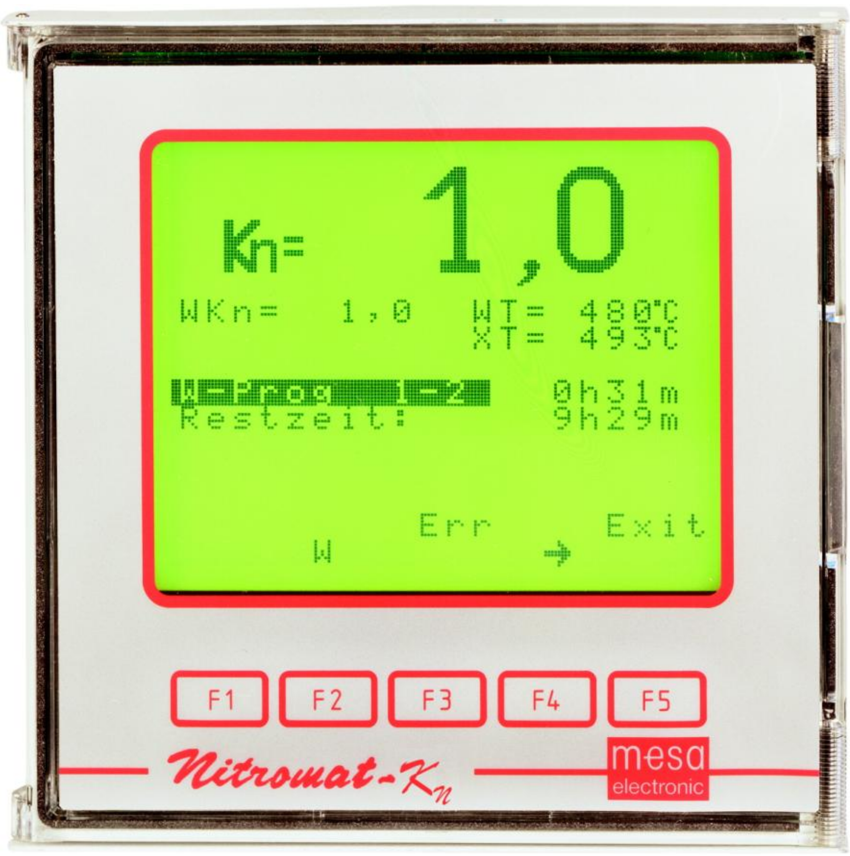
User manual

Nitromat - Kn



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1. Basic 5
2. Menu overview 6
   2.1 Main menu 6
   2.2 Current values page 1: 7
   2.3 Current values page 2: 9
   2.4 Set value menu 11
      2.4.1 1st page W-prog.menu 13
      2.4.2 2nd . page W-prog. menu 14
      2.4.3 Common data 15
      2.4.4 Set values 17
         2.4.4.1 Set values 1st part 17
         2.4.4.2 Set values 2nd part , control track 18
      2.4.5 Example for set value program 19
   2.5 Service menu and it's submenu 24
3. Scale Analog IN 25
   3.1 Scale Analog OUT 26
   3.2 Temperature correction 28
   3.3 Process data 29
   3.4 Regulator data 30
      3.4.1 Regulating parameters 31
      3.4.2 Output limits 33
   3.5 Calculation 34
   3.6 Probe purging 34
   3.7 Serial interface 34
   3.8 DIP-switches 34
   3.9 Calibration (HW) 35
4. Alarms and warnings 35
   4.1 Error menu example 36
5. Nitromat-Kn outputs 37
   5.1 Nitromat-Kn digital outputs 37

5.2 Analog outputs of Nitromat-Kn 38

6. Inputs of Nitromat-Kn 38

6.1 Digital inputs of Nitromat-Kn 38

6.2 Analog inputs of Nitromat-Kn 39

Appendix A: Using the DIP switches 40

Appendix B: Connector terminal marking 41

Appendix C: Nitromat-Kn connector position 42

Introduction

Nitriding is thermo-chemical process for hardening the surface layer of steel workpiece. Nitriding is applied in order to increase the resistance to wearing and corrosion and to improve the dynamical hardness of steel parts. The surface layer provide the resistance to wear and corrosion while the diffuse layer located below, preserve hardness.
Process temperature during nitriding is between 450ºC and 580ºC while it last from 1 up to 100 hours. Interconnect layers, made in gas nitriding process, are composed of intermetalic connection of iron and nitrogen (ε- and γ'- iron nitrides) which, depending of process duration, can achieve depth of 10...30 µm and can have high point of hardness with low brittle characteristic. But molding of this layer can be completely avoided.
A diffusion zone can be found below which achieve up to 0.8mm in depth into material. Here the nitrogen is diffusing into internal iron structure and with alloying component like Cr, Mo, Ti, Al, V creates special nitrides. This special nitrides are very important for high hardness and wear resistance of alloyed materials.

Carburizing is thermo-chemical process for doping and hardening the surface layer of workpiece. Carburizing is performed in gas atmosphere at temperature between 500ºC and 630ºC in mixture of gases which can release nitrogen (per example ammonia) or carbon (per example carbon dioxide). The aim is to increase the resistance to wearing and corrosion of low and medium alloyed steels.

Dissolution of ammonia is performed in correlation with the following formula

$$NH_3 \rightarrow [N] + \frac{3}{2} H_2$$

The nitriding characteristic number is known as

$$K_N = \frac{p(NH_3)}{p(H_2)^{\frac{3}{2}}}$$

In case of pure nitriding, the nitriding characteristic number can be calculated from the degree of dissolution of ammonia i.e. from the quantity of hydrogen in furnace.
The figure 1. shows the conditions for originating the specific phases of iron nitrides versus nitriding characteristic number and temperature. This diagram could be well implemented for low alloyed steels.

We would like to shortly present the basics of Nitromat-Kn functions.
For determination of H_2 in furnace atmosphere the H_2 probe is used. Nitromat-Kn is using the signal from this probe and calculating the nitriding characteristic number Kn and compares it with set value. In case of variation an adequate signal is sent to the mass-flow controller for ammonia which increase or decrease the ammonia flow. The flow is being tuned until the calculated Kn value is not equal to the setup Kn value.

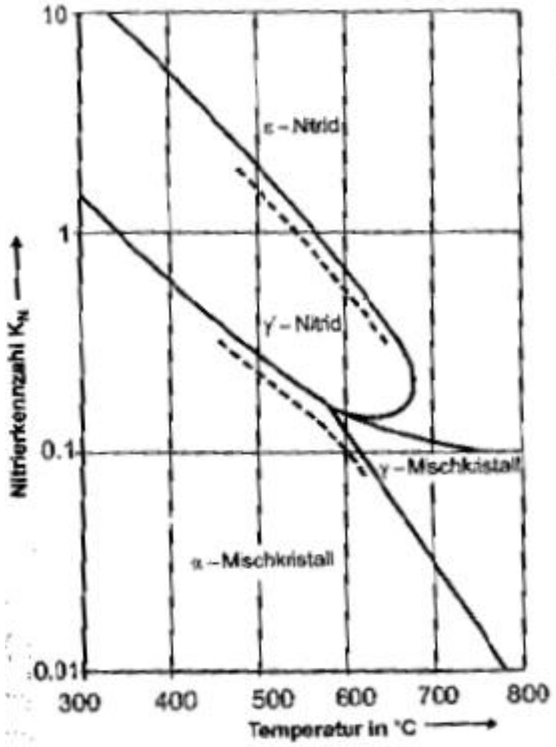


figure 1. The conditions for originating the specific phases of iron nitrides

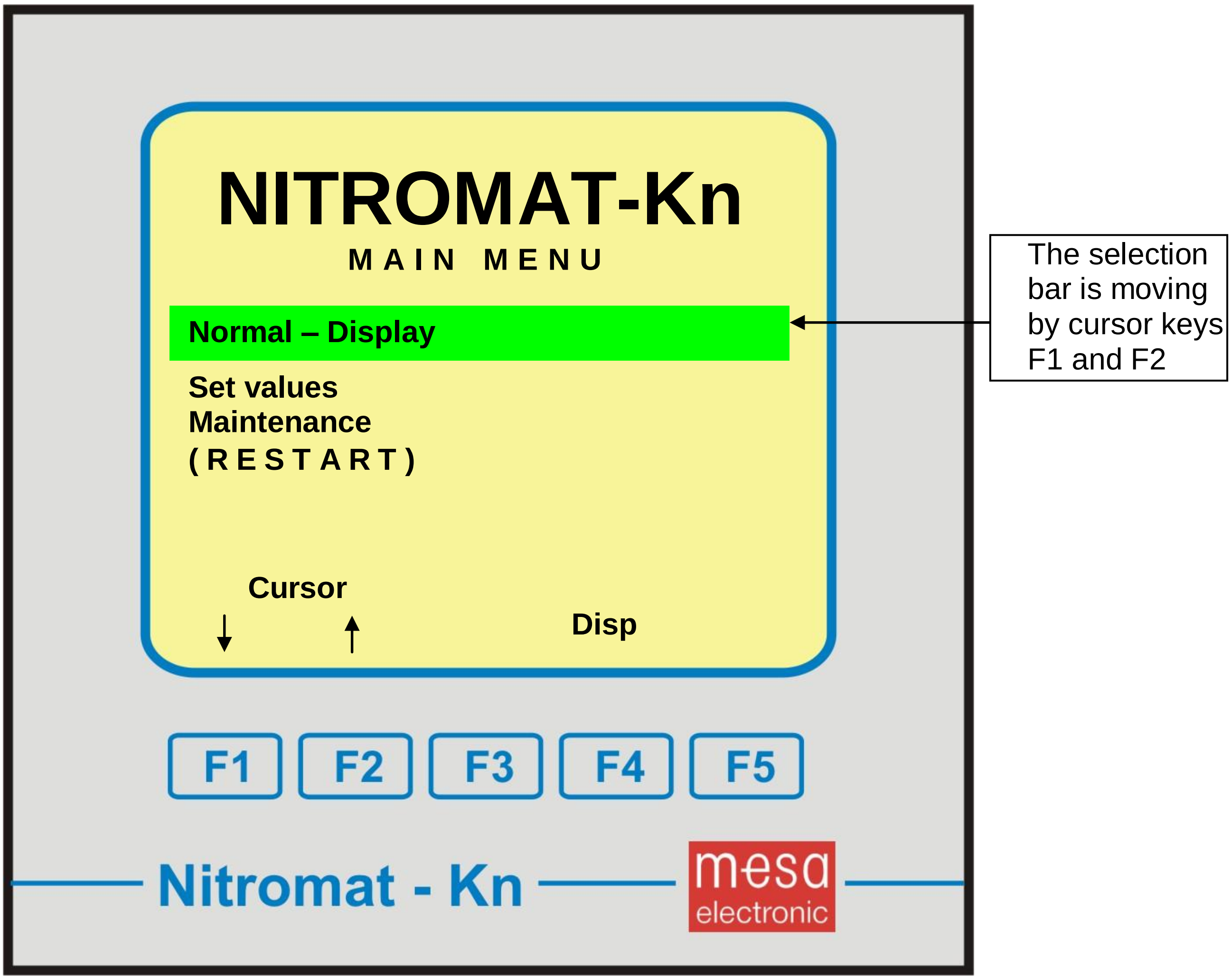
The current data about the flow Nitromat-Kn is getting from the mass-flow controllers which gives current signals 4...20mA. Thanks to the free input scaling Nitromat-Kn is capable to operate with various flow meters. Calculated results are interpreted as current signal 4...20mA and a free scale choose is also possible.
NH_3 flow can be controlled with two mass-flow controllers with different size. In order to provide such capability Nitromat-Kn dispose separate parameters for controller adjustment.

1. Basic

In each menu, except the main menu, there is key **F5 EXIT**. If you, at some point, do not know where you are just keep pressing F5 until you came back in main menu.

2. Menu overview

2.1 Main menu



The figure above shows the main menu of Nitromat –Kn from where you can reach the following subpoints:

Normal view: This view is spited in two sides showing current values and set values. Beside this, here are shown the current messages about the errors and about the current operating state.

Set values: Below this menu point there is overview of all available set values sources:

Constant value 1 – 5
Set value programs 1 - 99

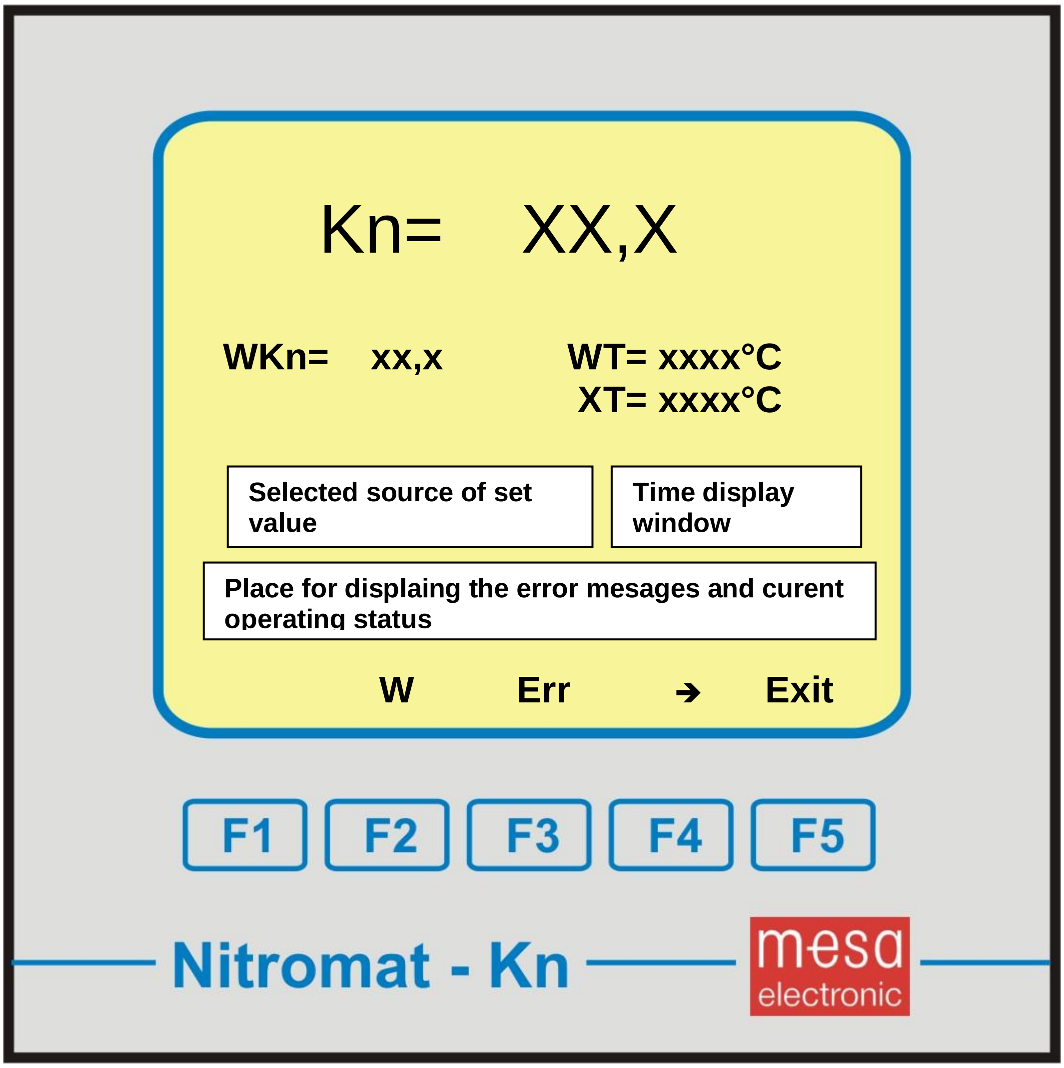
Maintenance: Here you can find settings and correction of controller, etc.

Input and output scaling
Temperature correction
Gas-treatment activation temperature
Initial gas quantity for treatment
Controller setting
DIP switch setting

Choosing menu point: The selection bar can be moved by pressing cursor keys F1 and F2 to the desired menu point and then the keys **F4 Disp** should be pressed.

In the following text different display will be explained:

2.2 Current values page 1:



The abbreviations shown above have the following meaning:

Kn: The current actual value, emitted at output AOUT1 as current signal 4...20mA

WKn: Current set value

WT: Current set temperature value is emitted at output AOUT2 as current signal 4...20mA

XT: Current temperature

Selected source of set value: Here is shown the name of selected source of set value. When set value program is used, here are shown the program number and program step.

Time display window: At set values program here are shown the elapsed and remaining program time

Error display and current working status: Beside the messages about the error, here are shown the info about the set value program status (i.e. „wait until current value is = set value“) and controller status (i.e. „regulation is normal ->“).

Key marking:

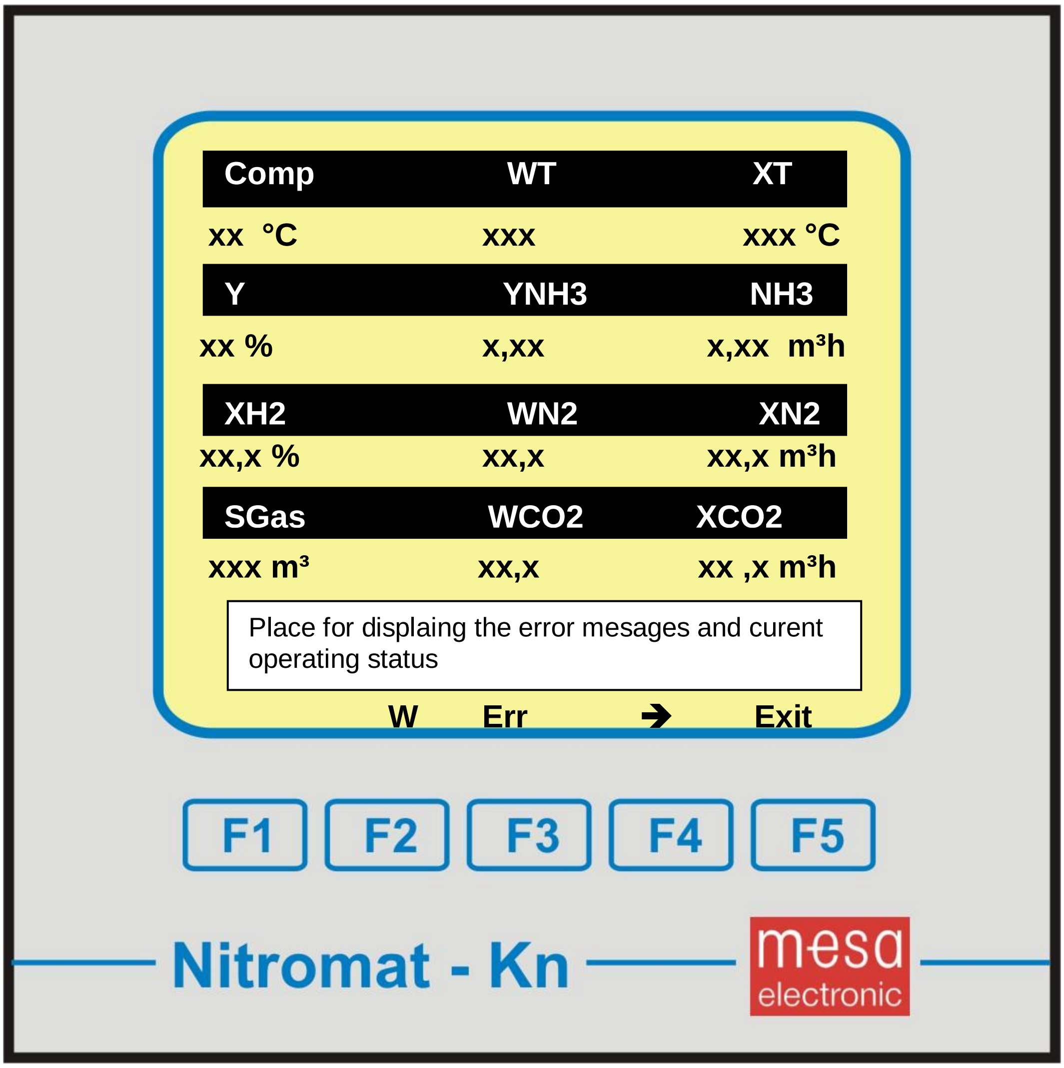
W: By pressing this key you will enter the set value menu

Err: By pressing this key you will enter the error menu

➔: Forward to the next value page

Exit: Return to the main menu

2.3 Current values page 2:



The abbreviations shown above have the following meaning:

Comp: Temperature comparing point

WT: Set temperature value is emitted at AOUT2 as current signal 4...20mA depending on output scaling (see page 17)

XT: Current temperature value

Y: Calculated opening degree of regulating device.

YNH3: Calculated opening degree of regulating device translated into m^3/h NH3. Scaling could be found in menu point Analog OUT (page 27).

XNH3: Current ammonia flowing in shown in standard cubic meters per hour. It is calculated based on the current signal from the flow meter (4...20mA) and on the input scaling (see page 26)

XH2: Current hydrogen concentration in furnace

WN2: Set value of nitrogen is emitted at output AOUT3 as current signal 4...20mA and in proportion with scaling (see page 27)

XN2: Current nitrogen flow in standard cubic meters per hour. It is calculated based on the current signal from the flow meter (4...20mA) and on the input scaling (see page 25)

SGas: Counter of gas quantity. Adds received quantities of NH_3 , N_2, and CO_2.

WCO2: Set value of carbon dioxide emitted at output AOUT4 as current signal 4...20mA (see page 27)

XCO2: Current carbon dioxide flow in standard cubic meters per hour. It is calculated based on the current signal from the flow meter (4...20mA) and on the input scaling (see page 25).

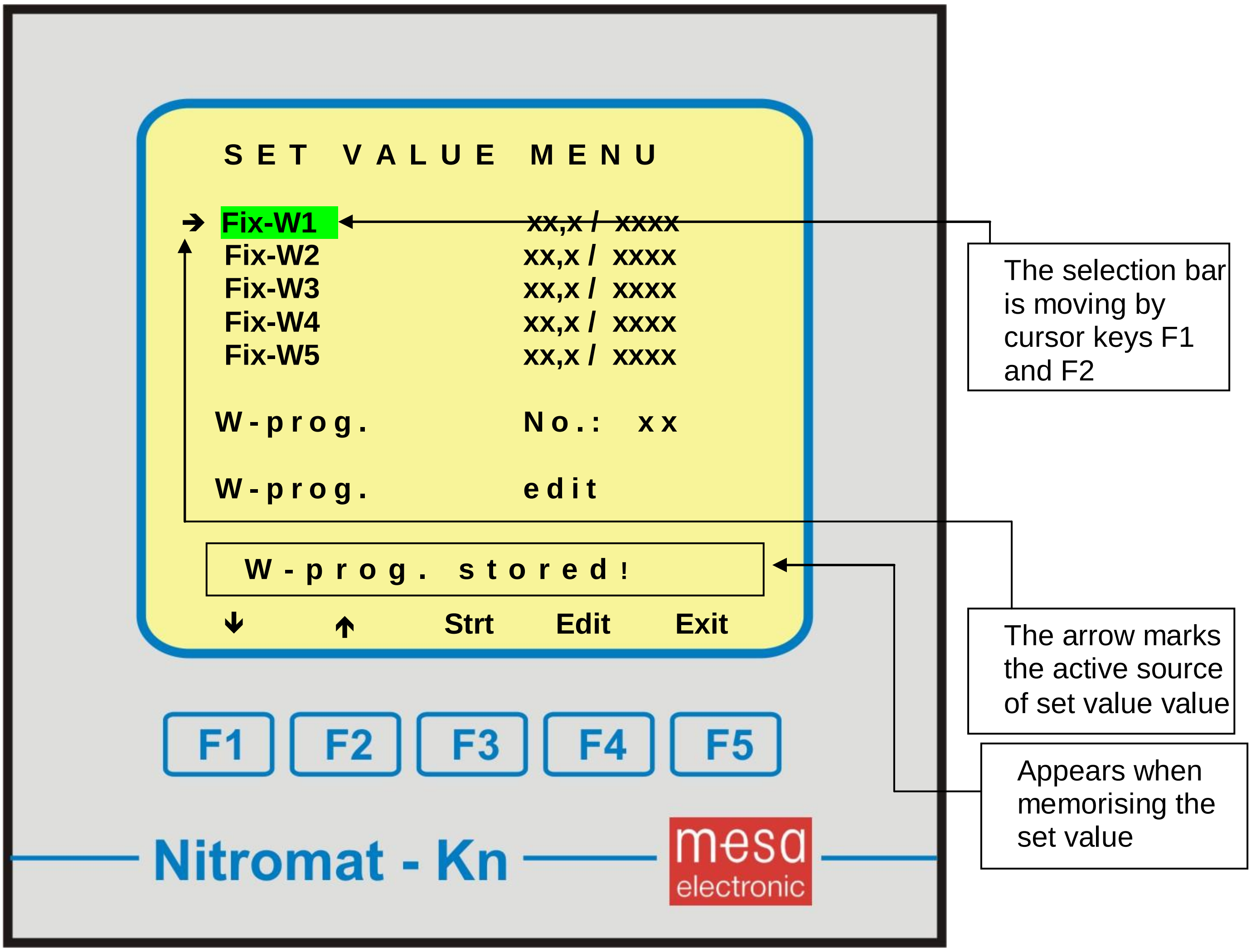
Key markings:

W: By pressing this key you enter the set value menu

Err: By pressing this key you enter the error menu
Return to the page 1 of the current value menu

Exit: Return to the main menu

2.4 Set value menu



The abbreviations shown above have the following meaning:

Fix-W1 – Fix-W5: Fix set values 1-5. The following numbers shows Kn-set value and temperature set value

W-prog No.: Shows the chosen set value program number. This set value program can be edited or run.

Edit W-program: Under W-prog.No.: Chosen program is available after choosing this menu point and after pressing **F4 Edit** key for editing the program.

Starting the set value source: With cursor keys F1 and F2 the selection bar should be set to the desired source of set value. Then, with key **F3 Strt**, start the source for set value.

Setting the number of
set value programs: Using the selection bar you should choose menu point W-prog.No. Then, with **F4 Edit** key activate the number of program for editing.

Keys F1-F5 now have different function:

F1: moves blinking cursor one step in right

F2: Increments the cursor value for 1

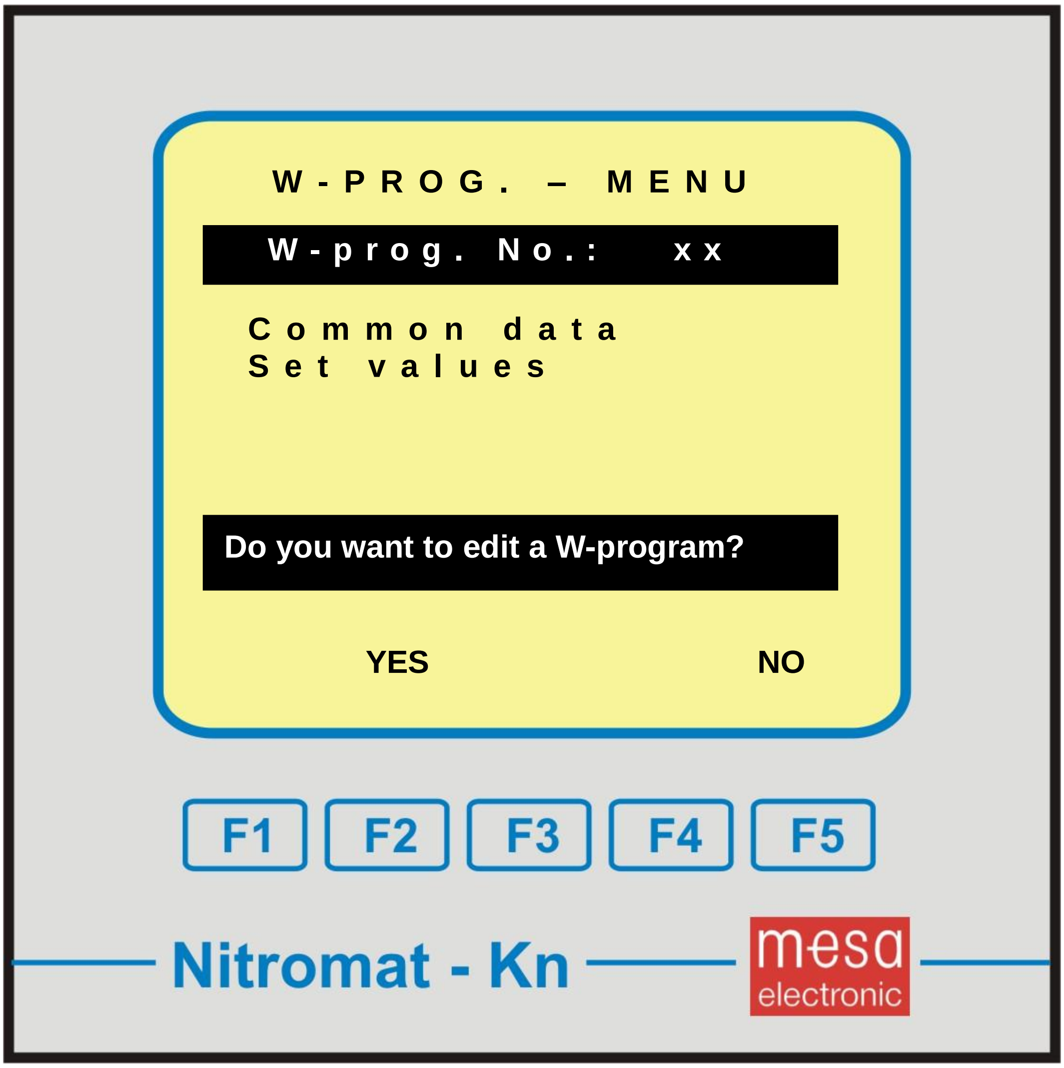
F3: Decrements the cursor value for 1

F4: Enter key, which accepts the new program No.

F5: Exit key, which stops the editing process and keeps the old program

Changing the
set value program: Selection bar should be set to menu point **Edit W-program**. Then by pressing **F4 Edit** key activate the chosen program for editing

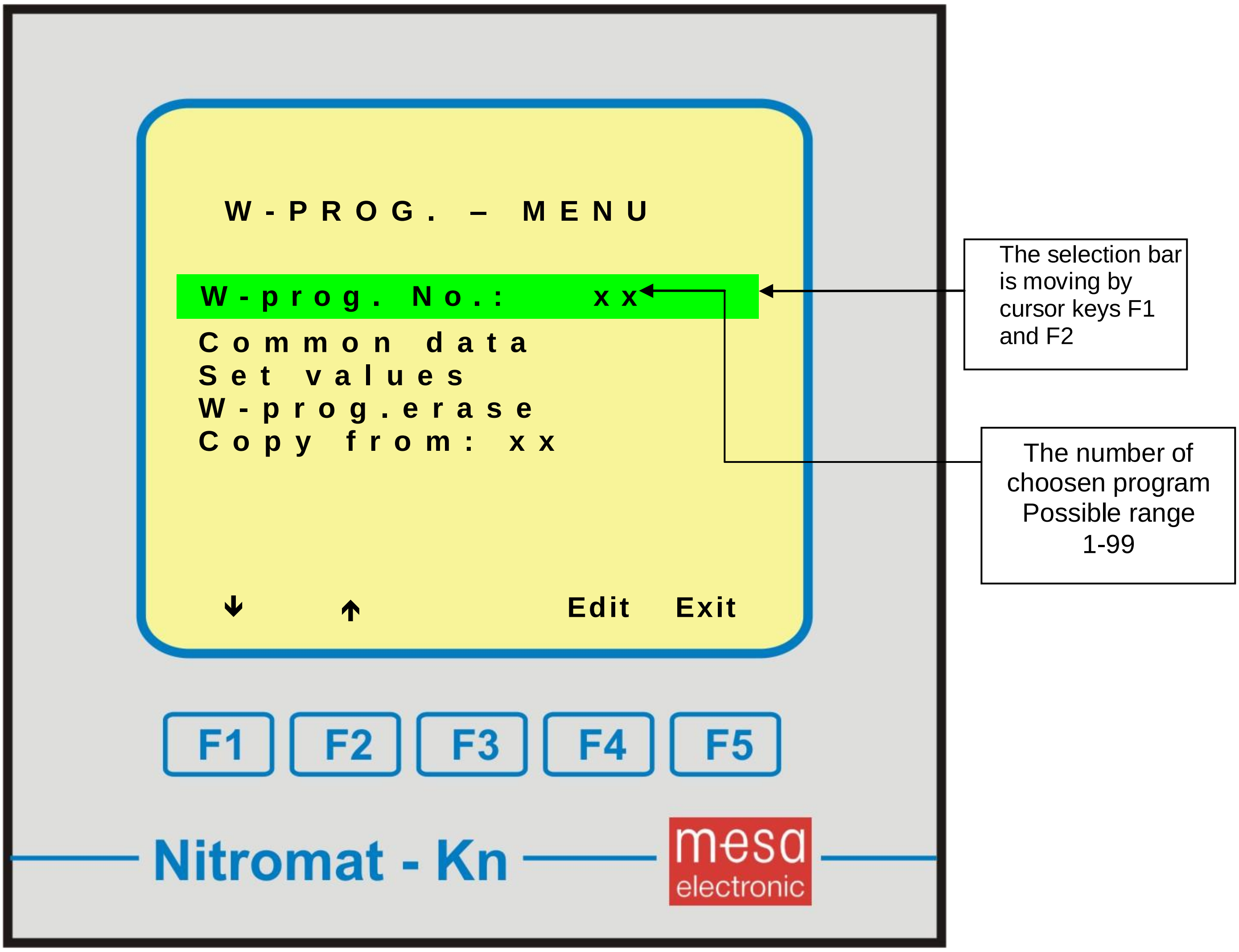
2.4.1 1st page W-prog. menu



With key **F5 No** you can reach to 2nd display of set value menu where you can check the set value program without any change.

With key **F2 Yes** you can enter u display 2 of set value menu and you can change the data.

2.4.2 2nd . page W-prog. menu



If you move the selection bar by key F1 and if chosen program is running as a source of set value then the following message will appear:

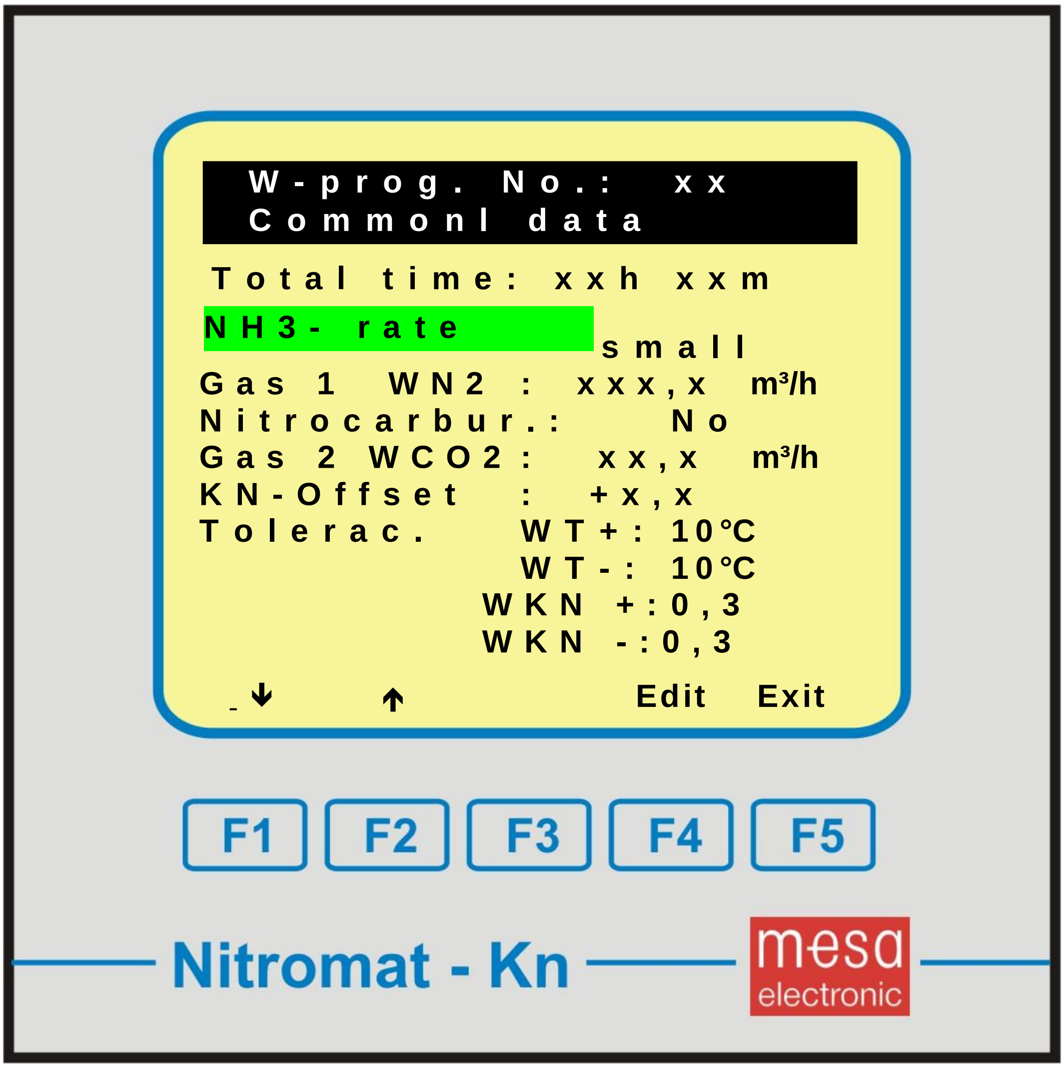
RUNNING! Changes are valid only for this program running!

This means that changes will take effect only for current program running and will be lost after program restart.
At the „current value display 1“ (page 7) in field „Selected source of set value” there is an description of changed program.

W-Pr(m) x-x
The letter **m** in brackets means modification. At the new program start the changes are lost and the original program is being executed.

After choosing the adequate menu point with keys **F1** ↓ and **F2** ↑, by pressing the key F4 Edit you can enter the adequate menu or execute the desired action.

2.4.3 Common data



This points have the following meaning:

Total time: The overall program duration consisted of duration of each segment (for segments see pages 17, 18)

NH_3 rate: Optional choice large / small
Nitromat-Kn should , by its position, be between 2 mass flow controllers. Depending of the chosen one there will be switched on the scaling of inputs(see page 17) and Y-outputs (see page 17).
With large quantity of NH_3 the control track E (see page 17) is used.

Gas1 WN2: **N_2 input flow**
Input range 0....100,0 m^3 / h

Nitrocarbur.: Optional YES / NO
Nitrocarburizing is possible only if:

- here is chosen YES
- DIP switch 1-2 is set to ON
- In adequate program segment the control track is set to D=1

Gas2 WCO2: **CO_2 flow quantity input**
Input range: 0...30,0 m³ / h

Kn-Offset: **Optional Kn Offset input**
Input range: ± 9,9

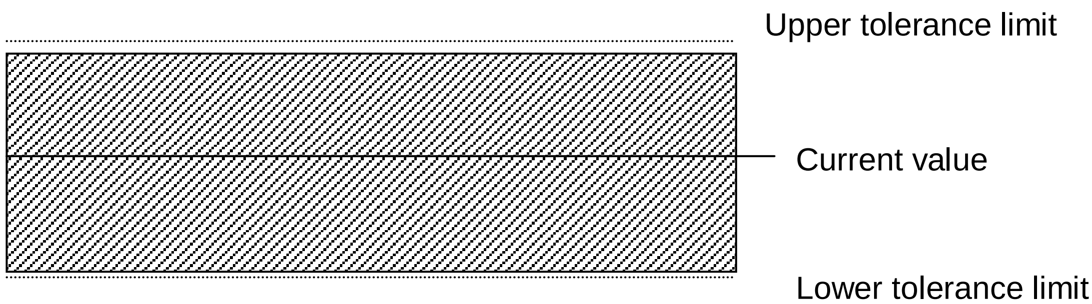
WT+ tolerance display bar: **the upper limit for temperature set value tolerance**
Input range 0...200ºC

WT- tolerance display bar: **the lower limit for temperature set value tolerance**
Input range 0...200ºC

WTKn+ tolerance display bar: **the upper limit for nitriding characteristic number tolerance**
Input range 0...9,9

WTKn- tolerance display bar: **the lower limit for nitriding characteristic number tolerance**
Input range 0...9,9

Setting the tolerance display bar is important for further switching in program for the next program segment. With set X-Bit (X=1) the program is waiting with switching on to next segment until the current and set value at least are close to set tolerance range for temperature and Kn number. In current value display 1 (page 8) , in current working status window, the following message will be displayed:
Wait until current value = set value.

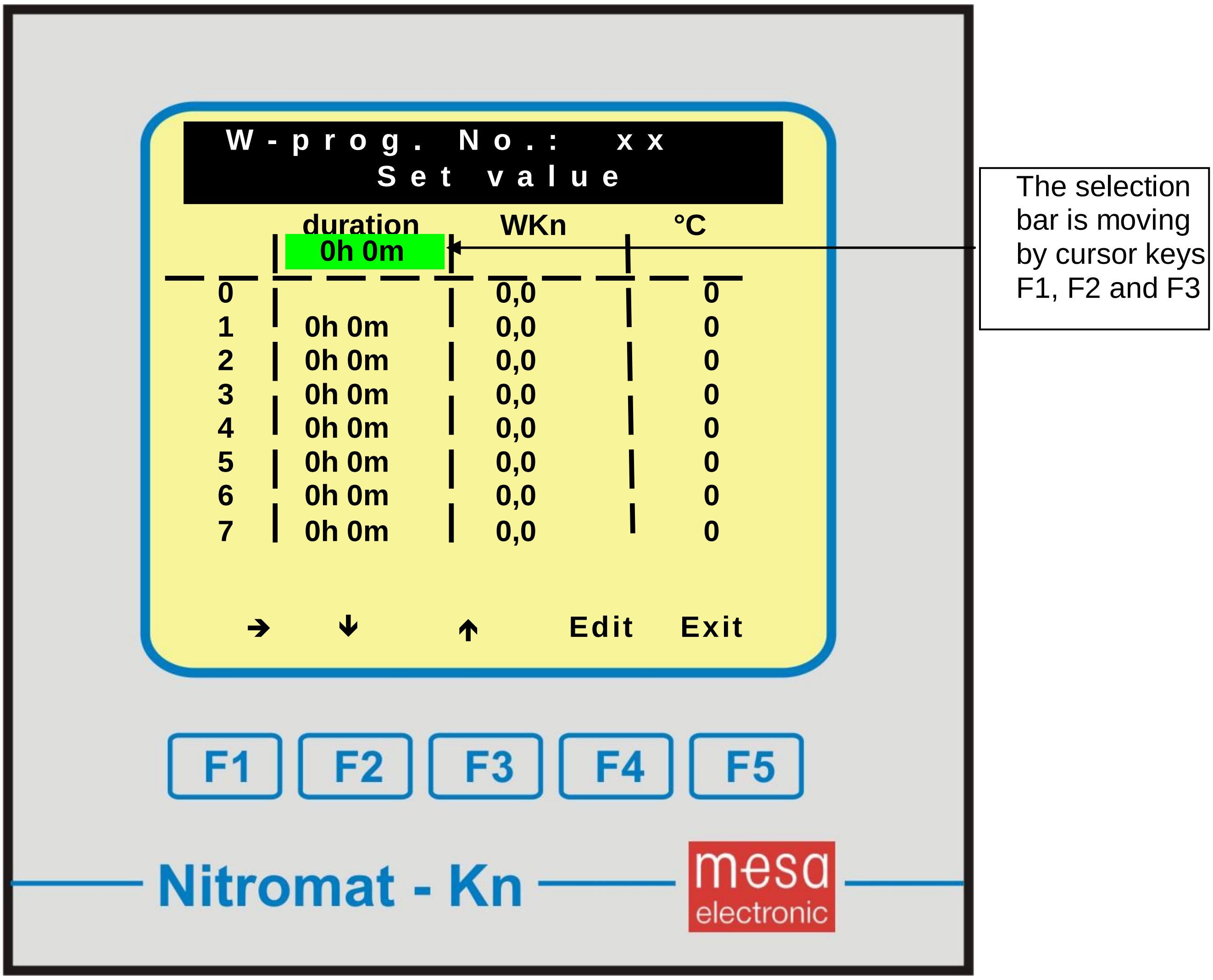


Set value should be inside the hatched region in order to execute the switching to the next program segment.

2.4.4 Set values

2.4.4.1 Set values 1st part

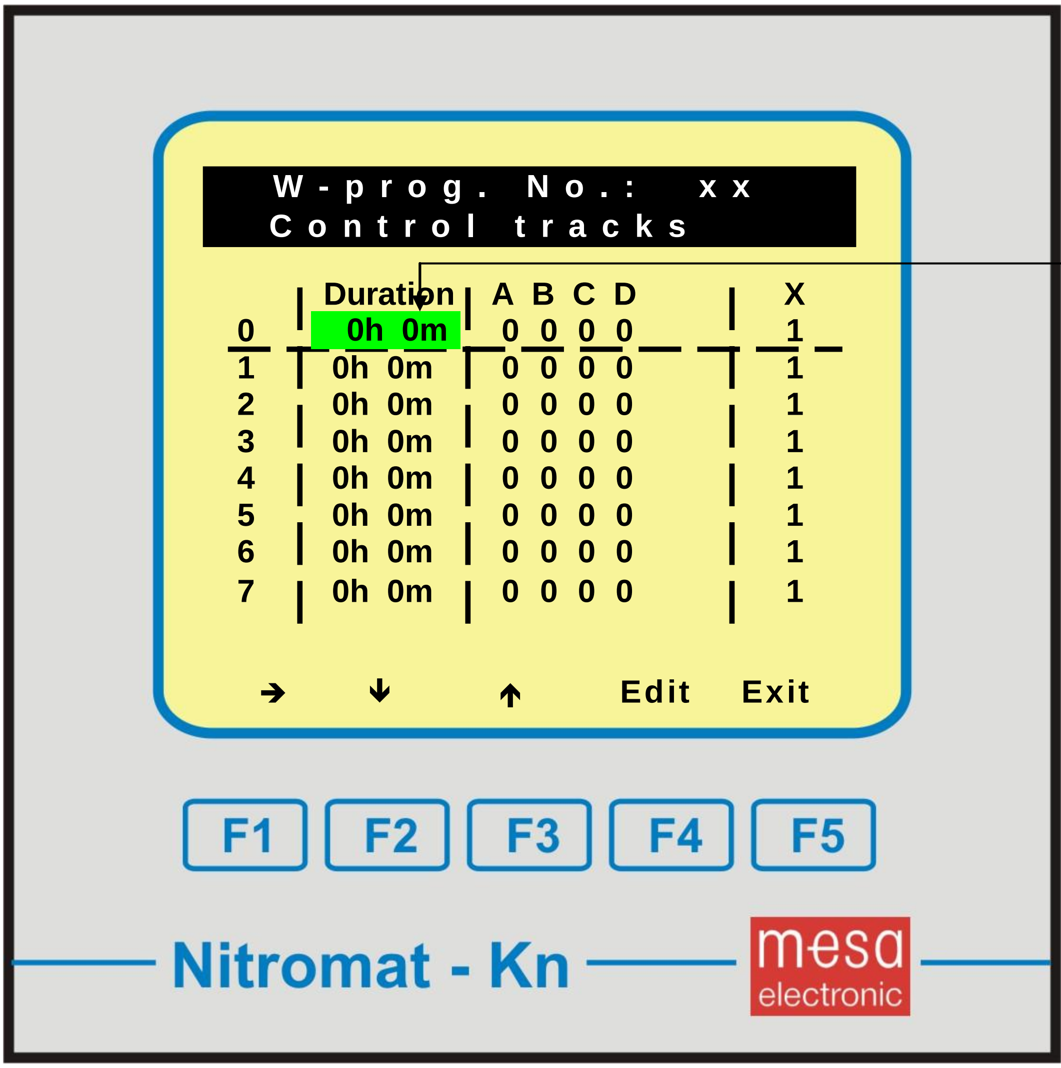
The set values display is divided in two parts. First part looks like the follows:



By pressing the key **F1** ➔ the selection bar goes to columns **WKn** and ºC. Further pressing leads to the second page for current value display.

1st column	**program segment number**
2nd column	**segment duration in hours and minutes** Hour input range: 0...99h Minutes input range: 0...59min
3rd column WKn	**Characteristic set value number** Input value: 0...50,0
4th column ºC	**setvalue for temperature** Input value: 0...1200ºC

2.4.4.2 Set values 2nd part , control track



The selection bar is moving by cursor keys F1, F2 and F3

1st column: **Segment duration in hours**
See previous page

2nd column: **control tracks A – D**
Setting option:
Set=1
Switched off=0
Function of control track A – C can be freely chosen (i.e. Fast cooling on, signal, proper segment is running).
The control track D is marked as „Carburizing ON“
Setting the control track switch on adequate digital output (see page 17)

3rd column: **X-bit**

Setting option: set=1
Not set=0

Whet X-bit is set the switching on to the next program segment will wait until the current and set values for temperature and Kn are inside the set tolerance range (see Common data, page 16).
If the set value and current value are not in tolerance range and if there should wait, then the programmed segment duration is exceeded.

2.4.5 Example for set value program

Caution: The arrow shown on the display, in set value menu, shows which kind of set value is chosen. If you change already started program then that change will have effect only for current program running and after that will be lost. If you want to input a program and to memorize it than this program should not be started during the input. The program number used here are random chosen.

Instructions for starting and running the program for set values

At set value program the first and the last segment with special features.
The set value program can run when:

- The temperature overrun appear (in example 430ºC) 1*. In opposite, the program is waiting for it (on figure 1, with standard display, will appear the message “Wait for StartTmp.”.
- Input IN0 is OFF (controller blocking / program stop)

Inside this waiting phase it is not possible to switch on the program over the digital input IN1 (further program switching) e.g. the starting conditions must be fulfilled . Digital output OUT6 (W-prog. is running) is not switched on.

1. Program segment is step “Temperature regulation” (setting the temperature in the furnace). During this step the digital output OUT9 (current value is in tolerance range) is not switched on although the temperature and C level are inside the tolerance range. Output OUT6 (W-prog is running) is switched on.

   The next segment is running normally. When X-bit is set there should be waited for current value and set value to be inside the tolerance range.

   When the program reaches further regulation is performed with the latest values fro temperature and Kn number. Digital output OUT6
   (W-prog is running) is switching off. Control tracks, which are set in the latest program segment, remain switched on.

   Detailed description of program input (step by step).

Sign description:

MAIN MENU current menu heading

F1 the key below the display (here Function key 1)

Set values move the cursor with keys till this sub-point. (here „set value“)

1. After switching the device you will be in **MAIN MENU**.
2. In **MAIN MENU** set the selection bar with keys **F1 (⇩)** and **F2 (⇧)** to **Set values**
3. press key **F4 (Disp)**. Now you are in **set value MENU**
4. In **set value MENU** with keys **F1 (⇩)** and **F2 (⇧)** set the selection bar to **W-prog edit**
5. Press key **F4 (Edit)** . Now you are in **W-prog. MENU**.

Note: Since this is about important input, Nitromat-Kn is now asking a question, do you really want to change or make a program.

6. Press key **F2 (Yes).**

Note: If key **F5 (NO)** is pressed, then the existing programs can be controlled. Input and changing of values are not possible.

7. Press key **F4 (Edit)**. Now you are in mode for input the number for set value program.

Note: For creation the example program choose the number which is not occupied.

8. Now enter the program number **W-prog. No.** 01 or other. All the rest of the inputs are related to this program.

9. After you finish the input exit with **F4 (Enter) or F5 (Exit)**. Move the selection bar with **F1 (⇩)** and. **F2 (⇧)** to **Common data.**

10. Press key **F4 (Edit).** Now you are in input mode **Common data**

11. Press key **F4 (Edit).** Now you are in input mode **NH_3 rate.**
12. With arrow keys **F2 (⇩)** and **F3 (⇧)** you can increase or decrease NH_3 quantity. Input the **NH_3 rate** = increasing
13. Finish the input with **F4 (Enter)** or **F5 (Exit).**
14. In **Common data** with keys **F1 (⇩)** and **F2 (⇧)** set the selection bar to **Gas1WN2.**
15. After pressing the key **F4 (Enter)** you will be in input mode. By pressing **F1 (⇨)** you can move the cursor one place to the right. By keys **F2 (⇩)** and **F3(⇧)** , in some points, you can set the values from 0 to 9.
16. Input Gas1WN2 = 0,0 m^3/h. Finish the input with **F4 (Enter)** or **F5 (Exit).**
17. With keys **F1 (⇩)** and. **F2 (⇧)** move the selection bar to point **Nitrocarbur.** Here select NO.
18. At point Gas2WCO2: set 10,0 m^3 / h (as displayed below at point 15).
19. Point Kn-Offset: gets setting 0,0.
20. In **Common data** with **F1 (⇩)** and. **F2 (⇧)** set the selection bar to **WT+**.
21. Input **WT+**=10ºC (as at point 15).
22. In **Common data** with **F1 (⇩)** and. **F2 (⇧)** set the selection bar to **WT-**.
23. Input **WT+**=10ºC (as at point 15).
24. In **Common data** with **F1 (⇩)**and. **F2 (⇧)** set the selection bar to **WKn+.**
25. Set **WKn+**=0,3 (as at point 15).
26. In **Common data** with **F1 (⇩)**and. **F2 (⇧)** set the selection bar to **WKn-.**
27. Set **WKn-**=0,3 (as at point 15).
28. Press key **F5 (Exit).** Now you are in **MENU W-prog** again.
29. In W-prog MENU with **F1 (⇩)** and **F2 (⇧)** move the selection bar to **Set values.**
30. Press key **F4 (Edit).** Now you are in **set value menu.**

Note: Program may consist of max 23 parts. One part consist of the length and the end value of temperature, characteristic number Kn for nitriding and control tracks which, at the beginning of this part, can be switched on and off.

Starting set value of one part is the last set value of the previous part.

If the control track has the value „1“, then it is switched on or if the control track has value „0“, it is switched off.

If you move the selection bar, with **F2 (⇩)** and **F3 (⇧)** , across the table above the edge of the display, then you will automatically go to the next display page.

The table with values for the above displayed program flow:

	Duration	Kn	°C	A B C D	X
0	0h 1m	29,0	430	0 0 0 0	0
1	0h 1m	5,0	620	0 0 0 0	1
2	7h 0m	5,0	620	0 0 0 0	1
3	0h 1m	5,0	20	0 0 0 0	1
4	0h 0m	0,0	0	0 0 0 0	1
5	0h 0m	0,0	0	0 0 0 0	1
6	0h 0m	0,0	0	0 0 0 0	1
7	0h 0m	0,0	0	0 0 0 0	1
8	0h 0m	0,0	0	0 0 0 0	0
9					

Note: The paths are freely available

Note: **Current value control**
Nitomat-Kn can, during the program running, control if the current measured values are in tolerance range which is entered in **Common data.** If the control track „X“ is switched on, in the last table column („1“), then the flow of the program time is stopped until the current values are not again in the defined tolerance range. At some processes this function is not desirable and can be avoided by turning off the control track („X“).

31. Press key **F4 (Edit).** Input the duration of the 0. part = 00h01m. (as at point 15)

32. Press key **F1 (⇨).** Now you are in field for input Kn number for 0. part.

33. Press key **F4 (Edit).** Input the Kn number for 0.part. Kn = 29,0 (as at point 15). Finish the input by pressing the key **F4 (Edit).**

34. Press key **F1 (⇨) .** You are now in the temperature edit field for 0. part.

35. Press key **F4 (Edit).** Input the temperature for 0. part ºC = 430. (as at point 15)

36. Press key **F1 (⇨)** twice. Now you are in the field for input the current value control for 0. part.

37. Press key **F4 (Edit).** Using the key **F5 (No)** answer the question if the current value control should be active. Nitromat-Kn automatically store „0“ in the last column.

38. Press key **F1 (⇨).** Press key **F2 (⇩).** Now you are in the field for input the 1. part duration.

39. Press key **F4 (Edit).** Input the duration for the 1. part = 00h01m (as at point 15)

40. Press key **F1 (⇨).** Now you are in field for input Kn number for 1. part.

41. Press key **F4 (Edit).** Input the Kn number for 1.part. Kn = 5,0 (as at point 15).

42. Press key **F1 (⇨).**You are now in the temperature edit field for 1. part.

43. Press key **F4 (Edit).** Input the temperature for 1. part ºC = 620. (as at point 15)

44. Press key **F1 (⇨).**You are now in the control track edit field for 1. part.

45. Press key **F4 (Edit). Cursor** (®) is now blinking at the control track A in 1. part.

46. Press **F3 (⇧).** The value of control track A is being switched to „1“ and the cursor is moving one place further.

Note: The control track values can be changed using arrow keys **F1 (⇨)** , **F2 (⇩)** and **F3 (⇧)** .as long as the cursor is blinking.

47. Press **F3 (⇧).**The value of control track B is being switched to „1“ and the cursor is moving one place further.

48. Press key **F4 (Enter).** The input for control track for 1. part is finished .

49. Press key **F1 (⇨)**. Now you are in the field for input the current value control for 1 part

50. Press key **F4 (Edit).** Using the key **F5 (Yes)** answer the question if the current value control should be active. Nitromat-Kn automatically store „1“ in the last column.

Note: Standard, in the last column, is entered “1“. Point 46 can be skipped if the change of current value is not needed.

51. Press key **F1 (⇨)** .

52. Press key **F2 (⇩).** Now you are in the field for input the 2. part duration.

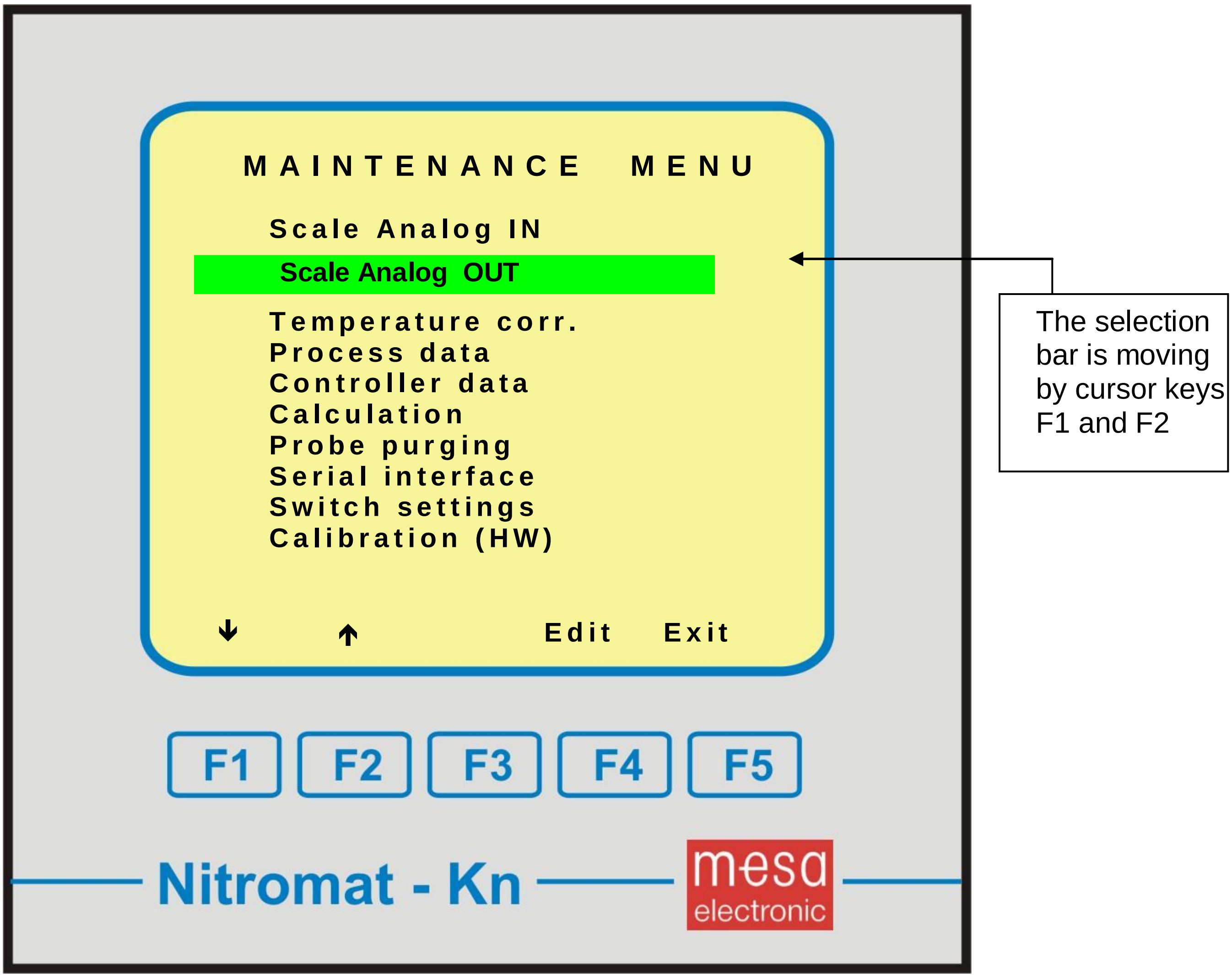
53. Repeat the points 31 to 48 for parts 2 and 3.

54. Press key **F5 (Exit) .** The current value program is now completely entered.

55. Press key **F5 (Exit) .** The current value program is stored in memory with program number.

56. Using key **F5 (Exit)** go back to the **MAIN MENU.**

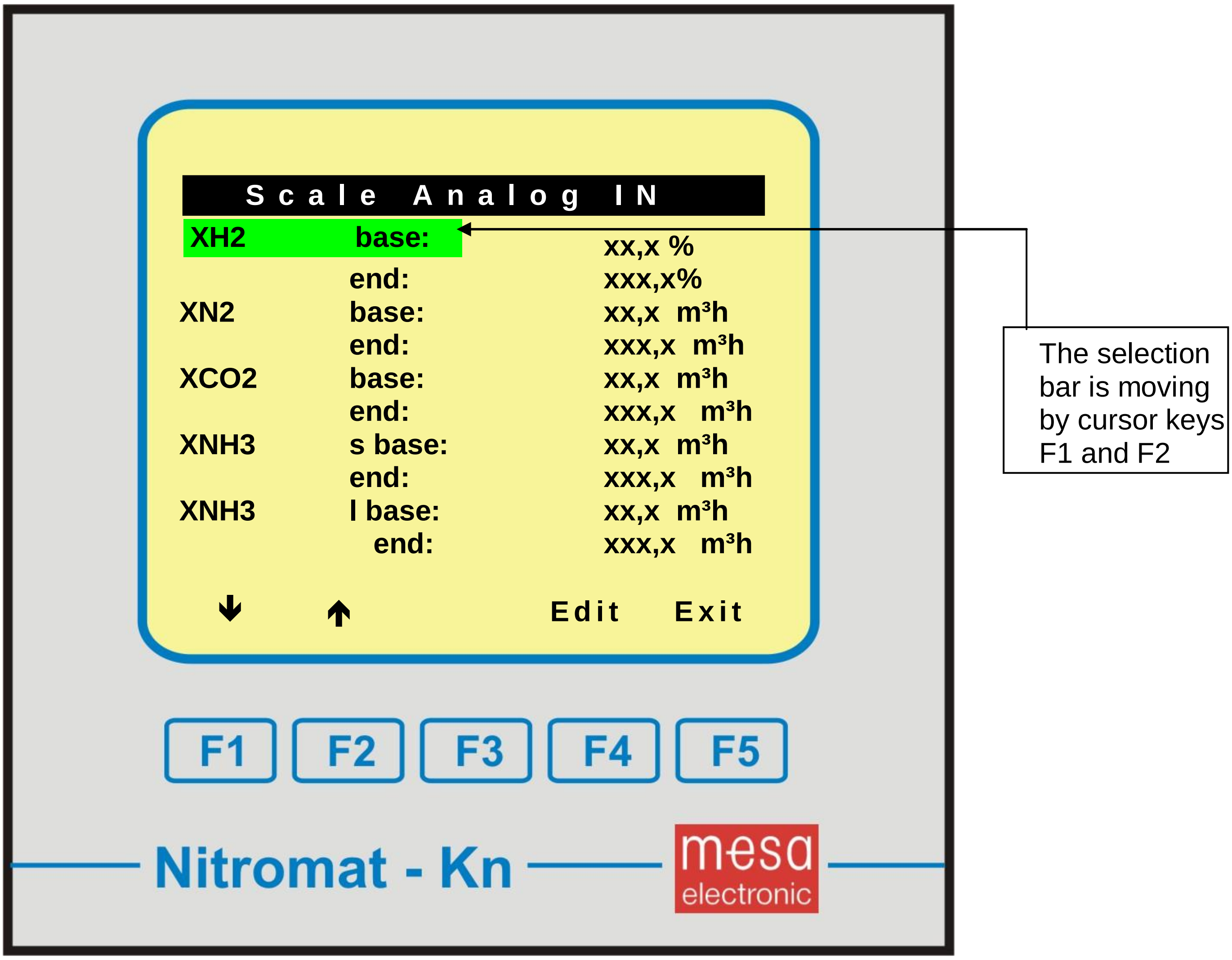
2.5 Service menu and it’s submenu



By pressing keys F1 and F2 you can move the selection bar to desired submenu points.
Pressing the key **F4 (Edit)** will activate the inversed represent submenu point.

Detailed sub-menu description:

3. Scale Analog IN



XH2 base: **Zero point of H_2 scale**
Setting range: 0,0...90,0 %

XH2 end: **End point of H_2-scale**
Setting range: 10,0...100,0 %

XN2 base : **Zero point of N_2 scale**
Setting range: 0,0...90,0 m³ / h

XN2 end: **End point of N_2-scale**
Setting range: 10,0...100,0 m³ / h

XCO2 base: **Zero point of CO_2 scale**
Setting range: 0,0...20,0 m³ / h

XCO2 end: **End point of CO_2-scale**

Setting range: 3,0...30,0 m^3 / h

XNH3 s base: **Zero point of NH_3 scale, small flow range**
Setting range: 0,00...9,00 m^3 / h

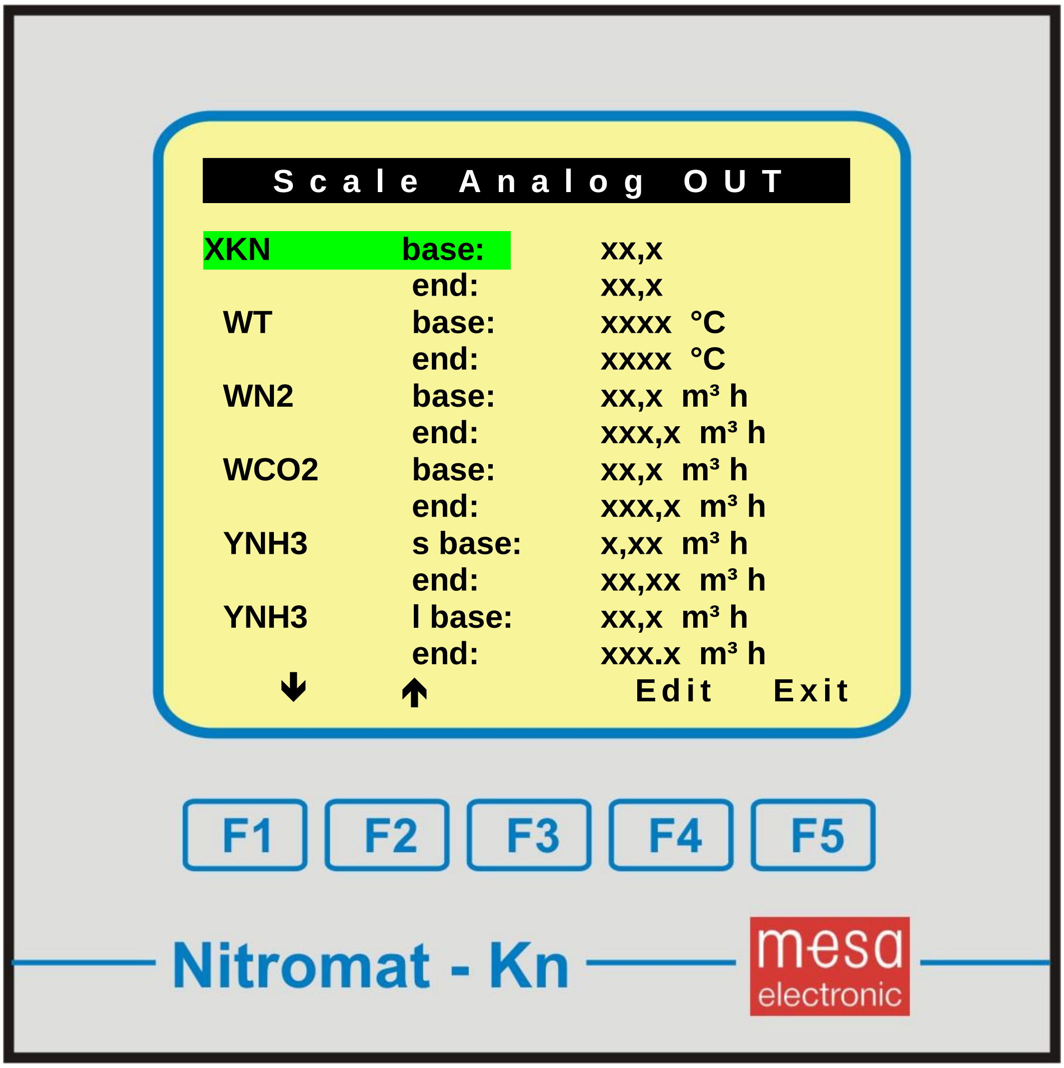
XNH3 small end: **End point of NH_3-scale, small flow range**
Setting range: 1,00...10,00 m^3 / h

XNH3 large start: **Zero point of NH_3 scale, large flow range**
Setting range: 0,0...90,0 m^3 / h

XNH3 large end: **End point of NH_3-scale, large flow range**
Setting range: 10,0...100,0 m^3 / h

The particular start and end values are used for adapting the Nitromat-Kn with different flow meters.

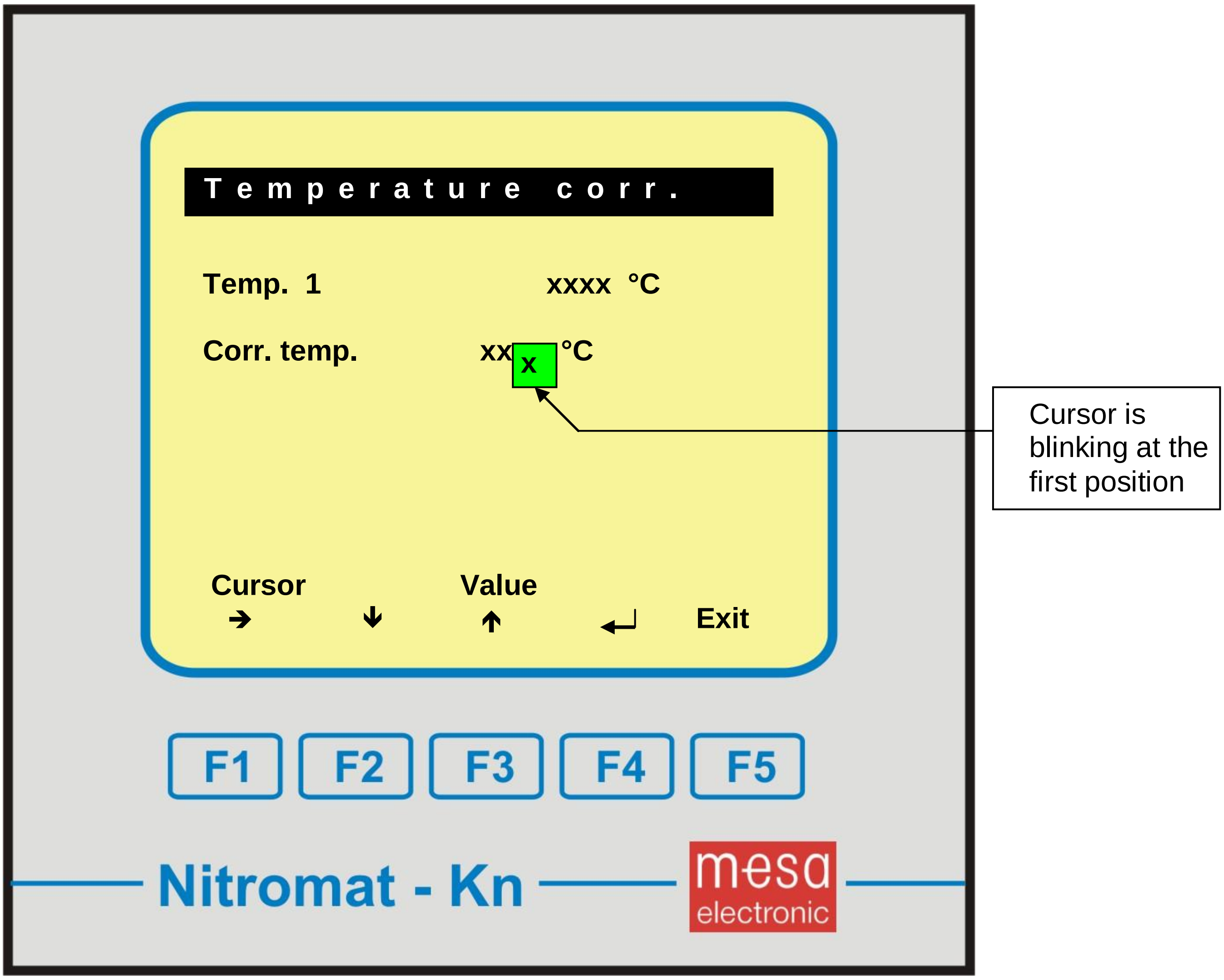
3.3 Scale Analog OUT



XKn base:	**Zero point for Kn calculation and analog output AOUT1** setting range: 0,0...40,0
XKn end:	**End value of the scale for Kn calculation and analog output AOUT1** Setting rage: 10,0...50,0
WT base:	**Zero point of scale for analog output AOUT2** Setting range: 0...900 °C
WT end:	**End value of scale for analog output AOUT2** Setting range: 100...1200 °C
WN2 base:	**Zero point of scale for analog output AOUT3** Setting range: 0,0...90,0 m³ / h
WN2 end:	**End value of scale for analog output AOUT3** Setting range: 10,0...100,0 m³ / h
WCO2 base:	**Zero point of scale for analog output AOUT4** Setting range: 0,0...27,0 m³ / h
WCO2 end:	**End value of scale for analog output AOUT4** Setting range: 3,0...30,0 m³ / h
YNH3 small base:	**Zero point of scale for analog output AOUT5 with using small NH_3 measuring range** Setting range: 0,00...9,00 m³ h
YNH3 small end:	**End value of scale for analog output AOUT5 with using small NH_3 measuring range** Setting range: 1,00...10,00 m³ / h
YNH3 large start:	**Zero point of scale for analog output AOUT5 with using large NH_3 measuring range** Setting range: 0,0...90,0 m³ / h
YNH3 large end:	**End value of scale for analog output AOUT5 with using small NH_3 measuring range** Setting range: 10,0...100,0 m³ / h

Under this points you can set the start and end values of analog outputs

3.2 Temperature correction



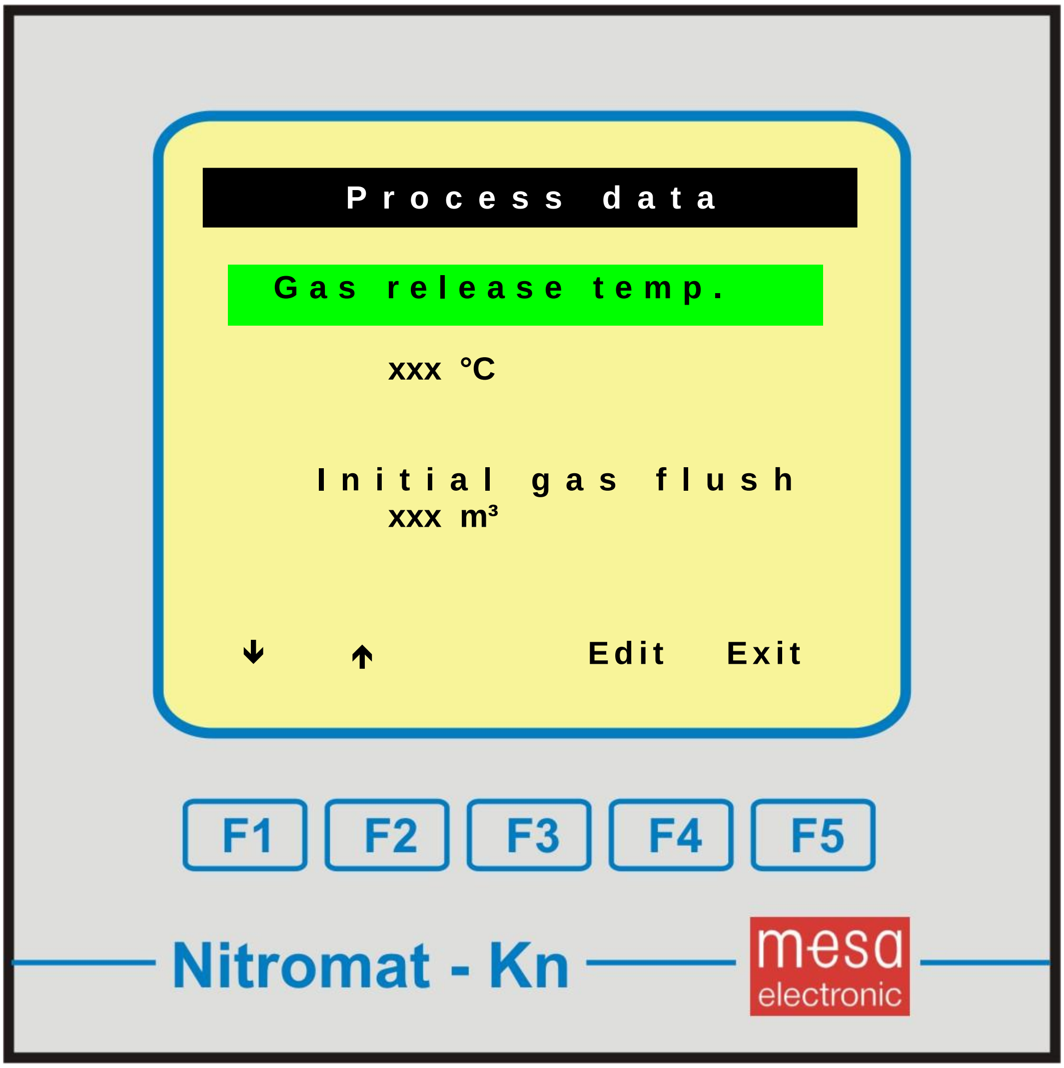
Temp1 **shows the current measured real temperature**

Corr. temp here is entered the correction temperature. If the temperature is corrected earlier, here stands the corrected temperature**.** Possible correction range: ± 100 °C

Using the key **F1 ➔** cursor can be placed at the desired point of the correction temperature. The numerical values under the blinking cursor can be increased and decreased using the keys **F2 🡻** and **F3 🡹**. The corrected value is being accepted by pressing the key F4 ↵ .

At the current value display 1 (see page 8) under XT is shown the corrected temperature and Nitromat-Kn is count on that.

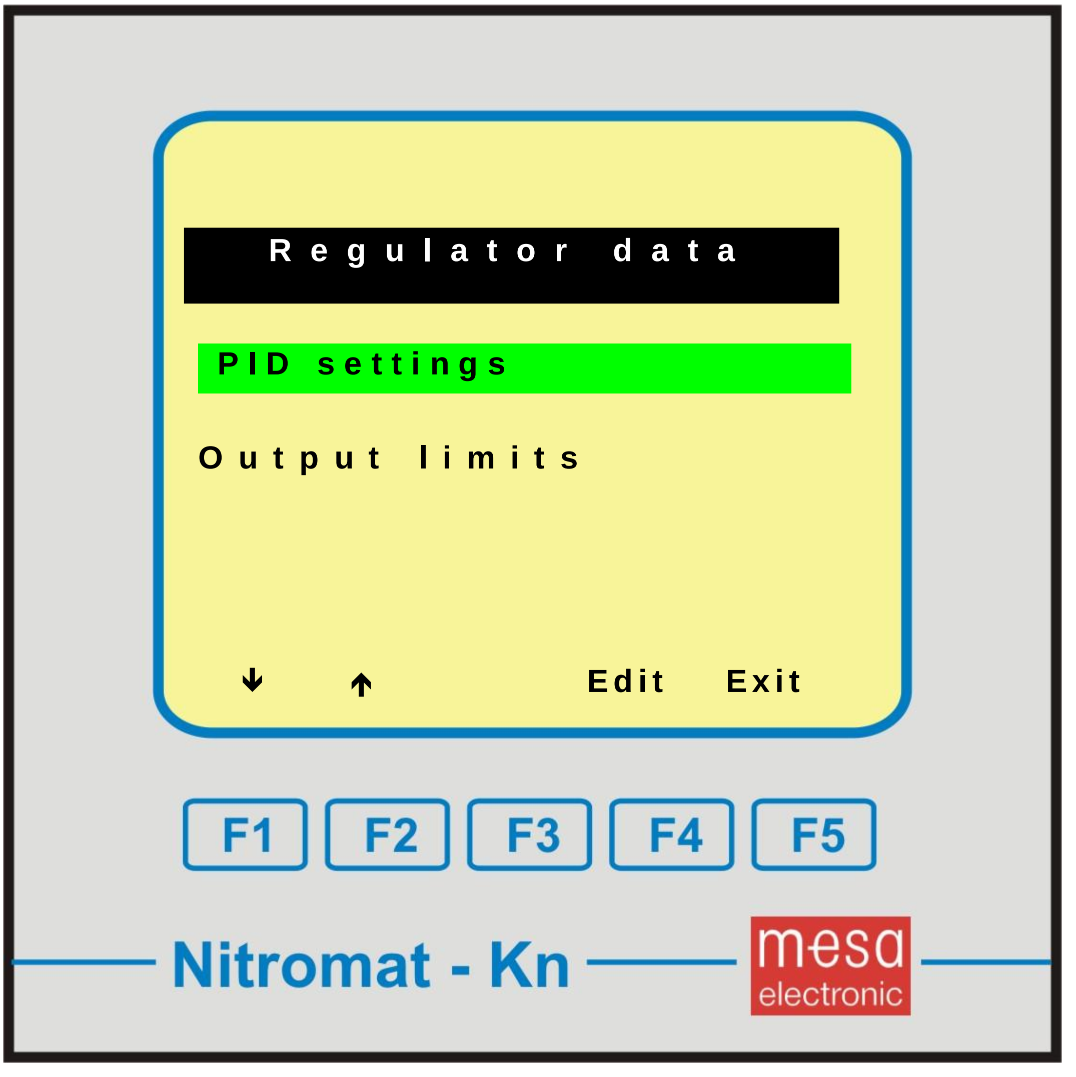
3.3 Process data



Gas release temp: Gas treatment is being performed from this furnace temperature. Besides, the set N2 and CO2 gas quantities and the Y value are held at 0.
Setting range: 390...1100 °C

Initial gas flush: Gas quantity which after starting the program must enter into furnace to make the atmosphere, thus the regulation. The initial gas treatment follows after the program step for temperature regulation and ends when the overall measurement of gas meter reach the value already set here.
The initial gas flush do not works with fix set value (Fix-W1 – Fix-W5)

3.4 Regulator data

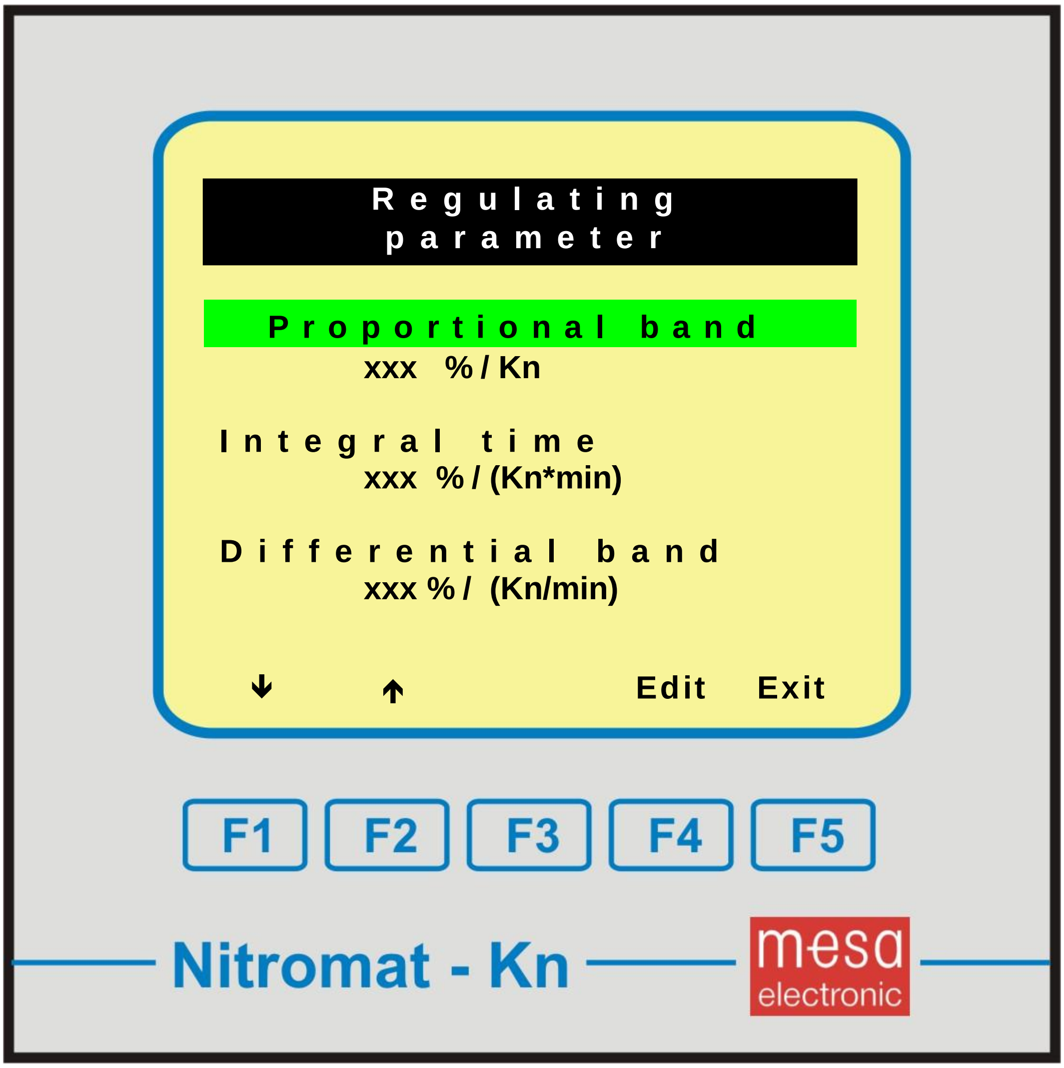


Regulator data: The menu point has subpoints:

- PID settings
- Outputlimits

In sub-point **PID settings** are held the regulator PID parameters

3.4.1 Regulating parameters



Proportional band: Proportional part of correcting value Y. Only the deviation between the current and the set value is important.

Example: It is set 400% / Kn. With deviation of 0,2 Kn between the current and the set value results:

$$Y_P = 400\% / Kn * 0{,}2\ Kn = 80\ \%$$

Input range: 0...999 % / Kn

Integral time: The integral part of correcting value Y. For I-part value it is important the time duration of deviation. As long the deviation last as high the I –part is.

Example: It is set 100% / (Kn * min). With deviation of 0,1 Kn, which last for 5 min, results:

Y_I = 100% / (Kn * min) * 0,1 Kn * 5 min = 50 %

Input range: 0...999 % / (Kn * min)

Differential band: Differential part of correcting value Y. For D-part is important the speed of change. The rising current value gives negative D-part while the falling current value gives positive D-part

Example: It is set 25%/(Kn/min). From the last but one to the last measuring the characteristic number has bee increased by 1Kn.

Then, the D-part is:

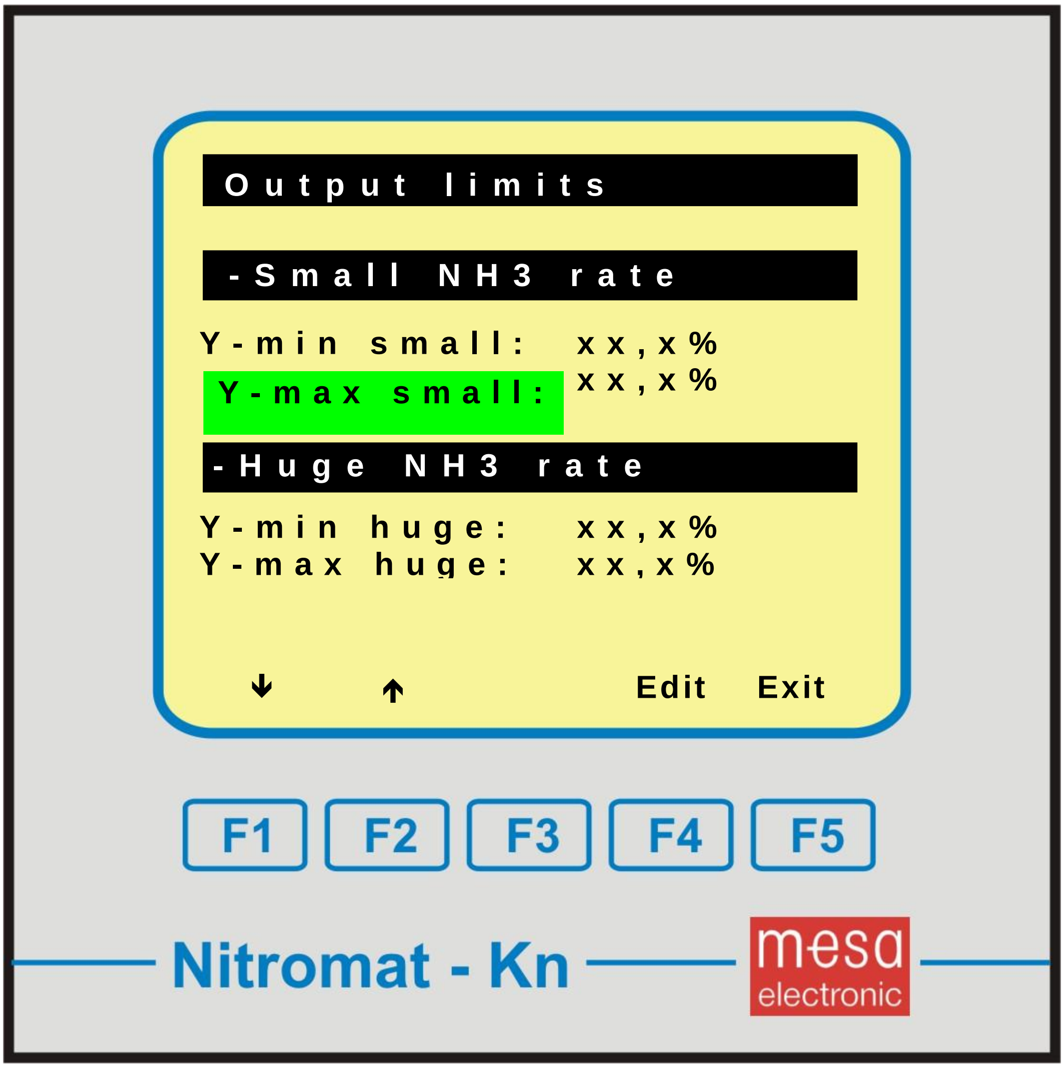
Y_D= -(1Kn/min * 25%/(Kn*min)) = -25 %

Input range: 0...999 % / (Kn / min)

The overall correcting value is being calculated upon three separated values:

$Y = Y_P + Y_I + Y_D$

3.4.2 Output limits



Y-min small:	minimal limit reach of output value when small NH_3 flow is used Setting range: 0,0...50,0 %
Y-max small:	max limit reach of output value when small NH_3 flow is used Setting range: 40,0...100,0 %
Y-min huge:	minimal limit reach of output value when huge NH_3 flow is used Setting range: 0,0...50,0 %
Y-max huge:	max limit reach of output value when huge NH_3 flow is used Setting range: 40,0...100,0 %

3.5 Calculation

Parameters in this submenu ***should not be changed.***

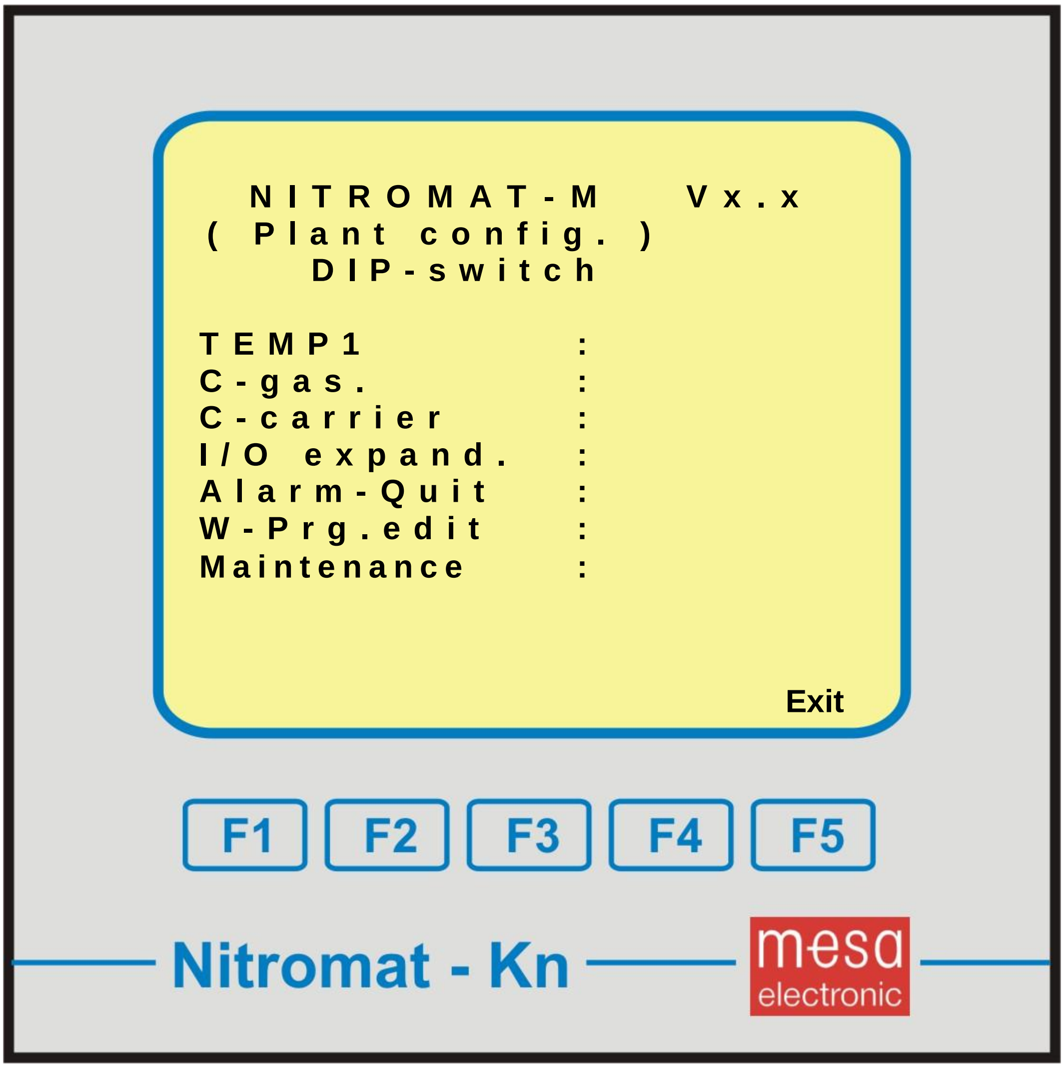
3.6 Probe purging

Parameters in this menu point ***do not*** have any function. ***Do not make any changes.***

3.7 Serial interface

In this submenu parameters can not be changed. Serial interface is not planned.

3.8 DIP-switches



In this menu you can check settings of DIP-switch placed at the back of the controller. The following display can appear (depending of switch positions).

When the switch is	In position	appears	The display
DIP 11	ON	TEMP1	PTRH-Pt
DIP 11	OFF	TEMP1	NiCr-Ni
DIP 12	ON	C-gas path	YES
DIP 12	OFF	C- gas path	NO
DIP 13	ON	C-carrier	Endogas
DIP 13	OFF	C- carrier	CO_2
DIP 15	ON	I / O expand.	YES
DIP 15	OFF	I / O expand.	NO
DIP 16	ON	Alarm-Quit	automat.
DIP 16	OFF	Alarm confirmation	manual
DIP 17	ON	W-Prg.edit	locked
DIP 17	OFF	W-Prg.edit	permitted
DIP 18	ON	maintenance	locked
DIP 18	OFF	maintenance	permitted

Take note: Generally all DIP-switches which are not used , must be in OFF position
IF I/O expansion do not exist then DIP switch 15 must be in OFF position.

In the first line of this manual the software version number can be found.

3.9 Calibration (HW)

In this menu point are located the calibrating data for inputs and outputs. The data can not be changed.

4. Alarms and warnings

Nitromat-Kn makes difference between the alarm and the warring.
Alarms represent hard disturbances so the device functioning is not guaranteed anymore. i.e. as alarm will be treated:

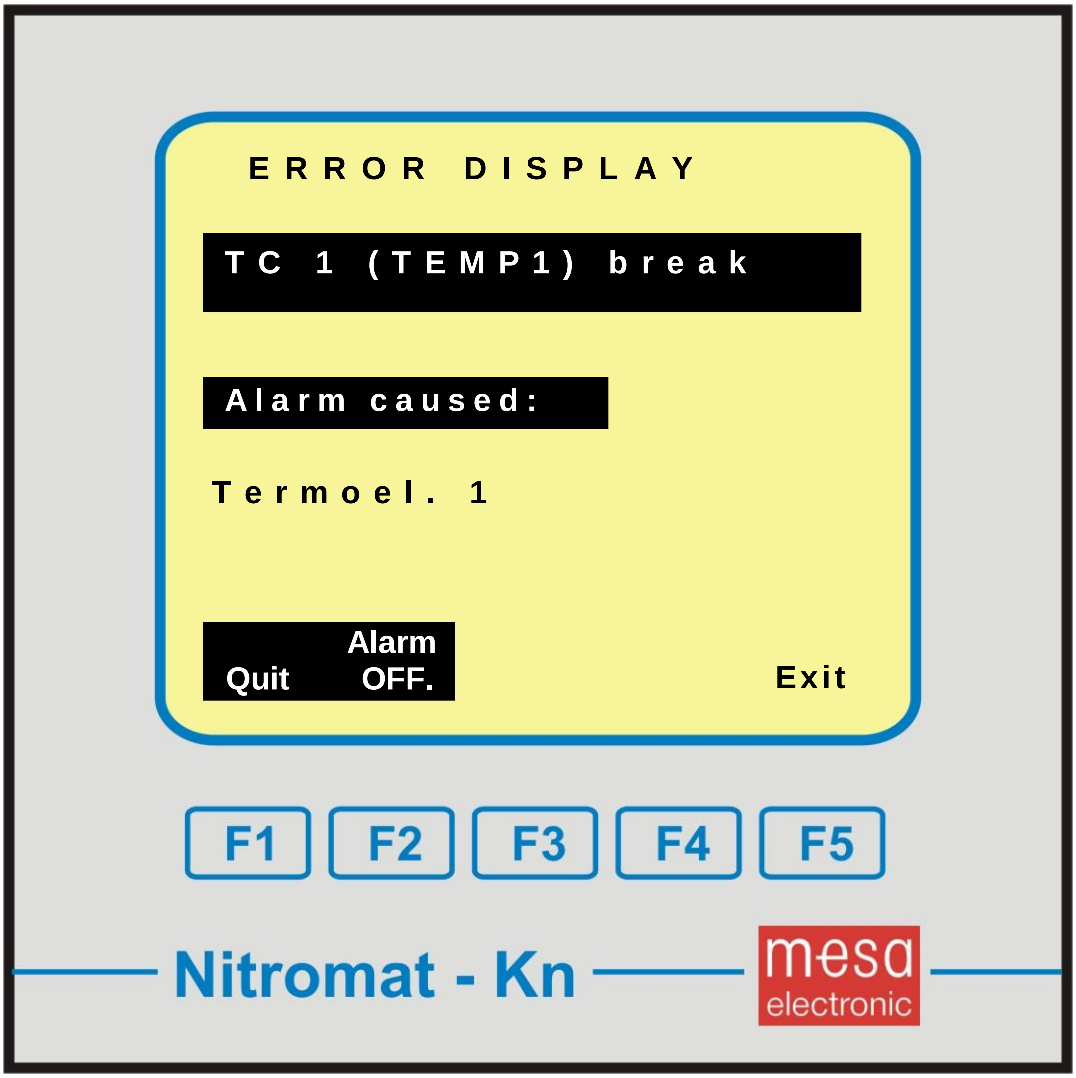
- Thermocouple damage

When the alarm is activated, from the safety reasons, all the regulating devices (valves) are being closed.

Warnings are not representing dangerous deviations from normal working conditions. i.e. power failure.

Warnings and alarms are appearing in adequate windows as part of current display 1 and 2. They are also memorized in error menu. This menu can be reached, through current value display, by pressing the key **Err** (see page 8 and page 10).
Confirmation of warnings and errors is being done manually (DIP-switch S16 OFF) or automatically (DIP switch S16 ON).

4.1 Error menu example



The errors are shown between heading and message „Alarm used“. Under the message „alarm used“ you can find a info about the error which caused the alarm activation.
Key **F2 Alarm Off** is resetting the alarm for control track (see page 17) causing switching off of the alarm indicators (horn, blinking light). Reports about error on the page are being stored.
With key **F1 Quit** you can erase error reports and reset alarm for control track.
With key **F5 Exit** you will go back to the display where you pressed ERR-key.
If DIP switch 1-6 is set to ON (automatic alarm confirmation) then the error report is being automatically erased after error elimination.

5. Nitromat-Kn outputs

5.1 Nitromat-Kn digital outputs

Nitromat-Kn has in total 2 digital outputs (open collector type). In order to be able to use them you will need external 24VDC power supply. Output connection can be found in appendix C.

Detailed output description:

- Probe purging	not used in Nitromat-Kn
- Gas treatment activation	In menu point for gas treatment activation (see Service menu, page 17), if the set temperature is overflowed then the output is being turned off.
- Control track D	Carburizing ON, in common data (see page 16) and in control tracks (see page 17) the switching on and off is performed.
- Control track E	decision if the large or small flow quantity will be used. Can be set based only on common program data.
- Current value program is running	Output is switched on as soon as the current value program is activated and the start temperature is reached.
- Alarm	is turned on if fatal error occurs (i.e. thermocouple damage)
- Control track C	Control track can be set from the control track column (see page 17) Control track **is not being temperature controlled** meaning that it can be involved into activating temperature. Thus, **external blocking can be necessary.**
Current value in tolerance range	the output is being switched on as soon as the variation between the set and the current value is in set tolerance range. At the current value display 1 (page 8) the working status is displayed regulation normal ->.
- Control track A	see control track C
- Control track B	see control track C

5.2 Analog outputs of Nitromat-Kn

Nitormat-M has 5 analog outputs. Each of them is emitting current 4...20mA with max resistance 500ohm.
Output scaling can be done in menu point Scale Analog out in service menu (page 17).

Detailed output description:

output	emitting	terminal +	terminal -
AOUT1	Characteristic Nitriding number	27	9
AOUT2	Set temperature	26	9
AOUT3	Set N_2 value	20	9
AOUT4	set CO_2 value	12	9
AOUT5	Correction value Y	11	9

6. Inputs of Nitromat-Kn

6.1 Digital inputs of Nitromat-Kn

Nitromat M has 3 digital inputs . You need external 24VDC power supply with min current of 20mA to be able to use the inputs.

Switching statuses are: OFF. = 0V
ON. = 12V – 24V

Detailed input description:

- **Program stop** — If this input is ON , the current value program will be stopped and the regulation will continue to perform based on current set value.

- **Further program switching ON** — ON impulse with min 3sec and max 10 sec duration ends current program step.
Switching to the next program step is performed or, if there is no next step, the program ends.

  1) ON impulse in 2minutes duration end the program completely and restarts it.
  2) There must be a break between two On impulses in min 10sec duration

  The input does not work until current value program is not started.

- **Input blocked** — If this input is ON then the data in current value and in service menu can not be changed

6.2 Analog inputs of Nitromat-Kn

Nitormat M has 6 analog inputs. 4 are provided for current 4...20mA, one for thermocouple and one for thermistor.

input	attached signal	Possible measuring range	terminal +	terminal -
TE 1	thermocouple	0...1200°C type S or K	1	2
Vst	junction	-10...99°C	3	4
H_2	H_2 analyst	4...20 mA 0...100 %	5	6
N_2	N_2 flow meter	4...20 mA 0...100 Nm³/h	7	8
CO_2	CO_2 flow meter	4...20 mA 0...30 Nm³/h	21	25
NH_3	NH_3 flow meter	4...20 mA Large measuring range: 0...100 Nm³/h Small measuring range: 0...10 Nm³/h	23	24

Current inputs resistance is 50ohm.
For junction temperature input an PT-100 resistor is needed.

Appendix A: Using the DIP switches

In the following list you can find info about setting the switches

Note:
After changing the DIP switch position, the device must be restarted so the new settings could take effect. The device must be switched off and on and in main menu new start option should be selected.
Note:
DIP switch setting could be checked in menu point **Maintenance** under subpoint DIP switches.

The following switches can be set:

S1:

Thermocouple1	S11
PTRH-PT (type S)	ON
NICR-NI (type K)	OFF

Gas line for C-carrier exist	S12
exist	ON
do not exist	OFF

C-carrier	S13
Endogas	ON
CO_2	OFF

I / O expansion	S15
exist	ON
do not exist	OFF

Alarm confirmation	S16
automatically	ON
manually	OFF

W-program edit blocking	S17
blocking on	ON
blocking off	OFF

Service menu edit blocking	S18
blocking on	ON
blocking off	OFF

All other switches should be set to OFF.

Appendix B: Connector terminal marking

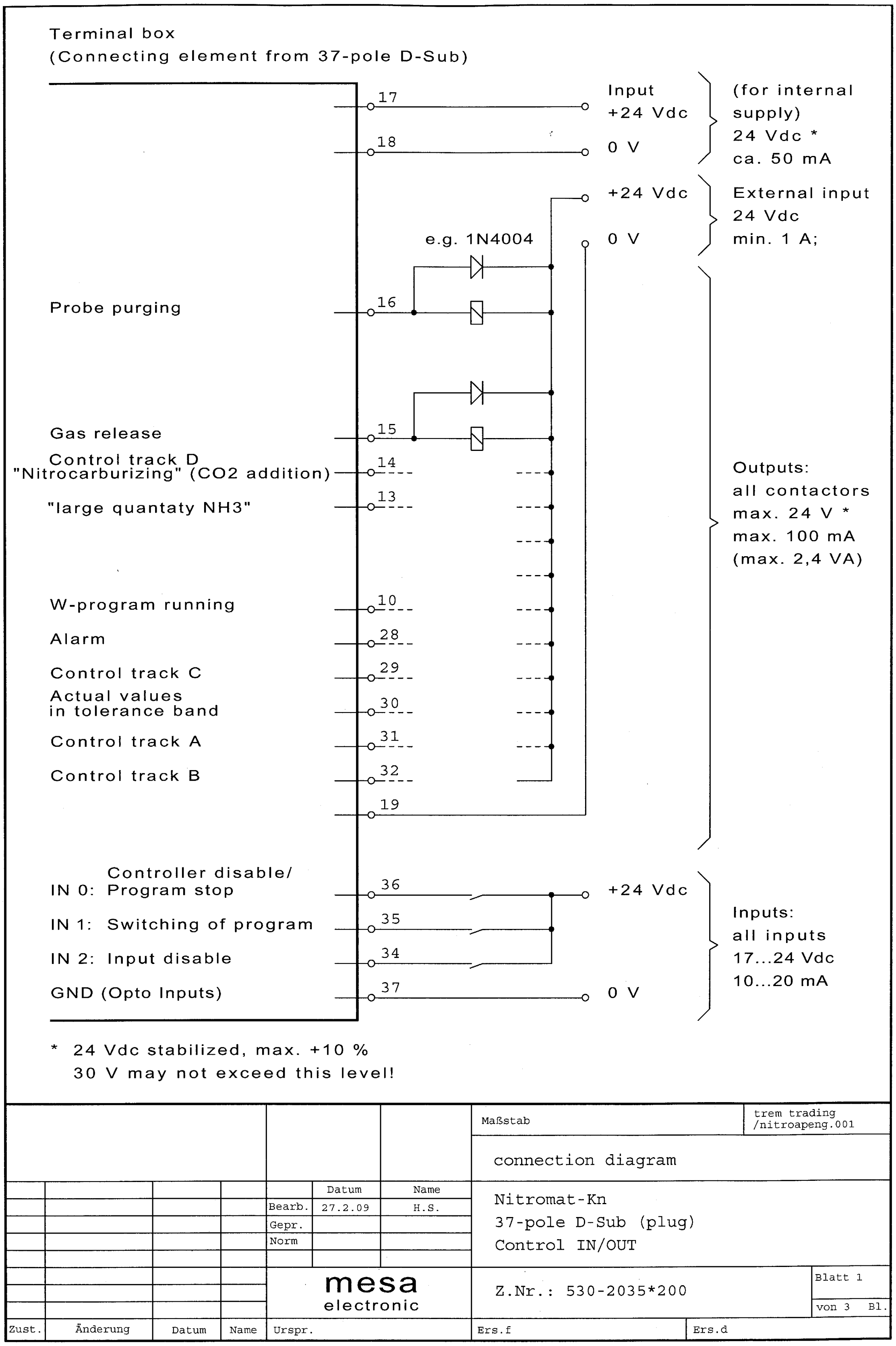
Connector: 37-pole Sub D-connector (male) with self-clinching fixing system

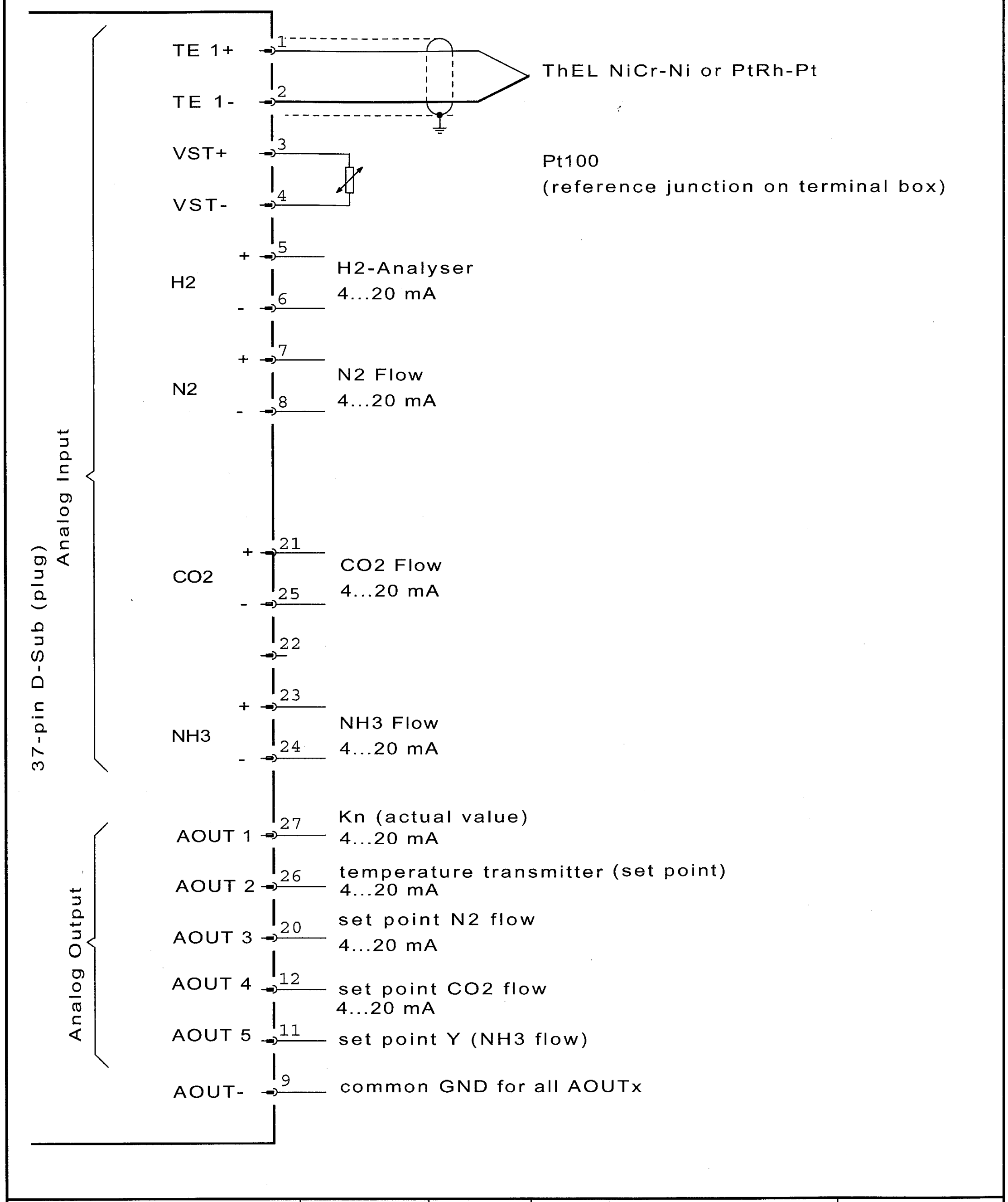
Cover:Cover (Sub D connectors metal shield) is connected with back plate of Nitromat-Kn and providing connection with grounding wire

Galvanic decoupling:

Digital inputs (Optocoupler inputs)
Digital outputs (Open collector outputs)
Analog inputs (TE1, TE2, Vst, H2, PG) i
Analog outputs (DA1, DA2) are galvanic decoupled of each other
Beside that, the inputs TE1, TE2, H2, PG have high resistance between each otter of > 50 Mohm
Input Vst is not separated from the other inputs

Appendix C: Nitromat-Kn connector position





Maßstab

trem trading
itroAPeng.0002

connection diagram

	Datum	Name
Bearb.	27.2.09	H.S.
Gepr.		
Norm		

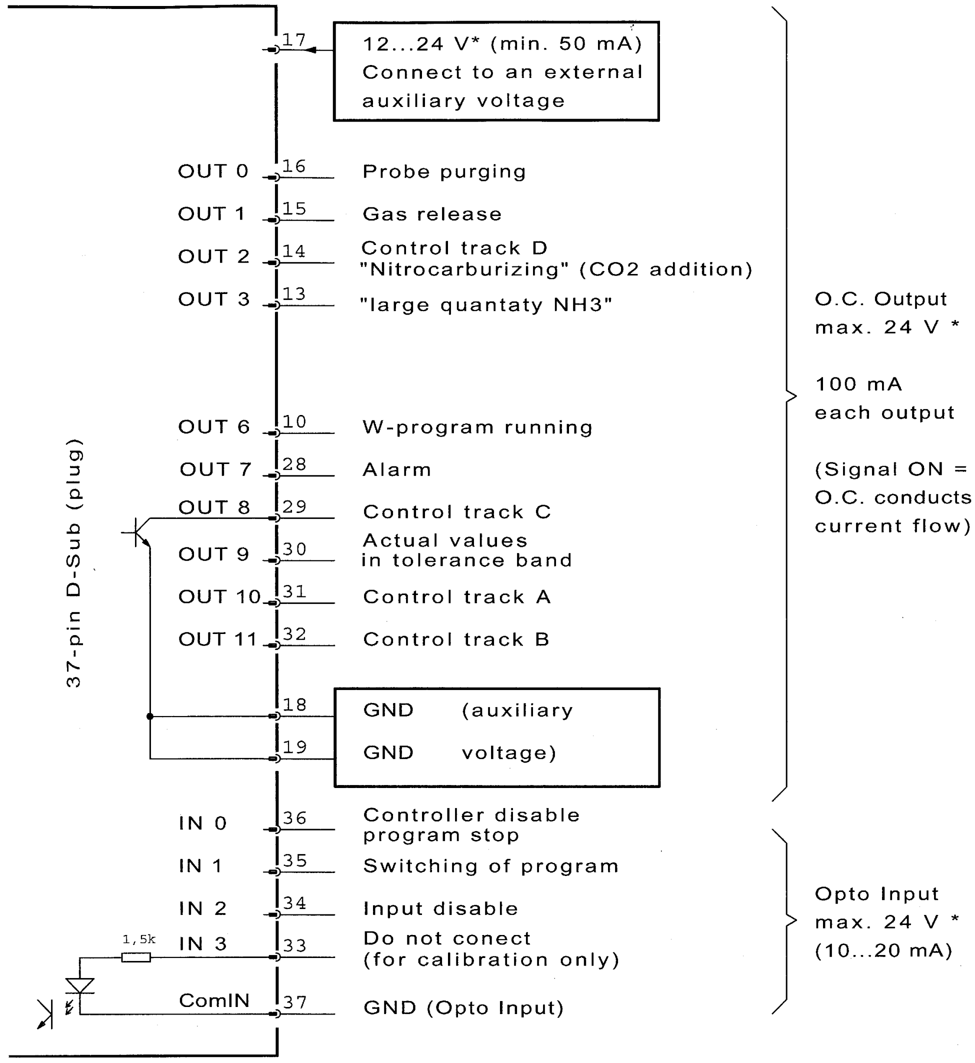
Nitromat-Kn
37-pin D-Sub (plug)
Control IN/OUT

mesa
electronic

Z.Nr.: 530-2035*200

Blatt 2
von 3 Bl.

Zust.	Änderung	Datum	Name	Urspr.	Ers.f	Ers.d



* 24 Vdc stabilized, max. +10 %
30 V dürfen may not exceed this level!

	Datum	Name
Bearb.	27.2.09	H.S.
Gepr.		
Norm		

Maßstab

trem trading itroAPeng.003

connection diagram

Nitromat-Kn
37-pin D-Sub (plug)
Control IN/OUT

mesa electronic

Z.Nr.: 530-2035*200

Blatt 3 von 3 Bl.

Zust.	Änderung	Datum	Name	Urspr.	Ers.f	Ers.d

```
        ---------ERROR text--------
F0::    DB  ´NITROMAT  malfunction(SW)    ´.0
F1::    DB  ´tc (TEMP1) break             ´.0
F2::    DB  ´junction error               ´.0
F3::    DB  ´H2-analys. overflow          ´.0
F4::    DB  ´N2-probe overflow            ´.0
F6::    DB  ´NH3-probe overflow           ´.0
F8::    DB  ´Error F8                     ´.0
F9::    DB  ´ Error F9                    ´.0
F10::   DB  ´Kn-calc. error               ´.0
F11::   DB  ´Error F11                    ´.0

        ---------WARNINGS----------
F128::  DB  ´Calibrating data missing     ´.0
F129::  DB  ´Control param. Miussing      ´.0
F130::  DB  ´ Set v. progr. Missing       ´.0
F131::  DB  ´Fixed set val. Missg.        ´.0
F132::  DB  ´set v. ext. input missing    ´.0
F133::  DB  ´ set v. ext. error           ´.0
F134::  DB  ´junction error               ´.0
F135::  DB  ´set v. remote error          ´.0
F140::  DB  ´  >"0"  ´.0     ;DA-calibr.
F141::  DB  ´  <Max  ´.0     ;DA-calibr.
F142::  DB  ´  no"0"´.0      ;DA-zero value F.
F143::  DB  ´no  full´.0     ;DA-end value.F.
F144::  DB  ´>count  ´.0     ;DA-setting cycle
F163::  DB  ´dev.Temp1-Temp2  HL´.0
F166::  DB  ´>>>>POWER FAILED<<<<´.0
```