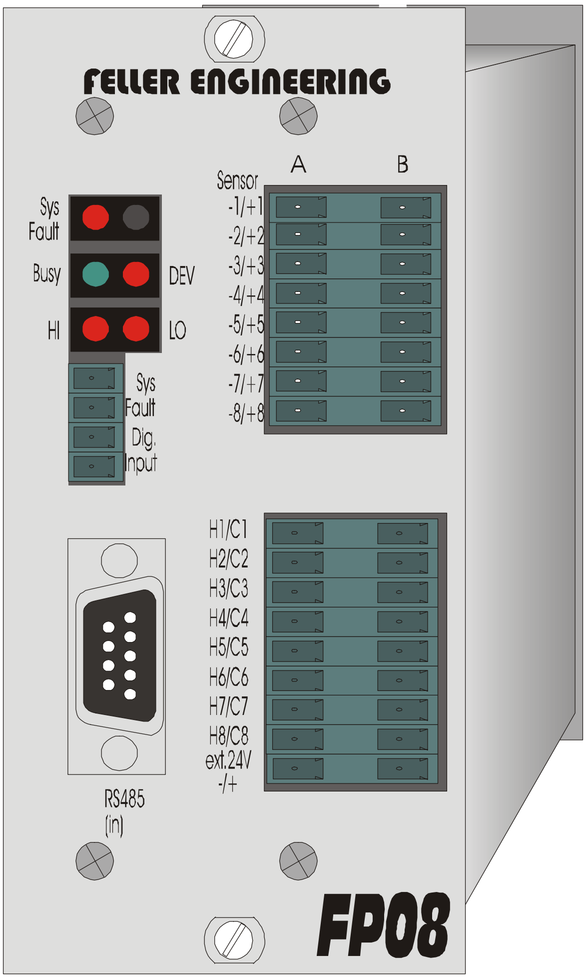
FELLER ENGINEERING GmbH

FP08

Operator Manual



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Version 6.2

Stand: 12/15-1112

Contents

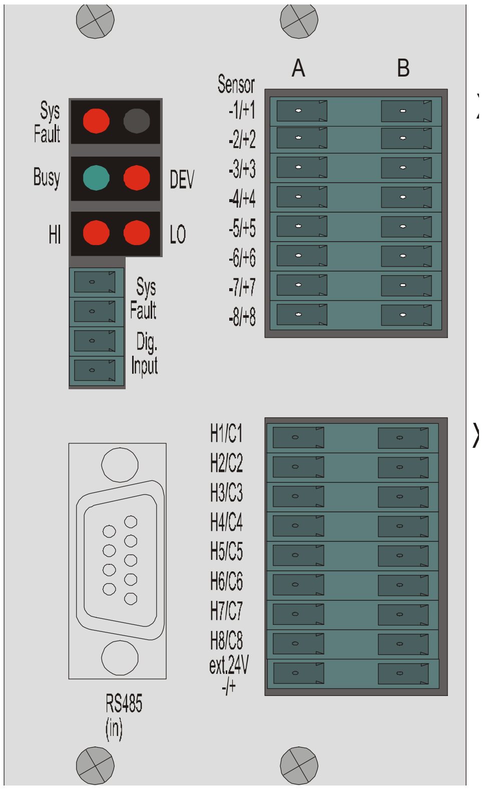
1 Basics of FP08

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)
X3.2 = RS485):Rx/Tx +
X3.3 = RS485): Rx/Tx -
X3.4 = RS232*): TxD (Receive)
X3.6 = RS232*): RxD (Transmit)
X3.5 = RS232*): GND (Ground)

*) nur bei Ausführung „mit RS232 Schnittstelle“ verfügbar.

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

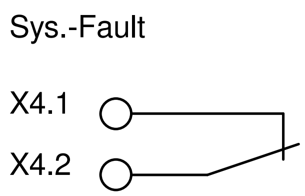
Different sensor types are available (also mixed) depending on the version. The sensors are connected to plug X1. In the case of thermocouples, the (-) pole is at the A-side (left) and the (+) pole at the B-side (right).

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.



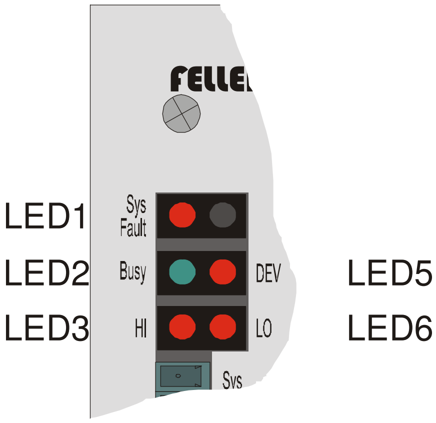
(normal condition shown!)

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).

LED5 DEV-Alarm. This lights up red as soon as one of the zones indicates deviation alarm (summary signal for all zones).

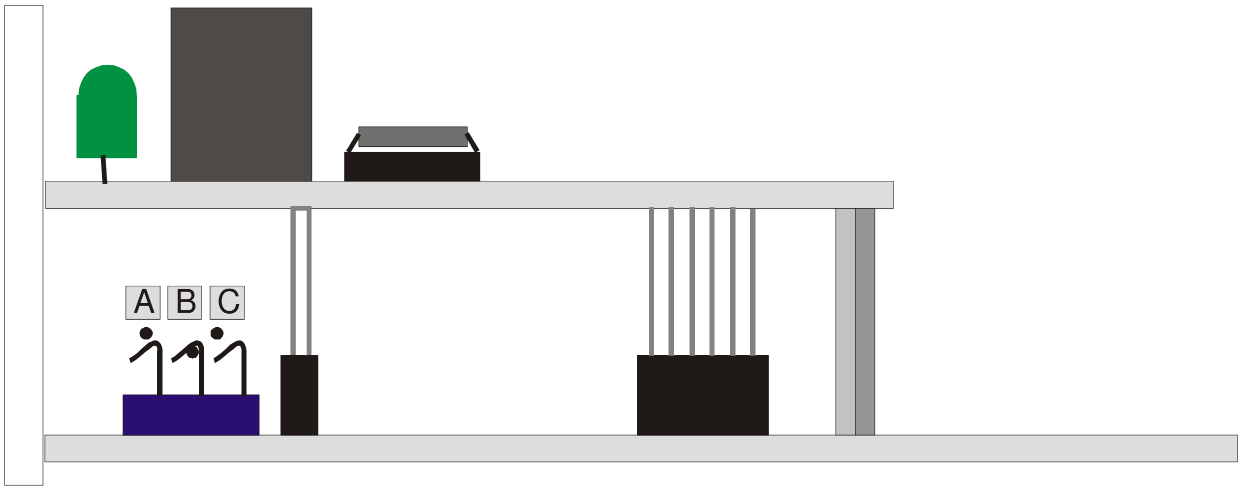
LED6 LO-Alarm. This lights up red as soon as one of the zones indicates LO-Alarm or broken sensor (summary signal for all zones).

2.2.7 Wiring of the Bus line for the RS485 interface

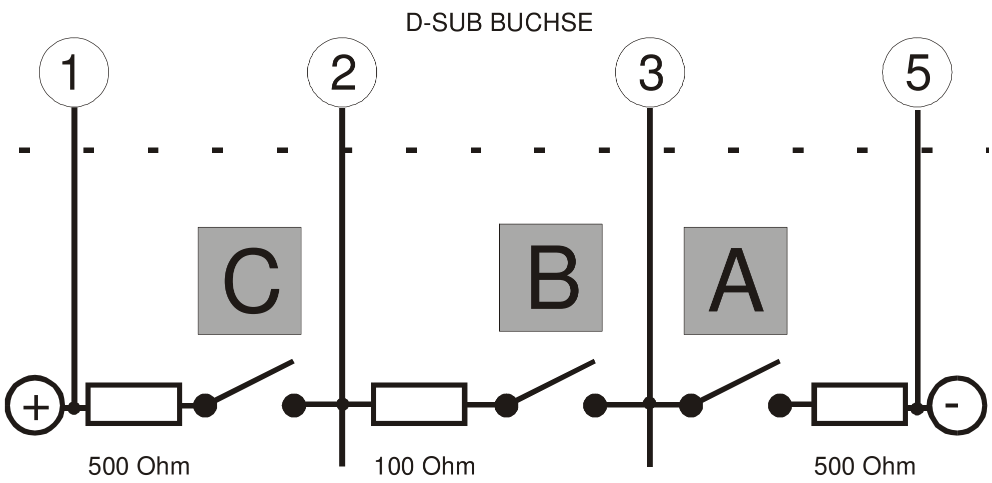
The lead device is connected via the RS485-bus interface **X3.** Here the pins **2** and **3** are to be connected parallel to the according pins at other FELLER component devices. A two-core twisted, well insulated data cable is required, where the isolation is connected to the earth of the device at both ends. To avoid possible earth loops via the screen grid, the devices must be additionally connected to each other via an earth balancing line.

The interface RS485 requires, even in case of very long or disturbed cabling, a pull-down resistor at both ends. FP08 is already fit with this resistor. It may be added by a jumper, if this FP08 is located at the end of a cable, as this is allowed only at one single unit, which is located in the greatest distance from the BUS-Master (PC or Terminal).

To reach the jumpers inside, the slide-in unit must be removed from the housing. The jumpers are located underneath the 9-pole interface socket (shown as A,B and C).



Position of jumpers A,B and C inside FP08



Generally, only jumper B is closed. If the Bus-master doesn't have the required serial resistance, the jumpers A and C have to be closed, too.

The connected units get addressed by the DIP-switches for individual separated communication.

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:

6-fold DIP-switch-block „S2" *)

	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6
ON	**sensor short circuit monitoring active**	**solid state-supervision active**	**temperature in Celsius**	thrust-free selection AUTO-MAN	No function	No function
OFF	sensor short circuit monitoring passive	solid state- supervision passive	temperature in Fahrenheit	**thrust selection AUTO-MAN**		

*) **Former versions use only 5-fold DIP-switches on this additional board (MAC-module), located behind the EPROM.**

6-fold DIP-switch-block „S1"

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)

DIP6	Function depending on the version of software	
ON	Parity EVEN	From version 5.4: 19200Baud
OFF	No Parity-Check	From version 5.4: 9600 Baud

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

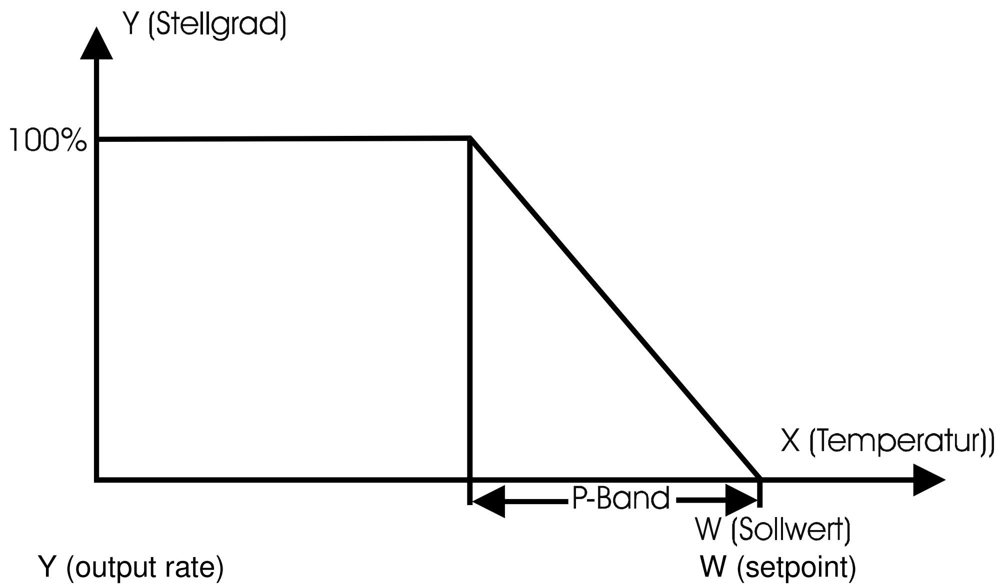
As soon as the actual value of a zone deviates from the setpoint by more than this value, the referring zone indicates deviation alarm.

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 increase 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:

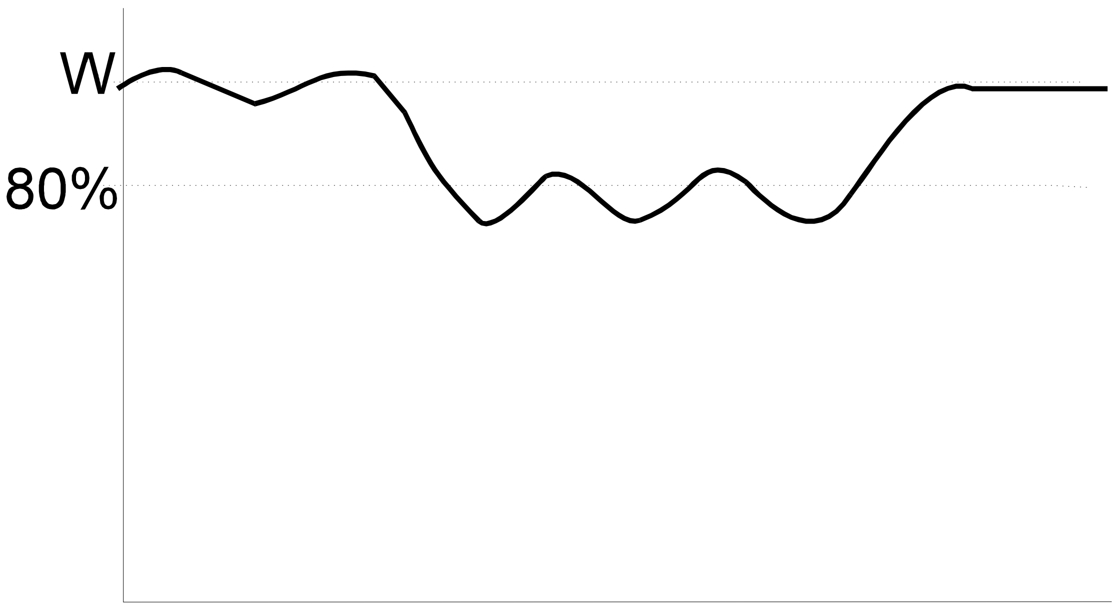
- The temperature was falling at the start of self tuning i.e. by cooling the zone
- The heating was still switched off externally at the start of self-tuning (results in a false delay time)
- The temperature was rising due to previous heating-up at the start of self-tuning (results in a too short delay 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 Data Interface RS485, Protocol-Description V3.03

The communication between the PC and the device is always incited by the 'MASTER', the PC. It demands certain data to be transmitted or certain actions to be executed by means of a transmission telegram. The device reacts with a reply telegram and possibly carries out the request.

Transmission parameters:

9600 or 19200	baud
8	data bits
NO PARITY	
1	stop bits

The transmission happens in ASCII-format, the telegrams are secured by a checksum (hexadecimal, only capital letters) and concluded with the ETX-sign (03h). A device does not react to faulty checksums or incomplete telegrams. No additional signs such as 'SPACE' or CR-LF are permitted in the protocol.

All values have to be transmitted with a leading zero. Negative values have to carry the sign at the 1st position. (e.g. **-010** as -10)

7.1 Print mode of this protocol description

The telegram contents described here are in bold print.
Telegrams from the PC to the device are additionally underlined.
Variables in the telegrams are shown in small letters.
These are to be considered as place holders for values required by the user.

gg always stands for the device address, input would be 01 02
kk always stands for channel number, input would be 01 02
pp always stands for parameter number.

Special labelling for pp:

00 = Setpoint (as parameter number 0 !)
II = Actual value
YY = Output rate
SS = State

wwww stands for a four digit variable numerical value
cc always comprises the calculated checksum

ETX corresponds to a transmitted 03h printed here as {etx} .
ACK (ACKnowledge) corresponds to a transmitted 06h, printed here as {ack}.
NAK (NegativeAcKnowledge) corresponds to a transmitted 15h, printed here as {ack}.

7.2 Checksum calculation

The checksum is calculated by adding the ASCII-values of all previous characters in the telegram. The last two characters of this number, hexadecimal speaking, are transmitted as a checksum in capitals. The device forms checksum for the answer in exactly the same way, however, not with confirmations such as 'ACK' or 'NAK'.

7.3 Time behaviour

The max. response time is approximately 20ms. If no response arrives from the controller after 40ms the telegram should be repeated up to twice before a system alarm is triggered. This repeat transmission has proved itself to be a reliable way of achieving a fault-free data transmission.

7.4 Contents of the telegrams

7.4.1 Channel specific telegrams

These refer just to one respective zone of the device and have the following layout:

Transmit value to controller

G*gg*K*kk*P*pp*=*wwwwcc*{etx}

Sets the value wwww.

Then the device replies with

G*gg*{ack}{etx} if the value was set successfully

or with

G*gg*{nak}{etx} if the value was not accepted
(possible violation of marginal value)

Demand value from the controller

G*gg*K*kk*P*pp*=*cc*{etx}

to demand for the parameter-value pp of channel kk

the device replies with

G*gg*=*wwwwcc*{etx}

wwww is the desired value

Request zone status:

G*gg*K*kk*PSS=*cc*{etx}

The device answer is once again
G*gg*=*wwwwcc*{etx}
whereby *wwww* contains the status of the zone, this can be seen BIT by BIT:

Bit 0 = 1	Zone ok, otherwise
Bit 1 = 1	-L- Alarm
Bit 2 = 1	-H- Alarm
Bit 3 = 1	-E- Alarm
Bit 4 = 1	-S- Alarm
Bit 5 =	LSB mode (mode: 0 =OFF 1=Man 2=Auto 3=Drop)
Bit 6 =	MSB mode
Bit 7 = 1	Tuning fault (is automatically set to 0 following a successful optimising at the start of optimising and, when re-starting the device)
Bit 8 = 1	Tuning active
Bit 9 = 1	- DEV Alarm
Bit 10= 1	+ DEV Alarm
Bit 11= 1	Alarm resulting from setpoint change
Bit 12= 1	Heater current fault

Change mode of a zone (r / w)

G*gg*K*kk*MOD=*wwwwcc*{etx}

Setting/inquiring about operational mode (corresponds exactly to parameter 19 on the FP16, has also been realised as a separate parallel command)

Mode = 0 --> Zone inactive
Mode = 1 --> Zone manual operation
Mode = 2 --> Zone control operation
Mode = 3 --> Zone drop-set operation

In manual operation the output performance can be set with

G*gg*K*kk*PYY=*wwwwcc*{etx}

In the control mode the setting of a reference output rate is ignored.

Select zone tuning operation (r / w)

G*gg*K*kk*TUN=*wwwwcc*{etx}

When wwww=0001 the zone is switched to tuning operation, when *wwww*=0000 the running tuning mode can be stopped.

7.5 Special form for fast protocol from all zones

G*gg*KALP*pp*=*cc*{etx}

The device answers with the transmission of the parameter pp of all zones at once in a single telegram.

G*gg*=*xxxxyyyy....zzzzcc*{etx}

xxxx = value of zone 1,
yyyy = value of zone 2,
zzzz = value of the last zone

7.5.1 Special form for fast programming of all zones

G*gg*KALP*pp*=*wwww*{etx}

From device *gg* set the parameter *pp* of all zones to the value *wwww*

Attention must be paid to the fact, that the device has to re-program all the zones resulting in a delayed reaction time (ACK) as opposed to single programming. Only numerical values are permissible for *pp*!

7.5.2 Request of parameter limits

The following telegrams request the limits of the parameters:

Lower limit, command form:
G*gg*K*kk*MIN=*cc*{etx}

Upper limit, command form:

G*gg*K*kk*MAX=*cc*{etx}

The answer has the following structure:

G*gg*=*xxxxyyyy.....zzzzcc*{etx}

xxxx=Threshold of parameter 1.
yyyy=Threshold of parameter 2.
zzzz=Threshold of the last parameter

The length of the reply telegram determines the number of parameters.

7.5.3 Device specific commands

List of device specific commands

Code	Definition	R=read, W=write P=Program *) - =Reserve	Index
STD	Loading default parameter (e.g. „STK")	P	0
RES	Device -Reset	P	1
DIA	Diagnosis mode	P	2
		-	3
		-	4
DS1	DIP-switch 1	R / W	5
DS2	DIP-switch 2	R	6
SER	Serial number	R	7
AZ#	AZ-Software variation	R	8
TYP	Device type, answer=8Byte-String	R	9
HIW	Upper operation value	R/W	10
PRV	Protocol version	R	11
VER	Software version	R	12
DAT	Software status (date), answer.=8ByteString	R	13
DAY	Software status (day)	R	14
MON	Software status (month)	R	15
YEA	Software status (year)	R	16
KAN	Number of zones	R	17
PRO	Setpoint program	R/W	18
STA	Status check for all zones **)	R	19
	Reserve	-	20
	Reserve	-	21
	Reserve	-	22
	Reserve	-	23
ABS	0 = Control mode, 1 = Standby mode	R/W	24
F60	0 = 50Hz net frequency, 1 = 60Hz net frequency	R/W	26
ENA	0 = Outputs disabled. 1=enabled	R/W	27
DLY	Alarm delay	R/W	32

*) The commands marked with P (program) effect a calling up of all device dependent sub-programs. In mnemonic script these respond to the paragraph "*Execute device specific sub-programs"*. In this index-script an attempt to read the appropriate parameter is sufficient.

**)When reading out a 32-bit word is transmitted (hexadecimal !), which shows a bit by bit status change of the individual zones (bit 0 = zone 1 ...bit 31=zone 32) the confirmation is with G*gg*?STA=00000000*cc{etx}*.

Commands marked with reserved are not available.

7.5.4 Mnemonic script

These refer to all zones of the device and have the following format:

G*gg*?*xxx*=*wwwwcc*{etx} for setting values the device then answers with

G*gg*{ack}{etx} if value was successfully set or with

G*gg*{nak}{etx} if the value was not accepted (poss. limit violation)

G*gg*?*xxx*=*cc*{etx} to demand values

the device then answers

G*gg*=*wwwwcc*{etx} whereby wwww shows the desired value.

xxx stands for the name according to the above table..

Index-script is available from protocol version 3.03 parallel to the mnemonic script.

For this reason a virtual channel 0 was introduced possessing a number of device specific parameters. The parameter number of this channel corresponds to the index number according to the above table.

The protocol syntax is then identical to the channel specific protocols i.e. request for serial numbers with

G01K00P07=cc{etx}

7.5.5 Execution of device specific sub-programs

Depending on the type of device, different device specific sub-programs can be activated by the interface.

Format:

G*gg*X*xxx*=*cc*{etx}

xxx here stands for the following possible commands:

STD = loading the default parameters depending on the DIP-switch position °F or °C, different values are loaded!

RES = executing a device re-set *)

Attention!

The execution of these commands always effects the running operation of the device.

7.5.6 Examples

Device 10, channel 5 should be set to the setpoint 50.

the PC transmits:

G10K05P00=00500A{etx}

the controller replies

G10{ack}{etx}

The actual value should be requested from device 8 channel 11.

the PC transmits:

G08K11PII=7B{etx}

the controller replies

G08=0120AF{etx} (120 ° actual value)

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 : (Relay contacts)	Self-control:	Relay contact
	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	RS485 or RS232	electrical isolated
	Protocol	FE3-Bus Version 3.03
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)

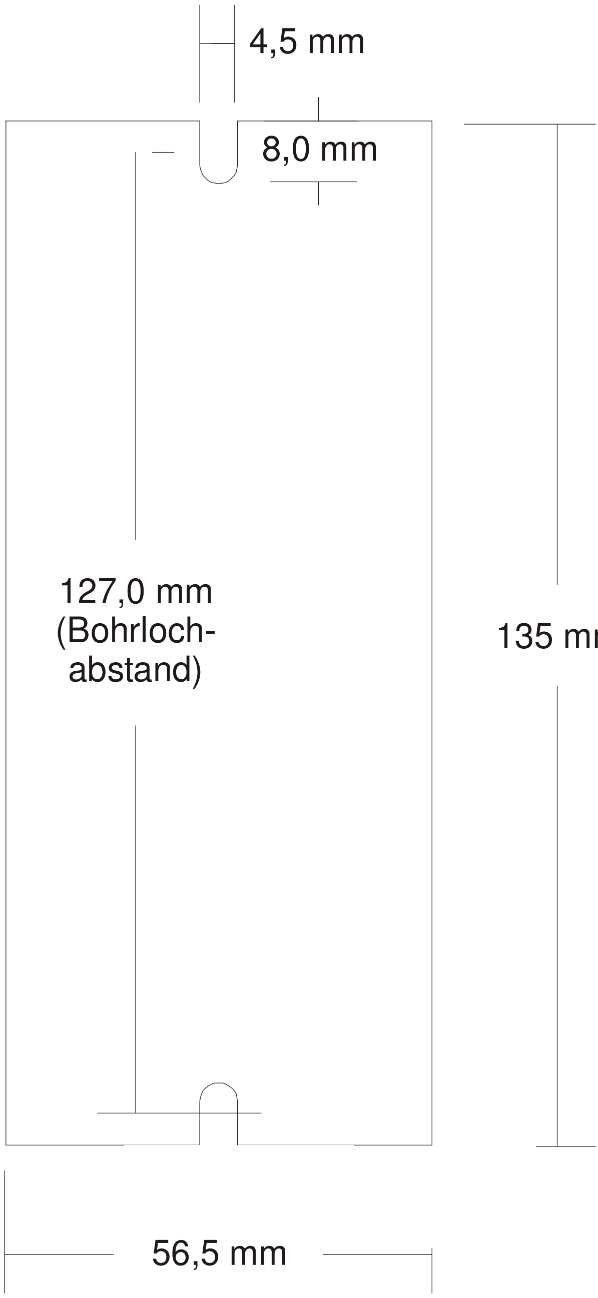
Interference transmissions:

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.

8.2 Additional software

FELLER ENGINEERING offers software for transmission of parameters as well as the universal process management system for all devices.