Protronic P.

Process controller Protronic

Configuration description

42/62-63 EN

Rev. 03

Contents

1 Introduction

This Manual applies to the units

Protronic PA, PE and PS[1]).

No programming knowledge is necessary to create special configurations.

The user of this Manual must be familiar with the instrument-specific Operating Manuals. It uses the abbreviations for switches and variables described in the Manuals mentioned.

The following Operating Manuals are available:

Standard controller Protronic PE	42/62 – 60 – ...[2])
Universal controller Protronic PS	42/62 – 61 – ...[2])
Indicator Protronic PA	42/62 – 62 – ...[2])
Serial Interface	42/62 – 64 – ...[2])
Configurator	42/62 – 65 – ...[2])

Knowledge of hexadecimal numbers ("hex" in following text) and their rules of addition is only necessary if configuration is carried out without a configurator and without a PC with the configuration program PROKON.

Decimal	Hexadec.	Decimal	Hexadec.
00	00H	08	08H
01	01H	09	09H
02	02H	10	0AH
03	03H	11	0BH
04	04H	12	0CH
05	05H	13	0DH
06	06H	14	0EH
07	07H	15	0FH

Table 1.

Examples of addition:

05H + 06H = 0BH (5 + 6 = 11)
0AH + OFH = 19H (10 + 15 = 25 = 1 · 16 + 9)

2 Memory organization

2.1 ROM

A part of the programming of the unit is stored in the mask-programmed 8051 microprocessor. In place of this processor, type 8031 with separate EPROM (IC 13) can also be used. The programming in this area is not alterable.

2.2 EPROM

The EPROM (IC 15) contains among other things the programs for the controller's various function packages (continuous controller, step action controller, cascade ...). Depending on the desired function of the unit, a part is copied from this EPROM to the working memory (RAM) by RCL PROGM = Recall Program or by a RESET.

Modification of this EPROM to customer requirements is not provided.

[1]) With software status
PS from 48/85
PE from 42/85
PA from 42/85
In the PS with older software, there are small differences in the configuration.

[2]) Editor designation

The following software variations have been supplied up till now:

Available as from	Version	Index to IC 15
Controller PS		
16.85	1.0	A
34.85	2.0	B
37.85	2.1	C
42.85	2.2	D
45.85	2.3	E
07.86	2.4	F
35.86	2.6	H
11.87	2.7	I
25.87	2.8	K
20.88	2.9	L
45.88	2.A	A
Controller PE		
42.85	1.0	A
48.85	1.1	B
07.86	1.2	C
28.86	1.3	D
11.87	1.4	E
20.88	1.5	F

2.3 Supplementary EEPROM

A supplementary EEPROM that can also be retrofitted to the universal controller Protronic PS permits storage of set parameters (Xp,Tn...) and also of special configurations.

Memory addresses:

Area A: C 480 H ... C 7 FFH
Area B: C 000 H ... C 3 FFH

2.4 RAM

The units contain two RAM memories. A smaller memory is located in the microprocessor. In this are stored among other things the results of logical operations on the binary variables. This RAM is not supplied by the built in buffer battery. A copy of this memory is therefore continuously kept in the large RAM memory.

The function of the unit is determined by the data stored in the large battery-backed RAM. These data may arrive in the RAM in different ways and originate from different sources:

Table 2.1

Data source	Load by	Function selection
EPROM (IC 15)	RCL PROGM or RESET	Data in RAM 87 DA to 87DC
EEPROM	RCL PROGM or RESET	Switch setting S1 priority code
Tape	LOAD CAS	Search on the tape
Configurator/PC	Transmit from configurator/PC	Entry in the configurator
Direct configuration of the units by operating the keys on the front panel		

The configuration entered in RAM by one of the named methods can be secured against change by write protection.

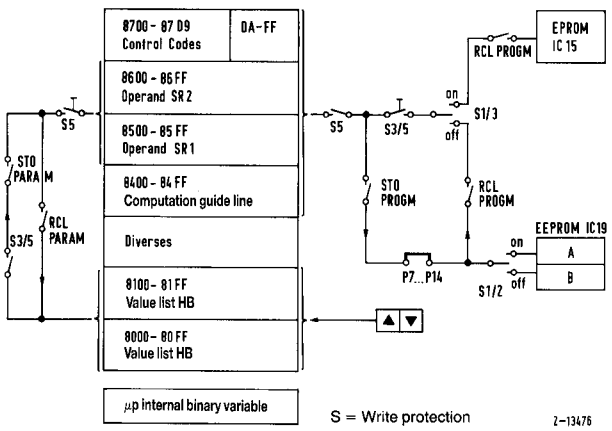


Fig. 2.1 Memory structure

The RAM is organized as follows:

Data type		Address		
			Configurator	
		Protronic	Working memory	Back-up memory
Values	Low byte LB	8000 to 80FF	C000 to C0FF	E000 to E0FF
	High byte HB	8100 to 81FF	C100 to C1FF	E100 to E1FF
Special data	Copy of µP RAM	8200 827F	C200 C27F	E200 E270
		8280 to 83FF	C280 to C3FF	E280 to E3FF[1])
Configuration data	Op codes	8400 to 84FF	C400 to C4FF	E400 to E4FF
	operand 1 (low)	8500 to 85FF	C500 to C5FF	E500 to E5FF
	operand 2 (high)	8600 to 86FF	C600 to C6FF	E600 to E6FF
Control code		8700 to 87DF	C700 to C7DF	E700 to E7DF
	Unit addr. calibration data	87E0 to 87FF	C7E0 to C7FF	E7E0 to E7FF

[1]) E31C to E35A contain the binary variables of the internal RAM

Table 2.2

The value lists are stored in areas 8000H to 81FFH. From this area the processor takes the values required for the respective calculation. Values enabled for adjustment (e.g. XP,TN...) can be changed via the controller keyboard.

In area 8200H to 83FFH are stored many different data items that do not normally have to be taken into account for configuration. Section 9 contains an overview of this area.

In area 8400H to 86FFH are entered the calculation specifications for determining analog values and logical results.

Area 8700H to 87FFH describes the functions that cannot be defined with a calculation specification. Here is specified e.g. which values are shown in the digital display or which letters are displayed next to the keys.

When the unit is loaded from the internal EPROM (IC 15) or the EEPROM or from a cassette unit, only areas 8400H to 87FFH are written to. The values defined in the configuration e.g. with FLX (default values) must therefore be copied to the value list with RCL PARAM = Recall Parameter so that they can be taken into account by the processor in the calculation. Otherwise the values that happen to be in RAM will be used for the calculation.

Conversely, only data from area 8400H to 87FFH can be stored in the EEPROM or on a disc. If values from the value list are to be stored at the same time as default values, before besing stored they must be copied to area 8500H to 86FFH with STO PARAM = Store Parameter. This option of storing values is restricted to the variables defined with op codes FLX, PT. and PW. (see Section 7).

3 Structure of commands

(Area 8400 to 86FF)

3.1 General

A brief description of all the commands and their syntax is listed in Annex 1 of this Manual. A full description of each command is given in Section 7.

3.2 Command types

In the Protronic P there are two different command codes (operation codes = op codes):

a) Transfer commands that compute an output variable from an input variable.

Fig. 3.1 Root extraction

b) Calculation commands that compute a new output variable from two input variables.

Fig. 3.2 Addition

Command NOP = "no command" has a special position. It is used when a variable is to remain undefined.

A different classification of the op codes results if they are distinguished by computing operation

a) Op codes for logical operations on analog values
   e.g. root extraction = transfer command
   addition = calculation command
b) Op codes for logical operations on binary values
   e.g. inversion = transfer command
   exclusive OR = calculation command
c) Op codes for logical operations on analog and binary values
   e.g. switch
d) Comparators that compute a binary value from two analog variables
e) Commands that define a value

The same syntax is used for all commands.

Result: (=) Command, input 1, input 2

This line is abbreviated as follows

RES : Op Code, SR1, SR2

or in the notation of the configurator:

```
RES :  OPC , SR1 , SR2
```

Here SR stands for source = input
OPC for op code

The transfer commands only require SR1 to be specified. If a variable is also entered in the SR2 position, this is ignored by the transfer commands.

Examples:

Command "DIR"

Fig. 3.3

The command assigns DIRectly to a RESult the value of an input variable.

```
X   :  DIR , /E1 , 000
```

/E1 = Input 1
000 = Free

This line could also read:

```
X   :  DIR , /E1 , /E2
```

/E2 = Input 2 is disregarded

Command "ADD"

Fig. 3.4

This command adds the two input values and assigns the result to an output variable:

```
X   :  ADD , /E1 , /E2
```

X is the sum of input 1 and input 2.

Command "ANI"

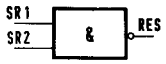


Fig. 3.5

This command performs a logical "AND" operation on binary inputs 1 and 2 according to the rules of Boolean algebra and inverts the output.

```
Q01 :  ANI , D01 , D02
```

D01 = Binary input 1
D02 = Binary input 2
Q01 = Binary input 2

Command "SIH"

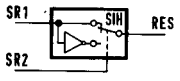


Fig. 3.6

This command assigns the value of input 1 to the result (output of the function block). If D01 goes to "1", the inverted value of input 1 is assigned to the result.

```
K1  :  SIH , K2  , D01
```

K1 and K2 are interim variables.

3.3 Structure of command seqquences

The result of a calculation or transfer operation can be used any number of times as the input for other transfer or calculation operations.

By linking several commands it is possible to carry out complicated, comprehensive computations. All op codes can be used more than once. The only restriction arises from the available number of variables = lines.

The following schematic applies:

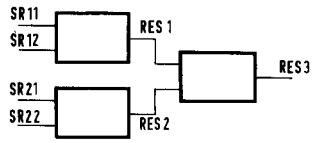


Fig. 3.7

RES1 : Op1, SR11,SR12
RES2 : Op2, SR21,SR22
RES3 : Op3, RES1,RES2

Here is an example of this:

The difference (control deviation) is to be formed from the value of input 1 = actual value X and the value of input 2 = set point W. First the input values of E1 and E2 must be assigned to variables X and W.
The difference is then formed.

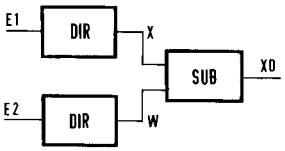


Fig. 3.8

```
X    :  DIR , /E1 , 00
W    :  DIR , /E2 , 00
Xd   :  SUB , X   , W
```

With SUB, X and W must be in the correct sequence.

4 Notes on constructing special configurations

4.1 Problem definition

From the process there emerges a problem which is to be solved with the Protronic controller. The most important step in solving the problem is a precise description of all requirements and conditions. The final measuring ranges of all primary detectors can usually be incorporated into the problem definition at a fairly late stage.

Nearly all problem definitions can be regarded as a modification of an existing configuration. The special configuration is thus limited to the part to be modified, the rest of the configuration remaining unchanged.

The hook-up lists in Section 10 and the associated graphic representation in Section 11 facilitate location of the interfaces.

4.2 Range of values

It is necessary to ensure in the configuration that the permitted range of values lies between −199.9% and +199.9%. If values outside these limits are produced in the computation, the maximum possible value is identified as the result and used in any further computations.

All calculation functions must therefore be checked at the time of configuration to see whether impermissible values are produced at the range limits from the combination of two variables.

Example:
Two inputs are to be added, subtracted, multiplied or divided. Both inputs have a range of 0...100%.

In the addition, subtraction and multiplication of two values the result is always in the range −199.9 ... +199.9%. In division, with a maximum input 1 (counter) an overflow is produced with values of input 2 less than 50% (100%:50% = 2).

If the computation requires a result for values of SR2 < 50%, and if values up to 100% cannot be ruled out for SR1, input 1 must first be divided down. After the division it is then usually possible to cancel the divisor factor.

Example:
Input 1: 0...100%
Input 2: 0...100%; important from 10...100%

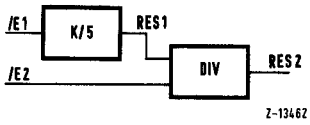


Fig. 4.1

For E1 = 100% the following critical maximum results are produced:

/E1	/E2	RES 2%
100 %	(1 %	2000.0)
	10 %	199.9
	50 %	40.0
	100 %	20.0

Table 4.1

At a suitable point in the further course of the calculation the factor 5 must be reincorporated in the calculation.

4.3 Block diagram

From the precise problem definition a block diagram is produced using the calculation and transfer commands available in the Protronic P. No knowledge of digital technology is required for this. The calculation and transfer commands are used like independent calculators and are interconnected in a suitable way.

The place of pipework in pneumatics and wiring in analog electronics is taken by naming for all outputs of the calculation functions used.

Section 13 contains a number of examples that provide information on solving special problems.

4.4 Defining variable names

Every output of a calculation or transfer function must be addressable with a name, i.e. of a variable or its hex address (= hex name).

The variables are to a great extent freely selectable from Annex. 2. It can be important here that the analog variables in each cycle beginning with Z. (= FFH) are computed in reverse alphabetical order (descending hex addresses). In other words, if the variables from the input to the output of a function chain are arranged in descending order (greatest hex address at the input, lowest at the output), the calculation result is established at the end of one cycle. If the reverse sequence is chosen, one cycle is needed per command for the calculations.

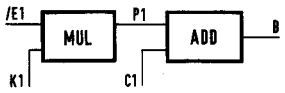


Fig. 4.2 B is calculated in 1 cycle

As the units have a short cycle time, the sequence of variables is normally not important.

Binary variables are calculated in one cycle and the result used in the next cycle; i.e. if several logical operations are connected in series, one cycle per command is needed to calculate the result. If binary signals are required in succession at different times, this processing mode must be taken into account.

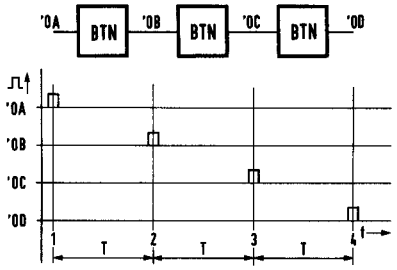


Fig. 4.3 Passage of binary signals

A few restrictions must be observed when selecting the variables:

- No variable may be used more than once for different values.
- In two-channel units, the variables **without point** in the display are always assigned to **channel 1**, the variables **with point** to **channel 2.**
- Some variables (identified by #) have a fixed meaning specific to the unit.
  Example:
  "XD" is always the input of the unconfigurable control module 1. In two-channel units the meaning of X.D is accordingly defined as the input of control module 2.
- A few calculation functions require certain rules to be observed when defining the variable names. See Section 7.
- If loops are configured (e.g. integrators) the variables must be so arranged that they can be calculated in one cycle, i.e. descending hex addresses in the direction of signal flow. The point at which the highest hex address at the output and the lowest hex address at the input of a calculation module meet may be selected at random.

If a variable in the loop is to be adjustable with keys ▲ and ▼ it must be given the lowest hex address in the loop.

4.4.1 Generally usable variables

With the restrictions mentioned, variables A1 to Z. can be used as desired for analog logical operations.

If these variables are used with the op code FLX, it must be specified on configuration whether the variable is to be adjustable with keys ▲ and ▼.

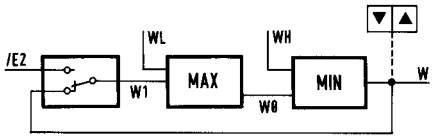
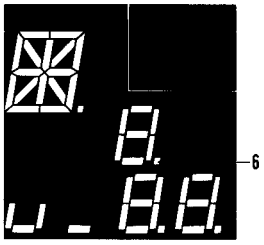


Fig. 4.4 Arrangement of variables in a loop. W = adjustable



An adjustable variable is indicated by the illuminated point (6) next to the index in the digital display.

This point can be switched on or off in the monitor routine MC 001C (Controller PE and indicator PA : MC 000C) with key 12 or with the configurator (see 6.2.4).

An unused variable is indicated by „u" in the display. It is extinguished automatically if the variable is used in a configuration.

4.4.2 Predefined variables

Some of the variables /w8 to /E1 (hex addresses 00H to 3FH) are reserved

/N8 to /N1	Constant
/E8 to /E1	Inputs E1 . . . E6. /E7 and /E8 are used to monitor current outputs A1 and A2
/R0 to /U7	Outputs of unconfigurable functions e.g. outputs of the control module

The remaining variables can be used as settable sources. Their values cannot be copied with STO PARAM to area 8500H to 86FFH and hence nor can they be stored in an EEPROM or on cassette.

These variables are represented by the controllers as small letters with a horizontal line above them.

For writing the text on paper, the notation of the configuration unit with preceding slash "/" should be used.

If an unused variable is to be used and adjustable with key ▲ and ▼, using the configurator or in monitor routine MC 001C (in PE with software ../84 and PA:NC000C) the point (6) must be switched on with key 10 (adjustability enabled) and the „u" switched off with key 12.

If the (hex) binary variable of the same name is dispensed with, a value can be assigned to this variable by direct entry to the controller – not with the configurator.

Example:
In manual operation the controller output is to follow an external signal and on transfer to automatic it is to start bumplessly from the last value.

The configuration necessary for this reads:

```
/R3 : SOL , /E3 , Y_0
1CH : 11H , 3DH , 60H
```

The binary variable Q09 (1CH) can now no longer be configured.

The associated memory addresses are ascertained in accordance with Section 5.2.2.

4.4.3 Variables for binary logical operations

For binary logical operations some variables are available from the range 00H to 3FH. See Section 8 and Annex 13.3.

4.4.4 Finding free variables

Free variables can be ascertained from the configuration lists of the units in Section 10, via the monitor MC 001C (000C), with the configurator or the worksheets in Annex 6.

4.5 Noting the configuration text

From the block diagram to which the variable names have been added, the configuration text is now determined by noting the input and output variables with the OP code for each transfer or calculcation operation in accordance with the pattern already used several times.

```
RES :  OPC , SR1 , SR2
```

The result is a function (0PC) of sources 1 and 2.

When entering the configuration to the configurator or directly to the controller any line sequence can be used.

5 Entering the configuration text

5.1 Configurator and configuration PC

The following remarks, concerning the configurator, also apply to the configuration PC with the Program PROKON.

Normally, the configuration text is entered to the configurator and from there transferred to the controller or the indicator PA.

As from October 1985 (software status 42/85) standard controllers have the connector and the required software to connect the configurator. Units without configurator connection can be configured in accordance with Section 5.2.

Operation of the configurator is described in Operating Manual 41/62-65-...

5.2 Entering the configuration at the front of the controller

It is possible to configure the Protronic P units with the manual control and display elements on the front without using a configurator.

As this method is very labour-intensive and complex it should only be used if only a few commands are to be altered. If extensive changes are to be made to the configuration it is always advisable to use the configurator.

For reasons of cost – especially in the case of a unit failure – it is advisable not to change the configuration of the standard controller or to change it as little as possible.

5.2.1 Preparation

Before the configuration lines can be entered to the controller they must be transformed manually into a form understandable by the controller.

This transcoding is normally carried out by the configurator.

Each OP code and each variable must be replaaced with the associated hexadecimal number. The respective hex numbers are given in Annex 1 and Annex 2.

Thus

```
X   :  DIR , /E1 , /E2
```

becomes in hex:

```
E2H :  3DH , 3FH , 3EH
```

The letter H indicates hexadecimal representation. It is only used when writing the variables and commands, and is not entered to the controller.

The procedure to ascertain the hex values required for entering absolute values is as follows:

1. Convert the percentage number into a four-digit hexadecimal number with the aid of the table in Annex 4.
2. Divide the hex number into two two-digit hex numbers. The original left half is the high byte HB, the right half the low byte LB.
3. Insert LB as SR1 and HB as SR2 in the configuration list.

Example: 100.0% = BE80H
SR1 = 80H
SR2 = BEH

By changing the last digit of the LB, the decimal point position in the display can be specified.

0 = 000.0
1 = 00.00
2 = 0.000
3 = 0000

The calculated value is not affected by this.

5.2.2 Determining the memory addresses

The following areas in RAM are specified for the op code and the input values of the commands:

Op code ..... 8400H to 84FFH
Input 1 (SR1) ..... 8500H to 85FFH
Input 2 (SR2) ..... 8600H to 86FFH

The address at which a command or a variable is entered within the named areas is specified by the name of the resulting variable.

Example:
The control deviation XD is to be formed from variables X and W. In normal notation the corresponding line reads:

```
XD  :  SUB , X   , W
```

or in hex:

```
EAH :  49H , E2H , D2H
```

With variable XD = EAH the destination addresses in the above mentioned areas are defined:

Op code = 49H must be entered in address ... 84EAH
SR1 = E2H must be entered in address ... 85EAH
SR2 = D2H must be entered in address ... 86EAH

5.2.3 Entry to the controller

Turn switch S4 (Fig. 5.1) to "MONIT+TEST" and operate key S5. Various displays may now appear in the digital display. What is displayed in detail depends on whether earlier work with monitor routines was terminated correctly or not.

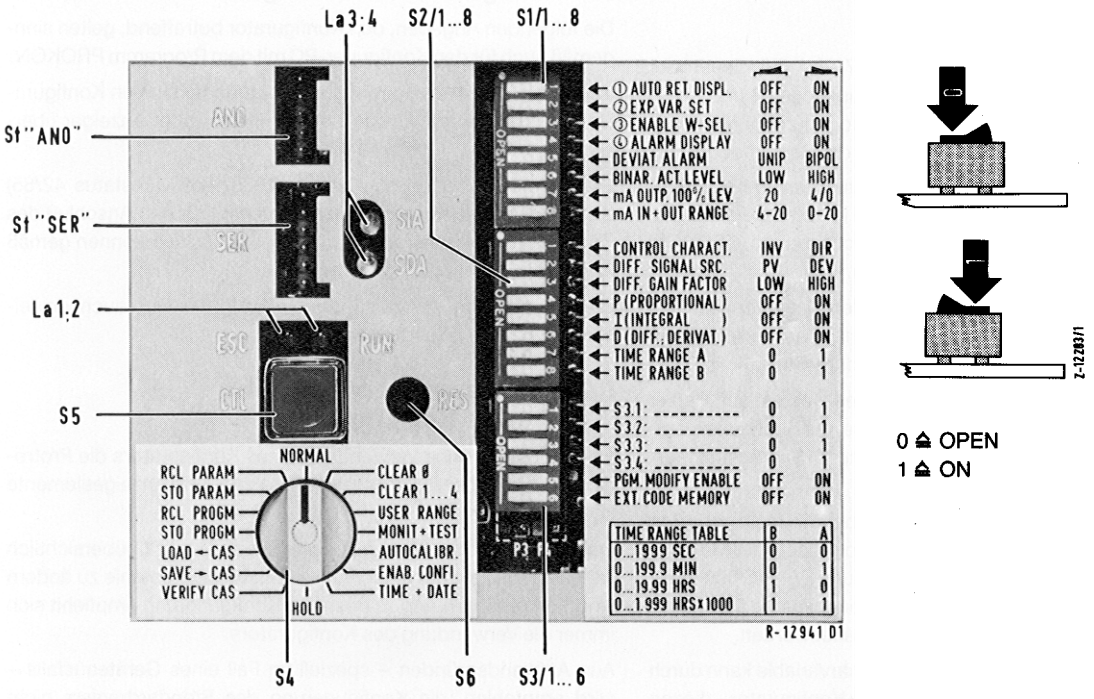


Fig. 5.1 Arrangement of switches

The flow diagram below shows which keys must be operated depending on the display.

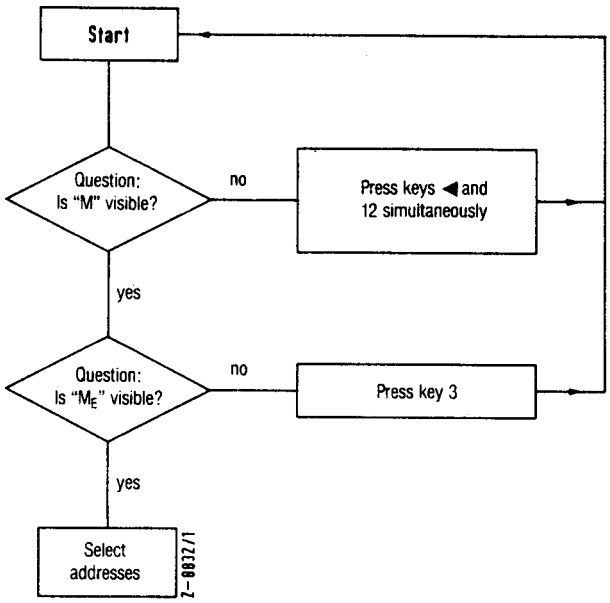
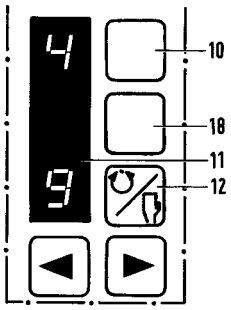


Fig. 5.2 Flow diagram for setting memory addresses

5.2.3.1 Selecting memory addresses

The address is selected with keys ▲ and ▼. Only the digit at which the decimal point is currently positioned as cursor can be altered. This cursor is moved by pressing key 10 and one of keys ▲ or ▼. Key ▲ moves the cursor to the left, key ▼ to the right.

5.2.3.2 Entering the memory contents



The display fields next to keys 10 and 12 indicate the current contents of the selected address, read from top to bottom. The displayed value can be increased with key ▶ and decreased with key ▲. Here too, only the value in the field in which the cursor is visible can be changed. In this case the cursor is moved by operating key 10 and simultaneously pressing one of keys ◀ or ▶.

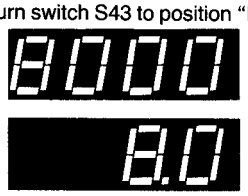
If the contents of one of the two display fields is altered with keys ◀ or ▶, both fields start to flash. The flashing indicates that by pressing key 10 the old value van be recalled and by pressing key 12 the new value can be confirmed and written to memory. If key 10 or 12 is operated the flashing ceases.

When writing in the data, the entry must be confirmed separately for each display field.

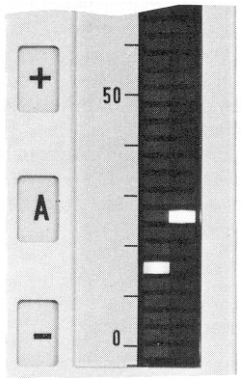
Once the desired hex numeral is visible in both display fields without flashing, the next address can be selected in the digital display and the next hex numerals entered there.

5.2.4 Entry to the indicator

Turn switch S43 to position "Monitor E" and operate key S5.



There appears in the digital display either a four-digit hex number beginning with 8 (an address) or a two-digit hex number (a memory content). In both cases a visible decimal point has no significance.



The other display is selected by holding key A for approx. 3 s.

The desired address is set with keys "+" and "–", it being only possible to change the decimal position at which the decimal point is currently positioned as cursor. The cursor is moved by simultaneously operating "A" and "+" or "–".

After the address has been set the address content is selected with prolonged pressure on key "A".

The contents are altered with "+" or "–". The cursor position is changed as in address setting.

After the first digit has been changed the display begins to flash. Only after the second decimal has also been set are the new memory contents transferred by repeatedly operating "A".

After the flashing has stopped, more data can be entered.

The configuration is terminated by turning switch S4 to "normal" and operating key S5.

6 Control codes for the address area 8700H ... 87FFH

The control codes describe the unit functions that cannot be described mathematically with configuration lines. The tables below show the delivery status of the controller in its basic configuration, i.e. without special functions.

Table 6.1 shows all addresses in area 8700H to 87FFH using the example of the single-channel continuous controller. By changing the memory contents very different results can be obtained. What can be accomplished with the individual addresses is described at the end of the tables.

Address	Contents	Function	Description in Operating Manual or section
00	87	Control code must always be 87H	
01	14	EEPROM – type and program time see test routine OF	42/62-61-...
02	00	No. of data set of cassette or special config.	42/62-61-...
03	F3	Baud rate of operator interface	6.7.2
04	FC	Baud rate of configurator interface	6.7.1
05	FF	No. of special configuration HB (LB in 8702)	
06	1E	Permitted number of seconds without telegram	6.7.5
07	1E	Permitted number of incorrect telegrams in 1 minute	6.7.5
08*	0C	Definition of outputs 0... or 4...20 mA	6.1.1
09*	00	Switch off outputs + default value for input below 0 %	6.1.2/6.1.3
0A*	00	Switch off filter	6.1.4
0B*	00	Definition of inputs 0 or 4...20 mA	6.1.1
0C*	00	Switch off inputs	6.1.2
0D*	00	Reduce sampling rate of inputs to 0.2 s	6.1.5
0E	FF	Filter characteristic	6.1.4
0F	FF	Mask, which of following variables is remotely controllable	6.2.6
10	D2	W	6.2.6
11	1C	Y	6.2.6
12	6E	G1	6.2.6
13	70	G2 — Remotely controllable variable	6.2.6
14	EC	XP	6.2.6
15	C4	Tn	6.2.6
16	E0	WL	6.2.6
17	DC	WH	6.2.6
18	FF	Reserved	
19	FF	Reserved	6.3.2
1A	FF	Reserved	
1B	FF	Enable message Q01 to Q04 in status telegram	6.7.2.2
1C	64	Y_4	
1D	66	Y_6 — List of additional binary variables in system image	6.7.2.2
1E	74	W_4 — (prepared for 2nd channel)	
1F	76	W_6	
20	FF	Reserved	
21	3B	D.L	
22	63	D.R — List of additional analog variables in	6.7.2.3
23	61	D.U — system image	
24	5F	X.D	
25	FF	Reserved	
26	FF	Reserved	
27	FF	Reserved	
28	FF	Reserved	
29	FF	Reserved	
2A	FF	Reserved	
2B	FF	Reserved	
2C	FF	Reserved	
2D	FF	Reserved	
2E	FF	Reserved	
2F	FF	Reserved	
30	FF	Switching status display of bin. variables in 31..34 0 = "on"	6.5.1
31	B8		6.5.1
32	B8	Code of binary variables 34 = ☐ = 31	6.5.1
33	1E	33 = ☐ = 32	6.5.1
34	1F		6.5.1
35	00	In 2-channel operation: divide switch levels W,F,Y	6.3.3
36	00	Start of loop in repeat operation of programmer 1	6.6.3
37	00	Start of loop in repeat operation of programmer 2	6.6.3
38	00	Selection of controller type, e.g. programmer	6.6
39	00	Separate definition of time ranges for channel 1 and 2	6.6.1
3A	21	S2 default and uni- or bipolar differentiation channel 1	6.6.1.2/6.6.2
3B	21	S2 default and uni- or bipolar differentiation channel 2	6.6.1.2/6.6.2
3C	D2	Switch off adjustability of variables in "external"	6.2.5
3D	09	Mask binary variable Q01 to Q04, status EUG,EA1,EA2,D00	6.5.2
3E	00	Mask binary variable Q05 to Q12	6.5.2
3F	00	Mask binary variable D01 to D08	6.5.2

Table 6.1 Single-channel continuous controller

* In standard controllers PE with software ../84 these funktion are at addresses 87DAH to 87DFH in the above sequence

Address	Contents	Function	Description in Operating Manual or section
40	FA	Hysteresis width op code CB0	7.1.1
41	FA	Hysteresis width op code CU0 — 0...25,5 % corresponds	7.1.1
42	FA	Hysteresis width op code CT0 — 00H to FFH	7.1.1
43	FA	Hysteresis width op code CL0	7.1.1
44	00	Mask of used seven-segment displays	6.4
45	9C	Variables in USER RANGE, address 60H to 67H	6.2.2
46	FF	Variables in USER RANGE, address 68H to 6FH	6.2.2
47	0F	Variables in USER RANGE, address 70H to 77H	6.2.2
48	BE	H	
49	CF	E	
4A	FE	A	
4B	CE	C — Characters for Y switch	6.3.2
4C	BE	H — (key 12)	
4D	CE	C	
4E	FE	A	
4F	CE	C	
50	80		
51	6D	2.	
52	DB	d	
53	D7	S — Characters for F switch	
54	FB	0 — (key 18)	6.3.2
55	EE	P	
56	80		
57	80		
58	F1	I	
59	CE	F	
5A	CF	E	
5B	CB	C — Characters for I/E switch	6.3.2
5C	F1	I — (key 10)	
5D	80		
5E	EE	P	
5F	80		
60	E2	X	
61	D2	W	
62	F0	Y	
63	EA	Xd — Small loop of variables shown in the digital display	6.2.1
64	5C	D — (number in 8778H)	
65	6E	G1	
66	70	G2	
67	72	G3	
68	74	G4	
69	FF		
6A	FF		
6B	FF	Large loop of variables shown in the digital display	6.2.1
6C	FF	(dependent on switch S1/2)	
6D	FF		
6E	EC	XP	
6F	C4	TN	
70	C2	TD	
71	F2	Y0	
72	FA	YL	
73	FB	YH	
74	E0	WL	
75	DC	WH	
76	E4	X0	
77	E6	X1	
78	09	Number of variables in the small loop	6.2.1
79	05	Mask for Y switch — Selection of functions,	6.3.1
7A	01	Mask for F switch — switch positions and	6.3.1
7B	05	Mask for W switch — characters next to the switches	6.3.1
7C	8F	USER RANGE: high-order byte range	6.2.2
7D	A0	USER RANGE: low-order byte range	6.2.2
7E	80	USER RANGE: high-order byte start	6.2.2
7F	00	USER RANGE: low-order byte start	6.2.2

		07	06	05	04	03	02	01	00	
80	FF	/W2	/W3	/W4	/W5	/W6	/W7	/W8	—	
81	07	/UB	/UC	/UD	/UE	/UF	/W	/W0	/W1	
82	00	/U3	/U4	/U5	/U6	/U7	/U8	/U9	/UA	6.2.4
83	F8	/R0	/R1	/R2	/R3	/R4	/U0	/U1	/U2	
84	FF	/N1	/N2	/N3	/N4	/N5	/N6	/N7	/N8	
85	00	/M8	/M9	/MA	/MB	/MC	/MD	/ME	/MF	
86	00	/M0	/M1	/M2	/M3	/M4	/M5	/M6	/M7	

Table 6.1 (continued)

Address	Contents	Function								Description in Operating Manual or section
87	FF	/E1	/E2	/E3	/E4	/E5	/E6	/E7	/E8	
88	FF	C.	C	B.	B	A4	A3	A2	A1	
89	1B	C.3	C3	C.2	C2	C.1	C1	C.0	C0	
8A	FE	C.7	C7	C.6	C6	C.5	C5	C.4	C4	
8B	FF	D.L	DL	D.	D	C.9	C9	C.8	C8	
8C	FF	F.	F	E.	E	D.U.	DU	D.R	DR	
8D	BF	G.1	G1	F.3	F3	F.2	F2	F.1	F1	
8E	EA	H.	H	G.4	G4	G.3	G3	G.2	G2	
8F	FF	K.0	K0	K.	K	J.	J	I.	I	
90	AA	K.4	K4	K.3	K3	K.2	K2	K.1	K1	
91	FF	K.8	K8	K.7	K7	K.6	K6	K.5	K5	
92	FF	M.1	M1	M.	M	L.	L	K.P	KP	6.2.4
93	FF	P.0	P0	P.	P	N.1	N1	N.	N	
94	FF	P.4	P4	P.3	P3	P.2	P2	P.1	P1	
95	FF	P.8	P8	P.7	P7	P.6	P6	P.5	P5	
96	FF	S.	S	R.	R	Q.	Q	P.9	P9	
97	FF	T.3	T3	T.2	T2	T.1	T1	T.0	T0	
98	EB	T.U	TU	T.N	TN	T.D	TD	T.4	T4	
99	FF	V.1	V1	V.0	V0	V.	V	U.	U	
9A	F3	W.1	W1	W.0	W0	W.	W	V.2	V2	
9B	EF	W.I	WI	W.H	WH	W.E	WE	W.2	W2	
9C	FE	X.1	X1	X.0	X0	X.	X	W.L	WL	
9D	EF	X.U	XU	X.P	XP	X.D	XD	X.2	X2	
9E	FB	Y.2	Y2	Y.1	Y1	Y.0	Y0	Y.	Y	
9F	FA	Z.	Z	Y.R	YR	Y.L	YL	Y.H	YH	
A0	FF	Mask 0								
A1	FF	Mask 1								
A2	FF	Mask 2								
A3	00	Mask 3								
A4	FF	Mask 0								
A5	FF	Mask 1								
A6	FF	Mask 2								
A7	00	Mask 3								
A8	FF	Mask 0								
A9	FF	Mask 1								
AA	FF	Mask 2								6.9
AB	28	Mask 3								
AC	FF	Mask 0								
AD	FF	Mask 1								
AE	FF	Mask 2								
AF	C0	Mask 3								
B0	FF	Mask 0								
B1	FF	Mask 1								
B2	FF	Mask 2								
B3	30	Mask 3								
B4	00	Decimal point position standard								6.2.3
B5	00	Decimal point position USER RANGE								6.2.3
B6	00									
B7	8C									
B8	6C									
B9	70									
BA	84									
BB	74									
BC	14									
BD	28									
BE	6C	low-value byte of table function TA0								7.6
BF	A8									
CO	98									
C1	FC									
C2	A0									
C3	54									
C4	EC									
C5	80									
C6	80									
C7	00									
C8	00									
C9	02									
CA	05	higher-value byte of table function TA0								7.6
CB	09									
CC	0E									

Table 6.1 (continued)

Address	Contents	Function	Description in Operating Manual or section
CD	14	low-value byte of table function TA0	7.6
CE	1A		
CF	20		
D0	26		
D1	2C		
D2	31		
D3	36		
D4	3A		
D5	3C		
D6	3E		
D7	3E		
D8	03	Bit 0 and 1 for data blanking	6.5.3
D9	0A	Length of start phase	see binary byte 33
DA	31	Variable number 3rd position	
DB	41	Variable number 4th position	42/62-60-...
DC	51	Variable number 5th position	42/62-61-...
DD	00	Reserved	
DE	00	Protection of autocalibration data	6.8
DF	FF	EEPROM priority determination by S1/3 = "off"	42/62-61-...
E0	99	Unit address for RS 422	6.7.2.2
E1		Test byte	
E2		Input 6	
E3		Input 5	
E4		Input 4	
E5		Input 3	
E6		Input 2 — Autocalibration data zero point 0...20 mA	6.8
E7		Input 1	
E8		Output 1	
E9		Output 2	
EA		Output 3	
EB		Output 4	
EC		Input 1	
ED		Input 2	
EE		Input 3	
EF		Input 4	
F0		Input 5 — Autocalibration data zero point 4...20 mA	6.8
F1		Input 6	
F2		Output 1	
F3		Output 2	
F4		Output 3	
F5		Output 4	
F6		Input 6	
F7		Input 5	
F8		Input 4	
F9		Input 3	
FA		Input 2 — Autocalibration data range	6.8
FB		Input 1	
FC		Output 1	
FD		Output 2	
FE		Output 3	
FF		Output 4	

Table 6.1 (continued)

Different control codes for the controller types / input circuits

Single-channel step action controller

Address	Contents	Function	Description in Operating Manual or section
30	00	Switching status display activated	6.5.1
38	10	Controller type	6.6
71	76	H in place of Y0 in the display loop	
DA	32	Variant number	

Table 6.2 Different control codes for the step action controller

Two-channel continuous controller

Address	Contents	Function	Description in Operating Manual or section
14	D3	W.	
15	1D	Y.	6.2.6
16	6F	G.1 — Remotely adjustable variable	
17	71	G.2	
35	05	Division of switch level	6.3.3
39	08	Controller 2 is activated	6.6.1
3F	03	D01 and D02 are inverted	6.5.2
50	B0	1 = 1st channel	6.3.2
67	FF	Blank	
68	FF	Blank	
7A	03	Mask of F switch	6.3.1
DA	34	Variant number 3rd position	
DB	45	Variant number 4th position	

In override controllers, the only additional difference is address 87DCH in which the variant number position is stored.

Table 6.3 Different control codes for the two-channel continuous controller

Cascade controller with continuous output

Address	Contents	Function	Description in Operating Manual or section
14	D3	W.	
15	1D	Y.	6.2.6
16	6F	G.1 — Remotely controllable variable	
17	71	G.2	
35	01	Division of switch level	6.3.3
39	08	Controller 2 is activated	6.6.1
3F	03	D01 and D02 are inverted	6.5.2
44	80	Flashing of display next to key 12	6.4
50	B0	1 = 1st channel	6.3.2
67	FF	Blank	
68	FF	Blank	
58	9D	o = open cascade	6.3.2
59	8D	c = closed cascade	6.3.2
7A	03	Mask of F switch	6.3.1
7B	03	Mask of W switch	6.3.1
DA	34	Variant number 3rd position	
DB	45	Variant number 4th position	
DC	52	Variant number 5th position	

Table 6.4 Different control codes for the cascade controller with continuous output

Two-channel step action controller

Address	Contents	Function	Description in Operating Manual or section
14	D3	W.	
15	1D	Y.	6.2.6
16	6F	G.1 — Remotely adjustable variable	
17	71	G.2	
30	00	Switching status display activated	6.5.1
31	1D	Switching status display of Q10	6.5.1
32	1C	Switching status display of Q09	6.5.1
35	05	Division of switch level	6.3.3
38	11	Two-channel step-action controller	6.6
39	08	Controller 2 is activated	6.6.1
3F	03	D01 and D02 are inverted	6.5.2
50	B0	1 = 1st channel	6.3.2
67	FF	Blank	
68	FF	Blank	
6B	76	H in display loop	
71	FF	Blank	
7A	03	Mask of F switch	6.3.1
DA	35	Variant number 3rd position	
DB	45	Variant number 4th position	

In override controllers, the only additional difference is address 87DCH in which the variant number 5th position is stored.

Table 6.5 Different control codes for the two-channel step action controller

Two-channel controller with continuous and step action output

Address	Contents	Function	Description in Operating Manual or section
14	D3	W.	6.2.6
15	1D	Y.	
16	6F	G.1 — Remotely adjustable variable	
17	71	G.2	
30	00	Switching status display activated	6.5.1
31	1D	Switching status display of Q10	6.5.1
32	1C	Switching status display of Q09	6.5.1
33	B8	Q12 no longer in switching status display	6.5.1
34	B8	Q11 no longer in switching status display	6.5.1
35	05	Division of switch level	6.3.3
38	01	Controller type: 2nd channel = step action controller	6.6
39	08	Controller 2 is activated	6.6.1
3F	03	D01 and D02 are inverted	6.5.2
50	B0	1 = 1st channel	6.3.2
67	FF	Blank	
68	FF	Blank	
6B	76	H in display loop	
7A	03	Mask of F switch	6.3.1
DA	36	Variant number 3rd position	
DB	45	Variant number 4th position	

In override controllers, the only additional difference is address 87DCH in which the catalog number 5th position is stored.

Table 6.6 Different control codes for the two-channel controller with continuous and step action output.

Cascade controller with step action output

Address	Contents	Function	Description in Operating Manual or section
14	D3	W.	6.2.6
15	1D	Y.	
16	6F	G.1 — Remotely adjustable variable	
17	71	G.2	
30	00	Switching status display activated	6.5.1
31	1F	Switching status display of Q12	6.5.1
32	1E	Switching status display of Q11	6.5.1
33	B8		6.5.1
34	B8		6.5.1
35	01	Division of switch level	6.3.3
38	01	Controller type: 2nd channel = step action controller	6.6
39	08	Controller 2 is activated	6.6.1
3F	03	D01 and D02 are inverted	6.5.2
50	B0	1 = 1st channel	6.3.2
58	9D	o = open cascade	6.3.2
59	8D	c = closed cascade	6.3.2
6B	77	H. in display loop	
67	FF	Blank	
68	FF	Blank	
7A	03	Mask of F switch	6.3.1
7B	03	Mask of W switch	
DA	36	Variant number 3rd position	
DB	45	Variant number 4th position	
DC	52	Variant number 5th position	

Table 6.7 Different control codes for the cascade controller with step action output.

Input multicomponent and extreme value selection

Address	Contents	Function	Description in Operating Manual or section
69	3F	Input E1	6.2.1
6A	3E	Input E2	6.2.1
6B	3D	Input E3 — In display loop	6.2.1
6C	3C	Input E4	6.2.1
6D	3B	Input E5	6.2.1
DB		42 for multi-component, 44 for extreme value selection	42/62-61-

Table 6.8 Input combination multicomponent and extreme value selection

Ratio input circuit

Address	Contents	Function	Description in Operating Manual or section
45	9C	Variable in USER range	6.2.2
46	CF		
47	CF		
60	CA	V = Ratio actual value (In display loop)	6.2.1
69	E2	X = Input E3 (In display loop)	6.2.1
6A	E8	X2 = Input E4 (In display loop)	6.2.1
6B	6A	F2 = Sum E3 + E4 (In display loop)	6.2.1
6C	CC	V0 = Lower analog display limit (In display loop)	6.2.1
6D	CE	V1 upper analog display limit (In display loop)	6.2.1
78	0B	11 displayed values in the small loop	6.2.1
DB	43	Variant number 4th position	42/62-61-

Table 6.9 Ratio input circuit

Single-channel controller

Address	Contents	Function	Description in Operating Manual or section
0F	C3	Mask of remotely controllable variables	6.2.6
12	D8	W2	
13	DA	WE (Remotely controllable variable (note Operating Manual))	6.2.6
14	98	N	
15	B4	R	
1B	0F	Binary outputs Q001 to Q04 not in status telegram	6.7.2.3
38	40	Unit type 4 = programmer in 1st channel	6.6
45	0E	Variable in USER RANGE	6.2.2
46	F0	Variable in USER RANGE	6.2.2
47	E7	Variable in USER RANGE	6.2.2
48	9E	h	
49	8C	r (Displays for Y switch)	6.3.2
4A	0C	r.	
4B	8F	t	
5A	EE	P Display for W switch	6.3.2
60	D2	W	
61	98	N	
62	C6	TU (Small display loop in digital display)	6.2.1
63	B4	R	
64	9E	P0	
65	A0	P1	
66	A2	P2	
67	A4	P3	
68	A6	P4	
69	A8	P5	
6A	AA	P6	
6B	AC	P7 (Large display loop in digital display)	6.2.1
6C	4A	C1	
6D	4C	C2	
6E	4E	C3	
6F	50	C4	
70	52	C5	
71	54	C6	
72	56	C7	
73	E0	WL	
74	DC	WH	
75	FF	—	
76	FF	—	
77	FF	—	
78	04	Number of variables in the small display loop	6.2.1
79	0F	Mask of Y switch	6.3.1
94	AA	Incrementable variable	6.2.4
95	EA	Incrementable variable	6.2.4
B0	FD	Error mask	6.9
B1	FD	Error mask	6.9
DA	33	Variant number 3rd position (Catalog No.)	

Table 6.10 Different control codes for the single-channel programmer

Continuous program controller

Address	Contents	Function	Description in Operating Manual or section
0F	33	Mask of remotely controllable variables	6.2.6
14	D3	W.	
15	1D	/R2 — Remotely controllable variable (note Operating Manual)	6.2.6
16	D9	W.2	
17	DB	W.E	
B1	3F	Q01 and Q02 in status telegram	6.7.2.3
35	55	Division of switches	6.3.3
38	04	Unit type	6.6
39	08	Channel 2 activated	6.6.1
3F	03	Mask of binary variables D1 to D8	6.5.2
4C	9E	h	
4D	8C	r	
4E	0C	r. — Displays for Y switch	6.3.2
4F	8F	t	
51	6E	P.	
59	CF	E — Displays for W switch	6.3.2
5A	EE	P	
64	99	N.	
67	C7	T.U — Small display in digital display	6.2.1
68	B5	R.	
78	0C	Number of variables in the small display loop	6.2.1
79	F5	Mask for Y switch	6.3.1
7A	03	Mask for F switch	6.3.1
7B	25	Mask for W switch	6.3.1
94	00	Incrementable variable	6.2.4
95	00	Incrementable variable	6.2.4
B0	FD	Error mask	6.9
B1	FD	Error mask	6.9
DA	37	Variant number 3rd position (Catalog No.)	42/62-61-

Table 6.11 Different control codes for the continuous program controller

Program controller with step action output

Address	Contents	Function	Description in Operating Manual or section
0F	33	Mask of remotely controllable variables	6.2.6
14	D3	W.	
15	1D	/R2 — Remotely controllable variable (note Operating Manual)	6.2.6
16	D9	W.2	
17	DB	W.E	
B1	3F	Q01 and Q02 in status telegram	6.7.2.3
30	00	Display of switching status of controller outputs	6.5.1
35	55	Division of switches	6.3.3
38	14	Unit type	6.6
39	03	Channel 2 activated	6.6.1
3F	03	Mask of binary variables D1 to D8	6.5.2
4C	9E	h	
4D	8C	r	
4E	0C	r. — Displays for Y switch	6.3.2
4F	8F	t	
51	6E	P.	
59	CF	E — Displays for W switch	6.3.2
5A	EE	P	
64	99	N.	
67	C7	T.U — Small display loop in digital display	6.2.1
68	B5	R.	
71	76	H in large display loop	
78	0C	Number of variables in the small display loop	6.2.1
79	F5	Mask for Y switch	6.3.1
7A	03	Mask for F switch	6.3.1
7B	25	Mask for W switch	6.3.1
94	00	Incrementable variable	6.2.4
95	00	Incrementable variable	6.2.4
B0	FD	Error mask	6.9
B1	FD	Error mask	6.9
DA	38	Variant number 3rd position (Catalog No.)	42/62-61-

Table 6.12 Different control codes for the program controller with step action output

Two-channel programmer

Address	Contents	Function	Description in Operating Manual or section
10	D2	W — Remotely controllable	6.2.6
11	1C	/R3 — Output of programmer module	
1B	0F	Q01 and Q04 are not in status telegram	6.7.2.3
35	15	Division of switches	6.3.3
38	44	Unit type	6.6
45	0E	Variable in USER RANGE	6.2.2
46	F0	Variable in USER RANGE	6.2.2
47	E7	Variable in USER RANGE	6.2.2
48	9E	h	
49	8C	r — Displays for Y switch	
4A	0C	r.	6.3.2
4B	8F	t	
50	EE	P — Display for F switch	6.3.2
59	CE	F — Display for W switch	6.3.2
60	D2	W	
61	98	N — Small display loop	
62	C6	TU	
63	B4	R	
64	9E	P0	
65	A0	P1	
66	A2	P2 — Large display loop	6.2.1
67	A4	P3	
68	A6	P4	
69	A8	P5	
6A	AA	P6	
6B	AC	P7	
6C	4A	C1	
6D	4C	C2	
6E	4E	C3	
6F	50	C4	
70	52	C5	
71	54	C6	
72	56	C7	
73	E0	WL	
74	DC	WH	
75	FF	—	
76	FF	—	
77	FF	—	
78	04	Number of variables in the small loop	6.2.1
79	04	Mask for Y switch	
7B	03	Mask for F switch	
B0	FD	Error mask	6.9
B1	FD	Error mask	6.9
DA	39	Variant number 3rd position	42/62-61-

Table 6.13 Different control codes for the two-channel programmer

Double indicator

Address	Contents	Function	Description in Operating Manual or section
04	FC	Baud rate of interface to configurator	6.7.1
06	FF	Reserved	
07	FF	Reserved	
08	00	Definition of outputs	6.1.1
10	6E	G1	
11	70	G2 — Alarm pointer in left hand system	6.10
12	6E	G1	
13	70	G2	
14	6F	G.1	
15	71	G.2 — Alarm pointer in right hand system	6.10
16	6F	G.1	
17	71	G.2	
18 to 1E	FF	Reserved	
51	CE		
52	DB	USER RANGE right hand display	
53		Decimal point right hand display	
54		High-order byte range	
55		Low-order byte range	6.2.2
56		High-order byte span	
57		Low-order byte span	

Table 6.14 Different control codes for the double indicator

Address	Contents	Function	Description in Operating Manual or section
60	64	E	
61	6E	G1 } Small display loop in digital display	
62	70	G2	
63	4A	C1	
64	4C	C2 } large display loop in digital display	
65	9E	P0	
66	A0	P1	
67			
to	FF	Free	
77			
78	03	Number of variables in the small loop	6.2.1
B3	20	Error mask	6.9
DE	00	Protection of autocalibration data	6.8
DF	0F	Reserved	

Table 6.14 (continued)

6.1 Changing analog inputs and outputs

6.1.1 Different signal ranges

Particulary when installing instrumentation for older systems it may be necessary to have different signal ranges at the inputs and outputs of a unit.

The configurator contains an auxiliary routine that renders familiarity with the section that follows unnecessary.

For work without a configurator, the following rules apply:

The tables give the necessary addresses and their contents for a few important applications.

Standard controller

Outputs independent of S1/8		8708H
1	2	
0...20 mA	0...20 mA	83H
4...20 mA	0...20 mA	82H
0...20 mA	4...20 mA	81H
4...20 mA	4...20 mA	80H

For software ../84 address 87DAH.

Table 6.15

Inputs independent of S1/8		878BH
1	2	
0...20 mA	0...20 mA	83H
4...20 mA	0...20 mA	82H
0...20 mA	4...20 mA	81H
4...20 mA	4...20 mA	80H

For software ../84 address 87DAH.

Table 6.16

Universal controller

Outputs independent of S1/8				8708H
1	2	3	4	
0 4	0 4	0 4	0 4	8FH 80H

Inputs						870BH
1	2	3	4	5	6	
0 4	0 4	0 4	0 4	0 4	0 4	BFH B0H

0 = 0...20 mA (0...10V), 4 = 4...20 mA (2...10V)

Table 6.17

If mixed signal ranges are to be used on the input or output side, the required memory contents can be calculated as follows:

The value in 870.H is represented by an eight-digit binary number. Each of the digits describes the signal range of an input or output. The required contents are produced by converting the resulting binary number to hexadecimal.

8708H								
Bit	7	6	5	4	3	2	1	0
Output					4	3	2	1
Function	U-S18	–	–	–	DZ	DZ	DZ	DZ
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

U-S18 = 1: Switch S1/8 inactive for outputs 1 and 2
(S1/8 is always inactive for A3 and A4)
DZ = 0: 4...20 mA (A3,A4 = 2...10 V)
DZ = 1: 0...20 mA (A3,A4 = 0...10 V)

Table 6.18 (Basic configuration 111)

870BH								
Bit	7	6	5	4	3	2	1	0
Inputs		–	6	5	4	3	2	1
Function	U-S18	–	DZ	DZ	DZ	DZ	DZ	DZ
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

U-S18 = 1: Switch S1/8 inactive for inputs 1 and 6
DZ = 0: 4...20 mA (A3,A4 = 2...10 V)
DZ = 1: 0...20 mA (A3,A4 = 0...10 V)

Table 6.19 (Basic configuration 111)

Bit 7 normally contains a 0. This "0" lspecifies that the signal range of the inputs (870BH) or the outputs (8708H) is determined by switch S2/8. The other bits are then disregarded. If a "1" is entered at U-S18 the switch is inactive for the address selected.

Exception: Switch S1/8 does not affect outputs A3 and A4. The signal range depends only on the hex number entered.

The entries of "1" and "0" in the individual positions specify the signal range.

Example:

Outputs: all the same.
Inputs: 2 and 3 signal range 4...20 mA;
4 unused;
1, 5 and 6 signal range 0...20 mA.

Switch S1/8 is set to the signal range of the outputs. It is therefore only necessary to alter the address 870BH responsible for the inputs.

The unused input can be set to either 0 or 4...20 mA (in this case 4...20 mA). This results in the following table:

870BH								
Bit	7	6	5	4	3	2	1	0
Contents	1	0	1	1	0	0	0	1
Hex number	B ·				1			
in 870B	B1H							

Table 6.20

6.1.2 Disconnection of inputs and outputs

In order to save processing time it is possible to remove individual unused inputs or outputs from processing. The output values of disconnected outputs are undefined.

If the inputs are to be monitored for a measured value less than 0, all unused inputs must be disconnected and thus removed from the monitoring process (Er.LE).

Which inputs are interrogated is specified in address 870CH, which outputs are interrogated in address 8709H.

(Standard controller PE with software ../84 addresses 87DE and 87DB.) A "0" stands for an active input/output, a "1" indicates the disconnected status.

8709H								
Bit	7	6	5	4	3	2	1	0
Output	See 6.1.3				4	3	2	1
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.21 (Basic configuration 111)

870CH								
Bit	7	6	5	4	3	2	1	0
Input	–	–	6	5	4	3	2	1
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.22 (Basic configuration 111)

6.1.3 Arithmetical value of inputs if measured value < 0 %

If the measured value is approx. 5% below the lower range value, a default value of

–1.0 % in the standard controller,
–0.0 % in the universal controller

is set for the measured value.

This setting can be altered in pairs for two inputs at a time.

For this a configurator auxiliary routine or the following procedure (without configurator) is available.

8709H								
Bit	7	6	5	4	3	2	1	0
Input	–	6+5	4+3	2+1	See 6.1.2			
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.23 (Basic configuration 111)

6.1.4 Switch input filtering on and off

Incorporated in the software in inputs 1 to 6 are low-pass filters with a time constant of approx. 2 s, which switch off if the input variable changes faster than 0.75 %/s. These software-implemented filters can be switched on and off by changing the contents of address 870AH.

Which filters are activated is specified by an eight-digit binary number, the individual positions of which represent the inputs and the value of which describes the function of the filters. A "0" stands for an active, a "1" for a switched off filter.

870AH								
Bit	7	6	5	4	3	2	1	0
Input	–	–	6	5	4	3	2	1
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.24 (Basic configuration 111)

The entry in 870EH specifies the time after which the filter is switched on again:

0: after 4 s if the change < 0.75 %/s
1: immediately if the change < 0.75 %/s

870EH								
Bit	7	6	5	4	3	2	1	0
Input	–	–	6	5	4	3	2	1
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.25 (Basic configuration 111)

6.1.5 Sampling rate of inputs

The sampling rate is specified individually for inputs 1 to 6 in address 870DH (PE with software ../84 87DFH)

The address contains an eight-digit binary number the individual positions of which represent the inputs and the value of which specifies the sampling rate.

A "0" stands for the normal sampling rate of approx. 25–30/s corresponding to the cycle time, a "1" reduces the sampling rate to approx 5/s.

870DH								
Bit	7	6	5	4	3	2	1	0
Input	–	–	6	5	4	3	2	1
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.26 (Basic configuration 111)

6.2 Display and setting of analog variables

6.2.1 Important variables

In addresses 8760H to 8777H are entered the hex names (= hex addresses) of the variables that appear in the large display loop. Starting at address 8760 a small display loop can be defined, the length of which must be entered in 8778H in hexadecimal form. Switch S1/2 determines which loop is obtained with key 3.

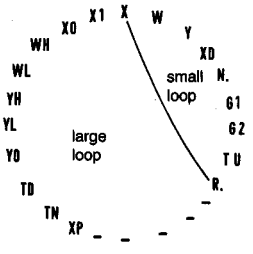


Fig. 6.1 Display loops

The configurator provides a routine for changing the display loops. If the configurator is not available, the hex names of the desired variables must be entered directly via monitor ME in the named addresses. (Variables not defined in the configuration are not displayed even if entered in one of the loops.)

For the two-channel units, only the variables without a point (even hex address) are generally entered into the list 8760H to 8777H. When the second channel is displayed, the respective variable with point is displayed.

If a variable with a point is entered into the list (uneven hex address) it is displayed in both channels.

6.2.2 Variables in USER RANGE

The three times 8 bits in addresses 8745H to 8747H mark the positions of the variables of the large loop that are to be displayed in the USER RANGE.

0 = USER RANGE
1 = Normal display

8745H								
Bit	7	6	5	4	3	2	1	0
Address	67H	66H	65H	64H	63H	62H	61H	60H
Variable	G3	G2	G1	D	XD	Y	W	X
Contents	1	0	0	1	1	1	0	0
Hex number	9				C			

Table 6.27 (Basic configuration 111)

8746H								
Bit	7	6	5	4	3	2	1	0
Address	6FH	6EH	6DH	6CH	6BH	6AH	69H	68H
Variable	TN	XP	–	–	–	–	–	G4
Contents	1	1	1	1	1	1	1	1
Hex number	F				F			

8747H								
Bit	7	6	5	4	3	2	1	0
Address	77H	76H	75H	74H	73H	72H	71H	70H
Variable	X1	X0	WH	WL	YH	YL	Y0	TD
Contents	0	0	0	0	1	1	1	1
Hex number	0				F			

Table 6.27 (Basic configuration 111)

The configurator provides a routine for entering the flags.

It is possible here to replace or to remove from the USER RANGE variables in the small or large loop. XD and D can only be accepted in the USER RANGE if the measuring range starts at zero **and** is linear.

The USER RANGE data is stored at addresses 877CH to 877FH. It is possible to change these addresses but not advisable, as setting the USER RANGE is considerably simpler if the Operating Manual is followed.

For a desired range the data in the above addresses is calculated as follows:

Span:

$\frac{\&r(\%)}{4}$ = XXXXH e.g. $\frac{120.0}{4}$ = 30.0 = 92C0H

Start:

$\frac{\&o(\%)}{4}$ = XXXXH e.g. $\frac{30.0}{4}$ = 7.5 = 84B0H

These hex values are given in the table in Annex 4.

The decimal point position is stored in 87B5H:

000.0 contents 00
00.00 contents 01
0.000 contents 02
0000 contents FF

6.2.3 Decimal point position

For variable readout in the digital display the decimal point position is defined by bits 0 and 1 in the low-order byte of the value (see Section 5.2.1).

The decimal point position of all variables can additionally be shifted without changing bits 0 and 1, by way of address 87B4H.

00H causes no shift
01H shifts 1 additional place to the left
02H shifts 2 additional places to the left
03H shifts 3 additional places to the left
If the original position plus additional shift results in more than 3 positions, 3 positions are disregarded.

IMPORTANT! As this measure causes a shift in all variables used in the unit, address 87B4H should only be used with great care.

Variables in the USER RANGE undergo special treatment. If they are shown as part of the display loops, i.e. only called by operating key 3, the decimal point position is determined solely by the USER RANGE. The associated decimal point position is held in 87B5H.

If the same variables are called by simultaneous operation of key S5 (internal) and key 3, they are treated as normal values and the USER RANGE function is not used.

The resulting decimal point position does not affect the value of a variable.

Exceptions:
Bits 0 and 1 for TN and TD (T.N and T.D if the 2nd channel is activated) are defined by switches S2/7 and S2/8 or address 8739H (see 6.6.1.1). These bits are interpreted by the control algorithm as a time base.

For the time sections in the programmer too, the time base is determined by bits 0 and 1 in the low-order byte of the value of the variables used for setting the sections.

Op codes FIX, FLX, PW., PT. and the mask op codes MA0 to MA3 are used for individual definition of the decimal point position (see Section 7).

6.2.4 Incrementable variables

Which variables are alterable with keys ▲ and ▼ is stored in addresses 8790H to 877FH. To each of the 256 variables is assigned in the 32 bytes 8780H to 879FH a bit that flags the adjustability via keyboard or remote control.

0 means: adjustable.

It is usually not advisable to enable or block a variable by directly changing the memory contents. This can be done more quickly with the configurator or with monitor function MC 001C.

6.2.4.1 Entry at the front of the controller

Individual variables are enabled or blocked with monitor function MC. The procedure is as follows:

Turn switch S4 (see illustration on the fold-out page at the back) to "MONIT+TEST" and operate key S5. Various displays may now appear in the digital display. What is shown in detail depends on whether earlier work with monitor routines was correctly terminated or not.

The flow diagram below indicates what keys are to be operated depending on the display visible.

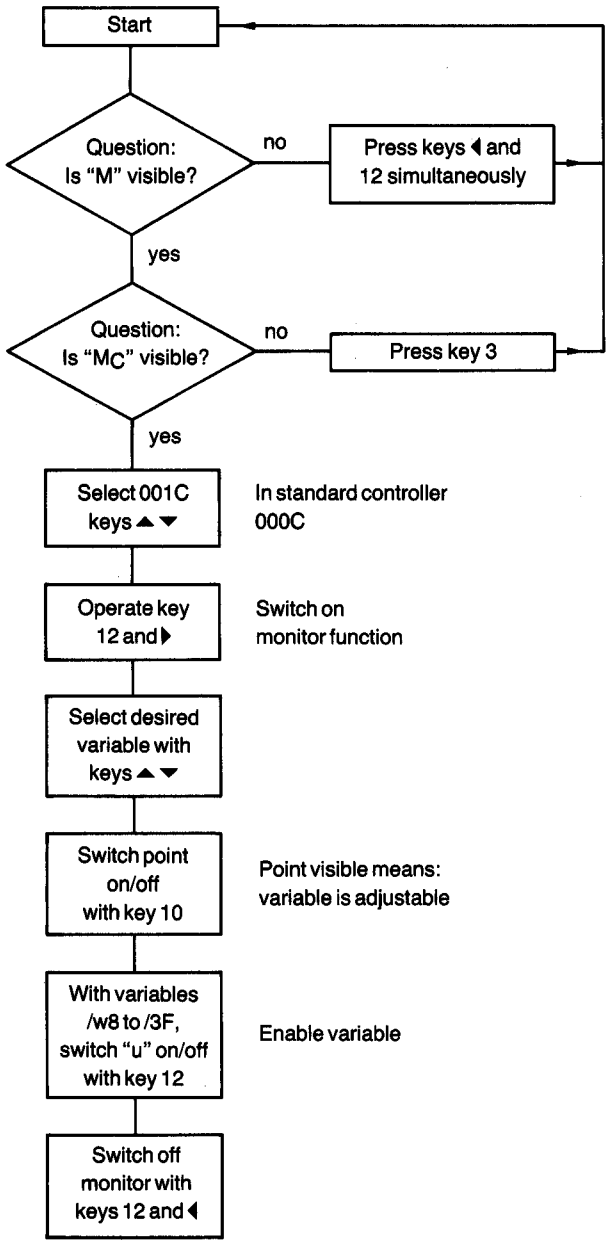


Fig. 6.2

After switching back to "NORMAL" operation the variables thus defined are adjustable with keys ▲ and ▼.

6.2.5 Cancelling the adjustability of a variable in "external" operating mode

The adjustability of the variable entered in address 873CH is removed via the keyboard if bit 72H is set, with the W switch divided also by bit 76H in position "external". The variable remains adjustable via remote control.

In two-channel units the hex name of the variables can optionally be entered with or without point (D2 = W or D3 = W.). In both cases the adjustability of the entered variables (W for channel 1 and W. for channel 2) is removed in the „external" operating mode.

6.2.6 Remotely controllable variables

In addresses 8710H to 8717H are entered the variables that are remotely adjustable via the binary inputs.

Remote adjustability is enabled via the mask in 870FH.

0 = remotely adjustable
1 = not remotely adjustable

870FH								
Bit	7	6	5	4	3	2	1	0
Address 87..	17	16	15	14	13	12	11	10
Variable	WH	WL	TN	XP	G2	G1	/R3	W
Contents	1	1	1	1	1	1	1	1
Hex number	F				F			

Table 6.28 (Basic configuration 111)

6.3 Switches

Keys 10, 18 (not present in controller PE) and 12 act on 3 bytes in the internal RAM that are hereinafter designated "switches".

Key 10 (W switch) acts on byte 2AH
Key 18 (F switch) acts on byte 29H
Key 12 (Y switch) acts on byte 28H

In each switch one bit, in divided switches (see 6.3.3) one bit respectively in each half is set.

6.3.1 Switch settings

By pressing the key for less than 1 second the switch bit is shifted from its present position to the next higher enabled position. When the highest enabled position is reached, the next brief key depression shifts the bit to the lowest enabled position. Holding the keys for longer than 1 second causes shifting in the opposite direction at a rate of 0.4 seconds.

If a switch is divided (see 6.3.3), a key depression shifts the switch bit within bit positions 0 to 3 if channel 1 is displayed, or within bit positions 4 to 7 if channel 2 is displayed.

The following switch settings have a fixed, unalterable meaning:

Undivided switch:	Y_ 0 = Manual	(halt)
	Y_ 2 =	(repeat)
Divided switch:	Y_ 0 = Manual	(Halt)
	Y_ 2 =	(repeat)
	Y_ 4 = Manual	(halt)
	Y_ 6 =	(repeat)

Information in () applies to programmer.

All other switch settings mean "not manual". Their function depends on the configuration.

Which of the switch settings are enabled is specified in addresses

877BH for the W switch
877AH for the F switch
8779H for the Y switch

The meanings are

1 = enabled
0 = blocked.

The flow diagram below indicates what keys are to be operated depending on the display visible.

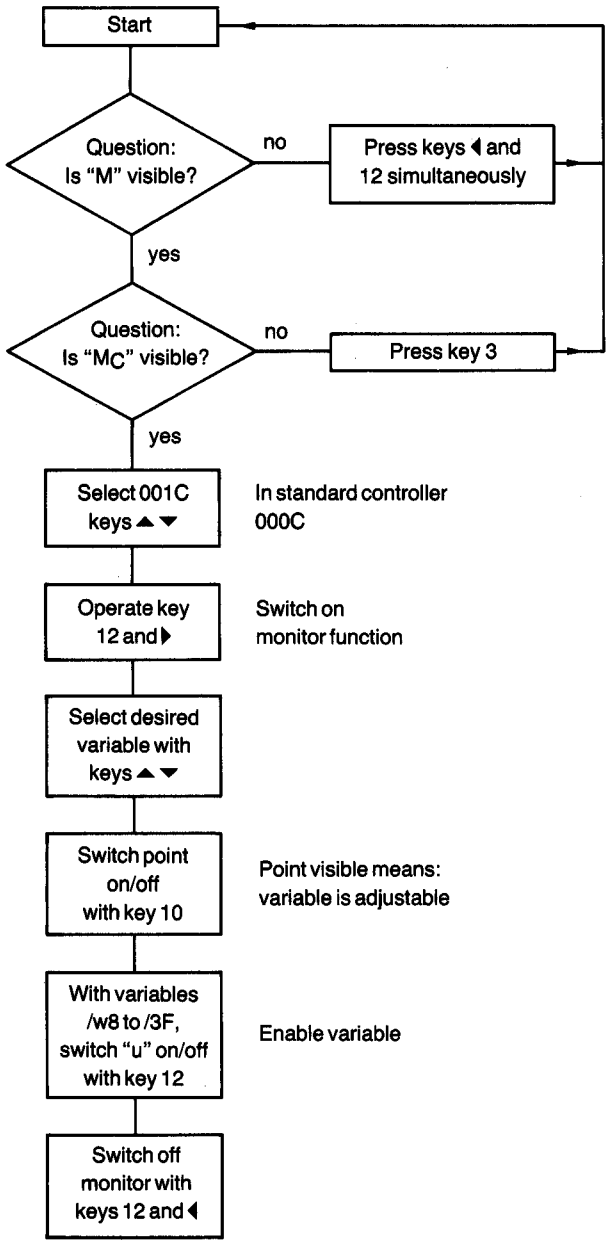


Fig. 6.2

After switching back to "NORMAL" operation the variables thus defined are adjustable with keys ▲ and ▼.

6.2.5 Cancelling the adjustability of a variable in "external" operating mode

The adjustability of the variable entered in address 873CH is removed via the keyboard if bit 72H is set, with the W switch divided also by bit 76H in position "external". The variable remains adjustable via remote control.

In two-channel units the hex name of the variables can optionally be entered with or without point (D2 = W or D3 = W.). In both cases the adjustability of the entered variables (W for channel 1 and W. for channel 2) is removed in the „external" operating mode.

6.2.6 Remotely controllable variables

In addresses 8710H to 8717H are entered the variables that are remotely adjustable via the binary inputs.

Remote adjustability is enabled via the mask in 870FH.

0 = remotely adjustable
1 = not remotely adjustable

870FH								
Bit	7	6	5	4	3	2	1	0
Address 87..	17	16	15	14	13	12	11	10
Variable	WH	WL	TN	XP	G2	G1	/R3	W
Contents	1	1	1	1	1	1	1	1
Hex number	F				F			

Table 6.28 (Basic configuration 111)

6.3 Switches

Keys 10, 18 (not present in controller PE) and 12 act on 3 bytes in the internal RAM that are hereinafter designated "switches".

Key 10 (W switch) acts on byte 2AH
Key 18 (F switch) acts on byte 29H
Key 12 (Y switch) acts on byte 28H

In each switch one bit, in divided switches (see 6.3.3) one bit respectively in each half is set.

6.3.1 Switch settings

By pressing the key for less than 1 second the switch bit is shifted from its present position to the next higher enabled position. When the highest enabled position is reached, the next brief key depression shifts the bit to the lowest enabled position. Holding the keys for longer than 1 second causes shifting in the opposite direction at a rate of 0.4 seconds.

If a switch is divided (see 6.3.3), a key depression shifts the switch bit within bit positions 0 to 3 if channel 1 is displayed, or within bit positions 4 to 7 if channel 2 is displayed.

The following switch settings have a fixed, unalterable meaning:

Undivided switch:	Y_ 0 = Manual	(halt)
	Y_ 2 =	(repeat)
Divided switch:	Y_ 0 = Manual	(Halt)
	Y_ 2 =	(repeat)
	Y_ 4 = Manual	(halt)
	Y_ 6 =	(repeat)

Information in () applies to programmer.

All other switch settings mean "not manual". Their function depends on the configuration.

Which of the switch settings are enabled is specified in addresses

877BH for the W switch
877AH for the F switch
8779H for the Y switch

The meanings are

1 = enabled
0 = blocked.

877BH	W-switch							
Bit	7	6	5	4	3	2	1	0
Enabled	0	0	0	0	0	1	0	1
Hex	0				5			
Character		P		I	C	E	F	I
In addr. 87..H	5F	5E	5D	5C	5B	5A	59	58

877AH	F-switch							
Bit	7	6	5	4	3	2	1	0
Enabled	0	0	0	0	0	0	0	1
Hex	0				1			
Character			P	0	S	G	2.	
In addr. 87..H	57	56	55	54	53	52	51	50

8779H	Y-switch							
Bit	7	6	5	4	3	2	1	0
Enabled	0	0	0	0	0	1	0	1
Hex	0				5			
Character	F	A	F	H	F	A	E	H
In addr. 87..H	4F	4E	4D	4C	4B	4A	49	48

Table 6.29 (Basic configuration 111)

Hex.		Hex.		Hex.		Hex.	
FB		FF		CE		9D	
B0		F7		DB		EE	
ED		FE		9E		8C	
F5		9F		BE		(D7)	
B6		CB		F1		8F	
D7		8D		8B		BB	
DF		BD		9C		99	
F0		CF		(FB)		B7	

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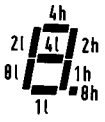
Fig. 6.3 Characters shown by the seven-segment display (80H = dark)



Special characters can be defined as follows:
l = low-order segment
h = high-order segment

6.3.2 Switch setting display

In addresses
8748H to 874FH for the Y switch
8750H to 8757H for the F switch
8758H to 875FH for the switch

are entered characters that can be displayed by operating the keys in the adjacent display fields (see Fig. 6.3). Of the characters entered, only those whose associated switch setting is enabled are displayed.

Hex 80H is the blank character. If 80H is subtracted from the specified hex values, the same display is obtained but with a decimal point.

6.3.3 Division of switch levels

If a value other than "0" is entered in 8735H, the switches (Y, F and W) are divided in the middle, i.e. for each channel there are then four switch settings available. It is not possible to set a different number for the two channels.

It is possible to determine which switch is divided from the contents of 8735H.

Bit 0 = 1 : Y switch divided
Bit 1 = 1 : F switch divided
Bit 2 = 1 : W switch divided
Bit 4 = 1 : Character set for Y switch divided
for 1st channel addresses 8748H to 874BH
for 2nd channel addresses 874CH to 874FH
Bit 5 = 1 : Character set for F switch divided
for 1st channel addresses 8750H to 8753H
for 2nd channel addresses 8754H to 8757H
Bit 6 = 1 : Character set for W switch divided
for 1st channel addresses 8758H to 875BH
for 2nd channel addresses 875CH to 875FH

8735H								
Bit	7	6	5	4	3	2	1	0
	Character set for switch				Switch			
		W	F	Y		W	F	Y
Divided	0	0	0	0	0	0	0	0
Hex	0				0			

Table 6.30 (Basic configuration 111)

This division, of the character set also, is a precondition for a different number of switch settings in both the channels.

6.4 Disconnection of seven-segment displays

The seven-segment-displays can be switched on and off individually. Disconnection of a display does not alter the function of the unit. If for instance the display next to the W switch is disconnected the key remains active but the function switch on cannot be read.

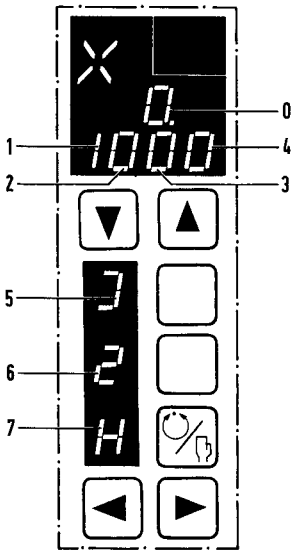


Fig. 6.4

The status of the 8 displays is determined by the bits in mask 8744H if this is activated by the binary variable BLD ('23) = 1. If BLD = 0 all displays are switched on.

In the mask the meaning of
1 = display off
0 = display on.

8744H								
Bit	7	6	5	4	3	2	1	0
Display	7	6	5	4	3	2	1	0
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.31 (Basic configuration 111)

Application:
If one or more displays are to flash, these must be flagged in the above mask and BLD configured for example as follows:

BLD : BTN, TF2.

6.5 Binary variables

6.5.1 Display of switching status of selected binary variables

In the F key display the switching status of up to 4 binary variables can be shown. This function is used serially in the step action controller.

The function is switched on by entering a zero in address 8730H. A different hex number at the same position switches the display off.

Which variable is displayed is specified in addresses 8731H to 8734H by entering the hex name of the desired variable.

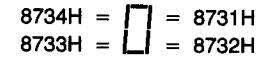


Fig. 6.5 Assignment of variables to the display segments

If the binary variable entered in the named addresses = 1, the associated segment lights up. The top and bottom segment always light if the switching status display was activated via 8730H.

6.5.2 Operating and quiescent current signaling

6.5.2.1 Outputs

Operating and quiescent current signaling is specified for all binary outputs by the contents of addresses 873DH and 873EH by setting a 0 or a 1 at the appropriate bit position.

"0" = output conducting if binary variable = 1
"1" = output blocked if binary variable = 0

The action of outputs Q01 to Q04 (G1 to G4) is also determined by switch S1/6.

If S1/6 = 0 the entries in 873DH apply
S1/6 = 1 the action is the inverse of 873DH.

In addresses 873DH and 873EH the binary outputs are sorted as follows:

873DH								
Bit	7	6	5	4	3	2	1	0
Variable	Q04	Q03	Q02	Q01	EUG	EA2	EA1	D00
Contents	0	0	0	0	1	0	0	1
Hex number	0				9			

873EH								
Bit	7	6	5	4	3	2	1	0
Variable	Q12	Q11	Q10	Q09	Q08	Q07	Q06	Q05
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.32 (Basic configuration 111)

Here: Q01...Q04 : Alarm values
Q05...Q12 : Binary outputs
D00: see 6.5.2.2

Error messages in byte 30H of the internal RAM (see 6.9):
EUG : Transmitter suplly
EA1 : Output 1
EA2 : Output 2

6.5.2.2 Inputs

In the delivery status of the units the following applies to all binary inputs:

"0" = Input is open or U = 10...36 V
"1" = Input short circuited or U = −2...+3 V

Voltage data and short circuit against instrument ground "C".

This can be reversed in controllers (PS with software before 16/85 and PE with software ../84) with switch S1/6. In instruments with later software status the function depends solely on the entry in address 873FH (D00 in 873DH).

Entry "0" = delivery status
"1" = reversal of delivery status

873FH								
Bit	7	6	5	4	3	2	1	0
Variable	D08	D07	D06	D05	D04	D03	D02	D01
Contents	0	0	0	0	0	0	0	0
Hex number	0				0			

Table 6.33 (Basic configuration 111)

6.5.3 Real-time clock – timing marks

The real-time clock affects bit BEH (timing mark 1) and BFH (timing mark 2) (in byte 33H of the internal RAM) by comparing the current time with timing marks 1 and 2. (See 42/62-61-.)

The bits are
"0" = The current time is less than the timing mark
"1" = The current time is equal to/greater than the timing mark

The bits are reset respectively at 0 hours. Address 87D8H determines how the comparison is effected.

"0" = Date is noted too for both marks
"1" = Date is only noted for mark t2
"2" = Date is only noted for mark t1
"3" = Date is not noted for either mark

6.6 Controller and programmer functions

The principal function is defined in accordance with the Operating Manual by entering values in addresses 87DAH to 87DCH.

Which function is configured by this means is contained in address 8738H.

8738H								
Bit	7	6	5	4	3	2	1	0
Function	Channel 1				Channel 2			
	0	0	0	0	0	0	0	0
Hex number	0				0			

"0000" = Continuous controller
"0001" = Step action controller
"0100" = Programmer

Table 6.34 (Basic configuration 111)

6.6.1 Different structures for two channels

The unit structure and time ranges are normally specified jointly for both channels with switches S2/7 and S2/8. In special circumstances the two channels can be separated.

In the programmer/controller the time ranges of the sections are defined solely by bits 0 and 1 of the variable (recognizable by the decimal point position).

6.6.1.1 Time ranges and channel number

Address 8739 specifies which channels are activated and which time ranges are valid for the two control channels if switches S2/7 and S2/8 have been inactivated.

8739H								
Bit	7	6	5	4	3	2	1	0
	Channel 1				Channel 2			
Function	0	0	0	0	0	0	0	0
Hex number	0				0			

Bit 7: 0 = Channel 1 is active
1 = Channel 1 is not active
Bit 6: 0 = Switch S2/. is active
1 = Switch S2/. is inactive
for Channel 1
Bit 3: 0 = Channel 2 is **not** active
1 = Channel 2 is active
Bit 2: 0 = Switch S2/. is active
1 = Switch S2/. is inactive
for Channel 2
Bit 0,1,4,5: Bits 0,1 and 4,5 take the place of switches S2/7 and S2/8 (only for TN and TD)

Table 6.35 (Basic configuration 111)

Control-channel 1	8739H Bit 5 S2/7	Bit4 S2/8	
Control-channel 2	8739H Bit 1 S2/7	Bit 0 S2/8	
	0	0	0...1999 seconds
	1	0	0...199.9 minutes
	0	1	0...19.99 hours
	1	1	0...1.999 x 1000 hours

Table 6.36 (Basic configuration 111)

If the control function is switched off in a controller with bit 7 or bit 3 in byte 8739H, the controller output can still be displayed in the manual operating mode.

6.6.1.2 Control dynamics

Switches S2/1 to S2/6 are normally active for both channels. Channel 1 can be configured independently of the switch positions via the contents of address 873AH, channel 2 via address 873BH. Bits 1 to 4 take on the function of the mechanical switches if bit 7 = 1. Bits 0 and 5 are always active.

873AH 873BH								
Bit	7	6	5	4	3	2	1	0
Function		I	D+	X	P	VD	XD/ XU	D–
Contents	0	0	1	0	0	0	0	1
Hex number	2				1			

Table 6.37 (Basic configuration 111)

Bit 0: Function D-
1 = Only negative changes are differentiated
0 = Negative changes are not differentiated
Bit 1: Function XD/XU
1 = XD is differentiated
0 = XU is differentiated
Bit 2: Function VD
1 = Derivative gain large (approx. 4)
0 = Derivative gain small (approx. 1)
Bit 3: Function P
1 = P action switched on
Bit 4: Function characteristic
1 = Reverse action characteristic
0 = Direct action characteristic
Bit 5: Function D+
1 = Only positive changes are differentiated
0 = Positive changes are not differentiated
Bit 6: Function I
1 = Integral action is switched on
Bit 7: 1 = Switches S2/1 to S2/6 are inactive

6.6.2 Single-sided differentiation

In controller PS it is possible by setting bit 0 or bit 5 in addresses 873AH and 873BH to zero (in controller PE only address 873AH) to cause only positive or negative changes of XD or XU to be differentiated and affect the positioning signal.

6.6.3 Repeat operation in programmer

The number coded in hexadecimal of the restart point at which a repetition of the program is to start must be entered in:

address 8736H for programmer 1
address 8737H for programmer 2

6.6.4 Step-action controller (as from software "H" September 86)

In standard configuration the step-action controller has, within the dead band (in which the P-action is no more effective), a pulse duration decreasing with the control deviation

$$T_{on}(s) \sim 7.5 \cdot \frac{X_D}{X_P}$$

For final control elements not reacting to short control pulses, a constant switch-on period can be set by configuration (see table). For special cases the switching pulses within the dead band can be suppressed completely.

The switching behaviour within the dead band is defined in the bytes 872EH (channel 1) and 872FH (channel 2).

Default value in both bytes is FFH.

872EH channel 1 872FH channel 2								
Bit	7	6	5	4	3	2	1	0
$T_{on} = 0$ No positioning pulses	0	x	x	x	x	x	x	x
$T_{on}(s) \sim 7.5 \cdot \frac{X_D}{X_P}$	1	1	x	x	x	x	x	x
T_{on} = constant (0 ... 63) · 0,06 (s)	1	0	y	y	y	y	y	y

Table 6.38 Switching behaviour within the dead band
x = arbitrary, i.e. without function
y = depending on required switch-on period

Example:

Switch-on period constant approx. 0.6 s:

872EH or 872FH resp. = 1000 1010 = 8AH = factor 10

The stated pulse durations should be multiplied with factor

$$(1+\frac{T_{on}}{T_{off}})$$

The actual minimum pulse duration is approx. 70 ms ± cycle length (30 ... 40 ms).

6.7 Serial interface

For details see 42/62-64-...

6.7.1 Configuration interface

Data traffic via the side configuration interface (SER) follows the same rules as the operator interface described in 6.7.2 and Operating Manual 42/62-64...

This interface is set for the configurator to 15,625 baud. For connecting other instruments to the side connection the following standardized and non standardized baud rates can be configured by entering a hex number in address 8704H. This number can be taken from Table 6.38 or calculated as follows:

Decimal: 256 – n is converted to a hex number. The resulting baud rate is

62,500 : n = baud rate.

n	Hex	Baud rate	:	n	Hex	Baud rate
3	FD	20,833	:	12	F4	5,208
4	FC	15,625	:	13	F3	4,808
5	FB	12,500	:	14	F2	4,464
6	FA	10,417	:	15	F1	4,167
7	F9	8,929	:	20	F0	3,125
8	F8	7,813	:	26	E6	2,404
9	F7	6,944	:	52	BB	1,202
10	F6	6,250	:	104	98	601
11	F5	5,682	:	208	30	300

Table 6.39

The maximum transmission speed is also determined by the cycle time of the controller, as in each cycle a maximum of 6 telegrams can be received from the controller or the associated reply sent.

6.7.2 Operator interface RS 422

The standard operator interface – via which configuration can also be accomplished – complies with standard RS 422 from mid-1985. Units supplied before that date still have an RS 232 C interface.

The valid baud rate is entered in clear text in monitor MC 0015 and stored in code in address 8703H. Direct entry of the hex numbers to the address is possible.

6.7.2.1 Controller address

The unit address required to operate the controller at an RS 422 transmission system is entered – a different address for every connected controller – at storage address 87E0H as a hex numeral in the value range

1H ... FFH = 1 ... 254

The unit address can also be entered via monitor routine MC 0014.

The unit address can be protected against overwriting e.g. from the EEPROM as described in Section 6.8.

6.7.2.2 Baud rate

For baud rates up to 20833 Bd, setting is also possible via monitor MC 0015.

6.7.2.3 System image

In addition to the preset variables in the system image, in addresses 8721H to 8724H four analog variables respectively and in addresses 871CH to 871FH four binary variables can be defined relating to the control loop.

By changing the memory contents the variables normally entered can be exchanged for others. In each case the hex code of the desired variable must be entered.

In address 1BH, bits 4 to 7 specify whether a message from binary outputs Q01 to Q04 is included in the status telegram (see 42/62-63-) (1 = include).

871BH								
Bit	7	6	5	4	3	2	1	0
Variable	Q04	Q03	Q02	Q01				
Contents	1	1	1	1	1	1	1	1
Hex number	F				F			

Table 6.40 (Basic configuration 111)

6.7.3 Error detection

In address 8706H can be entered the number of seconds ≦ 254 ≙ FEH that specifies the maximum time after which the controller expects a new telegram. If no telegram reaches the controller within this time it sets error bit ETC = 91H.

The controller counts the telegrams detected as faulty in one minute. If the number (hex) entered in address 8707H is exceeded, error bit ETS = '92 is set.

In the actual controller these error bits can be recorded in the configuration and processed.

In this way transmission errors can be detected and signalled if necessary by the controller.

6.8 Protection of the autocalibration data and the controller address at the RS 422 bus

If a configuration is loaded from cassette, EEPROM, configurator or a computer, generally the autocal data and the controller address at the RS 422 bus must be retained. This is possible by means of switch S1/1 (see 42/62-61-) or with address 87DEH.

If the configuration to be loaded is given the value FEH in address 87DEH, the autocal data and unit address remain unchanged.

Entering FEH in address 87DEH prior to loading has no effect.

Unit-related configurations that may also contain the default values as parameters should therefore contain FEH in address 87DEH.

In addresses 87E2H to 87FF, the units contain the calibration data of the inputs and outputs ascertained at the factory. Corrections can be made via the AUTOCAL routine.

6.9 Messages in the digital display and diagnostics output

The results of 32 internal monitoring functions and of 8 freely configurable binary functions can be shown in the digital display with a short text.

The conditions under which a message appears are specified by masks 0 to 2. Mask 3 determines, independently of this, whether a result bit of a dignostic routine is passed to diagnostic output Q00 by way of 0R operations.

Tables 6.41 to 6.46 give the assignment of mask bits, result bits and the message texts appearing in the digital display.

6.9.1 During the event

Masks 0 and 1 define jointly whether and when the message is transferred to the display register. If the mask is set accordingly and the result bit is set it is shown in the digital display for 2 s in 4 s.

X	Er.bA	X	Er.bA

If several messages occur simultaneously they are displayed in succession, the original display continuing to be visible in the intervals.

X	Er.bA	X	AL 1	X	Er.bA

In extreme circumstances up to 40 messages can be defined and displayed. A definition of this type can be useful for test purposes if it is suspected that some result bits only occur sporadically and briefly. Such messages can be "captured" by suitably selecting the entries in mask 2.

Bit in mask 0	Bit in mask 1	During the event
1	1	Message is not transferred to display
1	0	Rising edge of the result bit causes transfer to display register. Message occurs as long as result bit is set. If the message is acknowledged (see below) it disappears from the display.
0	1	As 1/0 but after acknowledgement if the result bit is still set the message reappears after max. 4 minutes.
0	0	As 1/0 but the message cannot be acknowledged as long as the result bit is set.

Table 6.41

Exception:
For the messages Er.H_, Er.bA, Er.LP, Er.00 see Operating Manual
assignments 1/1 and 0/0 are reversed, i.e. with 0/0 the message is not transferred.

6.9.2 After termination of the event

Mask 2 defines what takes place in memory.
Bit = 0: Message is retained even if the result bit has gone back to 0. The message desappears after acknowledgement from the display if masks 0 and 1 allow this.
Bit = 1: The message disappears if the result bit goes back to 0 or after acknowledgement if masks 0 and 1 allow this.

Acknowledgement is accomplished by simultaneously operating keys ▲ and ▼ when the message text is visible in the display. Messages Er.00, Er.nA and Er.H_ must be acknowledged with key 12.

6.9.3 Q00

Mask 3
Bit = 0 : Message does not affect Q00
Bit = 1 : Message is combined in OR operation other messages to Q00

87A0H	Mask 0		ERR0					
87A1H	Mask 1							
87A2H	Mask 2							
87A3H	Mask 3							
Bit	7	6	5	4	3	2	1	0
address	97H	96H	95H	94H	93H	92H	91H	90H
Messagetext	Er.SC	Er.SS	Er.dl	Er.dr	Er.cS	Er.tS	Er.tc	Er.to

Table 6.42

87A4H	Mask 0		BLW5					
87A5H	Mask 1							
87A6H	Mask 2							
87A7H	Mask 3							
Bit	7	6	5	4	3	2	1	0
Address	2FH	2EH	2DH	2CH	2BH	2AH	29H	28H
Messagetext	AL_4	AL_3	AL_2	AL_1	SC_4	SC_3	SC_2	SC_1

Table 6.43

87A8H	Mask 0		ERR1					
87A9H	Mask 1							
87AAH	Mask 2							
87ABH	Mask 3							
Bit	7	6	5	4	3	2	1	0
Address	A7H	A6H	A5H	A4H	A3H	A2H	A1H	A0H
Messagetext	Er.I2	Er.I2	Er.I2	Er.I1	Er.UG	Er.A2	Er.A1	Er.nn

Table 6.44

87ACH	Mask 0		ERR2					
87ADH	Maske 1							
87AEH	Mask 2							
87AFH	Mask 3							
Bit	7	6	5	4	3	2	1	0
Address	AFH	AEH	ADH	ACH	ABH	AAH	A9H	A8H
Messagetext	Er.H_	Er.LP	Er.bA	Er.rr	Er.PE	Er.nA	Er.Au	Er.LE

Table 6.45

87B0H	Mask 0		ERR3					
87B1H	Mask 1							
87B2H	Mask 2							
87B3H	Mask 3							
Bit	7	6	5	4	3	2	1	0
Address	B7H	B6H	B5H	B4H	B3H	B2H	B1H	B0H
Messagetext	Er.FC	Er.rt	Er.00	Er_2	Er_3	Er_4	Er_5	Er_6

Table 6.46

In the above tables the message text is shown in somewhat abbreviated form. A "." is always shown between "er" and the rest.

Section 8 contains an explanation of the message texts.

6.9.4 Delivery status

The diagnostics output combines:
Er.I.2 (PS only)
Er.I.1
Er.LP
Er.UG
Er.H_ = sum of Er.PU
Er.CO
Er.C5
Er.C7 (Controller PS only)
Er.EL
Er.00
Er._2
17H (binary variable)
HOLD
LOAD (PS only)
AUTOCAL

All masks are set in such a way that no messages other than Er.bA, Er.LP, Er.H_ and Er.00 are shown in the digital display. Of the messages mentioned, only Er.00 can be acknowledged with key (10).

6.10 Indicator with more than two alarm values

The hex names of the alarm values are entered twice each in addresses 8710H to 8713H and 8714H to 8717H. This reduces the possible four green pointers to two markers.

If the double designations are removed by entering other names, up to four markers may be produced.

It is therefore possible to assign more than two alarm value markers to a system.

To derive the alarm value comparison as well from an input variable it is necessary to change the configuration.

The unneeded alarm value markers in the other system are switched off jointly via bit 30H or bit 31H:

YST : BTI,LLL (left off)
or FST : BTI,LLL (right off)

7 Description of commands

On the following pages the commands used in the Protronic P are described. An abbreviated summary is given in Annex 1.

The following abbreviations are used.

RES = Result of an operation
stands in place of an output variable
SR1 = Input 1 of an operation command
stands in place of an input variable
SR2 = Input 2 of an operation command
stands in place of an input variable

7.1 Logical commands

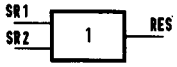
Overview:

SR1	SR2	ANN	ANI	AIN	AII	ONN	ONI	OIN	OII	XNN	XNI
1	1	1	0	0	1	1	0	1	0	0	1
0	1	0	1	1	0	1	0	1	0	1	0
1	0	0	1	0	1	1	0	0	1	1	0
0	0	0	1	0	1	0	1	1	0	0	1

Mnemonic: **BTN** **HEX 01H**

Function: **B**it-**T**ransfer-**N**ot negated
RES = SR1
SR2 is not processed

Symbol:



Truth table:

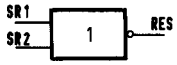
SR1	SR2	RES
1	1	1
0	1	0
1	0	1
0	0	0

Time requirement: 88...**89**...90 μs

Mnemonic: **BTI** **HEX 02H**

Function: **B**it **T**ransfer **I**nverted
RES = $\overline{SR1}$
SR2 is not processed

Symbol:



Truth table:

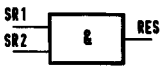
SR1	SR2	RES
1	1	0
0	1	1
1	0	0
0	0	1

Time requirement: 88...**89**...90 μs

Mnemonic: **ANN** **HEX 03H**

Function: **A**nd **N**ot **N**egated = AND
Input and output not inverted
RES = SR1 AND SR2

Symbol:



Truth table:

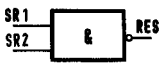
SR1	SR2	RES
1	1	1
0	1	0
1	0	0
0	0	0

Time requirement: 109...**111**...112 μs

Mnemonic: **ANI** **HEX 04H**

Function: **A**nd **N**ot-inverted **I**nverted
Input not inverted, output inverted
RES = $\overline{SR1 \text{ AND } SR2}$

Symbol:



Truth table:

SR1	SR2	RES
1	1	0
0	1	1
1	0	1
0	0	1

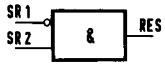
Time requirement: 109...**111**...112 μs

Mnemonic: **AIN** **HEX 05H**

Function: **A**nd **I**nverted **N**ot-inverted
Input 1 inverted, output not inverted

RES = $\overline{SR1}$ AND SR2

Symbol:



Truth table:

SR1	SR2	RES
1	1	0
0	1	1
1	0	0
0	0	0

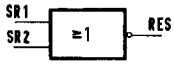
Time requirement: 109...**111**...112 μs

Mnemonic: **ONI** **HEX 08H**

Function: **O**r **N**ot-invertiert **I**nverted
Input not inverted, output inverted

RES = $\overline{SR1\ OR\ SR2}$

Symbol:



Truth table:

SR1	SR2	RES
1	1	0
0	1	0
1	0	0
0	0	1

Time requirement: 109...**111**...112 μs

Mnemonic: **AII** **HEX 06H**

Function: **A**nd **I**nverted **I**nverted
Input 1 and output inverted

RES = $\overline{\overline{SR1}\ AND\ SR2}$

Symbol:

Truth table:

SR1	SR2	RES
1	1	1
0	1	0
1	0	1
0	0	1

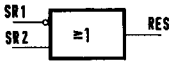
Time requirement: 109...**111**...112 μs

Mnemonic: **OIN** **HEX 09H**

Function: **O**r **I**nverted **N**ot-Inverted
Input 1 inverted, output not inverted

RES = $\overline{SR1}$ OR SR2

Symbol:



Truth table:

SR1	SR2	RES
1	1	1
0	1	1
1	0	0
0	0	1

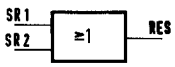
Time requirement: 109...**111**...112 μs

Mnemonic: **ONN** **HEX 07H**

Function: **O**r **N**ot **N**egated = OR
Input and output not inverted

RES = SR1 OR SR2

Symbol:



Truth table:

SR1	SR2	RES
1	1	1
0	1	1
1	0	1
0	0	0

Time requirement: 109...**111**...112 μs

Mnemonic: **OII** **HEX 0AH**

Function: **O**r **I**nverted **I**nverted
Input 1 and output inverted

RES = $\overline{\overline{SR1}\ OR\ SR2}$

Symbol:

Truth table:

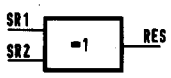
SR1	SR2	RES
1	1	0
0	1	0
1	0	1
0	0	0

Time requirement: 109...**111**...112 μs

Mnemonic: **XNN** **HEX 0BH**

Function: **EX**clusive **O**r **N**ot-inverted
Inputs and output not inverted
RES = SR1 exclusive Or SR2

Symbol:



Truth table:

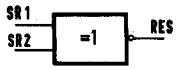
SR1	SR2	RES
1	1	0
0	1	1
1	0	1
0	0	0

Time requirement: 109...**111**...112 μs

Mnemonic: **XNI** **HEX 0CH**

Function: **EX**clusive **O**r **I**nverted
Inputs not inverted, output inverted
RES = $\overline{\text{SR1 exclusive Or SR2}}$

Symbol:



Truth table:

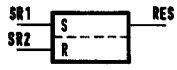
SR1	SR2	RES
1	1	1
0	1	0
1	0	0
0	0	1

Time requirement: 109...**111**...112 μs

Mnemonic: **FRS** **HEX 0DH**

Function: Static RS Flip-flop

Symbol:



Truth table:

t_n			t_n+1
SR1	SR2	RES	RES
1	0	0	1
1	0	1	1
x	1	x	0

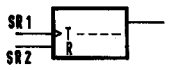
x = any

Time requirement: 85...**101**...119 μs

Mnemonic: **FTR** **HEX 0EH**

Function: Edge-triggered TR Flip-flop

Symbol:



Truth table:

t_n			t_n+1
SR1	SR2	RES	RES
⌐/	0	0	1
⌐/	0	1	0
x	1	x	0

x = any
⌐/ = positive edge

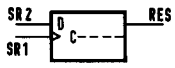
Time requirement: 118...**137**...154 μs

Mnemonic: **FDH** **HEX 0FH**

Function: Edge-triggered D Flip-flop
rising edge

Positive edge of SR1 switches RES to "1" if SR2 = "1"
Positive edge of SR1 switches RES auf "0" if SR2 = "0"

Symbol:



Truth table:

t_n			t_n+1
SR1	SR2	RES	RES
⌐/	0	0	0
⌐/	1	0	1
⌐/	0	1	0
⌐/	1	1	1
0	x	0	0
0	x	1	1

x = any
⌐/ = positive edge

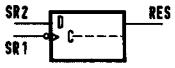
Time requirement: 118...**132**...154 μs

Mnemonic: **FDL** **HEX 10H**

Function: Edge-triggered D flip-flop
falling edge

Negative edge of SR1 switches RES to "1" if SR2 = "1"
Negative edge of SR1 switches RES to "0" if SR2 = "0"

Symbol:



Truth table:

t_n			t_n+1
SR1	SR2	RES	RES
_	0	0	0
_	1	0	1
_	0	1	0
_	1	1	1
0	x	0	0
0	x	1	1

x = any
_ = negative edge

Time requirement: 118...**132**...154 μs

7.2 Switch functions

Mnemonic: SOL **HEX 11H**

Function: **S**witch **O**pen if actuation "0" (0 = **L**ow)

Symbol:

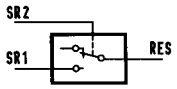


Table:

SR2	RES
1	SR1
0	Last value of SR1

Time requirement: 74...**83**...91 μs

Mnemonic: SOH **HEX 12H**

Function: **S**witch **O**pen if actuation "1" (1 = **H**igh)

Symbol:

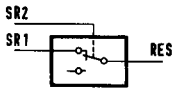


Table:

SR2	RES
0	SR1
1	Last value of SR1

Time requirement: 75...**84**...92 μs

Mnemonic: SIH **HEX 13H**

Function: **S**witch - **I**nverse Output if actuation = "1" (**H**igh)

Symbol:

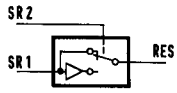


Table:

SR2	RES
1	−SR1
1	+SR1

Time requirement: 92...**93**...94 μs

Mnemonic: SIL **HEX 14H**

Function: **S**witch - **I**nverse Output if actuation = "0" (**L**ow)

Symbol:

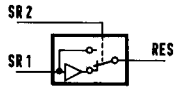


Table:

SR2	RES
1	SR1
0	−SR1

Time requirement: 93...**94**...95 μs

Mnemonic: SZL **HEX 15H**

Function: **S**witch - RES = (**Z**ero) if actuation = "0" (**L**ow)

Symbol:

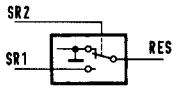


Table:

SR2	RES
1	SR1
0	0

Time requirement: 92...**95**...97 μs

Mnemonic: SZH **HEX 16H**

Function: **S**witch - RES = (**Z**ero) if actuation = "1" (**H**igh)

Symbol:

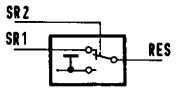


Table:

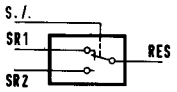
SR2	RES
0	SR1
1	0

Time requirement: 93...**96**...98 μs

Mnemonic: U31 to U33 **HEX 17H to 19H**

Function: **C**hangover switch actuated by **S3/1, S3/2** and **S3/3**

Symbol:



S3/1 or S3/2 or S3/3 replaces S3/.

Table:

SR3/.	RES
1	SR2
0 (open)	SR1

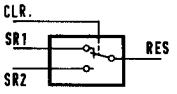
Time requirement: 94...**95** μs

Mnemonic: UC. **HEX. see table**

Mnemonic	Hex code
UC0	1AH
UC1	1BH
UC2	1CH
UC3	1DH
UC4	1EH

Function: **C**hangeover switch actuated by **CLEAR 0** to **CLEAR 4**

Symbol:



Function table:

CLR.	RES
0	SR1
1	SR2

Operation: See Operating Manual for PS, PE and PA

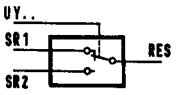
Time requirement: 94...**95** μs

Mnemonic: UY. **HEX. see table**

Mnemonic	Hex code
UY0	1FH
UY1	20H
UY2	21H
UY3	22H
UY4	23H
UY5	24H
UY6	25H
UY7	26H

Function: **C**hangeover switch actuated by key 12
(mode selector switch **Y**)

Symbol:



UY..	RES
0	SR1
1	SR2

Time requirement: 89...**90** μs

Explanation: Key 12 can be used to select 8 (0...7) switch positions. In switch position UYn, switch is changed over.

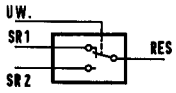
The switches actuated are specified by memory position 8779H (see section 6.3.1). The characters displayed next to the key are entered in memory positions 8748H to 874FH (see section 6.3.2).

Mnemonic: UW. **HEX. see table**

Mnemonic	Hex code
UW0	2FH
UW1	30H
UW2	31H
UW3	32H
UW4	33H
UW5	34H
UW6	35H
UW7	36H

Function: **C**hangeover switch actuated by key 10
(I/E - key **W**)

Symbol:



UW..	RES
0	SR1
1	SR2

Time requirement: 89...**90** μs

Explanation: Key 10 can be used to select 8 (0...7) switch positions. In switch position n, switch UWn is changed over.

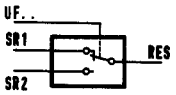
The switches actuated are specified by memory position 877BH (see section 6.3.1). The characters displayed next to the key are entered in memory positions 8758H to 875FH (see section 6.3.2).

Mnemonic: UF. **HEX. see table**

Mnemonic	Hex code
UF0	27H
UF1	28H
UF2	29H
UF3	2AH
UF4	2BH
UF5	2CH
UF6	2DH
UF7	2EH

Function: **C**hangeover switch actuated by key 18
(**F** key)

Symbol:



UF..	RES
0	SR1
1	SR2

Time requirement: 89...**90** μs

Explanation: Key 18 can be used to select 8 (0...7) switch positions. In switch position n, switch UFn is changed over.

The switches actuated are specified by memory position 877AH (see section 6.3.1). The characters displayed next to the key are entered in memory positions 8750H to 8757H (see section 6.3.2).

7.3 Limiters

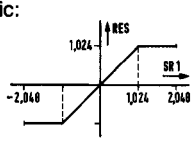
Mnemonic: LB1 **HEX 37H**

Function: **L**imiter **B**ipolar

RES = SR1 for $-102.4 \leqq SR1 \leqq +102.4$ %
RES = 102.4 for $102.4 \leqq SR1 \leqq 204.8$ %
RES = -102.4 for $-204.8 \leqq SR1 \leqq -102.4$ %

Symbol:

Characteristic:



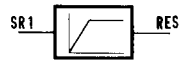
Time requirement: 78...**82**...85 μs

Mnemonic: LU1 **HEX 38H**

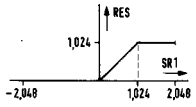
Function: **L**imiter **U**nipolar

RES = SR1 for 0.0 ≦ SR1 ≦ 102.4 %
RES = 0 for −102.4 ≦ SR1 ≦ 0.0 %
RES = 102.4 for 102.4 ≦ SR1 ≦ 204.8 %

Symbol:



Characteristic:



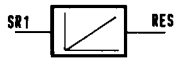
Time requirement: 82...**88**...93 µs

Mnemonic: LU2 **HEX 39H**

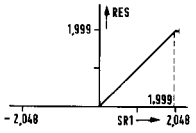
Function: **L**imiter **U**nipolar

RES = SR1 for 0.0 ≦ SR1 ≦ 199.9 %
RES = 0.0 for −204.8 ≦ SR1 ≦ 0.0 %
RES = 199.9 for 199.9 ≦ SR1 ≦ 204.8 %

Symbol:



Characteristic:



Time requirement: 82...**85**...89 µs

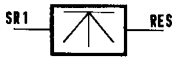
7.4 Calculation functions

Mnemonic: NEG **HEX 3AH**

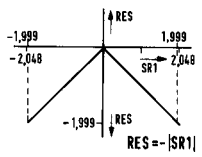
Function: **Neg**ative absolute value of the input

RES = −I SR1 I for −199.9 ≦ SR1 ≦ 199.9 %
RES = −199.9 for 199.9 ≦ SR1 ≦ 204.8 %

Symbol:



Characteristic:



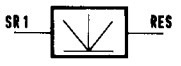
Time requirement: 86...**89**...91 µs

Mnemonic: ABS **HEX 3BH**

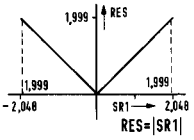
Function: Formation of the **Abs**olute value

RES = SR1 for 0.0 ≦ SR1 ≦ 199.9 %
RES = 199.9 for 199.9 ≦ SR1 ≦ 204.8 %
RES = −SR1 for −199.9 % ≦ SR1 ≦ 0.0 %
RES = −199.9 for −204.8 ≦ SR1 ≦ −199.9 %

Symbol:



Characteristic:



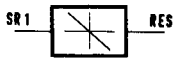
Time requirement: 83...**86**...88 µs

Mnemonic: INV **HEX 3CH**

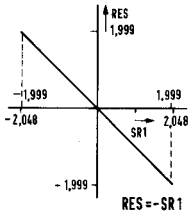
Function: **Inv**ert the input

RES = −SR1 for −199.9 ≦ SR1 ≦ 199.9 %
RES = 199.9 for 199.9 ≦ SR1 ≦ 204.8 %
RES = −199.9 for −204.8 ≦ SR1 ≦ −199.9 %

Symbol:



Characteristic:



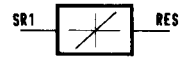
Time requirement: 85...**88**...90 µs

Mnemonic: DIR **HEX 3DH**

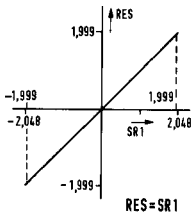
Function: **Dir**ect transfer of the input to the output

RES = SR1 for −199.9 ≦ SR1 ≦ 199.9 %
RES = 199.9 for 199.9 ≦ SR1 ≦ 204.8 %
RES = −199.9 for −204.8 ≦ SR1 ≦ −199.9 %

Symbol:



Characteristic:



Time requirement: 82...**85**...87 µs

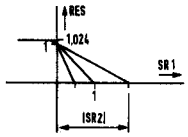
Mnemonic: YC1 **HEX 42H**

Function: Characteristic displacement and rotation

$$RES = 100\,\% - \frac{SR1}{|SR2|}\,\%$$

Symbol:

Characteristic:



Value range: Inputs: −199.9 ... +199.9 %
Output: 0.0 ... +102.4 %

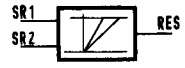
Time requirement: 163...**368**...387 µs

Mnemonic: YC2 **HEX 43H**

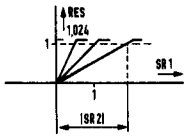
Function: Characteristic displacement and rotation

$$RES = \frac{SR1}{|SR2|}\,\%$$

Symbol:



Characteristic:

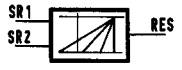


Mnemonic: YC3 **HEX 44H**

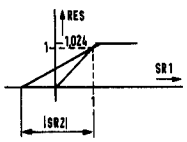
Function: Characteristic displacement and rotation

$$RES = 100\,\% + \frac{SR1 - 100}{|SR2|}\,\%$$

Symbol:



Characteristic:



Value range: Inputs: −199.9 ... +199.9 %
Output: 0.0 ... +102.4 %

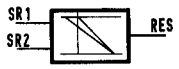
Time requirement: 163...**368**...387 µs

Mnemonic: YC4 **HEX 45H**

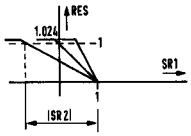
Function: Characteristic displacement and rotation

$$RES = \frac{100\,\% - SR1}{|SR2|}\,\%$$

Symbol:



Characteristic:



Value range: Inputs: −199.9 ... +199.9 %
Output: 0.0 ... +102.4 %

Time requirement: 163...**368**...387 µs

Mnemonic: MAX **HEX 46H**

Function: **Max**imum selection

RES = SR1 if SR1 ≧ SR2
RES = SR2 if SR1 < SR2

Symbol:

Value range, input and output
−204.8 ... +204.8 %

Time requirement: 132...**139**...145 µs

Mnemonic: MIN **HEX 47H**

Function: **Min**imum selection

RES = SR1 if SR1 ≦ SR2
RES = SR2 if SR1 > SR2

Symbol:

Value range, input and output:
−204.8 ... +204.8 %

Time requirement: 130...**137**...142 µs

Mnemonic: ADD **HEX 48H**

Function: **Add**ition

RES = SR1 + SR2

Symbol:

Value range, input and output:
−199.9 ... +199.9 %

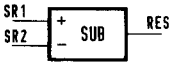
Time requirement: 143...**150**...160 μs

Mnemonic: SUB **HEX 49H**

Function: **Sub**traction

RES = SR1 − SR2

Symbol:



Value range, input and output:
−199.9 ... +199.9 %

Time requirement: 146...**153**...163 μs

Mnemonic: MUL **HEX 4AH**

Function: **Mul**tiplication

RES = SR1 · SR2

Symbol:

Value range, input and output:
−199.9 ... +199.9 %

Example: 100.0 % x 50.0 % = 50.0 % No overflow
150.0 % x 150.0 % = 225.0 % Overflow!
Limitation to 199.9 %

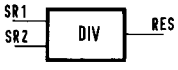
Time requirement: 181...**209**...211 μs

Mnemonic: DIV **HEX 4BH**

Function: **Div**ision

RES = SR1 : SR2

Symbol:



Value range, input and output:
−199.9 ... +199.9 %

Examples: 40.0 % : −50.0 % = −80.0 % No overflow
80.0 % : 20.0 % = 400.0 % Overflow!
Limitation to 199.9 %

Time requirement: 156...**322**...338 μs

Mnemonic: REZ **HEX 4CH**

Function: Formation of **Reci**procal

$$RES = \frac{1}{SR1}$$

Symbol:

Value range: Input: −204.8 ... +204.8 %
Output: −199.9 ... +199.9 %
Overflow as from SR1 $\leqq$ 50.0 %

Examples: 1 : 40.0 % = 250.0 % Overflow!
Limitation to 199.9 %

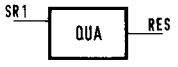
Time requirement: 117...**259**...264 μs

Mnemonic: QUA **HEX 4DH**

Function: **Squa**re

$$RES = SR1^2$$

Symbol:



Value range: Input: −204.8 ... +204.8 %
Output: −199.9 ... +199.9 %

Overflow as from SR1 = 141.4
Example: $(150.0\ \%)^2$ = 225.0 % Overflow!
Limitation to 199.9 %

Time requirement: 152...**180**...182 μs

Mnemonic: RAD **HEX 4EH**

Function: Square root extraction

$RES = + \sqrt{SR1}$ for SR1 $\geqq 0$
$RES = - \sqrt{SR1}$ for SR1 < 0

Symbol:

Value range: Input: −199.9 ... +199.9 %
Output: −141.4 ... +141.4 %

Time requirement: 129...**283**...320 μs

Mnemonic: EXP **HEX 4FH**

Function: Form the **exp**onential function

$$RES = 0.1 \cdot 10^{SR1}$$

Symbol:

Value range: Input: −199.9 ... +199.9 %
Output: 0.0 ... +199.9 %
Overflow as from SR1 = 130.0 %

Example: $0.1 \cdot 10^{150.0\,\%} = 316.2$ Overflow!
Limitation to 199.9 %

Time requirement: 141...**263**...325 μs

7.5 Tables functions

Mnemonic: TA0 to TA7 **HEX 50H TO 57H**

Function: **Ta**bles for linearisation

RES = Function of SR1

Tables available:

Op code	Hex	Function
TA0	50	Variable (addresses 87B6H–87D7H)
TA1	51	Fe-CuNi DIN 0... 900 °C ≙ 0...53,14 mV
TA2	52	Type J 0...1200 °C ≙ 0...69,54 mV
TA3	53	Type K 0...1370 °C ≙ 0...54,81 mV
TA4	54	Type S 0...1760 °C ≙ 0...18,61 mV
TA5	55	Type B 0...1820 °C ≙ 0...13,81 mV
TA6	56	WRe3-WRe25 0...1999 °C ≙ 0...35,75 mV
TA7	57	Pt 100 DIN −220... 850 °C ΔR = 379,85 Ω

Table 7.1

TA0 converts 17 input values each spaced 6.4 % apart into 17 predefinable output values that can be stored in addresses 87B6H to 87D7H (Table 7.2). If the input takes on values between the coincidence points the output value is interpolated linearly.

As from software October 1985 the controllers have an input routine MC 0013 available for entering the 17 coincidence points which allows the values to be entered directly as a percentage. For older controllers and the indicator PA the required values are given in the table in Section 10.4.2.

The configurator does not support entry of the tables.

The table below may be of assistance in entering the values to the controller:

Number of Coincidence point	Value in % Input	Output
0	0	0.0
1	6.4	
2	12.8	
3	19.2	
4	25.6	
5	32.0	
6	38.4	
7	44.8	
8	51.2	
9	57.6	
10	64.0	
11	70.4	
12	76.8	
13	83.2	
14	89.6	
15	96.0	
16	102.4	

Table 7.2

7.5.1 Using the tables

If the transmitter signal only represents a section of the stored tables, the procedure is as follows:

From the 0 ... 100 % input signal must be calculated a signal with which the table can be accessed. This is calculated as follows:

$$X = (H - L) \cdot /E1 + L$$

where $H = \frac{\text{Table value for E1 = 100 \%}}{\textbf{Upper} \text{ table value}^{1)}}$

and $L = \frac{\text{Table value for E1 = 0 \%}}{\textbf{Upper} \text{ table value}^{1)}}$

X = Temperature in °C
H = End of measuring range
L = Start of measuring range

Example:

Transmitter signal:
0 ... 100 % ≙ 300 ... 700 °C FeCu-Ni DIN

$$H = \frac{39.72\,mV}{53.14\,mV} \cdot 100.00\,\% \triangleq 74.7\,\%$$

$$L = \frac{16.56\,mV}{53.14\,mV} \cdot 100.00\,\% \triangleq 31.2\,\%$$

The signal, linear after conversion in the table, must then be prepared for the analog display. This is carried out according to the following formula:

$$DL = \frac{X-L}{H-L} \cdot 100.0\,\%$$

The associated configuration looks like this:

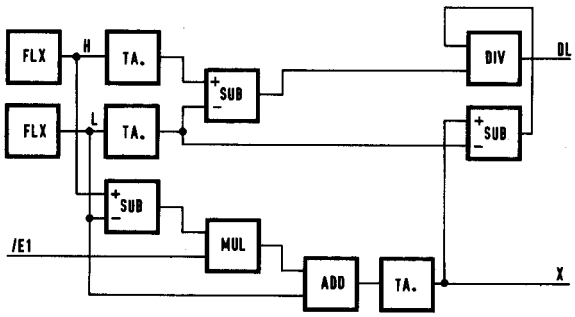


Fig. 7.1

[1] see table 7.1

On commissioning, the variables that were used for values L and H in the configuration must be set to the calculated values.

Instead of the method shown of calculating the values, it is also possible to make the actual units determine the values.

Procedure:

A continuous controller is provisionally configured:

X : TAy,A1 (y ≙ 0 ... 7 according to desired table)

If the output signal is now displaced in manual operation the signal linearized by the table function can now be read off in the digital display.

For the above example the output is displaced until 300 or 700 can be read in the digital display.

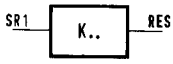
The associated values in each case for the output signal are noted and subsequently used in place of L and H.

7.6 Multiplication factors

Mnemonic	Hex	Factor
K.1	58H	1/10
K/8	59H	1/8
K/5	5AH	1/5
K/4	5BH	1/4
K/3	5CH	1/3
K/2	5DH	1/2
K02	5EH	2
K03	5FH	3
K04	60H	4
K05	61H	5
K08	62H	8
K10	63H	10
K20	64H	20
K40	65H	40
K50	66H	50
KHU	67H	100

Table 7.3

Symbol:



Time requirement: K.1 to K/2: 158 µs
K02 to KHU: 151...**153**...154 µs

Value range, input and output: −199.9 ... + 199.9 %

Arithmetical results that fall outside these limits are limited to the numerical value 199.9.

7.7 Time functions (without programmer)

Integrators and delay elements have the common feature:

The variables for the result must be taken from the range K1 to Z. All variables can be used for SR1 and SR2.

If there are further functional modules in the negative feedback circuit (the connection from the output to input 2), these must be computed in one cycle, i.e. the variables must be arranged in reverse alphabetical order (descending hex addresses) from the output to input 2 (see Section 4.4).

7.7.1 Rate Limiter

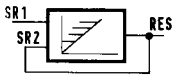
Mnemonic	Hex	Time for 100 % change
RL1	68H	2 s
RL2	69H	4 s
RL3	6AH	8 s
RL4	6BH	16 s
RL5	6CH	50 s
RL6	6DH	100 s
RL7	6EH	200 s
RL8	6FH	400 s
RL9	70H	1000 s
RLA	71H	2000 s
RLB	72H	4000 s
RLC	73H	8000 s

Table 7.4

Function: Rapid changes of input signal SR1 are limited to the rate of change defined by the module used. Slower rates of change are not affected. Continuous adjustement of the rate of change is not possible.

Permitted output variable: K1 to Z.

Symbol:



Value range for input and output:
−199.9 ... +199.9 %

Time requirement: RL 1 to RL4: 176 ... **187** ... 201 µs
RL 5 to RL8: 164 ... **175** ... 189 µs
RL 9 to RLC: 166 ... **177** ... 191 µs

7.7.2 Fixed-time integrators

Mnemonic	Hex	Time constant TN
IG1	74	1 s
IG2	75	4 s
IG3	76	10 s
IG4	77	25 s
IG5	78	2 min
IG6	79	8 min
IG7	7A	20 min
IG8	7B	50 min

Table 7.5

Function: Integration of the input signal with the selected time constant

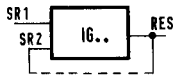
$$RES = SR2 + \frac{SR1}{TN} \cdot t$$

Permitted result variable: K1 to Z.

Value range, input and output: −199.9 ... +199.9 %

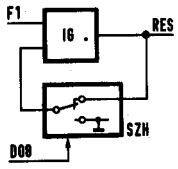
Time requirement: IG1 to IG4: 476 ... **506** ... 543 µs
IG5 to IG8: 470 ... **500** ... 537 µs

Symbol:

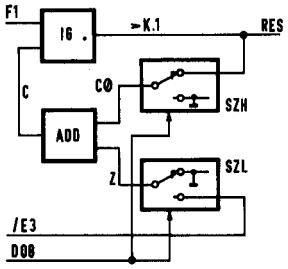


Circuit examples:

a) Initial condition 0%:



b) Initial condition corresponding to another variable:



Processing of variables in loop K.1 – C0 – C, interface at module IG5. (See section 4.4.)

7.7.3 Delays

Mnemonic	Hex	Time constant T1
VZ1	A7H	1 s
VZ2	A8H	4 s
VZ3	A9H	10 s
VZ4	AAH	25 s
VZ5	ABH	2 min
VZ6	ACH	8 min
VZ7	ADH	20 min
VZ8	AEH	50 min

Table 7.7

Function: Delay of input signal according to the selected time constant

$$RES = SR2 + \frac{SR1 - SR2}{T1} \times t$$

Permitted variable: K1 ... Z.

Symbol:

Value range, input and output: −199.9 ... +199.9 %

Time requirement: VZ1 to VZ4: 546...**584**...630 µs
VZ5 to VZ8: 540...**578**...624 µs

7.8 Decimal point position in the display

Mnemonic: MA0 to MA3 **HEX 3EH to 41H**

Function: Sets the position of the decimal point for a variable, provided it is not defined in the USER RANGE (Section 6.2.2). If address 87B4H contains 00 the following decimal point position results. The calculated value is not altered by this.

Mnemonic	Hex	Display
MA0	3EH	123.4
MA1	3FH	12.34
MA2	40H	1.234
MA3	41H	1234

Symbol:

Value range, input and output: −199.9 ... +199.9

Time requirement: 78...**81**...83 µs

7.9 Assignment of values

Mnemonic: FIX **HEX A4H**

Function: Initialization of a variable and assignment of a fixed value including the decimal point position

RES = Input value

Symbol:

Value range: −199.9 ... +199.9

Time requirement: **68** µs

Note: The value cannot be adjusted with keys ▲ and ▼ even if the point (6) in the index displays is illuminated, i.e. adjustability appears to be enabled.

For entry in the configurator, please note its Operating Manual.

For assignment of the numerical value to SR1 and SR2 for entry via the controller front, see Section 5.2.1.

Low-Byte Bit1	Bit0	Configurator notation	Display see 6.2.3	Calculated value in %
0	0	FIX,#+100.0	100.0	100.0
0	1	FIX,#−100.0	−10.00	−100.0
1	0	FIX,#+0.500	0.500	50.0
1	1	FIX,#+1999	1999	199.9

Mnemonic: FLX **HEX A5H**

Function:

1. A variable is initialized. In the computation the value is disregarded until RCL PARAM is initiated and its value thus copied to the value list. It is adjustable over the whole range with keys ▲ and ▼, if the adjustability is enabled (6.2.4).

2. The contents of SR1 and SR2 is the default value. The decimal point position for the display is coded in bits 0 and 1 (see FIX).

3. The current value in the value list can be transferred to the configuration with STO PARAM in place of the original values SR1 and SR2.

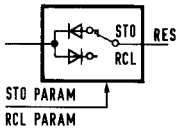
   If the configuration is stored on a disc or in the E(E)PROM (IC19) the new value functions as the default value. In the standard configuration in IC 15 the default values cannot be changed.

4. After a RESET (message Er.00) the current value in the value list is replaced by the default value from the configuration stored with priority code (see 42/62-61-). If no E(E)PROM IC19 is present the controller retrieves the default values from IC15.

RES = Input value

Symbol:

Equivalent diagram:



Value range: −199.9 ... +199.9 %

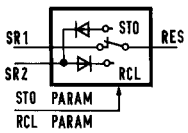
Time requirement: 58...**73**...90 µs

Mnemonic: PAR **HEX A6H**

Function:
1. Transfer of input SR1 to output RES
2. Transfer of output to SR2 on operating STO PARAM (switch S4 and S5)
3. Transfer of input SR2 to output RES on operating RCL PARAM (switch S4 and S5)

Symbol:

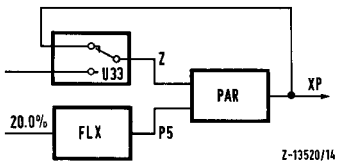
Equivalent diagram:



Configuration example:
The value for XP can either be set directly (S33 in the position drawn) or come from outside after switching over S33. Via STO PARAM the value of XP is transferred to P5, with RCL PARAM the value of P5 to XP.

Value range: −199.9 ... +199.9

Time requirement: 70...**92**...100 µs



7.10 Comparators and hysteresis functions

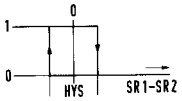
Mnemonic	Hex	Hysteresis width
CB0	7C	Adjustable (8740H)
CB1	7D	0.025 %
CB2	7E	0.05 %
CB3	7F	0.1 %
CB4	80	0.25 %
CB5	81	0.5 %
CB6	82	0.8 %
CB7	83	1.0 %
CB8	84	1.5 %
CB9	85	2.0 %

Table 7.8

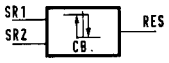
Function: Compare input 1 with input 2
Output is a binary variable

RES = 0 for (SR1 − SR2) > HYS/2
RES = 1 for (SR1 − SR2) < HYS/2
RES = Old result within the hysteresis

Characteristic:



Symbol:



Value range of inputs: −199.9 ... +199.9

Hysteresis setting for CB0:
Entry of a hex value in address 8740H.

Setting range: 0.0 ... 25.5 %
Value in 8740: 00H ... FFH (see table 7.12)

Time requirement: CB0 : 197...**230**...258 µs
CB1 ... CB9 : 204...**237**...265 µs

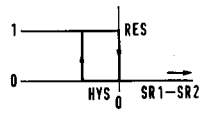
Mnemonic	Hex	Hysteresis width
CU0	86	Adjustable (8741H)
CU1	87	0.025 %
CU2	88	0.05 %
CU3	89	0.1 %
CU4	8A	0.25 %
CU5	8B	0.5 %
CU6	8C	0.8 %
CU7	8D	1.0 %
CU8	8E	1.5 %
CU9	8F	2.0 %

Table 7.9

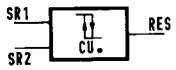
Function: Compare input 1 with input 2
Output is a binary variable

RES = 0 for (SR1 − SR2) > 0
RES = 1 for (SR1 − SR2) ≦ − HYS
RES = Old result within the hysteresis

Characteristic:



Symbol:



Value range of inputs: −199.9 ... +199.9

Hysteresis setting for CU0:
Entry of a hex value in address 8741H

Setting range: 0.0 ... 25.5 %
Value in 8741H: 00H ... FFH (see table 7.12)

Time requirement: CU0 : 159...**184**...203 µs
CU1 ... CU0 : 166...**191**...210 µs

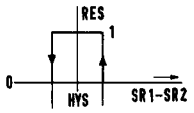
Mnemonic	Hex	Hysteresis width
CT0	90	Adjustable (8742H)
CT1	91	0.0 %
CT2	92	0.05 %
CT3	93	0.1 %
CT4	94	0.25 %
CT5	95	0.5 %
CT6	96	0.8 %
CT7	97	1.0 %
CT8	98	1.5 %
CT9	99	2.0 %

Table 7.10

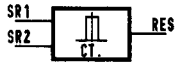
Function: Compare input 1 with input 2
Output is a binary variable

RES = 0 for (SR1 – SR2) > HYS/2
RES = 1 for (SR1 – SR2) ≦ HYS/2

Characteristic:



Symbol:



Value range of inputs: −199.9 ... +199.9 %

Hysteresis setting for CT0:
Entry of a hex value in address 8742H.

Setting range: 0.0 ... 25.5 %
Value in 8742H: 00H ... FFH (see table 7.12)

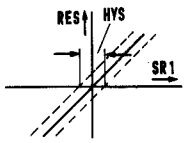
Time requirement: CT0 : 160...**188**...213 µs
CT1 ... CT9 : 167...**195**...220 µs

Mnemonic	Hex	Hysteresis width
CL0	9A	Adjustable (8743H)
CL1	9B	0.025 %
CL2	9C	0.05 %
CL3	9D	0.1 %
CL4	9E	0.25 %
CL5	9F	0.5 %
CL6	A0	0.8 %
CL7	A1	1.0 %
CL8	A2	1.5 %
CL9	A3	2.0 %

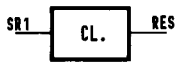
Table 7.11

Function: Transfer of input to output has changed by more than half the hysteresis width compared with the output (= previous input value).

Characteristic:



Symbol:



Value range of inputs: −199.9 ... +199.9 %

Hysteresis setting for CL0:
Entry of a hex value in address 8743H.

Setting range: 0.0 ... 25.5 %
Value in 8743H: 00H ... FFH (see table 7.12)

Time requirement: CL0 : 147...**175**...200 µs
CL1 ... CL9 : 154...**182**...207 µs

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0.0	00	01	02	03	04	05	06	07	08	09
1.0	0A	0B	0C	0D	0E	0F	10	11	12	13
2.0	14	15	16	17	18	19	1A	1B	1C	1D
3.0	1E	1F	20	21	22	23	24	25	26	27
4.0	28	29	2A	2B	2C	2D	2E	2F	30	31
5.0	32	33	34	35	36	37	38	39	3A	3B
6.0	3C	3D	3E	3F	40	41	42	43	44	45
7.0	46	47	48	49	4A	4B	4C	4D	4E	4F
8.0	50	51	52	53	54	55	56	57	58	59
9.0	5A	5B	5C	5D	5E	5F	60	61	62	63
10.0	64	65	66	67	68	69	6A	6B	6C	6D
11.0	6E	6F	70	71	72	73	74	75	76	77
12.0	78	79	7A	7B	7C	7D	7E	7F	80	81
13.0	82	83	84	85	86	87	88	89	8A	8B
14.0	8C	8D	8E	8F	90	91	92	93	94	95
15.0	96	97	98	99	9A	9B	9C	9D	9E	9F
16.0	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9
17.0	AA	AB	AC	AD	AE	AF	B0	B1	B2	B3
18.0	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD
19.0	BE	BF	C0	C1	C2	C3	C4	C5	C6	C7
20.0	C8	C9	CA	CB	CC	CD	CE	CF	D0	D1
21.0	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB
22.0	DC	DD	DE	DF	E0	E1	E2	E3	E4	E5
23.0	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
24.0	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
25.0	FA	FB	FC	FD	FE	FF	—	—	—	—

Table 7.12

Table for conversion of decimal values to hex values. (Decimal point position only applies to hysteresis of comparators).

7.11 Programmer OP-CODES

Mnemonic: PW0 to PWF **HEX E0H to EFH**

Function:

1. Specification of restart values (W) for programmer with the same function as op code FLX
2. Specification of binary values for programmer by the third character in the name of the op code. This hex numeral is transferred in the associated program section to the lower half of address 3AH (1st channel) or 39H (2nd channel) in the internal RAM. It thus determines for a program section the value of the binary variables 'F3 to 'F0 or 'EB to 'E8.

Permitted variables:

Single-channel and 1st channel	All variables without point (hex address = even-numbered)
2nd channel and program controller	All variables with point (hex address = odd)
Permitted value range:	−199.9 ... 199.9 %

On configuration, note that with op code PWx one instruction must be present more (value at time 0) than the instructions with op code PTy.

The configuration lines are processed in ascending order of hex address of the resulting variables.

P0 : PW1,#+030.0 is processed before
P1 : PW5,#+050.0

Definition of binary variables:

	1st channel/single-channel				2nd channel/program controller			
Hex	P14 F3H	P13 F2H	P12 F1H	P11 F0H	P24 EBH	P23 EAH	P22 E9H	P21 E8H
PW0	0	0	0	0	0	0	0	0
PW1	0	0	0	1	0	0	0	1
PW2	0	0	1	0	0	0	1	0
PW3	0	0	1	1	0	0	1	1
PW4	0	1	0	0	0	1	0	0
PW5	0	1	0	1	0	1	0	1
PW6	0	1	1	0	0	1	1	0
PW7	0	1	1	1	0	1	1	1
PW8	1	0	0	0	1	0	0	0
PW9	1	0	0	1	1	0	0	1
PWA	1	0	1	0	1	0	1	0
PWB	1	0	1	1	1	0	1	1
PWC	1	1	0	0	1	1	0	0
PWD	1	1	0	1	1	1	0	1
PWE	1	1	1	0	1	1	1	0
PWF	1	1	1	1	1	1	1	1

Table 7.13

Definition of binary variables:

	1st channel/single-channel				2nd channel/program controller			
Hex	P18 F7H	P17 F6H	P16 F5H	P15 F4H	P28 EFH	P27 EEH	P26 EDH	P25 ECH
PT0	0	0	0	0	0	0	0	0
PT1	0	0	0	1	0	0	0	1
PT2	0	0	1	0	0	0	1	0
PT3	0	0	1	1	0	0	1	1
PT4	0	1	0	0	0	1	0	0
PT5	0	1	0	1	0	1	0	1
PT6	0	1	1	0	0	1	1	0
PT7	0	1	1	1	0	1	1	1
PT8	1	0	0	0	1	0	0	0
PT9	1	0	0	1	1	0	0	1
PTA	1	0	1	0	1	0	1	0
PTB	1	0	1	1	1	0	1	1
PTC	1	1	0	0	1	1	0	0
PTD	1	1	0	1	1	1	0	1
PTE	1	1	1	0	1	1	1	0
PTF	1	1	1	1	1	1	1	1

Table 7.15

Mnemonic: PT0 to PTF **HEX F0H to FFH**

Function:

1. Specification of the time section (T) for programmer with the same functions as in op code FLX. Bits 0 and 1 determine the time base valid in the section (see table 7.14).
2. Specification of the binary values for the programmer by the third character in the name of the op code. This hex numeral is transferred in the associated program section to the higher half of address 3AH (1st channel) or 39H (2nd channel) in the internal RAM. It thus determines for a program section the value of binary variables 'F7 to 'F4 or 'EF to 'EC (see table 7.15).

Permitted variables:

Single-channel and 1st channel	All variables without point (hex address = even-numbered)
2nd channel and program controller	All variables with point (hex address = odd)
Permitted value range:	0 ... 1999 seconds 0 ... 199.9 minutes 0 ... 19.99 hours 0 ... 1.999 x 1000 hours

The configuration lines are processed in ascending order of hex address of the resultung variables.

C1 : PT1, #+03.00 is processed before
C2 : PT5, #+05.00

Programmer	Value of LB Bit 1	Bit 0	Time range
	1	1	0 ... 1999 s
	0	1	0 ... 199.9 min.
	1	0	0 ... 19.99 h
	0	0	0 ... 1999 h

Table 7.14

8 Explanation of binary variables and monitor Md

Terms used in logic control systems for processing binary signals include

- binary inputs
- binary outputs
- binary notes = binary storage locations in which interim results are stored (noted).

In the Protronic P there are also the operating mode status messages and the controller changeover functions (see Annex 3).

In the Protronic P the binary variables are stored in the processor RAM in bytes 1CH to 3BH. The monitor Md shows among other things the contents of these bytes. The other information that can be read in the monitor Md is described in Section 8.9.

The following applies to processing all binary variables:

A value can be assigned by the configuration to the variables with hex address 00H = '00 to 3FH = CT1. They themselves can in turn be used as sources in further configuration lines.

Binary variables 40H = T1S to FFH = D08 report the status of the various device functions and the binary inputs. In configurations they can only be used as source variables.

8.1 Binary inputs

Inputs D00 to D08 are nominally equivalent. However in the basic configuration D00 is used solely for forced trip to manual. The switching action is specified in accordance with Section 6.5.

8.2 Binary outputs

Binary outputs Q01 to Q12 are equivalent. With a view to maximum uniformity of configurations the following pattern should be approximately retained:

Q01 to Q04 : Alarm values
Q05 to Q08 : Status messages
Q09 to Q12 : Controller outputs

Q00 is used solely as a diagnostics output in accordance with Section 6.9.

The switching action of all binary outputs is specified in accordance with Section 6.5.

8.3 Internal binary functions

8.3.1 Timing mark pulse generator

Binary variables 40H = T1S to 4FH = T0H periodically change value:

Variable Hex	Mnem.	Cycle time T	Pulse duration t
40H	T1S	1 s	
41H	T2S	2 s	
42H	T4S	4 s	
43H	T8S	8 s	
44H	THS	16 s	
45H	T1M	1 min.	1 computation cycle approx. 40 ms
46H	T2M	2 min.	
47H	T4M	4 min.	
4CH	T01	0.1 s	
4DH	T02	0.2 s	
4EH	T04	0.4 s	
4FH	T0H	1.6 s	
48H	TF1	200 ms	100 ms (5.0 Hz)
49H	TF2	400 ms	200 ms (2.5 Hz)
4AH	TF4	1.0 s	400 ms (1.0 Hz)
4BH	TF8	1.0 s	200 ms (1.0 Hz)

Table 8.1

The timing marks MT1 = BEH and MT2 = BFH are set by the optionally built in real-time clock (see 6.5.3)

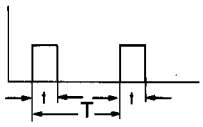


Fig. 8.1 Pulse generator

8.3.2 Sundry information

Byte 26 combines various information items from the controller.

C1D = 50H = 1, if the automatic range of controller 1 is switched off. It shows the contents of 8739H bit 1 (see 6.6.1.1)

C2E = 51H = 1, if the automatic range of controller 2 is switched on. It shows the contents of 8739H bit 3 (see 6.6.1.1)

ERF = 52H = 0 contains the same information as output Q00 (not variable Q00)

NFL = 53H = 1, if function list, i.e. the configuration is not processed e.g. during cassette operation.

NDI = 54H = 1, if MONITOR, USER RANGE or similar functions are selected so that the controller is not operable.

N00 = 55H = 1, if the program part that processes the usual controller displays and manual control functions is not active.

NEC = 56H ist reserved
'78 = 78H to
'7F = 7FH = 1, if a decimal point is visible in the associated display.

LLL = B8H = 0 LLL is by definition logical 0 of the units.

I00 = B9H = 1 in the first cycle after HOLD and after restoration of power.

IFF = BAH = 1 in the first 256 cycles after restoration of power (approx. 10 s).

IUD = BBH = 1 in the first n cycles after restoration of power. n is entered in 87D9H 0 ≦ n ≦ FFH (= 255).

IPD = BCH = 1 in the first n cycles after restoration of power a power failure longer than 0.8 s. n is entered in 87D9H 0 ≦ n ≦ FFH (= 255)

III = BDH = 1 in the first n cycles after Er.00 n is entered 87D9H. 0 ≦ n ≦ FFH (= 255)

Q00 = 17H = 1 switches the diagnostics output Q00 off, as binary variable Q00 has been combined by OR with the error messages (see 6.9)

8.3.3 Switch settings

8.3.3.1 Key S5

CTL = 57H = 1 for the duration of depression of key S5

8.3.3.2 Switch S4

Switch positions and their functions

The mechanical positions of S4 are coded in addresses S41 = CCH to S44 = CFH. The following truth table applies:

Position Nr.	Funktion	CFH S44	CEH S43	CDH S42	CCH S41
0	HOLD	0	0	0	0
1	VERIFY CAS	0	0	0	1
2	SAVE CAS	0	0	1	0
3	LOAD CAS	0	0	1	1
4	STO PROGM	0	1	0	0
5	RCL PROGM	0	1	0	1
6	STO PARAM	0	1	1	0
7	RCL PARAM	0	1	1	1
8	NORMAL	1	0	0	0
9	CLEAR 0	1	0	0	1
A	CLEAR 1...4	1	0	1	0
B	USER RANGE	1	0	1	1
C	MONIT+TEST	1	1	0	0
D	AUTOCALIB	1	1	0	1
E	ENAB CONFI	1	1	1	0
F	TIME + DATE	1	1	1	1

Table 8.2

The function assigned to the current mechanical switch setting is activated by operating key S5.

The following bits have the value 1 while the key is depressed:

CL0 = 58H = CLEAR 0
CL1 = 59H = CLEAR 1
SPA = 5DH = STO PARAM
RPA = 5EH = RCL PARAM
SPG = 5FH = STO PROGM

For bits CL1 = 59H to CL4 = 5CH, the switch setting of S1/1 to S1/4 is also important:
S4 at setting CLEAR 1...4

S1/2	S1/3	S1/4	CL2	CL3	CL4
0	0	0	0	0	0
1	0	0	1	0	0
0	1	0	0	1	0
0	0	1	0	0	1

Table 8.3

If several switches of S1 are at ON = 1, the corresponding bits CL1 to CL4 are set to 1.

The current function activated by S4 and S5 and the previous function are stored in byte 34H.

The previous function is stored in half byte C0H to C3H as a hex numeral (see Table 8.2).

The function currently activated is stored in half byte C4H to C7H.

This byte can be changed via the serial interface and via the configurator without changing the mechanical position of switch S4.

If a value is entered in the byte, first the "previous function" corresponding to the first numeral is activated and then the function corresponding to the 2nd numeral as the "current function".

Exception: If one of the cassette functions LOAD, SAVE or VERIFY, or USER-RANGE, MONITOR+TEST, AUTOCALIB, ENAB CONFI or TIME+DATE is first selected, the function of the 2nd numeral is not activated.

Example:
Entry "98": 9 = CLEAR 0 = previous function
8 = NORMAL

The function CLEAR 0 is performed and subsequently the NORMAL function is produced.

If the configurator interface is to continue being operated after a manipulation of this type, "E" must be entered as the 2nd numeral (e.g. 9E).

8.3.3.3 Switches S1/ ... to S3/ ...

The mechanical settings of switches S1, S2 and S3 are stored in bits S31 = C8H to S34 = CBH and S21 = D0H to S18 = DFH. The bits have the value 1 if the respective switch is set to "ON" = 1.

Switch S1 has an image in address 8324H that can be influenced via the serial interface. By this means the switch settings of S1/1 to S2/3 required for RCL PROGR can be set temporarily by telegram from the processor.

8.3.3.4 Mode selector switch

The switches described in Section 6.3 can be changed over via

the keyboard
remote control
the serial interface.

The keys act directly on the switches and with the exception of key 10 cannot be decoupled from the changeover function. The remote control acts on the switches via bits YST = 30H to WSE = 36H. If YST, FST or WST are equal to 1, they switch the respective switch forward by one enabled position in each cycle in accordance with Table 8.4.

If certain operating modes are intended not to be selectable from time to time under certain conditions, they must be disabled by the software.

Example: If D08 = 1, the controller is not to be capable of being transferred to manual.

	Single-channel 8739H bit 3 = 0 8739H bit 7 = 0	Two-channel 8739H bit 3 = 1 8739H bit 7 = 0	
	Switch not divided (see 6.3.3)	Switch divided see 6.3.3	
	0L2(16H) = any	0L2 = 0	0L2 = 1
YSM =1	Y_ 0 = 1 (priority!)	Y_0 = 1	Y_4 = 1
YSA =1	Y_ 2 = 1	Y_2 = 1	Y_6 = 1
YST =1	Y_ 0 to Y 7	Y_0 to Y 3	Y_4 to Y 7
FST =1	F_ 0 to F 7	F_0 to F 3	F_4 to F 7
WST =1	W_0 to W 7	W_0 to W 3	W_4 to W 7
WST =1	W_0 = 1 (priority!)	W_0 = 1	W_4 = 1
WSE =1	W_3 = 1	W_3 = 1	W_6 = 1

Table 8.4

If YSM and YSA have the value 1, YSM has priority.

If WSI and WSE have the value 1, WSI has priority.

if OKD = 37H has the value 0, the associated display changes directly after operation of a key. It flashes for approx. 2 s. The new operating mode is not effective until the flashing has stopped.

If OKD has the value 1, changeover takes place directly.

Whether a key is operated is recorded in bytes 2CH and 2DH.

Byte 2DH

KA1 = 88H to KA8 = 8FH respectively have the value 1 for 1 cycle after the associated key is actuated.

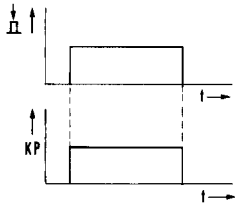


Fig. 8.2

Byte 2CH

KP1 = 80H to KP8 = 87H respectively have the value 1 while the associated key is actuated.

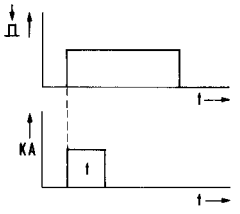


Fig. 8.3

	Bit Name	Bit Hex	Message	Description	Bit generated, if cause present	Bit reset, if cause gone	In self test	Unmasked display	Unmasked Q0
	ESC	97H	Er.SC	Undefined op code in 8400H – 84FFH	In each normal cycle	After 1s	Yes	–	–
	ESS	96H	Er.SS	Op code in wrong range	Every 5.12 s	As set	Yes	–	–
	EDI	95H	Er.di	Write protection set	In each normal cycle	As set		–	–
	EDR	94H	Er.dr	External RAM suspect (8700H not = 87)	In each normal cycle	As set		–	–
	ECS	93H	Er.cS	Circuit board with RS 232 C interface	In each normal cycle	As set		–	–
	ETS	92H	Er.tS	Too many incorrect telegrams, see 6.7.5	Every minute	As set		–	–
	ETC	91H	Er.tc	Too long no telegrams received, see 6.7.5	After present time	As set		–	–
	ETO	90H	Er.to	Cycle too long	In each normal cycle if > 1 s	After 1 s		–	–
	EJ2	A7H	Er.I.2	Interface module 2 = faulty (IC 23)	In each normal cycle (1)	As set		–	Yes
	EI2	A6H	Er.I2	Interface module 2 suspect	In each normal cycle (2)	As set	Yes	–	–
	EJ1	A5H	Er.I.1	Interface module 1 = faulty (IC 22)	In each normal cycle (1)	As set		–	Yes
	EI1	A4H	Er.I1	Interface module 1 suspect	In each normal cycle (2)	As set	Yes	–	–
	EUG	A3H	Er.UG	Transmitter supply voltage too low	In each normal cycle	As set	Yes	–	Yes
	EA2	A2H	Er.A2	Load at output 2 too high	In each normal cycle	As set		–	–
	EA1	A1H	Er.A1	Load at output 1 too high	In each normal cycle	As set		–	–
	D00	A0H	Er.nn	Input D00 activated	In each normal cycle	As set		–	–
	E_H	AFH	Er.H_	Hardware fault PU, C0, C7, C5, EL, I.1 or I.2	At least every 8 s	As per display	Each one!	Yes	Yes
	ELP	AEH	Er.LP	Power supply too low	In each normal cycle	After 1 s		Yes	Yes
	EBA	ADH	Er.bA	Battery voltage too low	In each normal cycle	After 1 s	Yes	Yes	–
	ERR	ACH	Er.rr	Too frequent reset	If more than 3 times in 16 s	After 1 s		–	–
	EPE	ABH	Er.PE	Program run error	In each normal cycle	After 1 s		–	–
	ENA	AAH	Er.nA	Data transfer not accomplished	After STO ..., RCL ...	With Y key		–	–
	EAU	A9H	Er.Au	Outputs A1 and A2 not monitored	After 1 s	As set	Yes	–	–
	ELE	A8H	Er.LE	At least 1 input below zero (see 6.1.3)	After 1 s	As set	Yes	–	–
	EFP	B7H	Er.FC	File faulty (on E(E)PROM, cassette)	After STO PROGM, LOAD, VERIFY	With Y key	Yes	–	–
	ERT	B6H	Er.rt	Real-time clock faulty or not present	If 1.6 s no 1 Hz clock	As set	Yes	–	–
	E00	B5H	Er.00	Bootstrap 8400H to 87DF(FF) done/attempted	With error in config./reset	With Y key		Yes	Yes
	E_2	B4H	Er._2	No processing of config. no normal cycle	With HOLD, LOAD CAS, AUTOCAL	After 1 s		–	Yes
	E_3	B3H	Er._3	Prozessor pin T1 = high (UART at configurator)	In each normal cycle	As set		–	–
	E_4	B2H	Er._4	New configuration loaded as per Cat.No.	After RCL PROGM	With Y key		–	–
	E_5	B1H	Er._5	Programmer program run faulty	At start or end schedule	With Y key		–	–
	E_6	B0H	Er._6	Not used					

(1) If control word output 3 times (2) If control word incorrect

Table 8.4

8.5 Binary inputs and outputs of the control and programmer modules

8.5.1 Controller binary outputs

The continuous control module has no binary outputs.

The switch function of the on/off controller is generated by configuration outside the continuous control module.

The step action control module sets binary variables R11 = E0H and R12 = E1H for channel 1 and variables R21 = E4H and R22 = E5H for channel 2 as the controller outputs.

These variables are switched to binary outputs of the overall unit, mutually inhibited (see 11. 14. 2).

8.5.2 Programmer binary outputs

Depending on the configuration, the programmer sets bits P11 = F0H to P18 = F7H for channel 1 and bits P21 = E8H to P28 = EFH for channel 2 (see 7.12).

8.5.3 Binary inputs of the control modules

The binary inputs of the control modules are combined in byte 23H.

CC2 = 38H = 1 causes characteristic switchover for control channel 2 to DIR = direct action characteristic.
CD2 = 39H = 1 switches D action of control channel 2 on.
CI2 = 3AH = 1 switches I action of control channel 2 on.
CT2 = 3BH = 1 switches the track function for control channel 2 on. In automatic mode (Y_4 = 0) the output/R2 is set to the value of Y.R.
CC1 = 3CH = 1 switches characteristic of control channel 1 to DIR = direct action characteristic.
CD1 = 3DH = 1 switches D action of control channel 1 on.
CI1 = 3EH = 1 switches I action of control channel 1 on.
CT1 = 3FH = 1 switches the track function for control channel 1 on. In automatic mode (Y_0 = 0) the output /R3 is set to the value of YR.

8.5.4 Binary inputs in the programmer module

Bits CC2 = 38H to CT1 = 3FH control the program run of the programmer.

CC2 = 38H = 1 causes reset of channel 2
CD2 = 39H = 1 causes start of channel 2
CI2 = 3AH = 1 causes jump to start of next section in channel 2
CT2 = 3BH = 1 has no function
CC1 = 3CH = 1 causes reset of channel 1
CD1 = 3DH = 1 causes start of channel 1
CI1 = 3EH = 1 causes jump to start of next section in channel 1
CT1 = 3FH = 1 has no function

8.6 Binary inputs in the indicator module

Display functions on the indicator module can be selectively switched on and off with four bits.

BLX = 20H = 1 switches the red pointer of the analog display off.
BLW = 21H = 1 switches the green pointer of the analog display off.
BLY = 22H = 1 switches the output display (across the bottom) off.
BLD = 23H = 1 switches the seven-segment displays off depending on 8744H (see 6.4). (The 16-segment display cannot be switched off.)
OL2 = 16H = 1 Channel 2 is brought to the front of the unit and can now be observed and operated.

8.7 Flags

Flags '00 = 00H to '15 = 15H and SC1 = 28H to AL4 = 2FH can be freely used in configurations, if not being in use.
If control channel 2 is not used, variables CC2 to CT2 (see 8.6) can also be used as flags.

8.8 Serial interface

The telegrams entering and exiting via the serial interface are buffered in bytes 5DH to 68H of the internal RAM. The components of the telegrams can be read via Md to monitor individual telegrams.

Received telegrams: 63H to 68H
Outgoing telegrams: 5DH to 62H

8.9 Further information in monitor Md

All other information in monitor Md have internal significance and cannot be used for configurations.

9 Notes on RAM area 8200H to 83FFH

Area 8200H to 827FH contains no information exploitable by the user.

Areas 8280H to 82FFH and 8380H to 83FFH are used to store interim values of the integrators (IG..), delays (VZ..) and the rate limiters (RL..). Since only these addresses are available for the interim values, only the variables K1 (80H) to Z. (FFH) can be used as the Result of the above mentioned op codes.

For special applications using the serial interface, RAM area 8300H to 83FFH offers the following possibilities:

The RAM adresses cannot be affected by configuring the unit.

In addition to the data in Table 9.2, the value 40H must be sent to 8358H in order for the time to be transferred to the named addresses and the clock started. To transfer the date, x8H must be sent to 835DH, x standing for the desired month (1H to CH).

In 8358H is also stored which display is visible first when the time display is selected (TIME+DATE).

Display:	0	0	0	0	=	Time HH.MM + SS
	0	0	1	0	=	Date DD.M0
Setting:	0	1	0	0	=	Time HH.MM
	0	1	1	0	=	Date DD.M0
	1	0	0	0	=	Timing mark 1 HH.MM
	1	0	1	0	=	Timing mark 1 DD.M0
	1	1	0	0	=	Timing mark 2 HH.MM
	1	1	1	0	=	Timing mark 2 DD.M0

SS = Seconds (00 to 59)
MM = Minutes (00 to 59)
HH = Hours (00 to 23)
DD = Day (00 to 31)
M0 = Month (0H to BH = 00 to 12)

The clock has no automatic date switch.

Address	Function	Application
8319H	Cycle counter over 1 second	The content is displayed via MC 0016
831AH	Reset counter, counts the RESETs initiated by the watchdog function	Normally set to 0. In systems with heavy electromagnetic interference it is possible to read here whether this actually disturbs the controller.
8324H	Image of switches S1/1 to S1/8	See 8.3.3.3
8325H	Counter for detected program errors	See 6.7.5
8326H	Counter for seconds without telegram	See 6.7.5
832EH	HB of selected address	
8331H	Value of selected address	
8334H	LB of selected address or no. of self test routine	Is 11H with monitor MC 0011
8335H	Monitor operating mode MC = 01H, ME = 00H, MD = 02H, self test = 21H	Call of monitor via serial interface
8358H –8367H	Real-time clock data	Clock and timing marks set via the serial interface

Table 9.1

Time	Address Timing mark 1	Timing mark 2	Function	
8359H	835EH	8363H	Seconds	
835AH	835FH	8364H	Minutes	
835BH	8360H	8365H	Hours	(coded in decimal)
835CH	8361H	8366H	Date (day)	
835DH	8362H	8367H	Month (coded in hexadecimal)	

Table 9.2

10 Hook-up lists

In the hook-up lists the normal configuration of the units is described.

10.1 Standard controller PE

10.1.1 Continuous controller (software up to Nov. 1985)

Mnemonic	Hexa decimal	✻	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	Flashing X pointer with S1/4
'02 : 0NN,'00,'01	02H : 07H,00H,01H	G	and at least 1 alarm
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	
'04 : CT7,/E2,W	04H : 97H,3EH,D2H	W	W_E – W less than 1 %
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,'A1,'A9	06H : 07H,A1H,A9H	A	'A1 and 'A9 indicate errors in output
0L2 : BTN,LLL	16H : 01H,B8H,00H	R	'16 = "0", (1 = 2nd control channel)
Q00 : BTN,111	17H : 01H,B8H,00H	Ü	'17 = "0" (1 sets Q00)
BLX : ANN,TF2,'03	20H : 03H,49H,03H	G	'49 is flash source, red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		Green pointer on ('21 = "0"), off ('21 = "1")
BLY : 0II,'06,TF1	22H : 0AH,06H,48H	Y	'48 is flash source, y pointer flashes if '06
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1 – compare X with G1
Q02 : CU7,G2,X	25H : 8DH,70H,E2H	G	Alarm value 2 – compare G2 with X
Q03 : CU7,F2,/N1	26H : 8DH,6AH,27H	G	Alarm value 3 – compare F2 with 0 %
Q04 : CU7,M,G4	27H : 8DH,94H,74H	G	Alarm value 4 – compare M with G4
YST : BTN,LLL	30H : 01H,B8H,00H	B	'30 = 0, (1 = Y key one step forward!)
FST : BTN,LLL	31H : 01H,B8H,00H	B	'31 = 0, (1 = F key one step forward!)
WST : BTN,LLL	32H : 01H,B8H,00H	B	'32 = 0, (1 = W key one step forward!)
YSM : BTN,D00	33H : 01H,A0H,00H	B	Forced trip to manual, A0 corresponds to input D00
YSA : BTN,LLL	34H : 01H,B8H,00H	B	'34 = 0 (1 = forced to automatic)
WSI : BTN,LLL	35H : 01H,B8H,00H	B	'35 = 0 (1 = forced to internal)
WSE : BTN,LLL	36H : 01H,B8H,00H	B	'36 = 0 (1 = forced to external)
OKD : BTN,LLL	37H : 01H,B8H,00H	B	'37 = 0 (1 = direct changeover)
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Inversion of S2/1 = characteristic
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch setting of S2/6 at '3D
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch setting of S2/5 at '3E
CT1 : BTN,LLL	3FH : 01H,B8H,00H	R	'3F = 0 (1 = external feedback is active)
A1 : ADD,Y1,Y2	40H : 48H,F4H,F6H	A	Output 1 = sum of Y1 and Y2
A2 : DIR,W,	41H : 3DH,E2H,00H	W	Output 2 = set point
D : SUB,/E2,W	5CH : 49H,3FH,D2H	W	D is difference input 2 – set point
DL : CL2,X	5EH : 9CH,E2H,00H	X	Left hand display (red) = actual value X
DR : CL2,W	60H : 9CH,D2H,00H	W	Right hand display (green) = set point
DU : UY0,P3,/R3	62H : 1FH,A4H,1CH	A	Analog display at bottom = correction value
E : INV,XD	64H : 3CH,EAH,00H	R	E = negative control deviation
F2 : SIL,F3,S15	6AH : 14H,6CH,DCH	G	Alarm value 3 changeover XD unipolar or bipolar
F3 : SUB,M,G3	6CH : 49H,94H,72H	G	Alarm value 3
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G3 : FLX,+100.0	72H : A5H,80H,BEH	G	Default value G3
G4 : FLX,+100.0	74H : A5H,80H,BEH	G	Default value G4
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = reciprocal value of XP
M : MAX,XD,P4	94H : 46H,EAH,A6H	G	For XD – alarm values
P3 : DIR,/R3,DU	A4H : 3DH,F0H,62H	A	P3 = output of control module
P4 : SIL,P5,S15	A6H : 14H,A8H,DCH	G	Changeover Xd unipolar or bipolar
P5 : ABS,XD	A8H : 3BH,EAH,00H	G	Formation of absolute value of XD
P6 : UC0,X0,X	AAH : 1AH,E4H,E2H	X	Reset non-return pointer X0 with CLEAR 0
P7 : UC0,X1,X	ACH : 1AH,E6H,E2H	X	Reset non-return pointer X1 with CLEAR 0
S : DIR,/N1	B6H : 3DH,27H,00H	R	Auxiliary variable injection at Y = 0
TD : FLX,0010	C2H : A5H,A3H,80H	R	Default value for TD
TN : FLX,0040	C4H : A5H,83H,82H	R	Default value for TN
W : MIN,WH,W0	D2H : 47H,DCH,D4H	W	Max. limit for W
W0 : MAX,WL,W1	D4H : 46H,E0H,D6H	W	Min. limit for W
W1 : UW0,W2,W	D6H : 2FH,D8H,D2H	W	Int./Ext. changeover
W2 : ADD,WE,X2	D8H : 48H,DAH,E8H	W	Addition after changeover
WE : SZH,Z,'05	DAH : 16H,FEH,'05	W	Changeover if E2 – W ≦ 0.5 %
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Default value WH
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Default value WL
X : DIR,/E1,/E2	E2H : 3DH,3FH,3EH	X	Assignment of input 1 to X
X0 : MIN,X,P6	E4H : 47H,E2H,AAH	X	Non-return pointer MIN
X1 : MAX,X,P7	E6H : 46H,E2H,ACH	X	Non-return pointer MAX
X2 : SZL,/E2,'05	E8H : 15H,3EH,05H	W	Part of changeover switch /E2 : Z
XD : SUB,X,W	EAH : 49H,E2H,D2H	R	Control deviation
XP : FLX,0100	ECH : A5H,80H,BEH	R	Default value XP
XU : DIR,X	EEH : 3DH,E2H,00H	R	D action input in control module

Continuous controller PE (continued)

Mnemonic	Hexa decimal	*	Commentary
Y : MA0,/R3,Y	F0H : 3EH,1CH,F0H	A	Masking for digital display 99.9
Y0 : FLX,050.0	F2H : A5H,40H,9FH	R	Default value Y0
Y1 : SIH,DU ,S17	F4H : 13H,62H,DEH	A	Output characteristic with Y2
Y2 : SZL,/N8,S17	F6H : 15H,20H,DEH	A	Output characteristic with Y1
YH : FLX,+100.0	F8H : A5H,80H,BEH	A	Default value for YH
YL : FLX,+000.0	FAH : A5H,00H,80H	A	Default value for YL
YR : DIR,/E2	FCH : 3DH,E2H,00H	R	External feedback with input 2 (unused)
Z : RL4,/E2,W	FEH : 6BH,3EH,D2H	W	Limitation of rate of change W → W_E

10.1.2 Standard controller PE as continuous controller (software from November 1985)

Basic configuration 62511-0-xx10000

The new software was matched to the universal controller PS as far as possible.

Variables not mentioned are not used (NOP).

Mnemonic	Hexa decimal	*	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	Flashing X pointer with S1/4 and at least 1 alarm
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	
'02 : 0NN,'00,'01	02H : 07H,00H,01H	G	
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	
'04 : CT7,W ,WE	04H : 97H,D2H,DAH	W	WE – W less than 1 %
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	EA1 and EAU indicate error in output
OL2 : BTN,LLL	16H : 01H,B8H,00H	S	1 switches 2nd channel on
Q00 : BTN,LLL	17H : 01H,B8H,00H	Ü	Sets Q00
Q12 : CB0,/N1,P7	1FH : 07C,27H,ACH	–	Has no function
BLX : ANN,'03,TF2	20H : 03H,03H,49H	G	Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		Green pointer on
BLY : 0II,'06,TF1	22H : 0AH,06H,48H	A	Output supervision derived from 06H
Q01 : CU7,X ,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2 ,X	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : CU7,G3 ,M1	26H : 8DH,72H,96H	G	Alarm value 3
Q04 : CU7,M ,G4	27H : 8DH,94H,74H	G	Alarm value 4
YST : BTN,LLL	30H : 01H,B8H,00H	F	
FST : BTN,LLL	31H : 01H,B8H,00H		
WST : BTN,LLL	32H : 01H,B8H,00H	F	
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		Man. operation after reset or forced man. from outside
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,LLL	37H : 01H,B8H,00H		1 switches channel 2 on
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Switch aharacteristic inverted
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch S2/6
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch S2/5
CT1 : BTN,LLL	3FH : 01H,B8H,00H	F	Set controller output (track)
A1 : ADD,C9 ,C8	40H : 48H,5AH,58H	A	Output 1
A2 : DIR,W	41H : 3DH,D2H,00H	E	Output 2 = W
C1 : FLX,+000.0	4AH : A5H,00H,80H	E	Weighting input 1
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Weighting of E2 (external set point)
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	A	Manual characteristic with C9
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	A	With C8 characteristic changeover
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference to WE (E2)
DL : DIR,X	5EH : 3DH,D2H,00H	X	Left hand analog display = X
DR : DIR,W	60H : 3DH,D2H,00H	W	Right hand analog display = set point (W)
DU : DIR,/R3	62H : 3DH,1CH,00H	A	Output of control module 1 directly at bottom display
E : INV,XD	64H : 3CH,EAH,00H	E	E = – XD
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G3 : FLX,–100.0	72H : A5H,80H,3EH	G	Default value G3
G4 : FLX,+100.0	74H : A5H,80H,BEH	G	Default value G4
K1 : FLX,+100.0	80H : A5H,80H,BEH	E	Weighting input 1
K2 : FLX,+100.0	82H : A5H,80H,BEH	E	Weighting input 2
K7 : UC0,X0 ,X	8CH : 1AH,E4H,E2H	E	CLEAR 0 reset non-return pointer min.
K8 : UC0,X1 ,X	8EH : 1AH,E6H,E2H	E	CLEAR 0 reset non-return pointer max.
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = 1/XP
M : MAX,XD ,N	94H : 46H,EAH,98H	G	Absolute value calculation for alarm values 3 and 4
M1 : SIH,M ,S15	96H : 13H,94H,DCH	G	Absolute value calculation for alarm values 3 and 4
N : SIL,N1 ,S15	98H : 14H,9AH,DCH		Absolute value calculation for alarm values 3 and 4
N1 : ABS,XD	9AH : 3BH,EAH,00H	G	Calculation of absolute value

10.1.2 Standard controller PE as continuous controller (continued)

Mnemonic	Hexa decimal	✻	Commentary
P : SZL,WE,'05	9CH : 15H,DAH,05H	W	Changeover WE to W(int) if difference < 1%
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	E	P1 = E1 · K1 input weighting E1
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	E	P2 = E2 · K2 input weighting E2
P7 : IG3,P8,P7	ACH : 76H,AEH,ACH	–	Has no function
P8 : SUB,A1,P9	AEH : 49H,1CH,B0H	–	Has no function
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	–	Has no function
Q : SZH,R,'05	B2H : 16H,B4H,05H	W	Changeover to WE if difference < 1%
R : RL4,WE,W	B4H : 6BH,DAH,D2H	W	Limitation of rate of change WE ⟵ W
S : DIR,/N1	B6H : 3DH,27H,00H	R	Disturbance variable feedforward = 0
TD : FLX,+0010	C2H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switch S2)
TN : FLX,+0040	C4H : A5H,83H,82H	R	Int. action time 40 (dimension depends on switch S2)
W : MIN,WH,W0	D2H : 47H,DCH,D4H	W	Set point limitation max
W0 : MAX,WL,W1	D4H : 46H,E0H,D6H	W	Set point limitation min
W1 : UW0,W2,W	D6H : 2FH,D8H,D2H	W	Changeover int/ext
W2 : ADD,P,Q	D8H : 48H,9CH,B2H	W	Limitation of rate of change
WE : ADD,P2,C2	DAH : 48H,A2H,4CH	W	Weighting input 2
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Setting of WH
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Setting of WL
X : ADD,P1,C1	E2H : 48H,A0H,4AH	X	
X0 : MIN,X,K7	E4H : 47H,E2H,8CH	X	Non-return pointer min.
X1 : MAX,X,K8	E6H : 46H,E2H,8EH	X	Non-return pointer max.
XD : SUB,X,W	EAH : 49H,E2H,D2H	R	Formation of control deviation
XP : FLX,+0100	ECH : A5H,43H,86H	R	Setting of XP
XU : DIR,X	EEH : 3DH,E2H,00H		Variable to be differentiated
Y : MA0,/R3	F0H : 3EH,56H,00H	A	Display of output value with 1 decimal place
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	R	Setting of Y0 = operating point
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Setting of output limit max.
YL : FLX,+000.0	FAH : A5H,00H,80H	R	Setting of output limit min.
YR : DIR,/R3	FCH : 3DH,1CH,00H	R	External feedback

10.1.3 Standard controller PE as step-action controller

Basic configuration 62511-0-XX20000

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	✻	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	–	Has no function
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	} Flashing X pointer with S1/4
'02 : ANI,Q01,Q02	02H : 04H,24H,25H	G	} and at least 1 alarm
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	}
'04 : CT7,W,WE	04H : 97H,D2H,DAH	W	WE – W less than 1%
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	–	Has no function
OL2 : BTN,LLL	16H : 01H,B8H,00H	S	1 switches 2nd channel on
Q00 : BTN,LLL	17H : 01H,B8H,00H	Ü	Sets Q00
Q12 : CB0,/N1,P7	1FH : 7CH,27H,ACH	–	
BLX : ANN,'03,TF2	20H : 03H,03H,49H	G	Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		Green pointer on
BLY : BTN,LLL	22H : 01H,B8H,00H	–	
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2,X	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : AIN,R11,R12	26H : 05H,E0H,E1H	G	Controller output "lower"
Q04 : AIN,R12,R11	27H : 05H,E1H,E0H	G	Controller output "raise"
YST : BTN,LLL	30H : 01H,B8H,00H	F	
FST : BTN,LLL	31H : 01H,B8H,00H		
WST : BTN,LLL	32H : 01H,B8H,00H	F	
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		Man. operation after reset or forced man. from outside
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,LLL	37H : 01H,B8H,00H		1 switches channel 2 on
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Switch characteristic inverted
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch S2/6
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch S2/5
CT1 : BTN,LLL	3FH : 01H,B8H,00H	F	Set controller output (track)

Standard controller PE as step action controller (continued)

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	✻	Commentary
A1 : FIX,+100.0	40H : A4H,80H,BEH	S	Supply for position feedback
A2 : DIR,W	41H : 3DH,D2H,00H	E	Output 2 is W
C1 : FLX,+000.0	4AH : A5H,00H,80H	E	Weighting input 1
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Weighting of input 2 (external set point)
C6 : FLX,+000.0	54H : A5H,00H,80H	S	Adjustment of position feedback
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	–	Has no function
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	–	Has no function
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference to WE (E2)
DL : DIR,X	5EH : 3DH,E2H,00H		Left hand analog display weighted input E1 = B
DR : DIR,W	60H : 3DH,D2H,00H	W	Right hand analog display: set point
DU : DIR,Y	62H : 3DH,F0H,00H	A	Position feedback directly at bottom display
E : INV,XD	64H : 3CH,EAH,00H	E	E = – XD
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G3 : FLX,-100.0	72H : A5H,80H,3EH	G	Default value G3
G4 : FLX,+100.0	74H : A5H,80H,BEH	G	Default value G4
H : FLX,+001.0	76H : A5H,A0H,80H	R	Dead band for P channel
K1 : FLX,+100.0	80H : A5H,80H,BEH	E	Weighting input 1
K2 : FLX,+100.0	82H : A5H,80H,BEH	E	Weighting input 2
K6 : FLX,+100.0	8AH : A5H,80H,BEH	R	Adjustment of position feedback
K7 : UC0,X0 ,X	8CH : 1AH,E4H,E2H	E	CLEAR 0 reset non-return pointer min.
K8 : UC0,X1 ,X	8EH : 1AH,E6H,E2H	E	CLEAR 0 reset non-return pointer max.
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = 1/ XP
M : MAX,XD ,N	94H : 46H,EAH,98H	G	Absolute value calculation for alarm values 3 and 4
M1 : SIH,M ,S15	96H : 13H,94H,DCH	G	Absolute value calculation for alarm values 3 and 4
N : SIL,N1 ,S15	98H : 14H,9AH,DCH	G	Changeover XD against I XD I
N1 : ABS,XD	9AH : 3BH,EAH,00H	G	Calculation of absolute value
P : SZL,WE ,'05	9CH : 15H,DAH,05H	W	Changeover WE to W(int) if difference < 1%
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	E	P1 = E1 · K1 input weighting E1
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	E	P2 = E2 · K2 input weighting E2
P6 : ADD,/E2,C6	AAH : 48H,3EH,54H	S	Position feedback
P7 : IG3,P8 ,P7	ACH : 76H,AEH,ACH	–	Has no function
P8 : SUB,A1 ,P9	AEH : 49H,40H,B0H	–	Has no function
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	–	Has no function
Q : SZH,R ,'05	B2H : 16H,B4H,05H	W	Changeover to WE if difference < 1%
R : RL4,WE ,W	B4H : 6BH,DAH,D2H	W	Limitation of rate of change WE – W
S : DIR,/N1	B6H : 3DH,27H,00H	R	Disturbance variable feedforward = 0
TD : FLX,+0010	C2H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switch S2)
TN : FLX,+0040	C4H : A5H,83H,82H	R	Int. action time 40 (dimension depends on switch S2)
W : MIN,WH ,W0	D2H : 47H,DCH,D4H	W	Set point limitation max
W0 : MAX,WL ,W1	D4H : 46H,E0H,D6H	W	Set point limitation m in
W1 : UW0,W2 ,W	D6H : 2FH,D8H,D2H	W	Changeover int/ext
W2 : ADD,P ,Q	D8H : 48H,9CH,B2H	W	Limitation of rate of change
WE : ADD,P2 ,C2	DAH : 48H,A2H,4CH	W	Weighting input 2
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Setting of WH
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Setting of WL
X : ADD,P1 ,C1	E2H : 48H,A0H,4AH	A	
X0 : MIN,X ,K7	E4H : 47H,E2H,8CH	X	Non-return pointer min.
X1 : MAX,X ,K8	E6H : 46H,E2H,8EH	X	Non-return pointer max.
XD : SUB,X ,W	EAH : 49H,E2H,D2H	R	Formation of controll deviation
XP : FLX,+0100	ECH : A5H,43H,86H	R	Setting of XP
XU : DIR,X	EEH : 3DH,E2H,00H	R	Input to differentiator
Y : MUL,P6 ,K6	F0H : 4AH,AAH,8AH	S	Display of position reported back
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	–	Has no function
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Setting of output limit max.
YL : FLX,-001.2	FAH : A5H,C0H,00H	R	Setting of output limit min.
YR : DIR,/R3	FCH : 3DH,1CH,00H	R	External feedback (track)

10.1.4 Standard controller as programmer

Basis configuration 62511-0-XX30000

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	*	Commentary
'00 : BTI,Y_0	00H : 02H,60H,00H		
'10 : CU1,E ,N	10H : 87H,64H,98H		Program end
'12 : CU1,F ,TU	12H : 87H,66H,C6H		Program end
0L2 : BTN,LLL	16H : 01H,B8H,00H		
Q00 : BTN,LLL	17H : 01H,B8H,00H		Diagnostics output
Q12 : CB0,/N1,P7	1FH : 7CH,27H,ACH		Has no function
BLX : BTI,LLL	20H : 02H,B8H,00H		
BLW : BTN,LLL	21H : 01H,B8H,00H		
BLY : BTN,LLL	22H : 01H,B8H,00H		
Q01 : BTN,P15	24H : 01H,F4H,00H		Binary output
Q02 : BTN,P16	25H : 01H,F5H,00H		Binary output
Q03 : BTN,P17	26H : 01H,F6H,00H		Binary output
Q04 : ANN,'10,'12	27H : 03H,10H,12H		Output program end
YST : BTN,LLL	30H : 01H,B8H,00H		
FST : BTN,LLL	31H : 01H,B8H,00H		
WST : BTN,LLL	32H : 0EH,B8H,00H		
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		Stop if forced manual and after power restoration
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		Goes to internal after power restoration
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,LLL	37H : 01H,B8H,00H		
CC1 : BTN,LLL	3CH : 01H,B8H,00H		
CD1 : BTN,LLL	3DH : 01H,B8H,00H		
CI1 : FTR,'00,CI1	3EH : 0EH,00H,3EH		Start if not halt
A1 : DIR,W	40H : 3DH,D2H,00H		Set point output
C1 : PT1,00.10	4AH : F1H,A1H,80H		Time setting for the sections
C2 : PT2,00.10	4CH : F2H,A1H,80H		
C3 : PT3,00.20	4EH : F3H,41H,81H		
C4 : PT4,00.50	50H : F4H,21H,83H		
C5 : PT5,00.50	52H : F5H,21H,83H		
C6 : PT6,00.25	54H : F6H,91H,81H		
C7 : PT7,00.25	56H : F7H,91H,81H		
DR : DIR,W	60H : 3DH,D2H,00H		
DU : DIR,TU	62H : 3DH,C6H,00H		
E : FIX,000.6	64H : A4H,60H,80H		Program end after section 6
F : FIX,099.9	66H : A4H,70H,BEH		Program end after TU = 99.9
N : MA3,/U2	98H : 41H,18H,0H		
P0 : PW0,010.0	9EH : E0H,40H,86H	P	Setting of restart values
P1 : PW0,050.0	A0H : E0H,40H,9FH	P	
P2 : PW0,050.0	A2H : E0H,40H,9FH	P	
P3 : PW0,080.0	A4H : E0H,00H,B2H	P	
P4 : PW0,080.0	A6H : E0H,00H,B2H	P	
P5 : PW0,070.0	A8H : E0H,C0H,ABH	P	
P6 : PW0,060.0	AAH : E0H,80H,A5H	P	
P7 : PW0,020.0	ACH : E0H,80H,8CH	P	
R : MA3,/U3	B4H : 41H,17H,00H		
TU : DIR,/U1	C6H : 3DH,19H,00H		Time in section in progress
W : MIN,WH ,W0	D2H : 47H,DCH,D4H	W	Set point max. limitation
W0 : MAX,WL ,W1	D4H : 46H,E0H,D6H	W	Set point min. limitation
W1 : UW0,/U0,W	D6H : 2FH,1AH,D2H	W	Changeover P/I
W2 : K20,N	D8H : 64H,98H,00H	F	Section counter times 20
WE : K20,R	DAH : 64H,B4H,00H	F	Repetition counter times 20
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Set point max. limitation
WL : FLX,000.0	E0H : A5H,00H,80H	W	Set point min. limitation

10.1.5 Standard controller PE as manual station

Basic configuration 625-0-XX4/50000

Differences from continuous standard controller.

Mnemonic	Hexa decimal	✻	Commentary
'01 : AIN,YSA,'02	01H : 05H,43H,02H	S	
'02 : ANN,S13,Y_0	02H : 03H,DAH,60H	S	
'03 : ANN,'00,S14	03H : 03H,00H,DBH	S	Block Y switch
'07 : 0NN,D00,III	07H : 07H,A0H,BDH	S	
'08 : 0IN,S13,'07	08H : 09H,DAH,07H	S	
BLW : BTI,LLL	21H : 02H,B8H,00H		Switch off green pointer
BLD : BTI,NDI	23H : 02H,54H,00H		
Q03 : NOP	26H : 00H,00H,00H		
Q04 : BTN,Y_0	27H : 01H,60H,00H		Manual feedback
YSM : 0NN,'01,'07	33H : 07H,01H,07H	S	Block Y switch
YSA : FRS,Y_2,'08	34H : 0DH,62H,08H	S	
CC1 : BTN,LLL	3CH : 01H,B8H,00H		Direct action characteristic
CD1 : BTN,LLL	3DH : 01H,B8H,00H		
CI1 : BTI,LLL	3EH : 02H,B8H,00H		
CT1 : BTI,LLL	3FH : 02H,B8H,00H		Track function (continuous station only)
A2 : FIX,000.0	41H : A4H,00H,80H		Output A2 = 0
XD : FIX,000.0	EAH : A4H,00H,80H		Control deviation = 0
YR : DIR,/E2	FCH : 3DH,3EH,00H		Track input permanently connected to E2
additionall differences in manual station with three-position step output			
BLY : BTN,LLL	22H : 01H,B8H,00H		
Q03 : AIN,R11,R12	26H : 05H,E0H,E1H		
Q04 : AIN,R12,R11	27H : 05H,E1H,E0H		
CT1 : NOP	3FH :		
A1 : FIX,+100.0	40H : A4H,80H,BEH		
C6 : FLX,000.0	54H : A5H,00H,80H		
DU : DIR,Y	62H : 3DH,F0H,00H		
H : FLX,+001.0	76H : A5H,A0H,80H		
K6 : FLX,+100.0	8AH : A5H,80H,BEH		
P6 : ADD,/E2,C6	AAH : 48H,3EH,54H		
Y : MUL,P6,K6	F0H : 4AH,AAH,8AH		
YL : DIR,/E2	FCH : 3DH,3EH,00H		

10.1.6 Standard controller PE as Bias-, set point or ratio station

Basic configuration 62511-0-XX6/70000 Differences from continuous standard controller.

Mnemonic	Hexa decimal	✻	Commentary
Common:			
BLD : BTI,NDI	23H : 02H,54H,00H		
Q03 : N0P	26H :		
Q04 : N0P	27H :		
Set point station:			
'06 : 0NN,EA2,EAU	06H : 07H,A2H,A9H		Output monitoring A2 = set point
BLX : BTI,LLL	20H : 02H,B8H,00H		Switch off red pointer
BLY : ANI,'06,TF1	22H : 04H,06H,48H		No output display
Q01 : N0P	24H :		
Q02 : N0P	25H :		
A1 : FIX,000.0	40H : A4H,00H,80H		A1 = 0. (A2 = W)
DU : FIX,000.0	62H : A4H,00H,80H		No output display
Ratio station:			
'02 : ANN,'03,TF2	02H : 03H,03H,49H		Output monitoring A1
'03 : ANN,'00,S14	03H : 03H,00H,DBH		Visual alarm signalling
BLX : 0NN,'02,S21	20H : 07H,02H,D0H		
A1 : DIR,Y	40H : 3DH,F0H,00H		Output A1 = Y = /E1 * W
DU : DIR,Y	62H : 3DH,F0H,00H		Output display
WE : DIR,/E2	DAH : 3DH,3EH,00H		
X : DIR,/E1	E2H : 3DH,3FH,00H		
Y : MUL,X,W	F0H : 4AH,E2H,D2H		
Bias station:			
'02 : ANN,'03,TF2	02H : 03H,03H,49H		Output monitoring A1
'03 : ANN,'00,S14	03H : 03H,00H,DBH		Visual alarm signalling
BLX : 0NN,'02,S21	20H : 07H,02H,D0H		
A1 : DIR,Y	40H : 3DH,F0H,00H		Output A1 = Y = /E1 · K1 + W
DU : DIR,Y	62H : 3DH,F0H,00H		Output display
WE : MUL,/E2,K2	DAH : 4AH,3EH,82H		Multiplicative input weighting
WI : SIL,W,S22	DEH : 14H,D2H,D1H		Addition or subtraction changeover
X : MUL,/E1,K1	E2H : 4AH,3FH,80H		Multiplicative input weighting
Y : ADD,X,WI	F0H : 48H,E2H,DEH		Calculation of output

10.2 Universal controller PS

10.2.1 Continuous controller, single-channel

Basic configuration 62515-0-XX111XX

Mnemonic	Hexa decimal	*	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	Flashing X pointer with S1/4
'02 : 0NN,'00,'01	02H : 07H,00H,01H	G	and at least 1 alarm
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	
'04 : CT7,W,WE	04H : 97H,D2H,DAH	W	WE – W less than 1%
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	EA1 and EAU indicate error in output
'07 : N0P	07H		
'08 : N0P	08H		
'09 : N0P	09H		
'0A : N0P	0AH		
'0B : N0P	0BH		
'0C : N0P	0CH		
'0D : N0P	0DH		
'0E : N0P	0EH		
'0F : N0P	0FH		
'10 : N0P	10H		
'11 : N0P	11H		
'12 : N0P	12H		
'13 : N0P	13H		
'14 : N0P	14H		
'15 : N0P	15H		
0L2 : BTN,LLL	16H : 01H,B8H,00H	S	OL2 = 1 : 2nd channel is displayed
Q00 : BTN,LLL	17H : 01H,B8H,00H	Ü	Sets Q00
Q05 : BTN,W_0	18H : 01H,70H,00H	F	Internal feedback signal
Q06 : BTN,Y_0	19H : 01H,60H,00H	F	Manual feedback signal
Q07 : N0P	1AH		
Q08 : N0P	1BH		
Q09 : N0P	1CH		
Q10 : N0P	1DH		
Q11 : N0P	1EH		
Q12 : CB0,/N1,P7	1FH : 7CH,27H,ACH	Z	On/off controller output
BLX : ANN,'03,TF2	20H : 03H,03H,49H	G	Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		Green pointer on
BLY : 0II,'06,TF1	22H : 0AH,06H,48H	A	Output monitoring derived from 06H
BLD : N0P	23H		
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2,X	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : CU7,G3,M1	26H : 8DH,72H,96H	G	Alarm value 3
Q04 : CU7,M,G4	27H : 8DH,94H,74H	G	Alarm value 4
SC1 : BTI,S34	28H : 02H,CBH,00H		
SC2 : N0P	29H		
SC3 : N0P	2AH		
SC4 : N0P	2BH		
AL1 : N0P	2CH		
AL2 : N0P	2DH		
AL3 : N0P	2EH		
AL4 : N0P	2FH		
YST : FTR,D02,YST	30H : 0EH,F9H,30H	F	Remote changeover man./aut.
FST : BTN,LLL	31H : 01H,B8H,00H		Define F key
WST : FTR,D01,WST	32H : 0EH,F8H,32H	F	Remote control int/ext
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		Man. operation after reset or forced man. from outside
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,LLL	37H : 01H,B8H,00H		Changeover without flashing
CC2 : N0P	38H		
CD2 : N0P	39H		
CI2 : N0P	3AH		
CT2 : N0P	3BH		
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Switch characteristic inverted.
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch S2/6 switches D-component
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch S2/5 switches I-component
CT1 : 0NN,D08,Y_3	3FH : 07H,FFH,63H	F	Setting of control output

Continuous controller, single-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
A1 : ADD,C9 ,C8	40H : 48H,5AH,58H	A	Output 1
A2 : U31,B ,W	41H : 17H,44H,D2H	E	Output 2 either E2 weighted or W
A3 : DIR,/R4	42H : 3DH,1BH,00H	F	Display of remote controlled variable
A4 : NOP	43H		
B : ADD,P1 ,C1	44H : 48H,A0H,4AH	E	B = (E1 · K1) + C1 with P1 = E1 · K1
B. : NOP	45H		
C : NOP	46H		
C. : NOP	47H		
C0 : NOP	48H		
C.0 : NOP	49H		
C1 : FLX,+000.0	4AH : A5H,00H,80H	E	Weighting input 1
C.1 : NOP	4BH		
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Weighting of input 2 (external set point)
C.2 : NOP	4DH		
C3 : FLX,+000.0	4EH : A5H,00H,80H	E	Weighting input 3
C.3 : NOP	4FH		
C4 : FLX,+000.0	50H : A5H,00H,80H	E	Weighting input 4
C.4 : NOP	51H		
C5 : NOP	52H		
C.5 : NOP	53H		
C6 : NOP	54H		
C.6 : NOP	55H		
C7 : NOP	56H		
C.7 : NOP	57H		
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	A	Manual characteristic with C9
C.8 : SZL,/N8,S17	59H : 15H,20H,DEH	A	As C8 prepared for second channel
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	A	With C8 manual characteristic changeover
C.9 : SIH,/R2,S17	5BH : 13H,1DH,DEH	A	With C.8 manual characteristic changeover prepared
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference from WE (E2)
D. : NOP	5DH		
DL : DIR,B	5EH : 3DH,44H,00H	X	Left hand analog display, weighted input E1 = B
D.L : NOP	5FH		
DR : DIR,W	60H : 3DH,D2H,00H		Right hand analog display; set point
D.R : NOP	61H		
DU : DIR,/R3	62H : 3DH,1CH,00H	A	Output of control module 1 directly at bottom display
D.U : DIR,/R2	63H : 3DH,1DH,00H		Prepared for channel 2
E : INV,XD	64H : 3CH,EAH,00H	E	E = – XD
E. : NOP	65H		
F : NOP	66H		
F. : SUB,/N8,/E5	67H : 49H,20H,3BH	–	} Preparation for external control of output limits
F1 : NOP	68H		
F.1 : MIN,F. ,F.2	69H : 47H,67H,6BH	–	
F2 : NOP	6AH		
F.2 : FLX,+100.0	6BH : A5H,80H,BEH		
F3 : MAX,F.3,/E6	6CH : 46H,6DH,3AH	–	
F.3 : FLX,+000.0	6DH : A5H,00H,80H	–	
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G.1 : NOP	6FH		
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G.2 : NOP	71H		
G3 : FLX,-100.0	72H : A5H,80H,3EH	G	Default value G3
G.3 : NOP	73H		
G4 : FLX,+100.0	74H : A5H,80H,BEH	G	Default value G4
G.4 : NOP	75H		
H : NOP	76H		
H. : NOP	77H		
I : NOP	78H		
I. : NOP	79H		
J : NOP	7AH		
J. : NOP	7BH		
K : NOP	7CH		
K. : NOP	7DH		
K0 : NOP	7EH		
K.0 : NOP	7FH		

Continuous controller, single-channel (continued)

Mnemonic	Hexa decimal	*	Commentary
K1 : FLX,+100.0	80H : A5H,80H,BEH	E	Weighting input 1
K.1 : NOP	81H		
K2 : FLX,+100.0	82H : A5H,80H,BEH	E	Weighting input 2
K.2 : NOP	83H		
K3 : FLX,+100.0	84H : A5H,80H,BEH	E	Weighting input 3
K.3 : NOP	85H		
K4 : FLX,+100.0	86H : A5H,80H,BEH	E	Weighting input 4
K.4 : NOP	87H		
K5 : NOP	88H		
K.5 : NOP	89H		
K6 : NOP	8AH		
K.6 : NOP	8BH		
K7 : UC0,X0,X	8CH : 1AH,E4H,E2H	E	CLEAR 0 reset non-return pointer min.
K.7 : NOP	8DH		
K8 : UC0,X1,X	8EH : 1AH,E6H,E2H	E	CLEAR 0 reset non-return pointer max.
K.8 : NOP	8FH		
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = 1/XP
K.P : NOP	91H		
L : NOP	92H		
L. : NOP	93H		
M : MAX,XD,N	94H : 46H,EAH,98H	G	Absolute value calculation for alarm values 3 and 4
M. : NOP	95H		
M1 : SIH,M,S15	96H : 13H,94H,DCH	G	Absolute value calculation for alarm values 3 and 4
M.1 : NOP	97H		
N : SIL,N1,S15	98H : 14H,9AH,DCH	G	Changeover XD against I XD I
N. : NOP	99H		
N1 : ABS,XD	9AH : 3BH,EAH,00H	G	Calculation of absolute value
N.1 : NOP	9BH		
P : SZL,WE,'05	9CH : 15H,DAH,05H	W	Changeover WE to W(int) if difference $\leqq$ 1%
P. : NOP	9DH		
P0 : NOP	9EH		
P.0 : NOP	9FH		
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	E	P1 = E1 · K1 input weighting E1
P.1 : NOP	A1H		
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	E	P2 = E2 · K2 input weighting E2
P.2 : NOP	A3H		
P3 : MUL,/E3,K3	A4H : 4AH,3DH,84H	E	P3 = E3 · K3 input weighting E3
P.3 : NOP	A5H		
P4 : MUL,/E4,K4	A6H : 4AH,3CH,86H	E	P4 = E4 · K4 input weighting E4
P.4 : NOP	A7H		
P5 : NOP	A8H		
P.5 : NOP	A9H		
P6 : NOP	AAH		
P.6 : NOP	ABH		
P7 : IG3,P8,P7	ACH : 76H,AEH,ACH	Z	Generation of on/off function
P.7 : IG3,P.8,P.7	ADH : 76H,AFH,ADH	Z	
P8 : SUB,A1,P9	AEH : 49H,1CH,B0H	Z	
P.8 : SUB,A2,P.9	AFH : 49H,1DH,B1H	Z	} Preparation 2nd channel
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	Z	
P.9 : SZL,/N8,Q10	B1H : 15H,20H,1DH	Z	
Q : SZH,R,'05	B2H : 16H,B4H,05H	W	Changeover to WE if difference < 1%
Q. : NOP	B3H		
R : RL4,WE,W	B4H : 6BH,DAH,D2H	W	Limitation of rate of change WE ⟵ W
R. : NOP	B5H		
S : DIR,/N1	B6H : 3DH,27H,00H	R	Disturbance variable feedforward = 0
S. : NOP	B7H		
T0 : NOP	B8H		
T.0 : NOP	B9H		
T1 : NOP	BAH		
T.1 : NOP	BBH		
T2 : NOP	BCH		
T.2 : NOP	BDH		
T3 : NOP	BEH		
T.3 : NOP	BFH		

Continuous controller, single-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
T4 : NOP	C0H		
T.4 : NOP	C1H		
TD : FLX,+0010	C2H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switches S2/...)
T.D : NOP	C3H		
TN : FLX,+0040	C4H : A5H,83H,82H	R	Int. action time 40 (dimension depends on switches S2/...)
T.N : NOP	C5H		
TU : NOP	C6H		
T.U : NOP	C7H		
U : NOP	C8H		
U. : NOP	C9H		
C : NOP	CAH		
V. : NOP	CBH		
V0 : NOP	CCH		
V.0 : NOP	CDH		
V1 : NOP	CEH		
V.1 : NOP	CFH		
V2 : NOP	D0H		
V.2 : NOP	D1H		
W : MIN,WH,W0	D2H : 47H,DCH,D4H	W	Set point limitation max
W. : NOP	D3H		
W0 : MAX,WL,W1	D4H : 46H,E0H,D6H	W	Set point limitation min
W.0 : NOP	D5H		
W1 : UW0,W2,W	D6H : 2FH,D8H,D2H	W	Changeover int/ext
W.1 : NOP	D7H		
W2 : ADD,P,Q	D8H : 48H,9CH,B2H	W	W ⟶ WE limitation of rate of change
W.2 : NOP	D9H		
WE : ADD,P2,C2	DAH : 48H,A2H,4CH	W	Weighting input 2
W.E : NOP	DBH		
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Setting of WH
W.H : NOP	DDH		
WI : NOP	DEH		
W.I : NOP	DFH		
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Setting of WL
W.L : NOP	E1H		
X : DIR,B	E2H : 3DH,44H,00H	A	Display X = input 1 direct or weighted
X. : NOP	E3H		
X0 : MIN,X,K7	E4H : 47H,E2H,8CH	X	Non-return pointer min
X.0 : NOP	E5H		
X1 : MAX,X,K8	E6H : 46H,E2H,8EH	X	Non-return pointer max
X.1 : NOP	E7H		
X2 : NOP	E8H		
X.2 : NOP	E9H		
XD : SUB,B,W	EAH : 49H,44H,D2H	R	Formation of control deviation
X.D : NOP	EBH		
XP : FLX,+0100	ECH : A5H,43H,86H	R	Setting of XP
X.P : NOP	EDH		
XU : DIR,X	EEH : 3DH,E2H,00H	R	Input to differentiator
X.U : NOP	EFH		
Y : MA0,/R3,Y	F0H : 3EH,1CH,F0H	A	Display Y with a decimal point position
Y. : MA0,/R2	F1H : 3EH,1DH,00H		Display Y. with a decimal point position prepared
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	R	Setting of Y0 = operating point
Y.0 : NOP	F3H		
Y1 : NOP	F4H		
Y.1 : NOP	F5H		
Y2 : NOP	F6H		
Y.2 : NOP	F7H		
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Setting of output limit max.
Y.H : NOP	F9H		
YL : FLX,+000.0	FAH : A5H,00H,80H	R	Setting of output limit min.
Y.L : NOP	FBH		
YR : UY3,/E5,/R3	FCH : 22H,3BH,1CH		External feedback (track)
Y.R : NOP	FDH		
Z : NOP	FEH		
Z. : NOP	FFH		

10.2.2 Step action controller, single-channel

Basic configuration 62515-0-XX211XX

Mnemonic	Hexa decimal	*	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	Flashing X pointer with S1/4
'02 : 0NN,'00,'01	02H : 07H,00H,01H	G	and at least 1 alarm
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	
'04 : CT7,W,WE	04H : 97H,D2H,DAH	W	WE – W less than 1%
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	EA1 and EAU indicate error in output
'07 : N0P	07H		
'08 : N0P	08H		
'09 : N0P	09H		
'0A : N0P	0AH		
'0B : N0P	0BH		
'0C : N0P	0CH		
'0D : N0P	0DH		
'0E : N0P	0EH		
'0F : N0P	0FH		
'10 : N0P	10H		
'11 : N0P	11H		
'12 : N0P	12H		
'13 : N0P	13H		
'14 : N0P	14H		
'15 : N0P	15H		
OL2 : BTN,LLL	16H : 01H,B8H,00H	S	1 switches 2nd channel on
Q00 : BTN,LLL	17H : 01H,B8H,00H	Ü	Sets Q00
Q05 : BTN,W_0	18H : 01H,70H,00H	F	Internal feedback signal
Q06 : BTN,Y_0	19H : 01H,60H,00H	F	Manual feedback signal
Q07 : N0P	1AH		
Q08 : N0P	1BH		
Q09 : N0P	1CH		
Q10 : N0P	1DH		
Q11 : AIN,R11,R12	1EH : 05H,E0H,E1H	D	Lower step action controller output
Q12 : AIN,R12,R11	1FH : 05H,E1H,E0H	D	Raise step action controller output
BLX : ANN,'03,TF2	20H : 03H,03H,49H	G	Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H		Green pointer on
BLY : BTN,LLL	22H : 01H,B8H,00H	A	No output monitoring
BLD : N0P	23H		
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2,X	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : CU7,G3,M1	26H : 8DH,72H,96H	G	Alarm value 3
Q04 : CU7,M,G4	27H : 8DH,94H,74H	G	Alarm value 4
SC1 : N0P	28H		
SC2 : N0P	29H		
SC3 : N0P	2AH		
SC4 : N0P	2BH		
AL1 : N0P	2CH		
AL2 : N0P	2DH		
AL3 : N0P	2EH		
AL4 : N0P	2FH		
YST : FTR,D02,YST	30H : 0EH,F9H,30H	F	Remote changeover man./automatic
FST : BTN,LLL	31H : 01H,B8H,00H		Define F key
WST : FTR,D01,WST	32H : 0EH,F8H,32H	F	Remote control int/ext
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		YSM = 1 sets controller to manual
YSA : BTN,LLL	34H : 01H,B8H,00H		YSA = 1 sets controller to automatic
WSI : BTN,III	35H : 01H,BDH,00H		WSI = 1 sets controller to internal
WSE : BTN,LLL	36H : 01H,B8H,00H		WSE = 1 sets controller to external
OKD : BTN,LLL	37H : 01H,B8H,00H		
CC2 : N0P	38H		
CD2 : N0P	39H		
CI2 : N0P	3AH		
CT2 : N0P	3BH		
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Switch characteristic inverted.
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch S2/6
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch S2/5
CT1 : 0NN,D08,Y_3	3FH : 07H,FFH,63H	F	Set controller output

The configuration of the step action controller (and other functions) is derived from the configuration of the continuous controller. Non-interfering continuous controller configuration lines are not always deleted.

Step action controller, single-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
A1 : FIX,+100.0	40H : A4H,80H,BEH	S	Supply for position feedback signal
A2 : U31,B ,W	41H : 17H,44H,D2H	E	Output 2 either E2 weighted or W
A3 : DIR,/R4	42H : 3DH,1BH,00H	F	Display of remote controlled variable
A4 : NOP	43H		
B : ADD,P1 ,C1	44H : 48H,A0H,4AH	E	B = (E1 · K1) + C1 with P1 = E1 · K1
B. : NOP	45H		
C : NOP	46H		
C. : NOP	47H		
C0 : NOP	48H		
C.0 : NOP	49H		
C1 : FLX,+000.0	4AH : A5H,00H,80H	E	Weighting input 1
C.1 : NOP	4BH		
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Weighting of input 2 (external set point)
C.2 : NOP	4DH		
C3 : FLX,+000.0	4EH : A5H,00H,80H	E	Weighting input 3
C.3 : NOP	4FH		
C4 : FLX,+000.0	50H : A5H,00H,80H	E	Weighting input 4
C.4 : NOP	51H		
C5 : NOP	52H		
C.5 : NOP	53H		
C6 : FLX,+000.0	54H : A5H,00H,80H	Y	Adjustment of output display
C.6 : NOP	55H		
C7 : NOP	56H		
C.7 : NOP	57H		
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	–	Has no function
C.8 : SZL,/N8,S17	59H : 15H,20H,DEH	–	Has no function
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	–	Has no function
C.9 : SIH,/R2,S17	5BH : 13H,1DH,DEH	–	Has no function
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference from WE (E2)
D. : NOP	5DH		
DL : DIR,B	5EH : 3DH,44H,00H	X	Left hand analog display weighted input E1 = B
D.L : NOP	5FH		
DR : DIR,W	60H : 3DH,D2H,00H	W	Right hand analog display: set point
D.R : NOP	61H		
DU : DIR,Y	62H : 3DH,F0H,00H	A	Position feedback signal directly at bottom display
D.U : DIR,/R2	63H : 3DH,1DH,00H		Prepared for channel 2 (has no function)
E : INV,XD	64H : 3CH,EAH,00H	E	E = –XD no longer in the large loop
E. : NOP	65H		
F : NOP	66H		
F. : SUB,/N8,/E5	67H : 49H,20H,3BH	–	} Prepared external control of output limits
F1 : NOP	68H		
F.1 : MIN,F. ,F.2	69H : 47H,67H,6BH	–	
F2 : NOP	6AH		
F.2 : FLX,+100.0	6BH : A5H,80H,BEH	–	
F3 : MAX,F.3,/E6	6CH : 46H,6DH,3AH	–	
F.3 : FLX,+000.0	6DH : A5H,00H,80H	–	
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G.1 : NOP	6FH		
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G.2 : NOP	71H		
G3 : FLX,-100.0	72H : A5H,80H,3EH	G	Default value G3
G.3 : NOP	73H		
G4 : FLX,+100.0	74H : A5H,80H,BEH	G	Default value G4
G.4 : NOP	75H		
H : FLX,+001.0	76H : A5H,A0H,80H	R	Dead band for P channel
H. : NOP	77H		
I : NOP	78H		
I. : NOP	79H		
J : NOP	7AH		
J. : NOP	7BH		
K : NOP	7CH		
K. : NOP	7DH		
K0 : NOP	7EH		
K.0 : NOP	7FH		

Step action controller, single-channel (continued)

Mnemonic	Hexa decimal	*	Commentary
K1 : FLX,+100.0	80H : A5H,80H,BEH	E	Weighting input 1
K.1 : NOP	81H		
K2 : FLX,+100.0	82H : A5H,80H,BEH	E	Weighting input 2
K.2 : NOP	83H		
K3 : FLX,+100.0	84H : A5H,80H,BEH	E	Weighting input 3
K.3 : NOP	85H		
K4 : FLX,+100.0	86H : A5H,80H,BEH	E	Weighting input 4
K.4 : NOP	87H		
K5 : NOP	88H		
K.5 : NOP	89H		
K6 : FLX,+100.0	8AH : A5H,80H,BEH	R	Adjustment of position feedback signal
K.6 : NOP	8BH		
K7 : UC0,X0 ,X	8CH : 1AH,E4H,E2H	E	CLEAR 0 reset non-return pointer min.
K.7 : NOP	8DH		
K8 : UC0,X1 ,X	8EH : 1AH,E6H,E2H	E	CLEAR 0 reset non-return pointer max.
K.8 : NOP	8FH		
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = 1/XP
K.P : NOP	91H		
L : NOP	92H		
L. : NOP	93H		
M : MAX,XD ,N	94H : 46H,EAH,98H	G	Absolute value calculation for alarm values 3 and 4
M. : NOP	95H		
M1 : SIH,M ,S15	96H : 13H,94H,DCH	G	Absolute value calculation for alarm values 3 and 4
M.1 : NOP	97H		
N : SIL,N1 ,S15	98H : 14H,9AH,DCH	G	Changeover XD against I XD I
N. : NOP	99H		
N1 : ABS,XD	9AH : 3BH,EAH,00H	G	Calculation of absolute value
N.1 : NOP	9BH		
P : SZL,WE ,'05	9CH : 15H,DAH,05H	W	Changeover WE to W(int) if difference ≦ 1%
P. : NOP	9DH		
P0 : NOP	9EH		
P.0 : NOP	9FH		
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	E	P1 = E1 · K1 input weighting E1
P.1 : NOP	A1H		
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	E	P2 = E2 · K2 input weighting E2
P.2 : NOP	A3H		
P3 : MUL,/E3,K3	A4H : 4AH,3DH,84H	E	P3 = E3 · K3 input weighting E3
P.3 : NOP	A5H		
P4 : MUL,/E4,K4	A6H : 4AH,3CH,86H	E	P4 = E4 · K4 input weighting E4
P.4 : NOP	A7H		
P5 : NOP	A8H		
P.5 : NOP	A9H		
P6 : ADD,/E6,C6	AAH : 48H,3AH,54H	S	Position feedback signal
P.6 : NOP	ABH		
P7 : IG3,P8 ,P7	ACH : 76H,AEH,ACH	–	Has no function
P.7 : IG3,P.8,P.7	ADH : 76H,AFH,ADH	–	Has no function
P8 : SUB,A1 ,P9	AEH : 49H,40H,B0H	–	Has no function
P.8 : SUB,A2 ,P.9	AFH : 49H,41H,B1H	–	Has no function
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	–	Has no function
P.9 : SZL,/N8,Q10	B1H : 15H,20H,1DH	–	Has no function
Q : SZH,R ,'05	B2H : 16H,B4H,05H	W	Changeover to WE if difference ≦ 1%
Q. : NOP	B3H		
R : RL4,WE ,W	B4H : 6BH,DAH,D2H	W	Limitation of rate of change WE ⟵ W
R. : NOP	B5H		
S : DIR,/N1	B6H : 3DH,27H,000	R	Disturbance variable feedforward = 0
S. : NOP	B7H		
T0 : NOP	B8H		
T.0 : NOP	B9H		
T1 : NOP	BAH		
T.1 : NOP	BBH		
T2 : NOP	BCH		
T.2 : NOP	BDH		
T3 : NOP	BEH		
T.3 : NOP	BFH		

Step action controller, single-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
T4 : NOP	C0H		
T.4 : NOP	C1H		
TD : FLX, 0010	C2H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switches S2/...)
T.D : NOP	C3H		
TN : FLX, 0040	C4H : A5H,83H,82H	R	Int. action time 40 (dimension depends on switches S2/...)
T.N : NOP	C5H		
TU : NOP	C6H		
T.U : NOP	C7H		
U : NOP	C8H		
U. : NOP	C9H		
V : NOP	CAH		
V. : NOP	CBH		
V0 : NOP	CCH		
V.0 : NOP	CDH		
V1 : NOP	CEH		
V.1 : NOP	CFH		
V2 : NOP	D0H		
V.2 : NOP	D1H		
W : MIN,WH ,W0	D2H : 47H,DCH,D4H	W	Set point limitation max
W. : NOP	D3H		
W0 : MAX,WL ,W1	D4H : 46H,E0H,D6H	W	Set point limitation min
W.0 : NOP	D5H		
W1 : UW0,W2 ,W	D6H : 2FH,D8H,D2H	W	Changeover int/ext
W.1 : NOP	D7H		
W2 : ADD,P ,Q	D8H : 48H,9CH,B2H	W	W ⟶ WE limitation of rate of change
W.2 : NOP	D9H		
WE : ADD,P2 ,C2	DAH : 48H,A2H,4CH	W	Weighting input 2
W.E : NOP	DBH		
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Setting of WH
W.H : NOP	DDH		
WI : NOP	DEH		
W.I : NOP	DFH		
WL : FLX, 0.0%	E0H : A5H,00H,80H	W	Setting of WL
W.L : NOP	E1H		
X : DIR,B	E2H : 3DH,44H,00H	A	Display X = input 1 direct or weighted
X. : NOP	E3H		
X0 : MIN,X ,K7	E4H : 47H,E2H,8CH	X	Non-return pointer min
X.0 : NOP	E5H		
X1 : MAX,X ,K8	E6H : 46H,E2H,8EH	X	Non-return pointer max
X.1 : NOP	E7H		
X2 : NOP	E8H		
X.2 : NOP	E9H		
XD : SUB,B ,W	EAH : 49H,44H,D2H	R	Formation of control deviation
X.D : NOP	EBH		
XP : FLX,+0100	ECH : A5H,43H,86H	R	Setting of XP
X.P : NOP	EDH		
XU : DIR,X	EEH : 3DH,E2H,00H	R	Input of differentiator
X.U : NOP	EFH		
Y : MUL,P6 ,K6	F0H : 4AH,AAH,8AH	S	Display of reported back position
Y. : MA0,/R2	F1H : 3EH,1DH	–	Has no function
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	R	Setting of Y0 = operating point
Y.0 : NOP	F3H		
Y1 : NOP	F4H		
Y.1 : NOP	F5H		
Y2 : NOP	F6H		
Y.2 : NOP	F7H		
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Setting of output limit max.
Y.H : NOP	F9H		
YL : FLX,−000.0	FAH : A5H,00H,80H	R	Setting of output limit min.
Y.L : NOP	FBH		
YR : UY3,/E5./R3	FCH : 22H,3DH,1CH	R	External feedback
Y.R : NOP	FDH		
Z : NOP	FEH		
Z. : NOP	FFH		

10.2.3 Continuous controller, two-channel

Basic configuration 62515-0-X451XX

Mnemonic	Hexa decimal	✻	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	
'01 : ANI,Q03,Q04	01H : 04H,26H,27H	G	Flashing X pointer with S1/4
'02 : 0NN,'00,'01	02H : 07H,00H,01H	G	and at least 1 alarm
'03 : ANN,'02,S14	03H : 03H,02H,DBH	G	
'04 : CT7,W,WE	04H : 97H,D2H,DAH	W	W_E – W less than 1 % –
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	If '04, '05 is set. Reset with '70 = internal
'06 : 0NN,'09,EAU	06H : 07H,09H,A9H	A	EA1 and EAU indicate error in output
'07 : CT7,W.,W.E	07H : 97H,D3H,DBH	W	As '04 but 2nd channel
'08 : FRS,'07,W_4	08H : 0DH,07H,74H	F	As '05 but 2nd channel
'09 : 0NN,EA1,EA2	09H : 07H,A1H,A2H	A	Output monitoring 1st and 2nd channel
'0A : N0P	0AH		
'0B : N0P	0BH		
'0C : 0NN,D00,'0D	0CH : 07H,A0H,0DH	H	Forced manual if input D00 or '0D
'0D : ANN,'0E,'0F	0DH : 03H,0EH,0FH	H	Remote control manual/automatic
'0E : ANI,D01,D02	0EH : 04H,F8H,F9H	F	Remote control manual/automatic
'0F : XNN,0L2,D07	0FH : 0BH,16H,FEH	F	Remote adjustment of variables of 2nd channel
'10 : N0P	10H		
'11 : N0P	11H		
'12 : N0P	12H		
'13 : N0P	13H		
'14 : N0P	14H		
'15 : N0P	15H		
OL2 : BTN,F_1	16H : 01H,69H,00H	S	F key switches 2nd channel on
Q00 : BTN,LLL	17H : 01H,B8H,00H	Ü	Sets output Q00
Q05 : BTN,W_0	18H : 01H,70H,00H	F	Internal feedback signal
Q06 : BTN,Y_0	19H : 01H,60H,00H	F	Manual feedback 2nd channel
Q07 : BTN,W_4	1AH : 01H,74H,00H	F	Internal feedback 2nd channel
Q08 : BTN,Y_4	1BH : 01H,64H,00H	F	Manual feedback 2nd channel
Q09 : N0P	1CH		
Q10 : CB0,/N1,P.7	1DH : 7CH,27H,ADH	Z	Output 2nd channel on/off controller
Q11 : N0P	1EH		
Q12 : CB0,/N1,P7	1FH : 7CH,27H,ACH	Z	Output 1st channel on/off controller
BLX : ANN,'03,TF2	20H : 03H,03H,49H	G	Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		Green pointer on
BLY : 0II,'06,TF1	22H : 0AH,06H,48H	A	Output monitoring derived from 06H
BLD : N0P	23H		
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2,X.	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : CU7,/X.,G.1	26H : 8DH,E3H,6FH	G	Alarm value 1, 2nd channel
Q04 : CU7,G.2,/X.	27H : 8DH,71H,E3H	G	Alarm value 2, 2nd channel
SC1 : BTI,S34	28H : 02H,CBH,00H		
SC2 : N0P	29H		
SC3 : N0P	2AH		
SC4 : N0P	2BH		
AL1 : N0P	2CH		
AL2 : N0P	2DH		
AL3 : N0P	2EH		
AL4 : N0P	2FH		
YST : FTR,D02,YST	30H : 0EH,F9H,30H	F	Remote changeover manual/automatic
FST : FTR,'0C,FST	31H : 0EH,0CH,31H	F	Switch F key forward with '0C
WST : FTR,D01,WST	32H : 0EH,F8H,32H	F	Remote control int/ext
YSM : 0NN,D00,III	33H : 07H,A0H,BDH		Man. operation after reset or forced man. from outside
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,KP5	37H : 01H,84H,00H	B	Direct changeover 1st/2nd channel without flashing
CC2 : BTI,S21	38H : 02H,D0H,00H	R	Controller characteristic 2nd channel
CD2 : BTN,S26	39H : 01H,D5H,00H	R	D action 2nd channel on/off
CI2 : BTN,S25	3AH : 01H,D4H,00H	R	I action 2nd channel on/off
CT2 : BTN,Y_7	3BH : 01H,67H,00H	B	Not activated
CCI : BTI,S21	3CH : 02H,D0H,00H	R	Switch characteristic inverted
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	Switch S2/6
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	Switch S2/5
CT1 : BTN,Y_3	3FH : 01H,63H,00H	B	Not activated

Continuous controller, two-channel (continued)

Mnemonic	Hexa decimal	*	Commentary
A1 : ADD,C9 ,C8	40H : 48H,5AH,58H	A	Output 1
A2 : ADD,C.8,C.9	41H : 48H,59H,5BH	A	Output 2 = controller output of channel 2
A3 : DIR,/R4	42H : 3DH,1BH,00H	F	Display of remote controlled variable
A4 : U32,B.,B.	43H : 18H,45H,44H	E	Output 4 = either weighted input 1 or 3
B : ADD,P1 ,C1	44H : 48H,A0H,4AH	E	B = (E1 · K1) + C1 with P1 = E1 · K1
B. : ADD,P.1,C.1	45H : 48H,A1H,4BH	E	B.= (E3 · K.1) + C.1 with P.1 = E3 · K.1
C : NOP	46H		
C. : NOP	47H		
C0 : NOP	48H		
C.0 : NOP	49H		
C1 : FLX,+000.0	4AH : A5H,00H,80H	E	Weighting of input 1
C.1 : FLX,+000.0	4BH : A5H,00H,80H	E	Weighting of input 3
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Weighting of input 2 (external set point)
C.2 : FLX,+000.0	4DH : A5H,00H,80H	E	Weighting of input 4 (external set point 2nd channel)
C3 : NOP	4EH	–	
C.3 : NOP	4FH		
C4 :	50H	–	
C.4 : NOP	51H		
C5 : NOP	52H		
C.5 : NOP	53H		
C6 : NOP	54H		
C.6 : NOP	55H		
C7 : NOP	56H		
C.7 : NOP	57H		
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	A	Manual characteristic with C9
C.8 : SZL,/N8,S17	59H : 15H,20H,DEH	A	As C8 prepared for second channel
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	A	With C8 manual characteristic changeover
C.9 : SIH,/R2,S17	5BH : 13H,1DH,DEH	A	With C.8 manual characteristic changeover prepared
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference from WE (E2)
D. : SUB,W.E,W.	5DH : 49H,DBH,D3H	W	Set point difference 2nd channel
DL : DIR,B	5EH : 3DH,44H,00H	X	Left hand analog display, weighted input E1 = B
D.L : DIR,B.	5FH : 3DH,45H,00H	X	Left hand analog display, weighted input E3 = B.
DR : DIR,W	60H : 3DH,D2H,00H	W	Right hand analog display: set point
D.R : DIR,W.	61H : 3DH,D3H,00H	W	Right hand analog display: set point of 2nd channel
DU : DIR,/R3	62H : 3DH,1CH,00H	A	Output of control module 1 directly at bottom display
D.U : DIR,/R2	63H : 3DH,1DH,00H	A	Output of control module 2 directly at bottom display
E : INV,XD	64H : 3CH,EAH,00H	E	E = – XD no longer in large display loop
E. : INV,X.D	65H : 3CH,EBH,00H	E	E. = – X.D no longer in large display loop
F : NOP	66H		
F. : SUB,/N8,/E5	67H : 49H,20H,3BH	–	
F1 : NOP	68H		
F.1 : MIN,F. ,F.2	69H : 47H,67H,6BH	–	
F2 : NOP	6AH		
F.2 : FLX,+100.0	6BH : A5H,80H,BEH	–	
F3 : MAX,F.3,/E6	6CH : 46H,6DH,3AH	–	
F.3 : FLX,+000.0	6DH : A5H,00H,80H	–	
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Default value G1
G.1 : FLX,+100.0	6FH : A5H,80H,BEH	G	Default value G.1
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Default value G2
G.2 : FLX,+000.0	71H : A5H,00H,80H	G	Default value G.2
G3 : DIR,G.1	72H : 3DH,6FH,00H		G.1 allocated to system image (processor coupling)
G.3 : NOP	73H		
G4 : DIR,G.2	74H : 3DH,71H,00H		G.2 allocated to system image (processor coupling)
G.4 : NOP	75H		
H : NOP	76H		
H. : NOP	77H		
I : NOP	78H		
I. : NOP	79H		
J : NOP	7AH		
J. : NOP	7BH		
K : NOP	7CH		
K. : NOP	7DH		
K0 : NOP	7EH		
K.0 : NOP	7FH		

Continuous controller, two-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
K1 : FLX,+100.0	80H : A5H,80H,BEH	E	Weighting input 1
K.1 : FLX,+100.0	81H : A5H,80H,BEH	E	Weighting input 3
K2 : FLX,+100.0	82H : A5H,80H,BEH	E	Weighting input 2
K.2 : FLX,+100.0	83H : A5H,80H,BEH	E	Weighting input 4
K3 : NOP	84H		
K.3 : NOP	85H		
K4 : NOP	86H		
K.4 : NOP	87H		
K5 : NOP	88H		
K.5 : NOP	89H		
K6 : NOP	8AH		
K.6 : NOP	8BH		
K7 : UC0,X0,X	8CH : 1AH,E4H,E2H	E	CLEAR 0 reset non-return pointer min.
K.7 : UC1,C.0,X.	8DH : 1BH,E5H,E3H	E	CLEAR 1 reset non-return pointer min. 2nd channel
K8 : UC0,X1,X	8EH : 1AH,E6H,E2H	E	CLEAR 0 reset non-return pointer max.
K.8 : UC1,X.1,X.	8FH : 1BH,E7H,E3H	E	CLEAR 1 reset non-return pointer max. 2nd channel
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	R	KP = 1/XP
K.P : DIV,/N2,X.P	91H : 4BH,26H,EDH	R	K.P = 1/X.P
L : NOP	92H		
L. : NOP	93H		
M : MAX,XD,N	94H : 46H,EAH,98H	–	Has no function
M. : NOP	95H		
M1 : SIH,M,S15	96H : 13H,94H,DCH	–	Has no function
M.1 : NOP	97H		
N : SIL,N1,S15	98H : 14H,9AH,DCH	–	Has no function
N. : NOP	99H		
N1 : ABS,XD	9AH : 3BH,EAH,00H	–	Has no function
N.1 : NOP	9BH		
P : SZL,WE,'05	9CH : 15H,DAH,05H	W	Changeover WE to W(int) if difference ≦ 1%
P. : SZL,W.E,'08	9DH : 15H,DBH,08H	W	Changeover W.E to W(int) if difference ≦ 1%
P0 : NOP	9EH		
P.0 : NOP	9FH		
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	E	P1 = E1 · K1 input weighting E1
P.1 : MUL,/E3,K.1	A1H : 4AH,3DH,81H	E	P.1 = E3 · K.1 input weighting E3
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	E	P2 = E2 · K2 input weighting E2
P.2 : MUL,/E4,K.2	A3H : 4AH,3CH,83H	E	P.2 = E4 · K.2 input weighting E4
P3 : NOP	A4H		
P.3 : NOP	A5H		
P4 : NOP	A6H		
P.4 : NOP	A7H		
P5 : NOP	A8H		
P.5 : NOP	A9H		
P6 : NOP	AAH		
P.6 : NOP	ABH		
P7 : IG3,P8,P7	ACH : 76H,AEH,ACH	Z	Generation of on/off function
P.7 : IG3,P.8,P.7	ADH : 76H,AFH,ADH	Z	Generation of on/off function of 2nd channel
P8 : SUB,/A1,P9	AEH : 49H,40H,B0H	Z	See P7
P.8 : SUB,/A2,P.9	AFH : 49H,41H,B1H	Z	See P.7
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	Z	See P7
P.9 : SZL,/N8,Q10	B1H : 15H,20H,1DH	Z	See P.7
Q : SZH,R,'05	B2H : 16H,B4H,05H	W	Changeover to WE if difference ≦ 1%
Q. : SZH,R.,'08	B3H : 16H,B5H,08H	W	Changeover to W.E if difference ≦ 1%
R : RL4,WE,W	B4H : 6BH,DAH,D2H	W	Limitation of rate of change WE ⟵ W
R. : RL4,W.E,W.	B5H : 6BH,DBH,D3H	W	Limitation of rate of change W.E ⟵ W.
S : DIR,/N1	B6H : 3DH,27H,00H	R	Disturbance variable feedforward = 0
S. : DIR,/N1	B7H : 3DH,27H,00H	R	Disturbance variable feedforward = 0
T0 : NOP	B8H		
T.0 : NOP	B9H		
T1 : NOP	BAH		
T.1 : NOP	BBH		
T2 : NOP	BCH		
T.2 : NOP	BDH		
T3 : NOP	BEH		
T.3 : NOP	BFH		

Continuous controller, two-channel (continued)

Mnemonic	Hexa decimal	✻	Commentary
T4 : NOP	C0H		
T.4 : NOP	C1H		
TD : FLX,+0010	C2H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switches S2/...)
T.D : FLX,+0010	C3H : A5H,A3H,80H	R	Deriv. action time 10 (dimension depends on switches S2/..., 2nd channel)
TN : FLX,+0040	C4H : A5H,83H,82H	R	Int. action time 40 (dimension depends on switches S2/...)
T.N : FLX,+0040	C5H : A5H,83H,82H	R	Integral action time 40, 2nd channel
TU : NOP	C6H		
T.U : NOP	C7H		
U : NOP	C8H		
U. : NOP	C9H		
V : NOP	CAH		
V. : NOP	CBH		
V0 : NOP	CCH		
V.0 : NOP	CDH		
V1 : NOP	CEH		
V.1 : NOP	CFH		
V2 : NOP	D0H		
V.2 : NOP	D1H		
W : MIN,WH,W0	D2H : 47H,DCH,D4H	W	Set point limitation max
W. : MIN,W.H,W.0	D3H : 47H,DDH,D5H	W	Set point limitation max 2nd channel
W0 : MAX,WL,W1	D4H : 46H,E0H,D6H	W	Set point limitation min
W.0 : MAX,W.L,W.1	D5H : 46H,E1H,D7H	W	Set point limitation min 2nd channel
W1 : UW0,W2,W	D6H : 2FH,D8H,D2H	W	Changeover int/ext
W.1 : UW4,W.2,W.	D7H : 33H,D9H,D3H	W	Changeover int/ext, 2nd channel
W2 : ADD,P,Q	D8H : 48H,9CH,B2H	W	Limitation of rate of change
W.2 : ADD,P.,Q.	D9H : 48H,9DH,B3H	W	Limitation of rate of change
WE : ADD,P2,C2	DAH : 48H,A2H,4CH	W	Weighting input 2
W.E : ADD,P.2,C.2	DBH : 48H,A3H,4DH	W	Weighting input 4
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Setting of WH
W.H : FLX,+100.0	DDH : A5H,80H,BEH	W	Setting of W.H
WI : NOP	DEH		
W.I : NOP	DFH		
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Setting of WL
W.L : FLX,+000.0	E1H : A5H,00H,80H	W	Setting of WL
X : DIR,B	E2H : 3DH,44H,00H	E	Assignment to X
X. : DIR,B.	E3H : 3DH,45H,00H	E	Assignment to X.
X0 : MIN,X,K7	E4H : 47H,E2H,8CH	X	Non-return pointer min
X.0 : MIN,X.,K.7	E5H : 47H,E3H,8DH	X	Non-return pointer min 2nd channel
X1 : MAX,X,K8	E6H : 46H,E2H,8EH	X	Non-return pointer max
X.1 : MAX,X.,K.8	E7H : 46H,E3H,8FH	X	Non-return pointer max 2nd channel
X2 : NOP	E8H		
X.2 : NOP	E9H		
XD : SUB,B,W	EAH : 49H,44H,D2H	R	Formation of control deviation
X.D : SUB,B.,W.	EBH : 49H,45H,D3H	R	Formation of control deviation
XP : FLX,0100%	ECH : A5H,43H,86H	R	Setting of XP
X.P : FLX,0100%	EDH : A5H,43H,86H	R	Setting of X.P
XU : DIR,X	EEH : 3DH,E2H,00H	R	Input to differentiator
X.U : DIR,X.	EFH : 3DH,E3H,00H	R	Input to differentiator
Y : MA0,/R3	F0H : 3EH,1CH,00H	A	Display of output value with 1 decimal place
Y. : MA0,/R2	F1H : 3EH,1DH,00H		Display of Y. with one decimal place prepared
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	R	Setting of Y0 = operating point
Y.0 : FLX,+050.0	F3H : A5H,40H,9FH	R	Setting of Y.0 = operating point
Y1 : NOP	F4H		
Y.1 : NOP	F5H		
Y2 : NOP	F6H		
Y.2 : NOP	F7H		
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Setting of output limit max.
Y.H : FLX,+100.0	F9H : A5H,80H,BEH	R	Setting of output limit max, 2nd channel
YL : FLX,+000.0	FAH : A5H,00H,80H	R	Setting of output limit min.
Y.L : FLX,+000.0	FBH : A5H,00H,80H	R	Setting of output limit min, 2nd channel
YR : UY3,/N1,/R3	FCH : 22H,27H,1CH	R	External feedback 0 or last value not active
Y.R : UY7,/N1,/R2	FDH : 26H,27H,1DH	R	External feedback 0 or last value not active
Z : NOP	FEH		
Z. : NOP	FFH		

10.2.4 Two-channel step action controller

Basic configuration 62515-0-XX551XX

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	*	Commentary
Q09 : AIN,R21,R22	1CH : 05H,E4H,E5H	A	Output controller 2 "lower"
Q10 : AIN,R22,R21	1DH : 05H,E5H,E4H	A	Output controller 2 "raise"
Q11 : AIN,R11,R12	1EH : 05H,E0H,E1H	A	Output controller 1 "lower"
Q12 : AIN,R12,R11	1FH : 05H,E1H,E0H	A	Output controller 1 "raise"
BLY : BTN,LLL	22H : 01H,B8H,00H	Ü	No flashing of Y pointer provided
A1 : FIX,+100.0	40H : A4H,80H,BEH	A	Teletransmitter supply channel 1
A2 : FIX,+100.0	41H : A4H,80H,BEH	A	Teletransmitter supply channel 2
C6 : FLX,+000.0	54H : A5H,00H,80H	A	Weighting position feedback signal channel 1
C.6 : FLX,+000.0	55H : A5H,00H,80H	A	Weighting position feedback signal channel 2
DU : DIR,Y	62H : 3DH,F0H,00H	A	Display of position feedback signal channel 1
D.U : DIR,Y.	63H : 3DH,F1H,00H	A	Display of position feedback signal channel 2
H : FLX,+001.0	76H : A5H,A0H,80H	R	Hysteresis channel 1
H. : FLX,+001.0	77H : A5H,A0H,80H	R	Hysteresis channel 2
K6 : FLX,+100.0	8BH : A5H,80H,BEH	A	Weighting of position feedback signal channel 1
K.6 : FLX,+100.0	8CH : A5H,80H,BEH	A	Weighting of position feedback signal channel 2
P6 : ADD,/E6,C6	AAH : 48H,3AH,54H	A	Weighting of position feedback signal channel 1
P.6 : ADD,/E5,C.6	ABH : 48H,3BH,55H	A	Weighting of position feedback signal channel 2
P7 : N0P	ACH		
P.7 : N0P	ADH		
P8 : N0P	AEH		
P.8 : N0P	AFH		
P9 : N0P	B0H		
P.9 : N0P	B1H		
Y : MUL,P6 ,K6	F0H : 4AH,AAH,8AH	A	Definition of Y from position feedback signal 1
Y. : MUL,P.6,K.6	F1H : 4AH,ABH,8BH	A	Definition of Y. from position feedback signal 2
Y.0 : N0P	F3H		
YL : FLX,−001.2	FAH : A5H,C0H,00H	R	Output limit MIN, channel 1
Y.L : FLX,−001.2	FBH : A5H,C0H,00H	R	Output limit MIN, channel 2

10.2.5 Two-channel continuous controller/step action controller

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	*	Commentary
Q09 : AIN,R21,R22	1CH : 05H,E4H,E5H	A	Output controller 2 "lower"
Q10 : AIN,R22,R21	1DH : 05H,E5H,E4H	A	Output controller 2 "raise"
Q11 : N0P	1EH		
A2 : FLX,+100.0	41H : A4H,80H,BEH	A	Supply of position feedback signal channel 2
C.6 : FLX,+000.0	55H : A5H,80H,00H	A	Weighting of position feedback signal channel 2
D.U : DIR,Y.	63H : 3DH,F1H,00H	A	Display of position feedback signal channel 2
H. : FLX,+001.0	77H : A5H,A0H,80H	R	Hysteresis, channel 2
K.6 : FLX,+100.0	8BH : A5H,80H,BEH	A	Weighting of position feedback signal channel 2
P.6 : ADD,/E5,C.6	ABH : 48H,3BH,55H	A	Weighting of position feedback signal channel 2
P.7 : N0P	ADH		
P.8 : N0P	AFH		
P.9 : N0P	B1H		
Y. : MUL,P.6,K.6	F1H : 4AH,ABH,8BH	A	Definition of Y. from the position feedback signal
Y0 : N0P	F3H		
Y.L : FLX,-001.2	FBH : A5H,C0H,00H	R	Output limit MIN, channel 2

10.2.6 Cascade controller with continuous output

Basic configuration 62515-0-XX452XX

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	✻	Commentary
'05 : FRS,'04,'07	05H : 0DH,04H,07H	W	
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	Output monitoring controller output
'07 : BTI,W_2	07H : 02H,72H,00H	B	Set point changeover ext./int.
'09 : FTR,D00,'09	09H : 0EH,A0H,09H	B	Forced manual
'0A : FTR,'10,'0A	0AH : 0EH,10H,0AH	B	
'0B : 0NN,'0C,'12	0BH : 07H,0CH,12H	B	
'0C : 0NN,'0A,SC2	0CH : 07H,0AH,29H	B	
'0D : AIN,D02,'0F	0DH : 05H,F9H,0FH	B	
'0E : N0P	0EH		
'10 : AII,D00,YSA	10H : 06H,A0H,34H	B	
'11 : FTR,'0D,'11	11H : 0DH,0DH,11H	B	
'12 : ANN,D00,F_1	12H : 03H,A0H,69H	B	
'13 : AIN,OL2,'14	13H : 05H,16H,14H	B	
'14 : ANN,Y_2,Y_4	14H : 03H,62H,64H	B	
'15 : ANN,'13,TF8	15H : 03H,13H,4BH	B	
Q05 : BTN,W_2	18H : 01H,72H,00H	B	External feedback (master controller)
Q06 : BTN,Y_4	19H : 01H,64H,00H	F	Manual feedback
Q07 : BTN,W_0	1AH : 01H,70H,00H	F	Feedback "o" = open
Q08 : BTN,W_1	1BH : 01H,71H,00H	F	Feedback "c" = closed
Q10 : N0P	10H		
Q12 : CB0,/N1,P.7	1FH : 7CH,27H,A0H	Z	Output on/off controller
BLD : AIN,NDI,'15	23H : 05H,54H,15H	B	
SC2 : ANN,F_0,'09	28H : 03H,68H,09H	B	
FST : ONN,'11,'0C	31H : 07H,11H,0CH	B	
YSM : BTN,'0B	33H : 01H,0AH,00H	B	
YSA : ANN,F_0,Y_0	34H : 03H,68H,60H	B	
CT1 : 0NN,W_0,Y_4	3FH : 07H,70H,00H	R	Controller 1 is synchronized, if "o" or "H"
A1 : ADD,C.9,C.8	40H : 48H,5BH,59H	A	Controller output (c1/c2)
A2 : DIR,W	41H : 3DH,D2H,00H	A	Output for set of master controller
C.2 : N0P	4DH		
C8 : N0P	58H		
C9 : N0P	5AH		
D. : N0P	5DH		
DU : DIR,Y.	62H : 3DH,F1H,00H	A	Display of controller output
K.2 : N0P	83H		
P. : N0P	9DH		
P.2 : N0P	A3H		
P7 : N0P	ACH		
P8 : N0P	AEH		
P.8 : SUB,A1 ,P.9	AFH : 49H,40H,B1H	Z	Zweipunktausgang
P9 : N0P	B0H		
P.9 : SZL,/N8,Q12	B1H : 15H,20H,1FH	Z	Zweipunktausgang
Q. : N0P	B3H		
R. : N0P	B5H		
W1 : UW2,W ,W2	D6H : 31H,D2H,D8H	W	Set point formation master controller
W.1 : UW0,Y ,W.	D7H : 2FH,F0H,D3H	W	Set point formation slave controller
W.2 : N0P	D9H		
W.E : N0P	DBH		
YR : DIR,X.	FCH : 3DH,E3H,00H	R	Synchronization signal for master controller

10.2.7 Cascade controller with step output

Basic configuration 62515-0-XX652XX

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	✻	Commentary
'05 : FRS,'04,'07	05H : 0DH,04H,07H	W	
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	Output monitoring controller output
'07 : BTI,W_2	07H : 02H,72H,00H	B	Sollwertumschaltung E / 1
'09 : FTR,D00,'09	09H : 0EH,A0H,09H	B	Forced manual
'0A : FTR,'10,'0A	0AH : 0EH,10H,0AH	B	
'0B : 0NN,'0C,'12	0BH : 07H,0CH,12H	B	
'0C : 0NN,'0A,SC2	0CH : 07H,0AH,29H	B	
'0D : ONI,D02,0L2	0DH : 08H,F9H,16H	B	Remote control
'0E : N0P	0EH		
'10 : AII,D00,YSA	10H : 06H,A0H,34H	B	
'11 : FTR,'0D,'11	11H : 0EH,0DH,11H	B	
'12 : ANN,D00,F_1	12H : 03H,A0H,69H	B	
'13 : AIN,0L2,'14	13H : 05H,16H,14H	B	
'14 : ANN,Y_2,Y_4	14H : 03H,62H,64H	B	
'15 : ANN,'13,TF8	15H : 03H,13H,4BH	B	
Q05 : BTN,W_2	18H : 01H,72H,00H	B	External feedback (master controller)
Q06 : BTN,Y_4	19H : 01H,64H,00H	F	Manual feedback
Q07 : BTN,W_0	1AH : 01H,70H,00H	F	Feedback "o" = open
Q08 : BTN,W_1	1BH : 01H,71H,00H	F	Feedback "c" = closed
Q10 : N0P	1DH		
Q11 : AIN,R21,R22	1EH : 05H,E4H,E5H	A	
Q12 : AIN,R22,R21	1FH : 05H,E5H,E4H	A	
BLD : AIN,NDI,'15	23H : 05H,54H,15H	B	
SC2 : ANN,F_0,'09	29H : 03H,68H,09H	B	
SC4 : ONI,D01,'0F	2BH : 08H,F8H,0FH		without function
FST : 0NN,'11,'0C	31H : 07H,11H,0CH	B	
YSM : BTN,'0B	33H : 01H,0AH,00H	B	
YSA : ANN,F_0,Y_0	34H : 03H,68H,60H	B	
CT1 : 0NN,W_0,Y_4	3EH : 07H,70H,00H	R	Controller 1 is synchronized, if "o" or "H"
A1 : FIX,+100.0	40H : A4H,80H,BEH	A	Supply for position feedback signal (C1/C2)
A2 : DIR,W	41H : 3DH,D2H,00H	A	Output for set point of master controller
C.2 : N0P	4DH		
C.6 : FLX,+000.0	55H : A5H,00H,80H	A	Measurement of position feedback signal
C8 : N0P	58H		
C9 : N0P	5AH		
D. : N0P	5DH		
DU : DIR,Y.	62H : 3DH,F1H,00H	A	Display of controller output
D.U : DIR,Y.	63H : 3DH,F1H,00H	A	As DU
H. : FLX,+001.0	77H : A5H,A0H,80H	R	Dead band
K.2 : N0P	83H		
K.6 : FLX,+100.0	8BH : A5H,80H,BEH	A	Measurement of position feedback signal
P. : N0P	9DH		
P.2 : N0P	A3H		
P.6 : ADD,/E5,C.6	ABH : 48H,3BH,55H	A	Measurement of position feedback signal
P7 : N0P	ACH		
P.7 : N0P	ADH		
P8 : N0P	AEH		
P.8 : N0P			
P9 : N0P	B0H		
P.9 :			
Q. : N0P	B3H		
R. : N0P	B5H		
W1 : UW2,W ,W2	D6H : 31H,D2H,D8H	W	Set point formation master controller
W.1 : UW0,Y ,W.	D7H : 2FH,F0H,D3H	W	Set point formation slave controller
W.2 : N0P	D9H		
W.E : N0P	DBH		
Y. : MUL,P.6,K.6	F1H : 4AH,ABH,8BH		
Y.L : FLX,-001.2	FBH : A5H,C0H,00H		
Y.0 : N0P	F3H		
YR : DIR,X.	FCH : 3DH,E3H,00H	R	Synchronization signal for master controller

10.2.8 Override controller, min. selection, continuous output

Basic configuration 65515-0-XX453XX

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	✻	Commentary
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	Output monitoring
'09 : FTR,D00,'09	09H : 0DH,A0H,09H	B	Forced manual
'0A : FTR,'10,'0A	0AH : 0DH,10H,0AH	B	
'0B : 0NN,'0C,'12	0BH : 07H,0CH,12H	B	
'0C : 0NN,'0A,SC1	0CH : 07H,0AH,28H	B	
'0D : 0NN,'0E,SC4	0DH : 07H,0EH,2BH	F	Remote control
'0E : 0NI,D2H,0L2	0EH : 08H,F9H,16H	F	Remote control
'10 : AII,D00,YSA	10H : 06H,A0H,34H	B	Manual to forced manual and reset
'11 : FTR,'0D,'11	11H : 0DH,0DH,11H	B	
'12 : ANN,D00,F_1	12H : 03H,A0H,69H	B	
'13 : AIN,0L2,'14	13H : 05H,16H,14H	B	
'14 : ANN,Y_2,Y_4	14H : 03H,62H,64H	B	
'15 : ANN,'13,TF8	15H : 03H,13H,4BH		
Q10 : N0P	1DH		
Q12 : CB0,/N1,P.7	1FH : 7CH,27H,A0H	Z	Output on/off controller
BLD : AIN,NDI,'15	23H : 05H,54H,15H	B	Flashing of „A" if controller 2 at manual
SC1 : ANN,F_0,'09	28H : 03H,68H,09H	B	
SC4 : 0NI,D01,'0F	2BH : 08H,F9H,0FH	F	Remote control
FST : 0NN,'11,'0C	31H : 07H,11H,0CH	B	
YSM : BTN,'0B	33H : 01H,0BH,00H	B	
YSA : ANN,F_0,Y_0	34H : 03H,68H,60H	B	
CT1 : BTN,Y_4	3EH : 01H,64H,00H	R	
A1 : ADD,C.9,C.8	40H : 48H,59H,5BH	A	Controller output (c1/c2)
A2 : DIR,W.	41H : 3DH,D2H,00H	A	Set point of master controller (d1/d2)
C8 : N0P	58H		
C9 : N0P	5AH		
DU : DIR,Y.	62H : 3DH,F1H,00H	A	Output display
P7 : N0P	ACH		
P8 : N0P	AEH		
P.8 : SUB,A1 ,P.9	AFH : 49H,40H,B1H	Z	
P9 : N0P	B0H		
P.9 : SZL,/N8,Q12	B1H : 15H,20H,1FH	Z	
YH : ADD,Y. ,/N3	F8H : 48H,F1H,25H	R	Output limit max for slave controller
Y.H : DIR,Y	F9H : 3DH,F0H,00H	R	Output limit max for master controller
YR : DIR,Y.	FCH : 3DH,F1H,00H	R	

10.2.9 Override controller, max. selection, continuous output

Basic configuration 62515-0-XX454XX

Differences from the configuration of the override controller min selection

Mnemonic	Hexa decimal	✻	Commentary
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	Max limit of slave controller at 100.0 %
Y.H : FLX,+100.0	F9H : A5H,80H,BEH	R	Max limit of master controller at 100.0 %
YL : SUB,Y. ,/N3	FAH : 49H,F1H,25H	R	Min limit of slave controller
Y.L : DIR,Y	FBH : 3DH,F0H,00H	R	Min limit of master controller

10.2.10 Override controller with step action output, min. selection

Basic configuration 62515-0-XX653XX

Differences from the configuration of the two-channel continuous controller.

Mnemonic	Hexa decimal	*	Commentary
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	A	Output monitoring
'09 : FTR,D00,'09	09H : 0EH,A0H,09H	B	Forced manual
'0A : FTR,'10,'0A	0AH : 0EH,10H,0AH	B	
'0B : 0NN,'0C,'12	0BH : 07H,0CH,12H	B	
'0C : 0NN,'0A,SC2	0CH : 07H,0AH,29H	B	
'0D : 0NN,'0E,SC4	0DH : 07H,0EH,2BH	F	Remote control
'0E : 0NI,D2H,0L2	0EH : 08H,F9H,16H	F	Remote control
'10 : AII,D00,YSA	10H : 06H,A0H,34H	B	Manual after forced manual and reset
'11 : FTR,'0D,'11	11H : 0EH,0DH,11H	B	
'12 : ANN,D00,F_1	12H : 03H,A0H,69H	B	
'13 : AIN,0L2,'14	13H : 05H,16H,14H	B	
'14 : ANN,Y_2,Y_4	14H : 03H,62H,64H	B	
'15 : ANN,'13,TF8	15H : 03H,13H,4BH		
Q10 : N0P	1DH		
Q11 : AIN,R21,R22	1EH : 05H,E4H,E5H	D	Step action output "lower"
Q12 : AIN,R22,R21	1FH : 05H,E5H,E4H	D	Step action output "raise"
BLD : AIN,NDI,'15	23H : 05H,54H,15H	B	Flashing of "A" if controller 2 at manual
SC2 : ANN,F_0,'09	29H : 03H,68H,09H	B	
SC4 : 0NI,D01,'0F	2BH : 08H,F9H,0FH	F	Remote control
FST : 0NN,'11,'0C	31H : 07H,11H,0CH	B	
YSM : BTN,'0B	33H : 01H,0BH,00H	B	
YSA : ANN,F_0,Y_0	34H : 03H,68H,60H	B	
CT2 : CB1,C8 , Y.	3BH : 7DH,58H,F1H	R	
CT1 : BTN,Y_4	3FH : 01H,64H,00H	R	
A1 : FIX,+100.0	40H : A4H,80H,BEH	A	Supply for position feedback signal
A2 : DIR,W.	41H : 3DH,D3H,80H	A	Set point of master controller d1/d2)
C.6 : FLX,+000.0	55H : A4H,00H,80H	Y	Adjustment of position display
C8 : ADD,Y.H,H.	58H : 48H,F9H,77H		
C9 : N0P	5AH		
DU : DIR,Y.	62H : 3DH,F1H,00H	A	Output display
D.U : DIR,Y.	63H : 3DH,F1H,00H	A	Output display
H. : FLX,+001.0	77H : A5H,A0H,80H	R	Dead band
K.6 : FLX,+100.0	8BH : A5H,80H,BEH	Y	Adjustment of position feedback signal
P.6 : ADD,/E5,C.6	AAH : 48H,3BH,55H	Y	Calculation of position feedback signal
P7 : N0P	ACH		
P.7 : N0P	ADH		
P8 : N0P	AEH		
P.8 : N0P	AFH		
P9 : N0P	B0H		
P.9 : N0P	B1H		
Y. : MUL,P.6,K.6	F1H : 4AH,ABH,8BH	Y	Position display
Y.0 : N0P	F3H		
Y.L : FLX,–001.2	FBH : A5H,C0H,00H	R	Output limit, below
YH : ADD,Y. ,/N3	F8H : 48H,F1H,25H	R	Output limits MAX for slave controller
Y.H : DIR,Y	F9H : 3DH,F0H,00H	R	Output limits MAX for master controller
YR : DIR,Y.	FCH : 3DH,F1H,00H		
Y.R : DIR,Y.H	FDH : 3DH,F9H,00H		

10.2.11 Override controller with step action output, max. selection

Basic configuration 62515-0-XX654XX

Differences from the configuration of the override controller with step action output MIN selection.

Mnemonic	Hexa decimal	*	Commentary
CT2 : CB1,Y. ,C8	3BH : 7DH,F1H,58H		
C8 : SUB,Y.L,H.	58H : 49H,FBH,77H		
YH : FLX,+100.0	F8H : A5H,80H,BEH	R	
Y.H : FLX,+100.0	F9H : A5H,80H,BEH	R	
YL : SUB,Y. ,/N3	FAH : 49H,F1H,25H	R	Output limit
Y.L : DIR,Y	FBH : 3DH,F0H,00H	R	Output limit
Y.R : DIR,Y.L	FDH : 3DH,FBH,00H	–	

10.3 Universal controller PS, input circuits

10.3.1 Multicomponent input circuit

Basic configuration 62515-0-XX121XX

Differences from the configuration of the fixed value/cascade input circuit.

Mnemonic	Hexa decimal	✻	Commentary
DL : DIR,K	5EH : 3DH,7CH,00H	X	X display
F : SUB,F1 ,F2	66H : 49H,68H,6AH	X	
F1 : ADD,P3 ,C3	68H : 48H,A4H,4EH	X	Weighting E3
F2 : ADD,P4 ,C4	6AH : 48H,A6H,50H	X	Weighting E4
K : ADD,B ,F	7CH : 48H,44H,66H	X	
X : U32,/E1,K	E2H : 18H,3FH,7CH	X	
XD : SUB,K ,W	EAH : 49H,7CH,D2H	X	
XU : U33,B ,F	EEH : 19H,44H,66H	R	Differentiation of B (input 1) or F (F1 – F2)

10.3.2 Ratio input circuit

Basic configuration 62515-0-XX131XX

Differences from the configuration of the fixed value/cascade input circuit.

Mnemonic	Hexa decimal	✻	Commentary
A2 : U32,I ,C.	41H : 18H,78H,47H		Output 2: V or W (see I) or min(E4,E1/V)
C : DIV,B ,W	46H : 4BH,44H,D2H		E1 / V
C. : MIN,C ,F2	47H : 47H,46H,6AH		Min (E4, E1/V)
DL : DIV,V.2,U	5EH : 4BH,D1H,C8H		V actual value
DR : DIV,V2 ,U	60H : 4BH,D0H,C8H		V set point
F : MAX,K. ,J.	66H : 46H,7DH,7BH		Total fuel
F1 : ADD,P3 ,C3	68H : 48H,A4H,4EH		Weighted input E3
F2 : ADD,P4 ,C4	6AH : 48H,A6H,50H		Weighted input E4
I : U31,DL ,DR	78H : 17H,5EH,60H		V actual value or V set point
J : U32,F2 ,/N1	7AH : 18H,6AH,27H		
J. : U32,/N1,F2	7BH : 18H,27H,6AH		
K : MUL,W ,F	7CH : 4AH,D2H,66H		
K. : ADD,F1 ,J	7DH : 48H,68H,7AH		
K2 : FLX,+199.9	82H : A5H,F0H,FCH		Constant for input 2
U : SUB,V1 ,V0	C8H : 49H,CEH,CCH		
V : DIV,B ,F	CAH : 4BH,44H,66H		V actual value (digital display)
V. : DIR,V	CBH : 3DH,CAH,00H	–	
V0 : FLX,+000.0	CCH : A5H,00H,80H		Lower value of analog display
V1 : FLX,+199.9	CEH : A5H,F0H,FCH		Upper value of analog display
V2 : SUB,W ,V0	D0H : 49H,D2H,CCH		
V.2 : SUB,V ,V0	D1H : 49H,CAH,CCH		
WH : FLX,+199.9	DCH : A5H,F0H,FCH		
X : DIR,/E1	E2H : 3DH,3FH,00H		
XD : SUB,B ,K	EAH : 49H,44H,7CH		
X2 : DIR,/E3	E8H : 3DH,3DH,00H		

10.3.3 Extreme value selection

Basic configuration 65515-0-XX141XX

Differences from the configuration of the fixed value/cascade input circuit.

Mnemonic	Hexa decimal	✻	Commentary
A2 : U31,X ,WI	41H : 17H,E2H,DEH		Output 2 X or effective set point
DL : DIR,X	5EH : 3DH,E2H,00H		
DR : DIR,WI	60H : 3DH,DEH,00H		
F : U32,K ,K.	66H : 18H,7CH,7DH		
F1 : ADD,P3 ,C3	68H : 48H,A4H,4EH		Weighting E3
F2 : ADD,P4 ,C4	6AH : 48H,A6H,50H		Weighting E4
I : U31,B ,W	78H : 17H,44H,D2H		
I. : MAX,WL ,F	79H : 46H,E0H,66H		
J : MAX,F1 ,I	7AH : 46H,68H,78H		
J. : MIN,F1 ,I	7BH : 47H,68H,78H		
K : MAX,J ,F2	7CH : 46H,7AH,6AH		
K. : MIN,J. ,F2	7DH : 47H,7BH,6AH		
WI : U31,W ,W.I	DEH : 17H,D2H,DFH		Effective W (W or MAX/MIN (W,E3,E4)
W.I : MIN,WH ,I.	DFH : 47H,DCH,79H		
X : U31,F ,B	E2H : 17H,66H,44H		
XD : SUB,X ,WI	EAH : 49H,E2H,DEH		

10.4 Universal controller PS, programmer or program controller

10.4.1 Single-channel programmer

Basic configuration 62515-0-XX311XX

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	*	Commentary
'00 : BTI,Y_0	00H : 02H,60H,00H		Start
'01 : 0NN,D00,D08	01H : 07H,A0H,FFH		Remote control
'10 : CU1,E ,N	10H : 87H,64H,98H		Program end if N greater than E
'12 : CU1,F ,TU	12H : 87H,66H,C6H		Program end if TU greater than F
OL2 : BTN,LLL	16H : 01H,B8H,00H		
Q00 : BTN,LLL	17H : 01H,B8H,00H		Diagnosstics output
Q05 : 0NN,Y_1,Y_3	18H : 07H,61H,63H		Feedback signal h,r,r.,t
Q06 : 0NN,Y_2,Y_3	19H : 07H,62H,63H		Feedback signal h,r,r.,t
Q10 : BTN,W_0	1DH : 01H,70H,00H		Feedback signal internal
Q11 : CB1,N ,/N2	1EH : 7DH,98H,26H		Feedback signal reset
Q12 : ANN,'10,'12	1FH : 03H,10H,12H		Feedback signal program end
BLX : BTI,LLL	20H : 02H,B8H,00H		
BLW : BTN,LLL	21H : 01H,B8H,00H		
BLY : BTN,LLL	22H : 01H,B8H,00H		
Q01 : BTN,P15	24H : 01H,F4H,00H		Binary output 1
Q02 : BTN,P16	25H : 01H,F5H,00H		Binary output 2
Q03 : BTN,P17	26H : 01H,F6H,00H		Binary output 3
Q04 : BTN,P18	27H : 01H,F7H,00H		Binary output 4
SC1 : BTI,S34	28H : 02H,CBH,00H		
YST : FTR,D02,YST	30H : 0EH,F9H,30H		Remote control h,r,r.,h
FST : BTN,LLL	31H : 01H,B8H,00H		
WST : FTR,D01,WST	32H : 0EH,F8H,32H		Remote control I,P
YSM : 0NN,'01,III	33H : 07H,01H,BDH		Stop if forced manual and after power restoration
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		Goes to internal after power restoration
WSE : BTN,LLL	36H : 01H,B8H,00H		
0KD : BTN,LLL	37H : 01H,B8H,00H		
CC1 : BTN,D08	3CH : 01H,FFH,00H		Remote control reset
CD1 : BTN,LLL	3DH : 01H,B8H,00H		1 = jump to next section
CI1 : FTR,'00,CI1	3EH : 0EH,00H,3EH		Start
A1 : DIR,W	40H : 3DH,D2H,00H		Set point output
A3 : DIR,/R4	42H : 3DH,1BH,00H		Output of remotely adjusted variables
C1 : PT1,+00.10	4AH : F1H,A1H,80H		Time setting of sections
C2 : PT2,+00.10	4CH : F2H,A1H,80H		
C3 : PT3,+00.20	4EH : F3H,41H,81H		
C4 : PT4,+00.50	50H : F4H,21H,83H		
C5 : PT5,+00.50	52H : F5H,21H,83H		
C6 : PT6,+00.25	54H : F6H,91H,81H		
C7 : PT7,+00.25	56H : F7H,91H,81H		
DR : DIR,W	60H : 3DH,D2H,00H		
DU : DIR,TU	62H : 3DH,C6H,00H		
E : FIX,+000.6	64H : A4H,60H,80H		
F : FIX,+099.6	66H : A4H,70H,BEH		
N : MA3,/U2	98H : 41H,18H,00		Section counter
P0 : PW0,+010.0	9EH : E0H,40H,86H	P	Setting of restart values
P1 : PW0,+050.0	A0H : E0H,40H,9FH	P	
P2 : PW0,+050.0	A2H : E0H,40H,9FH	P	
P3 : PW0,+080.0	A4H : E0H,00H,B2H	P	
P4 : PW0,+080.0	A6H : E0H,00H,B2H	P	
P5 : PW0,+070.0	A8H : E0H,C0H,ABH	P	
P6 : PW0,+060.0	AAH : E0H,80H,A5H	P	
P7 : PW0,+020.0	ACH : E0H,80H,8CH	P	
R : MA3,/U3	B4H : 41H,17H,00H		Repetition counter
TU : DIR,/U1	C6H : 3DH,19H,00H		Time in current section
W : MIN,WH ,W0	D2H : 47H,DCH,D4H	W	Set point max. limitation
W0 : MAX,WL ,W1	D4H : 46H,E0H,D6H	W	Set point min. limitation
W1 : UW0,/U0,W	D6H : 2FH,1AH,D2H	W	P/I changeover
W2 : K20,N	D8H : 64H,98H,00H	F	Feedback signal section counter times 20
WE : K20,R	DAH : 64H,B4H,00H	F	Feedback signal repetition counter times 20
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Set point max. limitation
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Set point min. limitation

10.4.2 Two-channel programmer

Basic configuration 62515-0-XX911XX

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	✻	Commentary
'00 : BTI,Y_0	00H : 02H,60H,00H		
'01 : 0NN,D00,'01	01H : 07H,A0H,0AH		
'08 : BTN,D08	08H : 01H,FFH,00H		
'09 : BTN,'08	09H : 01H,08H,00H		
'0A : BTN,'09	0AH : 01H,09H,00H		
'0B : 0NN,'0E,D08	0BH : 07H,0EH,FFH		
'0C : 0NN,D00,'0D	0CH : 07H,A0H,0DH		
'0D : ANN,'0B,'0F	0DH : 03H,0BH,0FH		
'0E : ANI,D01,D02	0EH : 04H,F8H,F9H		
'0F : XNN,0L2,D07	0FH : 0BH,16H,FEH		
'10 : CU1,E ,N	10H : 87H,64H,98H		Program end if N greater than E channel 1
'11 : CU1,E. ,N.	11H : 87H,65H,99H		Program end if N. greater than E. channel 2
'12 : CU1,F ,TU	12H : 87H,66H,C6H		Program end if TU greater than F channel 1
'13 : CU1,F. ,T.U	13H : 87H,67H,C7H		Program end if T.U greater than F. channel 2
0L2 : BTN,F_1	16H : 01H,69H,00H		Changeover to channel 2
Q00 : BTN,LLL	17H : 01H,B8H,00H		Diagnostics output
Q05 : 0NN,Y_1,Y_3	18H : 07H,61H,63H		Feedback signal h,r,r.,t 1st channel
Q06 : 0NN,Y_2,Y_3	19H : 07H,62H,63H		Feedback signal h,r,r.,t
Q07 : 0NN,Y_5,Y_7	1AH : 07H,65H,67H		Feedback signal h,r,r.,t 2nd channel
Q08 : 0NN,Y_6,Y_7	1BH : 07H,66H,67H		Feedback signal h,r,r.,t
Q09 : CB1,N. ,/N2	1CH : 7DH,99H,26H		Feedback signal reset channel 2
Q10 : ANN,'11,'13	1DH : 03H,11H,13H		Feedback signal program end channel 2
Q11 : CB1,N ,/N2	1EH : 7DH,98H,26H		Feedback signal program end channel 1
Q12 : ANN,'10,'12	1FH : 03H,10H,12H		Feedback signal reset channel 1
BLX : BTI,LLL	20H : 02H,B8H,00H		
BLW : BTN,LLL	21H : 01H,B8H,00H		
BLY : BTN,LLL	22H : 01H,B8H,00H		
Q01 : BTN,P15	24H : 01H,F4H,00H		Binary output 1, channel 1
Q02 : BTN,P16	25H : 01H,F5H,00H		Binary output 2, channel 1
Q03 : BTN,P25	26H : 01H,ECH,00H		Binary output 1, channel 2
Q04 : BTN,P26	27H : 01H,EDH,00H		Binary output 2, channel 2
YST : FTR,D02,YST	30H : 0EH,F9H,30H	F	Remote control H/A and h,r,r.,t
FST : FTR,'0C,FST	31H : 0EH,0CH,31H	F	Remote control channel
WST : FTR,D01,WST	32H : 0EH,F8H,32H	F	Remote control I/P
YSM : 0NN,'01,III	33H : 07H,01H,BDH	F	Forced manual
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		Internal after power restoration
WSE : BTN,LLL	36H : 01H,B8H,00H		
0KD : BTN,KP5	37H : 01H,84H,00H		Direct changeover as long as the F key is pressed
CC2 : ANN,D07,D08	38H : 03H,FEH,FFH		Reset 2nd channel
CD2 : BTN,LLL	39H : 01H,B8H,00H		
CI2 : FTR,CT2,CI2	3AH : 0EH,3BH,3AH		Start channel 2
CT2 : BTI,Y_4	3BH : 02H,64H,00H		
CC1 : AIN,D07,D08	3CH : 05H,FEH,FFH		Reset channel 1
CD1 : BTN,LLL	3DH : 01H,B8H,00H		
CI1 : FTR,'00,CI1	3EH : 0EH,00H,3EH		Start channel 1
A1 : DIR,W	40H : 3DH,D2H,00H		Set point output channel 1
A2 : DIR,W.	41H : 3DH,D3H,00H		Set point output channel 2
A3 : DIR,/R4	42H : 3DH,1BH,00H		Output remotely adjusted variable
C1 : PT1,+00.10	4AH : F1H,A1H,80H		Time settings of section
C.1 : PT1,+00.10	4BH : F1H,A1H,80H		
C2 : PT2,+00.10	4CH : F2H,A1H,80H		
C.2 : PT2,+00.10	4DH : F2H,A1H,80H		
C3 : PT3,+00.20	4EH : F3H,41H,81H		
C.3 : PT3,+00.20	4FH : F3H,41H,81H		
C4 : PT4,+00.50	50H : F4H,21H,83H		
C.4 : PT4,+00.50	51H : F4H,21H,83H		
C5 : PT5,+00.50	52H : F5H,21H,83H		
C.5 : PT5,+00.50	53H : F5H,21H,83H		
C6 : PT6,+00.25	54H : F6H,91H,81H		
C.6 : PT6,+00.25	55H : F6H,91H,81H		
C7 : PT7,+00.25	56H : F7H,91H,81H		
C.7 : PT7,+00.25	57H : F7H,91H,81H		

Two-channel programmer (continued)

Mnemonic	Hexa decimal	✻	Commentary
D.L : DIR,DL	5FH : 3DH,5EH,00H		
DR : DIR,W	60H : 3DH,D2H,00H		
D.R : DIR,W.	61H : 3DH,D3H,00H		
DU : DIR,TU	62H : 3DH,C6H,00H		Time display of section in progress
D.U : DIR,T.U	63H : 3DH,C7H,00H		Time display of section in progress
E : FIX,+000.6	64H : A4H,60H,80H		Program end signalling
E. : FIX,+000.6	65H : A4H,60H,80H		
F : FIX,+099.9	66H : A4H,70H,BEH		
F. : FIX,+099.9	67H : A4H,70H,BEH		
N : MA3,/U2	98H : 41H,18H,00H		Section counter channel 1
N. : MA3,/U6	99H : 41H,14H,00H		Section counter channel 2
P0 : PW0,+010.0	9EH : E0H,40H,86H	P	Setting of restart values
P.0 : PW0,+010.0	9FH : E0H,40H,86H	P	
P1 : PW0,+050.0	A0H : E0H,40H,9FH	P	
P.1 : PW0,+050.0	A1H : E0H,40H,9FH	P	
P2 : PW0,+050.0	A2H : E0H,40H,9FH	P	
P.2 : PW0,+050.0	A3H : E0H,40H,9FH	P	
P3 : PW0,+080.0	A4H : E0H,00H,B2H	P	
P.3 : PW0,+080.0	A5H : E0H,00H,B2H	P	
P4 : PW0,+080.0	A6H : E0H,00H,B2H	P	
P.4 : PW0,+080.0	A7H : E0H,00H,B2H	P	
P5 : PW0,+070.0	A8H : E0H,C0H,ABH	P	
P.5 : PW0,+070.0	A9H : E0H,C0H,ABH	P	
P6 : PW0,+060.0	AAH : E0H,80H,A5H	P	
P.6 : PW0,+060.0	ABH : E0H,80H,A5H	P	
P7 : PW0,+020.0	ACH : E0H,80H,8CH	P	
P.7 : PW0,+020.0	ADH : E0H,80H,8CH	P	
R : MA3,/U3	B4H : 41H,17H,00H		Repetition counter channel 1
R. : MA3,/U7	B5H : 41H,13H,00H		Repetition counter channel 2
TU : DIR,/U1	C6H : 3DH,19H,00H		Current time in section (channel 1)
T.U : DIR,/U5	C7H : 3DH,15H,00H		Current time in section (channel 2)
W : MIN,WH,W0	D2H : 47H,DCH,D4H	W	Max. set point limitation channel 1
W. : MIN,W.H,W.0	D3H : 47H,DDH,D5H	W	Max. set point limitation channel 2
W0 : MAX,WL,W1	D4H : 46H,E0H,D6H	W	Min. set point limitation channel 1
W.0 : MAX,W.L,W.1	D5H : 46H,E1H,D7H	W	Min. set point limitation channel 2
W1 : UW0,/U0,W	D6H : 2FH,1AH,D2H	W	Set point changeover I/P 1st channel
W.1 : UW4,/U4,W.	D7H : 33H,16H,D3H	W	Set point changeover I/P 2nd channel
W2 : K20,N	D8H : 64H,98H,00H		Feedback signal section counter times 20 (1st channel)
W.2 : K20,N.	D9H : 64H,99H,00H	–	Feedback signal section counter times 20 (2nd channel)
WE : K20,R	DAH : 64H,B4H,00H		Feedback signal repetition counter x 20 (1st channel)
W.E : K20,R.	DBH : 64H,B5H,00H		Feedback signal repetition counter x 20 (2nd channel)
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Max. set point limitation channel 1
W.H : FLX,+100.0	DDH : A5H,80H,BEH	W	Max. set point limitation channel 2
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Min. set point limitation channel 1
W.L : FLX,+000.0	E1H : A5H,00H,80H	W	Min. set point limitation channel 2

10.4.3 Program controller, continuous output

Basic configuration 62515-0-XX711XX

Unlisted variables are not used (NOP).

Mnemonic	Hexa decimal	✻	Commentary
'00 : ANI,Q01,Q02	00H : 04H,24H,25H	G	Alarm value interconnection for BLX
'01 : 0NN,D00,'0A	01H : 07H,A0H,0AH		
'03 : ANN,'00,S14	03H : 03H,00H,DBH	G	Flashing (BLX) if '00 and S14
'04 : CT7,W,WE	04H : 97H,D2H,DAH	W	Set point changeover W to WE, if WE – W < 1%
'05 : FRS,'04,W_0	05H : 0DH,04H,70H	W	Holds the set point changeover caused by '04
'06 : 0NN,EA1,EAU	06H : 07H,A1H,A9H	Ü	Output monitoring
'08 : BTN,D07,D08	08H : 03H,FEH,FFH	F	Remote control
'09 : BTN,'08	09H : 01H,08H,00H	F	Remote control
'0A : BTN,'09	0AH : 01H,09H,00H	F	Remote control
'0B : 0NN,'0E,D08	0BH : 07H,0EH,FFH	F	Remote control
'0C : 0NN,D00,'0D	0CH : 07H,A0H,0DH	F	Remote control
'0D : ANN,'0B,'0F	0DH : 03H,0BH,0FH	F	Remote control
'0E : ANI,D01,D02	0EH : 04H,F8H,F9H	F	Remote control
'0F : XNN,0L2,D07	0FH : 0BH,16H,FEH	F	Remote control
'11 : CU1,E.,N.	11H : 87H,65H,99H		Program end
'13 : CU1,F.,T.U	13H : 87H,67H,C7H		Program end
0L2 : BTN,F_1	16H : 01H,69H,00H		2nd channel visible at the front
Q00 : BTN,LLL	17H : 01H,B8H,00H		
Q05 : BTN,W_0	18H : 01H,70H,00H		Feedback signal internal
Q06 : BTN,Y_0	19H : 01H,60H,00H		Feedback signal manual
Q07 : 0NN,Y_5,Y_7	1AH : 07H,65H,67H		Feedback signal programmer mode with Q08
Q08 : 0NN,Y_6,Y_7	1BH : 07H,66H,67H		See Q07
Q09 : CB1,N.,/N2	1CH : 7DH,99H,26H		Feedback signal reset
Q10 : ANN,'11,'13	1DH : 03H,11H,13H		Program end
Q12 : CB0,/N1,P7	1FH : 7CH,27H,ACH	Z	On/off output
BLX : ANN,'03,TF2	20H : 03H,03H,49H		Red pointer flashes if '03
BLW : BTN,LLL	21H : 01H,B8H,00H		
BLY : 0II,'06,TF1	22H : 0AH,06H,48H		Output display flashes if '06
Q01 : CU7,X,G1	24H : 8DH,E2H,6EH	G	Alarm value 1
Q02 : CU7,G2,X	25H : 8DH,70H,E2H	G	Alarm value 2
Q03 : BTN,P25	26H : 01H,ECH,00H		Programmer binary output
Q04 : BTN,P26	27H : 01H,EDH,00H		Programmer binary output
SC1 : BTI,S34	28H : 02H,CBH,00H		
YST : FTR,D02,YST	30H : 0EH,F9H,30H	F	Remote control
FST : FTR,'0C,FST	31H : 0EH,0CH,31H	F	Remote control
WST : FTR,D01,WST	32H : 0EH,F8H,32H	F	Remote control
YSM : ONN,'01,III	33H : 07H,01H,BDH	F	Remote control
YSA : BTN,LLL	34H : 01H,B8H,00H		
WSI : BTN,III	35H : 01H,BDH,00H		
WSE : BTN,LLL	36H : 01H,B8H,00H		
OKD : BTN,KP5	37H : 01H,84H,00H		Direct changeover if F key is operated
CC2 : ANN,D07,D08	38H : 03H,FEH,FFH	F	Remote control reset
CD2 : BTN,LLL	39H : 01H,B8H,00H		
CI2 : FTR,CT2,CI2	3AH : 0EH,3BH,3AH	F	Remote control
CT2 : BTI,Y_4	3BH : 02H,64H,00H		
CC1 : BTI,S21	3CH : 02H,D0H,00H	R	Controller characteristic
CD1 : BTN,S26	3DH : 01H,D5H,00H	R	D action on
CI1 : BTN,S25	3EH : 01H,D4H,00H	R	I action on
CT1 : AIN,D07,D08	3FH : 05H,FEH,FFH	R	Track input activated
A1 : ADD,C9,C8	40H : 48H,5AH,58H		Output 1
A2 : U31,B,W	41H : 17H,44H,D2H		Output 2
A3 : DIR,/R4	42H : 3DH,1BH,00H		Output 3
B : ADD,P1,C1	44H : 48H,A0H,4AH	X	Input weighting /E1
C1 : FLX,+000.0	4AH : A5H,00H,80H	X	Input weighting /E1
C.1 : PT1,+00.10	4BH : F1H,A1H,80H	P	Time for section 1
C2 : FLX,+000.0	4CH : A5H,00H,80H	W	Input weighting /E2
C.2 : PT2,+00.10	4DH : F2H,A1H,80H	P	Time for section 2
C3 : FLX,+000.0	4EH : A5H,00H,80H	–	
C.3 : PT3,+00.20	4FH : F3H,41H,81H	P	Time for section 3
C4 : FLX,+000.0	50H : A5H,00H,80H	–	
C.4 : PT4,+00.50	51H : F4H,21H,83H	P	Time for section 4
C.5 : PT5,+00.50	53H : F5H,21H,83H	P	Time for section 5
C.6 : PT6,+00.25	55H : F6H,91H,81H	P	Time for section 6
C.7 : PT7,+00.25	57H : F7H,91H,81H	P	Time for section 7

10.4.3 Program controller, continuous output (continued)

Mnemonic	Hexa decimal	*	Commentary
C8 : SZL,/N8,S17	58H : 15H,20H,DEH	A	Output characteristic
C9 : SIH,/R3,S17	5AH : 13H,1CH,DEH	A	Output characteristic
D : SUB,WE ,W	5CH : 49H,DAH,D2H	W	Set point difference
DL : DIR,B	5EH : 3DH,44H,00H	X	X display (input 1)
D.L : DIR,DL	5FH : 3DH,5EH,00H	X	X display (input 1) also if programmer
DR : DIR,W	60H : 3DH,D2H,00H	W	W display
D.R : DIR,W.	61H : 3DH,D3H,00H	W	W. display
DU : DIR,/R3	62H : 3DH,1CH,00H	Y	Y display is controller output (channel 1)
D.U : DIR,T.U	63H : 3DH,C7H,00H	Y	Y display is current time in section (channel 2)
E : INV,XD	64H : 3CH,EAH,00H	–	
E. : FIX,+000.6	65H : A4H,60H,80H	P	Program end
F. : FIX,+099.9	67H : A4H,70H,BEH	P	Program end
G1 : FLX,+100.0	68H : A5H,80H,BEH	G	Alarm value 1
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Alarm value 2
K1 : FLX,+100.0	80H : A5H,80H,BEH	X	Input weighting /E1
K2 : FLX,+100.0	82H : A5H,80H,BEH	X	Input weighting /E2
K3 : FLX,+100.0	84H : A5H,80H,BEH	–	
K4 : FLX,+100.0	86H : A5H,80H,BEH	–	
K7 : UC0,X0 ,X	8CH : 1AH,E4H,E2H		Non-return pointer X0
K8 : UC0,X1 ,X	8EH : 1AH,E6H,E2H		Non-return pointer X1
KP : DIV,/N2,XP	90H : 4BH,26H,ECH	–	
M : MAX,XD ,N	94H : 46H,EAH,98H	G	Absolute value of XD
M1 : SIH,M ,S15	96H : 13H,94H,DCH	G	Changeover UNIPOL/BIPOL
N : SIL,N1 ,S15	98H : 14H,9AH,DCH	G	Changeover UNIPOL/BIPOL
N. : MA3,/U6	99H : 41H,14H,00H	P	Section counter
N1 : ABS,XD	9AH : 3BH,EAH,00H	G	Absolute value of XD
P : SZL,WE ,'05	9CH : 15H,DAH,05H	W	Set point changeover WE/W
P.0 : PW0,+010.0	9FH : E0H,40H,86H	P	Program start value
P1 : MUL,/E1,K1	A0H : 4AH,3FH,80H	X	Input weighting /E1
P.1 : PW0,+050.0	A1H : E0H,40H,9FH	P	Restart value 1
P2 : MUL,/E2,K2	A2H : 4AH,3EH,82H	W	Input weighting /E2
P.2 : PW0,+050.0	A3H : E0H,40H,9FH	P	Restart value 2
P3 : MUL,/E3,K3	A4H : 4AH,3DH,84H	–	Input weighting /E3
P.3 : PW0,+080.0	A5H : E0H,00H,B2H	P	Restart value 3
P4 : MUL,/E4,K4	A6H : 4AH,3CH,86H	–	Input weighting /E4
P.4 : PW0,+080.0	A7H : E0H,00H,B2H	P	Restart value 4
P.5 : PW0,070.0	A9H : E0H,C0H,ABH	P	Restart value 5
P.6 : PW0,+060.0	ABH : E0H,80H,A5H	P	Restart value 6
P7 : IG3,P8 ,P7	ACH : 76H,AEH,ACH	Z	On/off output
P.7 : PW0,+020.0	ADH : E0H,80H,8CH	P	Restart value 7
P8 : SUB,A1 ,P9	AEH : 49H,40H,B0H	Z	On/off output
P9 : SZL,/N8,Q12	B0H : 15H,20H,1FH	Z	On/off output
Q : SZH,R ,'05	B2H : 16H,B4H,05H	W	Set point changeover WE/W
R : RL4,WE ,W	B4H : 6BH,DAH,D2H	W	Set point changeover WE/W
R. : MA3,/U7	B5H : 41H,13H,00H	P	Repetition counter
S : DIR,/N1	B6H : 3DH,27H,00H	R	Disturbance variable feedforward
TD : FLX,+0010	C2H : A5H,A3H,80H	R	Derivative action time default value
TN : FLX,+0040	C4H : A5H,83H,82H	R	Integral action time default value
T.U : DIR,/U5	C7H : 3DH,15H,00H	P	Current time in section
W : MIN,WH ,W0	D2H : 47H,DCH,D4H	W	Max. set point limitation W
W. : MIN,W.H,W.0	D3H : 47H,DDH,D5H	W	Max. set point limitation W.
W0 : MAX,WL ,W1	D4H : 46H,E0H,D6H	W	Min. set point limitation W
W.0 : MAX,W.L,W.1	D5H : 46H,E1H,D7H	W	Min. set point limitation W.
W1 : UW0,W2 ,W	D6H : 2FH,D8H,D2H	W	Set point changeover I/P
W.1 : UW4,/U4,W.	D7H : 33H,16H,D3H	W	Set point changeover I/P (blocked)
W2 : UW2,Y.1,/U4	D8H : 31H,F5H,16H	W	Set point changeover WE – P (blocked)
W.2 : K20,N.	D9H : 64H,99H,00H	P	Feedback signal section counter times 20
WE : ADD,P2 ,C2	DAH : 48H,A2H,4CH	W	Input weighting /E2
W.E : K20,R.	DBH : 64H,B5H,00H	P	Feedback signal repetition counter times 20
WH : FLX,+100.0	DCH : A5H,80H,BEH	W	Max. set point limitation W
W.H : FLX,+100.0	DDH : A5H,80H,BEH	W	Max. set point limitation W.
WL : FLX,+000.0	E0H : A5H,00H,80H	W	Min. set point limitation W
W.L : FLX,+000.0	E1H : A5H,00H,80H	W	Min. set point limitation W.
X : DIR,B	E2H : 3DH,44H,44H	X	Changeover X = /E1 or X = B
X. : DIR,X	E3H : 3DH,E2H,00H	X	X display same for both channels
X0 : MIN,X ,K7	E4H : 47H,E2H,8CH		Non-return pointer
X1 : MAX,X ,K8	E6H : 46H,E2H,8EH		Non-return pointer
XD : SUB,B ,W	EAH : 49H,44H,D2H	R	Control deviation

10.4.3 Program controller, continuous output (continued)

Mnemonic	Hexa decimal	✻	Commentary
XP : FLX,+0100	ECH : A5H,43H,86H	R	Default value XP
XU : DIR,X	EEH : 3DH,E2H,00H	P	X as possible differentiation source (S2/2)
Y : MA0,/R3,Y	F0H : 3EH,1CH,F0H	Y	Decimal point position of Y display
Y0 : FLX,+050.0	F2H : A5H,40H,9FH	R	Operating point
Y.1 : ADD,P ,Q	F5H : 48H,9CH,B2H	W	External set point
YH : FLX,+100.0	F8H : A5H,80H,BEH	Y	Max. output limit
YL : FLX,+000.0	FAH : A5H,00H,80H	Y	Min. output limit
YR : UY3,/E5,/R3	FCH : 22H,3BH,1CH	R	Track function switchable (UY3 blocked)

10.4.4 Program controller, step action output

Basic configuration 65515-0-XX811XX

Differences from program controller with continuous output.

Mnemonic	Hexa decimal	✻	Commentary
Q11 : AIN,R11,R12	1EH : 05H,E0H,E10	A	Controller output lowered
Q12 : AIN,R12,R11	1FH : 05H,E1H,E0H	A	Controller output raised
BLY : BTN,LLL	22H : 01H,B8H,00H		No output monitoring
A1 : FIX,+100.0	40H : A4H,80H,BEH	A	Supply current for teletransmitter (20mA)
C6 : FLX,+000.0	54H : A5H,00H,80H	Y	Weighting of position feedback signal
DU : DIR,Y	62H : 3DH,F0H,00H	Y	Position feedback signal in bottom display
H : FLX,+001.0	76H : A5H,A0H,80H	R	Dead band
K6 : FLX,+100.0	8AH : A5H,80H,BEH	Y	Weighting of position feedback signal
P6 : ADD,/E6,C6	AAH : 48H,3AH,54H	Y	Weighting of position feedback signal
Y : MUL,P6 ,K6	F0H : 4AH,AAH,8AH	Y	Weighting of position display
YL : FLX,–001.2	FAH : A5H,C0H,00H	R	Min. output limit

10.5 Double indicator

Mnemonic	Hexa decimal	✻	Commentary
'01 : ANI,'02,S14	01H : 04H,02H,DBH	G	Display of an alarm
'02 : ANI,Q01,Q02	02H : 04H,24H,25H	G	
'03 : ANN,S14,'04	03H : 03H,DBH,04H	G	
'04 : ANI,Q03,Q04	04H : 04H,26H,27H	G	
'05 : ANN,F_0,TF2	05H : 03H,68H,49H	B	Marker arrows flash if input not displayed
'06 : ANN,'07,S15	06H : 03H,07H,DCH	G	Fetch alarm value from self holding with "+", "–"
'07 : ANN,KP1,KP3	07H : 03H,80H,82H	G	See '06
'10 : CU1,C1 ,/N1	10H : 87H,4AH,27H	G	Alarm value 1 left
'11 : CU1,C.1 ,/N1	11H : 87H,4BH,27H	G	Alarm value 1 right
'12 : CU1,C2 ,/N1	12H : 87H,4CH,27H	G	Alarm value 2 left
'13 : CU1,C.2 ,/N1	13H : 87H,4DH,27H	G	Alarm value 2 right
Q00 : BTN,S18	17H : 01H,17H,00H		
Q05 : XNN,AL1,'10	18H : 0BH,2CH,10H	G	Alarm value formation
Q06 : XNN,AL2,'11	19H : 0BH,2DH,11H	G	
Q07 : XNN,AL3,'12	1AH : 0BH,2EH,12H	G	
Q08 : XNN,AL4,'13	1BH : 0BH,2FH,13H	G	
Q09 : XNN,SC1,'10	1CH : 0BH,28H,10H	G	Used internally as markers
Q10 : XNN,SC2,'11	1DH : 0BH,29H,11H	G	
Q11 : XNN,SC3,'12	1EH : 0BH,2AH,12H	G	
Q12 : XNN,SC4,'13	1FH : 0BH,2BH,13H	G	
BLX : ANN,'01,TF2	20H : 03H,01H,49H	G	Flashing if an alarm
BLW : ANN,TF2,'03	21H : 03H,49H,03H	G	
BLY : 0NN,F_1,'05	22H : 07H,69H,05H	G	See '05
Q01 : FRS,Q05,Q09	24H : 0DH,18H,0BH	G	Output alarm value 1 left
Q02 : FRS,Q07,Q11	25H : 0DH,1AH,1EH	G	Output alarm value 2 left
Q03 : FRS,Q06,Q10	26H : 0DH,19H,1DH	G	Output alarm value 1 right
Q04 : FRS,Q08,Q12	27H : 0DH,1BH,1FH	G	Output alarm value 2 right

Double indicator (continued)

Mnemonic	Hexa decimal	✻	Commentary
V1 : ADD,E ,V2	CEH : 48H,64H,D0H	G	Hysteresis alarm value G2
V.1 : ADD,E. ,V.2	CFH : 48H,65H,D1H	G	Hysteresis alarm value G.2
V2 : SZH,C2 ,'06	D0H : 16H,4CH,06H	G	Resolution of self holding
V.2 : SZH,C.2,'06	D1H : 16H,4DH,06H	G	Resolution of self holding
W : SZL,W1 ,S24	D2H : 15H,D6H,D3H	X	Additional delay on left
W. : SZL,W.1,S28	D3H : 15H,D7H,D7H	X	Additional delay on right
W0 : SZH,W2 ,S24	D4H : 16H,D8H,D3H	X	See W
W.0 : SZH,W.2,S28	D5H : 16H,D9H,D7H	X	See W.
W1 : VZ5,W2 ,W1	D6H : ABH,D8H,D6H	X	See W
W.1 : VZ5,W.2,W.1	D7H : ABH,D9H,D7H	X	See W.
W2 : ADD,WH ,WE	D8H : 48H,DCH,DAH	X	Additional root extraction on left
W.2 : ADD,W.H,W.E	D9H : 48H,DDH,DBH	X	Additional root extraction on right
WE : SZL,WI ,S23	DAH : 15H,DEH,D2H	X	See WL
W.E : SZL,W.I,S27	DBH : 15H,DFH,D3H	X	See W.L
WH : SZH,WL ,S23	DCH : 16H,E0H,D2H	X	See WL
W.H : SZH,W.L,S27	DDH : 16H,E1H,D3H	X	See W.L
WI : VZ2,WL ,WI	DEH : A8H,E0H,DEH	X	Delay 4" on left
W.I : VZ2,W.L,W.I	DFH : A8H,E1H,DFH	X	Delay 4" on right
WL : ADD,X0 ,X1	E0H : 48H,E4H,E6H	X	Changeover linear/root extracted on left
W.L : ADD,X.0,X.1	E1H : 48H,E5H,E/H	X	Changeover linear/root extracted on right
X0 : SZH,/E1,S22	E4H : 16H,3FH,D1H	X	See WL
X.0 : SZH,/E2,S26	E5H : 16H,3EH,D5H	X	See W.L
X1 : SZL,X2 ,S22	E6H : 15H,E8H,D1H	X	See WL
X.1 : SZL,X.2,S26	E7H : 16H,E9H,D5H	X	See W.L
X2 : RAD,/E1	E8H : 4DH,3FH,00H	X	Root extraction on left
X.2 : RAD,/E2	E9H : 4DH,3EH,00H	X	Root extraction on right
SC1 : CU1,G1 ,E	28H : 87H,6EH,64H	G	Comparison G1/E
SC2 : CU1,G.1,E.	29H : 87H,6FH,65H	G	Comparison G.1/E.
SC3 : CU1,G2 ,E	2AH : 87H,70H,64H	G	Comparison G2/E
SC4 : CU1,G.2,E.	2BH : 87H,71H,65H	G	Comparison G.2/E.
AL1 : CU1,V ,G1	2CH : 87H,CAH,6EH	G	Comparison (E+C1)/G1
AL2 : CU1,V. ,G.1	2DH : 87H,CBH,6FH	G	Comparison (E.+C.1)/G.1
AL3 : CU1,V1 ,G2	2EH : 87H,CEH,70H	G	Comparison (E+C2)/G2
AL4 : CU1,V.1,G.2	2FH : 87H,CFH,71H	G	Comparison (E.+C.2)/G.2
YST : BTN,LLL	30H : 01H,B8H,00H		Switch off alarm pointer left
FST : BTN,LLL	31H : 01H,B8H,00H		Switch off alarm pointer right
A1 : DIR,E	40H : 3DH,64H,00H	A	Output 1 = input 1
A2 : DIR,E.	41H : 3DH,65H,00H	Q	Output 2 = input 2
C1 : FLX,+001.0	4AH : A5H,A0H,80H	G	Hysteresis G1 left
C.1 : FLX,+001.0	4BH : A5H,A0H,80H	G	Hysteresis G.1 right
C2 : FLX,−001.0	4CH : A5H,A0H,00H	G	Hysteresis G2 left
C.2 : FLX,−001.0	4DH : A5H,A0H,00H	G	Hysteresis G.2 right
DL : DIR,E	5EH : 3DH,64H,00H	X	Input 1 at left hand display
D.L : DIR,E.	5FH : 3DH,65H,00H	X	Input 2 at right hand display
E : ADD,W0 ,W	64H : 48H,D4H,D2H	X	Weighting of input 1
E. : ADD,W.0,W.	65H : 48H,D5H,D3H	X	Weighting of input 2
G1 : FLX,+100.0	6EH : A5H,80H,BEH	G	Alarm value 1 for input 1
G.1 : FLX,+100.0	6FH : A5H,80H,BEH	G	Alarm value 1 for input 2
G2 : FLX,+000.0	70H : A5H,00H,80H	G	Alarm value 2 for input 1
G.2 : FLX,+000.0	71H : A5H,00H,80H	G	Alarm value 2 for input 2
K7 : UX0,P0 ,E	8CH : 1AH,9EH,64H	X	Non-return pointer min. input 1
K.7 : UC1,P.0,E.	8DH : 1BH,9FH,65H	X	Non-return pointer min. input 2
K8 : UC0,P1 ,E	8EH : 1AH,A0H,64H	X	Non-return pointer max. input 1
K.8 : UC1,P.1,E.	8FH : 1BH,A1H,65H	X	Non-return pointer max. input 2
P0 : MIN,E ,K7	9EH : 47H,64H,8CH	X	
P.0 : MIN,E. ,K.7	9FH : 47H,65H,8DH	X	
P1 : MAX,E ,K8	A0H : 46H,64H,8EH	X	
P.1 : MAX,E. ,K.8	A1H : 46H,65H,8FH	X	
V : ADD,E ,V0	CAH : 48H,64H,CCH	G	Hysteresis alarm value G1
V. : ADD,E. ,V.0	CBH : 48H,65H,CDH	G	Hysteresis alarm value G.1
V0 : SZH,C1 ,'06	CCH : 16H,4AH,06H	G	Resolution of self holding
V.0 : SZH,C.1,'06	CDH : 16H,4BH,06H	G	Resolution of self holding

11 Graphic representation of the hook-up lists

The graphic representation of the hook-up list does not contain all details. Only those parts necessary for understanding the function and important for own configurations are shown.

In cases of doubt the hook-up list information in Section 10 applies.

11.1 Measured value processing

11.1.1 Input weighting

The analog inputs are weighted in the input. This weighting is not shown in the following representations.

Exception: Track input E5 is injected without weighting.

11.2 Set point generation

11.2.1 Fixed value/cascade, single and two-channel

WE and W.E are the weighted inputs /E2 and /E4.

The configuration comprises two parts:

The internal set point is formed according to Fig. 4.4 in Section 4.4.

On changeover to external set point, P = 0 as long as WI – WE < 1%. Q initially has the same value as W and approaches the value of WE with the time constants of RL4 (100%/16s).

As P is still 0, W is the same value as Q. If the difference WI – WE becomes < 1%, '04 and '05 become = 1 and P and Q are switched over. P = WE and Q = 0. This switch position is retained until the RS flip-flop is reset by switching back to internal set point W_0 (W_4) = 1.

The variables in () indicate the second channel.

11.2.2 Cascade controller

Set point generation in the master controller of the cascade controller differs only slightly from the circuits of the single or two-channel controllers without channel logic (see Fig. 11.3 a). Changeover to "E" is however usually blocked. (877BH, see 6.3).

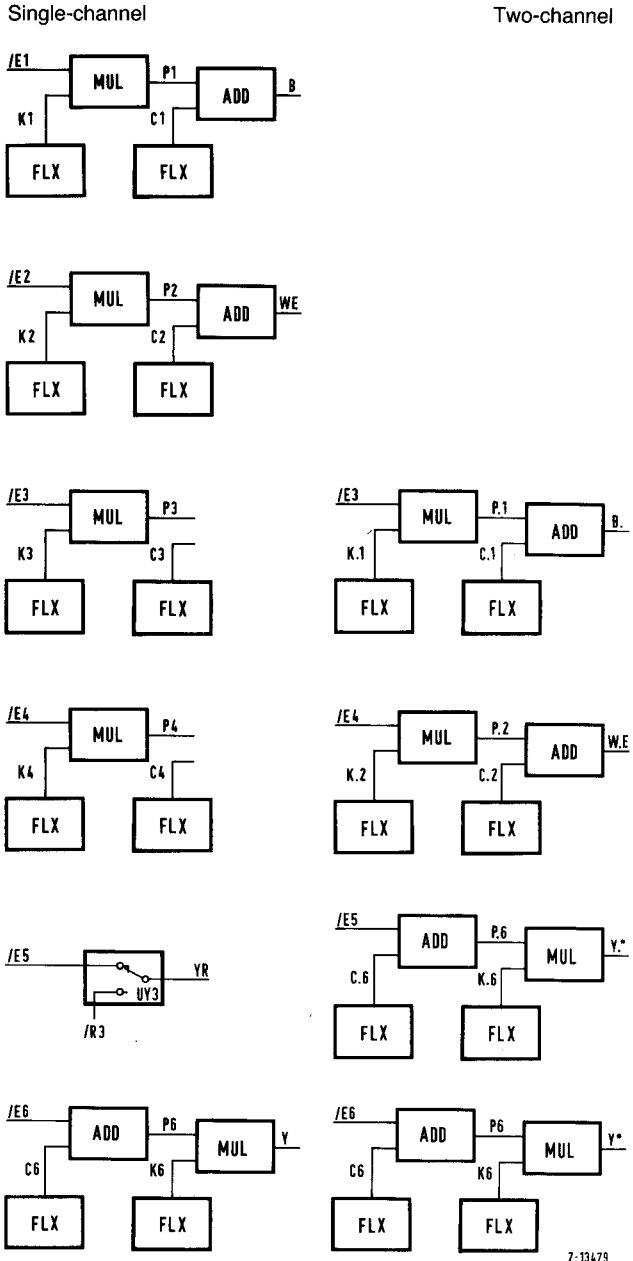


Fig. 11.1 Input weightings

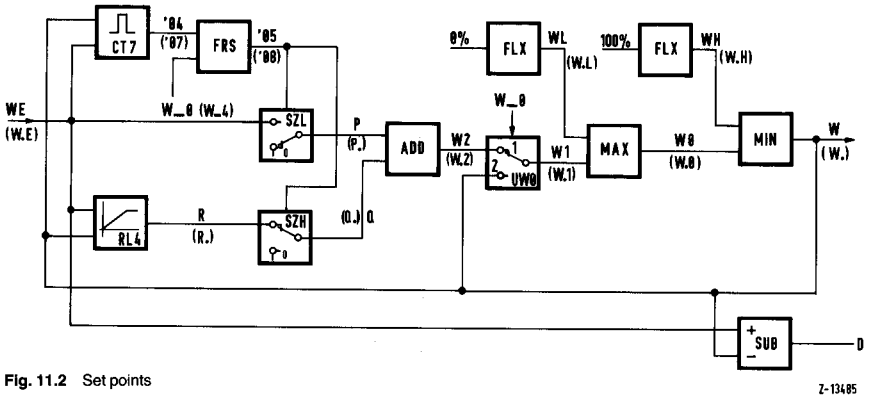


Fig. 11.2 Set points

In the slave controller set point generation is reduced to direct changeover of "c" and "o". Limitation by W.H. and W.L is still possible. For favourable control dynamics however, the output limits of the master controller effective in the same way should be used at this point.

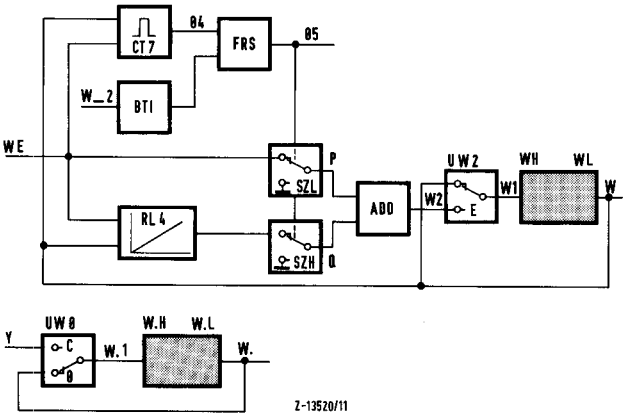


Fig. 11.3 Set point formation, cascade controller

11.2.3 Program controller

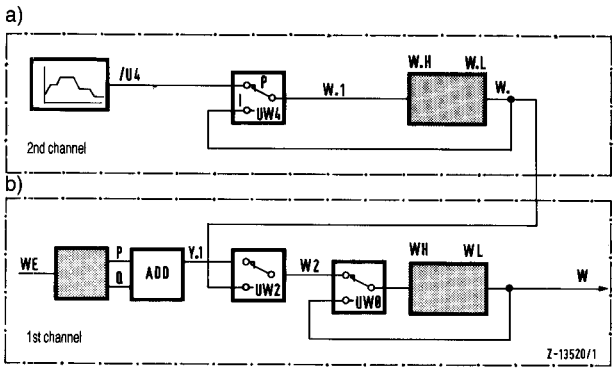


Fig. 11.4 Set point formation, program controller

Fig. 11.4 a shows the complete programmer, highly simplified. In the programmer, though changeover between the program set point and an "internal set point" is configured, it is normally blocked. (877BH = 25H).

In the controller section (Fig. 11.4 b), double changeover is provided between

E = external set point (changeover blocked 877BH see 6.3)
P = program set point
I = internal set point

Set point limitation is possible both in the programmer and in the controller section.

11.3 Fixed value/cascade input, single-channel

The fixed value/cascade input circuit forms the control difference XD = B – W.

The two selector switches have the following function:

S3/2 = 1 : X = B
S3/2 = 0 : X = /E1
S3/1 = 1 : A2 = W
S3/1 = 0 : A2 = B

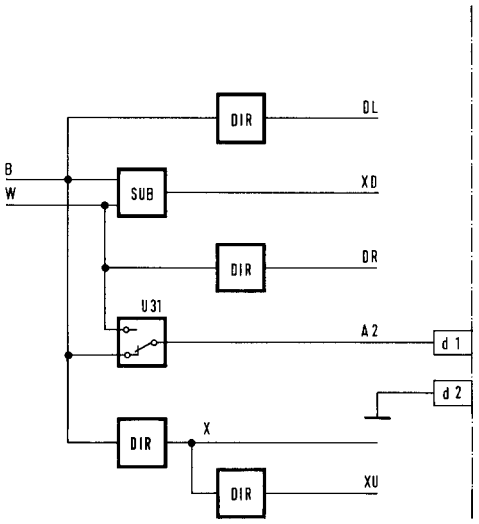


Fig. 11.5 Fixed value/cascade input, single-channel Z-13488

11.4 Fixed value/cascade input, two-channel

The input circuit is duplicated. The variables used are distinguished by the point in the name.

The control difference is calculated as XD = B – W.

The selector switch has the following function:

S3/2 = 1 : A4 = B
S3/2 = 0 : A4 = B.

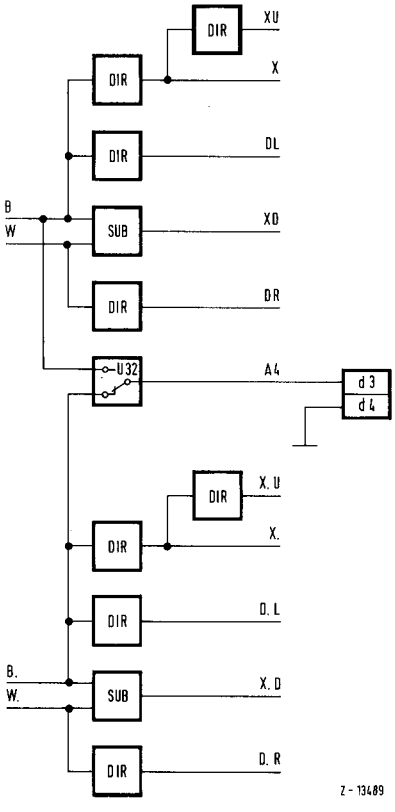


Fig. 11.6 Fixed value/cascade input, two-channel

11.5 Multi-component input

B, F1 and F2 are the weighted inputs /E1, /E3 and /E4.

$$B = K1 \cdot /E1 + C1$$
$$F1 = K3 \cdot /E3 + C3$$
$$F2 = K4 \cdot /E4 + C4$$

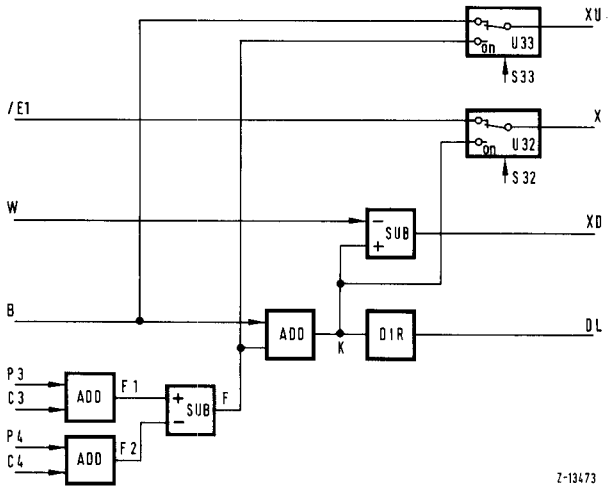


Fig. 11.7 Multi-component input

To the actual value B is added the difference of F1 and F2.

$$F = F1 - F2$$
$$K = B + (F1 - F2)$$

The control difference $XD = B + (F1 - F2) - W$

The selector switches have the following function:

S3/2 = 1 : X = K = B + (F1 – F2)
S3/2 = 0 : X = /E1

S3/3 = 1 : XU = F = (F1 – F2)
S3/3 = 0 : XU = B

11.6 Ratio input

11.6.1 Forming the control difference (S3/2 = OFF)

B, F1 and F2 are the weighted inputs /E1, /E3 and /E4.

$$B = K1 \cdot /E1 + C1$$
$$F1 = K3 \cdot /E3 + C3$$
$$F2 = K4 \cdot /E4 + C4$$

The control difference is calculated as follows:

$XD = B - W * (F1 + F2)$

Fig. 11.9 shows the simplified circuit for calculating XD.

To displace the zero (excess air) the setting of C1 is used.

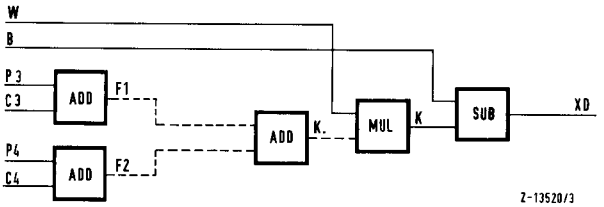


Fig. 11.9 Simplified calculation circuit for XD

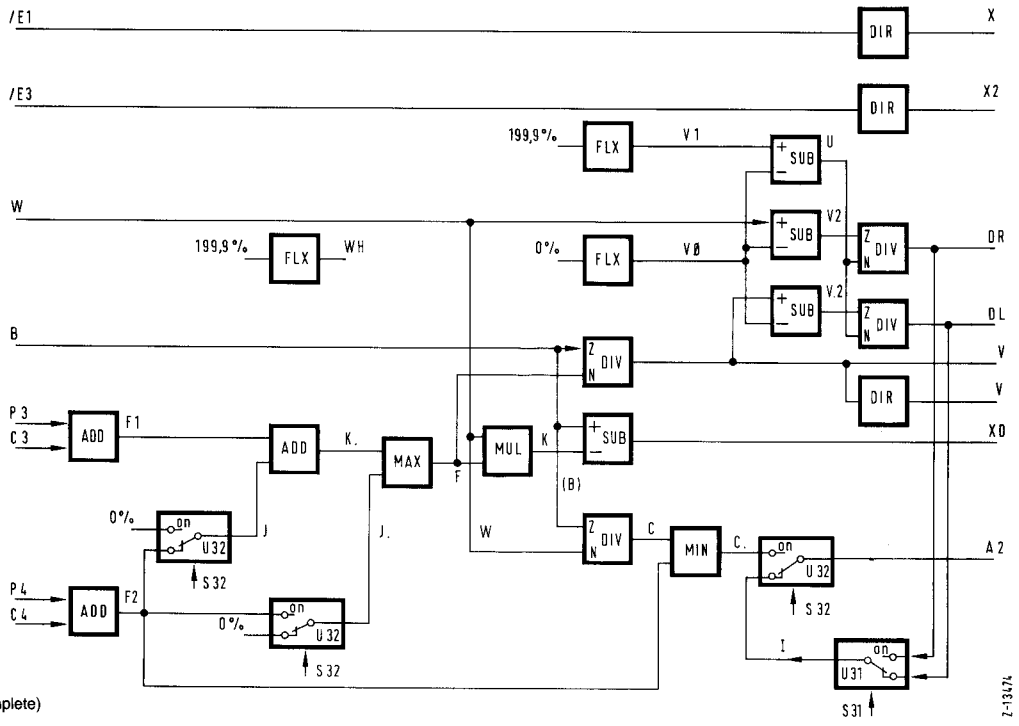


Fig. 11.8 Ratio input circuit (complete)

11.6.2 Ratio display

The ratio actual value is calculated as follows:

$$V = \frac{B}{F1 + F2}$$

The range is 0...2.

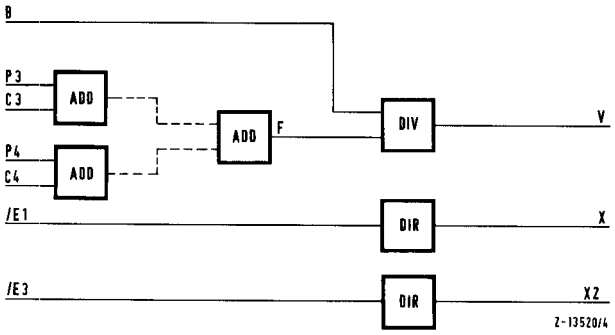


Fig. 11.10 Calculation of the actual ratio

For test purposes input /E1 is assigned to variable X and /E3 to variable X2.

11.6.3 Matching the analog displays

As the full computational range is frequently not used in the display, the display range can be limited for V (= ratio actual value) and W (= ratio set point) in parallel.

The formulae used for this are:

$$DL = \frac{V - V0}{V1 - V0} \quad \text{Actual value}$$

$$DR = \frac{W - V0}{V1 - V0} \quad \text{Set point}$$

The selector switch has the following function:

S3/1 = 1 : A2 = DR
S3/1 = 0 : A2 = DL

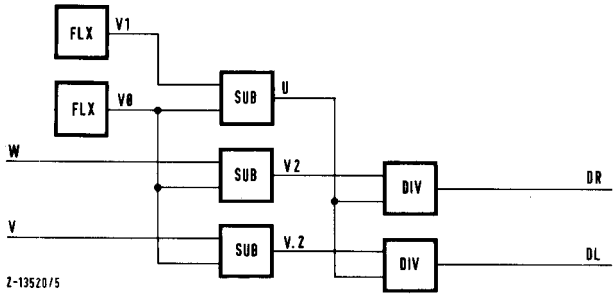


Fig. 11.11 Matching the analog display

11.6.4 Special ratio circuit (S3/2 = ON)

The ratio circuit described in Technical Information 30/62-1070 is invoked with S3/2 in position "ON".

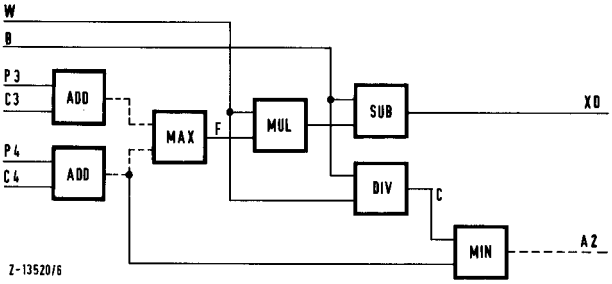


Fig. 11.12 Ratio circuit as described in 30/62-1070

The control deviation is calculated as follows:

XD = B – W · MAX(F1,F2)

Output A2 = MIN(B/W,F2)

11.7 Extreme value selection

B, F1 and F2 are weighted inputs /E1, /E3 and /E4.

$$B = K1 \cdot /E1 + C1$$
$$F1 = K3 \cdot /E3 + C3$$
$$F2 = K4 \cdot /E4 + C4$$

The switches have the following function:

S3/1 = 1 : WI = MIN/MAX(W, F1, F2)
A2 = WI
S3/1 = 0 : X = MIN/MAX(B, F1, F2)
A2 = X

S3/2 = 1 : MIN selection
S3/2 = 0 : MAX selection

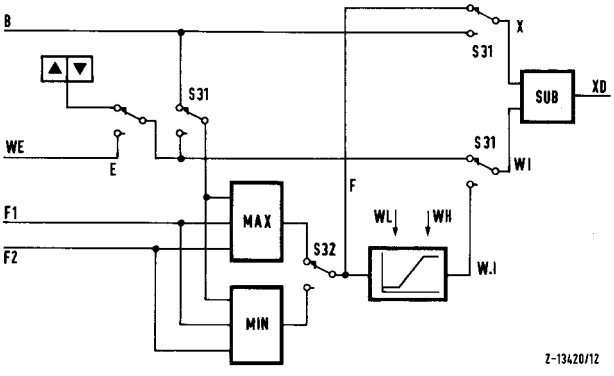


Fig. 11.13 Configuration of extreme value selection

11.8 Alarm values

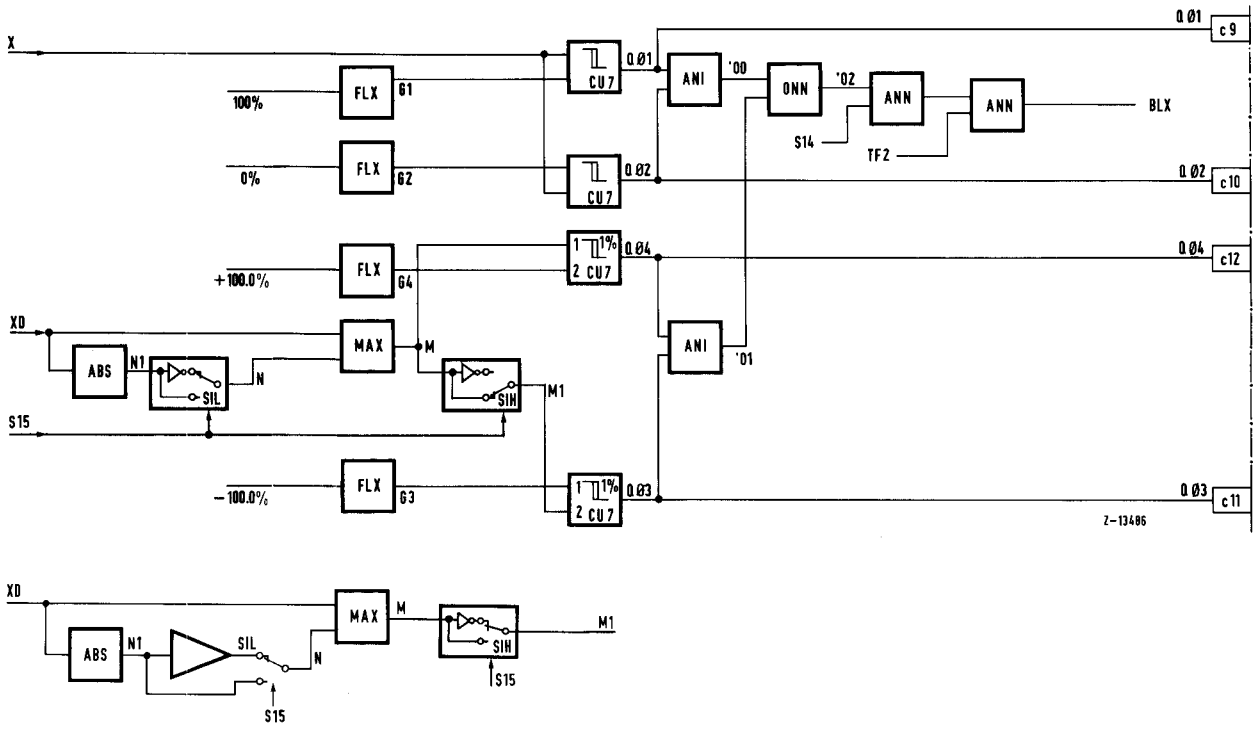


Fig. 11.14 Configuration of alarm values

Q01 to Q04 are the binary outputs of the alarm monitor. Binary variables '00 to '03 collect the results of this monitor so that if S14 = 0N the red pointer flashes in the event of an alarm.

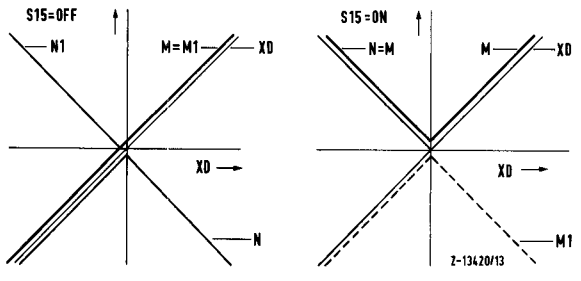


Fig. 11.15 Amount of control deviation

The amount of the control deviation is formed in accordance with Fig. 11.15. This unusual structure manages without binary variables.

11.9 Display sub-assembly

The three analog displays on the front panel contain

a) the analog values DL, DR and DU

b) binary variables BLX, BLW and BLY which switch off the respective display if they take on the value 1.
BLX is driven by the alarm values (see 11.8),
BLY by the output monitor (see 11.14).

The digital displays can each be switched on and off individually (see 6.4).

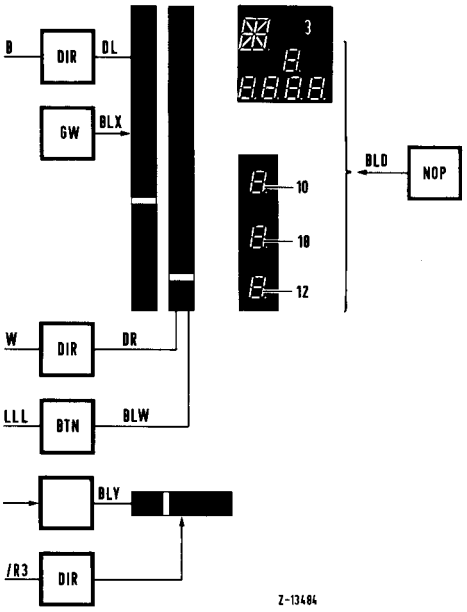


Fig. 11.16 Display sub-assembly

	Select key	Value	Addresses
	3 S1/2=OFF	X,W,Y,XD,D G1,G2,G3,G4	8760H– 8778H
	3 S1/2=ON	X,W,Y,XD,D,G1 G2,G3,G4,XP,TN TD,Y0,YL,YH,WL WH,X0,X1	8760H– 8778H
	S5 3	All used variables	
E	10	I = Internal E = External	8758H– 875FH 877BH 8735H
2	18		8750H– 8757H 8778H 8735H
A	12	H = Manual A = Automatic	8748H– 874FH 8779H 8735H

Table 11.1 Displays

11.10 Non-return pointers

The non-return pointers (X0 and X1) are generated in such a way that their output value is compared with the instantaneous value of X by way of an extreme value selection. If there is a difference, MIN selection takes the smaller and MAX selection the greater value as the new output.

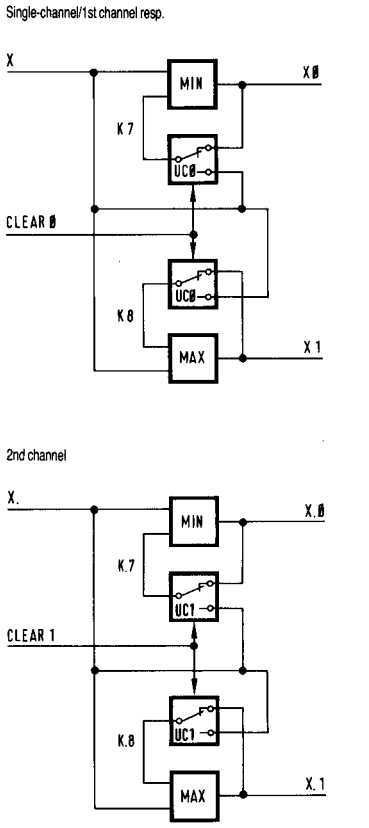


Fig. 11.17 Non-return pointers

By way of the CLEAR function both inputs of extreme value selection are combined with the measured value and in this way the output is set to the instantaneous value of X.

11.11 Control

Fgs. 11.18 and 11.19 show the unconfigurable control modules.

Figs. 11.20 and 11.21 show how these modules are integrated into the configuration.

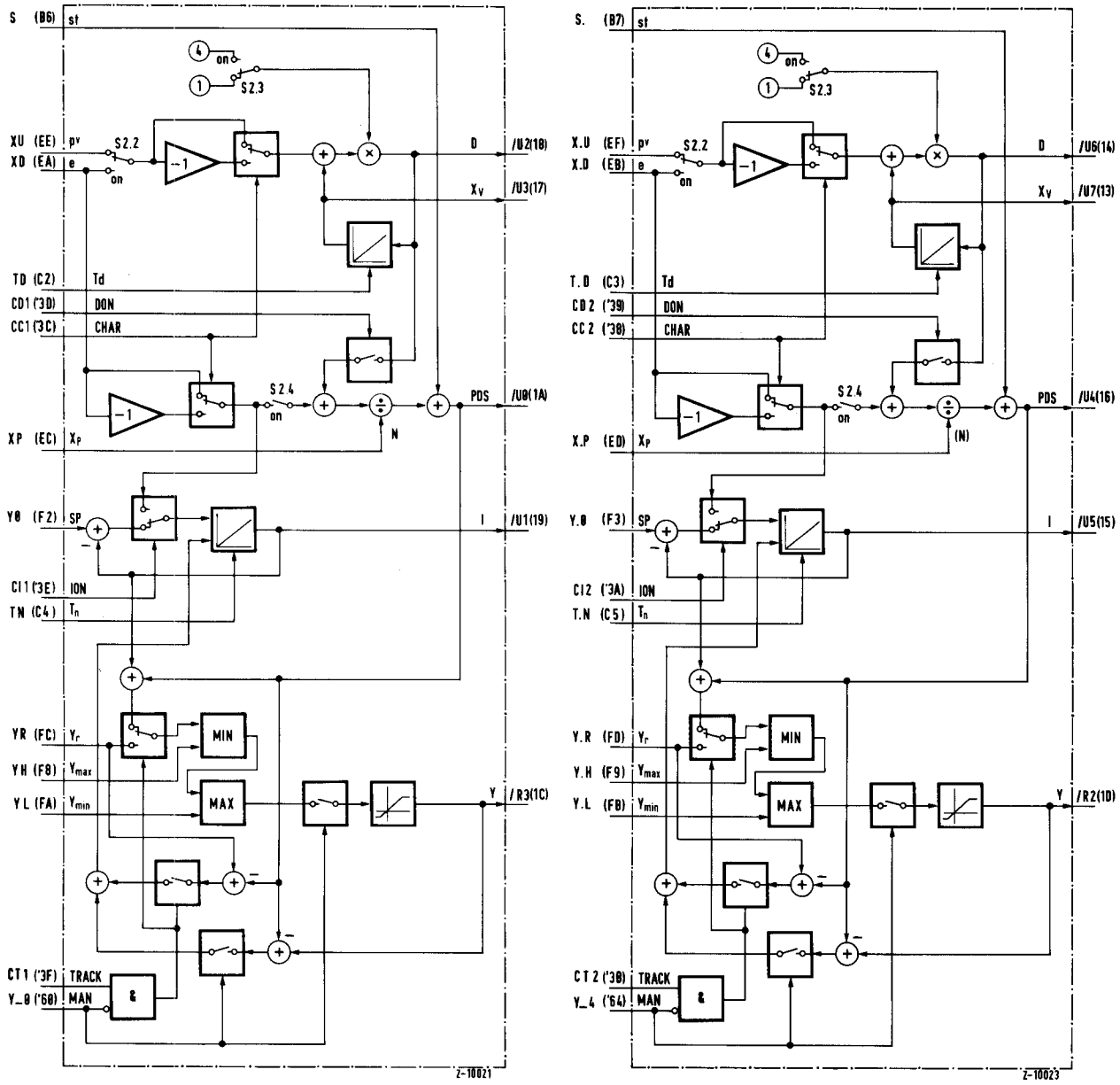


Fig. 11.18 Continuous control module

e	= Input for control deviation (XD)
p^v	= Differentiation input for freely configurable process variable
st	= Input for disturbance variable feedforward
X_p	= Input for value of proportional range
T_n	= Input for value of integral action time
T_d	= Input for value of derivative action time
SP	= Input for value of operating point
Ymax	= Input for value of upper output limit
Ymin	= Input for value of lower output limit
Y_r	= Feedback input (track input)
D	= Output of D action
X_V	= Output of feedback in D action
PDS	= Output sum of P action, D action and disturbance variable
I	= Integrator output
Y	= Controller output
CHAR	= Reverse action characteristic
DON	= D action active
ION	= Integrator active
TRACK	= YR active
MAN	= Manual operation
S2/2	= Switch to select the signal to be differentiated
S2/3	= Switch to select the derivative gain
S2/4	= Switch to disconnect the P action

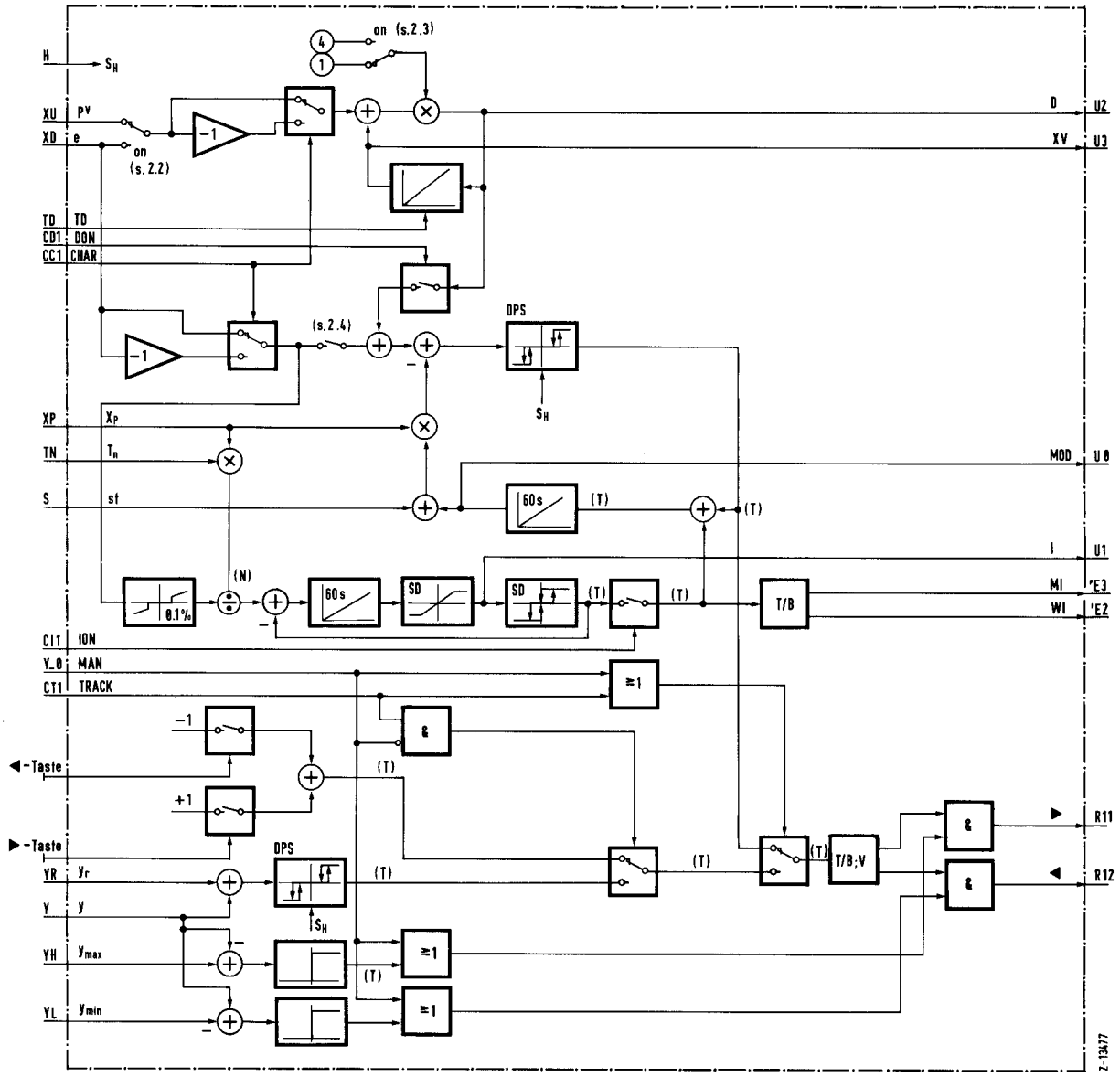


Fig. 11.19 a Control module for step action controller 1st channel

e	= Input for control deviation (XD)
p^v	= Differentiation input for freely configurable process variable
st	= Input for disturbance variable feedforward
X_P	= Input for value of proportional range
T_n	= Input for value of integral action time
T_d	= Input for value of derivative action time
S_H	= Input for value of dead band
Ymax	= Input for value of upper output limit
Ymin	= Input for value of lower output limit
Y_P	= Feedback input (track input)
y	= Feedback signal of position
D	= Output of D action
X_V	= Output of feedback in D action
I	= Output of pulse converter (I action)
MOD	= Output of follow-up circuit
CHAR	= Reverse action characteristic
DON	= D action active
ION	= Integrator active
TRACK	= YR active
MAN	= Manual operation
S2/2	= Switch to select the signal to be differentiated
S2/3	= Switch to select the derivative gain
S2/4	= Switch to disconnect the P action
MEHR	= Controller output "raise"
WENIGER	= Controller output "lower"
MI	= Pulse converter output "raise"
WI	= Pulse converter output "lower"
DPS	= Three-position switch, response threshold ± SH release threshold ± SH/2
T/B	= Ternary/binary converter
V	= Locking
(T)	= Ternary signal (+1/0/−1)
(N)	= Denominator in division
◀-Taste	= key ◀
▶-Taste	= key ▶

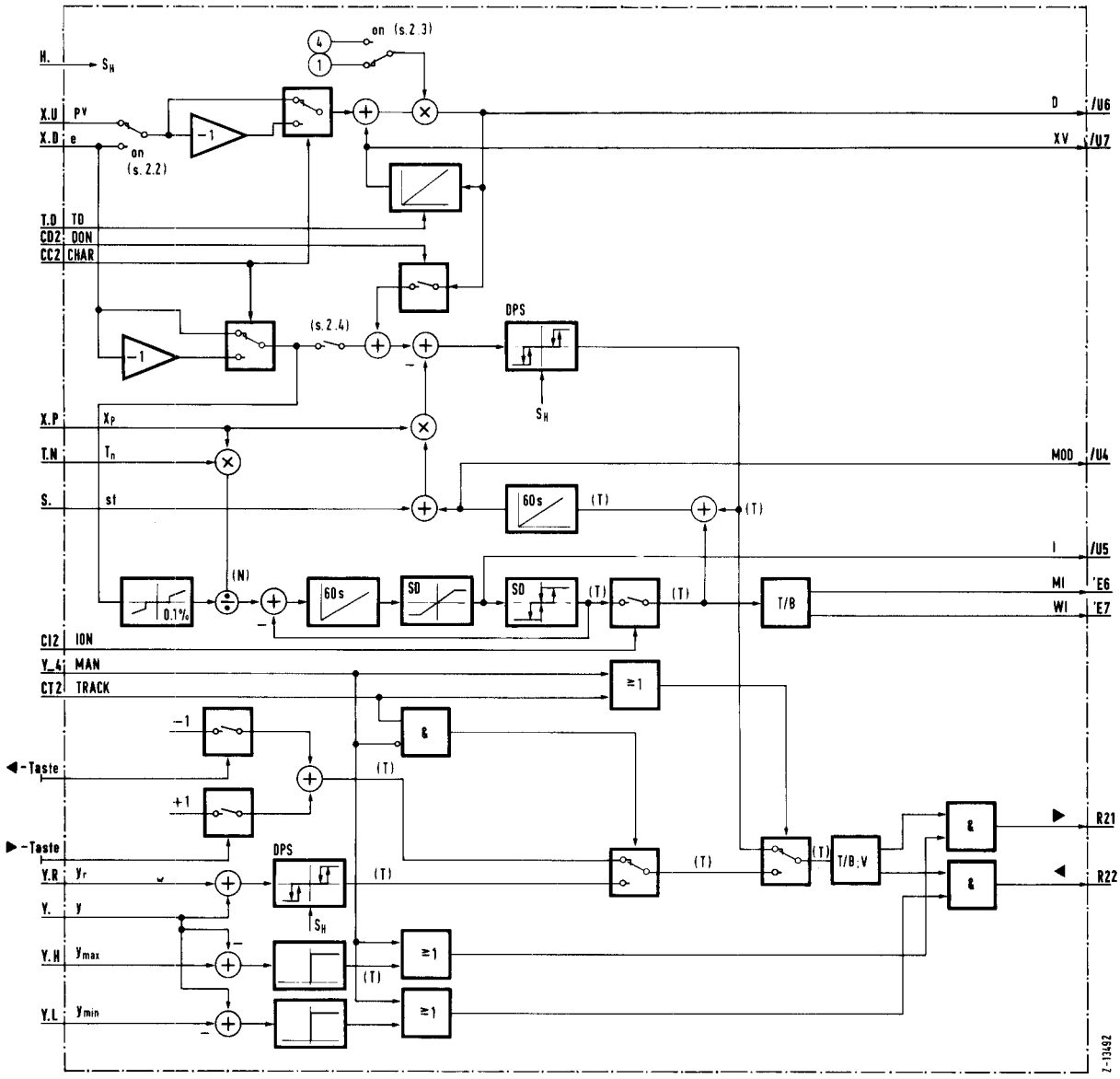


Fig. 11.19 b Control module for step action controller 2nd channel

e	= Input for control deviation (XD)
p^V	= Differentiation input for freely configurable process variable
st	= Input for disturbance variable feedforward
X_P	= Input for value of proportional range
T_n	= Input for value of integral action time
T_d	= Input for value of derivative action time
S_H	= Input for value of dead band
Ymax	= Input for value of upper output limit
Ymin	= Input for value of lower output limit
Y_p	= Feedback input (track input)
y	= Feedback signal of position
D	= Output of D action
X_V	= Output of feedback in D action
I	= Output of pulse converter (I action)
MOD	= Output of follow-up circuit
CHAR	= Reverse action characteristic
DON	= D action active
ION	= Integrator active
TRACK	= YR active
MAN	= Manual operation
S2/2	= Switch to select the signal to be differentiated
S2/3	= Switch to select the derivative gain
S2/4	= Switch to disconnect the P action
MEHR	= Controller output "raise"
WENIGER	= Controller output "lower"
MI	= Pulse converter output "raise"
WI	= Pulse converter output "lower"
DPS	= Three-position switch, response threshold ± SH release threshold ± SH/2
T/B	= Ternary/binary converter
V	= Locking
(T)	= Ternary signal (+1/0/−1)
(N)	= Denominator in division
◀-Taste	= key ◀
▶-Taste	= key ▶

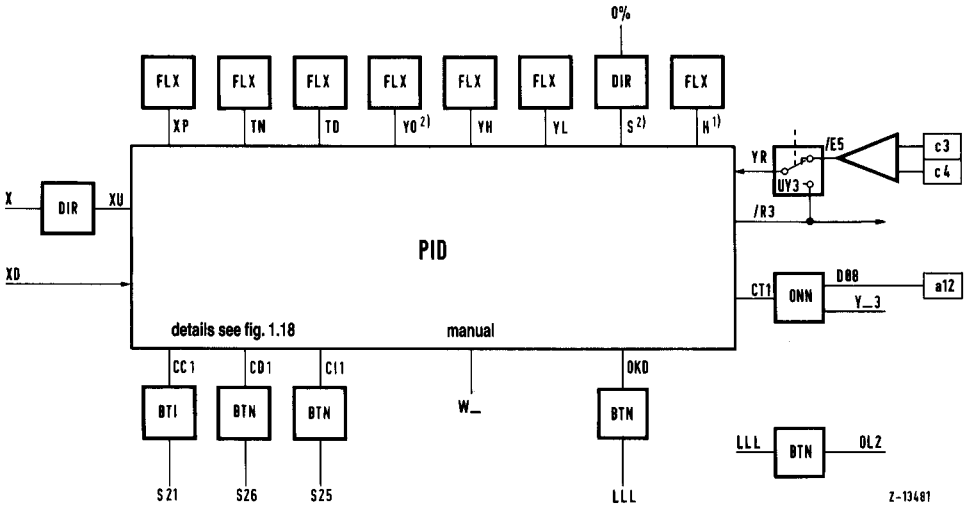


Fig. 11.20 Overview of inputs and outputs of the control module (single-channel)

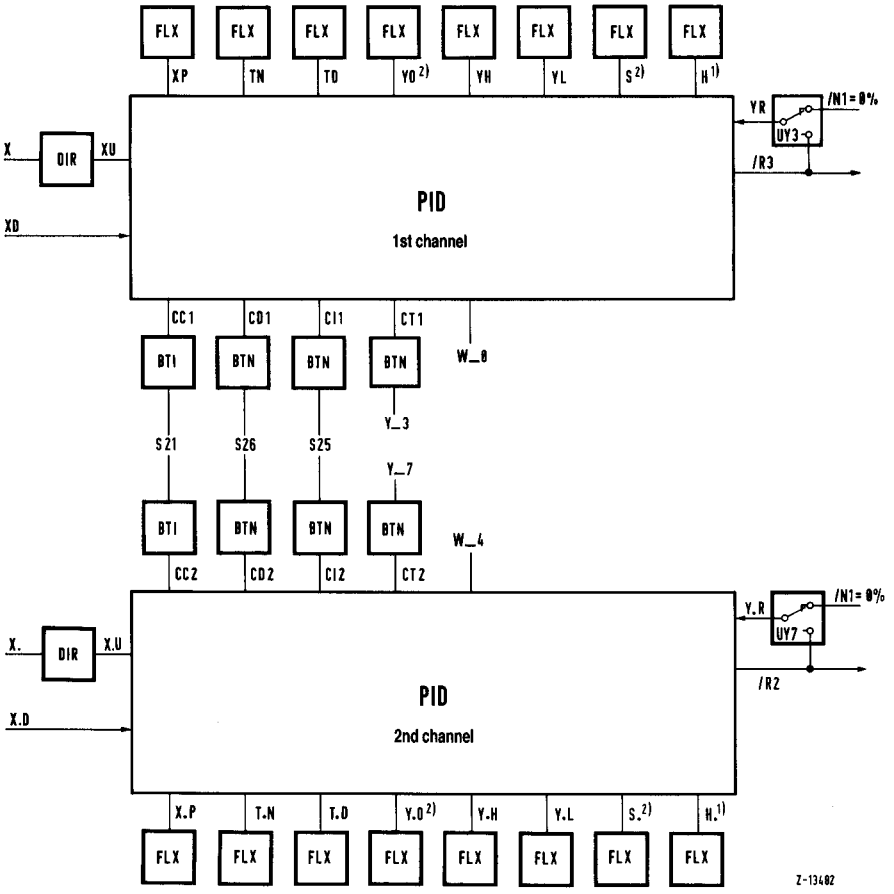


Fig. 11.21 Overview of inputs and outputs of the control modules (two-channel)

11.12 Programmer

Figs. 11.22, 11.20 show the structure of the unconfigurable programmer module in the configuration.

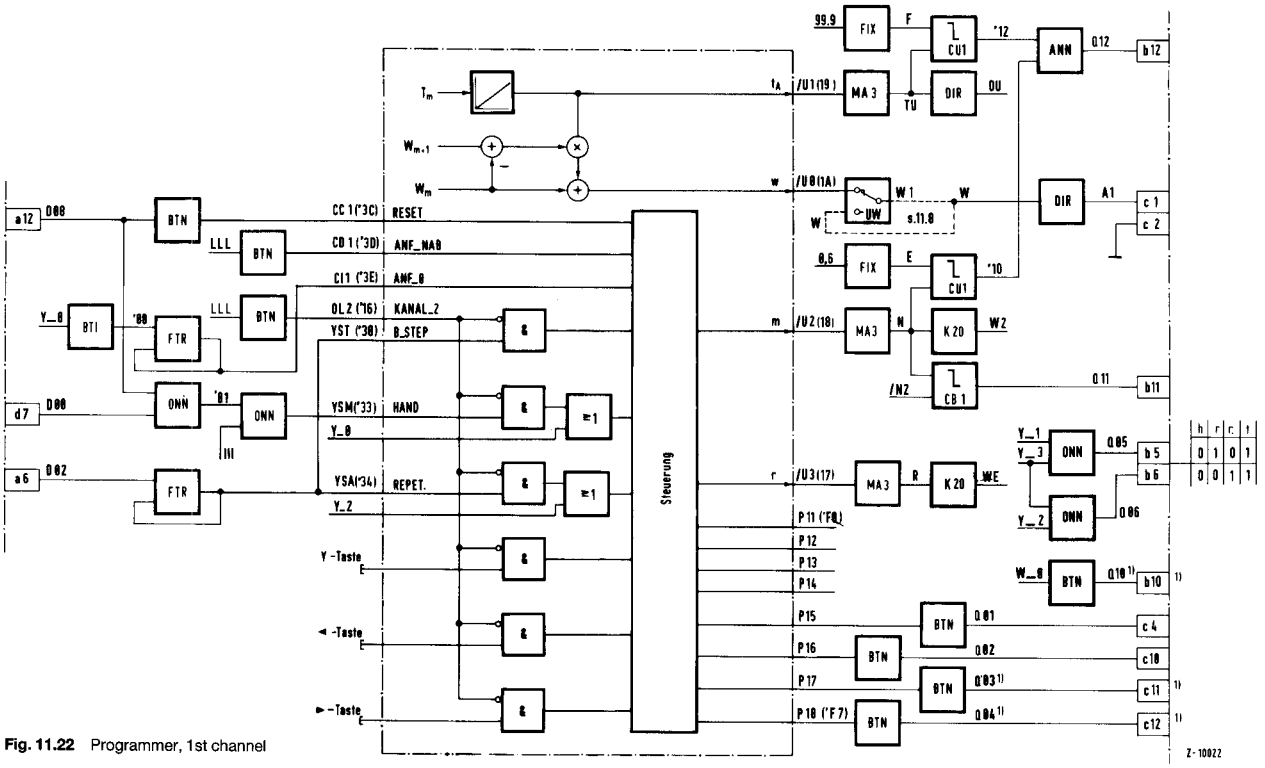


Fig. 11.22 Programmer, 1st channel

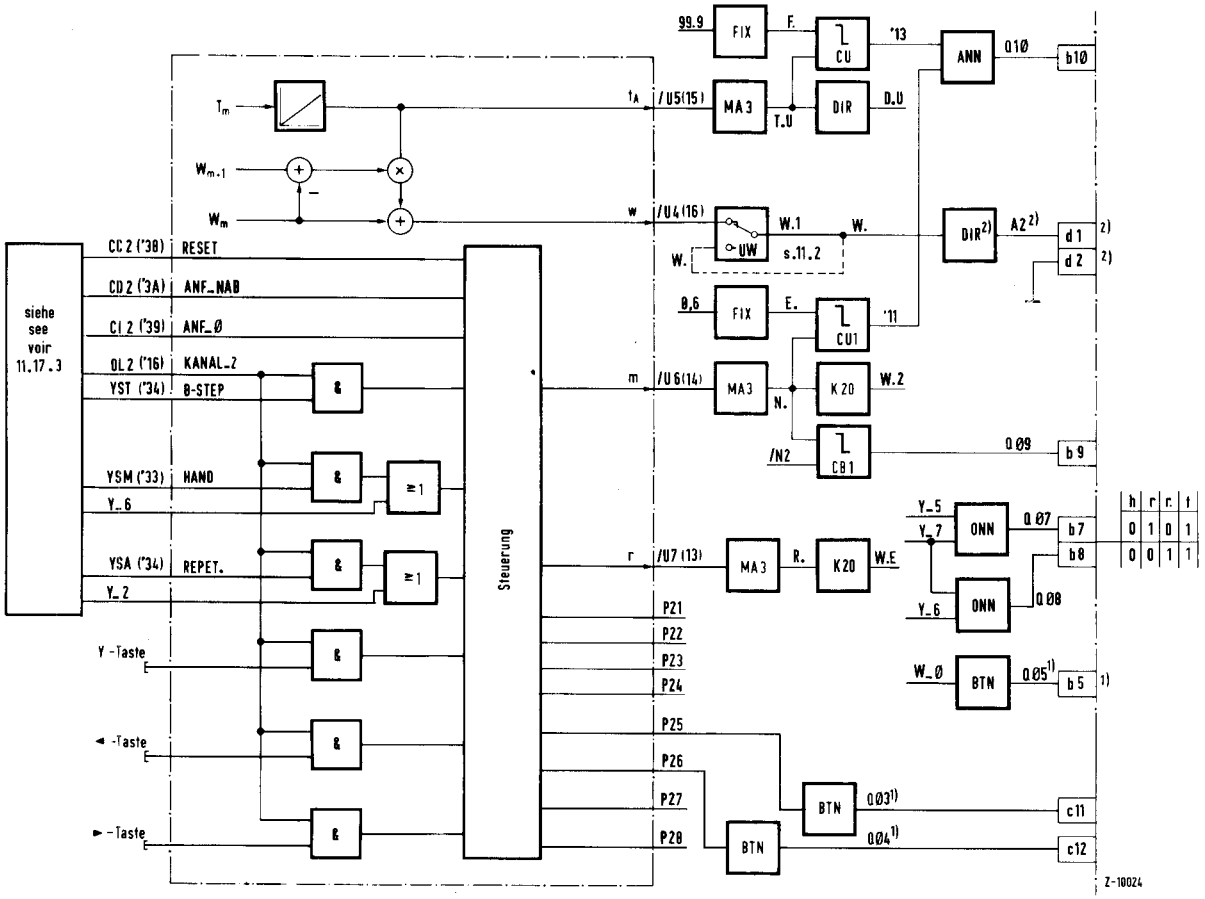


Fig. 11.23 Programmer, 2nd channel and program controller

1) Not in two-channel programmer.
2) Not in program controller.

11.13 Mode selector switch

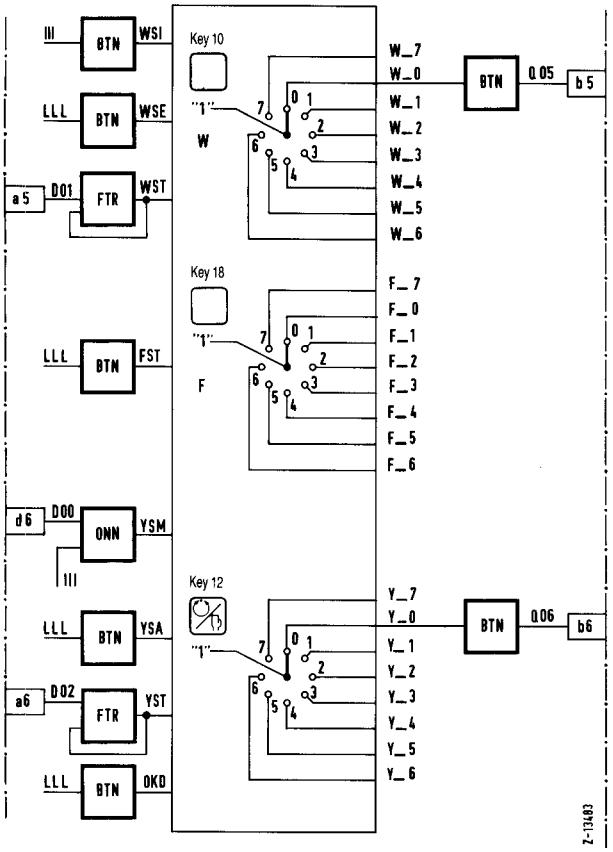


Fig. 11.24 Mode selector switches (single-channel)

Fig. 11.24 shows the mode selector switches and their control. Section 6.3.1 describes which of the possible switch settings are enabled and what characters are displayed.

In multi-channel units remote control of the mode selector switches is much more extensive. They are described in Sections 11.15.1 to 11.15.4.

11.14 Output

11.14.1 Continuous controller

The output circuits include the function continuous output and on/off output.

First the output value of the control module is assigned to the output display DU and the variable Y, the decimal point position for Y being adjusted at the same time.

Key to Figs. 11.22 and 11.23:

w	= Program set point
t_A	= Time base in section in progress
m	= Number of section in progress
r	= Number of completed loop passes
W_m	= Initial restart value of section m
W_{m+1}	= Final restart value of section m
T_m	= Duration of section m for 100 %
RESET	= Reset, m = 0, r is retained
ANF_0	= Start with m = 1 and r = 0
ANF_NAB	= Jump to start of next section
KANAL_2	= Channel 2 in operator panel
Hand	= Input for "halt" mode, w can be adjusted by hand
REPET	= Input for "repeat" mode = r."
B_STEP	= Switch forward one step

The output characteristics is switched over with switches SIH and SZL which are driven by S1/7.

By way of a D/A converter (not illustrated) the value of A1 goes as a current signal to output A1.

The value of A1 is continually converted to a proportional mark/space ratio for on/off operation. By suitable selection of hysteresis and integrator time constant the switching frequency can be altered within wide limits.

The switching frequency depends on the duty cycle and reaches its maximum with an output of 50 %. When delivered, the controller switches 6 times a minute at a duty cycle of 50 %. For a different switching frequency, the addresses named in the table below must be changed.

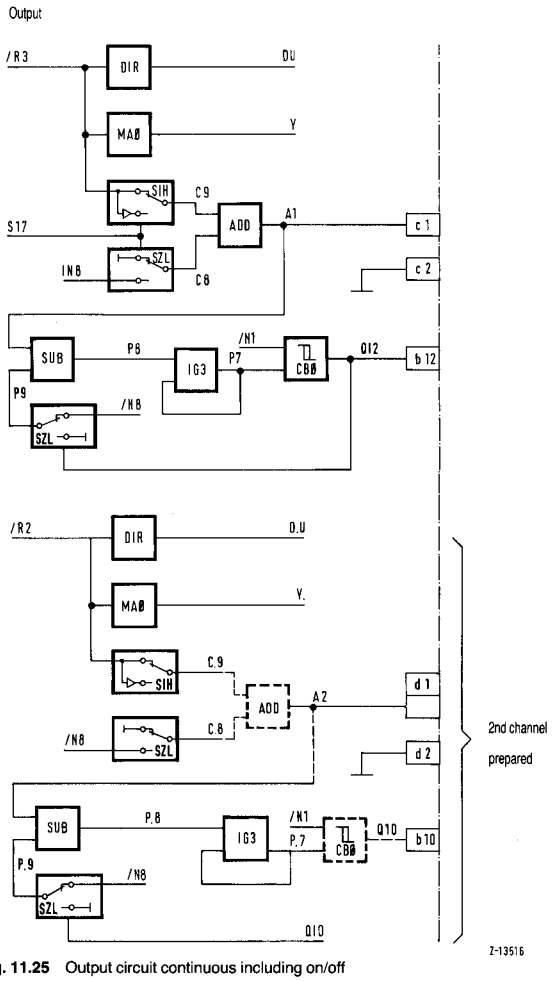


Fig. 11.25 Output circuit continuous including on/off

n/min	Address 84AC contents	Address 8740 contents
1	78 = 2 min	7D = 12.5 %
2		3F = 6.3 %
3	77 = 25 s	C8 = 20.0 %
4		96 = 15.0 %
5		78 = 12.0 %
6	**76** = 10 s	**FA** = 25.0 %
7		D6 = 21.4 %
8		BC = 18.7 %
9		A7 = 16.7 %
10		96 = 15.0 %
12		7D = 12.5 %
15		64 = 10.0 %
20		4B = 7.5 %
25		3C = 6.0 %
30		32 = 5.0 %
39		26 = 3.8 %
50		1E = 3.0 %
60		19 = 2.5 %

Table 11.2

Individually, the switching times can be calculated as follows:

$t_{on} = \frac{T(84AC) \cdot H(8740)}{(1-y)}$ switch on time

$t_{off} = \frac{T(84AC) \cdot H(8740)}{y}$ switch off time

$t_z = \frac{T(84AC) \cdot H(8740)}{y \cdot (1-y)}$ cycle time

$t_{max} = \frac{T(84AC) \cdot H(8740)}{25.0\,\%}$ max. cycle time

T = Time constant of integrator used in address 84AC (2nd channel 84AD)

H = Hysteresis of comparator used in address 8740 (for both channels)

The output circuit for the 2nd channel is already prepared in the single-channel units. Only the modules in dotted lines are added when the two-channel unit is loaded.

11.14.2 Step action output

The outputs of the control module are assigned directly to the binary outputs Q12(Q10) and Q11(Q09). The output characteristic is defined by the wiring to the servodrive.

For the position feedback signal the weighted input /E6(E5) is used for Y(Y.) and DU(D.U).

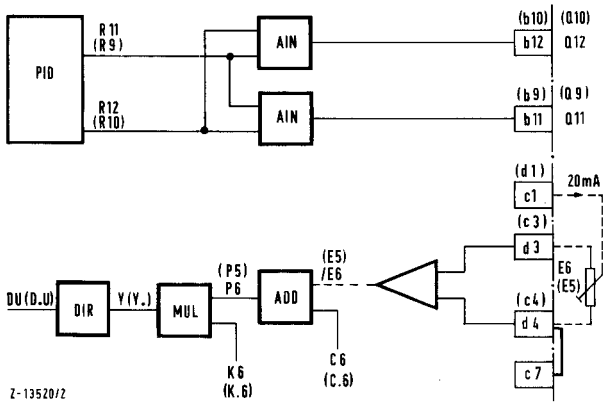


Fig. 11.26 Step action output

11.14.3 Output monitor

If the current preset by the controller does not flow in the monitored outputs A1 and/or A2, the output monitor EA1 or EA2 responds. EA1/EA2 = 1 (see 6.9).

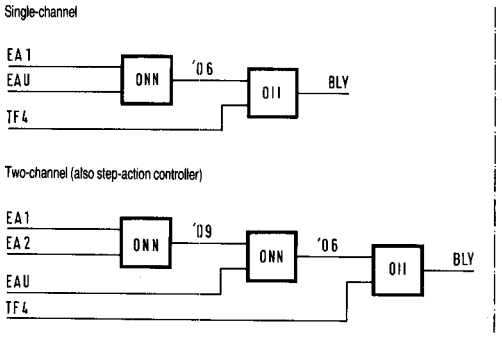


Fig. 11.27 Output monitor

If one of the conditions occurs, the output display starts to flash (BLY).

No output monitor is provided for the step action controller. It can, however, be constructed to the same pattern if the supply currents for the position feedback signal are to be monitored.

11.15 Diagnostics output

The diagnostics output combines a series of test routines (see 6.9).

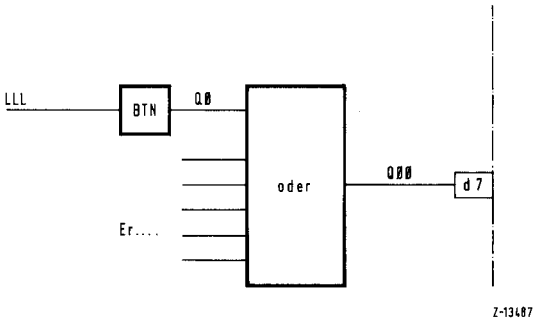


Fig. 11.28 Diagnostics output

11.16 Remote adjustment of values

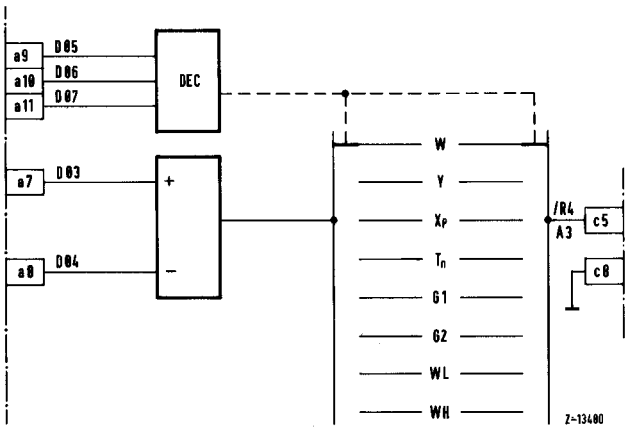


Fig. 11.29 Remote adjustment of values

11.17 Remote control

11.17.1 Single-channel controller

The configuration is contained in Fig. 11.20.

11.17.2 Two-channel controller without channel logic (451, 551, 651)

As described in Section 4.4, if several logical operators are connected in sequence one cycle respectively is required for processing a command.

D01 and D02 have a reversed switch function. (Open input = 1). Two different switch sequences must be noted:

1. Changeover of the controller visible on the front of the controller, i.e. D07 and 0L2 are equal and '0E = 0. Switch pulses from D01 or D02 do not reach FST. With their positive edge (= is the negative edge of the sensor) they switch the mode over directly with WST or YST.

2. Changeover of the controller not visible on the front, i.e. D07 and OL2 are not equal. '0E = 1. A switch pulse from D01 or D02 reaches FST after 4 cycles. Only when changeover to the other channel has been accomplished may the mode changeover be effected by taking the pulse at D01 or D02 back via WST or YST. The input pulses at D01 and D02 must hence be applied for at least 4 cycles.

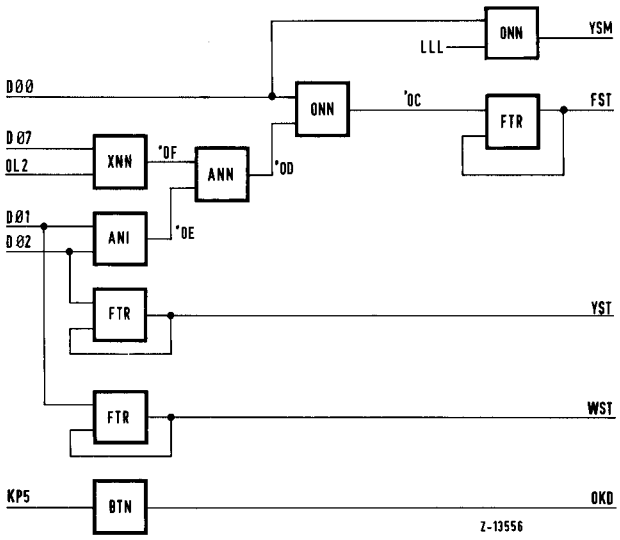


Fig. 11.30 Remote control of two-channel controller

11.17.3 Program controller and two-channel programmer

In the program controller the control largely corresponds to that of the two-channel controller. In addition, the changeover to "halt" (YST) invoked by the RESET function (D08) may only be accomplished if the programmer is selected (FST).

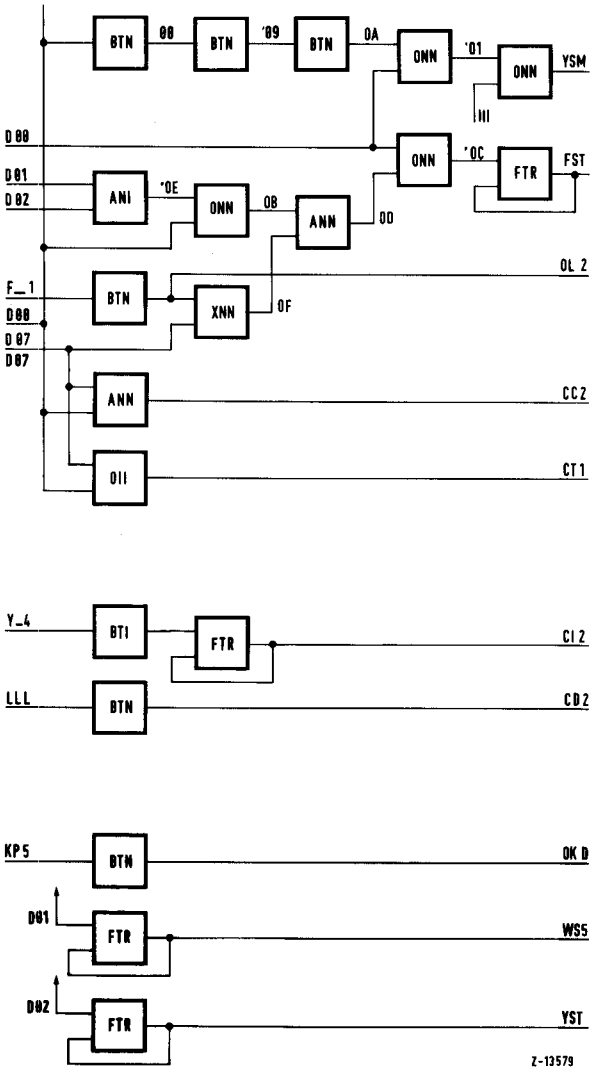


Fig. 11.31 Program controller

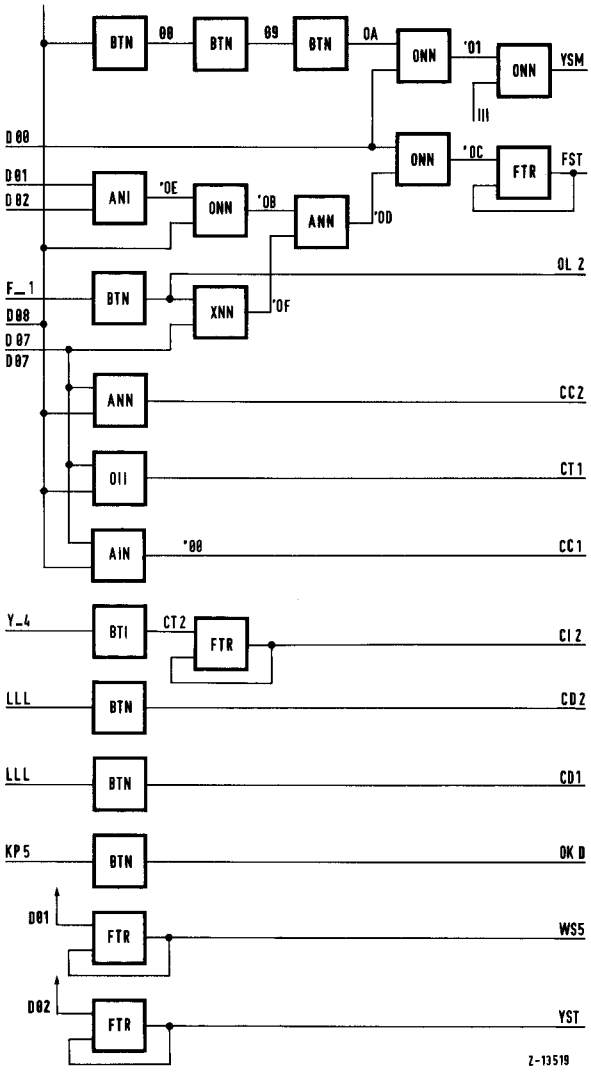


Fig. 11.32 Two-channel programmer

11.17.4 Cascade controller and override controller

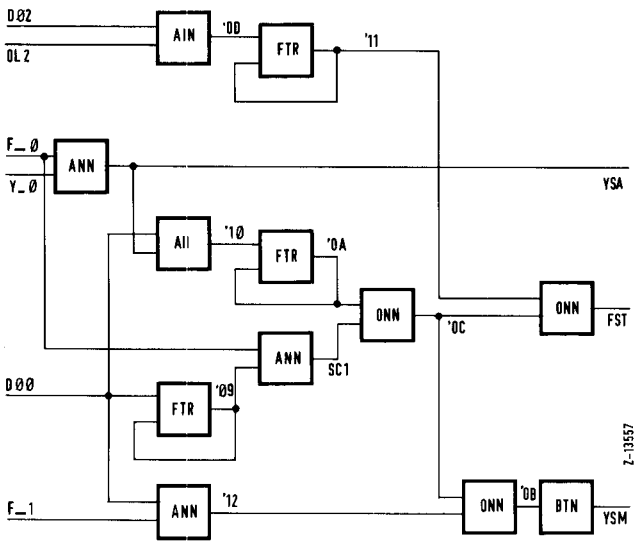


Fig. 11.33 Cascade controller

The upper part of Fig. 11.33, starting at inputs D02, D07 and 0L2, corresponds in structure to the control circuits of the two-channel controller. D01 is not included here as the W switch is not devided.

The lower part ensures that channel 1 always remains at automatic irrespective of what commands are given via D00 (forced manual) or D02 and D07.

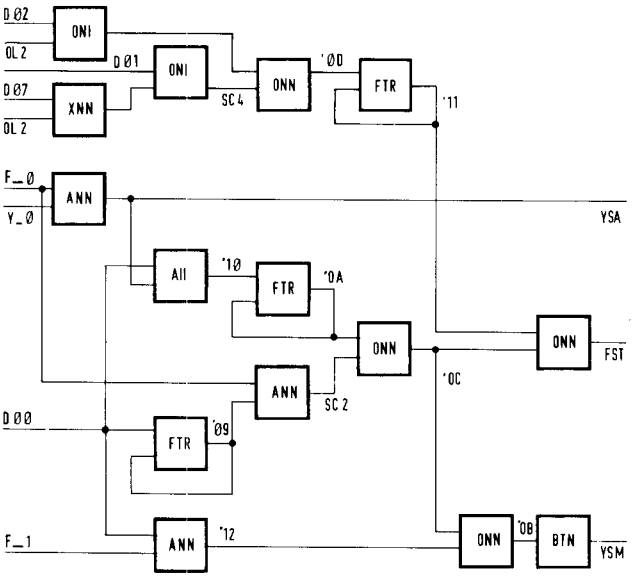


Fig. 11.34 Override controller

The override controller differs in the remote control only in that the W switch is divided. D01 and D02 are therefore initially combined as in the other two-channel units.

If the slave controller (master controller) is at manual and the master controller (override controller) switched to the front, it is no longer indicated that the control loop is not set to automatic.

In order to signal this, in the circumstances described the display "A" next to key 12 is made to flash. NDI causes the flashing to be suppressed on switchover to MONITOR or similar displays.

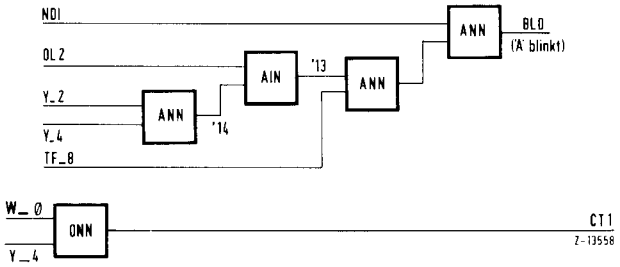


Fig. 11.35 Mode monitor

11.18 Channel logic

11.18.1 Cascade

Fig. 11.36 shows the interconnection of the two channels. With open cascade "o" or "H" the output of the master controller is steered to X. so that at the moment of changeover the control deviation at the slave controller is zero and the transfer is bumpless.

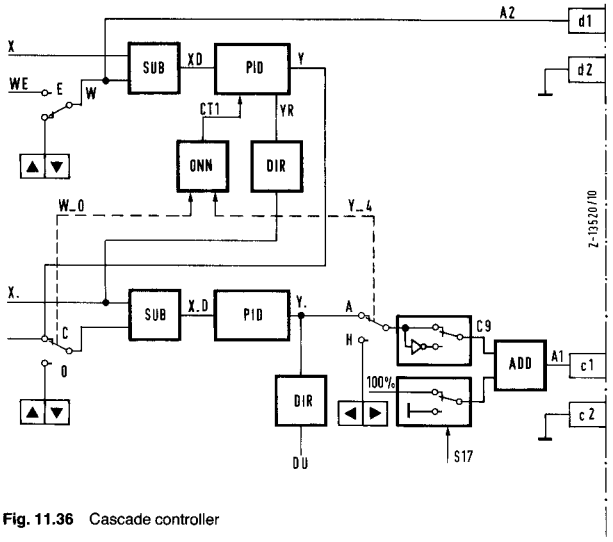


Fig. 11.36 Cascade controller

11.18.2 Override controller

Figs. 11.37 and 11.38 show the connection of controllers for override control. In Fig. 11.37 the max. limits of the control outputs are set and hence the smaller of the two output signals selected.

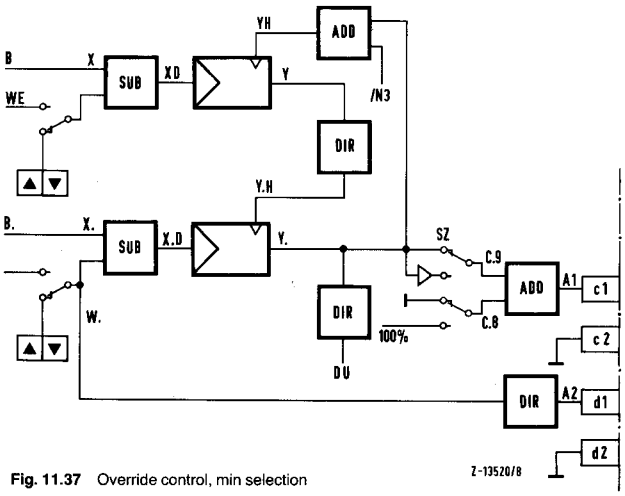


Fig. 11.37 Override control, min selection

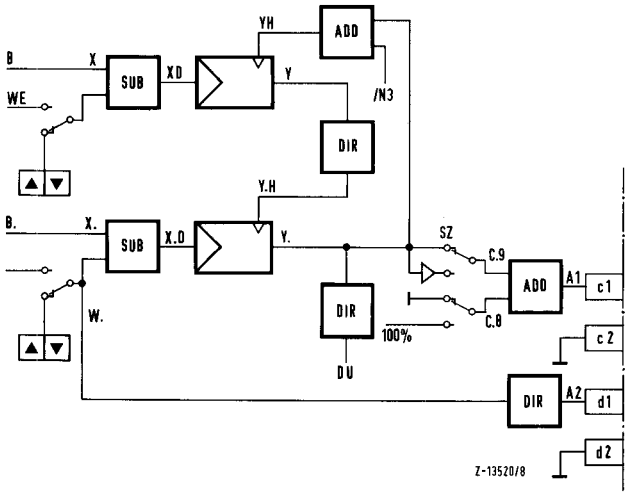


Fig. 11.38 Override control, max. selection

In Fig. 11.38 the greater of the two output signals is selected by setting the min. limits.

11.19 Double indicator

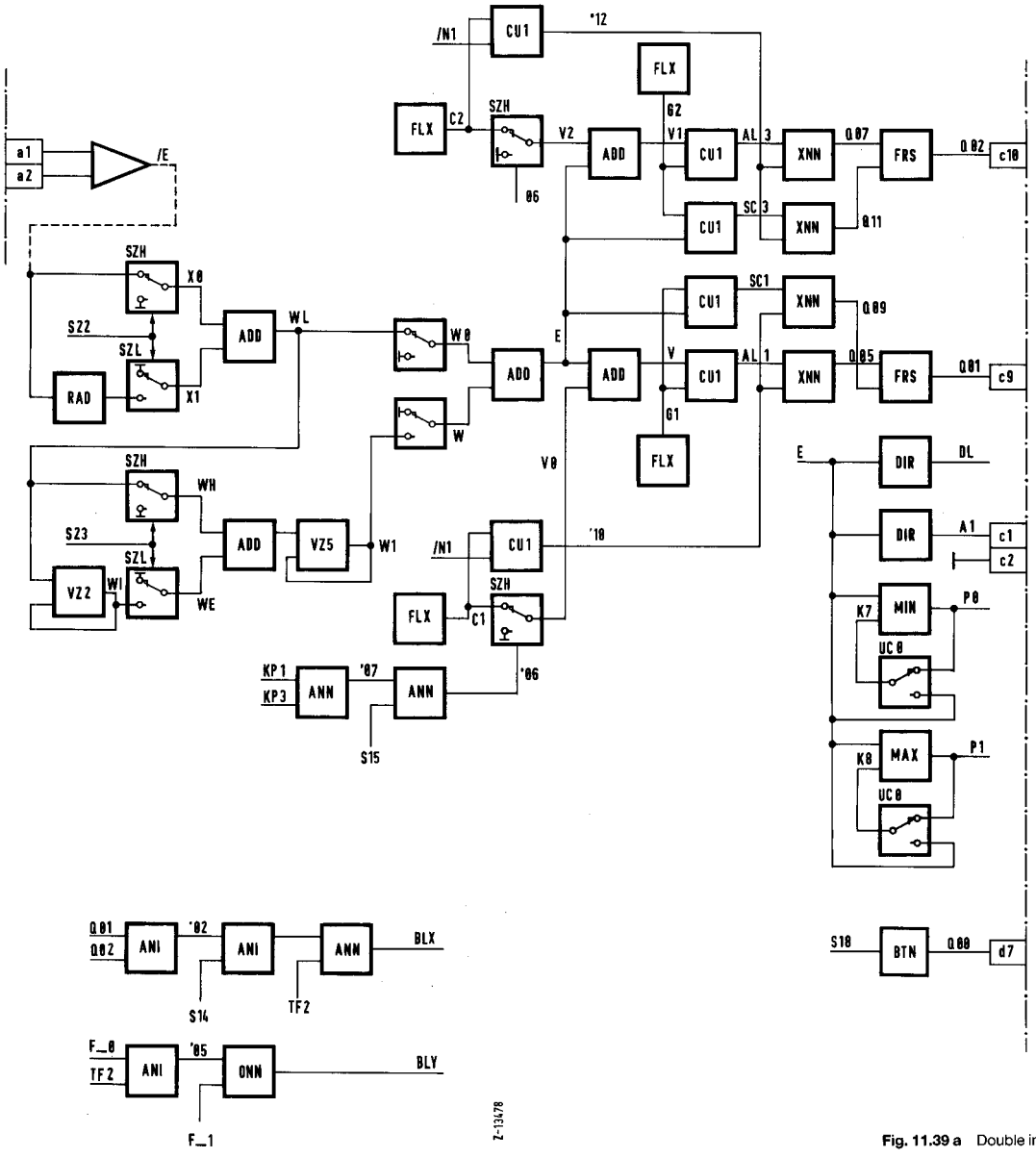


Fig. 11.39 a Double indicator, left-hand display

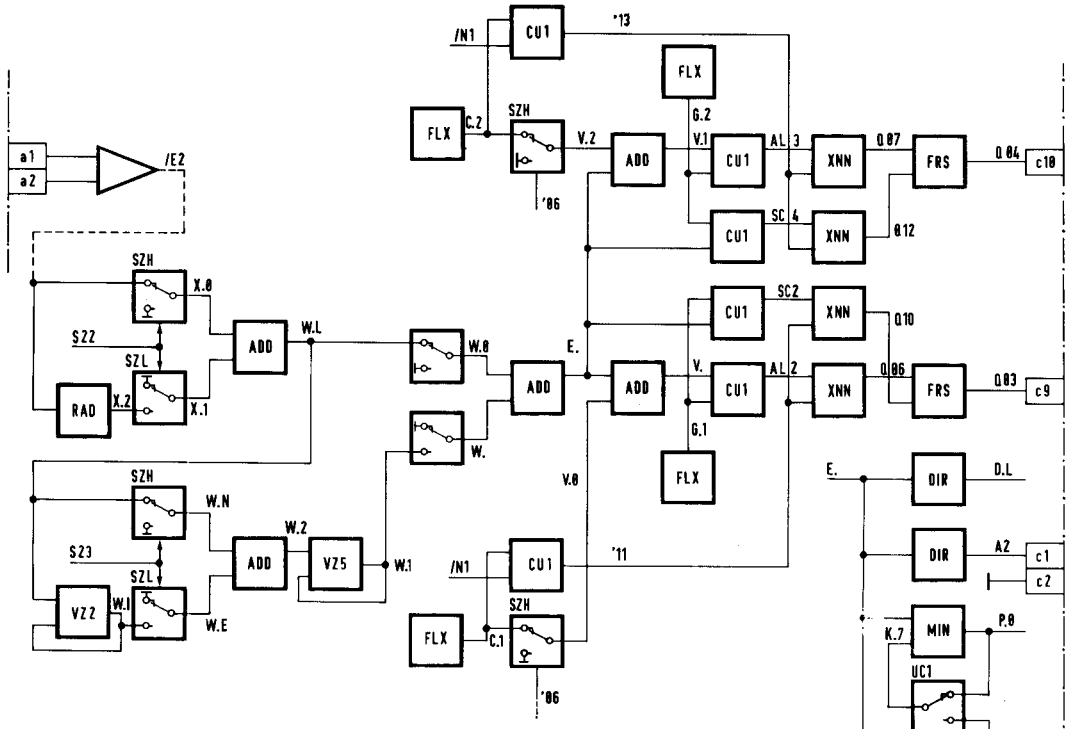


Fig. 11.39 b Double indicator, right-hand display

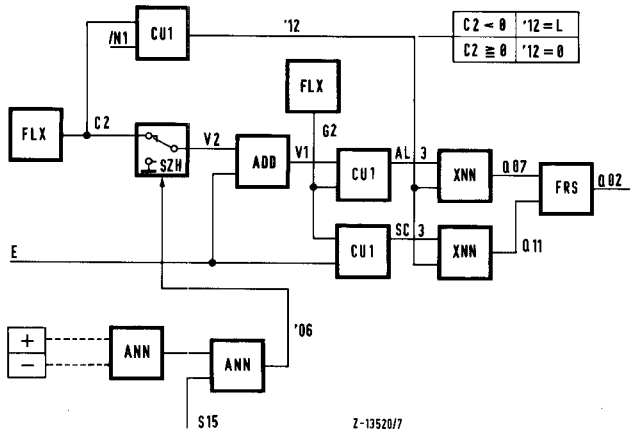


Fig. 11.40 Alarm value configuration of indicator (detail from Fig. 11.39 a)

The double indicators contain no special features in their configuration (Fig. 11.40). Only the formation of the adjustable switching hysteresis up to 100% differs from the procedures described (in Section 6).

This circuit provides the following options:

a) Adjustable hysteresis −100.0 to +100.0 %
Positive values (C2 > 0) give a MAX contact (transition from 1 to 0 if value exceeded).
Negative values (C2 < 0) give a MIN contact (transition from 1 to 0 if value fallen below). The switching slope is always assigned to the set value (e.g. G2).

b) The self-holding that occurs with large hysteresis can be eliminated by simultaneously operating keys "+" and "−".

Table 11.3 shows the switching status of the different variables:

C2 >0; '12 = 0

E	SC3	Q11	E+V2	AL3	Q07	Q02
G2	0	0	G2	1	1	1
G2	0	0	G2	0	0	1
G2	1	1	G2	0	0	0
G2	0	0	G2	0	0	0
G2	0	0	G2	1	1	1

C2 <0; '12 = 1

E	SC3	Q11	E+V2	AL3	Q07	Q02
G2	1	0	G2	0	1	1
G2	1	0	G2	1	0	0
G2	0	1	G2	1	0	0
G2	1	0	G2	1	0	0
G2	1	0	G2	0	1	1

Table 11.3

Note:

The W switch and the Y switch are not available. The F switch cannot be configured.

12 Use of data storage (EEPROM + tape)

12.1 Loading from the EEPROM

The EEPROM must be located in socket 19 (above the battery.

Special configurations, parameters and autocal data are stored in the optionally available EEPROM. The storage volume is large enough for two or (with EEPROM 2732) four different programs.

If the EEPROM was loaded in a different unit, the autocal data must not be used.

The necessary switch positions are shown in Table 12.1.

Switch	EEPROM	EEPROM A	EEPROM B	Tape
S1/1	x	ON = Without autocal data OFF = With autocal data		
S1/2	x	ON	OFF	x
S1/3	ON	OFF		x
S3/5	Write protection = ON			
S4	RCL PROGM			LOAD
S5	Operate			
S4	x	RCL PARAM		
S5	x	Operate		

Table 12.1 x = any

12.2 Storing configurations in an EEPROM[1)]

Switch	EEPROM A	EEPROM B	Tape
S4	STO PARAM		
S5	Operate		
S1/1	ON = Withour autocal data OFF = With autocal data		
S1/2	ON	OFF	x
S1/3	OFF = Priority		x
S4	STO PROGM		SAVE
S5	Operate		

Table 12.2 x = any

Before storing configurations, check that the plug-in jumpers S (Table 12.3 and Fig. 12.1) are correctly connected.

If the jumpers are withdrawn or only plugged in on one side, the EEPROM is write protected.

If S1/3 is set to "OFF" when storing, the stored configuration is given a priority code and automatically reloaded in the event of a RESET. It should therefore contain the parameters. (STO PARAM prior to saving). If more than one configuration is stored in this way, the one last stored with S1/3 OFF is loaded.

If it is intended to use the EEPROM in other units too, the autocal data should not be stored.

The necessary switch positions are shown in Table 12.2.

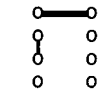
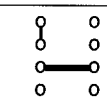
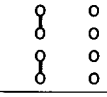
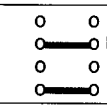
12.3 Storing single lines

In the EEPROM (IC 19) of controller PS there are 2 times 16 (in EPROM 2732A 4 times 16) sectors available in each of which can be stored 16 programs lines. These sectors are also used to store the time programs for the programmer/program controller (see Operating Manual 42/62-61-...).

Individual lines can be stored with the aid of routine E, which is not described in the above manual.

This routine is useful if identical program lines are to be copied to several configurations.

As a sector can only be reloaded in its entirety, only continguous program lines should be stored in a sector.

Type	Routine in MC000F	Plug-in jumpers	Programs
52B13	A		2
X2816A	B		2
2816	C		2
2732A EPROM	D	 Br*	4

o—— o = Jumper operational

o—— o = Jumper not operational (= parked)

* see Operating Manual

Table 12.3. Possible EEPROMs and arrangement of plug-in jumpers

Procedure:

- Remove write protection from EEPROMs.
- Select and start monitor routine MC 0012
- Select routine "E" key 12
- Choose sector 0...F
- Select a free line in the sector with key 18.
- Store program lines according to Table 12.2.

Sector

Line

Routine

12.4 Calling individual lines

Monitor routine MC 0011 can be used to load individual sectors with 16 program lines each to RAM without changing the other program parts. Having selected the right sector, loading is accomplished according to Table 12.1.

12.5 Saving on a disc

The RAM data can be saved on a disc using the configuration program PROKON or the call-up documentation program PRODOK.

12.6 Tape interface

A standard audio cassette unit can be connected at the "SER" connection (see fold-out illustration on last page). The controller is connected with a cable having the special plug on the controller side and two jack plugs of 3.5 mm diameter on the cassette unit side. See spare parts list for Catalog No.)

"SAVE" = Save unit data on tape
"LOAD" = Load unit from tape
"VERIFY" = Check data on tape

"SAVE" requires a connection from controller to microphone input, "LOAD" and "VERIFY" to the headphone output. In many cassette units the connection to the microphone input and headphone output cannot be maintained at the same time. This is shown by the fact that both yellows LEDs light and the load or save operations do not function. In such cases the line not used must be disconnected.

For "LOAD" and "VERIFY" the output level (loudness) of the cassette unit must be set so that the yellow LED SIA is brightly lit.

12.6.1 Saving the configuration on tape

Before the configuration – including the parameters saved with STO PARAM – can be transferred to tape, it is necessary to decide whether the calibration data (see Table 12.2) are to be stored too. As this data is specific to the unit, it is normally recommended not to save it at the same time.

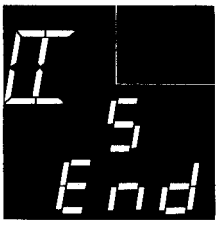
"SAVE"

- Connect cassette unit at microphone input (white plug) and switch on.
- See switch S1/1

- Switch S4 to "SAVE CAS" and press S5. The controller shows C_S in the digital display and asks for an F number (file number). The data record is stored on tape under this number (name). The F no. is displayed next to keys 12 and 18 and altered with these keys between 0...FF.
- Wind tape to a free position and start recording.

- Start controller with key ▲.

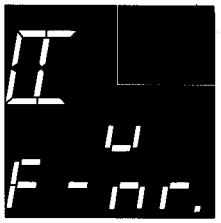
The display C_S and the hex number 8400 are shown in the digital display. In approx. 1.5 minutes the memory contents is written to the tape. This procedure can be followed on the changing display.



Saving terminates at counter status 87DF (without autocal data) or at 87FF.

After saving is complete the controller displays "End" instead of the last memory address.

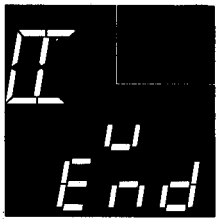
- **"VERIFY"**
- Rewind tape.
- Connect unit via headphone jack (black plug).
- Turn switch S4 to "VERIFY" and press key 5.



The units asks for the F no. (the name) of the data record on tape with which the current configuration is to be compared.

Input is accomplished with keys 18 and 12 next to which the set value is read.

- Start controller with key ▲.
- Start tape.



In the digital display C_U appears with the same data as during saving.

If the tape contents coincide with the memory contents the controller displays "End". If tape and memory contents do not coincide, an error message is given. In both cases key S5 must be pressed before "VERIFY" or "SAVE" can be started again.

12.6.2 Load of the controller from tape

Loading the controller from tape is the same as saving to tape

Switch 4 must be in position "LOAD CAS". C_L appears in the digital display.

Loading the autocal data is only permitted if it originates from the unit to be loaded.

13 Examples

The examples show some interesting problems. The variables used here are not always free. Before using an example it is therefore necessary to check whether these are still free in the basic configuration used. When defining other variables, follow the instructions in Section 4.

The representations in Section 11 are also worthy of note as other examples.

The Technical Information Publications also provides assistance for individual applications.

Explanation of the different examples

13.1 Control with dead zone

For an adjustable range (dead zone) the control deviation is always set to 0 via a selection circuit. The dead zone is set symmetrically to the zero with variable T0.

13.2 Slide register (dead time)

The value of the variable B is assigned to variable X, being delayed. When assigning variables for the registers, attention must be paid to the ascending hex figures from the input to the output of the slide register.

The increase depends on the number of registers and the clock time. The clock time is determined by the integrator time constant and the variable T0. By dimensioning accordingly, it was possible to set the delay time directly in seconds with the variable T0.

$$T_{delay}\,(s) = \frac{T0 \cdot TI \cdot N}{100\,\%} = \frac{T0 \cdot 10 \cdot 10}{100\,\%} = T0$$

13.3 TA0 splitting

Free linearization via 17 restart points is possible with table function. Frequently not all restart points are required, which means that one can distribute the TA0 among several characteristics.

13.4 Switch-on delay

A signal is sent by input D01 with a freely adjustable delay to binary output Q10. The delay time depends on the integrator time constant and the variable K.

13.5 Switch-off delay

As opposed to example 13.4, a decreasing signal is delayed here.

13.6 Limitation of the modification speed

It is possible to limit the modification speed using the Op codes RL1 to RLC. However, these Op codes do not permit adjustment of the time constant.

In the examples various gradients are adjusted for ramping up and ramping down directions, using the variables C5 and C6. The ramp gradient depends on variable C5 and C6 as well as on the integrator time constant.

13.7 Motor simulation

Simulation of a motor setting for testing a three-position step output circuit.

The run time of the motor (here 60 s) can be effected by the integrator time constant and the variable K.0.

13.8 XP-changeover (bumpless)

Changeover between two XP values takes place with the binary input D05. The XP values are set with the variables Y1 and Y2. Any P jump which might occur in the course of changeover is prevented by shortterm setting of the track bit CT1.

13.9 Scanning control (acquisition of actual value with large dead time)

The scanning control is activated by the F key, "t" appears in the display beside the F key.

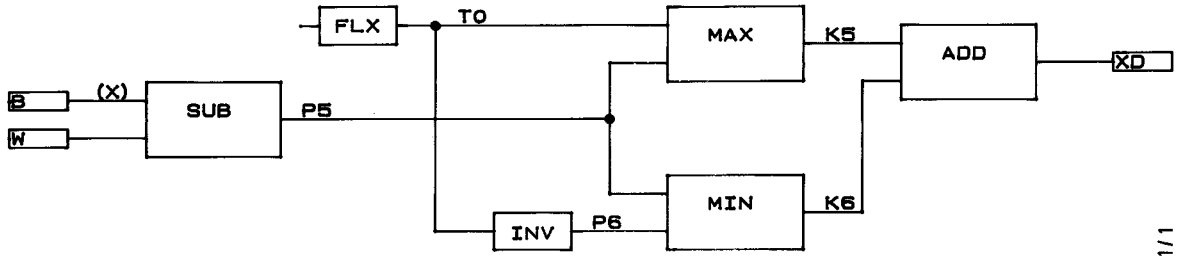
The overall cycle time is set (0 ... 199.9 min.) with the variable T0 and the waiting time (0 ... 199.9 min.) is set with variable T1. The overall cycle time is composed of waiting time (controller at manual) and the scanning time (controller at automatic).

Overall cycle time = waiting time + scanning time

13.10 Set point ramp (with x tracking)

To activate set point ramp, changeover with the W key to P. The set point goes from the current actual value with an adjustable gradient to the target set point WI which is set. On reaching the target set point, the latter is entered and display switches to I.

The gradient depends on the integrator time constant and the variable T1.



= Transition to the standard configuration

```
REFERENCE CONFIGURATION          62515-0-XX111XX  VERSION : 2.8     Konfi-Nr.:
K5 : MAX,T0 ,P5     88H: 46H,B8H,A8H  |   P6 : INV,T0 ,       AAH: 3CH,B8H,00H
K6 : MIN,P6 ,P5     8AH: 47H,AAH,A8H  |   T0 : FLX,#+005.0    B8H: A5H,20H,83H
P5 : SUB,B  ,W      A8H: 49H,44H,D2H  |   XD : ADD,K5 ,K6     EAH: 48H,88H,8AH
```

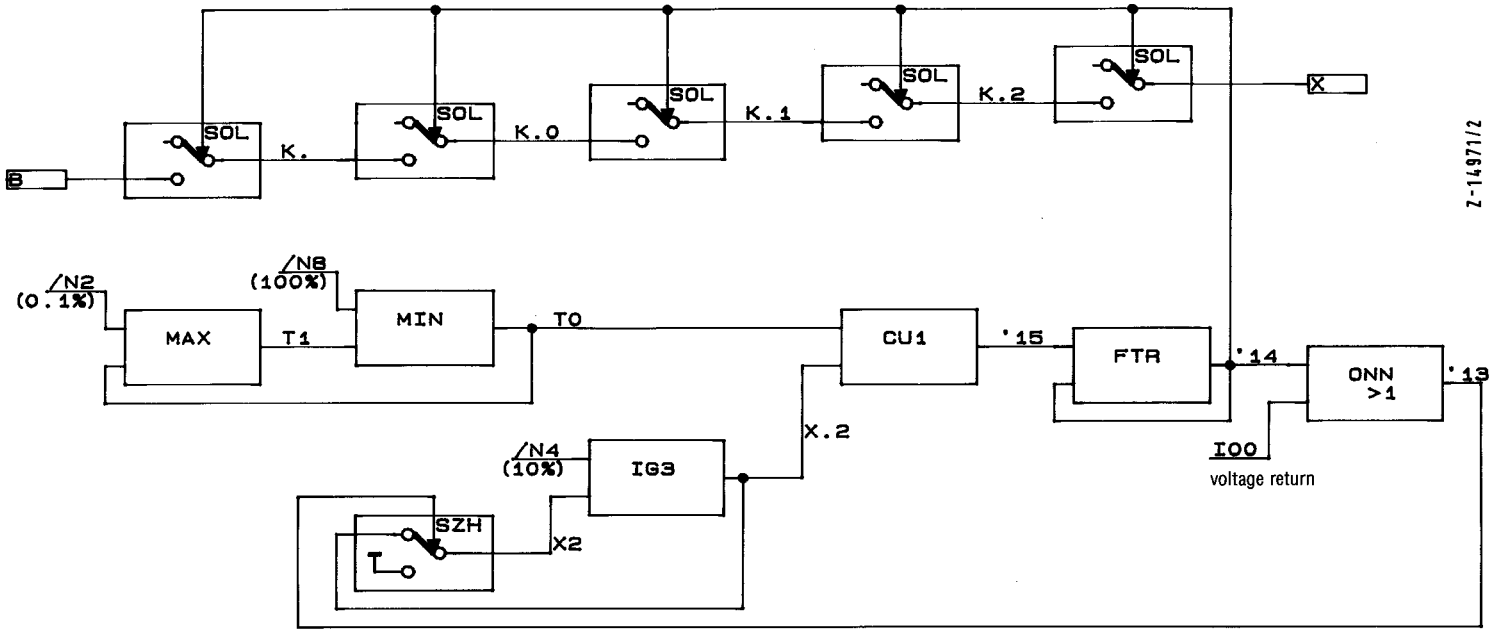
Program lines: 6 difference(s)

CONTROL CODES

```
    8797H : FE
```

Control codes: 1 difference(s)

Example 13.1



REFERENCE CONFIGURATION 62515-0-XX111XX VERSION : 2.8 Konfi-Nr.:

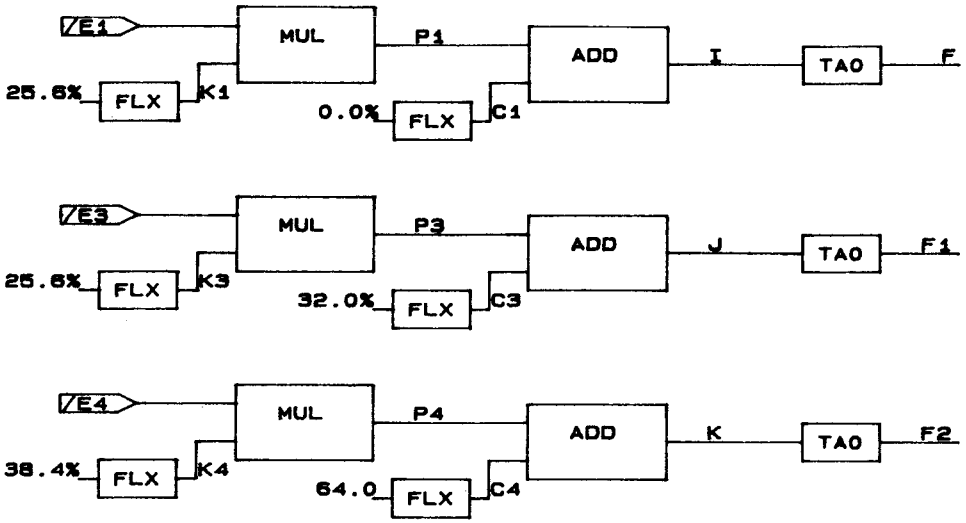
'13: ONN,I00,'14	13H: 07H,B9H,14H	K.2: SOL,K.1,'14	83H: 11H,81H,14H
'14: FTR,'15,'14	14H: 0EH,15H,14H	T0 : MIN,/N8,T1	B8H: 47H,20H,BAH
'15: CU1,T0 ,X.2	15H: 87H,B8H,E9H	T1 : MAX,/N1,T0	BAH: 46H,27H,B8H
K. : SOL,B ,'14	7DH: 11H,44H,14H	X : SOL,K.2,'14	E2H: 11H,83H,14H
K.0: SOL,K. ,'14	7FH: 11H,7DH,14H	X2 : SZH,X.2,'13	E8H: 16H,E9H,13H
K.1: SOL,K.0,'14	81H: 11H,7FH,14H	X.2: IG3,/N4,X2	E9H: 76H,24H,E8H

Program lines: 12 difference(s)

CONTROL CODES

Control codes: 0 difference(s)

Example 13.2




```
C2 : FLX,#+032.0    4CH: A5H,00H,94H
C3 : FLX,#+064.0    4EH: A5H,00H,A8H
F  : TA0,I   ,      66H: 50H,78H,00H
F1 : TA0,J   ,      68H: 50H,7AH,00H
F2 : TA0,K   ,      6AH: 50H,7CH,00H
I  : ADD,P1 ,C1     78H: 48H,A0H,4AH
```

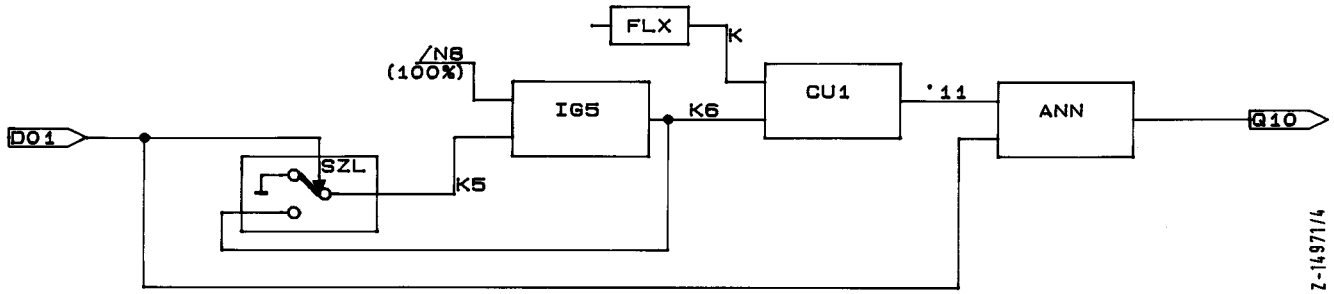
```
J  : ADD,P3 ,C3     7AH: 48H,A4H,4EH
K  : ADD,P4 ,C4     7CH: 48H,A6H,50H
K1 : FLX,#+025.6    80H: A5H,00H,90H
K3 : FLX,#+025.6    84H: A5H,00H,90H
K4 : FLX,#+038.4    86H: A5H,00H,98H
```

Program lines: 11 difference(s)

CONTROL CODES

Control codes: 0 difference(s)

Example 13.3




```
'11: CU1,K   ,K5     11H: 87H,7CH,88H  |  K  : FLX,#+005.0   7CH: A5H,20H,83H
Q10: ANN,D01,'11     1DH: 03H,F8H,11H  |  K5 : IG5,/N8,K6    88H: 78H,20H,8AH
WST: BTN,LLL,        32H: 01H,B8H,00H  |  K6 : SZL,K5 ,D01   8AH: 15H,88H,F8H
```

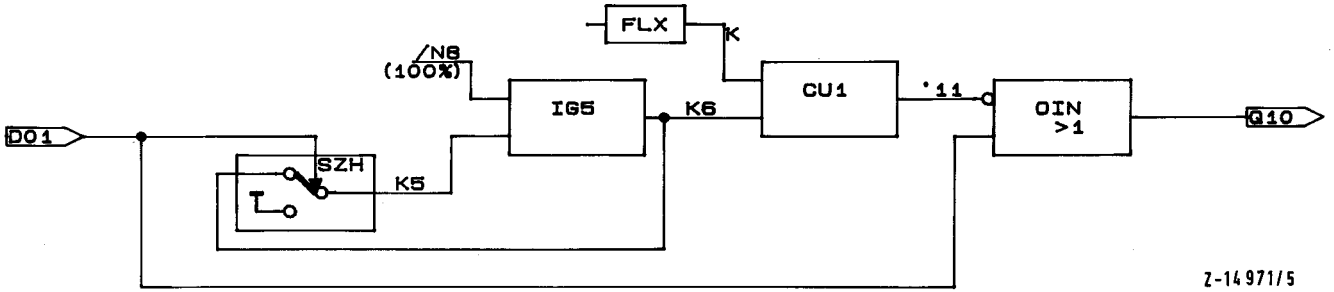
Program lines: 6 difference(s)

CONTROL CODES

```
    878FH : EF
```

Control codes: 1 difference(s)

Example 13.4




```
'11: CU1,K   ,K5      11H: 87H,7CH,88H  |  K  : FLX,#+005.0   7CH: A5H,20H,83H
Q10: OIN,'11,D01      1DH: 09H,11H,F8H  |  K5 : IG5,/N8,K6    88H: 78H,20H,8AH
WST: BTN,LLL,         32H: 01H,B8H,00H  |  K6 : SZH,K5 ,D01   8AH: 16H,88H,F8H
```

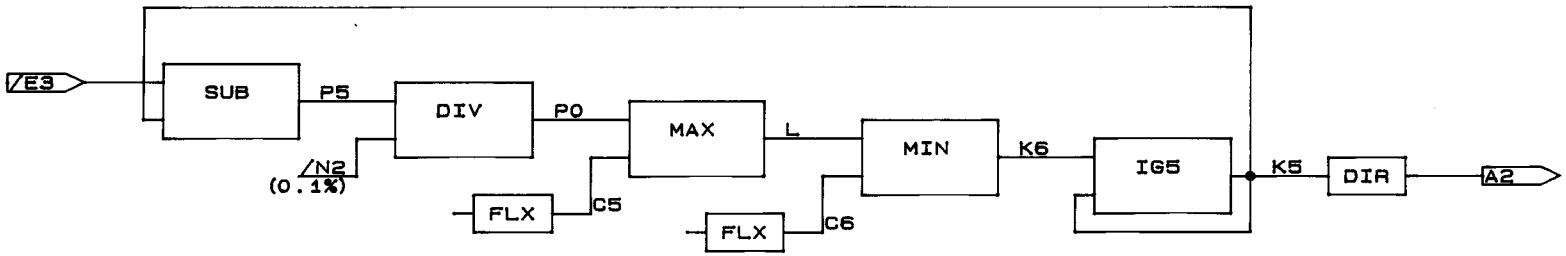
Program lines: 6 difference(s)

CONTROL CODES

```
    878FH : EF
```

Control codes: 1 difference(s)

Example 13.5



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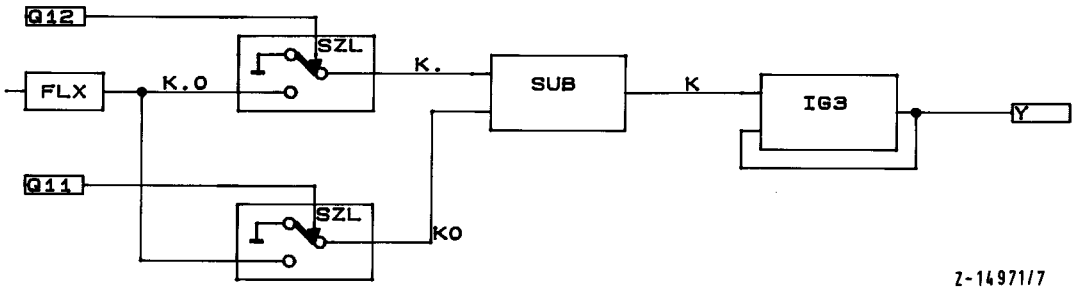
```
A2 : DIR,K5 ,        41H: 3DH,88H,00H  |  K6 : MIN,L  ,C6     8AH: 47H,92H,54H
C5 : FLX,#-020.0     52H: A5H,80H,0CH  |  L  : MAX,P0 ,C5     92H: 46H,9EH,52H
C6 : FLX,#+010.0     54H: A5H,40H,86H  |  P0 : DIV,P5 ,/N2    9EH: 4BH,A8H,26H
K5 : IG5,K6 ,K5      88H: 78H,8AH,88H  |  P5 : SUB,/E3,K5    A8H: 49H,3FH,88H
```

Program lines: 8 difference(s)

CONTROL CODES

Control codes: 0 difference(s)

Example 13.6



= Transition to the standard configuration

```
K   : SUB,K. ,K0     7CH: 49H,7DH,7EH  |  K.0: FLX,#+016.7   7FH: A5H,70H,8AH
K.  : SZL,K.0,Q12    7DH: 15H,7FH,1FH  |  Y  : IG3,K  ,Y     F0H: 76H,7CH,F0H
K0  : SZL,K.0,Q11    7EH: 15H,7FH,1EH  |
```

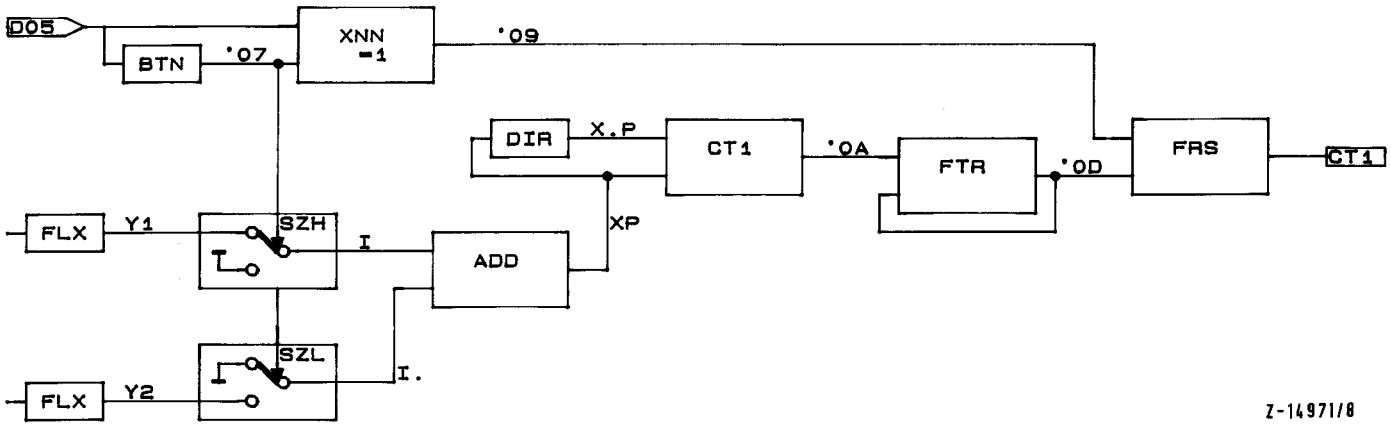
Program lines: 5 difference(s)

CONTROL CODES

```
    878FH : 7F
```

Control codes: 1 difference(s)

Example 13.7




```
'07: BTN,D05,       07H: 01H,FCH,00H  |  I. : SZL,Y2 ,'07    79H: 15H,F6H,07H
'09: XNN,D05,'07    09H: 0BH,FCH,07H  |  XP : ADD,I  ,I.     ECH: 48H,78H,79H
'0A: CT1,X.P,XP     0AH: 91H,EDH,ECH  |  X.P: DIR,XP ,       EDH: 3DH,ECH,00H
'0D: FTR,'0A,'0D    0DH: 0EH,0AH,0DH  |  Y1 : FLX,#+0100    F4H: A5H,43H,86H
CT1: FRS,'09,'0D    3FH: 0DH,09H,0DH  |  Y2 : FLX,#+0050    F6H: A5H,23H,83H
I  : SZH,Y1 ,'07    78H: 16H,F4H,07H  |  YR : DIR,/R3,      FCH: 3DH,1CH,00H
```

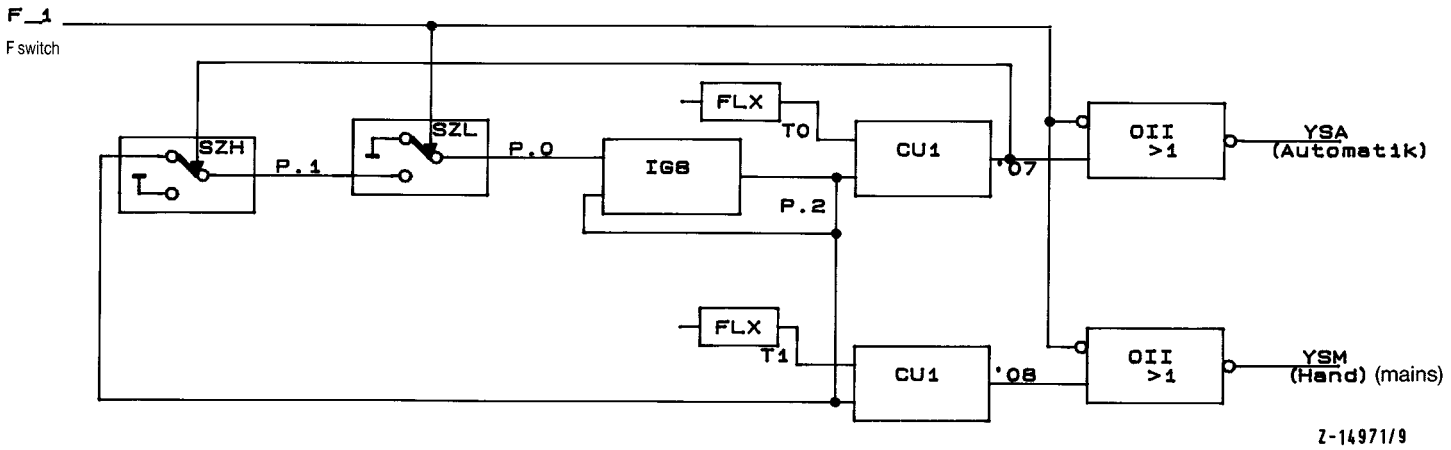
Program lines: 12 difference(s)

CONTROL CODES

```
879EH : A3
```

Control codes: 1 difference(s)

Example 13.8




```
'07: CU1,T0 ,P.2    07H: 87H,B8H,A3H  |  P.1: SZH,P.2,'07   A1H: 16H,A3H,07H
'08: CU1,T1 ,P.2    08H: 87H,BAH,A3H  |  P.2: IG8,/N6,P.0    A3H: 7BH,22H,9FH
YSM: OII,F_1,'08    33H: 0AH,69H,08H  |  T0 : FLX,#+000.4    B8H: A5H,40H,80H
YSA: OII,F_1,'07    34H: 0AH,69H,07H  |  T1 : FLX,#+000.2    BAH: A5H,20H,80H
P.0: SZL,P.1,F_1    9FH: 15H,A1H,69H  |
```

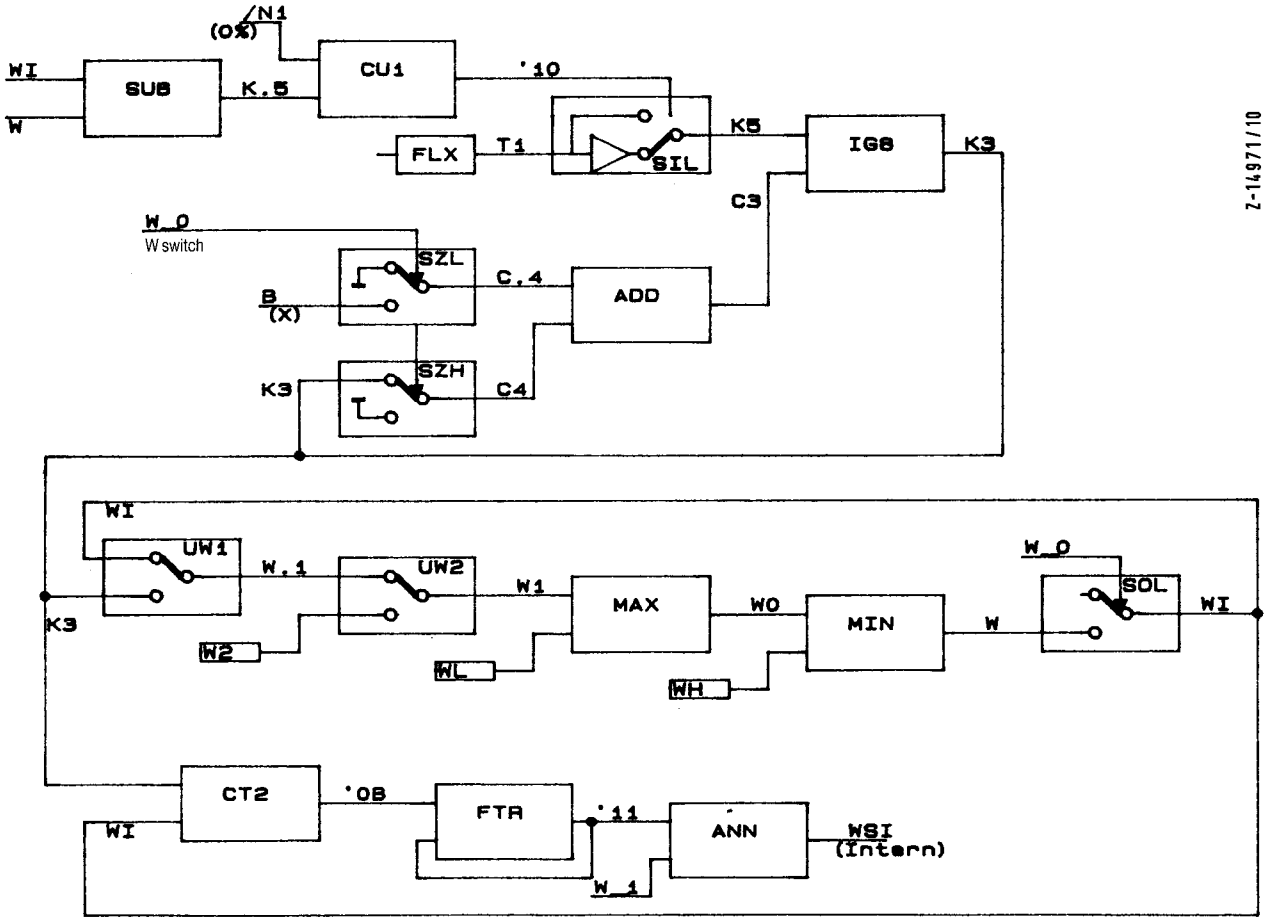
Program lines: 9 difference(s)

CONTROL CODES

```
    8751H : 8F
    877AH : 03
    8797H : FA
```

Control codes: 3 difference(s)

Example 13.9



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```
'0B: CT2,K3 ,WI     0BH: 92H,84H,DEH
'10: CU1,/N1,K.5    10H: 87H,27H,89H
'11: FTR,'0B,'11    11H: 0EH,0BH,11H
WSI: ANN,W_1,'11    35H: 03H,71H,11H
C3 : ADD,C4 ,C.4    4EH: 48H,50H,51H
C4 : SZH,K3 ,W_0    50H: 16H,84H,70H
C.4: SZL,B  ,W_0    51H: 15H,44H,70H

K3 : IG8,K5 ,C3     84H: 7BH,88H,4EH
K5 : SIL,T1 ,'10    88H: 14H,BAH,10H
K.5: SUB,WI ,W      89H: 49H,DEH,D2H
T1 : FLX,#+100.0    BAH: A5H,80H,BEH
W1 : UW2,W.1,W2     D6H: 31H,D7H,D8H
W.1: UW1,WI ,K3     D7H: 30H,DEH,84H
WI : SOL,W  ,W_0    DEH: 11H,D2H,70H
```

Program lines: 14 difference(s)

CONTROL CODES

```
    8746H : FD   |  879BH : 8F
    8759H : EE
    8769H : DE
    877BH : 07
    8797H : FB
```

Control codes: 6 difference(s)

Example 13.10

14 Appendix

14.1 contains the conversion tables form percent values to decimal representation in hexadecimal form and vice versa.

If another decimal point position should appear in the display or if the final figure in the hexadecimal representation is not equal to zero, observe Section 5.2.1.

The tables **14.2** show the conversion from decimal values to hex values, as required in the linearization functions.

Normally these tables are not needed since entry and reading via the monitor MX 0013 is carried out decimally.

14.3 contains a summary of the calculation modules (commands) described in detail in Section 7, together with a short explanation note.

14.4 Here the variables in Protronic P are listed as analog or binary variables.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.0	8000	8010	8020	8030	8040	8050	8060	8070	8080	8090
1.0	80A0	80B0	80C0	80D0	80E0	80F0	8100	8110	8120	8130
2.0	8140	8150	8160	8170	8180	8190	81A0	81B0	81C0	81D0
3.0	81E0	81F0	8200	8210	8220	8230	8240	8250	8260	8270
4.0	8280	8290	82A0	82B0	82C0	82D0	82E0	82F0	8300	8310
5.0	8320	8330	8340	8350	8360	8370	8380	8390	83A0	83B0
6.0	83C0	83D0	83E0	83F0	8400	8410	8420	8430	8440	8450
7.0	8460	8470	8480	8490	84A0	84B0	84C0	84D0	84E0	84F0
8.0	8500	8510	8520	8530	8540	8550	8560	8570	8580	8590
9.0	85A0	85B0	85C0	85D0	85E0	85F0	8600	8610	8620	8630
10.0	8640	8650	8660	8670	8680	8690	86A0	86B0	86C0	86D0
11.0	86E0	86F0	8700	8710	8720	8730	8740	8750	8760	8770
12.0	8780	8790	87A0	87B0	87C0	87D0	87E0	87F0	8800	8810
13.0	8820	8830	8840	8850	8860	8870	8880	8890	88A0	88B0
14.0	88C0	88D0	88E0	88F0	8900	8910	8920	8930	8940	8950
15.0	8960	8970	8980	8990	89A0	89B0	89C0	89D0	89E0	89F0
16.0	8A00	8A10	8A20	8A30	8A40	8A50	8A60	8A70	8A80	8A90
17.0	8AA0	8AB0	8AC0	8AD0	8AE0	8AF0	8B00	8B10	8B20	8B30
18.0	8B40	8B50	8B60	8B70	8B80	8B90	8BA0	8BB0	8BC0	8BD0
19.0	8BE0	8BF0	8C00	8C10	8C20	8C30	8C40	8C50	8C60	8C70
20.0	8C80	8C90	8CA0	8CB0	8CC0	8CD0	8CE0	8CF0	8D00	8D10
21.0	8D20	8D30	8D40	8D50	8D60	8D70	8D80	8D90	8DA0	8DB0
22.0	8DC0	8DD0	8DE0	8DF0	8E00	8E10	8E20	8E30	8E40	8E50
23.0	8E60	8E70	8E80	8E90	8EA0	8EB0	8EC0	8ED0	8EE0	8EF0
24.0	8F00	8F10	8F20	8F30	8F40	8F50	8F60	8F70	8F80	8F90
25.0	8FA0	8FB0	8FC0	8FD0	8FE0	8FF0	9000	9010	9020	9030
26.0	9040	9050	9060	9070	9080	9090	90A0	90B0	90C0	90D0
27.0	90E0	90F0	9100	9110	9120	9130	9140	9150	9160	9170
28.0	9180	9190	91A0	91B0	91C0	91D0	91E0	91F0	9200	9210
29.0	9220	9230	9240	9250	9260	9270	9280	9290	92A0	92B0
30.0	92C0	92D0	92E0	92F0	9300	9310	9320	9330	9340	9350
31.0	9360	9370	9380	9390	93A0	93B0	93C0	93D0	93E0	93F0
32.0	9400	9410	9420	9430	9440	9450	9460	9470	9480	9490
33.0	94A0	94B0	94C0	94D0	94E0	94F0	9500	9510	9520	9530
34.0	9540	9550	9560	9570	9580	9590	95A0	95B0	95C0	95D0
35.0	95E0	95F0	9600	9610	9620	9630	9640	9650	9660	9670
36.0	9680	9690	96A0	96B0	96C0	96D0	96E0	96F0	9700	9710
37.0	9720	9730	9740	9750	9760	9770	9780	9790	97A0	97B0
38.0	97C0	97D0	97E0	97F0	9800	9810	9820	9830	9840	9850
39.0	9860	9870	9880	9890	98A0	98B0	98C0	98D0	98E0	98F0
40.0	9900	9910	9920	9930	9940	9950	9960	9970	9980	9990
41.0	99A0	99B0	99C0	99D0	99E0	99F0	9A00	9A10	9A20	9A30
42.0	9A40	9A50	9A60	9A70	9A80	9A90	9AA0	9AB0	9AC0	9AD0
43.0	9AE0	9AF0	9B00	9B10	9B20	9B30	9B40	9B50	9B60	9B70
44.0	9B80	9B90	9BA0	9BB0	9BC0	9BD0	9BE0	9BF0	9C00	9C10
45.0	9C20	9C30	9C40	9C50	9C60	9C70	9C80	9C90	9CA0	9CB0
46.0	9CC0	9CD0	9CE0	9CF0	9D00	9D10	9D20	9D30	9D40	9D50
47.0	9D60	9D70	9D80	9D90	9DA0	9DB0	9DC0	9DD0	9DE0	9DF0
48.0	9E00	9E10	9E20	9E30	9E40	9E50	9E60	9E70	9E80	9E90
49.0	9EA0	9EB0	9EC0	9ED0	9EE0	9EF0	9F00	9F10	9F20	9F30
50.0	9F40	9F50	9F60	9F70	9F80	9F90	9FA0	9FB0	9FC0	9FD0

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50.0	9F40	9F50	9F60	9F70	9F80	9F90	9FA0	9FB0	9FC0	9FD0
51.0	9FE0	9FF0	A000	A010	A020	A030	A040	A050	A060	A070
52.0	A080	A090	A0A0	A0B0	A0C0	A0D0	A0E0	A0F0	A100	A110
53.0	A120	A130	A140	A150	A160	A170	A180	A190	A1A0	A1B0
54.0	A1C0	A1D0	A1E0	A1F0	A200	A210	A220	A230	A240	A250
55.0	A260	A270	A280	A290	A2A0	A2B0	A2C0	A2D0	A2E0	A2F0
56.0	A300	A310	A320	A330	A340	A350	A360	A370	A380	A390
57.0	A3A0	A3B0	A3C0	A3D0	A3E0	A3F0	A400	A410	A420	A430
58.0	A440	A450	A460	A470	A480	A490	A4A0	A4B0	A4C0	A4D0
59.0	A4E0	A4F0	A500	A510	A520	A530	A540	A550	A560	A570
60.0	A580	A590	A5A0	A5B0	A5C0	A5D0	A5E0	A5F0	A600	A610
61.0	A620	A630	A640	A650	A660	A670	A680	A690	A6A0	A6B0
62.0	A6C0	A6D0	A6E0	A6F0	A700	A710	A720	A730	A740	A750
63.0	A760	A770	A780	A790	A7A0	A7B0	A7C0	A7D0	A7E0	A7F0
64.0	A800	A810	A820	A830	A840	A850	A860	A870	A880	A890
65.0	A8A0	A8B0	A8C0	A8D0	A8E0	A8F0	A900	A910	A920	A930
66.0	A940	A950	A960	A970	A980	A990	A9A0	A9B0	A9C0	A9D0
67.0	A9E0	A9F0	AA00	AA10	AA20	AA30	AA40	AA50	AA60	AA70
68.0	AA80	AA90	AAA0	AAB0	AAC0	AAD0	AAE0	AAF0	AB00	AB10
69.0	AB20	AB30	AB40	AB50	AB60	AB70	AB80	AB90	ABA0	ABB0
70.0	ABC0	ABD0	ABE0	ABF0	AC00	AC10	AC20	AC30	AC40	AC50
71.0	AC60	AC70	AC80	AC90	ACA0	ACB0	ACC0	ACD0	ACE0	ACF0
72.0	AD00	AD10	AD20	AD30	AD40	AD50	AD60	AD70	AD80	AD90
73.0	ADA0	ADB0	ADC0	ADD0	ADE0	ADF0	AE00	AE10	AE20	AE30
74.0	AE40	AE50	AE60	AE70	AE80	AE90	AEA0	AEB0	AEC0	AED0
75.0	AEE0	AEF0	AF00	AF10	AF20	AF30	AF40	AF50	AF60	AF70
76.0	AF80	AF90	AFA0	AFB0	AFC0	AFD0	AFE0	AFF0	B000	B010
77.0	B020	B030	B040	B050	B060	B070	B080	B090	B0A0	B0B0
78.0	B0C0	B0D0	B0E0	B0F0	B100	B110	B120	B130	B140	B150
79.0	B160	B170	B180	B190	B1A0	B1B0	B1C0	B1D0	B1E0	B1F0
80.0	B200	B210	B220	B230	B240	B250	B260	B270	B280	B290
81.0	B2A0	B2B0	B2C0	B2D0	B2E0	B2F0	B300	B310	B320	B330
82.0	B340	B350	B360	B370	B380	B390	B3A0	B3B0	B3C0	B3D0
83.0	B3E0	B3F0	B400	B410	B420	B430	B440	B450	B460	B470
84.0	B480	B490	B4A0	B4B0	B4C0	B4D0	B4E0	B4F0	B500	B510
85.0	B520	B530	B540	B550	B560	B570	B580	B590	B5A0	B5B0
86.0	B5C0	B5D0	B5E0	B5F0	B600	B610	B620	B630	B640	B650
87.0	B660	B670	B680	B690	B6A0	B6B0	B6C0	B6D0	B6E0	B6F0
88.0	B700	B710	B720	B730	B740	B750	B760	B770	B780	B790
89.0	B7A0	B7B0	B7C0	B7D0	B7E0	B7F0	B800	B810	B820	B830
90.0	B840	B850	B860	B870	B880	B890	B8A0	B8B0	B8C0	B8D0
91.0	B8E0	B8F0	B900	B910	B920	B930	B940	B950	B960	B970
92.0	B980	B990	B9A0	B9B0	B9C0	B9D0	B9E0	B9F0	BA00	BA10
93.0	BA20	BA30	BA40	BA50	BA60	BA70	BA80	BA90	BAA0	BAB0
94.0	BAC0	BAD0	BAE0	BAF0	BB00	BB10	BB20	BB30	BB40	BB50
95.0	BB60	BB70	BB80	BB90	BBA0	BBB0	BBC0	BBD0	BBE0	BBF0
96.0	BC00	BC10	BC20	BC30	BC40	BC50	BC60	BC70	BC80	BC90
97.0	BCA0	BCB0	BCC0	BCD0	BCE0	BCF0	BD00	BD10	BD20	BD30
98.0	BD40	BD50	BD60	BD70	BD80	BD90	BDA0	BDB0	BDC0	BDD0
99.0	BDE0	BDF0	BE00	BE10	BE20	BE30	BE40	BE50	BE60	BE70
100.0	BE80	BE90	BEA0	BEB0	BEC0	BED0	BEE0	BEF0	BF00	BF10

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
100.0	BE80	BE90	BEA0	BEB0	BEC0	BED0	BEE0	BEF0	BF00	BF10
101.0	BF20	BF30	BF40	BF50	BF60	BF70	BF80	BF90	BFA0	BFB0
102.0	BFC0	BFD0	BFE0	BFF0	C000	C010	C020	C030	C040	C050
103.0	C060	C070	C080	C090	C0A0	C0B0	C0C0	C0D0	C0E0	C0F0
104.0	C100	C110	C120	C130	C140	C150	C160	C170	C180	C190
105.0	C1A0	C1B0	C1C0	C1D0	C1E0	C1F0	C200	C210	C220	C230
106.0	C240	C250	C260	C270	C280	C290	C2A0	C2B0	C2C0	C2D0
107.0	C2E0	C2F0	C300	C310	C320	C330	C340	C350	C360	C370
108.0	C380	C390	C3A0	C3B0	C3C0	C3D0	C3E0	C3F0	C400	C410
109.0	C420	C430	C440	C450	C460	C470	C480	C490	C4A0	C4B0
110.0	C4C0	C4D0	C4E0	C4F0	C500	C510	C520	C530	C540	C550
111.0	C560	C570	C580	C590	C5A0	C5B0	C5C0	C5D0	C5E0	C5F0
112.0	C600	C610	C620	C630	C640	C650	C660	C670	C680	C690
113.0	C6A0	C6B0	C6C0	C6D0	C6E0	C6F0	C700	C710	C720	C730
114.0	C740	C750	C760	C770	C780	C790	C7A0	C7B0	C7C0	C7D0
115.0	C7E0	C7F0	C800	C810	C820	C830	C840	C850	C860	C870
116.0	C880	C890	C8A0	C8B0	C8C0	C8D0	C8E0	C8F0	C900	C910
117.0	C920	C930	C940	C950	C960	C970	C980	C990	C9A0	C9B0
118.0	C9C0	C9D0	C9E0	C9F0	CA00	CA10	CA20	CA30	CA40	CA50
119.0	CA60	CA70	CA80	CA90	CAA0	CAB0	CAC0	CAD0	CAE0	CAF0
120.0	CB00	CB10	CB20	CB30	CB40	CB50	CB60	CB70	CB80	CB90
121.0	CBA0	CBB0	CBC0	CBD0	CBE0	CBF0	CC00	CC10	CC20	CC30
122.0	CC40	CC50	CC60	CC70	CC80	CC90	CCA0	CCB0	CCC0	CCD0
123.0	CCE0	CCF0	CD00	CD10	CD20	CD30	CD40	CD50	CD60	CD70
124.0	CD80	CD90	CDA0	CDB0	CDC0	CDD0	CDE0	CDF0	CE00	CE10
125.0	CE20	CE30	CE40	CE50	CE60	CE70	CE80	CE90	CEA0	CEB0
126.0	CEC0	CED0	CEE0	CEF0	CF00	CF10	CF20	CF30	CF40	CF50
127.0	CF60	CF70	CF80	CF90	CFA0	CFB0	CFC0	CFD0	CFE0	CFF0
128.0	D000	D010	D020	D030	D040	D050	D060	D070	D080	D090
129.0	D0A0	D0B0	D0C0	D0D0	D0E0	D0F0	D100	D110	D120	D130
130.0	D140	D150	D160	D170	D180	D190	D1A0	D1B0	D1C0	D1D0
131.0	D1E0	D1F0	D200	D210	D220	D230	D240	D250	D260	D270
132.0	D280	D290	D2A0	D2B0	D2C0	D2D0	D2E0	D2F0	D300	D310
133.0	D320	D330	D340	D350	D360	D370	D380	D390	D3A0	D3B0
134.0	D3C0	D3D0	D3E0	D3F0	D400	D410	D420	D430	D440	D450
135.0	D460	D470	D480	D490	D4A0	D4B0	D4C0	D4D0	D4E0	D4F0
136.0	D500	D510	D520	D530	D540	D550	D560	D570	D580	D590
137.0	D5A0	D5B0	D5C0	D5D0	D5E0	D5F0	D600	D610	D620	D630
138.0	D640	D650	D660	D670	D680	D690	D6A0	D6B0	D6C0	D6D0
139.0	D6E0	D6F0	D700	D710	D720	D730	D740	D750	D760	D770
140.0	D780	D790	D7A0	D7B0	D7C0	D7D0	D7E0	D7F0	D800	D810
141.0	D820	D830	D840	D850	D860	D870	D880	D890	D8A0	D8B0
142.0	D8C0	D8D0	D8E0	D8F0	D900	D910	D920	D930	D940	D950
143.0	D960	D970	D980	D990	D9A0	D9B0	D9C0	D9D0	D9E0	D9F0
144.0	DA00	DA10	DA20	DA30	DA40	DA50	DA60	DA70	DA80	DA90
145.0	DAA0	DAB0	DAC0	DAD0	DAE0	DAF0	DB00	DB10	DB20	DB30
146.0	DB40	DB50	DB60	DB70	DB80	DB90	DBA0	DBB0	DBC0	DBD0
147.0	DBE0	DBF0	DC00	DC10	DC20	DC30	DC40	DC50	DC60	DC70
148.0	DC80	DC90	DCA0	DCB0	DCC0	DCD0	DCE0	DCF0	DD00	DD10
149.0	DD20	DD30	DD40	DD50	DD60	DD70	DD80	DD90	DDA0	DDB0
150.0	DDC0	DDD0	DDE0	DDF0	DE00	DE10	DE20	DE30	DE40	DE50

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
150.0	DDC0	DDD0	DDE0	DDF0	DE00	DE10	DE20	DE30	DE40	DE50
151.0	DE60	DE70	DE80	DE90	DEA0	DEB0	DEC0	DED0	DEE0	DEF0
152.0	DF00	DF10	DF20	DF30	DF40	DF50	DF60	DF70	DF80	DF90
153.0	DFA0	DFB0	DFC0	DFD0	DFE0	DFF0	E000	E010	E020	E030
154.0	E040	E050	E060	E070	E080	E090	E0A0	E0B0	E0C0	E0D0
155.0	E0E0	E0F0	E100	E110	E120	E130	E140	E150	E160	E170
156.0	E180	E190	E1A0	E1B0	E1C0	E1D0	E1E0	E1F0	E200	E210
157.0	E220	E230	E240	E250	E260	E270	E280	E290	E2A0	E2B0
158.0	E2C0	E2D0	E2E0	E2F0	E300	E310	E320	E330	E340	E350
159.0	E360	E370	E380	E390	E3A0	E3B0	E3C0	E3D0	E3E0	E3F0
160.0	E400	E410	E420	E430	E440	E450	E460	E470	E480	E490
161.0	E4A0	E4B0	E4C0	E4D0	E4E0	E4F0	E500	E510	E520	E530
162.0	E540	E550	E560	E570	E580	E590	E5A0	E5B0	E5C0	E5D0
163.0	E5E0	E5F0	E600	E610	E620	E630	E640	E650	E660	E670
164.0	E680	E690	E6A0	E6B0	E6C0	E6D0	E6E0	E6F0	E700	E710
165.0	E720	E730	E740	E750	E760	E770	E780	E790	E7A0	E7B0
166.0	E7C0	E7D0	E7E0	E7F0	E800	E810	E820	E830	E840	E850
167.0	E860	E870	E880	E890	E8A0	E8B0	E8C0	E8D0	E8E0	E8F0
168.0	E900	E910	E920	E930	E940	E950	E960	E970	E980	E990
169.0	E9A0	E9B0	E9C0	E9D0	E9E0	E9F0	EA00	EA10	EA20	EA30
170.0	EA40	EA50	EA60	EA70	EA80	EA90	EAA0	EAB0	EAC0	EAD0
171.0	EAE0	EAF0	EB00	EB10	EB20	EB30	EB40	EB50	EB60	EB70
172.0	EB80	EB90	EBA0	EBB0	EBC0	EBD0	EBE0	EBF0	EC00	EC10
173.0	EC20	EC30	EC40	EC50	EC60	EC70	EC80	EC90	ECA0	ECB0
174.0	ECC0	ECD0	ECE0	ECF0	ED00	ED10	ED20	ED30	ED40	ED50
175.0	ED60	ED70	ED80	ED90	EDA0	EDB0	EDC0	EDD0	EDE0	EDF0
176.0	EE00	EE10	EE20	EE30	EE40	EE50	EE60	EE70	EE80	EE90
177.0	EEA0	EEB0	EEC0	EED0	EEE0	EEF0	EF00	EF10	EF20	EF30
178.0	EF40	EF50	EF60	EF70	EF80	EF90	EFA0	EFB0	EFC0	EFD0
179.0	EFE0	EFF0	F000	F010	F020	F030	F040	F050	F060	F070
180.0	F080	F090	F0A0	F0B0	F0C0	F0D0	F0E0	F0F0	F100	F110
181.0	F120	F130	F140	F150	F160	F170	F180	F190	F1A0	F1B0
182.0	F1C0	F1D0	F1E0	F1F0	F200	F210	F220	F230	F240	F250
183.0	F260	F270	F280	F290	F2A0	F2B0	F2C0	F2D0	F2E0	F2F0
184.0	F300	F310	F320	F330	F340	F350	F360	F370	F380	F390
185.0	F3A0	F3B0	F3C0	F3D0	F3E0	F3F0	F400	F410	F420	F430
186.0	F440	F450	F460	F470	F480	F490	F4A0	F4B0	F4C0	F4D0
187.0	F4E0	F4F0	F500	F510	F520	F530	F540	F550	F560	F570
188.0	F580	F590	F5A0	F5B0	F5C0	F5D0	F5E0	F5F0	F600	F610
189.0	F620	F630	F640	F650	F660	F670	F680	F690	F6A0	F6B0
190.0	F6C0	F6D0	F6E0	F6F0	F700	F710	F720	F730	F740	F750
191.0	F760	F770	F780	F790	F7A0	F7B0	F7C0	F7D0	F7E0	F7F0
192.0	F800	F810	F820	F830	F840	F850	F860	F870	F880	F890
193.0	F8A0	F8B0	F8C0	F8D0	F8E0	F8F0	F900	F910	F920	F930
194.0	F940	F950	F960	F970	F980	F990	F9A0	F9B0	F9C0	F9D0
195.0	F9E0	F9F0	FA00	FA10	FA20	FA30	FA40	FA50	FA60	FA70
196.0	FA80	FA90	FAA0	FAB0	FAC0	FAD0	FAE0	FAF0	FB00	FB10
197.0	FB20	FB30	FB40	FB50	FB60	FB70	FB80	FB90	FBA0	FBB0
198.0	FBC0	FBD0	FBE0	FBF0	FC00	FC10	FC20	FC30	FC40	FC50
199.0	FC60	FC70	FC80	FC90	FCA0	FCB0	FCC0	FCD0	FCE0	FCF0
200.0	FD00	FD10	FD20	FD30	FD40	FD50	FD60	FD70	FD80	FD90

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.0	0000	0010	0020	0030	0040	0050	0060	0070	0080	0090
-1.0	00A0	00B0	00C0	00D0	00E0	00F0	0100	0110	0120	0130
-2.0	0140	0150	0160	0170	0180	0190	01A0	01B0	01C0	01D0
-3.0	01E0	01F0	0200	0210	0220	0230	0240	0250	0260	0270
-4.0	0280	0290	02A0	02B0	02C0	02D0	02E0	02F0	0300	0310
-5.0	0320	0330	0340	0350	0360	0370	0380	0390	03A0	03B0
-6.0	03C0	03D0	03E0	03F0	0400	0410	0420	0430	0440	0450
-7.0	0460	0470	0480	0490	04A0	04B0	04C0	04D0	04E0	04F0
-8.0	0500	0510	0520	0530	0540	0550	0560	0570	0580	0590
-9.0	05A0	05B0	05C0	05D0	05E0	05F0	0600	0610	0620	0630
-10.0	0640	0650	0660	0670	0680	0690	06A0	06B0	06C0	06D0
-11.0	06E0	06F0	0700	0710	0720	0730	0740	0750	0760	0770
-12.0	0780	0790	07A0	07B0	07C0	07D0	07E0	07F0	0800	0810
-13.0	0820	0830	0840	0850	0860	0870	0880	0890	08A0	08B0
-14.0	08C0	08D0	08E0	08F0	0900	0910	0920	0930	0940	0950
-15.0	0960	0970	0980	0990	09A0	09B0	09C0	09D0	09E0	09F0
-16.0	0A00	0A10	0A20	0A30	0A40	0A50	0A60	0A70	0A80	0A90
-17.0	0AA0	0AB0	0AC0	0AD0	0AE0	0AF0	0B00	0B10	0B20	0B30
-18.0	0B40	0B50	0B60	0B70	0B80	0B90	0BA0	0BB0	0BC0	0BD0
-19.0	0BE0	0BF0	0C00	0C10	0C20	0C30	0C40	0C50	0C60	0C70
-20.0	0C80	0C90	0CA0	0CB0	0CC0	0CD0	0CE0	0CF0	0D00	0D10
-21.0	0D20	0D30	0D40	0D50	0D60	0D70	0D80	0D90	0DA0	0DB0
-22.0	0DC0	0DD0	0DE0	0DF0	0E00	0E10	0E20	0E30	0E40	0E50
-23.0	0E60	0E70	0E80	0E90	0EA0	0EB0	0EC0	0ED0	0EE0	0EF0
-24.0	0F00	0F10	0F20	0F30	0F40	0F50	0F60	0F70	0F80	0F90
-25.0	0FA0	0FB0	0FC0	0FD0	0FE0	0FF0	1000	1010	1020	1030
-26.0	1040	1050	1060	1070	1080	1090	10A0	10B0	10C0	10D0
-27.0	10E0	10F0	1100	1110	1120	1130	1140	1150	1160	1170
-28.0	1180	1190	11A0	11B0	11C0	11D0	11E0	11F0	1200	1210
-29.0	1220	1230	1240	1250	1260	1270	1280	1290	12A0	12B0
-30.0	12C0	12D0	12E0	12F0	1300	1310	1320	1330	1340	1350
-31.0	1360	1370	1380	1390	13A0	13B0	13C0	13D0	13E0	13F0
-32.0	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490
-33.0	14A0	14B0	14C0	14D0	14E0	14F0	1500	1510	1520	1530
-34.0	1540	1550	1560	1570	1580	1590	15A0	15B0	15C0	15D0
-35.0	15E0	15F0	1600	1610	1620	1630	1640	1650	1660	1670
-36.0	1680	1690	16A0	16B0	16C0	16D0	16E0	16F0	1700	1710
-37.0	1720	1730	1740	1750	1760	1770	1780	1790	17A0	17B0
-38.0	17C0	17D0	17E0	17F0	1800	1810	1820	1830	1840	1850
-39.0	1860	1870	1880	1890	18A0	18B0	18C0	18D0	18E0	18F0
-40.0	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
-41.0	19A0	19B0	19C0	19D0	19E0	19F0	1A00	1A10	1A20	1A30
-42.0	1A40	1A50	1A60	1A70	1A80	1A90	1AA0	1AB0	1AC0	1AD0
-43.0	1AE0	1AF0	1B00	1B10	1B20	1B30	1B40	1B50	1B60	1B70
-44.0	1B80	1B90	1BA0	1BB0	1BC0	1BD0	1BE0	1BF0	1C00	1C10
-45.0	1C20	1C30	1C40	1C50	1C60	1C70	1C80	1C90	1CA0	1CB0
-46.0	1CC0	1CD0	1CE0	1CF0	1D00	1D10	1D20	1D30	1D40	1D50
-47.0	1D60	1D70	1D80	1D90	1DA0	1DB0	1DC0	1DD0	1DE0	1DF0
-48.0	1E00	1E10	1E20	1E30	1E40	1E50	1E60	1E70	1E80	1E90
-49.0	1EA0	1EB0	1EC0	1ED0	1EE0	1EF0	1F00	1F10	1F20	1F30
-50.0	1F40	1F50	1F60	1F70	1F80	1F90	1FA0	1FB0	1FC0	1FD0

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-50.0	1F40	1F50	1F60	1F70	1F80	1F90	1FA0	1FB0	1FC0	1FD0
-51.0	1FE0	1FF0	2000	2010	2020	2030	2040	2050	2060	2070
-52.0	2080	2090	20A0	20B0	20C0	20D0	20E0	20F0	2100	2110
-53.0	2120	2130	2140	2150	2160	2170	2180	2190	21A0	21B0
-54.0	21C0	21D0	21E0	21F0	2200	2210	2220	2230	2240	2250
-55.0	2260	2270	2280	2290	22A0	22B0	22C0	22D0	22E0	22F0
-56.0	2300	2310	2320	2330	2340	2350	2360	2370	2380	2390
-57.0	23A0	23B0	23C0	23D0	23E0	23F0	2400	2410	2420	2430
-58.0	2440	2450	2460	2470	2480	2490	24A0	24B0	24C0	24D0
-59.0	24E0	24F0	2500	2510	2520	2530	2540	2550	2560	2570
-60.0	2580	2590	25A0	25B0	25C0	25D0	25E0	25F0	2600	2610
-61.0	2620	2630	2640	2650	2660	2670	2680	2690	26A0	26B0
-62.0	26C0	26D0	26E0	26F0	2700	2710	2720	2730	2740	2750
-63.0	2760	2770	2780	2790	27A0	27B0	27C0	27D0	27E0	27F0
-64.0	2800	2810	2820	2830	2840	2850	2860	2870	2880	2890
-65.0	28A0	28B0	28C0	28D0	28E0	28F0	2900	2910	2920	2930
-66.0	2940	2950	2960	2970	2980	2990	29A0	29B0	29C0	29D0
-67.0	29E0	29F0	2A00	2A10	2A20	2A30	2A40	2A50	2A60	2A70
-68.0	2A80	2A90	2AA0	2AB0	2AC0	2AD0	2AE0	2AF0	2B00	2B10
-69.0	2B20	2B30	2B40	2B50	2B60	2B70	2B80	2B90	2BA0	2BB0
-70.0	2BC0	2BD0	2BE0	2BF0	2C00	2C10	2C20	2C30	2C40	2C50
-71.0	2C60	2C70	2C80	2C90	2CA0	2CB0	2CC0	2CD0	2CE0	2CF0
-72.0	2D00	2D10	2D20	2D30	2D40	2D50	2D60	2D70	2D80	2D90
-73.0	2DA0	2DB0	2DC0	2DD0	2DE0	2DF0	2E00	2E10	2E20	2E30
-74.0	2E40	2E50	2E60	2E70	2E80	2E90	2EA0	2EB0	2EC0	2ED0
-75.0	2EE0	2EF0	2F00	2F10	2F20	2F30	2F40	2F50	2F60	2F70
-76.0	2F80	2F90	2FA0	2FB0	2FC0	2FD0	2FE0	2FF0	3000	3010
-77.0	3020	3030	3040	3050	3060	3070	3080	3090	30A0	30B0
-78.0	30C0	30D0	30E0	30F0	3100	3110	3120	3130	3140	3150
-79.0	3160	3170	3180	3190	31A0	31B0	31C0	31D0	31E0	31F0
-80.0	3200	3210	3220	3230	3240	3250	3260	3270	3280	3290
-81.0	32A0	32B0	32C0	32D0	32E0	32F0	3300	3310	3320	3330
-82.0	3340	3350	3360	3370	3380	3390	33A0	33B0	33C0	33D0
-83.0	33E0	33F0	3400	3410	3420	3430	3440	3450	3460	3470
-84.0	3480	3490	34A0	34B0	34C0	34D0	34E0	34F0	3500	3510
-85.0	3520	3530	3540	3550	3560	3570	3580	3590	35A0	35B0
-86.0	35C0	35D0	35E0	35F0	3600	3610	3620	3630	3640	3650
-87.0	3660	3670	3680	3690	36A0	36B0	36C0	36D0	36E0	36F0
-88.0	3700	3710	3720	3730	3740	3750	3760	3770	3780	3790
-89.0	37A0	37B0	37C0	37D0	37E0	37F0	3800	3810	3820	3830
-90.0	3840	3850	3860	3870	3880	3890	38A0	38B0	38C0	38D0
-91.0	38E0	38F0	3900	3910	3920	3930	3940	3950	3960	3970
-92.0	3980	3990	39A0	39B0	39C0	39D0	39E0	39F0	3A00	3A10
-93.0	3A20	3A30	3A40	3A50	3A60	3A70	3A80	3A90	3AA0	3AB0
-94.0	3AC0	3AD0	3AE0	3AF0	3B00	3B10	3B20	3B30	3B40	3B50
-95.0	3B60	3B70	3B80	3B90	3BA0	3BB0	3BC0	3BD0	3BE0	3BF0
-96.0	3C00	3C10	3C20	3C30	3C40	3C50	3C60	3C70	3C80	3C90
-97.0	3CA0	3CB0	3CC0	3CD0	3CE0	3CF0	3D00	3D10	3D20	3D30
-98.0	3D40	3D50	3D60	3D70	3D80	3D90	3DA0	3DB0	3DC0	3DD0
-99.0	3DE0	3DF0	3E00	3E10	3E20	3E30	3E40	3E50	3E60	3E70
100.0	3E80	3E90	3EA0	3EB0	3EC0	3ED0	3EE0	3EF0	3F00	3F10

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-100.0	3E80	3E90	3EA0	3EB0	3EC0	3ED0	3EE0	3EF0	3F00	3F10
-101.0	3F20	3F30	3F40	3F50	3F60	3F70	3F80	3F90	3FA0	3FB0
-102.0	3FC0	3FD0	3FE0	3FF0	4000	4010	4020	4030	4040	4050
-103.0	4060	4070	4080	4090	40A0	40B0	40C0	40D0	40E0	40F0
-104.0	4100	4110	4120	4130	4140	4150	4160	4170	4180	4190
-105.0	41A0	41B0	41C0	41D0	41E0	41F0	4200	4210	4220	4230
-106.0	4240	4250	4260	4270	4280	4290	42A0	42B0	42C0	42D0
-107.0	42E0	42F0	4300	4310	4320	4330	4340	4350	4360	4370
-108.0	4380	4390	43A0	43B0	43C0	43D0	43E0	43F0	4400	4410
-109.0	4420	4430	4440	4450	4460	4470	4480	4490	44A0	44B0
-110.0	44C0	44D0	44E0	44F0	4500	4510	4520	4530	4540	4550
-111.0	4560	4570	4580	4590	45A0	45B0	45C0	45D0	45E0	45F0
-112.0	4600	4610	4620	4630	4640	4650	4660	4670	4680	4690
-113.0	46A0	46B0	46C0	46D0	46E0	46F0	4700	4710	4720	4730
-114.0	4740	4750	4760	4770	4780	4790	47A0	47B0	47C0	47D0
-115.0	47E0	47F0	4800	4810	4820	4830	4840	4850	4860	4870
-116.0	4880	4890	48A0	48B0	48C0	48D0	48E0	48F0	4900	4910
-117.0	4920	4930	4940	4950	4960	4970	4980	4990	49A0	49B0
-118.0	49C0	49D0	49E0	49F0	4A00	4A10	4A20	4A30	4A40	4A50
-119.0	4A60	4A70	4A80	4A90	4AA0	4AB0	4AC0	4AD0	4AE0	4AF0
-120.0	4B00	4B10	4B20	4B30	4B40	4B50	4B60	4B70	4B80	4B90
-121.0	4BA0	4BB0	4BC0	4BD0	4BE0	4BF0	4C00	4C10	4C20	4C30
-122.0	4C40	4C50	4C60	4C70	4C80	4C90	4CA0	4CB0	4CC0	4CD0
-123.0	4CE0	4CF0	4D00	4D10	4D20	4D30	4D40	4D50	4D60	4D70
-124.0	4D80	4D90	4DA0	4DB0	4DC0	4DD0	4DE0	4DF0	4E00	4E10
-125.0	4E20	4E30	4E40	4E50	4E60	4E70	4E80	4E90	4EA0	4EB0
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-127.0	4F60	4F70	4F80	4F90	4FA0	4FB0	4FC0	4FD0	4FE0	4FF0
-128.0	5000	5010	5020	5030	5040	5050	5060	5070	5080	5090
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-130.0	5140	5150	5160	5170	5180	5190	51A0	51B0	51C0	51D0
-131.0	51E0	51F0	5200	5210	5220	5230	5240	5250	5260	5270
-132.0	5280	5290	52A0	52B0	52C0	52D0	52E0	52F0	5300	5310
-133.0	5320	5330	5340	5350	5360	5370	5380	5390	53A0	53B0
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-135.0	5460	5470	5480	5490	54A0	54B0	54C0	54D0	54E0	54F0
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-137.0	55A0	55B0	55C0	55D0	55E0	55F0	5600	5610	5620	5630
-138.0	5640	5650	5660	5670	5680	5690	56A0	56B0	56C0	56D0
-139.0	56E0	56F0	5700	5710	5720	5730	5740	5750	5760	5770
-140.0	5780	5790	57A0	57B0	57C0	57D0	57E0	57F0	5800	5810
-141.0	5820	5830	5840	5850	5860	5870	5880	5890	58A0	58B0
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-143.0	5960	5970	5980	5990	59A0	59B0	59C0	59D0	59E0	59F0
-144.0	5A00	5A10	5A20	5A30	5A40	5A50	5A60	5A70	5A80	5A90
-145.0	5AA0	5AB0	5AC0	5AD0	5AE0	5AF0	5B00	5B10	5B20	5B30
-146.0	5B40	5B50	5B60	5B70	5B80	5B90	5BA0	5BB0	5BC0	5BD0
-147.0	5BE0	5BF0	5C00	5C10	5C20	5C30	5C40	5C50	5C60	5C70
-148.0	5C80	5C90	5CA0	5CB0	5CC0	5CD0	5CE0	5CF0	5D00	5D10
-149.0	5D20	5D30	5D40	5D50	5D60	5D70	5D80	5D90	5DA0	5DB0
-150.0	5DC0	5DD0	5DE0	5DF0	5E00	5E10	5E20	5E30	5E40	5E50

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-150.0	5DC0	5DD0	5DE0	5DF0	5E00	5E10	5E20	5E30	5E40	5E50
-151.0	5E60	5E70	5E80	5E90	5EA0	5EB0	5EC0	5ED0	5EE0	5EF0
-152.0	5F00	5F10	5F20	5F30	5F40	5F50	5F60	5F70	5F80	5F90
-153.0	5FA0	5FB0	5FC0	5FD0	5FE0	5FF0	6000	6010	6020	6030
-154.0	6040	6050	6060	6070	6080	6090	60A0	60B0	60C0	60D0
-155.0	60E0	60F0	6100	6110	6120	6130	6140	6150	6160	6170
-156.0	6180	6190	61A0	61B0	61C0	61D0	61E0	61F0	6200	6210
-157.0	6220	6230	6240	6250	6260	6270	6280	6290	62A0	62B0
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-159.0	6360	6370	6380	6390	63A0	63B0	63C0	63D0	63E0	63F0
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-161.0	64A0	64B0	64C0	64D0	64E0	64F0	6500	6510	6520	6530
-162.0	6540	6550	6560	6570	6580	6590	65A0	65B0	65C0	65D0
-163.0	65E0	65F0	6600	6610	6620	6630	6640	6650	6660	6670
-164.0	6680	6690	66A0	66B0	66C0	66D0	66E0	66F0	6700	6710
-165.0	6720	6730	6740	6750	6760	6770	6780	6790	67A0	67B0
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-167.0	6860	6870	6880	6890	68A0	68B0	68C0	68D0	68E0	68F0
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-169.0	69A0	69B0	69C0	69D0	69E0	69F0	6A00	6A10	6A20	6A30
-170.0	6A40	6A50	6A60	6A70	6A80	6A90	6AA0	6AB0	6AC0	6AD0
-171.0	6AE0	6AF0	6B00	6B10	6B20	6B30	6B40	6B50	6B60	6B70
-172.0	6B80	6B90	6BA0	6BB0	6BC0	6BD0	6BE0	6BF0	6C00	6C10
-173.0	6C20	6C30	6C40	6C50	6C60	6C70	6C80	6C90	6CA0	6CB0
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-175.0	6D60	6D70	6D80	6D90	6DA0	6DB0	6DC0	6DD0	6DE0	6DF0
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-177.0	6EA0	6EB0	6EC0	6ED0	6EE0	6EF0	6F00	6F10	6F20	6F30
-178.0	6F40	6F50	6F60	6F70	6F80	6F90	6FA0	6FB0	6FC0	6FD0
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-180.0	7080	7090	70A0	70B0	70C0	70D0	70E0	70F0	7100	7110
-181.0	7120	7130	7140	7150	7160	7170	7180	7190	71A0	71B0
-182.0	71C0	71D0	71E0	71F0	7200	7210	7220	7230	7240	7250
-183.0	7260	7270	7280	7290	72A0	72B0	72C0	72D0	72E0	72F0
-184.0	7300	7310	7320	7330	7340	7350	7360	7370	7380	7390
-185.0	73A0	73B0	73C0	73D0	73E0	73F0	7400	7410	7420	7430
-186.0	7440	7450	7460	7470	7480	7490	74A0	74B0	74C0	74D0
-187.0	74E0	74F0	7500	7510	7520	7530	7540	7550	7560	7570
-188.0	7580	7590	75A0	75B0	75C0	75D0	75E0	75F0	7600	7610
-189.0	7620	7630	7640	7650	7660	7670	7680	7690	76A0	76B0
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-191.0	7760	7770	7780	7790	77A0	77B0	77C0	77D0	77E0	77F0
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-193.0	78A0	78B0	78C0	78D0	78E0	78F0	7900	7910	7920	7930
-194.0	7940	7950	7960	7970	7980	7990	79A0	79B0	79C0	79D0
-195.0	79E0	79F0	7A00	7A10	7A20	7A30	7A40	7A50	7A60	7A70
-196.0	7A80	7A90	7AA0	7AB0	7AC0	7AD0	7AE0	7AF0	7B00	7B10
-197.0	7B20	7B30	7B40	7B50	7B60	7B70	7B80	7B90	7BA0	7BB0
-198.0	7BC0	7BD0	7BE0	7BF0	7C00	7C10	7C20	7C30	7C40	7C50
-199.0	7C60	7C70	7C80	7C90	7CA0	7CB0	7CC0	7CD0	7CE0	7CF0
-200.0	7D00	7D10	7D20	7D30	7D40	7D50	7D60	7D70	7D80	7D90

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
+0.0	0000	0010	0020	0030	0040	0050	0060	0070	0080	0090
+1.0	00A0	00B0	00C0	00D0	00E0	00F0	0100	0110	0120	0130
+2.0	0140	0150	0160	0170	0180	0190	01A0	01B0	01C0	01D0
+3.0	01E0	01F0	0200	0210	0220	0230	0240	0250	0260	0270
+4.0	0280	0290	02A0	02B0	02C0	02D0	02E0	02F0	0300	0310
+5.0	0320	0330	0340	0350	0360	0370	0380	0390	03A0	03B0
+6.0	03C0	03D0	03E0	03F0	0400	0410	0420	0430	0440	0450
+7.0	0460	0470	0480	0490	04A0	04B0	04C0	04D0	04E0	04F0
+8.0	0500	0510	0520	0530	0540	0550	0560	0570	0580	0590
+9.0	05A0	05B0	05C0	05D0	05E0	05F0	0600	0610	0620	0630
+10.0	0640	0650	0660	0670	0680	0690	06A0	06B0	06C0	06D0
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+12.0	0780	0790	07A0	07B0	07C0	07D0	07E0	07F0	0800	0810
+13.0	0820	0830	0840	0850	0860	0870	0880	0890	08A0	08B0
+14.0	08C0	08D0	08E0	08F0	0900	0910	0920	0930	0940	0950
+15.0	0960	0970	0980	0990	09A0	09B0	09C0	09D0	09E0	09F0
+16.0	0A00	0A10	0A20	0A30	0A40	0A50	0A60	0A70	0A80	0A90
+17.0	0AA0	0AB0	0AC0	0AD0	0AE0	0AF0	0B00	0B10	0B20	0B30
+18.0	0B40	0B50	0B60	0B70	0B80	0B90	0BA0	0BB0	0BC0	0BD0
+19.0	0BE0	0BF0	0C00	0C10	0C20	0C30	0C40	0C50	0C60	0C70
+20.0	0C80	0C90	0CA0	0CB0	0CC0	0CD0	0CE0	0CF0	0D00	0D10
+21.0	0D20	0D30	0D40	0D50	0D60	0D70	0D80	0D90	0DA0	0DB0
+22.0	0DC0	0DD0	0DE0	0DF0	0E00	0E10	0E20	0E30	0E40	0E50
+23.0	0E60	0E70	0E80	0E90	0EA0	0EB0	0EC0	0ED0	0EE0	0EF0
+24.0	0F00	0F10	0F20	0F30	0F40	0F50	0F60	0F70	0F80	0F90
+25.0	0FA0	0FB0	0FC0	0FD0	0FE0	0FF0	1000	1010	1020	1030
+26.0	1040	1050	1060	1070	1080	1090	10A0	10B0	10C0	10D0
+27.0	10E0	10F0	1100	1110	1120	1130	1140	1150	1160	1170
+28.0	1180	1190	11A0	11B0	11C0	11D0	11E0	11F0	1200	1210
+29.0	1220	1230	1240	1250	1260	1270	1280	1290	12A0	12B0
+30.0	12C0	12D0	12E0	12F0	1300	1310	1320	1330	1340	1350
+31.0	1360	1370	1380	1390	13A0	13B0	13C0	13D0	13E0	13F0
+32.0	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490
+33.0	14A0	14B0	14C0	14D0	14E0	14F0	1500	1510	1520	1530
+34.0	1540	1550	1560	1570	1580	1590	15A0	15B0	15C0	15D0
+35.0	15E0	15F0	1600	1610	1620	1630	1640	1650	1660	1670
+36.0	1680	1690	16A0	16B0	16C0	16D0	16E0	16F0	1700	1710
+37.0	1720	1730	1740	1750	1760	1770	1780	1790	17A0	17B0
+38.0	17C0	17D0	17E0	17F0	1800	1810	1820	1830	1840	1850
+39.0	1850	1870	1880	1890	18A0	18B0	18C0	18D0	18E0	18F0
+40.0	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
+41.0	19A0	19B0	19C0	19D0	19E0	19F0	1A00	1A10	1A20	1A30
+42.0	1A40	1A50	1A60	1A70	1A80	1A90	1AA0	1AB0	1AC0	1AD0
+43.0	1AE0	1AF0	1B00	1B10	1B20	1B30	1B40	1B50	1B60	1B70
+44.0	1B80	1B90	1BA0	1BB0	1BC0	1BD0	1BE0	1BF0	1C00	1C10
+45.0	1C20	1C30	1C40	1C50	1C60	1C70	1C80	1C90	1CA0	1CB0
+46.0	1CC0	1CD0	1CE0	1CF0	1D00	1D10	1D20	1D30	1D40	1D50
+47.0	1D60	1D70	1D80	1D90	1DA0	1DB0	1DC0	1DD0	1DE0	1DF0
+48.0	1E00	1E10	1E20	1E30	1E40	1E50	1E60	1E70	1E80	1E90
+49.0	1EA0	1EB0	1EC0	1ED0	1EE0	1EF0	1F00	1F10	1F20	1F30

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
+50.0	1F40	1F50	1F60	1F70	1F80	1F90	1FA0	1FB0	1FC0	1FD0
+51.0	1FE0	1FF0	2000	2010	2020	2030	2040	2050	2060	2070
+52.0	2080	2090	20A0	20B0	20C0	20D0	20E0	20F0	2100	2110
+53.0	2120	2130	2140	2150	2160	2170	2180	2190	21A0	21B0
+54.0	21C0	21D0	21E0	21F0	2200	2210	2220	2230	2240	2250
+55.0	2260	2270	2280	2290	22A0	22B0	22C0	22D0	22E0	22F0
+56.0	2300	2310	2320	2330	2340	2350	2360	2370	2380	2390
+57.0	23A0	23B0	23C0	23D0	23E0	23F0	2400	2410	2420	2430
+58.0	2440	2450	2460	2470	2480	2490	24A0	24B0	24C0	24D0
+59.0	24E0	24F0	2500	2510	2520	2530	2540	2550	2560	2570
+60.0	2580	2590	25A0	25B0	25C0	25D0	25E0	25F0	2600	2610
+61.0	2620	2630	2640	2650	2660	2670	2680	2690	26A0	26B0
+62.0	26C0	26D0	26E0	26F0	2700	2710	2720	2730	2740	2750
+63.0	2760	2770	2780	2790	27A0	27B0	27C0	27D0	27E0	27F0
+64.0	2800	2810	2820	2830	2840	2850	2860	2870	2880	2890
+65.0	28A0	28B0	28C0	28D0	28E0	28F0	2900	2910	2920	2930
+66.0	2940	2950	2960	2970	2980	2990	29A0	29B0	29C0	29D0
+67.0	29E0	29F0	2A00	2A10	2A20	2A30	2A40	2A50	2A60	2A70
+68.0	2A80	2A90	2AA0	2AB0	2AC0	2AD0	2AE0	2AF0	2B00	2B10
+69.0	2B20	2B30	2B40	2B50	2B60	2B70	2B80	2B90	2BA0	2BB0
+70.0	2BC0	2BD0	2BE0	2BF0	2C00	2C10	2C20	2C30	2C40	2C50
+71.0	2C60	2C70	2C80	2C90	2CA0	2CB0	2CC0	2CD0	2CE0	2CF0
+72.0	2D00	2D10	2D20	2D30	2D40	2D50	2D60	2D70	2D80	2D90
+73.0	2DA0	2DB0	2DC0	2DD0	2DE0	2DF0	2E00	2E10	2E20	2E30
+74.0	2E40	2E50	2E60	2E70	2E80	2E90	2EA0	2EB0	2EC0	2ED0
+75.0	2EE0	2EF0	2F00	2F10	2F20	2F30	2F40	2F50	2F60	2F70
+76.0	2F80	2F90	2FA0	2FB0	2FC0	2FD0	2FE0	2FF0	3000	3010
+77.0	3020	3030	3040	3050	3060	3070	3080	3090	30A0	30B0
+78.0	30C0	30D0	30E0	30F0	3100	3110	3120	3130	3140	3150
+79.0	3160	3170	3180	3190	31A0	31B0	31C0	31D0	31E0	31F0
+80.0	3200	3210	3220	3230	3240	3250	3260	3270	3280	3290
+81.0	32A0	32B0	32C0	32D0	32E0	32F0	3300	3310	3320	3330
+82.0	3340	3350	3360	3370	3380	3390	33A0	33B0	33C0	33D0
+83.0	33E0	33F0	3400	3410	3420	3430	3440	3450	3460	3470
+84.0	3480	3490	34A0	34B0	34C0	34D0	34E0	34F0	3500	3510
+85.0	3520	3530	3540	3550	3560	3570	3580	3590	35A0	35B0
+86.0	35C0	35D0	35E0	35F0	3600	3610	3620	3630	3640	3650
+87.0	3660	3670	3680	3690	36A0	36B0	36C0	36D0	36E0	36F0
+88.0	3700	3710	3720	3730	3740	3750	3760	3770	3780	3790
+89.0	37A0	37B0	37C0	37D0	37E0	37F0	3800	3810	3820	3830
+90.0	3840	3850	3860	3870	3880	3890	38A0	38B0	38C0	38D0
+91.0	38E0	38F0	3900	3910	3920	3930	3940	3950	3960	3970
+92.0	3980	3990	39A0	39B0	39C0	39D0	39E0	39F0	3A00	3A10
+93.0	3A20	3A30	3A40	3A50	3A60	3A70	3A80	3A90	3AA0	3AB0
+94.0	3AC0	3AD0	3AE0	3AF0	3B00	3B10	3B20	3B30	3B40	3B50
+95.0	3B60	3B70	3B80	3B90	3BA0	3BB0	3BC0	3BD0	3BE0	3BF0
+96.0	3C00	3C10	3C20	3C30	3C40	3C50	3C60	3C70	3C80	3C90
+97.0	3CA0	3CB0	3CC0	3CD0	3CE0	3CF0	3D00	3D10	3D20	3D30
+98.0	3D40	3D50	3D60	3D70	3D80	3D90	3DA0	3DB0	3DC0	3DD0
+99.0	3DE0	3DF0	3E00	3E10	3E20	3E30	3E40	3E50	3E60	3E70

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
+100.0	3E80	3E90	3EA0	3EB0	3EC0	3ED0	3EE0	3EF0	3F00	3F10
+101.0	3F20	3F30	3F40	3F50	3F60	3F70	3F80	3F90	3FA0	3FB0
+102.0	3FC0	3FD0	3FE0	3FF0	4000	4010	4020	4030	4040	4050
+103.0	4060	4070	4080	4090	40A0	40B0	40C0	40D0	40E0	40F0
+104.0	4100	4110	4120	4130	4140	4150	4160	4170	4180	4190
+105.0	41A0	41B0	41C0	41D0	41E0	41F0	4200	4210	4220	4230
+106.0	4240	4250	4260	4270	4280	4290	42A0	42B0	42C0	42D0
+107.0	42E0	42F0	4300	4310	4320	4330	4340	4350	4360	4370
+108.0	4380	4390	43A0	43B0	43C0	43D0	43E0	43F0	4400	4410
+109.0	4420	4430	4440	4450	4460	4470	4480	4490	44A0	44B0
+110.0	44C0	44D0	44E0	44F0	4500	4510	4520	4530	4540	4550
+111.0	4560	4570	4580	4590	45A0	45B0	45C0	45D0	45E0	45F0
+112.0	4600	4610	4620	4630	4640	4650	4660	4670	4680	4690
+113.0	46A0	46B0	46C0	46D0	46E0	46F0	4700	4710	4720	4730
+114.0	4740	4750	4760	4770	4780	4790	47A0	47B0	47C0	47D0
+115.0	47E0	47F0	4800	4810	4820	4830	4840	4850	4860	4870
+116.0	4880	4890	48A0	48B0	48C0	48D0	48E0	48F0	4900	4910
+117.0	4920	4930	4940	4950	4960	4970	4980	4990	49A0	49B0
+118.0	49C0	49D0	49E0	49F0	4A00	4A10	4A20	4A30	4A40	4A50
+119.0	4A60	4A70	4A80	4A90	4AA0	4AB0	4AC0	4AD0	4AE0	4AF0
+120.0	4B00	4B10	4B20	4B30	4B40	4B50	4B60	4B70	4B80	4B90
+121.0	4BA0	4BB0	4BC0	4BD0	4BE0	4BF0	4C00	4C10	4C20	4C30
+122.0	4C40	4C50	4C60	4C70	4C80	4C90	4CA0	4CB0	4CC0	4CD0
+123.0	4CE0	4CF0	4D00	4D10	4D20	4D30	4D40	4D50	4D60	4D70
+124.0	4D80	4D90	4DA0	4DB0	4DC0	4DD0	4DE0	4DF0	4E00	4E10
+125.0	4E20	4E30	4E40	4E50	4E60	4E70	4E80	4E90	4EA0	4EB0
+126.0	4EC0	4ED0	4EE0	4EF0	4F00	4F10	4F20	4F30	4F40	4F50
+127.0	4F60	4F70	4F80	4F90	4FA0	4FB0	4FC0	4FD0	4FE0	4FF0
+128.0	5000	5010	5020	5030	5040	5050	5060	5070	5080	5090
+129.0	50A0	50B0	50C0	50D0	50E0	50F0	5100	5110	5120	5130
+130.0	5140	5150	5160	5170	5180	5190	51A0	51B0	51C0	51D0
+131.0	51E0	51F0	5200	5210	5220	5230	5240	5250	5260	5270
+132.0	5280	5290	52A0	52B0	52C0	52D0	52E0	52F0	5300	5310
+133.0	5320	5330	5340	5350	5360	5370	5380	5390	53A0	53B0
+134.0	53C0	53D0	53E0	53F0	5400	5410	5420	5430	5440	5450
+135.0	5460	5470	5480	5490	54A0	54B0	54C0	54D0	54E0	54F0
+136.0	5500	5510	5520	5530	5540	5550	5560	5570	5580	5590
+137.0	55A0	55B0	55C0	55D0	55E0	55F0	5600	5610	5620	5630
+138.0	5640	5650	5660	5670	5680	5690	56A0	56B0	56C0	56D0
+139.0	56E0	56F0	5700	5710	5720	5730	5740	5750	5760	5770
+140.0	5780	5790	57A0	57B0	57C0	57D0	57E0	57F0	5800	5810
+141.0	5820	5830	5840	5850	5860	5870	5880	5890	58A0	58B0
+142.0	58C0	58D0	58E0	58F0	5900	5910	5920	5930	5940	5950
+143.0	5960	5970	5980	5980	59A0	59B0	59C0	59D0	59E0	59F0
+144.0	5A00	5A10	5A20	5A30	5A40	5A50	5A60	5A70	5A80	5A90
+145.0	5AA0	5AB0	5AC0	5AD0	5AE0	5AF0	5B00	5B10	5B20	5B30
+146.0	5B40	5B50	5B60	5B70	5B80	5B90	5BA0	5BB0	5BC0	5BD0
+147.0	5BE0	5BF0	5C00	5C10	5C20	5C30	5C40	5C50	5C60	5C70
+148.0	5C80	5C90	5CA0	5CB0	5CC0	5CD0	5CE0	5CF0	5D00	5D10
+149.0	5D20	5D30	5D40	5D50	5D60	5D70	5D80	5D90	5DA0	5DB0

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
+150.0	5DC0	5DD0	5DE0	5DF0	5E00	5E10	5E20	5E30	5E40	5E50
+151.0	5E60	5E70	5E80	5E90	5EA0	5EB0	5EC0	5ED0	5EE0	5EF0
+152.0	5F00	5F10	5F20	5F30	5F40	5F50	5F60	5F70	5F80	5F90
+153.0	5FA0	5FB0	5FC0	5FD0	5FE0	5FF0	6000	6010	6020	6030
+154.0	6040	6050	6060	6070	6080	6090	60A0	60B0	60C0	60D0
+155.0	60E0	60F0	6100	6110	6120	6130	6140	6150	6160	6170
+156.0	6180	6190	61A0	61B0	61C0	61D0	61E0	61F0	6200	6210
+157.0	6220	6230	6240	6250	6260	6270	6280	6290	62A0	62B0
+158.0	62C0	62D0	62E0	62F0	6300	6310	6320	6330	6340	6350
+159.0	6360	6370	6380	6390	63A0	63B0	63C0	63D0	63E0	63F0
+160.0	6400	6410	6420	6430	6440	6450	6460	6470	6480	6490
+161.0	64A0	64B0	64C0	64D0	64E0	64F0	6500	6510	6520	6530
+162.0	6540	6550	6560	6570	6580	6590	65A0	65B0	65C0	65D0
+163.0	65E0	65F0	6600	6610	6620	6630	6640	6650	6660	6670
+164.0	6680	6690	66A0	66B0	66C0	66D0	66E0	66F0	6700	6710
+165.0	6720	6730	6740	6750	6760	6770	6780	6790	67A0	67B0
+166.0	67C0	67D0	67E0	67F0	6800	6810	6820	6830	6840	6850
+167.0	6860	6870	6880	6890	68A0	68B0	68C0	68D0	68E0	68F0
+168.0	6900	6910	6920	6930	6940	6950	6960	6970	6980	6990
+169.0	69A0	69B0	69C0	69D0	69E0	69F0	6A00	6A10	6A20	6A30
+170.0	6A40	6A50	6A60	6A70	6A80	6A90	6AA0	6AB0	6AC0	6AD0
+171.0	6AE0	6AF0	6B00	6B10	6B20	6B30	6B40	6B50	6B60	6B70
+172.0	6B80	6B90	6BA0	6BB0	6BC0	6BD0	6BE0	6BF0	6C00	6C10
+173.0	6C20	6C30	6C40	6C50	6C60	6C70	6C80	6C90	6CA0	6CB0
+174.0	6CC0	6CD0	6CE0	6CF0	6D00	6D10	6D20	6D30	6D40	6D50
+175.0	6D60	6D70	6D80	6D90	6DA0	6DB0	6DC0	6DD0	6DE0	6DF0
+176.0	6E00	6E10	6E20	6E30	6E40	6E50	6E60	6E70	6E80	6E90
+177.0	6EA0	6EB0	6EC0	6ED0	6EE0	6EF0	6F00	6F10	6F20	6F30
+178.0	6F40	6F50	6F60	6F70	6F80	6F90	6FA0	6FB0	6FC0	6FD0
+179.0	6FE0	6FF0	7000	7010	7020	7030	7040	7050	7060	7070
+180.0	7080	7090	70A0	70B0	70C0	70D0	70E0	70F0	7100	7110
+181.0	7120	7130	7140	7150	7160	7170	7180	7190	71A0	71B0
+182.0	71C0	71D0	71E0	71F0	7200	7210	7220	7230	7240	7250
+183.0	7260	7270	7280	7290	72A0	72B0	72C0	72D0	72E0	72F0
+184.0	7300	7310	7320	7330	7340	7350	7360	7370	7380	7390
+185.0	73A0	73B0	73C0	73D0	73E0	73F0	7400	7410	7420	7430
+186.0	7440	7450	7460	7470	7480	7490	74A0	74B0	74C0	74D0
+187.0	74E0	74F0	7500	7510	7520	7530	7540	7550	7560	7570
+188.0	7580	7590	75A0	75B0	75C0	75D0	75E0	75F0	7600	7610
+189.0	7620	7630	7640	7650	7660	7670	7680	7690	76A0	76B0
+190.0	76C0	76D0	76E0	76F0	7700	7710	7720	7730	7740	7750
+191.0	7760	7770	7780	7790	77A0	77B0	77C0	77D0	77E0	77F0
+192.0	7800	7810	7820	7830	7840	7850	7860	7870	7880	7890
+193.0	78A0	78B0	78C0	78D0	78E0	78F0	7900	7810	7920	7830
+194.0	7940	7950	7960	7970	7980	7990	79A0	79B0	79C0	79D0
+195.0	79E0	79F0	7A00	7A10	7A20	7A30	7A40	7A50	7A60	7A70
+196.0	7A80	7A90	7AA0	7AB0	7AC0	7AD0	7AE0	7AF0	7B00	7B10
+197.0	7B20	7B30	7B40	7B50	7B60	7B70	7B80	7B90	7BA0	7BB0
+198.0	7BC0	7BD0	7BE0	7BF0	7C00	7C10	7C20	7C30	7C40	7C50
+199.0	7C60	7C70	7C80	7C90	7CA0	7CB0	7CC0	7CD0	7CE0	7CF0

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-149.0	A2E0	A2D0	A2C0	A2B0	A2A0	A290	A280	A270	A260	A250
-148.0	A380	A370	A360	A350	A340	A330	A320	A310	A300	A2F0
-147.0	A420	A410	A400	A3F0	A3E0	A3D0	A3C0	A3B0	A3A0	A390
-146.0	A4C0	A4B0	A4A0	A490	A480	A470	A460	A450	A440	A430
-145.0	A560	A550	A540	A530	A520	A510	A500	A4F0	A4E0	A4D0
-144.0	A600	A5F0	A5E0	A5D0	A5C0	A5B0	A5A0	A590	A580	A570
-143.0	A6A0	A690	A680	A670	A660	A650	A640	A630	A620	A610
-142.0	A740	A730	A720	A710	A700	A6F0	A6E0	A6D0	A6C0	A6B0
-141.0	A7E0	A7D0	A7C0	A7B0	A7A0	A790	A780	A770	A760	A750
-140.0	A880	A870	A860	A850	A840	A830	A820	A810	A800	A7F0
-139.0	A920	A910	A900	A8F0	A8E0	A8D0	A8C0	A8B0	A8A0	A890
-138.0	A9C0	A9B0	A9A0	A990	A980	A970	A960	A950	A940	A930
-137.0	AA60	AA50	AA40	AA30	AA20	AA10	AA00	A9F0	A9E0	A9D0
-136.0	AB00	AAF0	AAE0	AAD0	AAC0	AAB0	AAA0	AA90	AA80	AA70
-135.0	ABA0	AB90	AB80	AB70	AB60	AB50	AB40	AB30	AB20	AB10
-134.0	AC40	AC30	AC20	AC10	AC00	ABF0	ABE0	ABD0	ABC0	ABB0
-133.0	ACE0	ACD0	ACC0	ACB0	ACA0	AC90	AC80	AC70	AC60	AC50
-132.0	AD80	AD70	AD60	AD50	AD40	AD30	AD20	AD10	AD00	ACF0
-131.0	AE20	AE10	AE00	ADF0	ADE0	ADD0	ADC0	ADB0	ADA0	AD90
-130.0	AEC0	AEB0	AEA0	AE90	AE80	AE70	AE60	AE50	AE40	AE30
-129.0	AF60	AF50	AF40	AF30	AF20	AF10	AF00	AEF0	AEE0	AED0
-128.0	B000	AFF0	AFE0	AFD0	AFC0	AFB0	AFA0	AF90	AF80	AF70
-127.0	B0A0	B090	B080	B070	B060	B050	B040	B030	B020	B010
-126.0	B140	B130	B120	B110	B100	B0F0	B0E0	B0D0	B0C0	B0B0
-125.0	B1E0	B1D0	B1C0	B1B0	B1A0	B190	B180	B170	B160	B150
-124.0	B280	B270	B260	B250	B240	B230	B220	B210	B200	B1F0
-123.0	B320	B310	B300	B2F0	B2E0	B2D0	B2C0	B2B0	B2A0	B290
-122.0	B3C0	B3B0	B3A0	B390	B380	B370	B360	B350	B340	B330
-121.0	B460	B450	B440	B430	B420	B410	B400	B3F0	B3E0	B3D0
-120.0	B500	B4F0	B4E0	B4D0	B4C0	B4B0	B4A0	B490	B480	B470
-119.0	B5A0	B590	B580	B570	B560	B550	B540	B530	B520	B510
-118.0	B640	B630	B620	B610	B600	B5F0	B5E0	B5D0	B5C0	B5B0
-117.0	B6E0	B6D0	B6C0	B6B0	B6A0	B690	B680	B670	B660	B650
-116.0	B780	B770	B760	B750	B740	B730	B720	B710	B700	B6F0
-115.0	B820	B810	B800	B7F0	B7E0	B7D0	B7C0	B7B0	B7A0	B790
-114.0	B8C0	B8B0	B8A0	B890	B880	B870	B860	B850	B840	B830
-113.0	B960	B950	B940	B930	B920	B910	B900	B8F0	B8E0	B8D0
-112.0	BA00	B9F0	B9E0	B9D0	B9C0	B9B0	B9A0	B990	B980	B970
-111.0	BAA0	BA90	BA80	BA70	BA60	BA50	BA40	BA30	BA20	BA10
-110.0	BB40	BB30	BB20	BB10	BB00	BAF0	BAE0	BAD0	BAC0	BAB0
-109.0	BBE0	BBD0	BBC0	BBB0	BBA0	BB90	BB80	BB70	BB60	BB50
-108.0	BC80	BC70	BC60	BC50	BC40	BC30	BC20	BC10	BC00	BBF0
-107.0	BD20	BD10	BD00	BCF0	BCE0	BCD0	BCC0	BCB0	BCA0	BC90
-106.0	BDC0	BDB0	BDA0	BD90	BD80	BD70	BD60	BD50	BD40	BD30
-105.0	BE60	BE50	BE40	BE30	BE20	BE10	BE00	BDF0	BDE0	BDD0
-104.0	BF00	BEF0	BEE0	BED0	BEC0	BEB0	BEA0	BE90	BE80	BE70
-103.0	BFA0	BF90	BF80	BF70	BF60	BF50	BF40	BF30	BF20	BF10
-102.0	C040	C030	C020	C010	C000	BFF0	BFE0	BFD0	BFC0	BFB0
-101.0	C0E0	C0D0	C0C0	C0B0	C0A0	C090	C080	C070	C060	C050
-100.0	C180	C170	C160	C150	C140	C130	C120	C110	C100	C0F0

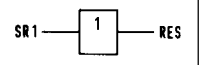
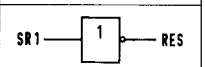
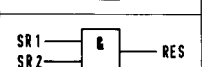
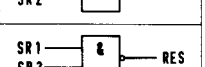
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-199.0	83A0	8390	8380	8370	8360	8350	8340	8330	8320	8310
-198.0	8440	8430	8420	8410	8400	83F0	83E0	83D0	83C0	83B0
-197.0	84E0	84D0	84C0	84B0	84A0	8490	8480	8470	8460	8450
-196.0	8580	8570	8560	8550	8540	8530	8520	8510	8500	84F0
-195.0	8620	8610	8600	85F0	85E0	85D0	85C0	85B0	85A0	8590
-194.0	86C0	86B0	86A0	8690	8680	8670	8660	8650	8640	8630
-193.0	8760	8750	8740	8730	8720	8710	8700	86F0	86E0	86D0
-192.0	8800	87F0	87E0	87D0	87C0	87B0	87A0	8790	8780	8770
-191.0	88A0	8890	8880	8870	8860	8850	8840	8830	8820	8810
-190.0	8940	8930	8920	8910	8900	88F0	88E0	88D0	88C0	88B0
-189.0	89E0	89D0	89C0	89B0	89A0	8990	8980	8970	8960	8950
-188.0	8A80	8A70	8A60	8A50	8A40	8A30	8A20	8A10	8A00	89F0
-187.0	8B20	8B10	8B00	8AF0	8AE0	8AD0	8AC0	8AB0	8AA0	8A90
-186.0	8BC0	8BB0	8BA0	8B90	8B80	8B70	8B60	8B50	8B40	8B30
-185.0	8C60	8C50	8C40	8C30	8C20	8C10	8C00	8BF0	8BE0	8BD0
-184.0	8D00	8CF0	8CE0	8CD0	8CC0	8CB0	8CA0	8C90	8C80	8C70
-183.0	8DA0	8D90	8D80	8D70	8D60	8D50	8D40	8D30	8D20	8D10
-182.0	8E40	8E30	8E20	8E10	8E00	8DF0	8DE0	8DD0	8DC0	8DB0
-181.0	8EE0	8ED0	8EC0	8EB0	8EA0	8E90	8E80	8E70	8E60	8E50
-180.0	8F80	8F70	8F60	8F50	8F40	8F30	8F20	8F10	8F00	8EF0
-179.0	9020	9010	9000	8FF0	8FE0	8FD0	8FC0	8FB0	8FA0	8F90
-178.0	90C0	90B0	90A0	9090	9080	9070	9060	9050	9040	9030
-177.0	9160	9150	9140	9130	9120	9110	9100	90F0	90E0	90D0
-176.0	9200	91F0	91E0	91D0	91C0	91B0	91A0	9190	9180	9170
-175.0	92A0	9290	9280	9270	9260	9250	9240	9230	9220	9210
-174.0	9340	9330	9320	9310	9300	92F0	92E0	92D0	92C0	92B0
-173.0	93E0	93D0	93C0	93B0	93A0	9390	9380	9370	9360	9350
-172.0	9480	9470	9460	9450	9440	9430	9420	9410	9400	93F0
-171.0	9520	9510	9500	94F0	94E0	94D0	94C0	94B0	94A0	9490
-170.0	95C0	95B0	95A0	9590	9580	9570	9560	9550	9540	9530
-169.0	9660	9650	9640	9630	9620	9610	9600	95F0	95E0	95D0
-168.0	9700	96F0	96E0	96D0	96C0	96B0	96A0	9690	9680	9670
-167.0	97A0	9790	9780	9770	9760	9750	9740	9730	9720	9710
-166.0	9840	9830	9820	9810	9800	97F0	97E0	97D0	97C0	97B0
-165.0	98E0	98D0	98C0	98B0	98A0	9890	9880	9870	9860	9850
-164.0	9980	9970	9960	9950	9940	9930	9920	9910	9900	98F0
-163.0	9A20	9A10	9A00	99F0	99E0	99D0	99C0	99B0	99A0	9990
-162.0	9AC0	9AB0	9AA0	9A90	9A80	9A70	9A60	9A50	9A40	9A30
-161.0	9B60	9B50	9B40	9B30	9B20	9B10	9B00	9AF0	9AE0	9AD0
-160.0	9C00	9BF0	9BE0	9BD0	9BC0	9BB0	9BA0	9B90	9B80	9B70
-159.0	9CA0	9C90	9C80	9C70	9C60	9C50	9C40	9C30	9C20	9C10
-158.0	9D40	9D30	9D20	9D10	9D00	9CF0	9CE0	9CD0	9CC0	9CB0
-157.0	9DE0	9DD0	9DC0	9DB0	9DA0	9D90	9D80	9D70	9D60	9D50
-156.0	9E80	9E70	9E60	9E50	9E40	9E30	9E20	9E10	9E00	9DF0
-155.0	9F20	9F10	9F00	9EF0	9EE0	9ED0	9EC0	9EB0	9EA0	9E90
-154.0	9FC0	9FB0	9FA0	9F90	9F80	9F70	9F60	9F50	9F40	9F30
-153.0	A060	A050	A040	A030	A020	A010	A000	9FF0	9FE0	9FD0
-152.0	A100	A0F0	A0E0	A0D0	A0C0	A0B0	A0A0	A090	A080	A070
-151.0	A1A0	A190	A180	A170	A160	A150	A140	A130	A120	A110
-150.0	A240	A230	A220	A210	A200	A1F0	A1E0	A1D0	A1C0	A1B0

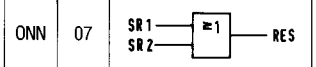
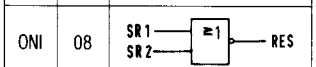
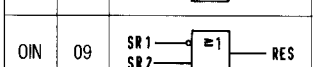
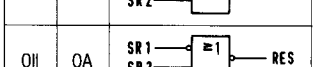
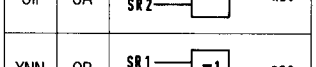
Hexadecimal values for calculation of linearization tables (continued)

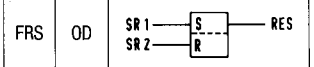
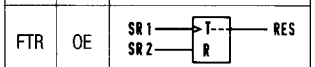
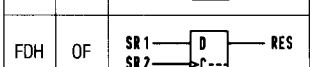
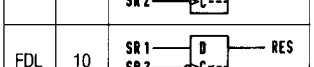
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-99.0	C220	C210	C200	C1F0	C1E0	C1D0	C1C0	C1B0	C1A0	C190
-98.0	C2C0	C2B0	C2A0	C290	C280	C270	C260	C250	C240	C230
-97.0	C360	C350	C340	C330	C320	C310	C300	C2F0	C2E0	C2D0
-96.0	C400	C3F0	C3E0	C3D0	C3C0	C3B0	C3A0	C390	C380	C370
-95.0	C4A0	C490	C480	C470	C460	C450	C440	C430	C420	C410
-94.0	C540	C530	C520	C510	C500	C4F0	C4E0	C4D0	C4C0	C4B0
-93.0	C5E0	C5D0	C5C0	C5B0	C5A0	C590	C580	C570	C560	C550
-92.0	C680	C670	C660	C650	C640	C630	C620	C610	C600	C5F0
-91.0	C720	C710	C700	C6F0	C6E0	C6D0	C6C0	C6B0	C6A0	C690
-90.0	C7C0	C7B0	C7A0	C790	C780	C770	C760	C750	C740	C730
-89.0	C860	C850	C840	C830	C820	C810	C800	C7F0	C7E0	C7D0
-88.0	C900	C8F0	C8E0	C8D0	C8C0	C8B0	C8A0	C890	C880	C870
-87.0	C9A0	C990	C980	C970	C960	C950	C940	C930	C920	C910
-86.0	CA40	CA30	CA20	CA10	CA00	C9F0	C9E0	C9D0	C9C0	C9B0
-85.0	CAE0	CAD0	CAC0	CAB0	CAA0	CA90	CA80	CA70	CA60	CA50
-84.0	CB80	CB70	CB60	CB50	CB40	CB30	CB20	CB10	CB00	CAF0
-83.0	CC20	CC10	CC00	CBF0	CBE0	CBD0	CBC0	CBB0	CBA0	CB90
-82.0	CCC0	CCB0	CCA0	CC90	CC80	CC70	CC60	CC50	CC40	CC30
-81.0	CD60	CD50	CD40	CD30	CD20	CD10	CD00	CCF0	CCE0	CCD0
-80.0	CE00	CDF0	CDE0	CDD0	CDC0	CDB0	CDA0	CD90	CD80	CD70
-79.0	CEA0	CE90	CE80	CE70	CE60	CE50	CE40	CE30	CE20	CE10
-78.0	CF40	CF30	CF20	CF10	CF00	CEF0	CEE0	CED0	CEC0	CEB0
-77.0	CFE0	CFD0	CFC0	CFB0	CFA0	CF90	CF80	CF70	CF60	CF50
-76.0	D080	D070	D060	D050	D040	D030	D020	D010	D000	CFF0
-75.0	D120	D110	D100	D0F0	D0E0	D0D0	D0C0	D0B0	D0A0	D090
-74.0	D1C0	D1B0	D1A0	D190	D180	D170	D160	D150	D140	D130
-73.0	D260	D250	D240	D230	D220	D210	D200	D1F0	D1E0	D1D0
-72.0	D300	D2F0	D2E0	D2D0	D2C0	D2B0	D2A0	D290	D280	D270
-71.0	D3A0	D390	D380	D370	D360	D350	D340	D330	D320	D310
-70.0	D440	D430	D420	D410	D400	D3F0	D3E0	D3D0	D3C0	D3B0
-69.0	D4E0	D4D0	D4C0	D4B0	D4A0	D490	D480	D470	D460	D450
-68.0	D580	D570	D560	D550	D540	D530	D520	D510	D500	D4F0
-67.0	D620	D610	D600	D5F0	D5E0	D5D0	D5C0	D5B0	D5A0	D590
-66.0	D6C0	D6B0	D6A0	D690	D680	D670	D660	D650	D640	D630
-65.0	D760	D750	D740	D730	D720	D710	D700	D6F0	D6E0	D6D0
-64.0	D800	D7F0	D7E0	D7D0	D7C0	D7B0	D7A0	D790	D780	D770
-63.0	D8A0	D890	D880	D870	D860	D850	D840	D830	D820	D810
-62.0	D940	D930	D920	D910	D900	D8F0	D8E0	D8D0	D8C0	D8B0
-61.0	D9E0	D9D0	D9C0	D9B0	D9A0	D990	D980	D970	D960	D950
-60.0	DA80	DA70	DA60	DA50	DA40	DA30	DA20	DA10	DA00	D9F0
-59.0	DB20	DB10	DB00	DAF0	DAE0	DAD0	DAC0	DAB0	DAA0	DA90
-58.0	DBC0	DBB0	DBA0	DB90	DB80	DB70	DB60	DB50	DB40	DB30
-57.0	DC60	DC50	DC40	DC30	DC20	DC10	DC00	DBF0	DBE0	DBD0
-56.0	DD00	DCF0	DCE0	DCD0	DCC0	DCB0	DCA0	DC90	DC80	DC70
-55.0	DDA0	DD90	DD80	DD70	DD60	DD50	DD40	DD30	DD20	DD10
-54.0	DE40	DE30	DE20	DE10	DE00	DDF0	DDE0	DDD0	DDC0	DDB0
-53.0	DEE0	DED0	DEC0	DEB0	DEA0	DE90	DE80	DE70	DE60	DE50
-52.0	DF80	DF70	DF60	DF50	DF40	DF30	DF20	DF10	DF00	DEF0
-51.0	E020	E010	E000	DFF0	DFE0	DFD0	DFC0	DFB0	DFA0	DF90
-50.0	E0C0	E0B0	E0A0	E090	E080	E070	E060	E050	E040	E030

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-49.0	E160	E150	E140	E130	E120	E110	E100	E0F0	E0E0	E0D0
-48.0	E200	E1F0	E1E0	E1D0	E1C0	E1B0	E1A0	E190	E180	E170
-47.0	E2A0	E290	E280	E270	E260	E250	E240	E230	E220	E210
-46.0	E340	E330	E320	E310	E300	E2F0	E2E0	E2D0	E2C0	E2B0
-45.0	E3E0	E3D0	E3C0	E3B0	E3A0	E390	E380	E370	E360	E350
-44.0	E480	E470	E460	E450	E440	E430	E420	E410	E400	E3F0
-43.0	E520	E510	E500	E4F0	E4E0	E4D0	E4C0	E4B0	E4A0	E490
-42.0	E5C0	E5B0	E5A0	E590	E580	E570	E560	E550	E540	E530
-41.0	E660	E650	E640	E630	E620	E610	E600	E5F0	E5E0	E5D0
-40.0	E700	E6F0	E6E0	E6D0	E6C0	E6B0	E6A0	E690	E680	E670
-39.0	E7A0	E790	E780	E770	E760	E750	E740	E730	E720	E710
-38.0	E840	E830	E820	E810	E800	E7F0	E7E0	E7D0	E7C0	E7B0
-37.0	E8E0	E8D0	E8C0	E8B0	E8A0	E890	E880	E870	E860	E850
-36.0	E980	E970	E960	E950	E940	E930	E920	E910	E900	E8F0
-35.0	EA20	EA10	EA00	E9F0	E9E0	E9D0	E9C0	E9B0	E9A0	E990
-34.0	EAC0	EAB0	EAA0	EA90	EA80	EA70	EA60	EA50	EA40	EA30
-33.0	EB60	EB50	EB40	EB30	EB20	EB10	EB00	EAF0	EAE0	EAD0
-32.0	EC00	EBF0	EBE0	EBD0	EBC0	EBB0	EBA0	EB90	EB80	EB70
-31.0	ECA0	EC90	EC80	EC70	EC60	EC50	EC40	EC30	EC20	EC10
-30.0	ED40	ED30	ED20	ED10	ED00	ECF0	ECE0	ECD0	ECC0	ECB0
-29.0	EDE0	EDD0	EDC0	EDB0	EDA0	ED90	ED80	ED70	ED60	ED50
-28.0	EE80	EE70	EE60	EE50	EE40	EE30	EE20	EE10	EE00	EDF0
-27.0	EF20	EF10	EF00	EEF0	EEE0	EED0	EEC0	EEB0	EEA0	EE90
-26.0	EFC0	EFB0	EFA0	EF90	EF80	EF70	EF60	EF50	EF40	EF30
-25.0	F060	F050	F040	F030	F020	F010	F000	EFF0	EFE0	EFD0
-24.0	F100	F0F0	F0E0	F0D0	F0C0	F0B0	F0A0	F090	F080	F070
-23.0	F1A0	F190	F180	F170	F160	F150	F140	F130	F120	F110
-22.0	F240	F230	F220	F210	F200	F1F0	F1E0	F1D0	F1C0	F1B0
-21.0	F2E0	F2D0	F2C0	F2B0	F2A0	F290	F280	F270	F260	F250
-20.0	F380	F370	F360	F350	F340	F330	F320	F310	F300	F2F0
-19.0	F420	F410	F400	F3F0	F3E0	F3D0	F3C0	F3B0	F3A0	F390
-18.0	F4C0	F4B0	F4A0	F490	F480	F470	F460	F450	F440	F430
-17.0	F560	F550	F540	F530	F520	F510	F500	F4F0	F4E0	F4D0
-16.0	F600	F5F0	F5E0	F5D0	F5C0	F5B0	F5A0	F590	F580	F570
-15.0	F6A0	F690	F680	F670	F660	F650	F640	F630	F620	F610
-14.0	F740	F730	F720	F710	F700	F6F0	F6E0	F6D0	F6C0	F6B0
-13.0	F7E0	F7D0	F7C0	F7B0	F7A0	F790	F780	F770	F760	F750
-12.0	F880	F870	F860	F850	F840	F830	F820	F810	F800	F7F0
-11.0	F920	F910	F900	F8F0	F8E0	F8D0	F8C0	F8B0	F8A0	F890
-10.0	F9C0	F9B0	F9A0	F990	F980	F970	F960	F950	F940	F930
-9.0	FA60	FA50	FA40	FA30	FA20	FA10	FA00	F9F0	F9E0	F9D0
-8.0	FB00	FAF0	FAE0	FAD0	FAC0	FAB0	FAA0	FA90	FA80	FA70
-7.0	FBA0	FB90	FB80	FB70	FB60	FB50	FB40	FB30	FB20	FB10
-6.0	FC40	FC30	FC20	FC10	FC00	FBF0	FBE0	FBD0	FBC0	FBB0
-5.0	FCE0	FCD0	FCC0	FCB0	FCA0	FC90	FC80	FC70	FC60	FC50
-4.0	FD80	FD70	FD60	FD50	FD40	FD30	FD20	FD10	FD00	FCF0
-3.0	FE20	FE10	FE00	FDF0	FDE0	FDD0	FDC0	FDB0	FDA0	FD90
-2.0	FEC0	FEB0	FEA0	FE90	FE80	FE70	FE60	FE50	FE40	FE30
-1.0	FF60	FF50	FF40	FF30	FF20	FF10	FF00	FEF0	FEE0	FED0
-0.0	0000	FFF0	FFE0	FFD0	FFC0	FFB0	FFA0	FF90	FF80	FF70

14.3 Computing commands and their hex.-code

Mnemonic	Op code	Description Symbol DIN 40700
BTN	01	
BTI	02	
ANN	03	
ANI	04	
AIN	05	
AII	06	

Mnemonic	Op code	Description Symbol DIN 40700
ONN	07	
ONI	08	
OIN	09	
OII	0A	
XNN	0B	
XNI	0C	

Mnemonic	Op code	Description Symbol DIN 40700
FRS	0D	
FTR	0E	
FDH	0F	
FDL	10	
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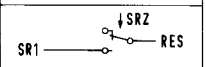
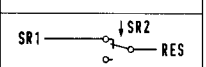
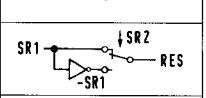
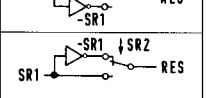
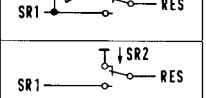
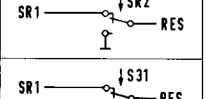
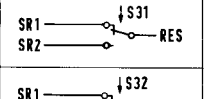
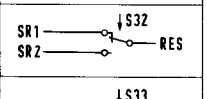
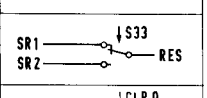
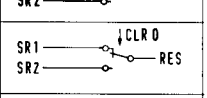
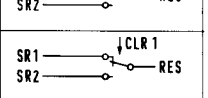
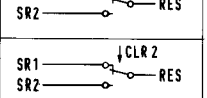
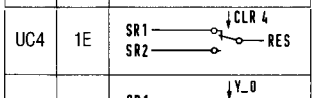
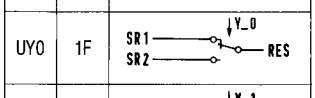
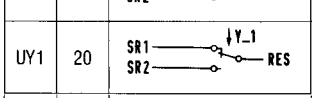
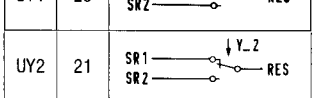
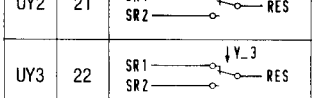
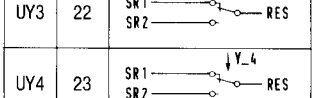
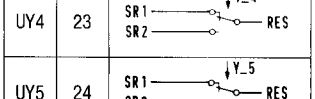
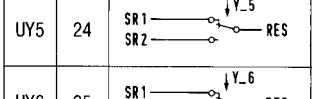
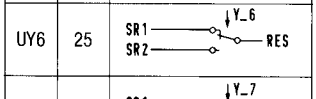
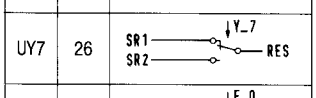
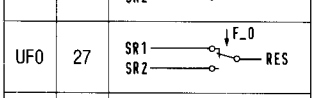
Switch functions

Mnemonic	Op code	Description
SOL	11	
SOH	12	
SIH	13	
SIL	14	
SZL	15	
SZH	16	
U31	17	
U32	18	
U33	19	
UC0	1A	
UC1	1B	
UC2	1C	
UC3	1D	

Mnemonic	Op code	Description
UC4	1E	
UY0	1F	
UY1	20	
UY2	21	
UY3	22	
UY4	23	
UY5	24	
UY6	25	
UY7	26	
UF0	27	
UF1	28	
UF2	29	
UF3	2A	

Mnemonic	Op code	Description
UF4	2B	
UF5	2C	
UF6	2D	
UF7	2E	
UW0	2F	
UW1	30	
UW2	31	
UW3	32	
UW4	33	
UW5	34	
UW6	35	
UW7	36	

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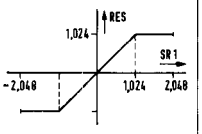
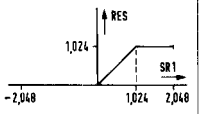
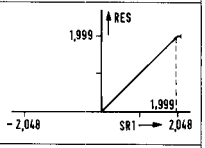
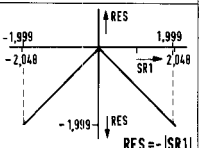
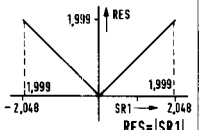
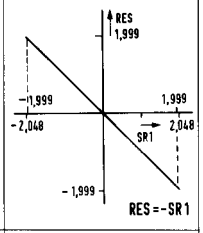
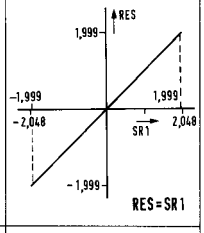
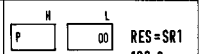
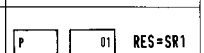
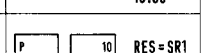
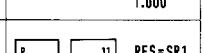
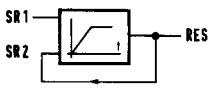
Limiting and transfer functions

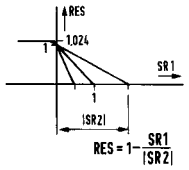
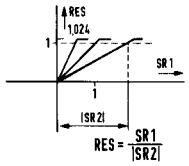
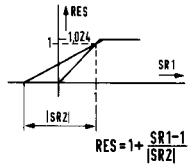
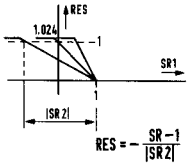
Mnemonic	Op code	Description
LB1	37	
LU1	38	
LU2	39	
NEG	3A	
ABS	3B	

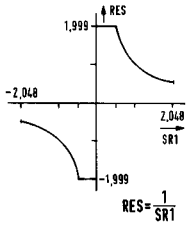
Mnemonic	Op code	Description
INV	3C	
DIR	3D	
MA0	3E	
MA1	3F	
MA2	40	
MA3	41	 Z-8879

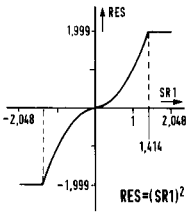
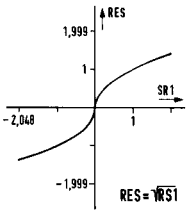
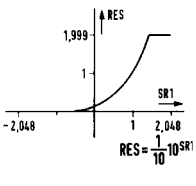
Slew rate limitation

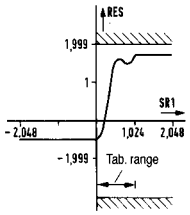
Mnemonic	Op code	Description
		RES = SR 2 + Sign (SR1 - SR2) K · ΔT Sign Increment - 1,999 ≦ RES ≦ 1,999 Circuit 
RL1	68	Rate (time for 100 % change) = 2″
RL2	69	Rate (time for 100 % change) = 4″
RL3	6A	Rate (time for 100 % change) = 8″
RL4	6B	Rate (time for 100 % change) = 16″
RL5	6C	Rate (time for 100 % change) = 50″
RL6	6D	Rate (time for 100 % change) = 100″
RL7	6E	Rate (time for 100 % change) = 200″
RL8	6F	Rate (time for 100 % change) = 400″
RL9	70	Rate (time for 100 % change) = 1000″
RLA	71	Rate (time for 100 % change) = 2000″
RLB	72	Rate (time for 100 % change) = 4000″
RLC	73	Rate (time for 100 % change) = 8000″

Arithmetic functions

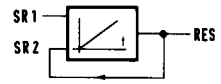
Mnemonic	Op code	Description
YC1	42	
YC2	43	
YC3	44	
YC4	45	

Mnemonic	Op code	Description
MAX	46	RES = SR1, if SR1 ≧ SR2 RES = SR2, if SR1 < SR2 − 2,048 ≦ RES ≦ 2,048
MIN	47	RES = SR1, if SR1 ≦ SR2 RES = SR2, if SR1 > SR2 − 2,048 ≦ RES ≦ 2,048
ADD	48	RES = SR1 + SR2 − 1,999 ≦ RES ≦ 1,999
SUB	49	RES = SR2 − SR2 − 1,999 ≦ RES ≦ 1,999
MUL	4A	RES = SR1 · SR2 − 1,999 ≦ RES ≦ 1,999
DIV	4B	RES = SR1 : SR2 − 1,999 ≦ RES ≦ 1,999
REZ	4C	

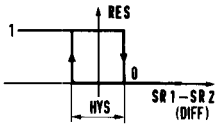
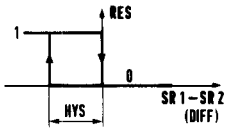
Mnemonic	Op code	Description
QUA	4D	
RAD	4E	
EXP	4F	

Mnemonic	Op code	Description
		
TA0	50	Variable (break in addr. 87B6...87D7)
TA1	51	Fe-CuNi DIN 0... 900°C f. RS1 = 0...1
TA2	52	Type J 0...1200°C f. RS1 = 0...1
TA3	53	Type K 0...1370°C f. RS1 = 0...1
TA4	54	Type S 0...1760°C f. RS1 = 0...1
TA5	55	Type B 0...1820°C f. RS1 = 0...1
TA6	56	WRe3-WRe25 0...1999°C f. RS1 = 0...1
TA7	57	Pt 100 DIN -220...850°C f. RS1 = 0...1
		RES = SR1 · CONSTANT −1,999 ≦ RES ≦ 1,999
K.1	58	CONSTANT = 1/10
K/8	59	CONSTANT = 1/8
K/5	5A	CONSTANT = 1/5
K/4	5B	CONSTANT = 1/4
K/3	5C	CONSTANT = 1/3
K/2	5D	CONSTANT = 1/2
K02	5E	CONSTANT = 2
K03	5F	CONSTANT = 3
K04	60	CONSTANT = 4
K05	61	CONSTANT = 5
K08	62	CONSTANT = 8
K10	63	CONSTANT = 10
K20	64	CONSTANT = 20
K40	65	CONSTANT = 40
K50	66	CONSTANT = 50
KHU	67	CONSTANT = 100 Z-8880

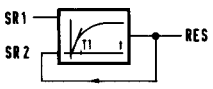
Fixed time integrator

Mnemonic	Op code	Description
		$RES = SR2 + \frac{SR1}{T_N} \cdot \Delta T$
		$-1{,}999 \leqq RES \leqq 1{,}999$
		Circuit 
IG1	74	T_N = 2 s
IG2	75	T_N = 8 s
IG3	76	T_N = 20 s
IG4	77	T_N = 50 s
IG5	78	T_N = 2 min
IG6	79	T_N = 8 min
IG7	7A	T_N = 20 min
IG8	7B	T_N = 50 min

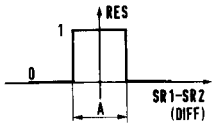
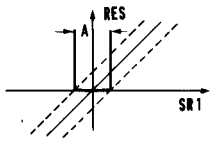
Hysteresis functions

Mnemonic	Op code	Description
		 DIFF > HYS/2: "0" DIFF < HYS/2: "1" Within HYS: old RES.
CB0	7C	HYS = Var. from 0...25.5% (in addr. 8740)
CB1	7D	= 0,025 %
CB2	7E	= 0,05 %
CB3	7F	= 0,1 %
CB4	80	= 0,25 %
CB5	81	= 0,5 %
CB6	82	= 0,8 %
CB7	83	= 1,0 %
CB8	84	= 1,5 %
CB9	85	= 2,0 %
		 DIFF pos. : „0" DIFF < – HYS: „1" Within HYS: old RES.
CU0	86	HYS = Var. from 0...25.5% (in addr. 8741)
CU1	87	= 0,025 %
CU2	88	= 0,05 %
CU3	89	= 0,1 %
CU4	8A	= 0,25 %
CU5	8B	= 0,5 %
CU6	8C	= 0,8 %
CU7	8D	= 1,0 %
CU8	8E	= 1,5 %
CU9	8F	= 2,0 %

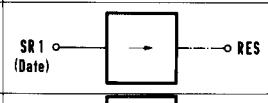
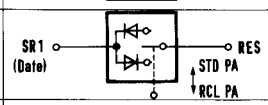
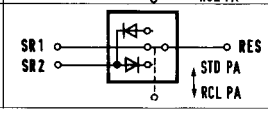
Delays

		$RES = SR2 + \frac{SR1 + SR2}{T1} \cdot \Delta T$
		$-1{,}999 \leqq RES \leqq 1{,}999$
		Circuit 
VZ1	A7	T_N = 1 s
VZ2	A8	T_N = 4 s
VZ3	A9	T_N = 10 s
VZ4	AA	T_N = 25 s
VZ5	AB	T_N = 2 min.
VZ6	AC	T_N = 8 min.
VZ7	AD	T_N = 20 min.
VZ8	AE	T_N = 50 min.

Hysteresis functions

Mnemonic	Op code	Description
		 I DIFF I > A/2: „0" I DIFF I ≦ A/2: „1"
CT0	90	A = Var. from 0...25.5% (in addr. 8742)
CT1	91	= 0,025 %
CT2	92	= 0,05 %
CT3	93	= 0,1 %
CT4	94	= 0,25 %
CT5	95	= 0,5 %
CT6	96	= 0,8 %
CT7	97	= 1,0 %
CT8	98	= 1,5 %
CT9	99	= 2,0 %
		 I SR1 – RES I > A/2: RES – SR1 I SR1 – RES I ≦ A/2: old RES
CL0	9A	A = Var. from 0...25.5% (in addr. 8743)
CL1	9B	= 0,025 %
CL2	9C	= 0,05 %
CL3	9D	= 0,1 %
CL4	9E	= 0,25 %
CL5	9F	= 0,5 %
CL6	A0	= 0,8 %
CL7	A1	= 1,0 %
CL8	A2	= 1,5 %
CL9	A3	= 2,0 %

Assignment of values

Mnemonic	Op code	Description
FIX	A4	 Date as result
FLX	A5	 Call a date or store a result
PAR	A6	 Output of SR1 as result, optionally also call SR2 or store a RES – SR2

Programmer

Mnemonic	Op code	Description
PW.	E0 to EF	Restart value
PT.	F0 to FF	Time register

14.4 Variables in Protronic P

Analog source variables, inputs and constants

Variable	Display	Hex	Function
Blank	Space	00	Free
/W8	w8	01	Free
/W7	w7	02	Free
/W6	w6	03	Free
/W5	w5	04	Free
/W4	w4	05	Free
/W3	w3	06	Free
/W2	w2	07	Free
/W1	w1	08	Free
/W0	w0	09	Free
/W	w	0A	Free
/UF	uF	0B	Free
/UE	uE	0C	Free
/UD	ud	0D	Free
/UC	uC	0E	Free
/UB	ub	0F	Free
/UA	uA	10	Free
/U9	u9	11	Free
/U8	u8	12	Free
/U7	u7	13	Difference signal controller 2
/U6	u6	14	D action controller 2
/U5	u5	15	I action controller 2
/U4	u4	16	P + D + S controller 2
/U3	u3	17	Difference signal controller 1
/U2	u2	18	D action controller 1
/U1	u1	19	I action controller 1
/U0	u0	1A	P + D + S controller 1
/R4	r4	1B	Remote-controlled variable
/R3	r3	1C	Output of control module 1
/R2	r2	1D	Output of control module 2
/R1	r1	1E	Digital displayed variable
/R0	r0	1F	Sawtooth test signal
/N8	n8	20	Fixed value 100.0 %
/N7	n7	21	Fixed value 75.0 %
/N6	n6	22	Fixed value 50.0 %
/N5	n5	23	Fixed value 25.0 %
/N4	n4	24	Fixed value 10.0 %
/N3	n3	25	Fixed value 1.0 %
/N2	n2	26	Fixed value 0.1 %
/N1	n1	27	Fixed value 0.0 %
/MF	mF	28	Free
/ME	mE	29	Free
/MD	md	2A	Free
/MC	mC	2B	Free
/MB	mb	2C	Free
/MA	mA	2D	Free
/M9	m9	2E	Free
/M8	m8	2F	Free
/M7	m7	30	Free
/M6	m6	31	Free
/M5	m5	32	Free
/M4	m4	33	Free
/M3	m3	34	Free
/M2	m2	35	Free
/M1	m1	36	Free
/M0	m0	37	Free
/E8	e8	38	(Input 8)
/E7	e7	39	(Input 7)
/E6	e6	3A	Input 6
/E5	e5	3B	Input 5
/E4	e4	3C	Input 4
/E3	e3	3D	Input 3
/E2	e2	3E	Input 2
/E1	e1	3F	Input 1

The free variables relate to the single-channel continuous controller. Binding information may be taken from the hook-up list in section 10.

Analog Variables

Variable	Hex	Function
A1 #	40	Output 1
A2 #	41	Output 2
A3 #	42	Output 3
A4 #	43	Output 4
B	44	B = E1 · K1 + C1
B.	45	Free
C	46	Free
C.	47	Free
C0	48	Free
C.0	49	Free
C1	4A	C1
C.1	4B	Free
C2	4C	C2
C.2	4D	Free
C3	4E	C3
C.3	4F	Free
C4	50	C4
C.4	51	Free
C5	52	Free
C.5	53	Free
C6	54	Free
C.6	55	Free
C7	56	Free
C.7	57	Free
C8	58	On/off controller
C.8	59	
C9	5A	
C.9	5B	
D	5C	W – WE
D.	5D	Free
DL #	5E	Left analog system display
D.L #	5F	Free
DR #	60	Right analog system display
D.R #	61	Free
DU #	62	Display across bottom
D.U #	63	Free
E	64	Difference x – w
E.	65	Free
F	66	Free
F.	67	Free
F1	68	Preparation for external control of output limits
F.1	69	
F2	6A	
F.2	6B	
F3	6C	
F.3	6D	
G1	6E	Alarm value 1
G.1	6F	Free
G2	70	Alarm value 2
G.2	71	Free
G3	72	Alarm value 3
G.3	73	Free
G4	74	Alarm value 4
G.4	75	Free
H	76	Free
H.	77	Free
I	78	Free
I.	79	Free
J	7A	Free
J.	7B	Free
K	7C	Free
K.	7D	Free
K0	7E	Free
K.0	7F	Free
K1	80	K1
K.1	81	Free
K2	82	K2
K.2	83	Free
K3	84	K3
K.3	85	Free

Analog Variables

Variable	Hex	Function
K4	86	K4
K.4	87	Free
K5	88	Free
K.5	89	Free
K6	8A	Free
K.6	8B	Free
K7	8C	Non-return pointer
K.7	8D	Free
K8	8E	Non-return pointer
K.8	8F	Free
KP	90	1/XP (not adjustable)
K.P	91	Free
L	92	Free
L.	93	Free
M	94	Intermediate variable for alarm value
M.	95	Intermediate variable for alarm value
M1	96	Intermediate variable for alarm value
M.1	97	Free
N	98	Transfer XD oder I XD I
N.	99	Free
N1	9A	Free
N.1	9B	Free
P	9C	Intermediate variable for w
P.	9D	Free
P0	9E	Free
P.0	9F	Free
P1	A0	P1 = E1 · K1
P.1	A1	Free
P2	A2	P2 = E2 · K2
P.2	A3	Free
P3	A4	P3 = E3 · K3 prepared
P.3	A5	Intermediate variable
P4	A6	P4 = E4 · K4 prepared
P.4	A7	Free
P5	A8	Free
P.5	A9	Free
P6	AA	Free
P.6	AB	Free
P7	AC	On/off controller
P.7	AD	
P8	AE	
P.8	AF	
P9	B0	
P.9	B1	
Q	B2	Intermediate variable for W
Q.	B3	Free
R	B4	Intermediate variable for W
R.	B5	Free
S #	B6	Disturbance variable feedforward to Y
S. #	B7	Free
T0	B8	Free
T.0	B9	Free
T1	BA	Free
T.1	BB	Free
T2	BC	Free
T.2	BD	Free
T3	BE	Free
T.3	BF	Free
T4	C0	Free
T.4	C1	Free
TD #	C2	Derivative action time
T.D #	C3	Free
TN #	C4	Integral action time
T.N #	C5	Free
TU	C6	Free
T.U	C7	Free
U	C8	Free
U.	C9	Free
V	CA	Free
V.	CB	Free

Analog variables

Variable	Hex	Function
V0	CC	Free
V.0	CD	Free
V1	CE	Free
V.1	CF	Free
V2	D0	Free
V.2	D1	Free
W	D2	Set point
W.	D3	Set point
W0	D4	Intermediate variable
W.0	D5	Free
W1	D6	Intermediate variable
W.1	D7	Free
W2	D8	Intermediate variable
W.2	D9	Free
WE	DA	WE = E2 · K2 + C2
W.E	DB	Free
WH	DC	Upper set point limit
W.H	DD	Free
WI	DE	Free
W.I	DF	Free
WL	E0	Lower set point limit
W.L	E1	Free
X	E2	Actual value X
X.	E3	Free
X0	E4	Non-return pointer
X.0	E5	Free
X1	E6	Non-return pointer
X.1	E7	Free
X2	E8	Free
X.2	E9	Free
XD #	EA	Control deviation X – W
X.D #	EB	Free
XP #	EC	Proportional range
X.P #	ED	Free
XU #	EE	Intermediate variable
X.U #	EF	Free
Y	F0	Controller output value
Y.	F1	Free
Y0 #	F2	Operating point
Y.0 #	F3	Free
Y1	F4	Free
Y.1	F5	Free
Y2	F6	Free
Y.2	F7	Free
YH #	F8	Upper output limit
Y.H #	F9	Free
YL #	FA	Lower output limit
Y.L #	FB	Free
YR #	FC	External feedback
Y.R #	FD	Free
Z	FE	Free
Z.	FF	Free

= Variable has fixed, unalterable meaning. Variables with a point and # may be used freely as long as only the first channel is enabled.

Binary variables

Variable	Hex	Byte	Function	described
'00	00H		Intermediate variable	
'01	01H		Intermediate variable	
'02	02H		Intermediate variable	8.7
'03	03H	1CH	Intermediate variable	
'04	04H		Intermediate variable	
'05	05H		Intermediate variable	
'06	06H		Intermediate variable	
'07	07H		Free	
'08	08H		Free	
'09	09H		Free	
'0A	0AH		Free	
'0B	0BH	1DH	Free	8.7
'0C	0CH		Free	
'0D	0DH		Free	
'0E	0EH		Free	
'0F	0FH		Free	
'10	10H		Free	
'11	11H		Free	
'12	12H		Free	
'13	13H	1EH	Free	8.7
'14	14H		Free	
'15	15H		Free	
OL2 #	16H		OL2 = 1 activates 2nd control loop on front	8.6
Q00 #	17H		Q00 = 1 sets output Q00	6.9
Q05 #	18H		Output Q05	
Q06 #	19H		Output Q06	
Q07 #	1AH		Output Q07	
Q08 #	1BH	1FH	Output Q08	8.2
Q09 #	1CH		Output Q09	
Q10 #	1DH		Output Q10	
Q11 #	1EH		Output Q11	
Q12 #	1FH		Output Q12	
BLX #	20H		1 = X pointer is switched off (flashing) } Enables flashing of displays	8.6
BLW #	21H		1 = W pointer is switched off	8.6
BLY #	22H		1 = Y pointer is switched off	8.6
BLD #	23H	20H	1 = 7-segment displays from s. 8744	8.6
Q01 #	24H		Alarm value 1 = Q01	8.2
Q02 #	25H		Alarm value 2 = Q02	8.2
Q03 #	26H		Alarm value 3 = Q03	8.2
Q04 #	27H		Alarm value 4 = Q04	8.2
SC1	28H		Free under "SC_1" } Assignable to digital as message	
SC2	29H		Free under "SC_2"	
SC3	2AH		Free under "SC_3"	
SC4	2BH	21H	Free under "SC_4"	8.6
AL1	2CH		Free under "AL_1"	
AL2	2DH		Free under "AL_2"	
AL3	2EH		Free under "AL_3"	
AL4	2FH		Free under "AL_4"	
YST #	30H		1 = y key one step further	8.3.3.4
FST #	31H		1 = F key one step further	8.3.3.4
WST #	32H		1 = W key one step further	8.3.3.4
YSM #	33H	22H	1 = Manual	8.3.3.4
YSA #	34H		1 = Automatic	8.3.3.4
WSI #	35H		1 = Internal	8.3.3.4
WSE #	36H		1 = External	8.3.3.4
OKD #	37H		1 = Transfer without flashing (without pause)	8.3.3.4
CC2 #	38H		Characteristic of loop 2 1 = falling INV	
CD2 #	39H		D action 2 on/off 1 = on	
CI2 #	3AH		I action 2 on/off 1 = on	
CT2 #	3BH	23H	Track bit 2 1 = on (Y. = Y.R)	8.5.3
CC1 #	3CH		Characteristic of loop 1 1 = falling INV	or
CD1 #	3DH		D action 1 on/off 1 = on	8.5.4
CI1 #	3EH		I action 1 on/off 1 = on	
CT1 #	3FH		Track bit 1 1 = on (Y = YR)	

= Variable has a fixed, unalterable meaning.

Binary variables

Binary variables 40H to FFH ca be used in configurations; their status (0 or 1) cannot, however, be directly changed by these.

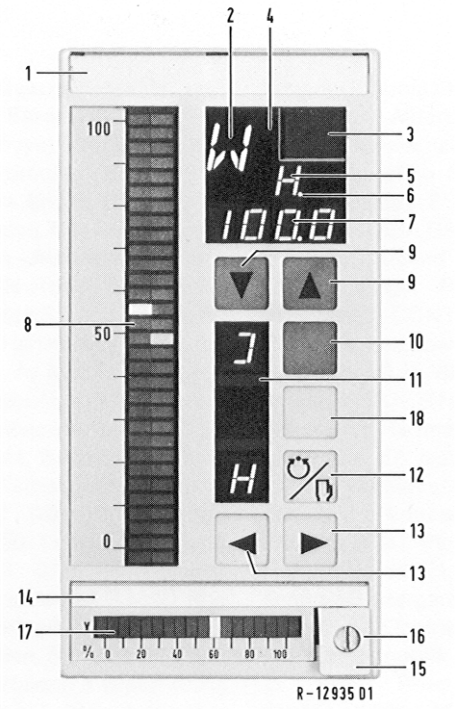
Variable	Hex	Byte	Function	described
T1S	40H	24H	Time register 1 s	8.3.1
T2S	41H		Time register 2 s	
T4S	42H		Time register 4 s	
T8S	43H		Time register 8 s	
THS	44H		Time register 16 s	
T1M	45H		Time register 1 min.	
T2M	46H		Time register 2 min.	
T4M	47H		Time register 4 min.	
			A pulse for the duration of cycle at the specified interval	
TF1	48H	25H	Flasher 1 5 Hz (100 ms on, 100 ms off)	8.3.1
TF2	49H		Flasher 2 2,5 Hz (200 ms on, 200 ms off)	
TF4	4AH		Flasher 3 1 Hz (400 ms on, 600 ms off)	
TF8	4BH		Flasher 4 1 Hz (200 ms on, 800 ms off)	
T01	4CH		Time register 0,1 s	
T02	4DH		Time register 0,2 s	
T04	4EH		Time register 0,4 s	
T0H	4FH		Time register 1,6 s	
			duration of a cycle at the specified interval	
C1D	50H	26H	Controller 1 "off"	8.3.2
C2E	51H		Controller 2 "on"	
ERF	52H		Error bit = Combination of errors as output Q00	
NFL	53H		Program lines off	
NDI	54H		Enable digital display	
N00	55H		Monitor and other routines on front	
NEC	56H		Reserved	
CTL	57H		CTL key	8.3.3.1
CL0	58H	27H	CLEAR 0	8.3.3.2
CL1	59H		CLEAR 1	
CL2	5AH		CLEAR 2	
CL3	5BH		CLEAR 3	
CL4	5CH		CLEAR 4	
SPA	5DH		STO PARAM	
RPA	5EH		RCL PARAM	
SPG	5FH		STO PROGM	
Y_0	60H	28H	Switch positions of Y switch 2nd channel	8.3.3.4 and 6.3
Y_1	61H			
Y_2	62H			
Y_3	63H			
Y_4	64H			
Y_5	65H			
Y_6	66H			
Y_7	67H			
F_0	68H	29H	Switch positions of F switch	8.3.3.4 and 6.3
F_1	69H			
F_2	6AH			
F_3	6BH			
F_4	6CH			
F_5	6DH			
F_6	6EH			
F_7	6FH			
W_0	70H	2AH	Switch positions of W switch	8.3.3.4 and 6.3
W_1	71H			
W_2	72H			
W_3	73H			
W_4	74H			
W_5	75H			
W_6	76H			
W_7	77H			
'78 #	78H	2BH	Index display	8.3.2
'79 #	79H		Left digit	
'7A #	7AH		Second digit	
'7B #	7BH		Third digit	
'7C #	7CH		Right digit	
'7D #	7DH		Display for W key	
'7E #	7EH		Display for F key	
'7F #	7FH		Display for Y key	
			Is 1 when decimal point at display position = on	

Binary variables

Variable	Hex	Byte	Function	described
KP1	80H	2CH	Display selector switch Key with down arrow Key with up arrow Int/Ext key F key Y key Key with arrow to right Key with arrow to left } Duration of key depression	8.3.3.4
KP2	81H			
KP3	82H			
KP4	83H			
KP5	84H			
KP6	85H			
KP7	86H			
KP8	87H			
KA1	88H	2DH	Display selector switch Key with down arrow Key with up arrow Int/Ext key F key Y key Key with arrow to right Key with arrow to left } Irrespective of the duration of key depression, the bit is set only for the duration of a cycle.	8.3.3.4
KA2	89H			
KA3	8AH			
KA4	8BH			
KA5	8CH			
KA6	8DH			
KA7	8EH			
KA8	8FH			
ET0	90H	2EH	"to" = Cycle time exceeded "Tc" = No telegram since (8706) sec "tS" = (8707) repeat telegrams "CS" = RS 232-C circuit board "dr" = RAM contents incorrect (8700H not 87H) "di" = Write protection switch set "S5" = Op code in wrong area "SC" = Undefined op code	8.4
ETC	91H			
ETS	92H			
ECS	93H			
EDR	94H			
EDI	95H			
ESS	96H			
ESC	97H			
'98 #	98H	2FH	} Internal general register	
'99 #	99H			
'9A #	9AH			
'9B #	9BH			
'9C #	9CH			
'9D #	9DH			
'9E #	9EH			
'9F #	9FH			
D00	A0H	30H	"nn" = Binary input D0 "A1" = A1 load too high "A2" = A2 load too high "UG" = Error bit transmitter supply "I1" = Interface module 1 malfunctioning "I.1" = Interface module 1 defective "I2" = Interface module 2 malfunctioning "I.2" = Interface module 2 defective	8.4
EA1	A1H			
EA2	A2H			
EUG	A3H			
EI1	A4H			
EJ1	A5H			
EI2	A6H			
EJ2	A7H			
ELE	A8H	31H	"LE" = Error bit inputs less than 0 "AU" = Error bit output supervision "nA" = Unsuccessful read/write access "PE" = Program derailment "rr" = Frequent reset "bA" = Error bit battery "LP" = Error bit power supply too low "H_" = Error bit hardware fault	8.4
EAU	A9H			
ENA	AAH			
EPE	ABH			
ERR	ACH			
EBA	ADH			
ELP	AEH			
E_H	AFH			
E_6	B0H	32H	Reserved "–5" = Error programmer "–4" = After new program standardization "–3" = Serial port "on" at front, "off" at back "–2" = No processing of interconnection "–1" = Initial program loading has taken place "rt" = Error bit clock not going "FC" = E(E)PROM fault (IC 19)	8.4
E_5	B1H			
E_4	B2H			
E_3	B3H			
E_2	B4H			
E00	B5H			
ERT	B6H			
EFP	B7H			
LLL	B8H	33H	Binary 0 = 1 in first cycles after hold and return of power = 1 in first 256 cycles after return of power = 1 in first n cycles (n in 87D9) after return of power = 1 in first n cycles with return of power after failure = 0.8 s = 1 in first n cycles with Er.00 (see Operatins Manual) Timing mark 1 Timing mark 2	8.3.2
I00	B9H			
IFF	BAH			
IUD	BBH			
IPD	BCH			
III	BDH			
MT1	BEH			
MT2	BFH			

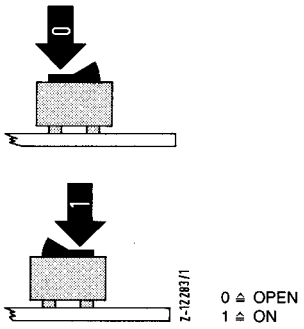
Binary variables

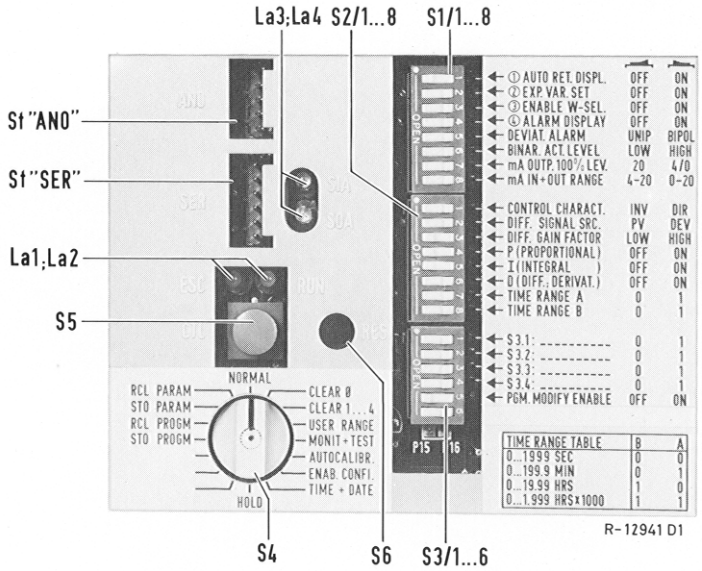
Variable	Hex	Byte	Function	described
'C0	C0H		Previous switch position of S4 (Hold = 0, continues clockwise)	8.3.3.2
'C1	C1H			
'C2	C2H			
'C3	C3H	34H		
'C4	C4H		Current switch position of S4 (Hold = 0, continues clockwise)	
'C5	C5H			
'C6	C6H			
'C7	C7H			
S31	C8H		Switch S3/1	8.3.3.3
S32	C9H		Switch S3/2	
S33	CAH		Switch S3/3	
S34	CBH	35H	Switch S3/4	
S41	CCH		Switch S4/1 1	8.3.2
S42	CDH		Switch S4/2 2	
S44	CEH		Switch S4/4 4	
S48	CFH		Switch S4/8 8	
S21	D0H		Switch S2/1	8.3.3.3
S22	D1H		Switch S2/2	
S23	D2H		Switch S2/3	
S24	D3H	36H	Switch S2/4	
S25	D4H		Switch S2/5	
S26	D5H		Switch S2/6	
S27	D6H		Switch S2/7	
S2/8	D7H		Switch S2/8	
S11	D8H		Switch S1/1	8.3.3.3
S12	D9H		Switch S1/2	
S13	DAH		Switch S1/3	
S14	DBH	37H	Switch S1/4	
S15	DCH		Switch S1/5	
S16	DDH		Switch S1/6	
S17	DEH		Switch S1/7	
S18	DFH		Switch S1/8	
R11	E0H		Bit "+" step action controller 1	8.5.1
R12	E1H		Bit "−"	
R13	E2H		Reserved	
R14	E3H	38H	Reserved	
R21	E4H		Bit "+" step action controller 2	
R22	E5H		Bit "−"	
R23	E6H		Reserved	
R24	E7H		Reserved	
P21	E8H		1 Set by PW. Binary function programmer 2	8.5.2
P22	E9H		2	
P23	EAH		4	
P24	EBH	39H	8	
P25	ECH		1 Set by PT. Binary function programmer 2	
P26	EDH		2	
P27	EEH		4	
P28	EFH		8	
P11	F0H		1 Set by PW. Binary function programmer 1	8.5.2
P12	F1H		2	
P13	F2H		4	
P14	F3H	3AH	8	
P15	F4H		1 Set by PT. Binary function programmer 1	
P16	F5H		2	
P17	F6H		4	
P18	F7H		8	
D01	F8H		Binary input D01	8.1
D02	F9H		Binary input D02	
D03	FAH		Binary input D03	
D04	FBH	3BH	Binary input D04	
D05	FCH		Binary input D05	
D06	FDH		Binary input D06	
D07	FEH		Binary input D07	
D08	FFH		Binary input D08	



Front view

1 Top legend plate
2 Code letter display
3 Selector switch for digital display
4 Digital display field
5 Index for code letters
6 Decimal point for 5, lights up when the variable displayed by 2 and 5 is adjustable
7 Four-digit display
8 Analog display: actual value red
set point green
9 "Raise/lower" keys for set point and parameter
10 Set point selection (int./ext. key) (can be inhibited)
11 Status display
12 Manual/automatic transfer (Mode selector switch)
13 "Raise/lower" keys for output variable
14 Lower legend plate
15 Handle for removal
16 Module locking screw (E)
17 Output variable display
18 Multi-function key (F-key)





Display and manual control elements of the processing electronics

Subject to technical changes.

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