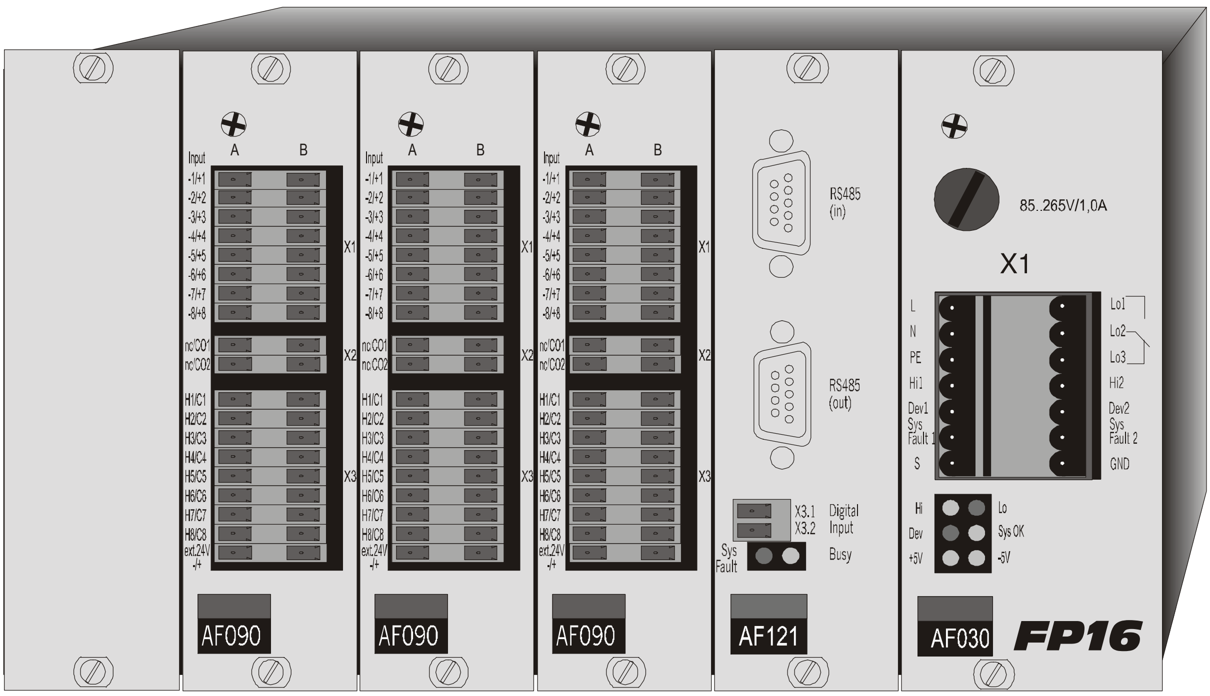
FP16

Operator Manual



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1 Contents

2 Basic overview

The series **FP16** is designed for temperature controllers in a rack version. Various combinations of boards allow supervision of temperatures as well as controlling and supervision of machine installations. One of the serial interfaces is in all cases the link to a visualisation or process-controller with operation surface.

2.1 Different solutions

This manual describes the versions for temperature controlling. For other fittings of **FP16** the manuals for the referring boards and programs will be added.

2.2 Fittings and functions

The rack of **FP16** is designed for 6 boards. 4 of these are prepared for input and output boards.
The rack of the **FP16** is fit with 6 slots for 4 different input and output boards.
The measured values setpoints and parameters are all available via an isolated serial interface RS485. Further interfaces are available additional in front of the processor board. The power supply board is available in AC or DC versions. There are fit alarm-outputs (relay-contacts) for:

- HI-Alarm, high temperature
- LO-Alarm, low temperature
- DEV-Alarm, deviation out of tolerance
- System fault (self control of the hardware).

These alarm may have different functions except the temperature control referring to the processor software.

3 The temperature controller FP16

The temperature controller **FP16** is designed for max. 32 zones. Overheating is supervised by:

- Recognition of shorted thermocouples
- Recognition of shorted Solid-State-Relays
- Optional heater current supervision
- 3 alarm contacts depending on the temperature.

3.1 Control mode

The temperature controller works in a 3-point mode for heating and cooling, in a 2-point mode for heating. The outputs are pulsed in these cases. The output boards are inapplicable for the function of temperature measuring.
The refresh cycle of 1,5secs for all zones is applicable even for fastest control loops.
A self tuning routine based on Fuzzy logic is available for all zones.
The switch cycle for heating and cooling can be set separately for each zone. This allows an adjustment to slower switch gears (relays).
The cooling system can be selected for each zone. AIR or WATERINJECTION for steaming. These are based on different routines. The air cooling allows a slower switch rate to avoid short pulses for fan-motors.

3.1.1 Stand-by mode

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

1. Drop for single zones by changes of parameter 19
2. Drop for all zones by setting 24VDC to the digital input (X3 at the processor board), depending on the software version.

3.2 Alarms

3.2.1 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 secs.
- and the reference value is not set to '0'

This procedure also monitors poled sensors and defective heating !

The consequences of such an alarm are the shut down 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 .

Attention!

The sensor short circuit alarm can also occur in zones in which 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%.

3.2.2 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>rise</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 secs.
- 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.

3.3 Self tuning

The **FP16** 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 **FP16**. The first process optimises by means of an oscillating trial at 80% of the reference value, the second process 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 parametering 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.

3.3.1 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 parametering 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)

3.3.2 Self tuning of the cooling by drop trial

An actual value near the reference value is required to begin correct parametering 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:

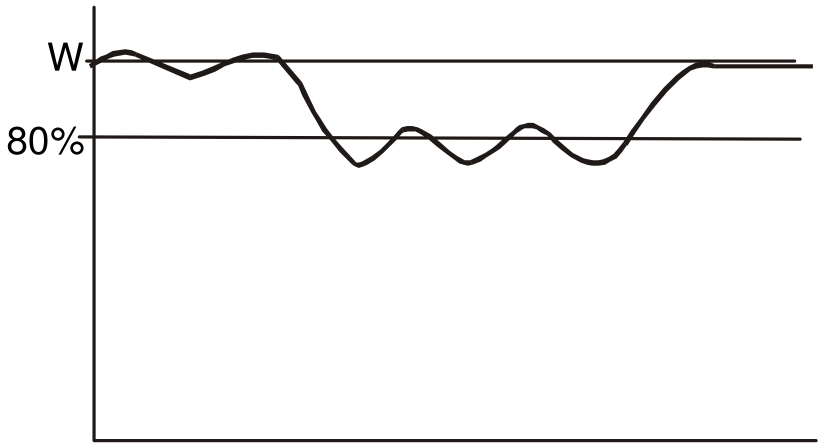
- The temperature was falling at the start of self tuning i.e. by cooling the zone
- The heating was still switched off externally at the start of self-tuning (results in a false delay time)
- The temperature was rising due to previous heating-up at the start of self-tuning (results in a too short delay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

3.3.3 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).



3.4 Heater current supervision

The **FP16** can be optionally equipped or post equipped with heating current supervision (from software version 5.20). In order to activate the heating current supervision the DIP-switch number 5 on the 5-fold DIP-switch block of the processor circuit board must be set to „ON“ and the heating current input board **AF060** inserted into the 2. slide-in unit from the left. With the aid of this option the ***FP16*** ensures a reliable supervision of the connected heating performance.

3.4.1 Number and function of the zones

With heating current supervision the number of temperature control zones is limited to a maximum of 16, the number of zones operated via the interface is always 32. Channel 17 is responsible for the current supervision of control zone 1, channel 18 for the control zone 2 and so on.

3.4.2 Function of the current supervision

Parallel to the control the actual flow current for all 16 current zones is measured and compared to the set current reference value. Currents in reference and actual value areas are measured and evaluated with a resolution of 1/10 amperes.
To avoid the indication of minimal current, resulting from solid state relays, all currents smaller than 10% of the nominal current are indicated as „000,0A“.

Recognition of heater current

As soon as the control zone demands heating power (control output >0%), the heating current supervision tries to measure the current in this zone. This, however, can only be done from a minimum control output of 5% as with a lower control output the current flow is too temporary. If, after several tries by the heating current supervision the zone still shows too low control output a temporary current flow of sufficient length is incited in the zone, (under heating current supervision). In this way a reliable current measurement is guaranteed even in the case of extremely low control output.

Recognition of shorted Solid State Relays

If the control zone demands no heating power (0% or zone cooling), the supervising facility monitors whether really no current is flowing (0 Amperes). The rest of the remaining current is reported as an actual value in this case. If the value measured in this way is > 0,9 A (maximum remaining current permitted), this is reported in the status word with an activated short circuit bit. In this way a solid state relay, short circuited at output, can be recognised.

Behaviour directly after start of the unit

As there is no current flow guaranteed in the zones directly after switching on the actual value of these zones is held at „-1“ until the first real measurement. This special value can be indicated accordingly on the operating surface (e.g. as „---“ or completely blinded out). A premature alarm for „insufficient current“ is thus avoided.

3.4.3 Parameters for heater current supervision

The current supervision occupies the device zones 17 to 32.

The same parameter are valid for configuring the heating current channels and for the temperature control:

Parameter 1 for the absolute LO-Alarm (in 0,1 A)
Parameter 2 for the absolute HI-Alarm (in 0,1 A)
Parameter 3 for the permissible deviation from the reference value (in 0,1 A)
Parameter 21 is constantly set to 5 (characteristic for the heating current zone)

All other parameters are present and operable, they have however no influence on the current supervision.

3.4.4 Alarms from heater current supervision

The alarms are not connected to the external alarm contacts, but are only reported via the interface.
The alarm bits correspond exactly to the significance of the control zones (Lo-Alarm, Hi-Alarm, DEV-Alarm). As soon as a heating current fault is recognised the fault bit 12 is additionally activated in the status word of the according temperature zone (=„current fault“).

In the event of a current flow being recognised although no triggering of this zone has taken place (short circuited solid state) bit 4 is activated in the status word (as with the temperatures „sensor short circuit“).
In the case of non-connected transformers and non-connected voltage sensors the actual value „0A“ is shown.

4 Parameters

There are two different types of parameters.

- Global parameters, valid for the total **FP16**
- Zone parameters, individual settings for the referring zone.

4.1 Reset to default parameters

This procedure effects a reset to the parameter set by the manufacturer. Loading the standard parameter can be remotely controlled via the interface (see protocol description) or even by setting the address on the processor board to „0“. The board has to be kept in the rack for min. 1 min under power.
Hint:
This reset effects all the parameters as well as the setpoints (0 = zone off).

4.2 Global parameters

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

4.2.1 Highest adjustable temperature („HI-value“)

The HI-value allows limitation of the adjustable values to a max. final value.
This value, however, has a secondary function.
All control parameters relate to this HI-value. A setting of x_p = 5% produces, for example, an effective P-Band of 35°C.at a HI-value of 700°C.
<u>Adjusting a HI-value has an affect on all controlled systems.</u>

Limits:	20.. 999
Default value	700

PROTOCOL: G01?HIW=0700 700° HI-value

4.2.2 Selection of the net frequency

To suppress possible interferences to sensor circuits the mains frequency (50cps or 60cps) is adjustable as a parameter (default setting = 50Hz).

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

PROTOCOL:	G01?F60=0001	60cps operation
	G01?F60=0000	50cps operation

4.2.3 Alarm delay

The controller may activate the alarms with a certain delay. The alarm must be true for the time that is set here (in seconds) to give a report via contacts or interface. This way shortly appearing alarms can be ignored, if they result from e.g. badly screened sensor cables.

Limits:	0 ... 90s
Default value	0 (no delay)

PROTOCOL : G01?DLY=0005 (5s delay)

4.2.4 Disable of the controller outputs

This parameter is used to switch off all controller outputs without operation of the zones. It helps to prepare the zones for the self tuning or setting values without heating the different zones.

This way has to be preferred instead of the main switch to disable the heaters. The I-part will not be overloaded during this time and inhibits overheating after restart.

The start up tune should be started this way.

First set passive by 0.
Wait for a stable condition (cold) of the referring zones.
During this time the required setpoints may be entered and tuning cab be started.
When the zones are in stable conditions, set active by this parameter (=1). The internal tuning starts only now. This is the favourite way to reach a synchronous heating of thermal connected zones.

Limits: 0 or 1
Default value 1

PROTOCOL: G01?ENA=0000 (all off)
G01?ENA=0001 (all on)

4.2.5 Standby of all zones (drop set)

This parameter is used to set all zones to a standby value without individual operation of all zones.

Limits: 0 or 1
Default value 1

PROTOKOLL: G01?ABS =0000 (drop set off)
G01?ABS =0001 (drop set on)

4.2.6 Function of the digital input at the processor board

This parameter selects the function of the digital input.
Activation of drop set value from parameter 12 when the setting is „0“.
Disable the controller output when the setting is „1“.
Serial heater current supervision via module AT083, when the setting is „2“. In this case a single transmitter is required for all zones.
Enable the controller output when the setting is „3“.

Limits: 0 .. 3
Default value 0

PROTOKOLL: „G01?SPS=0000“ (Input for drop set)

4.3 Parameters of the temperature controlled zones

A series of operation parameters refers to each zone. They are explained in the following:

4.3.1 PARAMETER 1: LO-Alarm

Underpassing the value set for parameter 1 triggers the respective zone LO-alarm thus tripping the appropriate alarm contact, LED **L4** lights up.

Limits:	0...9999
Default value	0

The LO-alarm is not supervised when the setpoint = 0 !

4.3.2 PARAMETER 2: HI-Alarm

Exceeding the value set for parameter 2 triggers the respective zone Hi-alarm thus tripping the appropriate alarm contact, LED **L1** does **not** light up!

Limits:	0...9999
Default value	400 °C

The HI-Alarm is also supervised when the setpoint = 0 so that short-circuited solid state relays at output are safely supervised even when zones are inactive !

4.3.3 PARAMETER 3: Deviation-Alarm

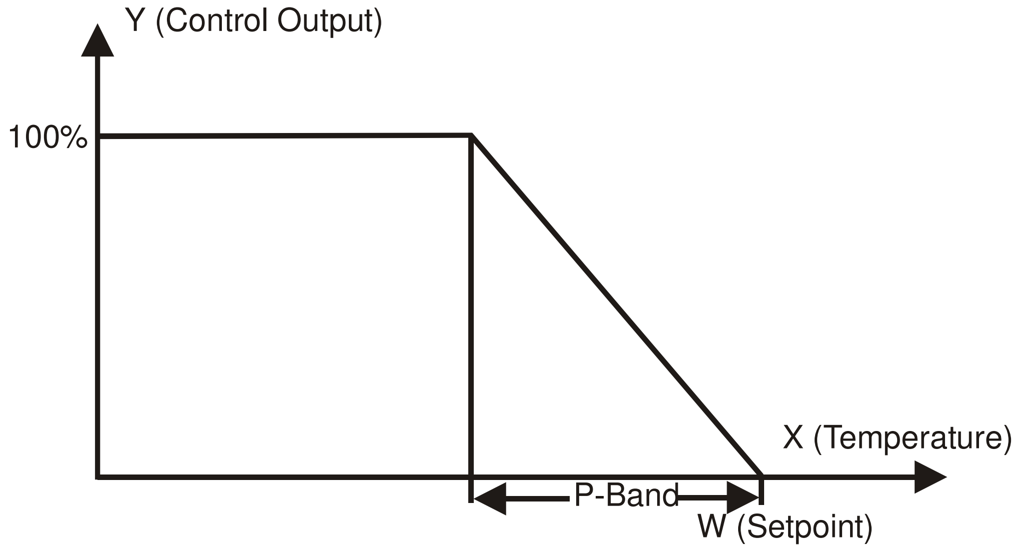
As soon as the actual value of a zone deviates from the setpoint by more than the setting here the respective zone deviation alarm is triggered. The appropriate alarm contact is tripped, LED **L2** lights up.

Limits:	1...999
Default value	15

The deviation alarm is not supervised when MODE=OFF!

4.3.4 PARAMETER 4: x_p of the 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 500°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 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 %

4.3.5 PARAMETER 5-t_n (Integral part of the 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

4.3.6 PARAMETER 6-t_v (Differential part of the 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

4.3.7 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 large values effect a slow ramp.

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

4.3.8 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

4.3.9 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

4.3.10 PARAMETER 10: Maximum output for heating

This parameter limits the maximum output of the heating.

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

4.3.11 PARAMETER 11: Diagnosis time

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

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

Setting the value „0“ means the plausibility supervision for this zone is inactive.

4.3.12 PARAMETER 12: Temperature drop

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

4.3.13 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)

4.3.14 PARAMETER 14: *xp* of the cooling

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

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

4.3.15 PARAMETER 15: t_n of the cooling

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

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

4.3.16 PARAMETER 16: Cycle time for the 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.

4.3.17 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)

4.3.18 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: READ ONLY !
Default value 0%

4.3.19 PARAMETER 19: Operation mode of the zone

Limits: 0...3
0 = outputs OFF
1 = Manual mode (=not controlled)
2 = Automatic (=controlled)
1 3 = Temperature drop
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 (see AF121) a soft or thrust change of the operation is selected.
The soft change will go on with the mean output rate, that has been stored by the controller before. An other 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 ,that has been preset in parameter 20 for the output rate. This does not refer to the previous controlled output rate.

4.3.20 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** operation.

4.3.21 PARAMETER 21: Sensor type

Limits: 0...5

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 = Heater current-supervision (is automatically set)
6 = 4..20mA
7 = 2-wire-Pt100, 1/10° resolution
8 = 4-wire-Pt100, 1/10° resolution

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

4.3.22 PARAMETER 22: Offset actual value

Limits:	-99 .. +99 °K
Default value	0

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

4.3.23 PARAMETER 23: max. value

Limits: 0 .. +1999
Default value 0

For the connection of standard signals the value for the max. input signal will be set here. Even an adjustment of the zones is possible. There is no influence to temperature sensors.

4.3.24 PARAMETER 24: t_V of the cooling

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

4.3.25 PARAMETER 25: Nominal current

This parameter sets the nominal current of the serial current supervision. The unit is 1/10 Amps.

Limits : 0...999,9 A
Default value 0 A

4.3.26 PARAMETER 26: Max. current tolerance.

This parameter sets the maximal permissible deviation of the nominal current for the serial current supervision. The unit is %.

Limits: 1...100 %
Default value 10 %

4.3.27 Parameter 27: Number of Steps for cooling power

To protect the controlled cooling-fans of short pulses, this parameter sets the number of power steps for the referring output.

Example:
The setting of „4“ cuts the cooling output rate to 4 steps of 25%,50%,75% and 100%.
Controller rate of 0..25% result in 0, rates of 26..50% result in 25% and so on.
As reduced settings may protect the installed cooler but do not control the zone in the best

Limits: 1...100
Default value: 100

4.3.28 Parameter 28: Output rate for drying

The setting of this parameter may limit the output rate during the heat up period.
Function:
As soon as the zone is started with a setpoint >100°C and the actual value is below 80°C, the drying routine is activated. The setting of this parameter limits the output rate to the selected value and increases the temperature to 100°C. 100°C will be kept for 4min before the heater start to reach the setpoint with full power.
The default setting is 100%, what disables this function.

Limits:	0...100
Default value:	100

5 Interface and protocol

5.1 Data interface RS485

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	baud
8	data bits
NO PARITY	
1	stop bits

The ***FP16*** recognizes automatically the baud rate of the telegrams. The Dip switch no.6 of the address block is disabled after adaptation, until next power start.

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.

5.2 Protocol description V3.03

As from protocol version 3.00 all setpoints and parameters which are transmitted from the PC to the device are checked for validity and ignored by the device if they do not conform and are subsequently answered with NAK.

All values to be transmitted are preceded by zeros. Negative values always have the sign first (i.e. **-010** for -10)

5.2.1 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'.

5.2.2 Time behaviour

Depending on the type of device, the max. answer time is approximately 120ms. If no answer from the controller arrives after 200ms the telegram should be repeated up to twice before a system alarm is triggered on the PC. This repeat transmission has proved itself to be a reliable way of achieving a fault-free data transmission.

5.2.3 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:

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

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}.

5.3 Channel specific telegrams

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

5.3.1 Transmit value to controller

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

to set the value wwww.

the device then replies with

G*gg*{ack}{etx} when the value was successfully set or with
G*gg*{nak}{etx} if the value was not accepted (poss. violation of marginal value)

5.3.2 Demand value from controller

G*gg*K*kk*P*pp*=*cc*{etx}
to demand for the parameter-value pp of channel kk.

the device then replies with
G*gg*=*wwwwcc*{etx}
wwww is the desired value.

5.3.3 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

5.3.4 Select zone mode (r / w)

GggKkkMOD=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
GggKkkPYY=wwwwcc{etx}
In the control mode the setting of a reference output rate is ignored.

5.3.5 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.
Special form for fast protocol of all zones

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

the device then 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

5.3.6 Special form for fast programming of all zones

G*gg*KALP*pp*=*wwwwcc*{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*!

5.3.7 Request parameter limits

Lower limits, command form:

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

Upper limits, 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.

5.4 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
		-	2
STP	Reset to default parameters	P	3
STK	Reset to default configuration (MASTER-RESET)	P	4
DS1	DIP-switch 1	R	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/W	19
-	-	-	20
F60	0=50Hz supply, 1=60Hz supply	R/W	26
ENA	Selection of active / passive for **all** controller outputs	R/W	27
DLY	Alarm delay	R/W	32
HSE	Heater current supervision enabled (0=no, 1=yes)	R	95

*) 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}*. AS soon as the change of a sttus was sent out, the controller disables further changes up to the next confirmation.

Commands marked with reserved are not available.

5.4.1 a) 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..

5.4.2 b) Index-script

Index-script is possible 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

G01K00P01=cc{etx}

5.4.3 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!

Executing these commands always effects the running operation of the device.

5.5 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)

5.6 Paracon:

Paracon is a software for transmission of parameters for all devices of the **FELLER ENGINEERING**. It works under MS Windows and is available via download from the homepage.

5.7 Visual-Fecon

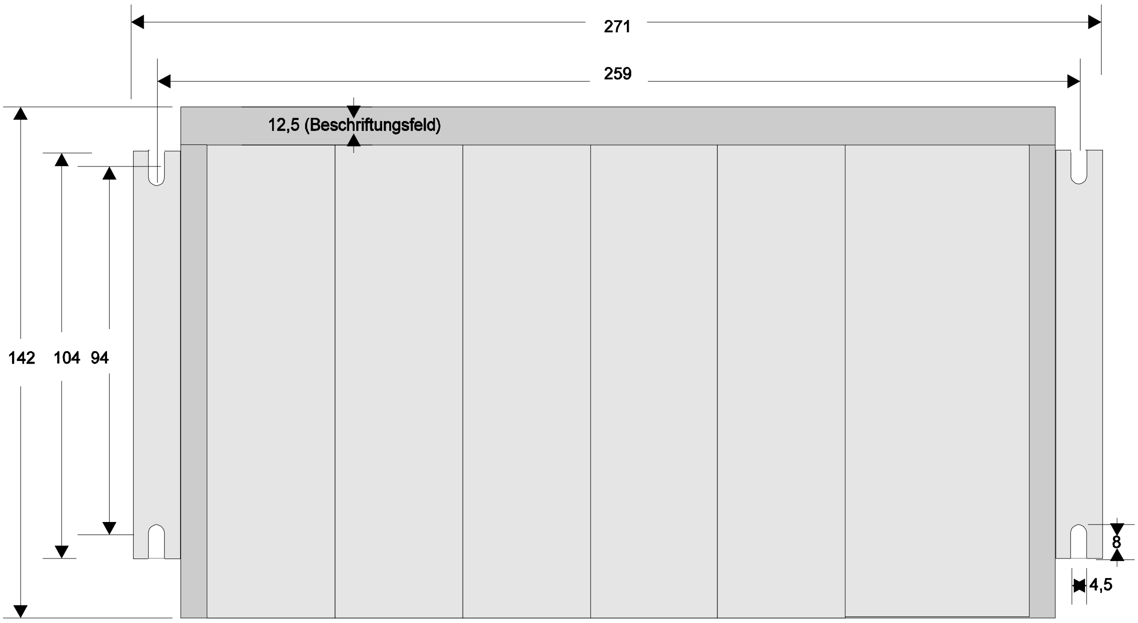
The universal process management system ***Visual-FECON*** is designed for visualisation, operation and storage of measuring data for up to 60 devices from all series of the **FELLER ENGINEERING** . The PC-software works under MS Windows.

6 Technical data

Operation voltage:	AF030	85..265VAC, 50/60Hz
	AF024	24VDC
Power consumption:	depending on the variations	10-20W
Power fuse	AF030	1 x 1A mean inert (5 x 20mm)
	AF024	1 x 1A mean inert (5 x 20mm)
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	for each input board, external
	Alignment	±0,25% v.E. ±1Digit
	Linearity	±0,2% v.E. ±1Digit
	Accuracy class	0,5%
Resistor sensors	Pt100/2-wire	0..600°C
	Measuring current	0,5mA
controller outputs	per zone	bistable, electrically isolated
Common alarm outputs :	Functions:	1 x system alarm
		3 x control alarm
(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 and manual settings, control parameters for all zones separate	
Data storage (EEPROM)	Long time storage	min. 10 years
Interfaces	RS485 / RS422 / RS232 / Profibus / CANbus *)	electrical isolated
	Protocol	FE3-Bus Version 3.03
Ambient conditions:	Ambient temperature acc. to EN 60204	+5°C to 40°C to 1000m above NN at a daily mean of max. 35°C.
	Housing temperature	max. 50°C when exceeding the ambient temperature
	Storage temperature	-25..+75 °C
	Humidity	< 95% rel. humidity, no dewing
Weight:	all slots used	2 kg

*) to specify with the order

6.1 Dimensions



Front view ***FP16***

6.2 Hints to EMC (electro magnetic compatibility)

The rack ***AF010*** has to be connected in a conductive way to the conductive mounting plate, which has to be grounded according to the regulations.

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

Level of acceptance:
VDE 0839 Part 10

Reliability class	**Z2**
Ambient class	**S2, I4, E3**

Suppression:
VDE 0843 Part I 2,3,4
IEC 801 Part 2,4,5

Ambient class	**3**
Degree of strength	**3, with external filter 4**

7 Construction of a temperature controller

7.1 AF010 housing FP16 with back plane

The basic casing is made out of 2mm aluminium chromated in yellow to ensure better EMV-compatibility and manufactured as a totally closed cabinet.

On the side there is an earthing bolt which serves as a safety earth for the whole system. (M4 screw thread).

The integrated bus circuit board is designed for the use of **FP16** plug-in boards. Various function boards (inputs, outputs, current supervisors) can be inserted in positions 1...6. Position 7 is reserved only for the processor board (e.g. AF121), position 8 is reserved for the power unit.

7.1.1 Variations for 3-point controlling

The following examples show different variations. A mix of input, output and combi boards is not allowed. Empty slots have to be closed by a cover. The parallel current measuring has to be plugged to the slots no.5.

16 zones with heater current supervision:

6	5	4	3	2	1
Cover	16xCurrent Zone 1-16	16x H / C Zone 1-16	16 FeCuNi Zone 1-16	Processor	Supply
ZD051	**AF060**	**AF080**	**AF040**	**AF121**	**AF030**

32 zones:

6	5	4	3	2	1
16x H / C Zone17-32	16 FeCuNi Zone17-32	16x H / C Zone 1-16	16 FeCuNi Zone 1-16	Processor	Supply
AF080	**AF040**	**AF080**	**AF040**	**AF121**	**AF030**

8 zones with combi boards:

6	5	4	3	2	1
Cover	Cover	Cover	8x H / C Zone 1-8	Processor	Supply
ZD051	**ZD051**	**ZD051**	**AF090**	**AF121**	**AF030**

24 zones with combi boards:

6	5	4	3	2	1
Cover	8x H / C Zone17-24	8x H / C Zone 9-16	8x H / C Zone 1-8	Processor	Supply
ZD051	**AF090**	**AF090**	**AF090**	**AF121**	**AF030**

7.1.2 Variation for 2-point controlling

32 zones:

6	5	4	3	2	1
Cover	16 FeCuNi Zone17-32	32x H Zone 1-32	16 FeCuNi Zone 1-16	Processor	Supply
ZD051	***AF040***	***AF080***	***AF040***	***AF121***	***AF030***

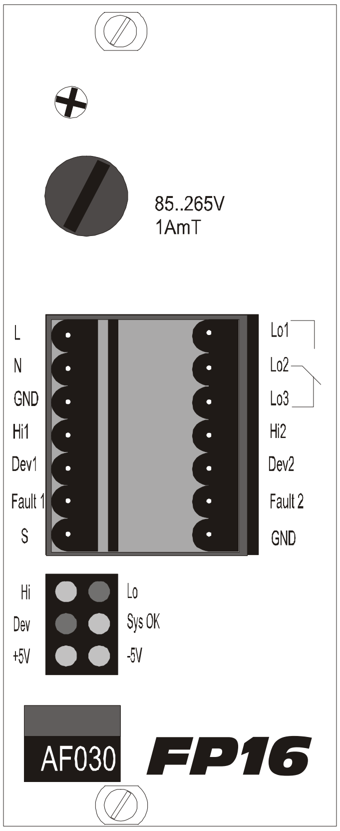
7.1.3 Variation for temperature measuring

64 zones:

6	5	4	3	2	1
16 FeCuNi Zone49-64	16 FeCuNi Zone33-48	16 FeCuNi Zone17-32	16 FeCuNi Zone 1-16	Processor	Supply
AF040	***AF040***	***AF040***	***AF040***	***AF121B***	***AF030***

7.2 AF030 Supply, 85..265 VAC

Function		Terminal
	A	
Supply L		A1
Supply N		A2
Net PE		A3
Hi-Alarm C		A4
Dev-Alarm C		A5
Sys-Alarm C		A6
GND		A7
	LED	
OK	green	Hi
Dev-Alarm	red	Dev
Supply	green	+5V



Function		Terminal
	B	
B1		Lo-Alarm NO
B2		Lo-Alarm C
B3		Lo-Alarm NC
B4		Hi-Alarm NO
B5		Dev-Alarm NO
B6		Sys-Alarm NC
B7		Internal GND
	LED	
Lo	rot	Lo-Alarm
Sys OK	green	System OK
–5V	green	Supply

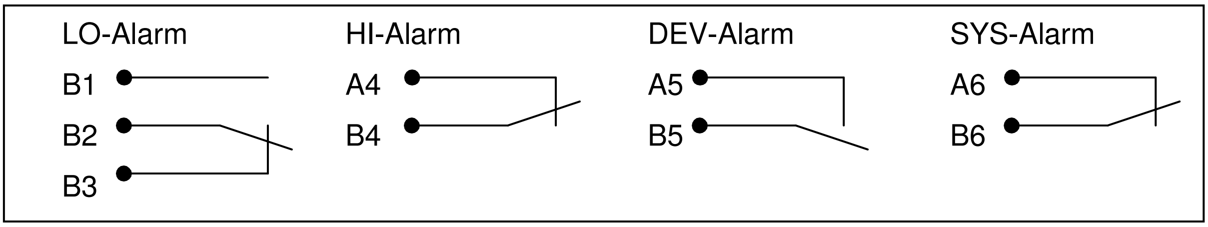
The supply is accepted from 85VAC to 265 VAC.
Frequency 50/60 cps
Fuse 1,0 A mT

7.2.1 Definition of the alarm contacts:

The alarm contacts Lo, Hi and Dev represent collective contacts, which means when one of the zones connected signals a respective fault the corresponding collective alarm is activated.

The "System-Fault Contact" is a supervision facility independent of the software version. This contact opens as soon as the program can no longer work properly e.g. defective hardware. This should lead to a general shut down of the device by switching off the main relay for the control.

7.2.2 Internal wiring for the alarm contacts



(The normal conditions are shown under voltage!)

The contacts are potential free and loadable up to 2 amps at 250volts.

7.2.3 Earthing regulations

The earth connection A3 on the power unit is to be wired, using a separate line, from the earthing bolt on the casing to the earthing bar in the control cabinet.

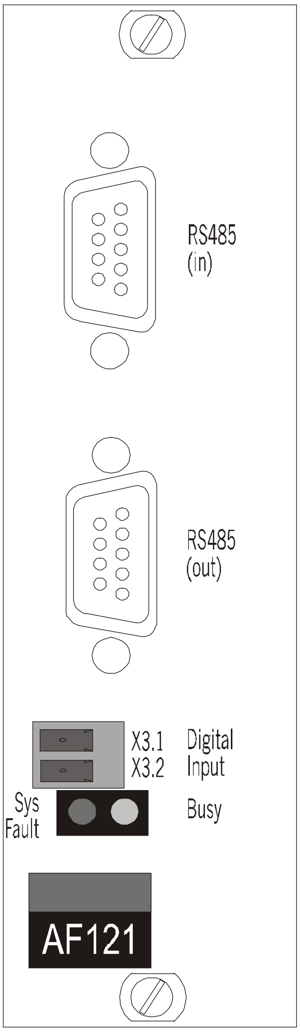
A bridge is to be wired between the earthing bolt on the casing and the mounting plate.

The terminals A7 and B7 are reserved for measuring purposes. They shall only get earthed, if required, to increase stability against disturbances.

7.3 AF121, 122, 124, 127, 129 Processor board

Type	COM1
AF121	RS485
AF124	RS485/A
AF127	RS422
AF129	RS485
AF121	RS485
AF124	RS485/A
AF129	RS485

Function	Terminal
Dig. Input*)	X3
0 VDC	1
24 VDC	2
	LED
Sys-Fault	red



Type	COM2
AF122	RS232
AF124	RS485/B
AF127	RS485
AF129	RS232
LED	
green	Busy

The interface COM1 is available at both plugs, it is linked internal.
*) Function according to parameter settings

Equal interfaces at COM1 and COM2 are separated by ~A und ~B.
The signification of the plugs is mentioned in the table.

7.3.1 General

The processor slide-in unit consists of a sandwich construction. The plugged-in circuit board (called MAC-module) comprises the actual controlling unit with controller, program memory module (EPROM) and the set value plus the parameter memory (EEPROM).
The basic circuit board comprises the interfaces and the driver modules for the remaining plug-in boards.

7.3.2 DIP-switch

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

There are two DIP switch blocks on the processor slide-in unit which allow a basic setting of the devices::

5-fold DIP-switch block on the plugged-in circuit board (MAC-module):

	DIP1	**DIP2**	**DIP3**	**DIP4**	**DIP5**
ON	sensor short circuit moni-toring active	solid state- su-pervision active	**temperature in ° Celsius**	thrust-free selec-tion AUTO-MAN	with heater cur-rent supervision
OFF	**sensor short circuit monitoring passive**	**solid state-supervision passive**	temperature in ° Fahrenheit	**thrust selection AUTO-MAN**	**without heater current supervision**

6-fold DIP-switch block on the basic circuit board

D DIP-switch 1..5 for setting the bus address in binary for the RS485-connection

DIP1	DIP2	DIP3	DIP4	DIP5	resulting ad-dress
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	Transmission rate
ON	19.200 Baud
OFF	9.600 Baud

7.3.3 LED functions

LED1 green BUSY-LED.
This flashes quickly when starting up the device, then it runs at normal operation at a frequency of approx. 0.5Hz.

LED2 red SYSTEM FAULT - LED.
When the LED is either permanently on or flashes irregularly, this is a sign of defective hardware. Simultaneously all outputs are shut down and the SYS-FAULT relay switches off at the power unit.

7.3.4 Variation B

The special variation „B“ of the processor board is available for 64 sensor inputs without temperature controller. Only boards AF040 or AF041 can be placed in this case.

7.3.5 Wiring of the bus-cable for the interface RS485

The link to the master device is done by the interface RS485 **X1** or **X2**. The pins **2** and **3** have to be linked to further controllers of the **FELLER** series (if installed). A well screened twisted 2 wire cable has to be used. The screening has to be done at both ends. To avoid earthing loops, the devices have to be connected by an additional PE wire.

To communicate with each device, the different addresses have to be set by the DIP-switches.

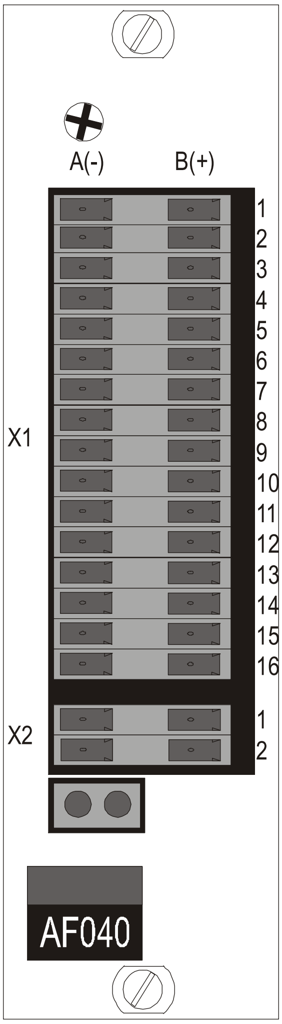
7.3.6 Interfaces

Interface		**COM1**					**COM2**				
Plug		**X1 / X2**					**X2**				
Pin		**2**	**3**	**4**	**5**		**4**	**5**	**6**	**7**	**8**
AF121	RS485	Rx/Tx +	Rx/Tx –								
AF122						RS232	TxD	GND	RxD		
AF124	RS485A	Rx/Tx +	Rx/Tx –			RS485B	Rx/Tx –		Rx/Tx +		
AF127	RS422	Tx +	Tx -	Rx +	Rx-	RS485	Rx/Tx-		Rx/Tx +		
AF129	RS485	Rx/Tx +	Rx/Tx –			RS232	TxD	GND	RxD		

The interface COM1 is available at both plugs, it is linked internal, except the board **AF127**.

7.4 AF040 Input board, 16-fold Thermocouple

Function	Terminal		Terminal	Function
Thermocouple Input	X1		X1	Thermocouple Input
1–		A1	B1	1+
2–		A2	B2	2+
3–		A3	B3	3+
4–		A4	B4	4+
5–		A5	B5	5+
6–		A6	B6	6+
7–		A7	B7	7+
8–		A8	B8	8+
9–		A9	B9	9+
10–		A10	B10	10+
11–		A11	B11	11+
12–		A12	B12	12+
13–		A13	B13	13+
14–		A14	B14	14+
15–		A15	B15	15+
16–		A16	B16	16+
	X2		X2	
Not used		A1	B1	Compensation
Not used		A2	B2	KTY210
Internal Supply-voltage	green	2 LED		



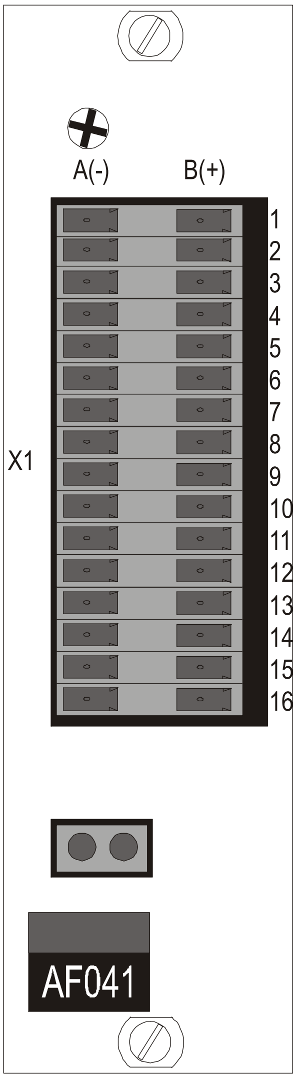
The inputs are counted synchronously with the zones. Multiples of 16 have to be added, if needed.

This slot is designed for operation in FP16 and FP16+. The jumper on the electronic board near the rear connector strip has to be set to the referring position, to recognize this slot in the rack.

7.5 AF041 Input board, 16-fold Pt100 / 2-wire

Function	Terminal	Terminal	Function
PT100 Input	X1	X1	Pt100 Input
1	A1	B1	1
2	A2	B2	2
3	A3	B3	3
4	A4	B4	4
5	A5	B5	5
6	A6	B6	6
7	A7	B7	7
8	A8	B8	8
9	A9	B9	9
10	A10	B10	10
11	A11	B11	11
12	A12	B12	12
13	A13	B13	13
14	A14	B14	14
15	A15	B15	15
16	A16	B16	16

Function	Colour	Indicator
Internal Supply-voltage	green	2 LED



The inputs are counted synchronously with the zones. Multiples of 16 have to be added, if needed.

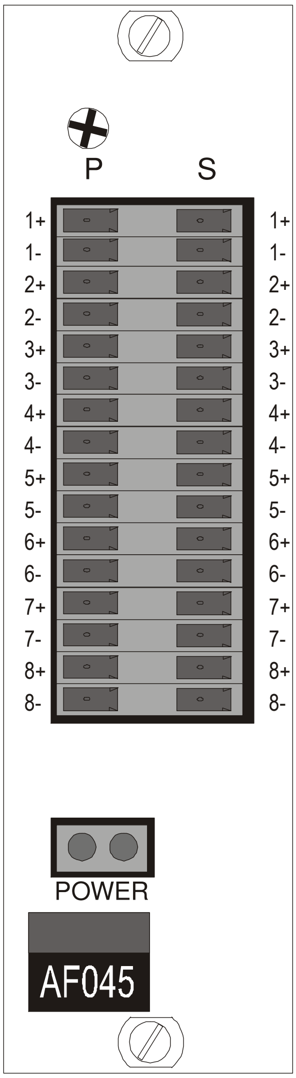
Not used inputs have to be shorted by a link.

This slot is designed for operation in FP16 and FP16+. The jumper on the electronic board near the rear connector strip has to be set to the referring position, to recognize this slot in the rack.

7.6 AF045 Input board, 8-fold Pt100 / 4-wire

Function	Terminal	Terminal	Function
PT100 Input	P	S	Offset Input
1+	1+	1+	1+
1–	1–	1–	1–
2+	2+	2+	2+
2–	2–	2–	2–
3+	3+	3+	3+
3–	3–	3–	3–
4+	4+	4+	4+
4–	4–	4–	4–
5+	5+	5+	5+
5–	5–	5–	5–
6+	6+	6+	6+
6–	6–	6–	6–
7+	7+	7+	7+
7–	7–	7–	7–
8+	8+	8+	8+
8–	8–	8–	8–

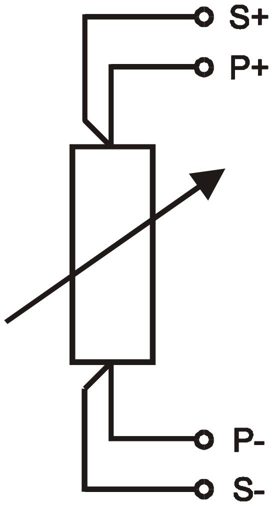
Function	Colour	Type
Internal Supply-voltage	green	2 LED



The inputs are counted synchronously with the zones. Multiples of 8 have to be added, if needed.

This slot is designed for operation in FP16 and FP16+. The jumper on the electronic board near the rear connector strip has to be set to the referring position, to recognize this slot in the rack.

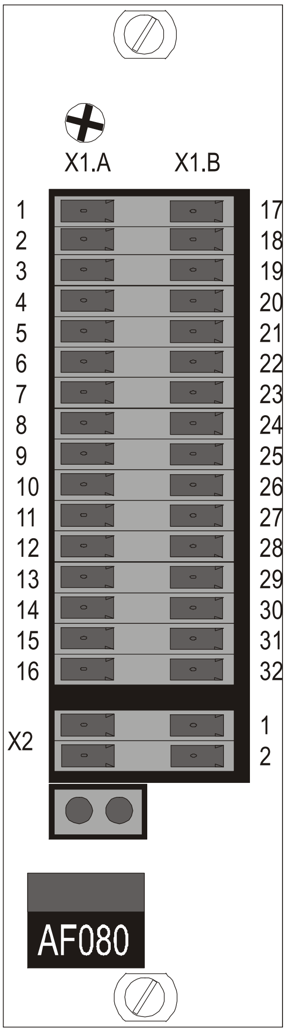
Circuit diagram of sensor Pt100 / 4-wire



The offset has to be wired to S+ and S-.

7.7 AF080 Output board, 32-fold digital

Function	Terminal		Terminal	Function
Heating				Heating/cooling
Digital-output	X1		X1	Digital-output
1+	A1		B17	17+
2+	A2		B18	18+
3+	A3		B19	19+
4+	A4		B20	20+
5+	A5		B21	21+
6+	A6		B22	22+
7+	A7		B23	23+
8+	A8		B24	24+
9+	A9		B25	25+
10+	A10		B26	26+
11+	A11		B27	27+
12+	A12		B28	28+
13+	A13		B29	29+
14+	A14		B30	30+
15+	A15		B31	31+
16+	A16		B32	32+
	X2		X2	
0V	A1		B1	24V
0V	A2		B2	24V
External Supply-voltage	green 2 LED			



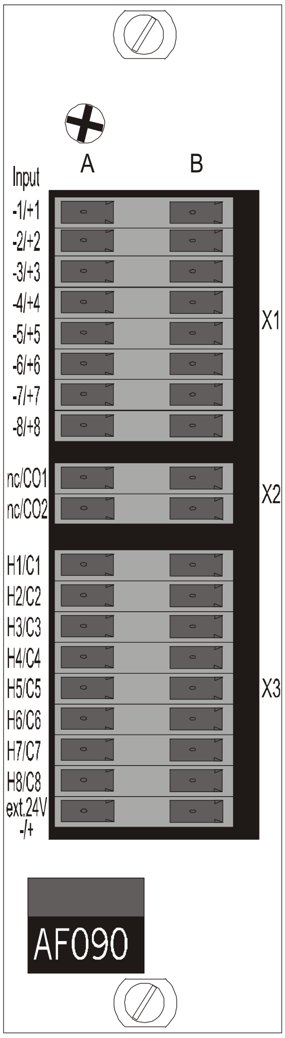
According to the task the outputs are used for the function of heating or cooling.
The inputs are counted synchronously with the zones. Multiples of 16 have to be added, if needed.

Output power: 24VDC, max. 25 mA

7.7.1 Outputs to trigger the solid-state relays

The 32 outputs of the output-board are supplied by an external voltage (24VDC) which is switched by the software to the outputs. The maximum load of the outputs is 25 mA and is short circuit proofed by series resistors. In the event of long-term short circuiting of all the outputs component defects are possible through overheating. The outputs are electrically isolated from the rest of the device. Internal hardware supervision ensures a shut down of all outputs in the event of incorrect program functioning or gradual drop in mains voltage.

7.8 AF090 Combi board, 8-fold Thermocouple



Function	Terminal	Terminal	Function
Thermocouple Input	X1	X1	Thermocouple Input
1–	–1	+1	1+
2–	–2	+2	2+
3–	–3	+3	3+
4–	–4	+4	4+
5–	–5	+5	5+
6–	–6	+6	6+
7–	–7	+7	7+
8–	–8	+8	8+
	X2	X2	
Not used	nc	C01	Compensation
Not used	nc	C02	KTY210
H-output	X3	X3	C-output
	H1	C1	
	H2	C2	
	H3	C3	
	H4	C4	
	H5	C5	
	H6	C6	
	H7	C7	
	H8	C8	
0 VDC External Supply-voltage	ext 24V –	ext 24V +	24 VDC External Supply-voltage

The inputs are counted synchronously with the zones. Multiples of 16 have to be added, if needed.
The outputs are used for the function of heating and cooling.

Output power: 24VDC, max. 25 mA

The combi board AF090 comprises 8 inputs for thermocouples and 16 outputs for triggering solid-state relays. This board can be plugged in at position 1..6 on the basic device. By subsequent equipping with combi boards the FP16 controller can be extended up to 32 control zones (heating/cooling). The outputs and inputs are electrically separated from the device potential.

This slot is designed for operation in FP16 and FP16+. The jumper on the electronic board near the rear connector strip has to be set to the referring position, to recognize this slot in the rack.

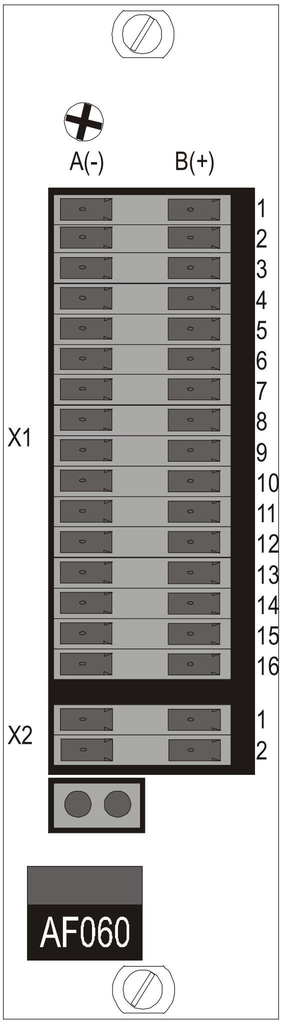
7.8.1 Sensor inputs

The thermocouple alignment for type FeCuNi (J-type) is set by the maker. An extremely good linearisation of the input characteristics is assured by software linearisation with a 0.25°C resolution from point to point. If required the inputs can be post-calibrated via 2 potentiometers. Filtering at every thermocouple input assures low interference risk. All input connections including the amplifier part and the AD-transformer are electrically isolated from the rest of the device.

7.8.2 Outputs to trigger the solid-state relays

The 32 outputs of the combi-board are supplied by an external voltage (24VDC) which is switched by the software to the outputs. The maximum load of the outputs is 25 mA and is short circuit proofed by series resistors. In the event of long-term short circuiting of all the outputs component defects are possible through overheating. The outputs are electrically isolated from the rest of the device. Internal hardware supervision ensures a shut down of all outputs in the event of incorrect program functioning or gradual drop in mains voltage.

7.9 AF060 Current-supervision-board, 16-fold



Function	Terminal		Terminal		Function
Heater-current-Input	X1			X1	Heater-current-Input
1–		A1	B1		1+
2–		A2	B2		2+
3–		A3	B3		3+
4–		A4	B4		4+
5–		A5	B5		5+
6–		A6	B6		6+
7–		A7	B7		7+
8–		A8	B8		8+
9–		A9	B9		9+
10–		A10	B10		10+
11–		A11	B11		11+
12–		A12	B12		12+
13–		A13	B13		13+
14–		A14	B14		14+
15–		A15	B15		15+
16–		A16	B16		16+
	X2			X2	
Not used		A1	B1		Net-comp.*) +
Not used		A2	B2		Net-comp.*) –
Internal Supply-voltage	green	2 LED			

The inputs are counted synchronously with the zones.
*) Compensation for the net supply voltage

This slot is designed for operation in FP16 and FP16+. The jumper on the electronic board near the rear connector strip has to be set to the referring position, to recognize this slot in the rack.

7.9.1 Compensation for the net supply voltage

The compensation of the net voltage happens at 2VDC. It has to be taken from the net of the heater supply. In case of dispense on the compensation, the inputs X2.1B and X2.2B have to be linked by a resistor of 68Kohm.
In this table n refers to the terminal no. and to the zone no.

8 Further equipment and functions

For **FP16** further boards are available for further interfaces, input- and output-signals. The manuals of these are added to this document, if required.