid a sensor short circuit signal in normal operation when control output =100%.

4.2 Recognition of defective (shorted) switch gears

It is assumed there is a short circuited actuator if

- the set DEV-Alarm threshold is exceeded and
- the calculated control output accords to minimum (0% if without cooling, otherwise the max. cooling performance) and
- the actual value continues to <u>increase</u> by 5°C and
- the time for this temperature increase is the same as the diagnosis time set in parameter 11
- the zone is in control or drop-set operation
- the set diagnosis time for the zone is > 0 sec.
- and the reference value is not set to '0'

This supervision is also effective for zones which have been switched off via parameter 19. The alarm is signalled externally when the HI-Alarm contact is activated. A flashing -H-is signalled at the respective zone within FECON. As with the sensor short circuit this alarm can be confirmed by resetting the reference value. It cancels itself however when the temperature returns to within the tolerance limits.

The short circuit recognition for actuators can be deactivated when the internal DIP switch 2 = OFF.

5 Stand-by mode

The stand-by mode (controlling during production stops) may be activated in 2 ways:

1. Drop for all zones by setting 24VDC to the digital input (X3 at the processor board), or via ABS telegram.
2. Drop for single zones by changes at parameter 19

6 Optimising a control loop by self tuning

The FP08 self tuning facility enables the analysis of the control loops connected, and the modification of the P- I- and D-parts via a suitable algorithm.

There are two different tuning processes integrated within FP08. The first routine optimises by means of an oscillating trial at 80% of the reference value, the second routine optimises the controller by determining the delay time and the heat-up speed at start.
The oscillating trial is more suitable for faster zones, for extremely slow zones the start trial is more suitable.
The decision which tuning mode to select is determined by the distance between the actual and reference values. If the actual value is under 80% at the start of the tuning process the start tuning is selected, above 80% of the reference value the controller attempts to find the parameter by an oscillation trial in the event that no cooling is activated.

6.1 Self tuning of heaters by start up

Self tuning via start-up trial should always be selected in the case of slow, possibly mutually thermal-influenced, heating zones (e.g. extruder heating).
An actual value well under 80% of the reference value is required to begin correct tuning in the start-up trial. Moreover, the temperature at start must be in a stable condition, which means it may not be falling or rising.
At the start of the tuning process the output is first set to 100% performance whereby a rise in the resulting temperature can be observed. As soon as the increase has reached maximum (v_{max}) the control parameter can be derived from v_{max} and the delay time t_u .

The self-tuning process will be stopped without changing the control parameter if:
- The actual value exceeds 80% of the reference value and no v_{max} was found (risk of overshooting)
- The actual value continues to drop despite 100% performance (wrong active direction)
- The actual temperature increase is > 1° / sec (risk of overshooting)
- The setpoint has changed meanwhile.

A false result is achieved when:
- The temperature was falling at the start of self-tuning i.e. by cooling the zone
- The heating was still switched off externally at the start of self-tuning (results in a false delay time)
- The temperature was rising due to previous heating-up at the start of self-tuning (results in a too short delay time)

6.2 Self tuning of the cooling by drop trial

An actual value near the reference value is required to begin correct tuning in the drop-set trial. Moreover, the temperature at start must be in a stable condition which means it may not be falling or rising.
At the start of the tuning process the output is first set to 100% performance (full cooling) whereby a rise in the resulting temperature can be observed. As soon as the increase has reached maximum (v_{max}), the control parameter can be derived from v_{max} and the delay time t_u .

The self-tuning process will be discontinued without changing the control parameter if::

- The actual value drops below 80% of the reference value and no v_{max} was found
- The actual value continues to rise despite 100% cooling (wrong active direction)

A false result is achieved when:

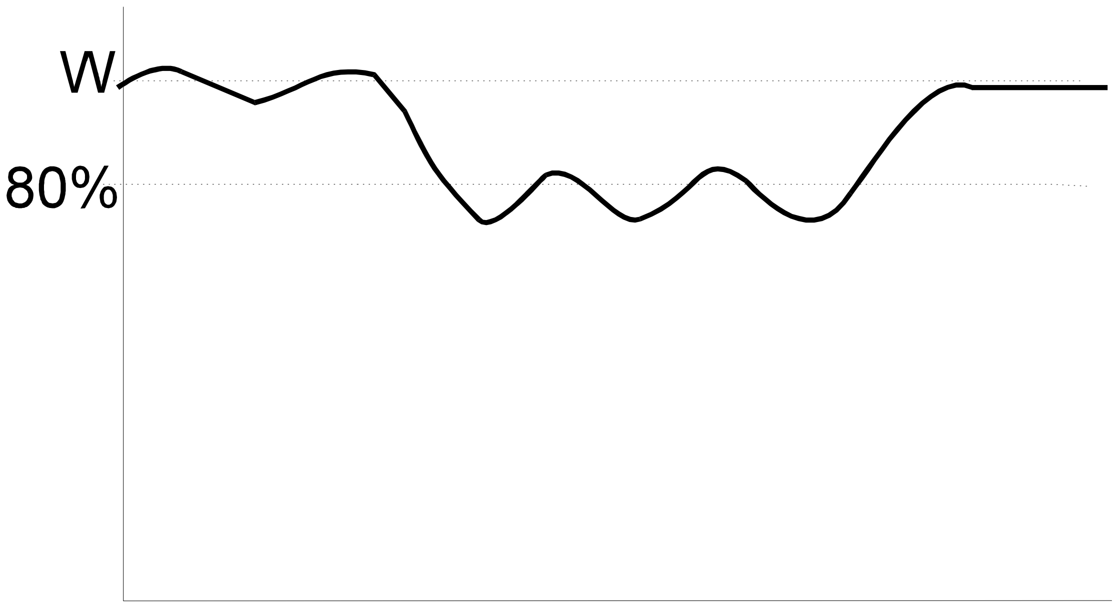
- The temperature was falling at the start of self tuning i.e. by cooling the zone
- The heating was still switched off externally at the start of self-tuning (results in a false delay time)
- The temperature was rising due to previous heating-up at the start of self-tuning (results in a too short delay time)

6.3 Self tuning by oscillation trial

An actual value near the reference value is required to begin correct parametering via the oscillation test. The cooling must be disabled (parameter 14 = 0). During self tuning the program evaluates the controlled process as follows:

- Internal drop of the reference temperature to 80%
- oscillation test at full heating performance
- determining parameter from the form of the 2.temperature oscillator
- heating up to the old reference value using the new parameters.

Moreover the program questions the necessity of the PID control and transforms the control function, if required, into a PI function with starting ramp (FUZZY-function).



7 Profibus-Profilbeschreibung (V2.09)

The interface Profibus DP:

- has a transmission rate of max. 12 Mbits/s.
- is electrical isolated.
- allows the transmission of all settings and parameters.
- is absolutely compatible to previous versions of the controllers.
- may be added to default FP16 or FP16+ by simple exchange of the processor board. No additional wiring is required except the Profibus cable.
- is wired to a compatible Sub-D plug according to DIN 19245.
- Was certified by the Organisation of Profibus Users (PNO).

7.1 Technical details

7.1.1 GSD-file

The required GSD-file "FEL_00A9.GSD" for various bus-masters is available from FELLER ENGINEERING. Even the file "FE00A9TD.200" for operation of different older SIEMENS-bus-masters is available. These files are prepared for download at www.fellereng.de.
The official PNO identification code is 00A9.

7.1.2 Addressing

The selection of the address has to be done exclusively by the DIP-switches on the controller (see manual). The SSA service of Profibus is not executed. The addresses are not able to be changed via bus. Valid addresses are 1..32.

7.1.3 Bus-parameters

The bus-parameters are fixed in the GSD-file. The data are to transfer via 10 datawords for input and 10 datawords for output. Manipulation of the length of data is not allowed. The controllers are limited to a max. baud rate of 12Mbit. This will be recognized automatically.

7.1.4 Pin assignment

The connection for Profibus has to be wired to the labelled. The assignment of the pins refers to the Profibus specification.

A - wire	= PIN 8
B - wire	= PIN 3
RTS	= PIN 4
GND	= PIN 5
+5V	= PIN 6

7.2 Transfer of Utility Data

All multi channel control systems are fit with several settings like setpoint, alarm limits and different control parameters for each single zone. There is further information about the actual condition of the zone (actual temperature, alarm reports, output rate) as well as global collective parameters for all zones.

The Profibus profile of Feller Engineering enables the handling of all these settings to present the controller as comfortable as possible.

It is not possible and makes no sense to transfer all these utility data together in a single telegram. That is why the bus-master has to demand all required data from the control system.

The data transfer with the controller happens by an input section and an output section, each with a size of 20 bytes.

Each section consists of a 4 bytes header and 16 bytes (8 words) utility data.

The bus-master demands the required data from the controller by the description of the output section. The controller will set these data into the input section of the bus-master.

That is the reason why the link to these controllers has more expense than to "smaller" partners like scales or valves, that may keep all data in a single section.

There are some important items the programmer has to concern about:

7.3 Safety 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 many Profibus-master 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.

7.4 Check after demand of data referring to 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.

7.5 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.

7.6 Transfer settings only with change

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.

7.7 Definition of the input and output sections

7.7.1 The output section in the bus-master (sent from master to slave)

Byte No.	Name	Function (contents)	
0	*oAction*	**1** = read values from slave **2** = send values to slave	HEADER
1	*oGroup*	A group includes a series of 8 zones. **1** = zones 1..8 **2** = zones 9..16 **3** = zones 17..24 a.s.o. Special group: **0** = global settings (see below)	
2	*oSignification*	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)	
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, if it is set to1. (bit0 ref. to dataword 1, bit7 ref. to dataword 8). This allows to enable the orders for single or more zones.	
4 5	*oDataword 1*	Value for the 1st zone of a group. With an order (Byte 0 = 1) the contents is not valid.	UTILITY-DATA
6 7	*oDataword 2*	Value for the 2nd zone of a group With an order (Byte 0 = 1) the contents is not valid.	
8 9	*oDataword 3*	Value for the 3rd zone of a group With an order (Byte 0 = 1) the contents is not valid.	
10 11	*oDataword 4*	Value for the 4th zone of a group With an order (Byte 0 = 1) the contents is not valid.	
12 13	*oDataword 5*	Value for the 5th zone of a group With an order (Byte 0 = 1) the contents is not valid.	
14 15	*oDataword 6*	Value for the 6th zone of a group With an order (Byte 0 = 1) the contents is not valid.	
16 17	*oDataword 7*	Value for the 7th zone of a group With an order (Byte 0 = 1) the contents is not valid.	
18 19	*oDataword 8*	Value for the 8th zone of a group With an order (Byte 0 = 1) the contents is not valid.	

7.7.2 The input section in the bus-master (sent from slave to 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 demanded by the master. Only when 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 when the signification of the input and output section are identical, the received utility-data should be used.	
3	*iConsistency*	Only when Bit0 of the consistence was set, the following utility-data shall be used. Bit 1 toggles in the transmission-cycle of the slave from 0 to 1.	
4 5	*iDataword 1*	Transferred value of the 1^{st} zone within the group	**UTILITY-DATA**
6 7	*iDataword 2*	Transferred value of the 2^{nd} zone within the group	
8 9	*iDataword 3*	Transferred value of the 3^{rd} zone within the group	
10 11	*iDataword 4*	Transferred value of the 4^{th} zone within the group	
12 13	*iDataword 5*	Transferred value of the 5^{th} zone within the group	
14 15	*iDataword 6*	Transferred value of the 6^{th} zone within the group	
16 17	*iDataword 7*	Transferred value of the 7^{th} zone within the group	
18 19	*iDataword 8*	Transferred value of the 8^{th} zone within the group	

7.8 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 *00001000* = 8. This way only Dataword 4 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 has exceeded.
11. The new setpoint can be taken from ***iDataword4*** for check.

7.9 State of the zone

The state 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.

7.10 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 2nd byte (group). The different parameters are to send in READONLY or READ/WRITE mode (see column R /RW). The 3rd 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
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	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
		Spare	RW
0	3	*Spare*	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
		Spare	R
0	4	*Spare*	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W
		Spare	W

8 Technical Data

Operation voltage:		24V DC +/- 10%
Power consumption:	(depending on the option)	Max. 6 W
Signal inputs	(depending on the option)	
Thermocouple inputs	Fe-CuNi Type J	0..700 °C
	Ni-CrNi Type K	0..999 °C
	Deviation of temperature by cable resistance	< 1K / 10Ω
	Thermocouple compensation	Internal or external
Resistor sensors	Pt100/2-wire	0..600°C
	- - - with 1/10° resolution	0..200,0°C
	Measuring current	0,5mA
Standard signals	0..10V	Ri=100kΩ
	0/4..20mA	Ri<20Ω
	Alignment	±0,25% v.E. ±1Digit
	Linearity	±0,2% v.E. ±1Digit
	Accuracy class	0,5%
	Auxiliary supply	external 24VDC
Controller outputs		bistable, electrically isolated
	per zone	1x heating, 1x cooling
	outputs	+24VDC pulsed
	max. current	25mA
	Ri	68Ω
Alarm outputs :	Self-control:	Relay contact
(Relay contacts)	max. voltage	250VAC
	max. current	4A at cosφ = 1 2A at cosφ = 0,5
Control behaviour	P, PI, PD or PID with automatic change of structure, control parameters for all zones separate	
Data storage (EEPROM)	Longterm storage	min. 10 years
Interfaces	Profi-Bus	electrical isolated
Ambient conditions:	Ambient temperature	0°C to 50°C
	Housing temperature	max. 60°C
	Storage temperature	-25..+75 °C
	Humidity	< 95% rel. humidity, no dewing
Weight:	all slots used	600 g
Dimensions:		56.5 x 135 x 175 mm

Hints to EMC (electromagnetic compatibility)

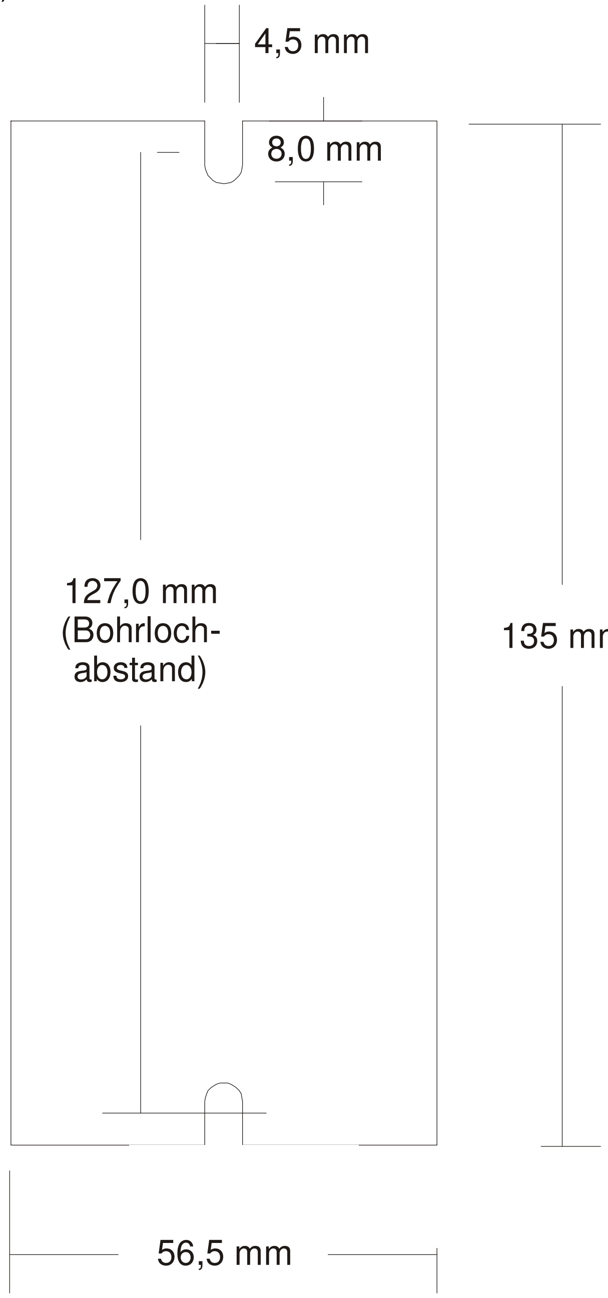
Interference transmissions:

The unit is relieved according to **EN 55011 /B** (interference transmissions).

The housing has to be connected in a conductive way to the conductive mounting plate, which has to be grounded according to the regulations.

8.1 Mounting sketch

(Distance of drill holes)



The FP08 is designed to get fixed to the mounting plate by 2 screws M4.