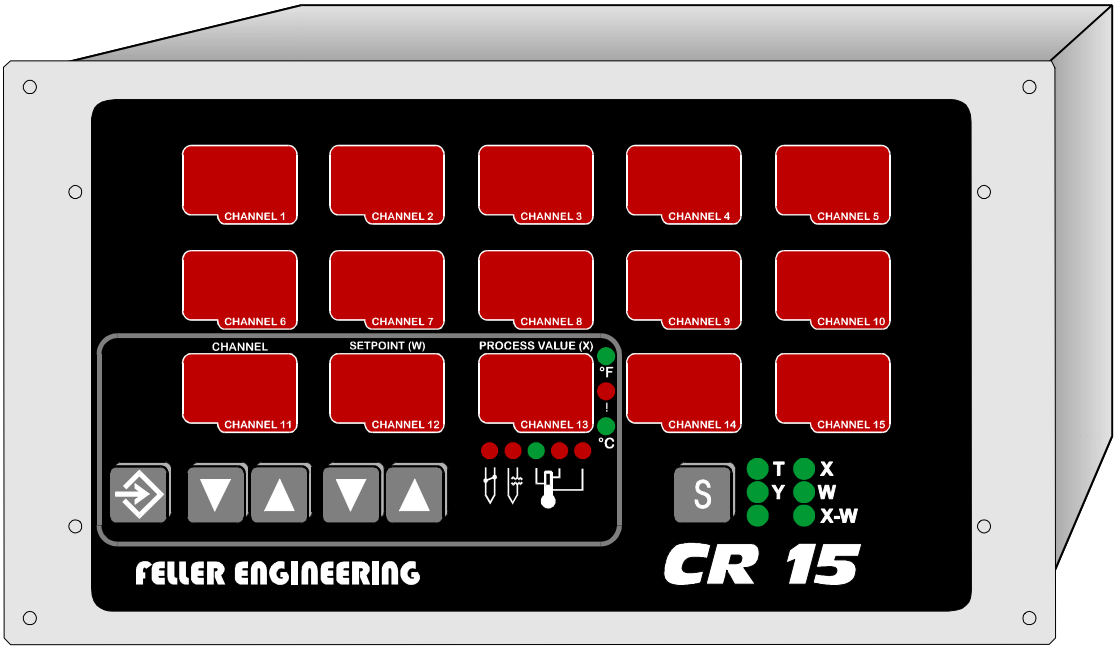
FELLER ENGINEERING GmbH

CR15 Operator Manual



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Version 1.0
Status: 10/16-0397

1. INTRODUCTION

1.1 HEATER - SENSOR - CONTROLLER - CONTACTOR

To change „heat“ to the high quality form of energy „controlled temperature“, it is necessary to use certain elements and to observe certain basic rules.

- The HEATER, which has different power according to the design and the dimension,
- the SENSOR, which picks up the temperature,
- the CONTROLLER, which takes over the signal of the sensor, compares it to a desired value and sends an according order to
- the CONTACTOR, which activates the according step to reach the setpoint.

These elements correspond continuously within a closed loop. It is important to know, that all involved elements influence the result „temperature“, in positive as well as in negative sence.

Incorrect sensors, wrong measuring points, less or incompetent controllers, contactors which are actiing to little, to strong, to slow or to fast might be the reason for an unsufficient result.

Some basic rules in the following:

1. The required heating should be 50% of the installed power!
2. The sensors should be placed as close as possible to the object!
3. The sensors should be placed between heater and object!
4. Heater and sensor should have proper contact to the object.
5. Solid-State-Relais should be prefered (reason of speed)! So the high speed algorythm of the micro-processor controllers, like **CR15**, may be used completely
6. Wires for sensors and power should be in the same cable!
7. Do not use relay coils without parallel RC-elements!
8. Avoid leakage currents and separate voltage at the sensor wires! Separate voltage at the sensor wires result in controller faults and might be dangerous!

1.2 SHORT DESCRIPTION

The micro-processor controller **CR15** is designed for 5, 10 or 15 control-loops according to the extension. It includes electrically isolated outputs (triacs, relays or transistors) as well as inputs, optional for thermocouples FeCuNi or NiCrNi), PT100 or analog signals (0-20mA/0-10V).

The outputs will be switched on or off during zero voltage. 3 groups of outputs allow to contact the loops to 3 phases (power division). The protection for the power elements is guaranteed by super fast fuses of 16A. The control voltage is protected by a 0,5A fuse.

Adjusted setpoints and control parameters stay stored after switching off the control voltage. The memory chip guarantees a storage of datas for a minimum of 10 years.

It is possible to define 2-point or 3-point control loops (maximum of 7 3-point loops). The selection may be done by DIP-switches, which are located below a cover on the top of the unit.

The **CR15** allows to store 4 different setpoint programms (for each control loop) and to activate, if required.

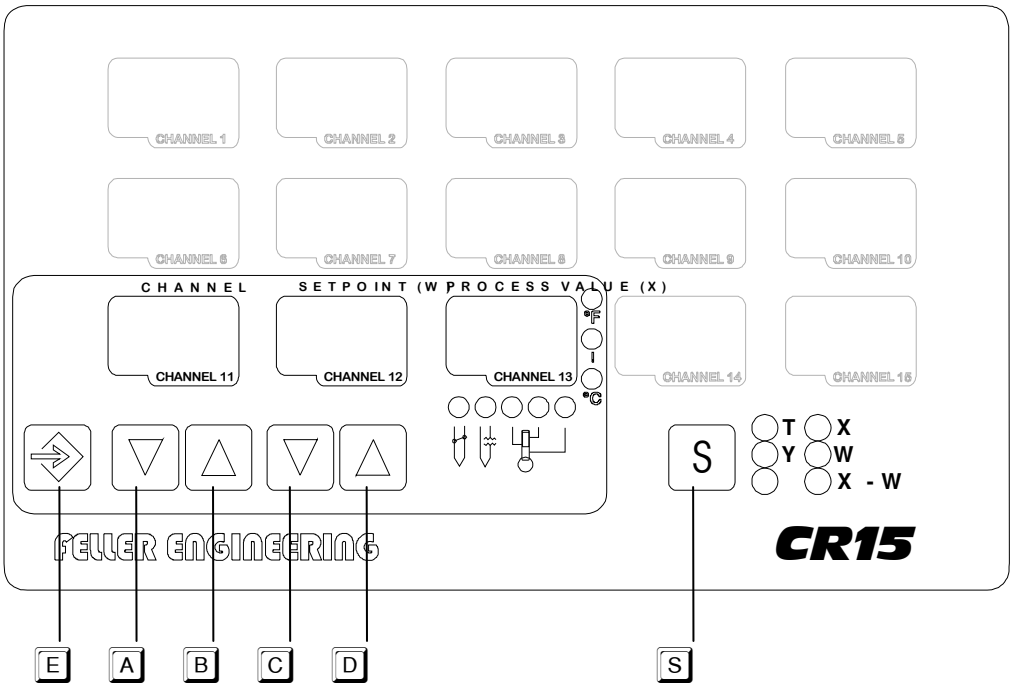
All control loops may be checked independently for high and low deviation temperature. A referring relay will switch the collective output. The dry contacts of these relays are available for individual use.

In case of sensor fault or missing sensor it is possible to to continue the referring channel with a constant power rate.

The control algorithm is similar to PID with start up conditions. The controller operates according to the DDC principle (Direct Digital Control). The adjustable parameters are adapted to the known parameters Xp, Tn, Tv.

The integrated total display allows the complete observation of all process values.

1.3 SHORT MANUAL



The following signs for the keys refer to this drawing of the front cover.

Total display:

After start of the unit or an operation pause of 20sec the controller is automatically in the total display mode for all zones. In this mode all actual values, setpoints, deviations or the output regulation rate may be observed.

The desired values may be selected by key S

Setting modes:

By operation of one of the keys A to E the total display chages to the setting mode. In this mode there are only the 3 displays in the frame activated. They are showing the the actually selected channel, the setpoint as well as the actual value (process value) under normal conditions.
All functions and operations are equivalent to the known multi zone controller FP13.
The key S returns from setting mode to the total display.

Selection of the desired channel number (zone):

by A or B

Setting of the setpoint:

by C or D set the desired setpoint, then enter the setting by E.

Setting of the OP-value (first channel number):

1. by A go below channel 1 "OP"-signification appears in the channel display
2. by C or D set the first channel number (only when the parameter level is unlocked - chapter 2.2.4)
3. by E enter the value (chapter 3.1.5)

Setting of the setpoit programm:

1. by A go below OP-signification, P appears in the channel display
2. by C or D set the setpoint programm (1..4)
3. by E enter the value (chapter 3.1.6)

Setting the max. setpoint:

1. by A go below P-value , HI appears in the channel display
2. by C or D set max. setpoint (only when parameter level is unlocked - chapter 2.2.4)
3. by E enter the value (chapter 3.1.7)

Setting the min. setpoint:

1. by A go below the HI-value LO appears in the channel display
2. by C or D set min. setpoint
3. by E enter the value (chapter 3.1.8)

Switching off a control channel:

By setting the setpoint to OOO respectively decreasing below the min. setpoint (LO-value, chapter 3.1.8) the referring channel will be switched off.

Indications and definitions by means of examples

a) CONTROLLER LEVEL:

01	060	060	Channel 01, setpoint and actual value = 60 degrees (normal operation)
12.	100	100	Display is in scan mode, at the present channel 12 (see chapter 3.1.2)
07	060	-L-	Channel 07, setpoint 60 degrees, actual temperature is below the low alarm limit (setpoint ./. Parameter 02) see chapter 3.3.2
04	100	-H-	Channel 04, setpoint 100 degrees, actual temperature is above the high alarm limit (setpoint + Parameter 01) seh chapter 3.3.1
06	---	---	Channel 06 is switched off (see chapter 3.1.3)
02	-HE	LP-	Channel 02 has exceeded the HI-value for 10 degrees or more, the heating circuits are switched off, the dry contact (W = watchdog) is opened (see chapter 4.3)
10	070	-S-	Channel 10 indicates short sensor (only Pt100) or crossed sensor wires (for thermocouples). See chapter 3.2.7
13	080	-E-	Channel 13 detects a broken sensor or no sensor is wired (see chapter 3.2.6)
OP	010		Lowest channel number is 10, the following channels get serial numbers automatically (see chapter 3.1.5)
P	3		Setpoint program No. 3 is activated (see chapter 3.1.6)
01	000	-P-	Channel 01 is in manual mode, output rate in % (see chapter 4.2)
HI	200		HI-value (max. setpoint) limited at 200 degrees (see chapter 3.1.7)
LO	050		LO-value (min. setpoint) limited at 50 degrees (see chapter 3.1.8)

01	250	Zone 1 is in indicator mode (see chapter 4.4)

11	180.	100	Channel 11 runs a internal setpoint, different from the setpoint programm, relevant during start up sequences (see chapter 3.3.7 and 6.1) as well as after HI-value changes (chapter 3.1.7)

b) PARAMETER LEVEL:

.1.1	016	.0.0.2	Channel 11 has a low temperature alarm limit of 16 degrees (Parameter 2)

2. FIRST COMMISSIONING

Before first commissioning take care of some important basic settings and connections and/or adjust.

2.1 CONNECTIONS

2.1.1 SENSORINPUTS

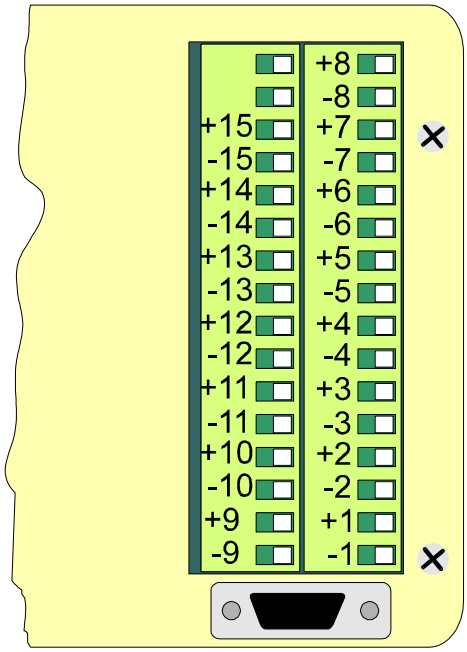
2.1.1.1 Connection of thermocouples (Fe-CuNi o. NiCr-Ni) at CR15

part of rear view of the unit

(**K = compensation resistor**; according to the type of unit, the compensation resistor will be delivered with the unit or is mounted inside)

2.1.1.2 Connection of thermoresistors (Pt100 2wire) at CR15

part of rear view of the unit

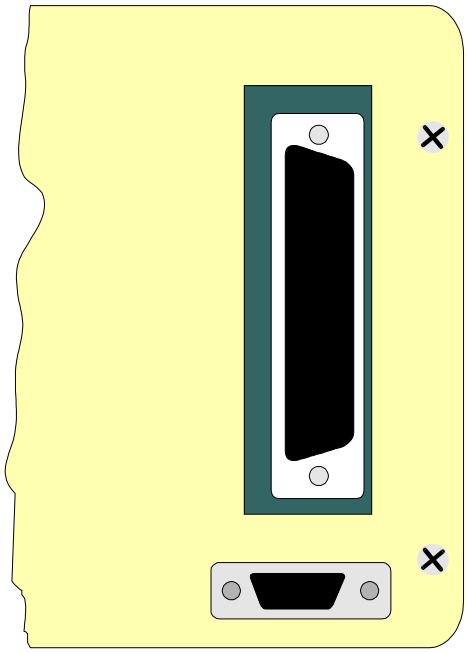


Not wired inputs should get linked to protect against EMC disturbances.

2.1.1.3 Connection of thermoresistors (Pt100 3wire) at CR15

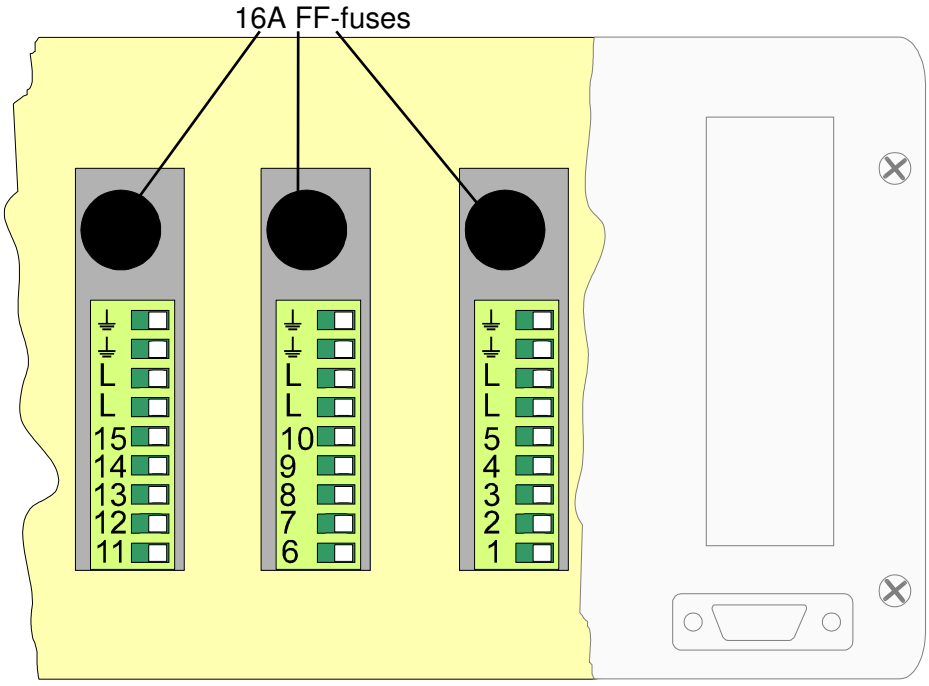
Part of rear view of the unit

In reason of the required number of terminals (3*15terminals) the PT100-3wire sensors will be connected via a 50 pins female plug.
For easier installation FELLER ENGINEERING may deliver adapted cable sets and interface modules, to fit on mounting rails for connection of PT100 sensors.



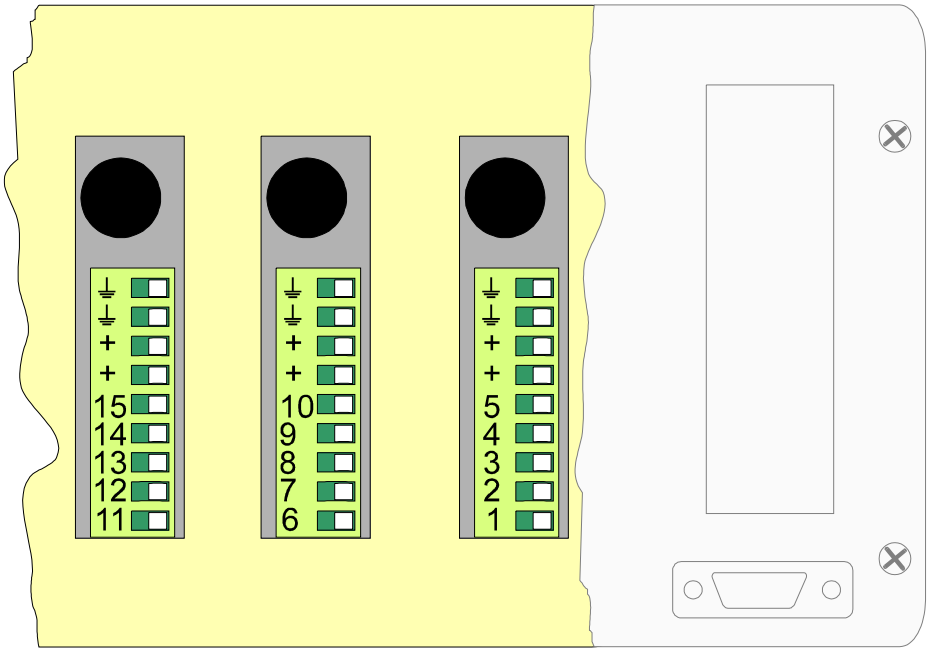
2.1.2 POWER-OUTPUTS (heating and cooling)

Connection in case of TRIAC-outputs (230V AC)



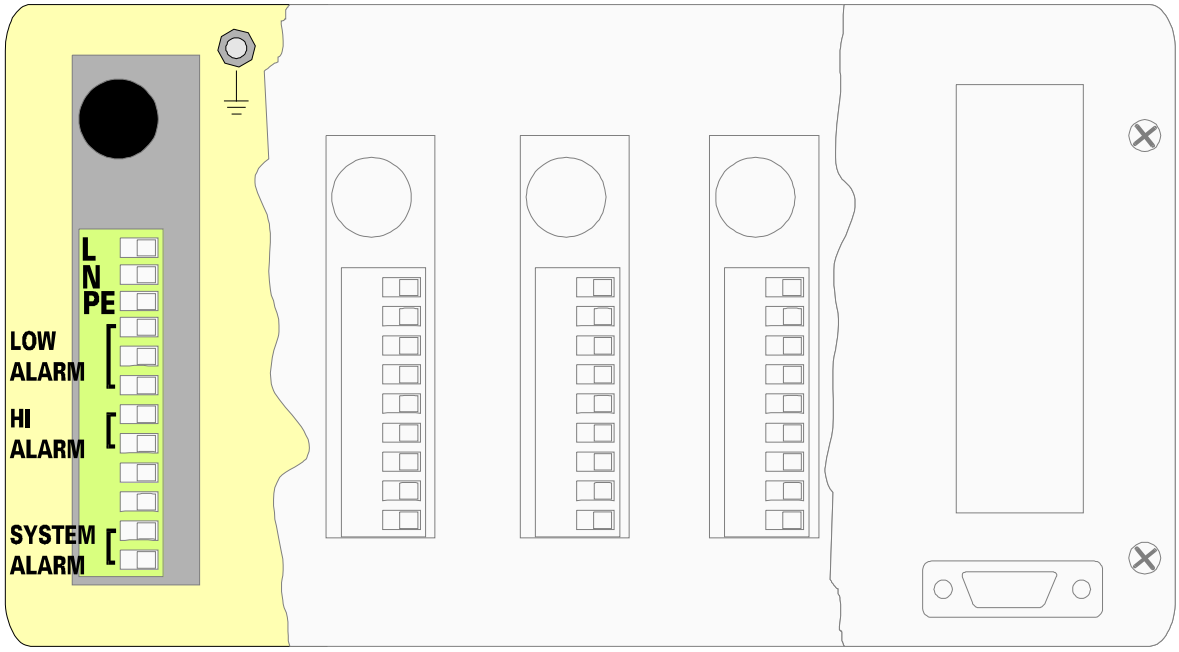
The three output boards are electrically isolated from the unit as well as from another. This is the reason why the supply **L** has to be wired separately to the three boards. If the three output boards will be supplied from 3 phases (**L1, L2, L3**) a 3-phase mode is easily wired.

Connections in case of low voltage outputs (24 V DC)



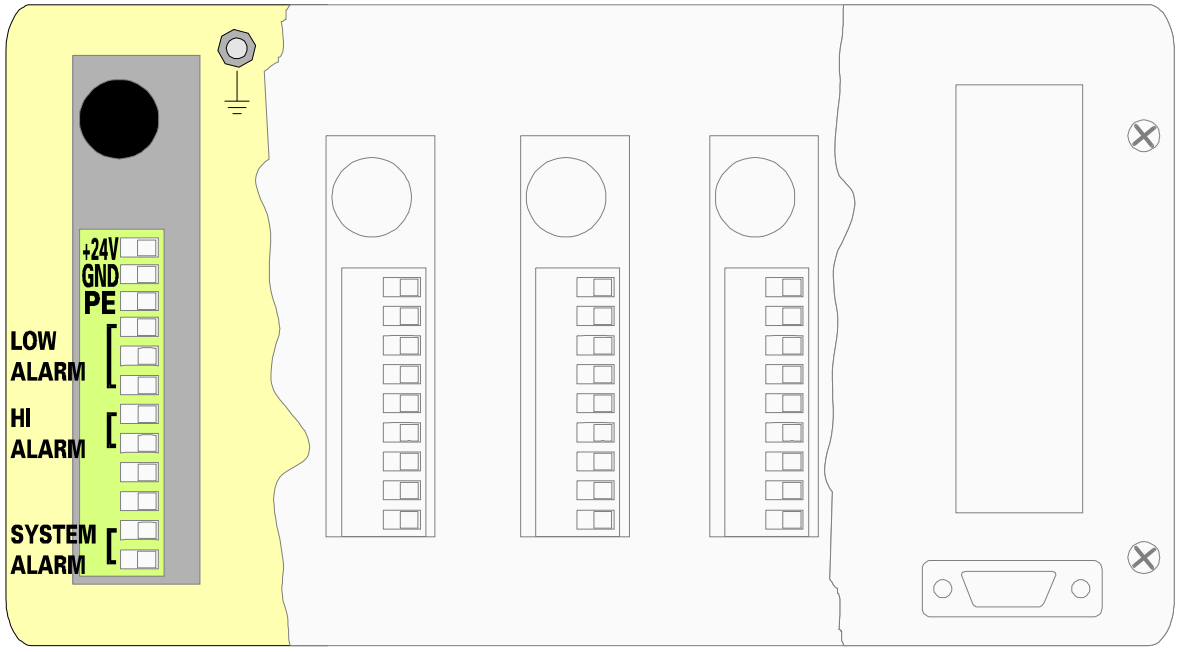
2.1.3 NET SUPPLY AND ALARM OUTPUTS

Net supply 24 VAC, 110 VAC or 230 VAC



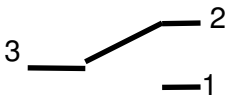
In case of non stable or disturbed net supply the design should include a voltage stabilizer!

Net supply 24 V DC



Alarm contacts

U (LO) = Low temperature (In case of low temperature active; 2-3 normally closed)



Ü (HI) = High temperature (In case of high temperature active; normally closed)

W = Watchdog (In case of watchdog passive; normally closed)

2.1.4 DATA INTERFACES

The **CR15** will be delivered according to the customers requirements without or with individual data intefaces.

- RS232
- RS422
- RS485
- TTY 20mA / Current Loop
- SPS-parallel-inputs

The position of the plugs at the rear side may be different according to the selected interface in combination with the selected input board (see drawing chapter 2.1.1.2 + 2.1.1.3).

The function of the pins for the different interfaces is described on the following pages. You will find protocols and examples for transmission in chapter 7.

2.1.4.1 PC-Interface RS232

The unit may be controlled via a 3-core cable by the interface RS232. To guarantee a mostly undisturbed transmission you should use a twisted data cable. The maximum length is 15 meters.

Function of the interface plug:

CR 15			**PC (9 pins)**		**PC (25 pins)**	
RXD	2	<-----	3	TXD	2	TXD
TXD	3	----->	2	RXD	3	RXD
GND	5	------	5	GND	7	GND

2.1.4.2 PC-Interface RS485

Up to 31 units may be controlled parallel via a 2-core cable by the interface RS485. To guarantee a mostly undisturbed transmission you should use a twisted data cable.

At both ends of this 2-core cable the wires „A“ and „B“ have to be linked by a 100 Ohm resistor. The resistor is fitted to tte interface adapter SI13 and the PC board from FELLER ENGINEERING. The maximum length of the cable is 1200 meters.

Function of the interface plug:

The interface is wired to a 9-pins female Sub-D plug using the pins 2 and 3:

(2 = TX+ or "A"; 3 = TX- or "B").

CR 15	
A(TX+)	2
B(TX-)	3

2.1.4.3 RS422 and 20mA current-loop

Function of the pins of the 9-pins female Sub-D plug on the rear side:

RS422:

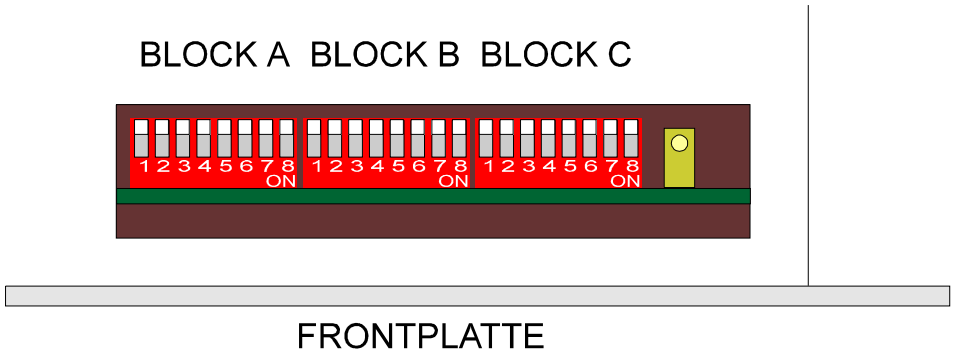
CR 15		
A(TX+)	2	----->
B(TX-)	3	----->
A(RX+)	4	<-----
B(RX-)	6	<-----

20mA current-loop:

CR 15		
I+	2	<---->
I-	3	<---->

2.2 DIP-SWITCH FUNCTIONS

The top of the unit includes 2 screw tightened covers. Below the front one there are 3 blocs of DIP switches, each with 8 switches.



2.2.1 SETTING OF THE DEVICE-ADDRESS

The DIP switch „A“ is relevant for data transmission with CR15 via interface.

RS 485 allows the communication of 31 devices with a computer. As all the devices are linked parallel via the bus, they have to be distinguished by a specifical device address. It has to be set binary by the user via the DIP-switches.

1..31 are the valid device addresses. No address has to be set twice internally of an RS485 interface network. The according switches for the divice address are 4..8 of the bloc „A“.

DIP“A1“	DIP“A2“	DIP“A3“	DIP“A4“	DIP“A5“	DIP“A6“	DIP“A7“	DIP“A8“	Address
any	any	any	on	on	on	on	on	0 (unvalid)
any	any	any	on	on	on	on	off	1
any	any	any	on	on	on	off	on	2
any	any	any	on	on	on	off	off	3
any	any	any	on	on	off	on	on	4
any	any	any	on	on	off	on	off	5
any	any	any	on	on	off	off	on	6
any	any	any						
any	any	any	off	off	off	off	off	31

The address may be checked via the display, when you press both channel keys together.

The original setting: address = "1"

2.2.2 CONFIGURATION FOR 2-/3-POINT-CONTROL (Heating/Cooling)

The DIP-Switches 1...8 of DIP-Switch block "B" and the DIP-Switches 1..5 of DIP-Switch block "C" designate for each zone whether that zone is used for 2- or 3-point control.

If the switch is in the "OFF" position (switch towards back of instrument), that zone is switched to 2-point control. If the switch is in the "ON" position, that zone is switched to 3-point control.

Please observe that only 15 outputs are available. Each 3-point control needs two outputs (Heating + Cooling), but the 2-point control only needs one output (Heating).

This means that the outputs have different functions according to the position of the DIP-switches. Following, the program determines the function of the various zones itself (see next diagram) as well as the number of usable zones.

This does not have any effect on the numbering of the thermocouple inputs (=control zones).

The output numbers of a zone can be checked in parameter 10 and 11 during operation (see chapter 3.3.10 + 3.3.11).

- Default setting: all zones 2-point

Two examples

Example 1: 15x 2-point controller (pure heater mode)

Zone	Function	DIP-Switch	Sensor	Output heat	Output cool
1	Heat	B1=OFF	1	1	-
2	Heat	B2=OFF	2	2	-
3	Heat	B3=OFF	3	3	-
4	Heat	B4=OFF	4	4	-
5	Heat	B5=OFF	5	5	-
6	Heat	B6=OFF	6	6	-
7	Heat	B7=OFF	7	7	-
8	Heat	B8=OFF	8	8	-
9	Heat	C1=OFF	9	9	-
10	Heat	C2=OFF	10	10	-
11	Heat	C3=OFF	11	11	-
12	Heat	C4=OFF	12	12	-
13	Heat	C5=OFF	13	13	-

Example 2: mixed mode (2- and 3-point mode)

Zone	Function	DIP-Switch	Sensor	Output heat	Output cool
1	Heat	B1=OFF	1	1	-
2	Heat/Cool	B2=ON	2	2	3
3	Heat	B3=OFF	3	4	-
4	Heat	B4=OFF	4	5	-
5	Heat	B5=OFF	5	6	-
6	Heat/Cool	B6=ON	6	7	8
7	Heat/Cool	B7=ON	7	9	10
8	Heat	B8=OFF	8	11	-
9	Heat	C1=OFF	9	12	-
10	Heat	C2=OFF	10	13	-
11	Heat	-	-	-	-
12	Heat	-	-	-	-
13	Not available	-	-	-	-

Defining cooling outputs the second example shows that the available number of control zones is (automatically) reduced to 12.

2.2.3 SELECTING CELSIUS OR FAHRENHEIT

The DIP-Switch No. 6 of block "C" changes the temperature unit from degrees C to F.

DIP-Switch in "ON" Position = Degrees Fahrenheit;

DIP-Switch in "OFF" Position = Degrees Celsius.

The switch in temperature unit changes all temperature values (even on the parameter level) to the new unit automatically.

- Default setting: degrees Celsius

2.2.4 SECURITY LOCK OF PARAMETER LEVEL

The DIP-Switch No. 7 of block "C" activates the security lock of the parameter level.

DIP-Switch in "ON" position = Change of parameter-, HI- and OP-Values using keys is allowed;

DIP-Switch in "OFF" position = Change of parameter-, HI- and OP -Values using keys is not possible;

- Default setting: parameter level is locked

2.2.5 RESETTING STANDARD PARAMETERS

The **CR15** can be delivered from the factory with customer specific parameter setting. These values can be stored in the EPROM. The activation of these parameters is performed by switching DIP-Switch No. 8 of block "C". Furthermore the reset to default parameters is possible by the keys.pressing the keys E, C and D together for 2 seconds. This function may only be activated in the parameter level.

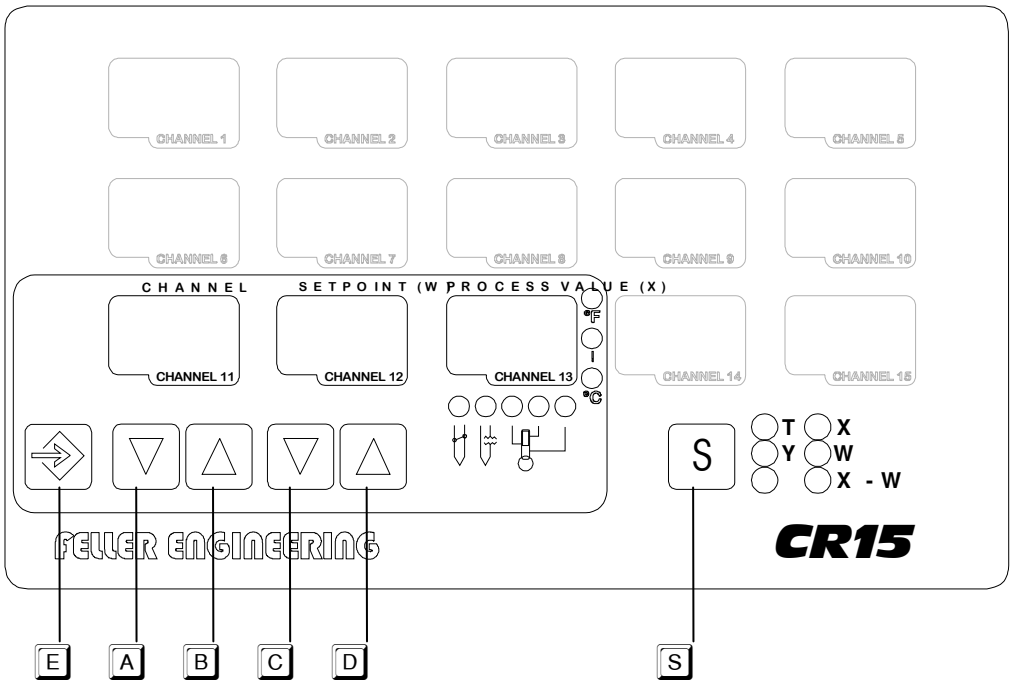
DIP-Switch in "ON" position = Loading standard parameters from EPROM into the EEPROM; all setpoints are set to „zero“.

DIP-Switch in "OFF" position = Together with DIP-Switch No. 7 of block "C" in "ON" position, all parameter are user changeable.

Default Setting: Standard Parameters are loaded (see chapter 3.3)

Caution !!! Each DIP-Switch change has to be confirmed while the unit is powered on by pressing the Enter key "E". Otherwise, the display will flash 8 dashes "-- --- ---" and the outputs are disabled.

3. OPERATING INSTRUCTIONS



After turning on the power of the **CR15** the display shows the software version number for a short time.

After that time The display shows the actual values of all zones together. Concurrently, there are several LED's which give information about the status of the controller.

By the key S the values of the total display may be selected.
The selection allows to see all actual vlues(X), setpoints (W), differences (X-W) as well as the actual regulation rates (Y). 20 seconds after the last key operation the display returns automatically to the actual values.

3.1 ADJUST OF THE CONTROLLER

Short operation of one of the keys A..E switches the device from display to setting mode. In this mode there are only the three sections actitivated, that are framed in the lower line. They are indicating the actual channel, the setpoint as well as the actual value under normal conditions.
All functions and operations in this mode are equal to the proved multi channel controler FP13

The key S returns to the total display.

The CR15 may be operated in an increase-decrease function by 5 keys. The keys A..D have double functions:

1. short pressing = chnges the value by 1
2. longer pressing = fast pass to the final value

Changed values (setpoints and parameters) are flashing in the display.

Only after quick confirmation by the E key (Enter) the display gets stable to indicate, that the new value has been accepted.

3.1.1 ZONE SELECTION

The zone number display is 2-digit and may display the following alphanumeric characters:

15	channel indication
14	
..	
03	
02	
01	channel indication
OP	sets the number of the first channel
P	setpoint programsSollwertprogramme
HI	HI-value (max. setpoint limit)
LO	LO-value (min. setpoint limit)

The setpoints and actual values of the desired channel may be selected by the keys A and B for monitoring.

3.1.2 CHANGING SETPOINTS

The keys A .. D select the setpoint which will be indicated in the display by 3 digits.

The setpoint can be changed with keys C or D and entered with the Enter key E. The combination of keys C or D makes the changing and setting of the selected setpoint.

During and after changing the setpoint the display flashes and the controller still controls, according to the old setpoint.

After short operation of key E the new setpoint is accepted and the flashing finishes.

The acceptable values range between the min. and max. setpoint limits. These should be set fixed before first setpoint settings (see chapter 3.1.7 and 3.1.8).

Switch off a control loop:

If a setpoint should be set below the min. setpoint, the referring control loop will be switched off. The indication of a non activated control loop is a group of dashes"--- ---" beside the channel number.

The HI- and LOW- temperature control function will no more be active (see chapter 3.3.1 and 3.3.2). The watchdog function - trips when exceeding the HI-value - stays active for switched off channels (see chapter 3.2.2 and 4.3).

Default setting: setpoints= zero

3.1.3 ACTUAL VALUE DISPLAY

During normal operation display shows the actual value with 3 digits. Depending on the status of the controller, different displays are it is possible.

The actual value display alternates between the actual value and

"-H-" at high temperature (see chapter 3.2.5 and 3.3.1)

"-L-" at low temperature (see chapter 3.2.3 and 3.3.2)

"-E-" with broken sensor (see chapter 3.2.6)

"-S-" with shorted sensor or wrong wiring (see chapter 3.2.7)

"HLP" at exceeded HI-value (see chapter 3.1.7)

When the zones are turned off (see chapter 3.1.3) dashes "--- ---" are displayed instead of the actual value. The actual value display stays unlit when OP-, HI-, LO- or P-Number is selected (see chapter 3.1.5..8).

If the temperature is displayed in degrees Fahrenheit then the 3 digit display is limited to 999 degrees. If the value exceeds 999, a decimal point appears in front of the 3 digit display to replace the missing 1 (eg.: .230 = 1230 Degrees F).

3.1.4 ASSIGNING A NUMBER TO THE FIRST ZONE

The OP-Value assigns a number to the first zone. The OP-Value is located with key A , and the number for the first zone is assigned with key C or D . The new value then flashes until it is confirmed with key E .

Highest possible OP-Value (for zone 01) = 95.

The CR15 numbers the remaining zones accordingly. This feature allows a continuous numbering system of control zones for several CR15 controllers.

- Default setting: 01

3.1.5 SETPOINT PROGRAMS

A setpoint program contains a group of temperature setpoints.

It is possible to store up to 4 different setpoint programs, that can be loaded in during a change in process such as a material change or a temperature drop during production interruptions. The setting of setpoints occurs automatically in the referring program.

The selection of setpoint programs is performed in zone identification P (below "OP"). The keys C or D enable to select the required setpoint program (1-4). The key E activates the program.

Default setting: setpoint program P1

3.1.6 MAX SETPOINT LIMIT (HI-VALUE)

The HI-value can be displayed by lowering the zone number with key A to below the setpoint programs. The HI-value should be set regardlessly before the first setpoint is selected.

The HI-Value represents an integral factor of the control computations. The P-Band makes use of this value. Therefore, changes should only be made under consideration of the effects on the P-Band (chapter 3.3.4).

Changes are only possible, if the DIP-Switch security lock of the parameter level is unlocked (see chapter 2.2.4). Thereafter, HI-Value changes are performed using key C C and D confirmed with key E.

It is advisable to lock the parameter level after changes are made to avoid accidental HI-value changes.

HI Value-Function:

The HI-Value acts as a limiting value, which has the following functions:

- If one of the connected control circuits (valid also for turned off zones, ie. no setpoint entry) reaches the HI-Value, a high temperature warning is signalled. (see chapter 3.2.5).
- If one of the connected control circuits reaches a temperature of the HI-value + 10 K, the watchdog alarm is immediately turned on (see chapter 3.2.2).
- HI-Value changes have priority over setpoint values. The lowering of the HI-Value below the setpoint also triggers the watchdog alarm. While the original set point remains in the display, the controller controls internally according to the new HI-Value. This internal deviation from the setpoint is indicated by a decimal point in the setpoint display, eg.: "250.". The first operation of key C or D changes the setpoint to the new max. allowable setting = HI-value.

The max. HI-Value depends on the type of sensor; Fe-CuNi up to 700 degrees C, NiCr-Ni up to 999 degrees C and PT100 up to 250 degrees C.

Default setting: 500 degrees C

3.1.7 MINIMUM SETPOINT LIMIT (LO-VALUE)

The LO-value can be displayed by lowering the zone number with key A to below the HI-Value.

The LO-Value acts as a lower limiting value for setpoint selections. There is no alarm signals linked with the LO-Value. The lowering of the setpoint below the LO-Value disables that zone.

LO-value changes have priority over setpoint values. Increasing the LO-value above the setpoint will not change the actual setpoint in the display. The first operation of key C or D changes the setpoint to the new LO-value (new min. setpoint limit).

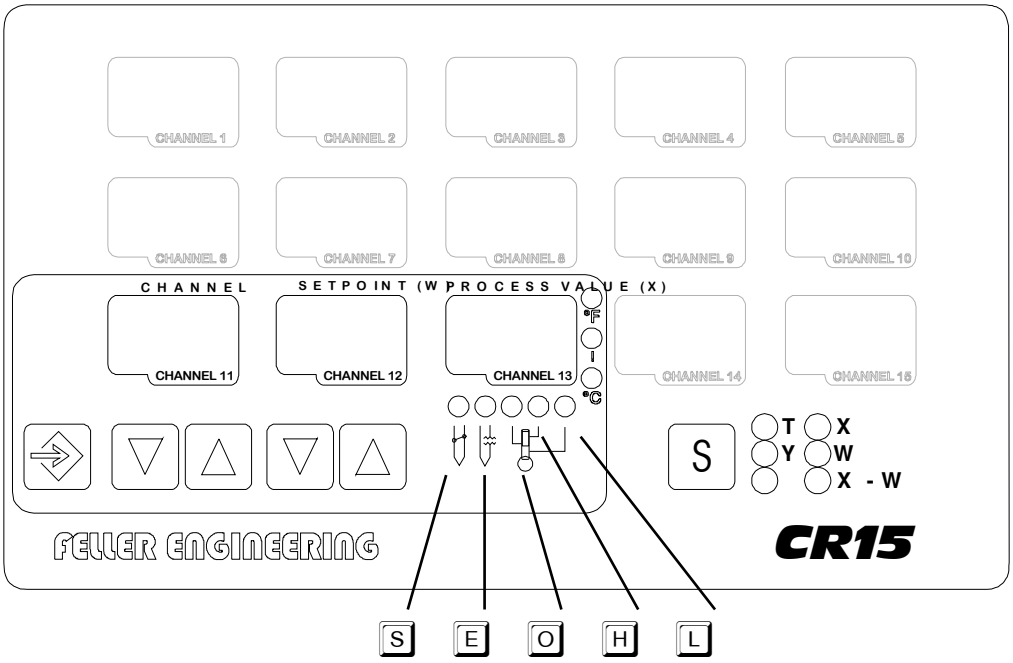
Default setting: 20 degrees C

3.2 LED-DISPLAYS

LO-Value changes have priority over setpoint values. Increasing the LO-Value above the setpoint will not alter the original set point in the display. Rather, the controller controls internally according to the new LO-Value. The first push of key C or D changes the setpoint to the new min. allowable setting = LO-Value.

Eight different LEDs indicate the status of the CR15. All the indicators have collective functions.

3.2.1 FAHRENHEIT- AND CELSIUS-LED



The LEDs °C and °F are located right beside the section „PROCESS VALUE“. Referring to the indication mode lights one of both.

The conversion from °C to °F is accomplished by switching a DIP-Switch (see chapter 2.2.3). If the temperature is displayed in °F, the 3 digit display is not sufficient for values >999°F. The indication for exceeded values is a decimal point in front of the 3 digit display to replace the missing 1 (eg.: .230 = 1230 Degrees F).

3.2.2 WATCHDOG-LED

The watchdog-LED is located between the °C and the °F LED. The Watchdog LED (P) is triggered, if the following conditions occur:

- The HI-value (see chapter 3.1.7) is exceeded by 10K
- The controller outputs are inhibited by the PLC inputs
- Problems with the AC Power Supply
- The processor's own error detector finds a hardware component problem

The potential free normally open contact (contact output W; see diagram 2.1.3) is opened at the back of the instrument which, for example, could disconnect the heaters from the AC power supply.

Hint: This error message can also occur, if the HI-value is lowered below a actual value.

3.2.3 LOW TERTEMPERATURE-LED

If the setpoint is not yet reached or if the actual value of one or more zones drops below the low temperature limit determined by parameter 2 (see chapter 3.3.2), the low temperature LED (K) lights up.

At the same time a potential free contact for external switching (contact output „LOW“, see diagram chapter 2.1.3) is activated. If the display is in the scan mode, the scan mode is terminated at the first zone which indicates low temperature. This zone is then displayed permanently.

The low temperature LED as well as the respective relay can also be triggered if the setpoint of a zone is raised. To utilize the contact of the low temperature relay to enable the machine, a low temperature is automatically indicated at:

- switching the device on
- sensor short (PT100)
- sensore break
- Diagnostics program

3.2.4 HIGH TEMPERATURE-LED

If the actual value of one or more zones exceeds the setpoint by more than the predetermined value set in parameter 1 (see chapter 3.3.1), the LED H will light up after a short delay.

At the same time a potential free contact for external switching (contact output „HI“, see diagram chapter 2.1.3) is activated. If the display is in the scan mode, the scan mode is terminated at the first zone which indicates high temperature. This zone is then displayed permanently.

3.2.5 OK-LED

The green LED O signifies the normal, trouble free operation of the CR15. This LED always lights up, if the active zones have a actual value which ranges within the high/low temperature band.

3.2.6 SENSOR BREAK LED

In the event of a sensor break of one or more zones, or if a zone with a disconnected thermocouple is turned on, the LED E is then activated.

The heater of the corresponding zone is turned off. The low temperature alarm (3.2.3) will be activated parallel in result of the turned off heater.

When sensor break or disconnection is present, the zone can be switched to %-On Time mode (see chapter 4.2).

3.2.7 SENSOR SHORT LED

(Relevant only for **FP13** units with PT100 inputs)

In the event of a sensor short or at PT100 or wrong wiring of thermocouples at one or more zones, the LED S is then activated.

The heater of the corresponding zone is turned off. The low temperature (3.2.3) will be activated parallel in result of the turned off heater.

3.3 PARAMETER LEVEL

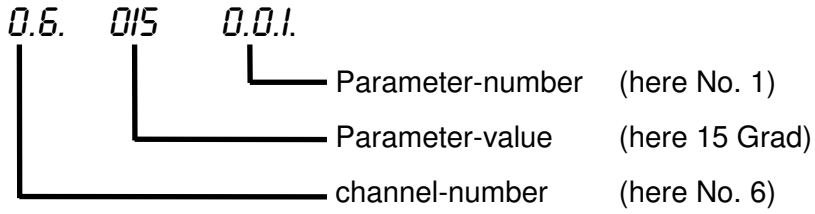
The **CR15** possesses a parameter level which serves to adjust the controller to special control tasks. This level accommodates 12 different controller specific parameters.

The parameter level of a zone is accessed by first pressing the key E and then jointly pressing the key A (executable for each zone).

Parameter Display:

After the level is accessed, decimal points appear in the zone number as well as in the actual value display.

Eg.:



In this example, the high temperature alarm for zone no. 6 is activated at 15 degrees above setpoint.

Parameter Selection:

Parameters can be selected by using key A or B. Climbing above the last parameter for one channel you will reach the first parameter of the following channel.

Parameter Change:

Changing parameter values is only possible if the parameter level is unlocked (see chapter 2.2.4). DIP-Switch No. 7 of DIP-Switch block "C" has to be in the "ON" position. The display shows flashing dashes "-- --- ---". After pressing key E once, the corresponding zone with its parameters appears in the display. It is now possible to enter a new parameter value using key C or D, confirm this value with key E.

!!! Caution !!! The parameter level should be locked again after changes have been made.

Exiting the parameter level:

The user can return to the normal display mode (Zone-Setpoint-Actual Value) by first pressing the key E and then jointly pressing the key B.

3.3.1 PARAMETER 1: HIGH TEMPERATURE ALARM LIMIT

Parameter 1 sets the alarm limit for the high temperature response respective to the setpoint. This limit can be adjusted for each zone.

Range	4 - 700 °C for FeCuNi/NiCrNi 4 - 250 °C for Pt100
Default setting	15 °C
Unit	Celsius or Fahrenheit

Function:

The high temperature alarm limit determines a range above the setpoint where, any overshoot above this range would trigger an alarm. There is an alarm on the display and a potential free relay contact at the rear of the device.

Example:

Setpoint = 100 degrees C
Parameter No. 1 = 15 degrees C

Result:

When the zone attains a temperature of 115 degrees (100 + 15), the HI-temperature will be indicated by a (flashing) -H-. At the same time the lights the high temperature LED (H) and the high temperature relay (contact „HI“) is activated to be used for external signalisation. The high temperature message remains until the value of the respective zone has dropped to

Setpoint + High Temperature Alarm Limit - 3 degrees C

(example: 100 + 15 - 3 = 112).

!!! Caution !!! The alarm value is not valid, if the sum of setpoint and the value of parameter 1 is greater than the defined HI-value.

3.3.2 PARAMETER 2: LOW TEMPERATURE ALARM LIMIT

Parameter 2 sets the alarm limit for the low temperature in relation to the setpoint. This limit can be adjusted for each zone.

Range	4 - 700 °C for FeCuNi/NiCrNi 4 - 250 °C for Pt100
Default setting	15 °C
Units	Celsius or Fahrenheit

Function:

The low temperature alarm limit determines a range below the setpoint where any drop below this range would trigger an alarm. There is an alarm on the display and at the back of the instrument as a potential free relay contact.

Example:

Setpoint = 100 degrees C
Parameter No. 2 = 15 degrees C

Result:

When the zone attains a temperature of 85 degrees (100 - 15), the LO-temperature will be indicated by a (flashing) -L-. At the same time the lights the low temperature LED (L) and the low temperature relay (contact „LO“) is activated to be used for external signalisation. The low temperature message remains until the value of the respective zone has risen to

Setpoint - Low Temperature Alarm Limit + 3 degrees

(example: 100 - 15 + 3 = 88).

3.3.3 PARAMETER 3: RELAY CYCLE TIME / INDICATION MODE

Parameter 3 has a dual function. It determines the switching time by setting power cycle times for each individual heater, as well as the definition of the indication mode of each channel separately.

Range	0 - 20
Default setting	1
Units	sec

Indication mode (Parameter value = 0):

The indication mode deactivates the setpoint display. The instrument measures the temperatures by the connected sensors and shows them in the display for each zone.

Control mode (Parameter value between 1 and 20):

The best control results are achieved when the electronic power output or the connected Solid State Relays switch at the highest speed. This is accomplished with a setting of "001".

The switching time should be adjusted according to the rated relay cycles, power requirements and type of load to avoid premature wearing out of contact relays. Nevertheless, this setting has a direct influence on the control fluctuations with respect to the delay time of the control cycle.

However, a compromise between low switching frequency and low control fluctuations is required. The fast switching time (default setting) should be used with electronic power contacts.

3.3.4 PARAMETER 4: PROPORTIONAL BAND Xp

Parameter 4 determines the P-Band of the controller in terms of percentage of the HI-Value (see chapter 3.1.7).

Range	0 - 100
Default setting	5
Units	% from HI-value

Function:

The Xp-Value demands 100% heating output until the P-Band is reached. Within the P-Band range thereafter, the heating output is reduced linearly. When the setpoint is reached the heating output is zero.

Example:

max. setpoint(HI-value) = 300 degrees C
Parameter No. 4 (P-Band) = 10 %
setpoint for channel No. 4 = 100 degrees C

Result:

The P-Band encompasses 30 degrees C (from 70 to 100 degrees C). The controller, in this example, demands 100% power until the onset of the P-Band (70 degrees C).
The demanded power is entirely channelled to the outputs, provided the I- and D-portion is turned off (P-Controller).
If the temperature reaches above 70 degrees C, the demanded power is reduced linearly up to the setpoint (eg.: 100 C).

3.3.5 PARAMETER 5: INTEGRAL TIME T_n

Parameter 5 sets the Integral time (I-Portion) of the controller in units of seconds.

Range	0 - 999
Default setting	80
Units	seconds

Function:

To avoid a permanent control deviation, the controller increases the power output cyclic and proportional with respect to the current control deviation. The speed which is used for this action can be adjusted with parameter 5.

Example:

Parameter No. 5 (I-Anteil) = 30 Sekunden

Result:

The I-Portion increases by an amount equal to the Xp-Value within 30 seconds by the rate of the Xp band.

If the control deviation becomes negative (actual value is higher than the setpoint), the I-Portion is reduced in the same way.

If the setting is zero and parameter No. 4 (Xp) and No. 6 (D-Portion) is activated, the controller then becomes a PD-Controller.

3.3.6 PARAMETER 6: DIFFERENTIAL TIME T_v

Parameter 6 sets the Derivative Time (D-Portion) of the controller in units of $\frac{1}{10}$ seconds.

Range	0 - 99,9
Default setting	20,0
Units	seconds

The decimal point will not be indicated in the display.

Function:

The D-Portion causes a reduction or an increase in heating power as an offset control depending on the current speed and direction of the temperature change. Tv compensates for the delay time in the heater.

Example:

Parameter No. 6 (D-portion) 50 = 5,0 seconds

Result:

The D-Portion causes a power output reduction during the one degree temperature rise, which depends on the current Xp-Value and on the time required for that temperature rise.

This power output reduction is diminished to zero within the time span (eg.: 5 seconds) preset with parameter No. 6.

If the setting is zero and parameter No. 4 (Xp) and No. 5 (I-Portion) is activated, the controller then becomes a PI-Controller. It may be advantageous to use a PI-control structure if the control circuits are very fast or subject to strong interferences. This is in conjunction with the temperature ramp; parameter No. 7 (see chapter 3.3.7).

3.3.7 PARAMETER 7: START UP RAMP

Parameter 7 sets the Speed with which each zone attains the setpoint.

Range	0 - 100
Default setting	0 (passiv)
Units	seconds per K

Function:

The start up ramp defines the internal 1 degree-setpoint-jump. The instrument reaches the actual setpoint in 1 degree-leaps, in a sense setpoint driven.

This function is very valuable in achieving even heat-up of machines, tools etc. Furthermore, the ramp can be very useful, if a pure PI-control structure is required (parameter No. 6 = zero).

Example:

Actual value = 30 degrees C
Parameter No. 7 = 5 (seconds per degree C)
Setpoint = 100 degrees C

Result:

The controller leads the internal setpoint with a 5 second cycle from 30 to 100 degrees C. This process requires 350 seconds, temperature difference (70) x 5 sec. = 350 sec.

This condition, where the internal setpoint differs from the selected setpoint, is indicated with a decimal point behind the setpoint. The display would show, in our example, "100." for 350 seconds.

!!! Caution !!! The temperature ramp is also effective when the setpoint is lowered. This ensures a controlled cooling process as well.

3.3.8 PARAMETER 8: DIAGNOSTIC TIME

Parameter 8 sets the Diagnostic Time during which each zone in the diagnostic program awaits a temperature increase, as chosen in parameter No. 9.

Range	1 - 999
Default setting	180
Units	seconds

Function:

The diagnostic program relates parameter No. 8 to No. 9. The program intends to realize a temperature increase (parameter No. 9) for each zone within the given time limit (parameter No. 8).

If the heater does not achieve the desired temperature increase within the given diagnostic time, the display will indicate an error message with a flashing "E".

Example:

Zone 3, Parameter No. 8 = 240 seconds diagnostic time

Zone 3, Parameter No. 9 = 10 degrees diagnostic temp. increase

Diagnostic-program is initiated (see chapter 4.1)

Result:

When the test phase 03 is reached, the heater of zone 3 is turned on.
Within 240 seconds (parameter No. 8) the heater has to produce the desired temperature rise of 10 degrees C (parameter No. 9).

Once this rise in temperature is achieved before the diagnostic time has run out, the diagnostic program switches to the next zone to be tested.

If the rise in temperature is not achieved within the preset diagnostic time, an error message flashing '03 E03' (for zone 3) is displayed.

There could be several reasons for this error, ie.:

- the diagnostic time for this zone may be too short (depending on the responsiveness of this zone)
- the thermocouple is broken or not connected (the controller receives no response in both cases)
- the load cable is defective, heater is not activated
- defective load cable, the heater can not get powered
- thermocouples or load cables could be crossed

3.3.9 PARAMETER 9: DIAGNOSTIC-TEMPERATURE INCREASE

Parameter 9 sets the Diagnostic Temperature Increase which each zone in the diagnostic program (see chapter 4.1) has to realize within the given diagnostic time, as chosen in parameter No. 8.

Range	5 - 10
Default setting	10
Units	°C

Function:

The diagnostic program relates parameter No. 8 to No. 9. The program intends to realize a temperature increase (parameter No. 9) for each zone within the given time limit (parameter No. 8).

If the heater does not achieve the desired temperature increase within the given diagnostic time the display would indicate an error message with a flashing "E".

Example see parameter 8

3.3.10 PARAMETER 10: HEATING OUTPUT RELAY NUMBER

Parameter No. 10 is not adjustable by key operation!

The program determines the division of outputs according to the DIP-Switch settings (2-/3-point control - heating/cooling).

For mixed heating/cooling applications it is absolutely necessary to obtain the proper output number for the heater of that zone from parameter No. 10. Hereby, the displayed number corresponds to the labelling of the outputs (see chapter 2.1.2 and 2.2.2).

3.1.11 PARAMETER 11: COOLING OUTPUT RELAY NUMBER

Parameter No. 11 is not adjustable by key operation and it is only present with activated 3-point control!

The program determines the division of outputs according to the DIP-Switch settings (2-/3-point control - heating/cooling).

For mixed heating/cooling applications it is absolutely necessary to obtain the proper output number for the heater of that zone from parameter No. 10. Hereby, the displayed number corresponds to the labelling of the outputs (see chapter 2.1.2 and 2.2.2).

3.3.12 PARAMETER 12: PROPORTIONAL BAND FOR COOLING

Parameter 12 (only when 3-point control is activated) determines the Cooling P-Band of the controller in terms of percentage of the HI-Value.

Range	0,1 - 99,9
Default setting	0,5
Units	% of HI-value

Function:

The cooling of a zone starts when the actual value exceeds the setpoint by + 3 degrees C. The Cooling P-Band governs the intensity of the cooling impact.

Beispiel:

Setpoint = 100 degrees C
Hi-value = 200 degrees C
Parameter No. 12 = 5 %

Result:

The Cooling P-Band encompasses 10 degrees C (5 % of 200 degrees C HI-Value). The Cooling P-Band in this example starts at 103 degrees (setpoint + 3 degrees) and ends at 113 degrees C).

If the temperature reaches above the Cooling P-Band, the demanded cooling power is increased to 100 %.

4.0 FURTHER FUNCTIONS

4.1 DIAGNOSTIC PROGRAM

This program is mainly used for checking all the wiring connections when the system is first installed or after assembly work is done, eg. tooling change etc. The diagnostic program initiates an error check routine which examines wire-crossings, -breaks, -shorts and incorrect hook-up.

It is also valuable to start the diagnostic program when control irregularities during normal operation are observed because this function also monitors the correct operation of the heater (a certain temperature increase within a certain time has to be realized).

Sequence of the diagnostic program:

The diagnostic program is started by pressing keys A and B together while turning on the power. As an indication of the diagnostic mode, a decimal point runs from left to right on the display.

In this case, the three display sections zone, setpoint and actual value take on a different function compared to the normal control program !

On the left side appears the test phase of the diagnostic program instead of the zone number.

The remaining test time for the current test phase is displayed in the centre instead of the setpoint.

The right display section is only active if the diagnostic program has detected an error. The type of error is then indicated with corresponding codes (see following pages from this chapter). The program stops automatically at the first detected error.

The diagnostic program runs self-operating through all heating circuits. If some zones are switched to 3-point control, the controller first checks the heating circuits and then, examines the cooling circuits, which have to be stopped manually.

Pressing Key D will advance the diagnostics program to the next test phase.

The diagnostics program does not check a zone, if there is no setpoint entered for that zone (zone is turned off).

The diagnostics program can be terminated prematurely by briefly turning off the unit and turning it back on.

After the diagnostics program has completed the run without any detected errors, the controller operates according to the selected setpoint program.

As mentioned above, the diagnostic program runs through several phases. The current test sequence is indicated on the zone display.

Phase 00:

All heating circuits are turned off. The controller checks the response of the heaters. The diagnostic time is the sum of the longest diagnistic time, set by parameter No.8, plus 10 seconds. If one of the heaters causes the temperature increase preset in parameter No. 9 (without activation from the controller), the following (flashing) error message is displayed:

Interpretation: Zone 1 heats, but it is not activated.

Phase 01 - 15:

During these phases the working condition of each heater will be checked. The diagnostic time for each phases is max. as long as the time set with parameter No. 8. Within this time limit the temperature must have increased by a value set with parameter No. 9. As soon as the heater realized the temperature increase, the controller jumps to next test phase, even if the diagnostic time has not run out yet.
If the temperature increase is not realized, the following (flashing) error message is displayed:

Interpretation: Zone 2 has not achieved the desired temperature increase within the given time limit.

Possible causes:

- Defective heater
- Broken heater wires
- Fühler defekt Defective sensor
- Sensor wires broken or wrongly connected
- Sensor wires crossed with a non-active zone
- Defective triac in the device
- Defective use in the device

If an other heater than the driven heater responds with a temperature increase, the following (flashing) error message is displayed:

Interpretation: Zone 3 is activated, but response is given by zone 4.

Possible causes:

- Heater wires crossed with an other zone
- sensor wires crossed with an other zone

In this case please compare the output numbers defined in parameter No. 10 and 11 with your installation at the rear of the device.

Phase "X.X - - -":

(Flashing decimal point in the zone display and three flashing dashes in the setpoint display)
The cooling circuits will be checked after the heating circuits have been checked.
The program requests the manual confirmation of each cooling circuit. The program stops at the first cooling circuit and displays a flashing decimal point in the zone display together with three dashes ("- - -") in the setpoint display.

Please ensure, that 

the proper cooling circuit is actuated and confirm it with a short pressing of key [A].

After the diagnostics program has finished without any detected errors, the controller starts automatically the selected setpoint program.

4.2 MANUAL MODE

Each temperature control loop can be switched to manual mode. Prerequisite: The sensor is broken or not connected (sensor interruption). The indication is a flashing -E- in the display for the actual value.

The switching is done by pressing key [E] and [A] simultaneously for the referring channel.

The letter "*P*" is displayed for the relevant zone on the right hand side of the display to indicate the manual mode. Now, the setpoint adjustment is not done in terms of degrees C or F, but rather as a percentage (0 - 100%) of output rate.

To leave the parameter level, press keys and E and B together, and the percent-on time display of the respective zone is reached. A new setpoint is required for the controller. The defective sensor should have been replaced meanwhile.

4.3 WATCHDOG-FUNCTION

The watchdog function performs Die Watchdog-Funktion wirkt als

- processor self monitoring checks for hardware faults
- controller limit HI-value plus 10 K (see chapter 3.1.7)
- power supply check

Additional explanations are listed under chapter 3.2.2 WATCHDOG-LED.

4.4 INDICATOR MODE

The **CR15** can also be used as an indicator. If the relay cycle time is turned off, parameter No. 3 (see chapter 3.3.3) in position "000", the corresponding output is not activated any more. The setpoint display is turned off.

There are no effects on the operability of the instrument. Reaching the parameter level, scan mode etc. is nonetheless applicable as described in the various chapters.

4.5 INTERNAL SETPOINT AND PERCENT OUTPUT INDICATION

Pressing keys C and D simultaneously the display shows instead of:

- the zone number ---> the No. of the current setpoint program
- the setpoint ---> the internal setpoint (see chapter 3.3.7 and 6.1)
- the actual value ---> the actual power output (in percent)

4.6 DISPLAY OF THE SOFTWARE IDENTIFICATION

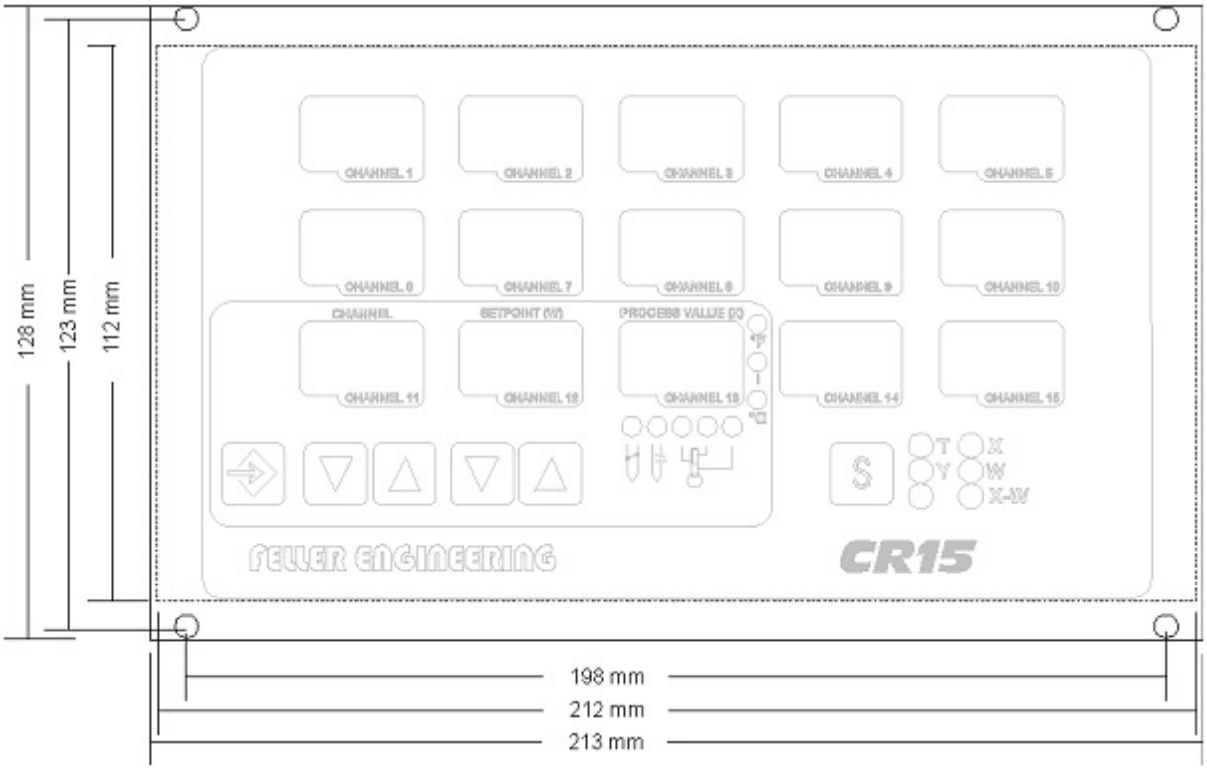
Pressing keys A and D together the display shows its vesion datas.

5. TECHNICAL DATA AND DIMENSIONS

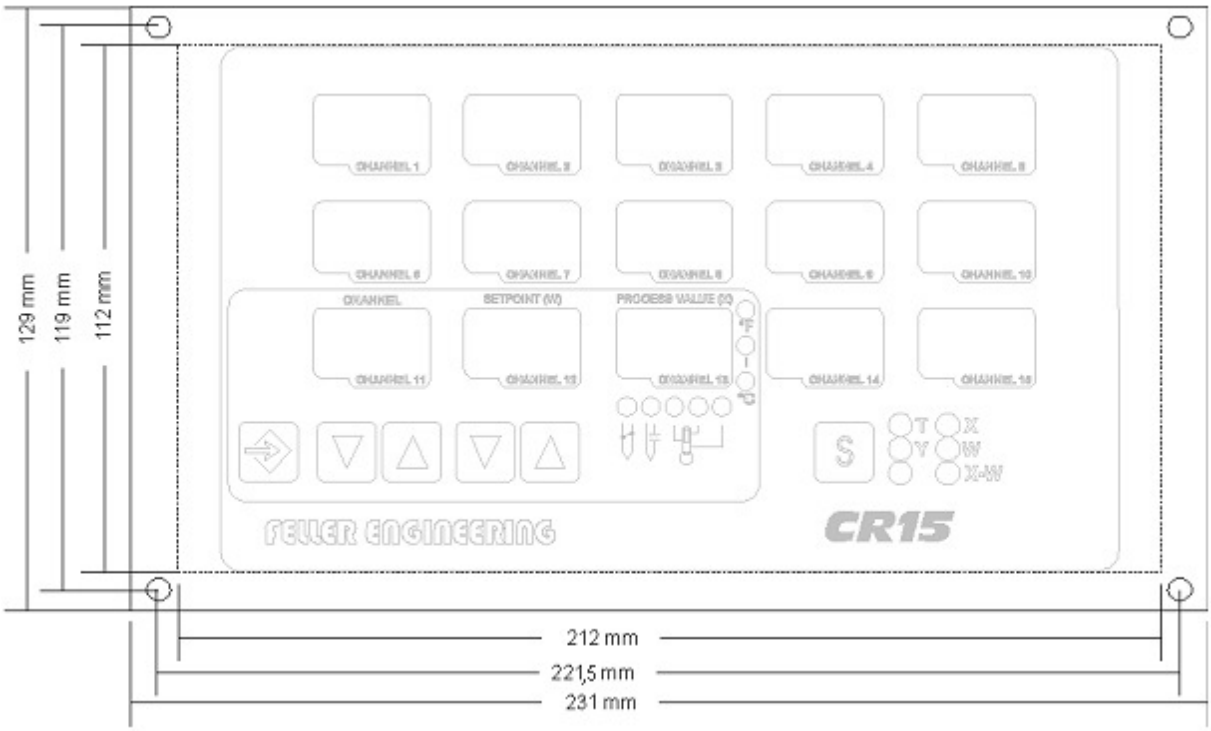
Number of control loops	5, 10 or 15 according to the type of device, 1, 2, or 3 groups may be connected to different phases, channel 1 is wired to each group and may be used in 3 lines at the 15 loops device
Outputs	Industrial TRIACS in binary controlled, max. 230V / 5A load for each channel, but max. 15 A for the group; max. 60 Grad C device surface temperature
Temperature range	0-700 degrees C for thermocouples 0-999 degrees C for Ni-CrNi 0-250 degrees C for Pt100 Selection of degrees C or Grad F by DIP-switch
Sensor inputs	Fe-CuNi adjusted by the software NiCr-Ni Pt100
Ambient temperature	max. 50 degrees C
Control algorythm	PI, PD or PID, with start up mode, control parameters adjustable for each channel separately
Floating limit alarms with relay contacts	1 x high temperature 1 x low temperature (each max. 230 VAC / 3 A)
Fix limit alarm with relay contact	1 x Watchdog function (HI-value + 10 K, HELP-function) (230 VAC / 3 A)
Fuses	1, 2 or 3 x 16 A superflink for the power outputs with TRIAC boards (6,35 x 32 mm) control voltage 1 x 0,5 A medium (6,35 x 32 mm)
Power supply	Power outputs 1, 2 or 3 x 230V/400V, 16A control voltage 230V +5% / -10%, 20VA, optional 115 VAC, 24 VAC or 24 VDC

Dimensions	Front - **Rack-version** - 3 HE = 128,4 mm 42 TE = 213,0 mm (19"-Version) Frontplatte - **Control panel-version** - 3 HE = 128,4 mm width = 230,0 mm deapth - **Rack-version** - without terminals = 215,0 mm with terminals = 230,0 mm with interface plug, straight = 255,0 mm **panel break out** H 114,4 x W 214,0 mm
Weight	according to the type 2,5 to 3,0 Kg

Frontview and sizes of CR15 - Rack-version



Frontview and sizes CR15 - control panel-version



6. OPTIONS

Special executions have been developed for different purposes of **CR15** . The most importent and interesting features are described in the following. Special functions that are not included in this manual will be decribed by an enclosure.

6.1 FUNCTION OF THE TURN-KEY

CR15 may be delivered with a key switch acording to customer's desire. A SIEMENS system, type KABA-MICRO will be installed.

This switch locks the device against changes of setpoints and parameters. Other functions are still valid.

The key numbers may be different or even the same for a certain customer; each **CR15** uses the same key.

6.2 PLC-PARALLEL-INPUT

CR15 may be fitted with optional PLC parallel inputs. Therewith a remote start of the four different setpoint programs (see chapter 3.1.6) is possible.

This special version of **CR15** is provided with a 15-pin Sub-D plug (male) at the rear side.

Pin-functions:

1	- selection of setpoint program 1
2	- selection of setpoint program 2
3	- selection of setpoint program 3
4	- selection of setpoint program 4
5	- locking of controller outputs
10..15	- ground

The inputs are PLC compatible, means they are accepting a voltage range of 13..30 VDC at a mean current of 8,5 mA.

The selection of a program is done by putting the voltage (24 VDC against the ground) to the referring input (pin 1..4 for the desired program). A short time of 0,1 seconds is sufficient for the program change. As long as the voltage is put to the referring pin, the change of program by the operation keys is locked.

7. PROTOCOLS OF THE SERIEL INTERFACES

The description of the available protocols may be delivered as required.