

# Manual AP40

## Display Controller



- 8 Digit display in DIN-enclosure 96 X 48 mm
- Supply voltage 10 – 35V DC
- All in- and outputs optically isolated
- Input for absolute SSI encoders, incremental encoders, analog and Start/Stop sensors
- CAN-bus, RS232, RS422/RS485
- 4 Digital inputs and 4 digital outputs
- 24 Programmable cams / 4 outputs
- 48 Programmable nominal values
- Dynamic cam-adjustment (cycle time 250 $\mu$ S)
- Programmable analog input (16 bit)
- Programmable analog output (16 bit)
- Programmable Linearization function

## Table of contents

<b>1</b>	<b>Introduction.....</b>	<b>6</b>
1.1	GENERAL.....	6
1.2	IMPORTANT INFORMATION .....	7
1.3	EMC .....	7
1.4	DEFINITIONS.....	7
1.4.1	<i>Display units AWE</i> .....	7
1.4.2	<i>Parameter number</i> .....	7
1.4.3	<i>Notation</i> .....	8
1.4.4	<i>Edges</i> .....	8
<b>2</b>	<b>Operation.....</b>	<b>9</b>
2.1	KEY FUNCTIONS .....	9
2.2	KEY FUNCTIONS IN PROGRAMMING MODE .....	10
2.3	DISPLAY FUNCTIONS.....	11
2.3.1	<i>Status functions</i> .....	11
2.3.2	<i>Error messages</i> .....	11
2.3.3	<i>Survey of error messages</i> .....	12
<b>3</b>	<b>Programming .....</b>	<b>14</b>
3.1	AUTOMATIC MODE .....	14
3.1.1	<i>Monitor function</i> .....	15
3.1.2	<i>Displaying the type number</i> .....	16
3.1.3	<i>Displaying the software-version</i> .....	16
3.1.4	<i>Status in- and outputs</i> .....	17
3.2	CHANGING NOMINAL VALUES.....	18
3.3	CHANGING PARAMETERS .....	19
3.3.1	<i>Menus</i> .....	19
3.3.2	<i>Input parameters</i> .....	20
<b>4</b>	<b>Functions.....</b>	<b>21</b>
4.1	BASIC FUNCTION .....	21
4.2	ACTUAL POSITION .....	24
4.3	VELOCITY MEASUREMENT.....	24
4.4	DISPLAY MULTIPLICATOR.....	25
4.5	DISPLAYING ACTUAL VELOCITY .....	25
4.6	DISPLAYING 1/F FUNCTION (TIME MEASUREMENT) .....	25
4.7	MULTIPLICATOR .....	27
4.8	POWER FAILURE PROTECTION .....	27
4.9	EDGE MULTIPLICATION (COUNTER INPUT) .....	28
4.10	PRESET (COUNTER INPUT AND INTERNAL FREQUENCY).....	29
4.10.1	<i>Preset using input K0</i> .....	29
4.10.2	<i>Preset using service parameter P[207]</i> .....	29
4.10.3	<i>Preset using front keys</i> .....	30
4.10.4	<i>Preset using input 1...4</i> .....	30
4.11	COUNTING RANGE (COUNTER INPUT AND INTERNAL FREQUENCY).....	31
4.11.1	<i>Set counting range by parameter "Counting range" P[004]</i> .....	31
4.11.2	<i>Set counting range by nominal value</i> .....	32
4.12	NUMBER OF BITS SSI.....	32
4.13	SSI MONITORING .....	33
4.13.1	<i>Output "SSI error"</i> .....	34

4.13.2	Reset "SSI error" .....	34
4.14	JUSTAGE ABSOLUTE SENSORS .....	34
4.14.1	Preset using the parameter "Adjustment absolute value" .....	34
4.14.2	Using the input K0 .....	35
4.14.3	Using service parameter P[207] .....	35
4.14.4	Justage using front keys .....	36
4.14.5	Justage using input 1...4 .....	36
4.15	MIN/MAX LIMIT FOR ACTUAL POSITION .....	36
4.16	CAN-BUS .....	37
4.16.1	AP-Link .....	37
4.16.2	Start/Stop sensor .....	39
4.17	ASCII PROTOCOL .....	40
4.17.1	Overview functions .....	40
4.17.2	General .....	41
4.17.3	Functions .....	42
4.17.4	Error messages .....	48
4.18	ANALOG INPUT .....	49
4.18.1	Voltage input .....	50
4.18.2	Current input .....	51
4.18.3	Example analog conversion .....	52
4.19	ANALOG OUTPUT .....	53
4.19.1	Voltage output .....	53
4.19.2	Current output .....	54
4.19.3	Example programming voltage output .....	55
4.20	TEACH FUNCTION ANALOG OUTPUT .....	55
4.21	CAMS .....	56
4.21.1	General .....	56
4.21.2	Cam with start- and end-value .....	56
4.21.3	Greater than or equal to limit value .....	57
4.21.4	Smaller than or equal to limit value .....	57
4.21.5	Dynamic cams .....	58
4.21.6	Start/stop cam .....	59
4.21.7	Output "Cams active" .....	59
4.21.8	Relative cams .....	60
4.22	EXTERNAL THUMBWHEEL SETS .....	62
4.22.1	General .....	62
4.22.2	Connecting thumbwheel sets .....	62
4.22.3	Parameter settings .....	63
4.23	LINEARIZATION .....	64
4.23.1	mode 0 "4-Quadrant" .....	65
4.23.2	mode 1 "Mirror Y-axis" .....	66
4.23.3	mode 2 "Mirror XY-axis" .....	66
5	Parameters .....	67
5.1	MENU 1 CONFIG .....	67
5.2	MENU 2 ACTUAL .....	70
5.2.1	Submenu 2.1 Counter .....	70
5.2.2	Submenu 2.2 SSI .....	71
5.2.3	Submenu 2.3 Internal frequency .....	73
5.2.4	Submenu 2.4 Analog .....	75
5.2.5	Submenu 2.5 CAN AP-Link .....	76

5.2.6	Submenu 2.6 Start/Stop .....	76
5.3	MENU 3 CAN-BUS .....	78
5.4	SUBMENU 3.1 CONFIG .....	78
5.5	SUBMENU 3.2 OBJ1/PDO1 IN .....	78
5.6	SUBMENU 3.3 OBJ1/PDO1 OUT .....	78
5.7	MENU 4 SERIAL .....	79
5.7.1	Submenu 4.1 Config .....	79
5.7.2	Submenu 4.2 Ser-1 (RS232) .....	79
5.7.3	Submenu 4.3 Ser-2 (RS422/485) .....	80
5.8	MENU 5 INPUT .....	81
5.9	MENU 6 OUTPUT .....	82
5.9.1	Submenu 6.1 – 6.4 Op1...4 .....	82
5.10	MENU 7 ANALOG INPUT .....	83
5.10.1	Submenu 7.1 Config .....	83
5.10.2	Submenu 7.2 AD-U (voltage) .....	83
5.10.3	Submenu 7.2 AD-I (current) .....	84
5.11	MENU 8 ANALOG OUTPUT .....	85
5.11.1	Submenu 8.1 Config .....	85
5.11.2	Submenu 8.2 DA-U (voltage) .....	85
5.11.3	Submenu 8.3 DA-I (current) .....	86
5.12	MENU 9 CAM .....	87
5.12.1	Submenu 9.1 ... 9.24 CA1...24 .....	87
5.13	MENU 10 EXTERNAL THUMBWHEEL SETS .....	88
5.13.1	Submenu 10.1 Config .....	88
5.13.2	Submenu 10.2 ... 10.4 Set-1...4 .....	89
5.14	MENU 8 LINEARIZATION .....	90
5.14.1	Submenu 8.1 Config .....	90
5.14.2	Submenu 11.2 ... 11.31 P1...P30 .....	90
5.15	OVERVIEW PARAMETERS .....	91
<b>6</b>	<b>Connections .....</b>	<b>94</b>
6.1	OVERVIEW CLAMP CONNECTIONS .....	95
6.2	SUPPLY .....	97
6.3	SSI INPUT .....	98
6.4	SSI ENCODER 24V .....	98
6.5	COUNTING INPUT .....	99
6.6	ENCODER 5V WITH INVERTED SIGNALS .....	99
6.7	ENCODER 5V WITHOUT INVERTED SIGNALS .....	100
6.8	ENCODER 10 – 30V .....	100
6.9	START/STOP SENSOR .....	101
6.10	DIGITAL INPUTS .....	102
6.11	DIGITAL OUTPUTS .....	102
6.12	ANALOG INPUT .....	103
6.13	ANALOG OUTPUT .....	103
6.14	CAN-BUS .....	104
6.15	RS232 SER-1 .....	104
6.16	RS422/485 SER-2 .....	105
<b>7</b>	<b>Technical specifications .....</b>	<b>106</b>
7.1	SPECIFICATIONS .....	106
7.2	TYPEKEY .....	109

7.3 TYPEKEY THUMBWHEEL SETS ..... 109

7.4 DIMENSIONS AP40 ..... 110

7.5 DIMENSIONS EMC BRACKET TYPE EMC-B04..... 111

    7.5.1 Connections RS232, RS422/485 on 9P sub-D connector..... 112

7.6 DIMENSIONS THUMBWHEEL SWITCHES APD-XX ..... 113

7.7 DIMENSIONS PROTECTIVE HOOD TYPE CDS-B02..... 114

## 1 Introduction

### 1.1 General

With the microcontroller based AP40 it is possible to connect the following encoder types:

- Incremental with quadrature (two 90°) signals
- Incremental with pulssignal and directionsignal
- Absolute with SSI (Synchron Serial Interface)
- Absolute with start/stop (MTS Sensors)
- Absolute with analogsignal

It is standard equipped with 4 digital inputs and 4 digital outputs, all free programmable. The AP40 features a CAN-bus, RS232 communication, RS422/485 communication, and a analog in- and output. All in- and outputs, including the communication-ports, are electrically isolated.

With the 24 programmable cams several functions can be realized like limit detection.

Another feature of the AP40 is the memory for the nominal values. The 48 programmable values can be used to determine the positions of the cams.

Up to 4 values can be read from external thumbwheel switches. These values can be used as positions for the cams or as preset values.

The microcontroller reads the actual sensor value and calculates the display-value and the actual velocity. A programmable power failure protection makes sure that the actual value is stored in an EEPROM. The AP40 is configurable for numerous applications by adjusting its parameters.

The AP40 can be programmed with the DST40 PC-based software.

## 1.2 Important information

- ✓ The AP40 is a high-tech electronic product. To ensure safety and a correct functioning of the product it is important that only qualified specialists will install and operate the AP40.
- ✓ If through a failure or fault of the AP40 an endangering of persons or damage to plant is possible, this must be prevented using additional safety measures. These must remain operational in all possible modes of the AP40.
- ✓ Necessary repairs to the AP40 are only to be carried out by the manufacturer.

## 1.3 EMC

To ensure the best possible electromagnetic compatibility, it is recommended to pay attention to shielding and grounding the AP40:

- ✓ Shielding on both sides and with the largest possible contact area.
- ✓ Keep wiring as short as possible.
- ✓ Earth-connections should be short and with the highest possible wiring-diameter.
- ✓ Signal-cables and supply-cables must be separated.
- ✓ The EMC-bracket type EMC-B04 should be used.

## 1.4 Definitions

### 1.4.1 Display units AWE

The display units, referred to as AWE, is the value shown on the display without regarding the decimal point. The decimal point is only used for the comfort of the operator, but has no functional meaning.  
(display = 347.4 >> AWE = 3474)

### 1.4.2 Parameter number

A parameter number is always shown in the format P[xxx]. It is possible that a parameter number appears in more than one menu.

### **1.4.3 Notation**

Values can be displayed in different notations like binary or hexadecimal. The character behind the value shows in which notation the value is represented:

100D	<u>D</u> ecimal
238H	<u>H</u> exadecimal
244G	<u>G</u> ray
10010011B	<u>B</u> inary

*for example 220D = DCH = 11011100B*

### **1.4.4 Edges**

L→H	: rising edge (low to high)
H→L	: falling edge (high to low)



## 2 Operation

### 2.1 Key functions



[P] key

- Cycle through monitoring displays
- Activate programming mode (in combination with other keys)



[+1] key

- View type number



[Cursor] key

- View software version
- View custom software version (in combination with the [Enter] key)



[Enter] key

- View status of inputs and outputs

## ***2.2 Key functions in programming mode***



[P] key

- one step back in menu
- discontinue programming mode
- discontinue changing nominal values/parameters (edit mode)
- LED is on when programming mode is active



[+1] key

- cycle through menu
- increase nominal value- / parameter number
- increase digit (in edit mode)



[Cursor] key

- activate edit mode
- move one digit to the left (in edit mode)

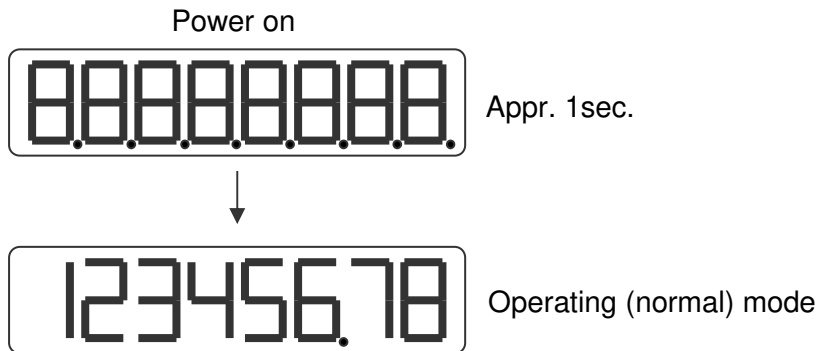


[Enter] key

- enter a submenu or parameter
- increase nominal value-/parameter number
- store a changed value
- clear value, hold down [Cursor] button (edit mode)

## 2.3 Display functions

### 2.3.1 Status functions

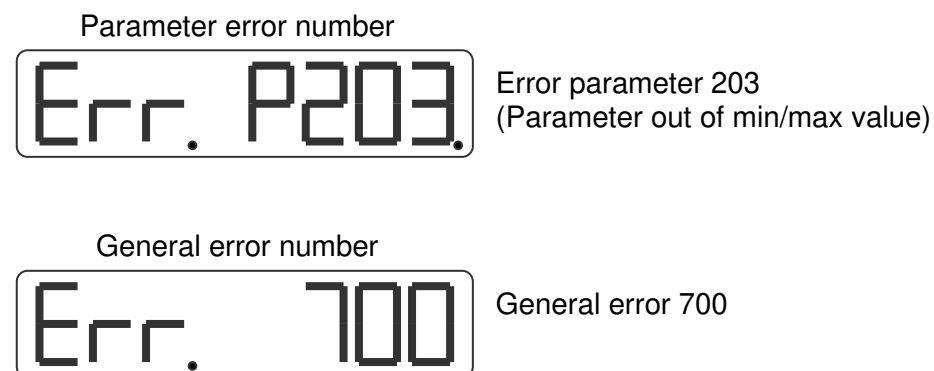


### 2.3.2 Error messages

There are two groups of errors:

- Parameter errors (error numbers 0...499, preceded by a "P")
- General error (error numbers from 500 and up)

Example:



### **2.3.3 Survey of error messages**

#### Error no:

000...499 Parameter error is displayed as PXXX on the display.

700 = Reference value P[003]  $\geq$  Counting range P[004]

701 = Adjustment value SSI P[005]  $\geq$  Counting range  
or Adjustment SSI P[005]  $<$  Offset P[002] (only if adjustment  
type = 1,2, or 4)

702 = Adjustment value parallel P[005]  $\geq$  Counting range

703 = Number of active SSI databits  $>$  number of SSI Clock pulses

704 = Transmitting and receiving with AP-Link not possible with the  
same adress

705 = Offset SSI P[002]  $>$  Counting range

708 = No Hold-Reset possible (only possible with incremental and  
internal frequency)

716 = Umin  $\geq$  Umax (analog output)

717 = Imin  $\geq$  Imax (analog output)

720 = Changelock nominal values active

721 = Changelock parameters active

725 = Serial RS232 and RS485 both with ASCII at the same time not possible

726 = U1  $\geq$  U2 (analog input)

727 = I1  $\geq$  I2 (analog input)

732 = Function input-2 not valid (equal to input-1)

733 = Function input-3 not valid (equal to input-1...input-2)

734 = Function input-4 not valid (equal to input-1...input-3)

800 = SSI error delta-s

801 = SSI error cable failure

810 = Start/Stop error no magnet detected

811 = Start/Stop error time-out no stop signal detected

Error messages linearization (xx = P1 ...P30)

9xx = Linearization  $X_n \leq X_{n-1}$

940 = Linearization (mode 1 or 2)  $X_1 < 0$

941 = Linearization mode 1)  $Y_1 < 0$

Error messages for cams (last 2 digits = cam number)

1001...1012      length cam = 0 (cam begin = cam end) or  
cam begin  $\leq$  cam end (with no counting range active)

1101...1112      length cam  $\leq$  Hysteresis

1201...1212       $(2 * \text{hysteresis}) + \text{cam length} \geq \text{counting range}$

1301...1312      cam begin and/or cam end outside counting range  
(incl. hysteresis)

Error messages ASCII

er 1 = parity error

er 2 = frame error

er 3 = overflow error

er 4 = buffer overrun

er 5 = number invalid

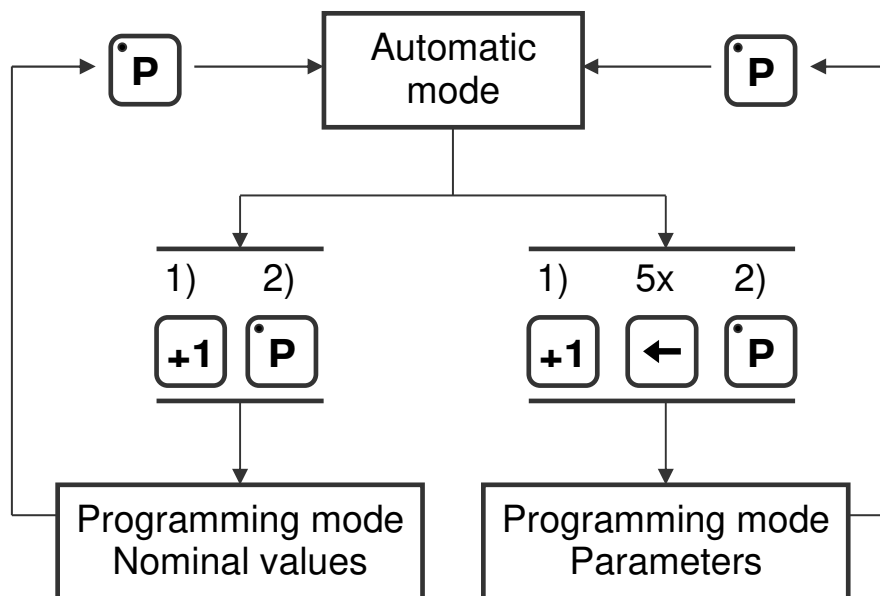
er 6 = data invalid (outside min/max value)

er 7 = programming mode parameters/nominal values active

### 3 Programming

There are three different modes of operation:

- Automatic mode
- Programming mode for nominal values
- Programming mode for parameters



1) hold

2) press once

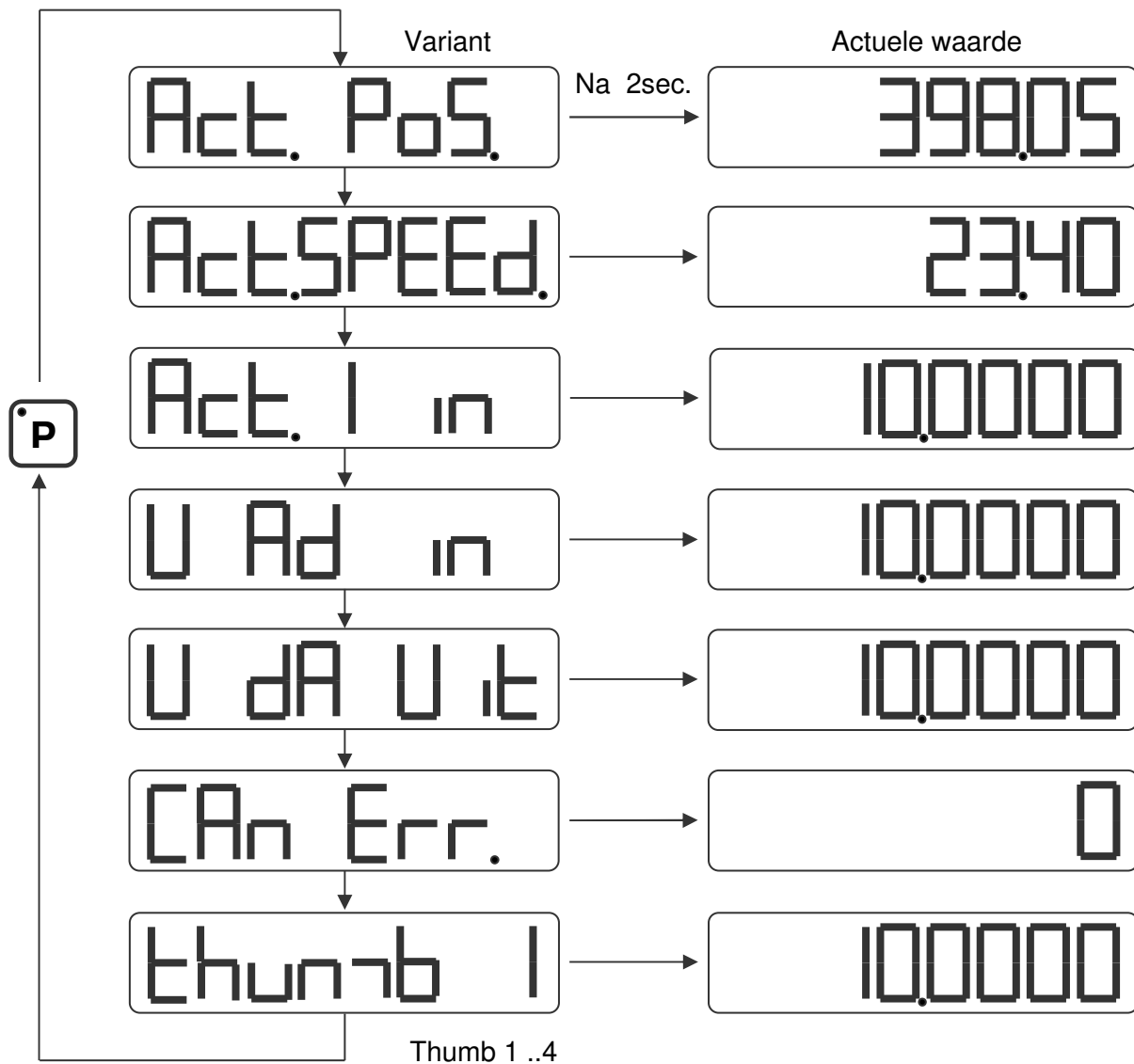
#### 3.1 Automatic mode

In the automatic mode, depending on the type of sensor, the increments are counted or the absolute position is read and the result is shown on the display as the actual value. The velocity is calculated and can be visualized as well.

### 3.1.1 Monitor function

In automatic mode different variables can be displayed. By using the [P] key one can cycle through the different pages:

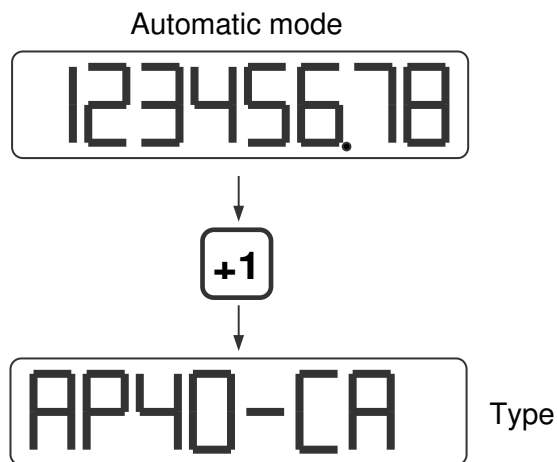
- Actual position
- Actual velocity
- Actual linearization
- Voltage or current of the AD (analog in)
- Voltage or current of the DA (analog out)
- CANbus error
- Actual values thumbwheel sets



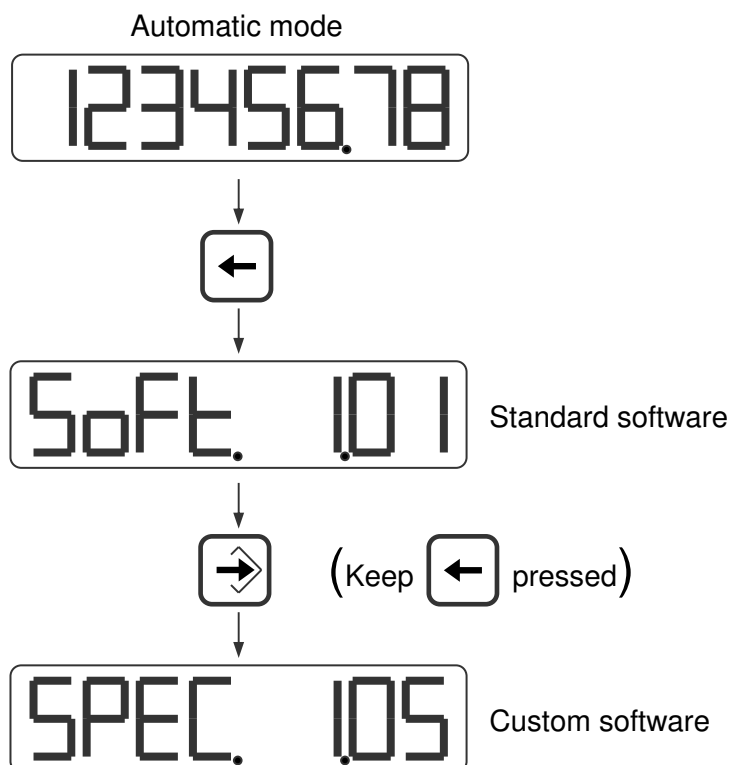
Parameter P[208] determines which option is visible after start-up.

Parameter P[222] determines which option "Act.SPEED" or "Act time" is displayed.

### 3.1.2 *Displaying the type number*

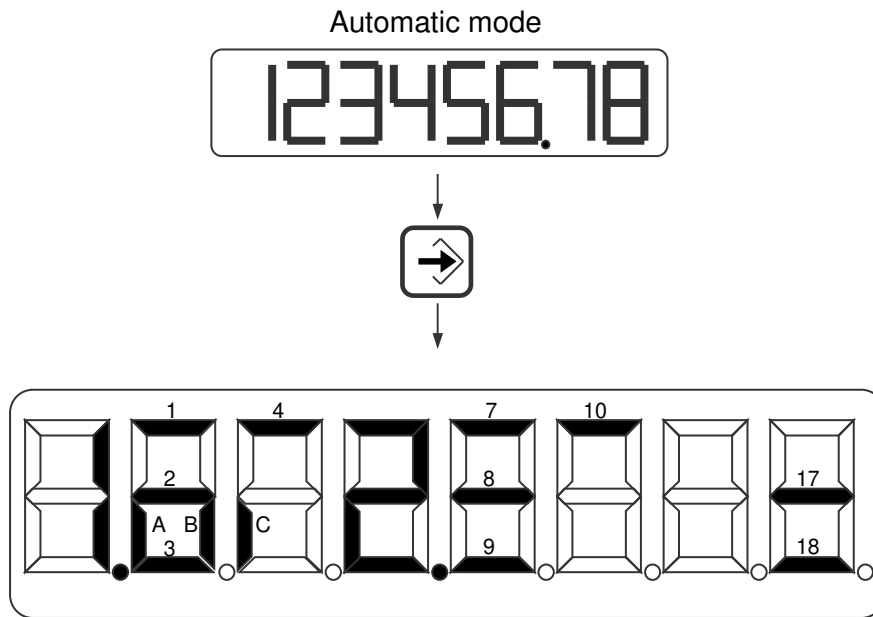


### 3.1.3 *Displaying the software-version*





## 3.1.4 Status in- and outputs



### Inputs

1 = input-1  
 2 = input-2  
 3 = input-3  
 4 = input-4  
 A = input K1  
 B = input K2  
 C = input K0

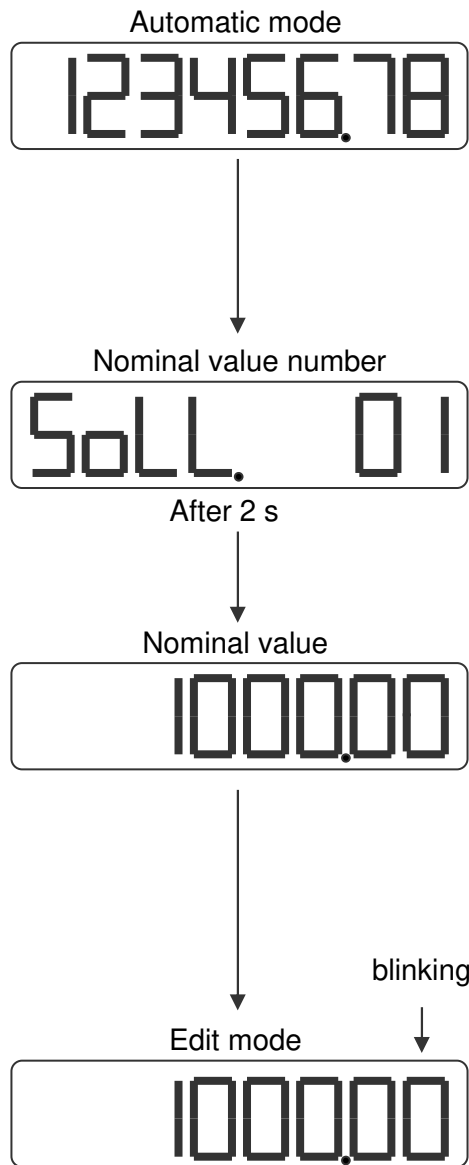
### Outputs

7 = output-1  
 8 = output -2  
 9 = output -3  
 10 = output -4

### Outputs

17 = Hold/Reset active  
 18 = Cams active

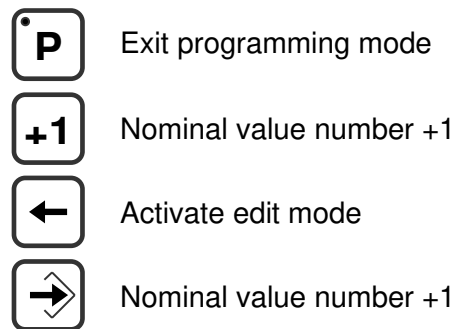
### 3.2 Changing nominal values



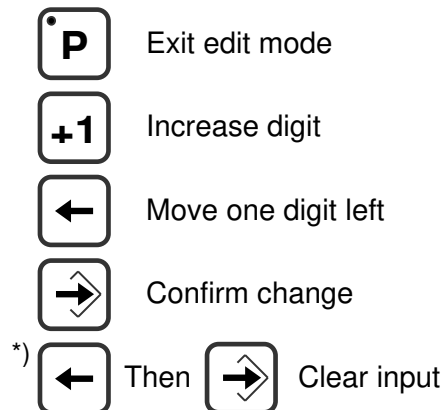
#### Access to nominal values



#### Select nominal values



#### Changing values



\*) keep pressed

### 3.3 Changing parameters

#### 3.3.1 Menus

The parameters are displayed in different menus and submenus:

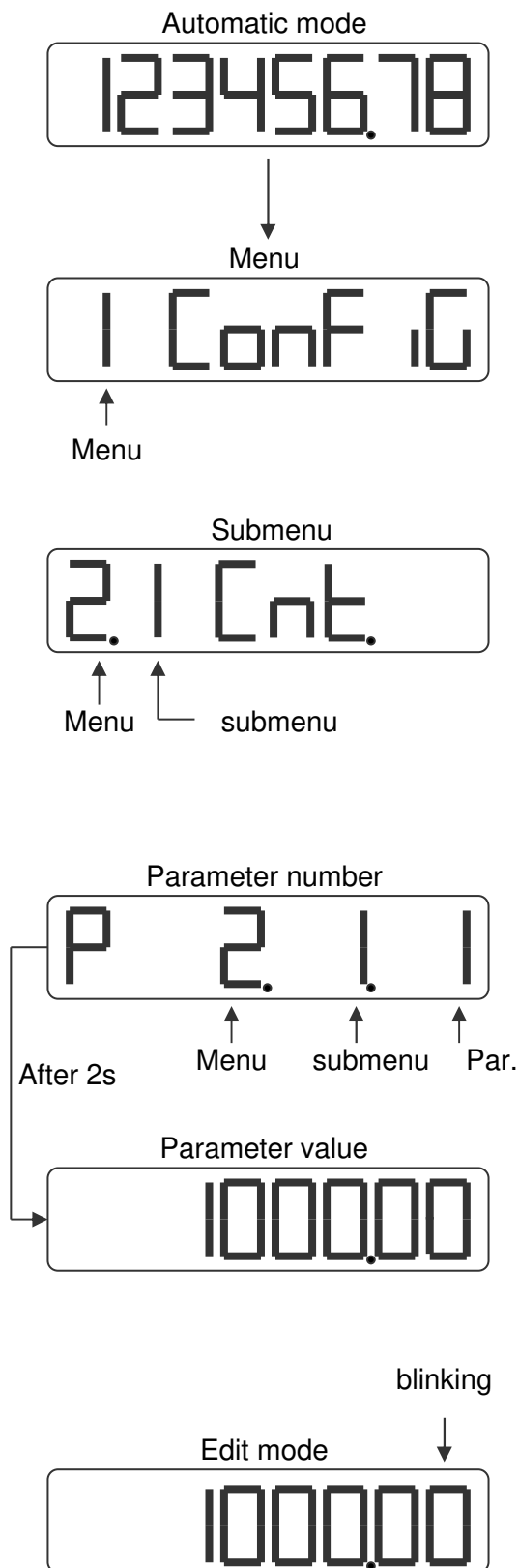
1 ConFiG	10 D-SEt
2 ActuaL	10.1 ConF.
2.1 Cnt.	10.2 SEt-1
2.2 SSI	10.3 SEt-2
2.3 FrEG.	10.4 SEt-3
2.4 Ana.	10.5 SEt-4
2.5 CAnAP	11 Lin
2.6 StStP	11.1 Conf
3 CAnbus	11.2 P 1
3.1 ConFG.	... ..
3.2 Obj/PDO in	... ..
3.3 Obj/PDO out	11.31 P30
4 SEriAL	
4.1 ConFG.	
4.2 SEr-1	
4.3 SEr-2	
5 InPut	
6 OutPut	
6.1 OP1	
6.2 op2	
6.3 op3	
6.4 OP4	
7 An in	
7.1 ConFG.	
7.2 Ad-U	
7.2 Ad-I	
8 An out	
8.1 ConFG.	
8.2 dA-U	
8.3 dA-I	
9 Cam	
9.1 CA1	
... ..	
... ..	
9.24 CA24	

*Example:*

*PAr. 6.1.1 means*

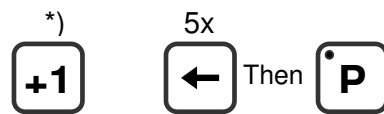
*menu 6, submenu 1, parameter 1*

### 3.3.2 Input parameters

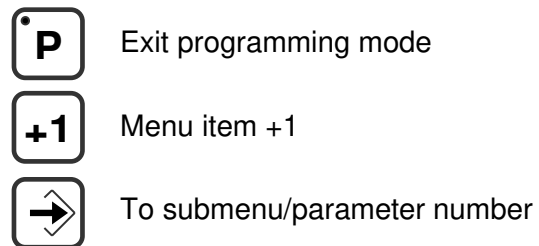


\*) keep pressed down

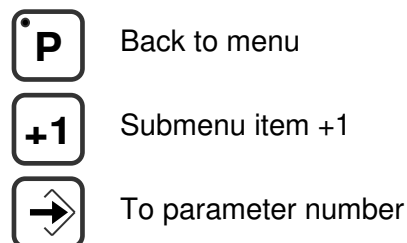
#### Access parameters



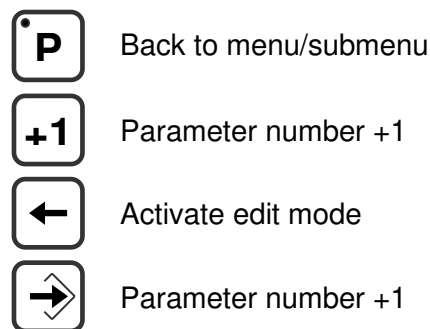
#### Menu selection



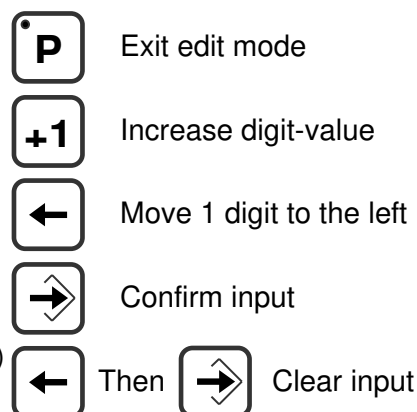
#### Submenu selection



#### Selecting parameters



#### Changing parameters



## 4 Functions

### 4.1 Basic function

The basic function of the AP40 is programmed at P[200].

Factory setting P[200] = 0, where the sensor-value will be shown on the display.

When using the counter-input or internal frequency (P[201] = 0 or 2) there is a special function available called "Hold/Reset". In this function the displayed value will be refreshed based upon an external start- and stopsignal.

start: internal countervalue is set to 0

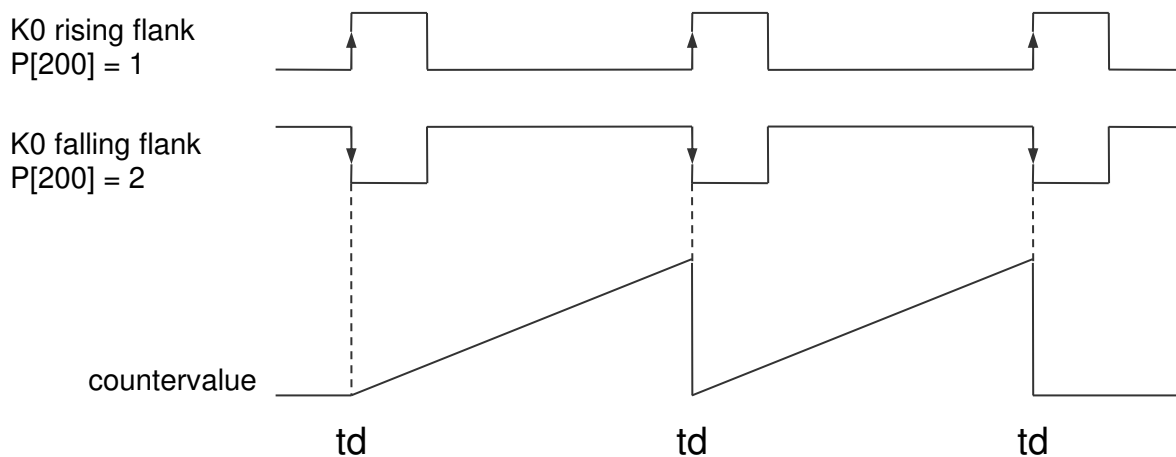
stop: display will be refreshed with internal countervalue

#### **Standard** (P[200] = 0)

Standard function.

#### **Hold/Reset K0 L → H and Hold/Reset K0 H → L** (P[200] = 1 or 2)

Hold/Reset start and stop with rising- or falling flank from input K0

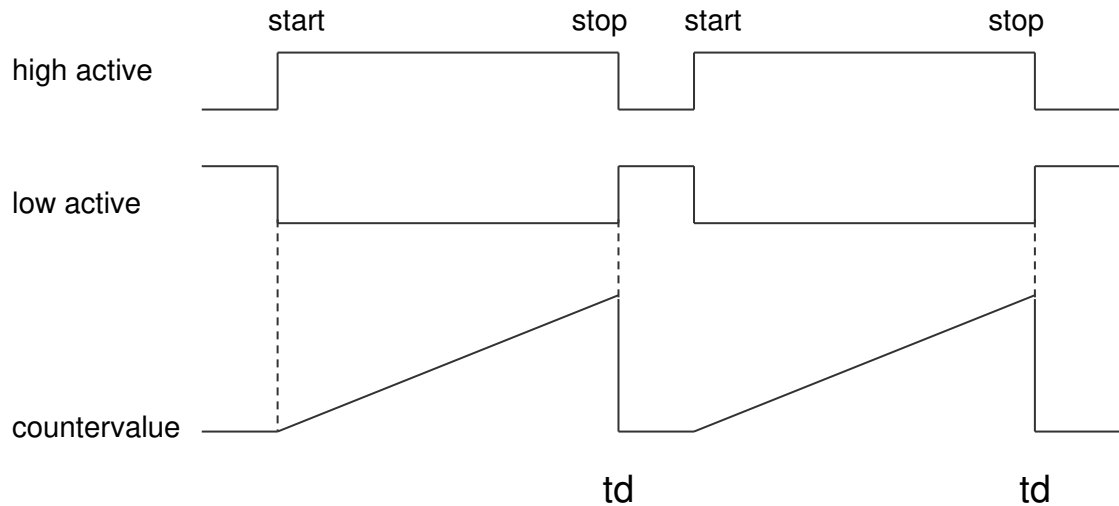


td = countervalue → display

If the Hold/Reset function 3...6 is active, the inputs for start and stop will have to be selected with P[249] ... [254].

### **Hold/Reset start/stop H and Hold/Reset start/stop L** (P[200] = 3 or 4)

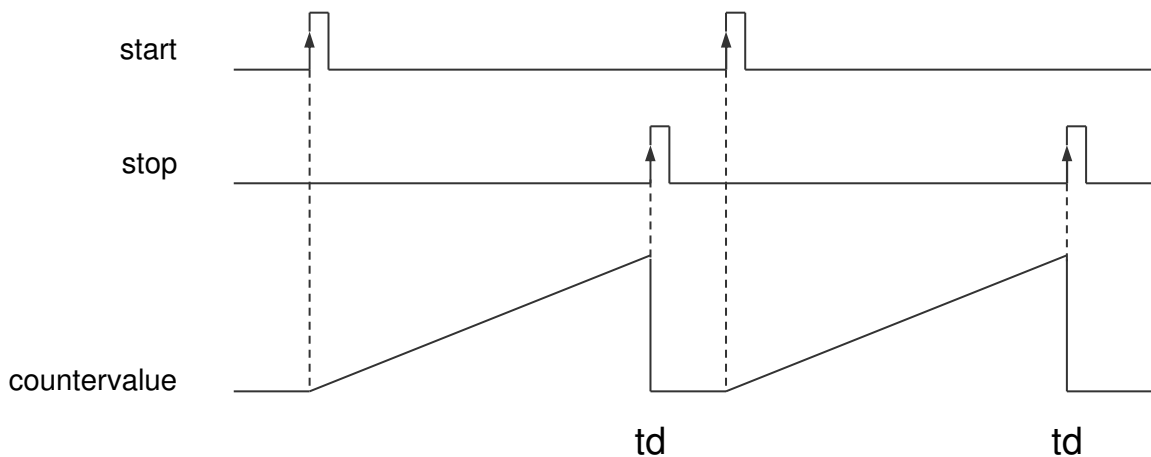
Hold/Reset start and stop using input (1...6) high and low active



td = countervalue → display

### **Hold/Reset start/stop L → H** (P[200] = 5)

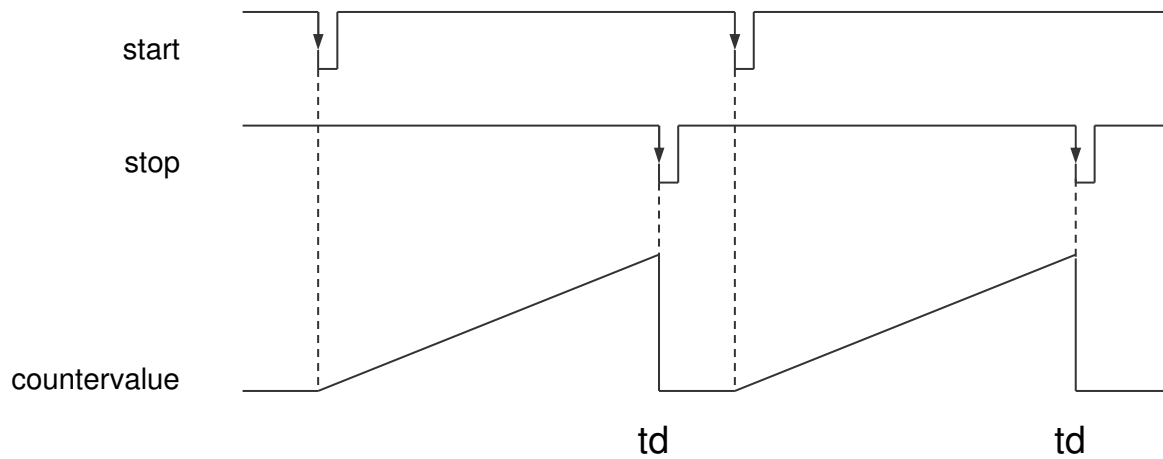
Hold/Reset start and stop using input 1...6 rising flank.



td = countervalue → display

## Hold/Reset start/stop H → L (P[200] = 6)

Hold/Reset start and stop using input 1...6 falling flank



td = countervalue → display

## 4.2 Actual position

The actual position shown on the display is depending on the selected sensor input (P[201]) and several parameters.

Counterinput and internal frequency:

$$\text{Actual position} = \text{Counter} \times \text{FL} \times \text{dir} \times \frac{\text{Mt}}{\text{Mn}}$$

SSI, Start/Stop and analog input:

$$\text{Actual position} = \text{input} \times \text{dir} \times \frac{\text{Mt}}{\text{Mn}} + \text{N}$$

FL	= edgemultiplier	P[210]
Mt	= multiplicator numerator	P[000]
Mn	= multiplicator denominator	P[001]
N	= offset	P[002]
dir	= direction (x1 or x -1)	P[211]

## 4.3 Velocity measurement

The velocity measurement is always active and delivers the actual speed in AWE/s.

Two parameters are necessary to configure the measurement:

### **P[088] = measuring time [AWE/s]**

The smaller the measurement time the more dynamic the velocity measurement will be. This time is also the refreshment-interval on the display.

### **P[202] = integrator**

The number of cycles are programmed. The average velocity (unit =AWE/s) of the programmed cycles is calculated.

*Example:*

*Measurement time = 50ms, integrator = 10.*

*The actual velocity will be refreshed every 50 ms and is the average velocity during the last 10 measurements.*



#### **4.4 Display multiplier**

The display multiplier can be programmed for the actual position and actual velocity in order to have an internal resolution which is higher than shown on the display.

##### **P[398] = Display multiplier**

0 = no function

1 = actual position + actual velocity x 0,1

2 = actual position + actual velocity x 0,01

3 = actual position + actual velocity x 0,001

#### **4.5 Displaying Actual Velocity**

Active when: **P[222] Function velocity measurement** = variant: "0  
**Standard**"

The actual velocity can be displayed using the [P]-key (always AWE/s)  
Parameter P[223] has no influence.

#### **4.6 Displaying 1/f function (time measurement)**

Active when:

**P[222] ] Function velocity measurement** = variant: "1 1/f time  
**measurement**"

The value 1/f will be displayed based upon the velocity measurement, which is in AWE/s. The result is a time and reciprocal to the frequency.

It is possible to display process times, for example a baking time or cooking time. The higher the velocity the shorter the process time and vice versa.

The function 1/f is configured by using the following 3 parameters.

##### **P[116] = 1/f Frequency (AWE/s)**

The frequency can be programmed here (in AWE/s) that corresponds with the value on the display (programmable at P[117]).

**P[117] = 1/f Display (AWE)**

The display value can be programmed here that corresponds with the frequency programmed at P[116].

**P[223] = Display format**

variant: "0 **Standard dp as P[203]**

variant: "1 **no dp"**

variant: "2 **xxxxxxx.x"**

variant: "3 **xxxxxx.xx"**

variant: "4 **xxxxx.xxx"**

variant: "5 **xxxxxx.xx m.sec of h.min"**

variant: "6 **xxxx.xx.xx h.min.sec"**

Calculation display value at 1/f (time measurement):

$$\text{Display value} = \frac{1/f \text{ Frequency P[116]} \times 1/f \text{ Display P[117]}}{\text{Actual velocity (AWE/s)}}$$

In case the actual velocity becomes smaller than 10% of Parameter 1/f Frequency P[116], the following message will be displayed:


**Example 1:**

*1/f Frequency P[116] = 1000, 1/f Display [117] = 400*

*Display format P203] = 1;*

*Assuming Mt P[000] and Mn P[001] are equal (multiplier = x1)*

*At the actual velocity of 1000 AWE/s the display value 400 will be displayed.*

*At the actual velocity of 500 the value 800 will be displayed.*

**Example 2:**

*A furnace with an encoder that is measuring the speed of the transport. At 200 impulses/s the baking time is 3 hours 28 minutes. The format of the display should be 3.28.00 (h.min.sec).*

*The actual velocity is  $200 \times 4 = 400$  AWE/s. The encoder input is set to x4 (edge multiplication). Assuming Mt P[000] and Mn P[001] are equal (multiplier x1).*

*3h28min equals 12480 sec  $\rightarrow (3 \times 3600) + (28 \times 60)$ . In other words, 400 AWE/s equals 12480 seconds.*

*The value 400 AWE/s (frequency) should be programmed at P[116] and the display value 12480 should be programmed at P[117]. It is possible to check this by choosing variant 1 at P[223] (no decimal point). The display will show 12480 at an input frequency of 200 Hz. In order to have the time displayed in the correct unit P[223] should be programmed to variant 6: **XXXX.XX.XX h.min.sec.***

**4.7 Multiplier**

By using the multiplier it is possible to convert the SSI-value to display-units (AWE).

**Example:**

*Encoder with 90° shifted signal and 1024 increments/revolution will have 4096 edges/revolution. If the desired value in the display is 360,0 (= 3600 AWE), the multiplier will be  $3600/4096 = 0,87890625$ .*

*It is possible to program the exact values (3600 and 4096) instead of the fraction.*

*Multiplier (numerator) P[000] = 3600*

*Multiplier (denominator) P[001] = 4096*

*Through P[203] it is possible to adjust the decimal point.*

**4.8 Power failure protection**

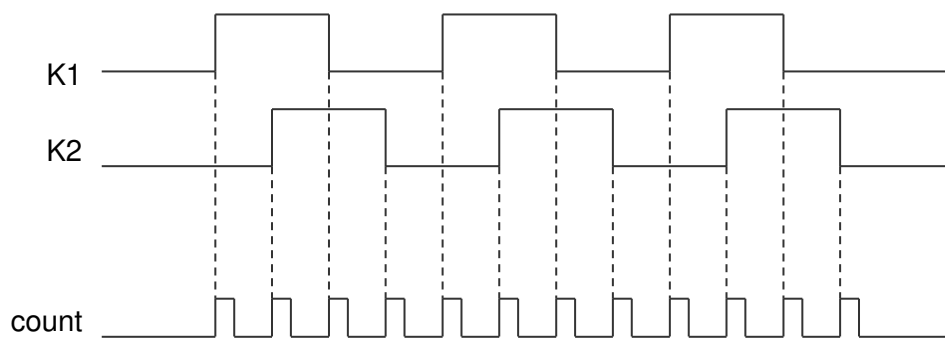
If P[206] = 1 then the actual position of the AP40 will be stored in EEPROM when power is shut down. After power up this value will be restored.

The power failure protection has no meaning with an absolute encoder (SSI, analog or Start/Stop).

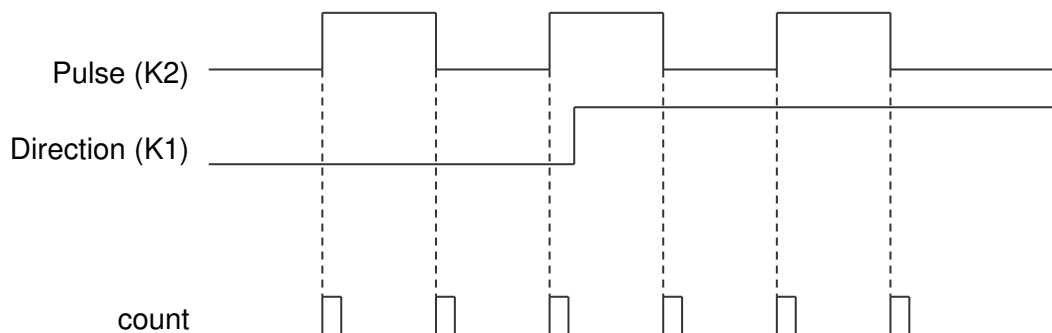
#### 4.9 Edge multiplication (counter input)

There are two possibilities for the counter input:

**V-signal x4:** edge multiplication x4, 90° shifted encoder signals.



**S-signal x2:** edge multiplication x2, encoder signal with directional signal.



## 4.10 Preset (counter input and internal frequency)

The preset function can be used in 4 ways:

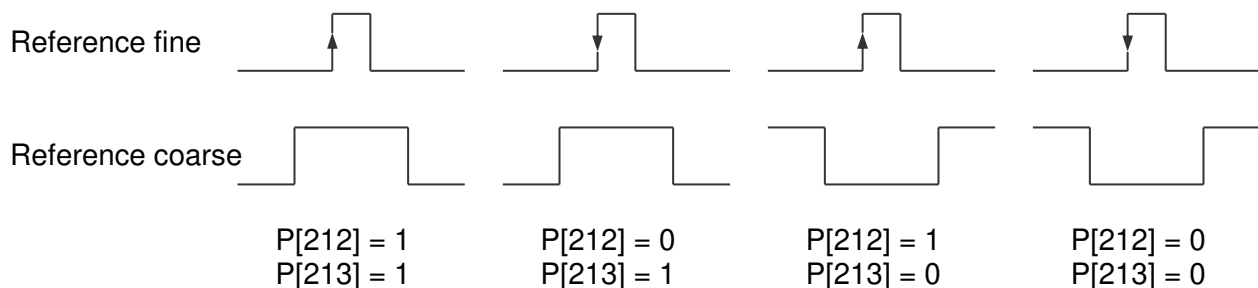
- Using input K0 (in combination with reference coarse)
- Using parameter service functions P[207]
- Using front keys
- Using input 1...4

### 4.10.1 Preset using input K0

The function preset is used to set the actual value to a programmed value, stored in P[003], P[102] or external thumbwheel-1.

The value will be set in case of an active edge from the reference fine signal K0.

If reference coarse has been activated (P[213]  $\neq$  0) one of the inputs has to be programmed to "1 - Reference Coarse".



### 4.10.2 Preset using service parameter P[207]

When P[207] has the value 111 then the actual position is preset with the value of P[003] when exiting the programming mode. The parameter reference coarse P[213] and direction reference fine P[209] have no function.

After executing this function parameter P[207] will have the value 0 again.

### **4.10.3 Preset using front keys**

The function preset can be executed with the key combination [Enter] + [P]. Holding down the [Enter] key and push the [P] key one time. Then the actual position is preset with the value of P[003]. The parameter reference coarse P[213] and direction reference fine P[209] have no function.

This function is active when: P[212] = variant **"3 front keys"**

### **4.10.4 Preset using input 1...4**

The function preset can be executed with a rising edge on input 1...4. Then the actual position is preset with the value of P[003]. The parameter reference coarse P[213] and direction reference fine P[209] have no function.

This function is active when: P[212] = variant **"6 rising edge input (1...4) "**.

One of the inputs has to be programmed to **"19 - SeRef/Adjustment "**.

### 4.11 Counting range (counter input and internal frequency)

The counting range used by the counter can be limited when using the counter input or the internal frequency (P[201] = 0 or 2). The counting range can be set either by parameter or nominal value.

#### 4.11.1 Set counting range by parameter "Counting range" P[004]

If P[233] = variant "0 parameter counting range" the increments for the counting range can be programmed in parameter P[004], ignoring the decimal point. If P[004] = 0 the counting range is deactivated.

$$\text{Counting range P[004]} = \frac{\text{Display range (AWE)} * \text{Mul (nominator) P[001]}}{\text{Mul (denominator) P[000]}}$$

The number of increments is programmed, ignoring the decimal point.

#### Counting range P[004]

0 = function not active

1 ... counting range

*Example:*

*Incremental encoder, 90° shifted signals, 1000 pulses/rev. and 1,5 rev.  
= 360,0 degrees.*

*1000 pulses/rev. is equal to 4000 increments/rev. (edge multiplication x4).*

*3600 AWE ⇔ 1,5 x 4000 = 6000 increments*

*Multiplicator (numerator) P[000] = 3600*

*Multiplicator (denominator) P[001] = 6000*

*Counting range P[004] = 6000 increments*

*At P[203] it is possible to program the use of a decimal point.*

Display will show:

→ 359,8 ... 359,9 ... 0,0 ... 0,1 ... 0,2 ←

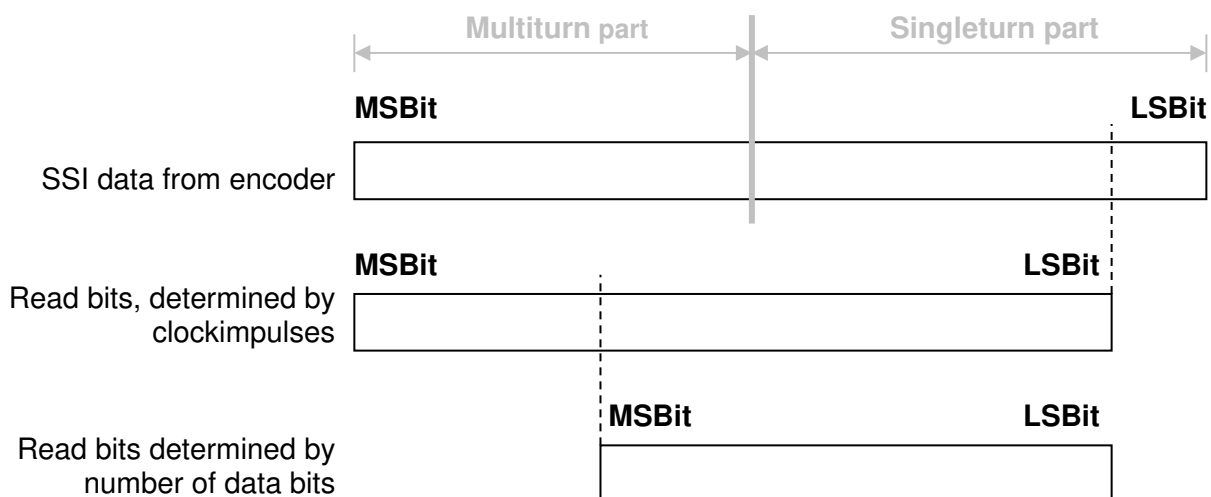
### 4.11.2 Set counting range by nominal value

If  $P[233]$  = variant "**x Nominal value x**" the increments in AWE for the counting range can be programmed by the selected nominal value. In this case  $P[004]$  is internally calculated. If the selected nominal value = 0 the counting range is deactivated

### 4.12 Number of bits SSI

To read the sensor values of SSI-encoders two parameters are important:

Number of clock impulses     $P[216]$   
 Number of data bits          $P[217]$



Normally the most significant bit (MSB) is transmitted first by the encoder.

The number of clock pulses determine the number of bits that will be read by the AP40. Basically this will be the number of bits that the encoder transmits.

*Example:*

*The SSI-encoder has a resolution of 4096 positions per revolution and 4096 coded revolutions. The number of clock pulses will be 12 (bit) + 12 (bit) = 24 (bit).*

The number of data bits will normally be the same: 24.

In some cases however it can be desirable to change the number of clock pulses and/or data bits.



*Example:*

*The SSI-encoder has 16 single turn bits (65535 positions/rev.) and 14 multi turn bits (16384 coded revolutions).*

*The resolution should be 8192 positions/rev. = 13 bit. The number of revolutions should not be changed (remains 14).*

*Number of clock pulses will be:  $P[216] = 27 \quad (13+14)$*

*Number of data bits will be:  $P[217] = 27 \quad (13+14)$*

### **4.13 SSI monitoring**

The SSI-value is being read and processed every single cycle (250µs).

Due to external electromagnetic interference it may happen that during 1 cycle incorrect information has been read.

To prevent unwanted cam actions switching actions, the SSI value can be monitored.

There are two different ways of monitoring the SSI-value: detection of cable-failure (see also P[232], P[252]) and monitoring the delta-SSI.

The delta-SSI value is a maximum value that two separate readings may differ from each other (P[006]). It is possible to set the number of times that this value may be overrun (P[220]).

If there is a reading which is exceeding the max. difference, the last reading is interpolated. When the max overrun counting is reached there will be a SSI error generated.

#### 4.13.1 Output "SSI error"

It is possible to create a SSI-error signal using one of the outputs 1..4:

Output SSI error

Output-x = option "**2 SSI error**" (Low = SSI error)

#### 4.13.2 Reset "SSI error"

The SSI error-signal can be reset by using one of the following options:

- Activate and exit programming mode parameters
- Reset with PC-program DST40
- Serial communication (ASCII)
- Set one of the inputs 1...4 to "**4 Reset SSI error**" and apply a high signal

### 4.14 Justage absolute sensors

The justage of absolute sensors can be done in 5 ways:

- Using the parameter "Adjustment absolute value" P[005]
- Using the input K0
- Using parameter service functions P[207]
- Using front keys
- Using input 1...4

#### 4.14.1 Preset using the parameter "Adjustment absolute value"

This function is applicable for absolute sensors and is active when parameter "Adjustment" P[218] or P[219] has been set to: "**3 PAR**"

Parameter "Adjustment absolute value" P[005] can be set to a value to adjust the encoder. This value (which can be negative and positive) will be added to the actual value and for SSI sensors compensated with the display counting range.

$$\text{Display counting range} = \frac{\text{max SSI value} * \text{Multiplier (numerator) P[000]}}{\text{Multiplier (denominator) P[001]}}$$

#### 4.14.2 Using the input K0

In this function the actual position can be preset to a certain value. The function is active when parameter "adjustment" P[218] or P[219] is set to one of the following options:

option: "1	L→H K0 RAM"	(rising edge K0)
option: "2	H→L K0 RAM"	(falling edge K0)
option: "4	L→H K0 EEPROM"	(rising edge K0)
option: "6	L→H K0 RAM thumbwheel-1"	(rising edge K0)
option: "7	H→L K0 RAM thumbwheel-1"	(falling edge K0)

Parameter "adjustment value" P[005] (or thumbwheel-1) can be set to a value to which the actual position will be adjusted when K0 detects a rising edge, possibly combined with a reference coarse signal ([P213]).

If through parameter [P213] reference coarse has been activated ([P213] <> 0), the option "1 – Reference coarse" should be selected for one of the inputs 1...4 (P[249]...P[252]).

The calculated offset will be stored in either RAM or EEPROM depending on the option chosen in parameter "adjustment" P[218] or P[219]. When storing into RAM-memory (option 1 and 2) this will occur on an interrupt basis and can be performed during movement. The memory however is volatile and the value will not be permanently stored.

Storing the value into EEPROM (option 4) is not initiated by an interrupt. It is recommendable to perform this only when not moving or moving very slow. This value will be stored permanently.

#### 4.14.3 Using service parameter P[207]

When P[207] has the value 111 then the actual position is adjusted to the value of P[005] when the programming mode is left.

After executing this function parameter P[207] will have the value 0 again.

#### ***4.14.4 Justage using front keys***

The function preset the absolute position can be executed with the key combination [Enter] + [P].

Holding down the [Enter] key and push the [P] key once. Then the actual position is preset to the value of P[005].

This function is active when:

Sensor type SSI en Start/Stop

P[218] = variant **"5 front keys"**

Sensor type analog

P[219] = variant **"5 front keys"**

#### ***4.14.5 Justage using input 1...4***

The function preset the absolute position can be executed with a rising edge on input 1...4. Then the actual position is preset to the value of P[005].

This function is active when:

Sensor type SSI en Start/Stop

P[218] = variant **"8 rising edge input (1...4)"**

P[249] ... [252]) variant **"19 - SetRef/Adjustment"** (only for 1 input)

Sensor type analog

P[219] = variant **"8 rising edge input (1...4)"**

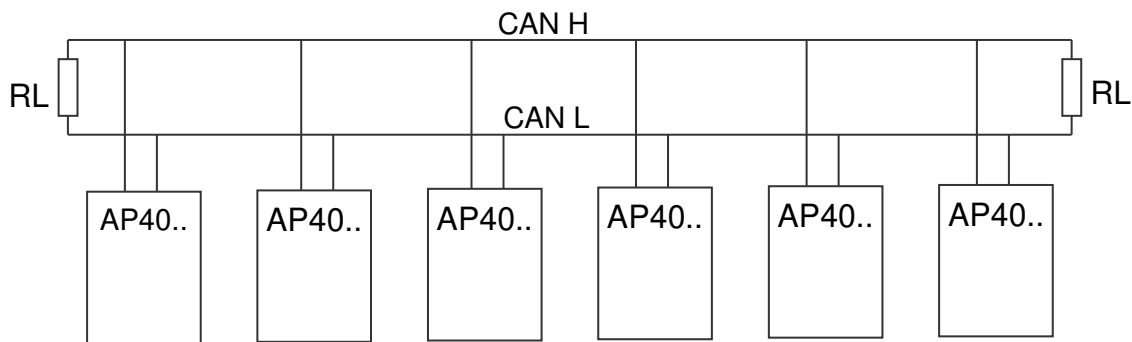
P[249] ... [252]) variant **"19 - SetRef/Adjustment"** (only for 1 input)

#### ***4.15 min/max limit for actual position***

This function is active when Parameter P[227] is set to variant **"1 - min/max"**. The actual position is limited by P[113] for the minimum value and P[114] for the maximum value.

## 4.16 CAN-bus

The baudrate for the CAN-bus is stored in parameter P[228] and has a maximum of 1 Mbit/s. The highest usable baudrate is depending on used cable type and length. The first and last unit must have terminal resistors.

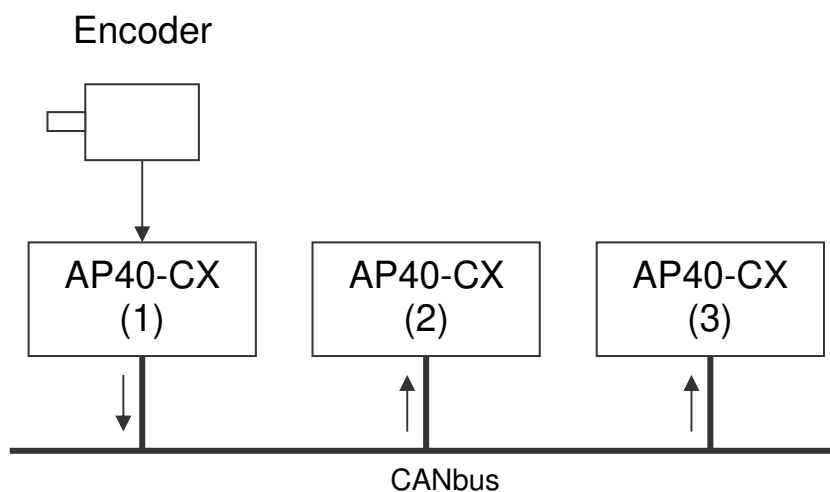


Using switch S3 enables the terminal resistor (120E).

The CAN-bus can be monitored on the display (see also paragraph 3.1.1), where “0” = no error and “1” = bus off.

### 4.16.1 AP-Link

Using the CAN-bus it is possible to sent the actual position and velocity in just one message to one or more other AP40's (AP80,s). Example:



AP40-CX (1) sending data on CANbus

AP40-CX (2) receiving data from AP40-CX (1)

AP40-CX (3) receiving data from AP40-CX (1)

Settings for example as shown above

	PAR	AP40 (1)	AP40 (2)	AP40 (3)
Input actual position	P[201]	0...3	4	4
Baudrate	P[228]	5	5	5
Obj1/PDO1 In adress	P[089]	-	1	1
Obj1/PDO1 In function	P[229]	0	1	1
Obj1/PDO1 Out adress	P[090]	1	-	-
Obj1/PDO1 Out function	P[230]	1	0	0
Time-out AP-Link	P[079]	-	> 0	> 0
Reset Time-out AP-Link	P[215]	-	0 or 1	0 or 1

In this example the first AP40 (1) is sending the actual position and velocity to adress 1 with 500 kbit/s (dataframe COB-ID 385...511).

AP40 (2) and (3) receive this data as actual position and velocity.

If the time-out value stored in P[079] is exceeded, the display will blink and an output will be set (programmable option).

This time-out error will be reset automatically when new data has been received, or by performing a reset through one of the inputs 1..6 (choose option 14: "reset time-out error AP-link").

## **ATTENTION!**

If there are (dynamic) cams positioned on the 0-position while using a closed counting range, the display-counting range P[103] must be programmed.

For example the master (AP40) is sending:

→ 599,8 ... 599,9 ... 0,0 ... 0,1 ... 0, 2 ←

The display counting range should be set to 6000.

Parameter P[103] has no influence on the displayed value and is only used for calculating the cams.

P[103] is calculated as follows:

## **Incremental encoders and internal frequency (P[201] = 0 or 2):**

$$\text{Display counting range P[103]} = \frac{\text{Counting range P[004]} * \text{Multiplier (numerator) P[000]}}{\text{Multiplier (denominator) P[001]}}$$

## **SSI encoders (P[201] = 1):**

$$\text{Display counting range P[103]} = \frac{\text{Active data bits P[217]}}{2} - 1$$

### **4.16.2 Start/Stop sensor**

The AP40 sends a start signal to the sensor and then waits for the stop signal to return from the sensor. The time between the start and stop signal is an measure for the sensor (magnet) position.

Every sensor has it's own characteristic internal sensor speed. This speed is defined as gradient in m/s. for example 2789,00 m/s.

For MTS sensors this gradient is written on the type shield.

The gradient value can be programmed as Parameter P[115] in the AP40. The measurement position will then be displayed correctly.

Parameter "Sensor length" P[118] can be set to the nominal sensor length so the AP40 can calculate the number of measurements per second.

## **4.17 ASCII protocol**

The serial ports of the AP40, both RS232 and RS422/485, are able to work with the ASCII protocol, however not at the same time.

Using the ASCII protocol, actual values can be read, parameters and nominal values can be stored and read, the status of the digital inputs and outputs can be monitored etc.

### **4.17.1 Overview functions**

<b>sc</b>	<b>select AP40</b>
<b>r0</b>	<b>Read actual position (AWE)</b>
<b>r1</b>	<b>Read actual velocity (AWE/s)</b>
<b>r2</b>	<b>Read actual voltage analog output (0,1mV units)</b>
<b>r3</b>	<b>Read actual current analog output (0,1 mA units)</b>
<b>r4</b>	<b>Read actual voltage analog input (0,1mV eenheden)</b>
<b>r5</b>	<b>Read actual current analog input (0,1 mA eenheden)</b>
<b>r6</b>	<b>Read actual value analog input (AWE)</b>
<b>r8</b>	<b>Lezen actuele linearization (AWE)</b>
<b>ri</b>	<b>Read status inputs</b>
<b>ru</b>	<b>Read status outputs</b>
<b>rk</b>	<b>Read status input K1, K2 and K0</b>
<b>wu</b>	<b>Write outputs</b>
<b>rp</b>	<b>Read parameter</b>
<b>wp</b>	<b>Write parameter (Only EEPROM)</b>
<b>rs</b>	<b>Read nominal value</b>
<b>ws</b>	<b>Write nominal value (RAM + EEPROM)</b>
<b>rx</b>	<b>Read software version</b>
<b>rt</b>	<b>Read type number</b>
<b>rh</b>	<b>Read hardware version</b>
<b>rf</b>	<b>Read error number</b>
<b>wf</b>	<b>Reset SSI error</b>
<b>rn</b>	<b>Read status bits</b>
<b>rd</b>	<b>Read actual value thumbwheel sets</b>
<b>bp</b>	<b>Load and activate</b>

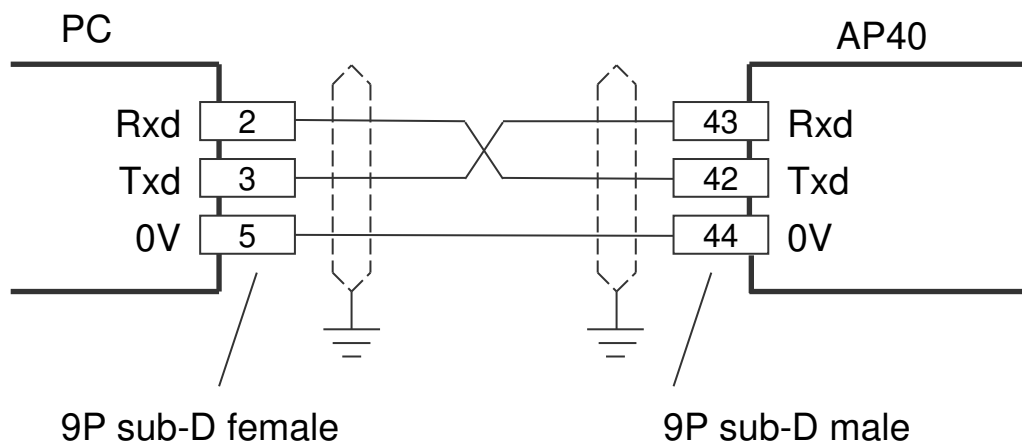


### 4.17.2 General

Through the ASCII protocol it is possible to communicate with the AP40.

Send: Data from PC, PLC → AP40

Receive: Data from AP40 → PC, PLC



Send structure:

Functioncode (space) [argument 1](space)[argument 2] <CR>

Receive structure:

Functioncode (space) [argument1](space)[argument 2] <CR> <LF>

Functioncode (space) [argument1] [argument 2].

Argument 1 and 2 are depending on the function and are separated by a space.

*Example:*

**wp 20 250** (write value 250 to parameter 20)

### 4.17.3 Functions

#### **sc Select AP40**

send: **sc xx**  
receive: **sc xx**  
transmitting parameter: Unit Id number

The AP40 with the unit Id number is selected, all consecutive commands are relevant for this unit.

An AP40 with unit Id number 0 will always respond. This is the reason that only one unit is allowed to have unit Id number 0.

#### **r0 Read actual position (AWE)**

send: **r0**  
receive: **r0 xxxxxxxx**  
transmitting parameter: none

#### **r1 Read actual velocity (AWE/s)**

send: **r1**  
receive: **r1 xxxxxxxx**  
transmitting parameter: none

#### **r2 Read actual voltage analog output (0,1mV units)**

send: **r2**  
receive: **r2 xxxxxxxx**  
transmitting parameter: none

#### **r3 Read actual current analog output (0,1 mA units)**

send: **r3**  
receive: **r3 xxxxxxxx**  
transmitting parameter: none

**r4 Read actual voltage analog input (0,1mV units)**

send: **r4**  
 receive: **r4 xxxxxxxx**  
 transmitting parameter: none

**r5 Read actual current analog input (0,1 mA units)**

send: **r5**  
 receive: **r5 xxxxxxxx**  
 transmitting parameter: none

**r6 Read actual value analog input (AWE)**

send: **r6**  
 receive: **r6 xxxxxxxx**  
 transmitting parameter: none

**r8 Lezen actuele linearization (AWE)**

zenden: **r8**  
 ontvangen: **r8 xxxxxxxx**  
 overgaveparameter: geen

**ri Read status inputs**

send: **ri**  
 receive: **ri xxx**  
 transmitting parameter: none

B0 = input K0  
 B1 = input-1  
 B2 = input-2  
 B3 = input-3  
 B4 = input-4  
 B5 = 0  
 B6 = 0  
 B7 = 0

*Example: ri 23 gives the following answer:  
 23 → 17H, 0001 0111 B*

*K0 = "1"*  
*input-1 = "1"*  
*input-2 = "1"*  
*input-3 = "0"*  
*input-4 = "1"*

## **ru Read status outputs**

send: **ru**  
 receive: **ru xxx**  
 transmitting parameter: none

B0 = output-1  
 B1 = output-2  
 B2 = output-3  
 B3 = output-4

## **rk Read status input K1, K2 and K0**

send: **rk**  
 receive: **rk x**  
 transmitting parameter: none

B0 = K0  
 B1 = K1 or counting direction  
 B2 = K2 or counting pulse

## **wu Write outputs**

(only valid for outputs with "ASCII protocol" selected)

send: **wu xxx**  
 receive: **wu xxx**  
 transmitting parameter: data for output

B0 = output-1  
 B1 = output-2  
 B2 = output-3  
 B3 = output-4

*Example:*  
*Output-2 and output-4 should be set to "1":*

*00001010B = AH = 10D*

*send: wu 10*

*receive: wu 10*

## **rp Read parameter**

send: **rp xxx**

receive: **rp xxxxxxxx**

transmitting parameter : parameter number

*Example reading parameter P[004]*

*send: **rp 4***

*answer: **rp 4 10000***

## **wp write parameter (only EEPROM)**

send: **wp xxx xxxxxxxx**

receive: **wp xxx xxxxxxxx**

transmitting parameter: parameter number and parameter value

*Example writing parameter P[004] with value 185000*

*send: **wp 4 185000***

*answer: **wp 4 185000***

Parameter will be stored to EEPROM but is not yet active.

## **rs Read nominal value**

send: **rs xx**

receive: **rs xx xxxxxxxx**

transmitting parameter: nominal value

*Example reading nominal value 22*

*send: **rs 22***

*answer: **rs 22 72500***

**ws Write nominal value (RAM + EEPROM)**

send: **ws xx xxxxxxxx**  
 receive: **ws xx xxxxxxxx**  
 transmitting parameter: nominal value number and nominal value

*Example writing nominal value 22 with value 195200*

*send: **wp 22 195200***

*answer: **wp 22 195200***

**rx Read software version**

send: **rx**  
 receive: **rx SW Vxx.xx SSW xx.xx**  
 transmitting parameter: none

SW = standard software version

SSW = special software version

*Example:*

*send: **rx***

*answer: **rx SW 4.02 SSW 1.00***

**rt Read type number**

send: **rt**  
 receive: **rt AP40**  
 transmitting parameter: none

*Example:*

*send: **rt***

*answer: **rt AP40-CA***

**rh Read hardware version**

send: **rh**  
 receive: **rh HW x RV x**  
 transmitting parameter: none

**rf Read error number**

send: **rf**  
 receive: **rf xxxx**  
 transmitting parameter: none

When -1 returns no error is present.

*Example:*

*send: rf*  
*answer: rf 800 (SSI error)*  
*or*  
*answer: rf -1 (no error)*

**wf Reset SSI error**

send: **wf**  
 receive: **wf**  
 transmitting parameter: none

**rn Read status bits**

send: **rn**  
 receive: **rn xxx**  
 transmitting parameter: none

B0 = cams active (started)  
 B1 = reference/adjustment set

*Example:*

*rn 3 gives the following answer:*  
*3 → 3H, 0011 B*  
*cams are active and ref/adjustment have been set*

**rd Read actual values thumbwheel sets**

send: **rd 1**  
 receive: **rd 1 xxxxxxxx**  
 transmitting parameter: thumbwheel number

**bp Load and activate**

send: **bp**  
receive: **bp xxx**  
transmitting parameter: none

In case of an error the error number will be returned (-1 is no errors).

*Example: answer: **bp -1** (no errors)  
          answer: **bp 20** (error parameter 20)*

**4.17.4 Error messages**

In case of an error the AP40 will send an error message followed by an error number.

overview error messages

**er 1** = parity error  
**er 2** = frame error  
**er 3** = overflow error  
**er 4** = buffer overrun  
**er 5** = number invalid  
**er 6** = data invalid (for example outside min/max range)  
**er 7** = programming mode parameters/nominal values still active  
**er 8** = function impossible



## **4.18 Analog input**

The AP40 has an optional, galvanic isolated analog input. Using parameter P[226] it is possible to choose between a current input or a voltage input. When using the current input DIP-switch 4 must be in the “on” position.

The analog input can be used as an actual position input when  $P[201] = 3$ .

The analog input value (voltage or current) is converted to AWE units.  
(for example  $0 - 10V \Rightarrow 0 - 1200,0 \text{ mm}$ )

This measuring value can be used as actual position  $P[201] = 3$ .

If  $P[383] = 3$  the analog input value can be connected directly to the analog output. A simple analog conversion (volt to current or current to volt) can be made. Furthermore the cam positions can be directly programmed on the analog input value (AWE). Even when there is already an encoder in used for the actual position of the AP40.

There are 2 Parameters who configure the dynamic response of the analog input:

### **P[104] = measuring time**

The smaller the measurement time the more dynamic the analog input will be.

### **P[225] = integrator**

The number of cycles are programmed. The average analog value (in AWE) of the programmed cycles is calculated.

*Example:*

*Measurement time = 60ms, integrator = 10.*

*The actual analog value will be refreshed every 60 ms and is the average velocity during the last 10 measurements.*

### 4.18.1 Voltage input

The voltage input has a resolution of  $305\ \mu\text{V}$  and is programmable through the parameters below.

P[105] = U1 in V (input in 0,0001V units)

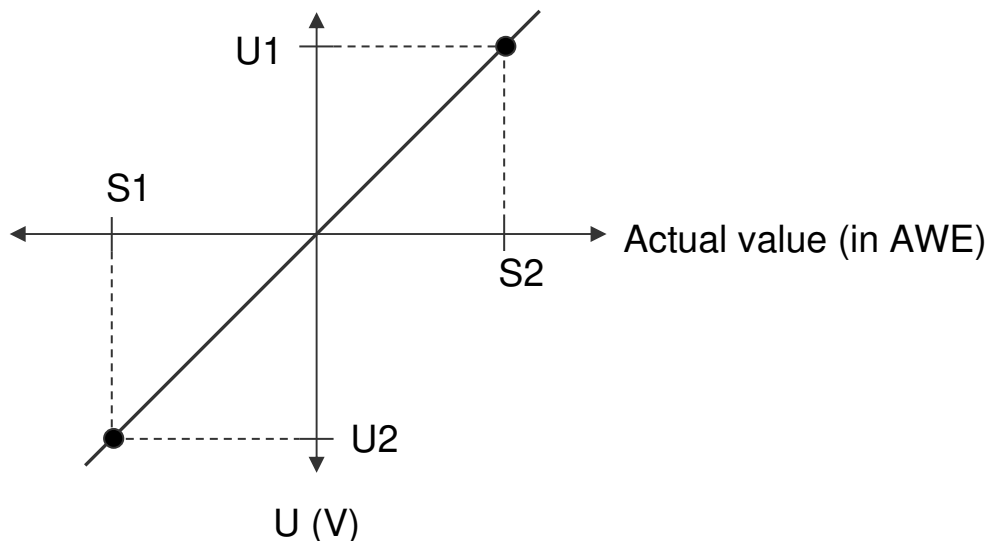
P[106] = U2 in V (input in 0,0001V units)

P[107] = S1 in AWE (actual value at U1)

P[108] = S2 in AWE (actual value at U2)

P[104] = measuring time analog

P[225] = integrator analog



### 4.18.2 Current input

The current input has a resolution of 610  $\mu\text{A}$  and is programmable through the parameters below.

P[109] = I1 [mA] (input in 0,0001mA units)

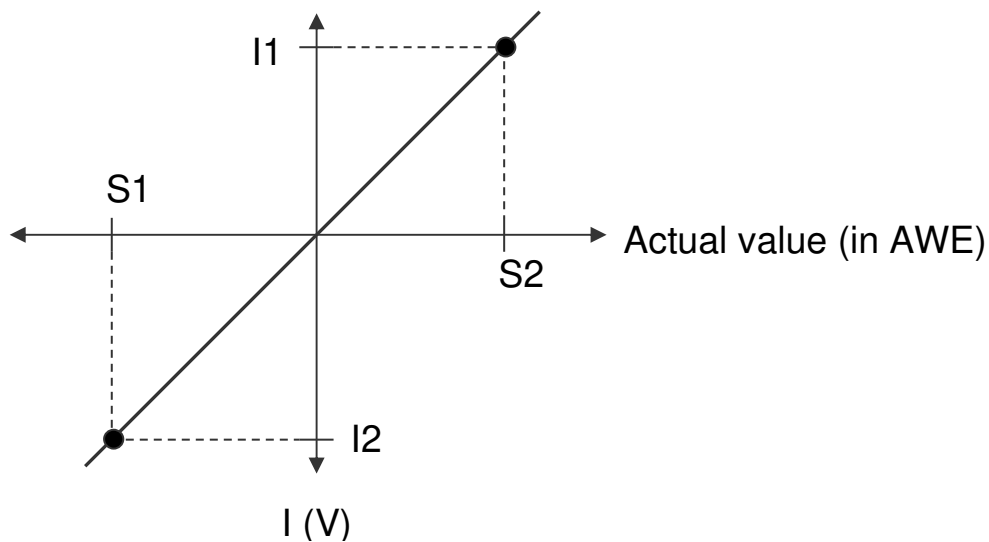
P[110] = I2 [mA] (input in 0,0001mA units)

P[111] = S1 in AWE (actual value at I1)

P[112] = S2 in AWE (actual value at I2)

P[104] = measuring time analog

P[225] = integrator analog



### 4.18.3 Example analog conversion

Conversion of an analog signal.

> analog input -8 to +8 V

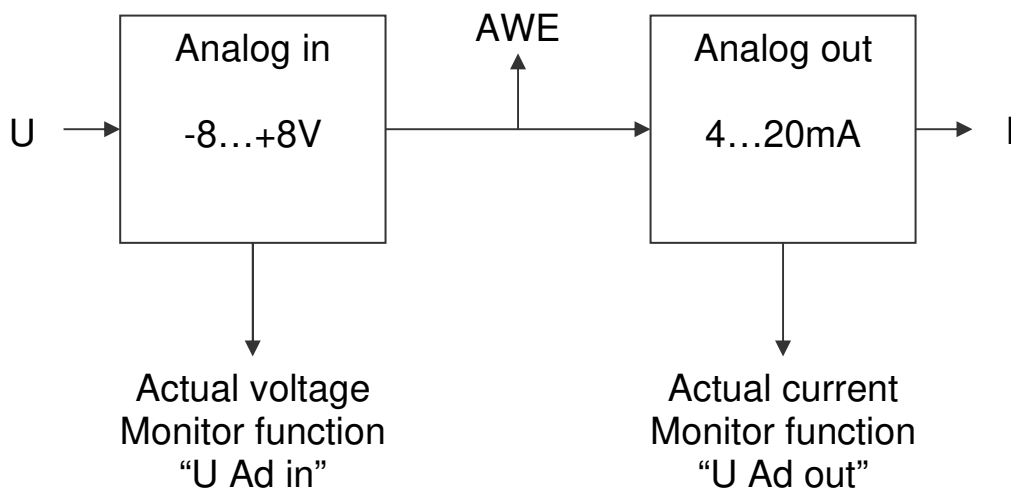
> analog output 4 to 20mA

#### Analog in

P[226] = 0 (Voltage)  
 P[109] = -8,0000 V  
 P[110] = +8,0000 V  
 P[111] = -100000 AWE  
 P[112] = +100000 AWE  
 P[104] = 0,05 s  
 P[225] = 10

#### Analog out

P[388] = 2 (current)  
 P[383] = 2  
 P[084] = 4,0000 mA  
 P[085] = 20,0000 mA  
 P[086] = -100000 AWE  
 P[087] = +100000 AWE



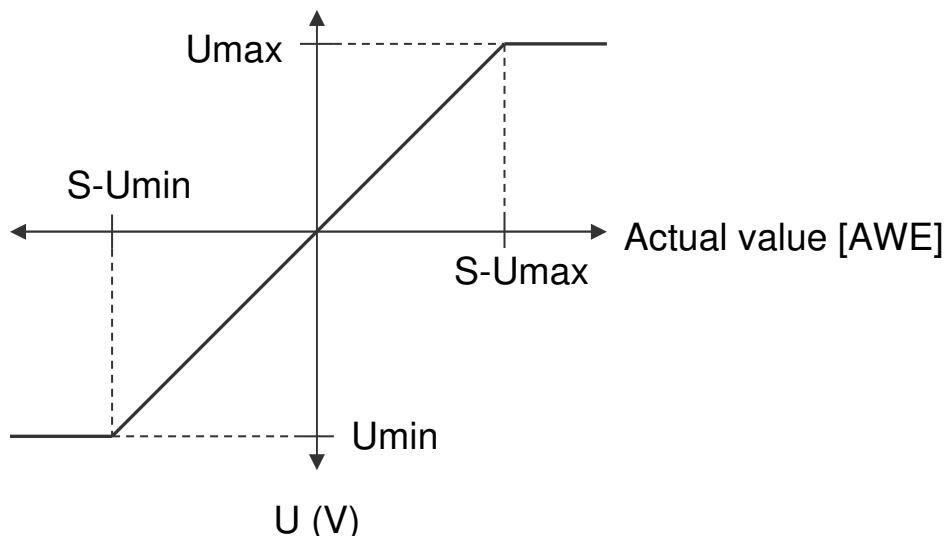
## 4.19 Analog output

The AP40 has an optional, galvanically isolated analog output. Using parameter P[388] it is possible to choose between a current output or a voltage output. The analog output can be used to give out the actual position, velocity or linearization (see parameter P[383]).

### 4.19.1 Voltage output

The voltage output has a resolution of 305  $\mu\text{V}$  and is programmable through P[080] ... P[083].

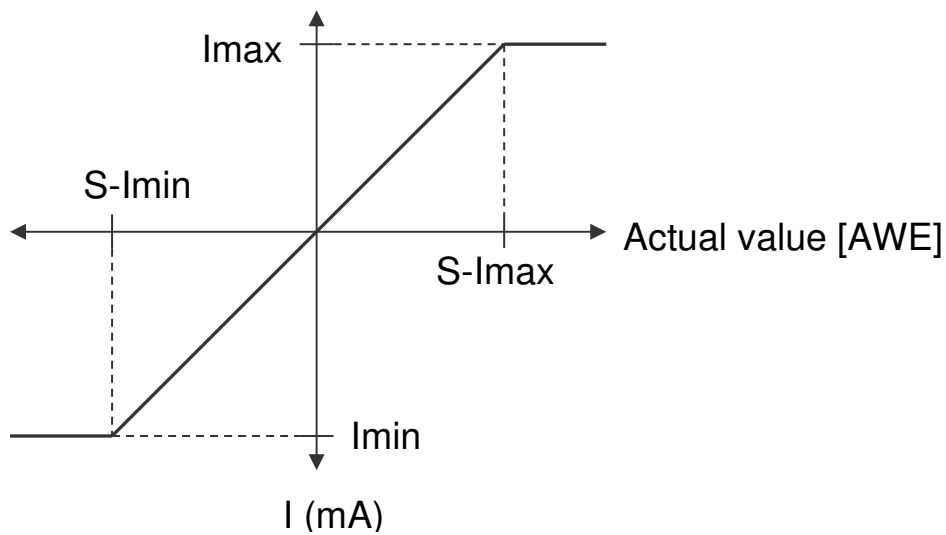
- P[080] =  $U_{\min}$  [V] (input in 0,0001V units)
- P[081] =  $U_{\max}$  [V] (input in 0,0001V units)
- P[082] = S- $U_{\min}$  [AWE] (actual value at  $U_{\min}$ )
- P[083] = S- $U_{\max}$  [AWE] (actual value at  $U_{\max}$ )



### 4.19.2 Current output

The current output has a resolution of 610  $\mu\text{A}$  and is programmable through P[084] ... P[087].

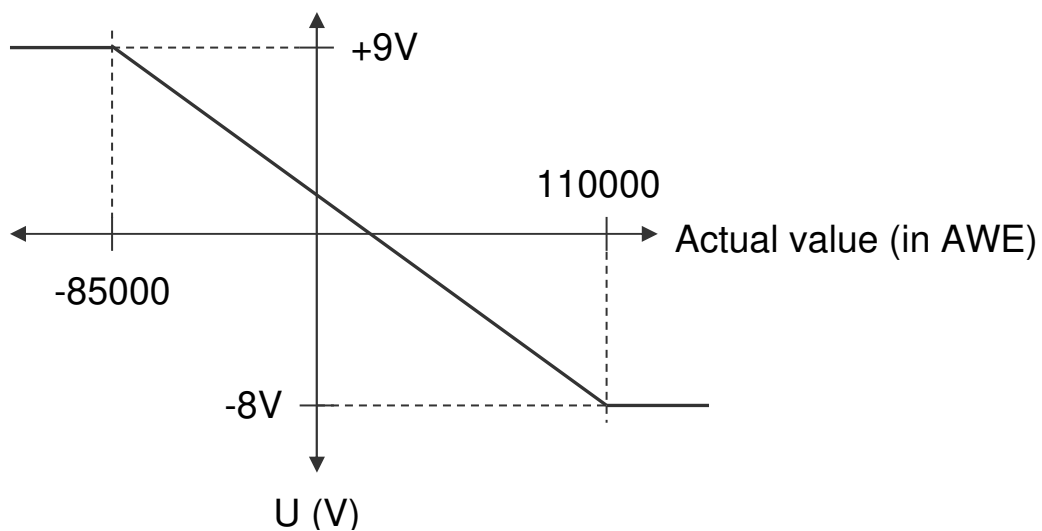
P[084] =  $I_{\min}$  [A] (input in 0,0001mA units)  
P[085] =  $I_{\max}$  [A] (input in 0,0001mA units)  
P[086] = S- $I_{\min}$  [AWE] (actual value at  $I_{\min}$ )  
P[087] = S- $I_{\max}$  [AWE] (actual value at  $I_{\max}$ )



### 4.19.3 Example programming voltage output

- > 0,01 mm units
- > actual position at +9V should be -850,00 mm
- > actual position at -8V should be 1100,00 mm

$P[080] = U_{min} = -8,0000 [V]$   
 $P[081] = U_{max} = +9,0000 [V]$   
 $P[082] = S-U_{min} = 110000 [AWE]$   
 $P[083] = S-U_{max} = -85000 [AWE]$



### 4.20 Teach function analog output

The value for  $S_{min}$  and  $S_{max}$  can be set by an external input signal. For this function parameter  $P[234]$  and or  $P[235]$  can be set to variant "**1 Teach via input**". The function for the input 1...4 can be set to variant "**15 DAC Set  $S_{min}$** " or variant "**16 DAC Set  $S_{max}$** ".

On the positive edge of the input signal the teach function will be executed. The value of  $S_{min}$  or  $S_{max}$  will be stored with the actual position or the actual speed depending on parameter  $P[388]$ . The display will show "teach Lo" or "teach hi" for a short time.

## 4.21 Cams

### 4.21.1 General

The AP40 has a maximum of 24 programmable cams divided over a maximum of 4 outputs.

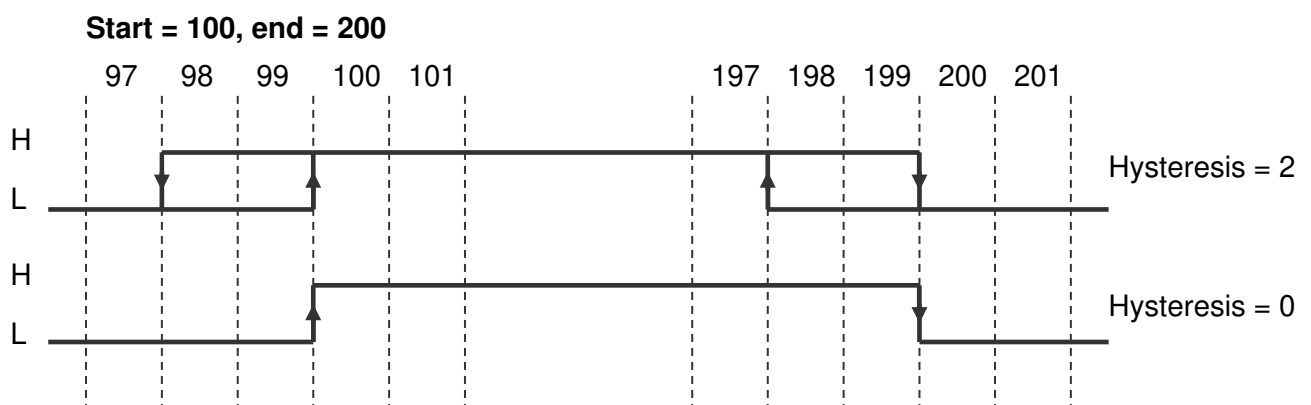
#### Programmable functions:

- Type
  1. Cam with start- and end-value
  2. Greater than or equal to limit value
  3. Smaller than or equal to limit value
- Source (actual position, actual velocity or analog input)
- Nominal value location number for start-, end-, or limit value
- Hysteresis
- Output for cam

Per cam one can choose whether to program the values directly into the parameters or to use a nominal value location number where the values are programmed. In addition the external thumbwheel sets can be used as start and end value.

### 4.21.2 Cam with start- and end-value

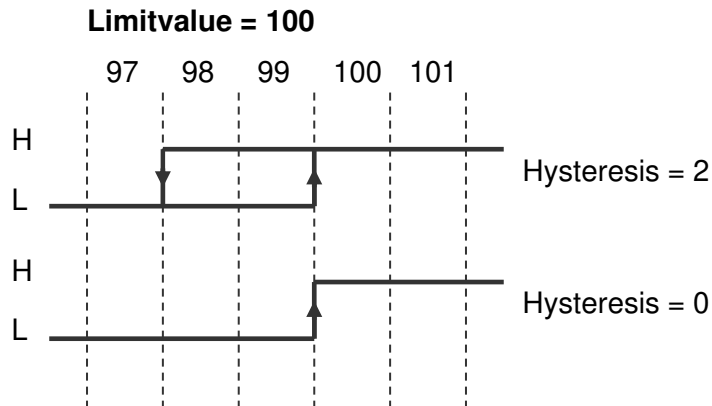
Two values are programmed, a start value and an end-value.





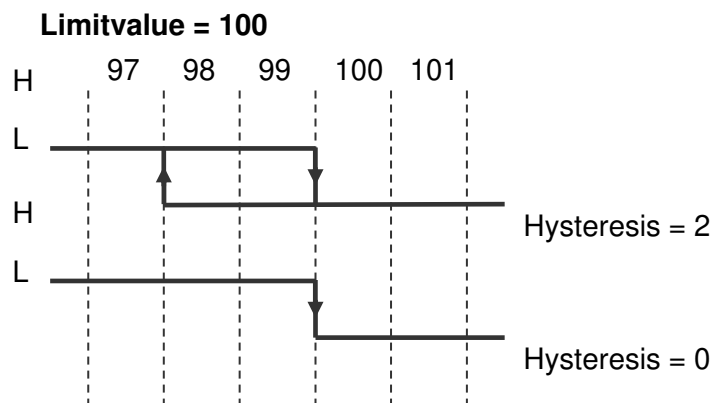
### 4.21.3 Greater than or equal to limit value

Only one limit value needs to be programmed.



### 4.21.4 Smaller than or equal to limit value

Only one limit value needs to be programmed.



### 4.21.5 Dynamic cams

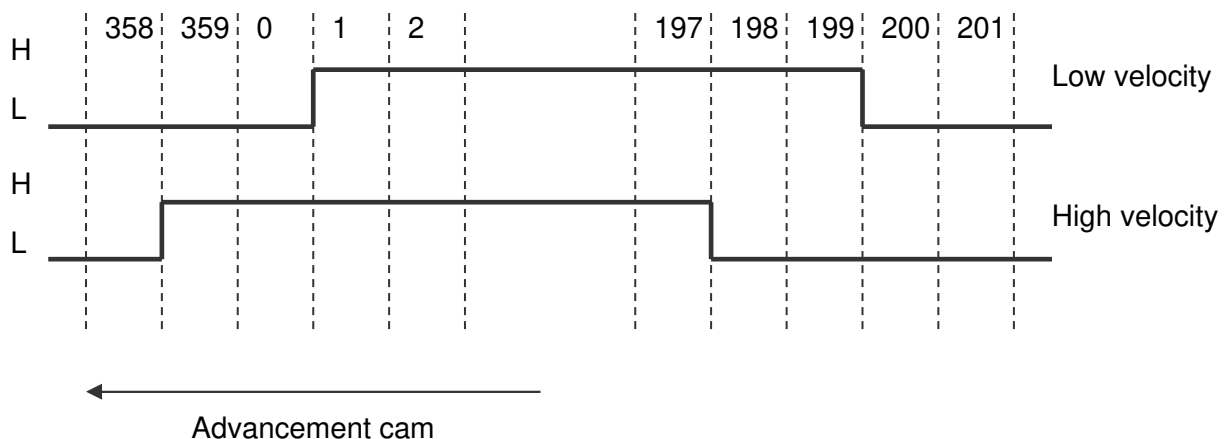
To compensate for actions with a static time, for example the switch time of a valve, it is possible to program a time for each output individually. The cams will be shifted according to this programmed time.

This function is only available for cams with a start- and end-value (P[256] ... P[279] = 1) and when the source of this cam is the actual position (P[280] ... P[303] = 1).

When working with a counting range the possibility of cams shifting over the zero-point is taken into account.

*Example:*

<i>startvalue:</i>	<i>1</i>
<i>endvalue:</i>	<i>200</i>
<i>hysteresis:</i>	<i>0</i>
<i>counting range display:</i>	<i>360</i>



#### **4.21.6 Start/stop cam**

The outputs for the cams can be enabled or disabled. If for one of the inputs 1..6 the function start/stop cams has been chosen.

##### Start/stop cams with one signal

Input-x = option "**5 start/stop cams**" (high = cams enabled)

##### Start/stop cams with double signal

Input-x = option "**6 start cams**" (rising edge = enable cams)

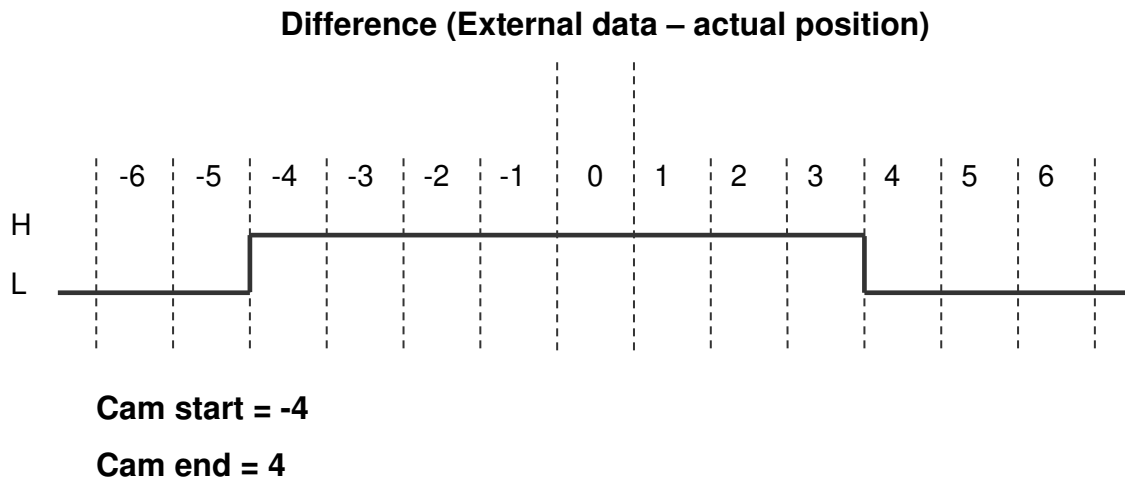
Input-x = option "**7 stop cams**" (rising edge = disable cams)

#### **4.21.7 Output "Cams active"**

On one of the outputs 1...4 the signal "cams active" can be generated by choosing option "**4 cams active**" (high = cams enabled).

### 4.21.8 Relative cams

When using relative cams it is possible to configure simple positioning systems. The cams will switch based on the difference between the actual position and an external value. This value is provided through the data input module.



*Example:*

*A 2-speed motor should be positioned towards an externally provided position. The signals to be used for the drive are:*

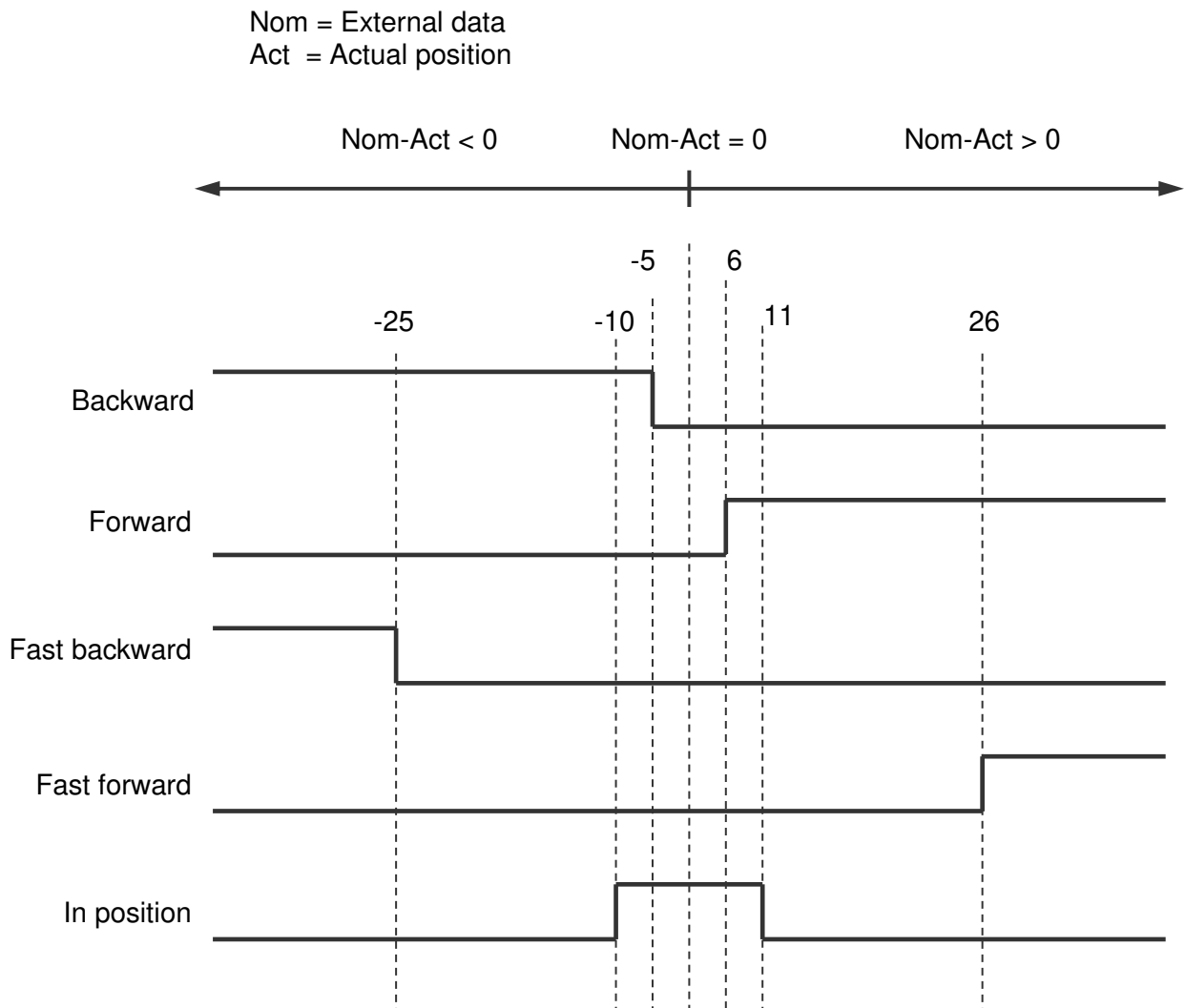
<i>forward:</i>	<i>output-1</i>
<i>backward:</i>	<i>output-2</i>
<i>fast forward:</i>	<i>output-3</i>
<i>fast backward:</i>	<i>output-3</i>
<i>in-position:</i>	<i>output-4</i>

<i>start input:</i>	<i>input-1</i>
<i>stop input:</i>	<i>input-2</i>

*Start stop cams*

*Input-1 = option "6 start cams"*

*Input-2 = option "7 stop cams"*



Signal	Outp. Nr.	Cam Nr.	Cam Function	Cam Source	Cam start	Cam end
Backward	1	1	3	3	-5	---
Forward	2	2	2	3	6	---
Fast backward	3	3	3	3	-25	---
Fast forward	3	4	2	3	26	---
In position	4	5	1	3	-10	11

To keep the switch distances in positive and negative direction the same, for all the positive switch distances the value should be raised by 1.

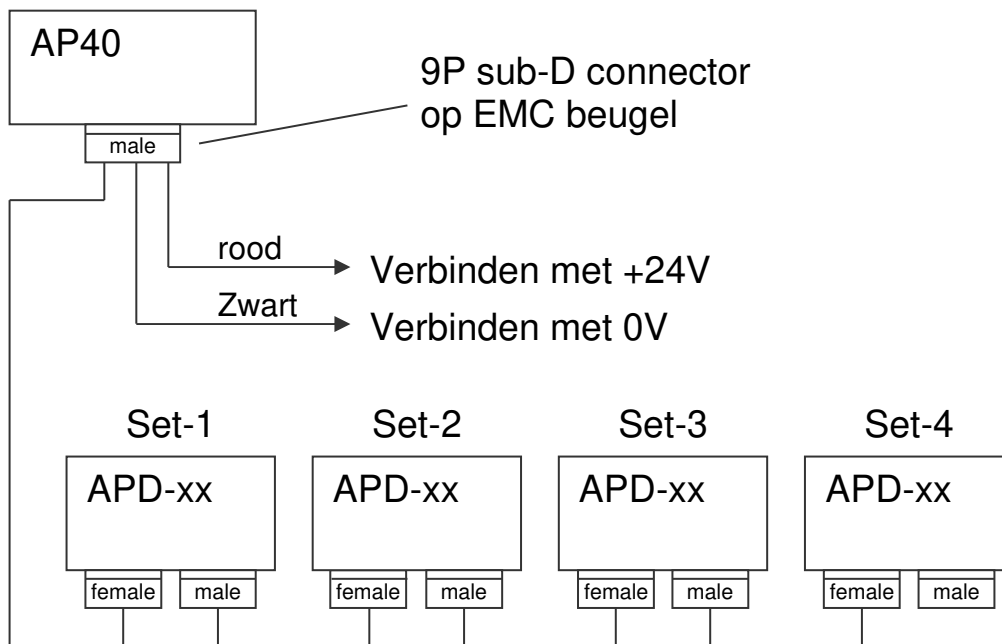
In the example above output-3 is used for Fast backward and Fast forward.

## 4.22 External thumbwheel sets

### 4.22.1 General

Up to 4 external thumbwheel sets can be connected to the AP40. The data is read by the RS422 serial interface (ser-2) and can be configured separately. The thumbwheel value can also be read by the monitor function in auto mode. They can be used for different functions such as begin and end values for the cams. Thumbwheel-1 can also be used for justage/presetting of the actual position.

### 4.22.2 Connecting thumbwheel sets



Cable KBL101-0003 (30cm): connection AP40 to first thumbwheel

Cable KBL102-0003 (30cm): connection between thumbwheel sets

#### Available types:

APD-04 4 decades  
 APD-05 5 decades  
 APD-06 6 decades  
 APD-07 7 decades

APD-T4 4 decades with sign  
 APD-T5 5 decades with sign  
 APD-T6 6 decades with sign

### 4.22.3 Parameter settings

P[245] must be set to 0 (if RS422/RS485 ser-2 is not active)

Parameter P[376] determines the number of thumbwheel sets that will be read.

P[377] determines the method of reading the thumbwheel value:

option: "0 auto"

option: "1 on ext. input" (rising edge)

When P[377] = 1 then one of the inputs must be programmed with option 18  
"read thumbwheel switches"

For each thumbwheel set there are 4 parameters.

#### Parameter "Format" P[130] ... P[133]

option: "0 7654321"	option: "7 -654321"
option: "1 x654321"	option: "8 x-54321"
option: "2 xx54321"	option: "9 xx-4321"
option: "3 xxx4321"	option: "10 xxx-321"
option: "4 xxxx321"	option: "11 xxxx-21"
option: "5 xxxxx21"	option: "12 xxxxx-1"
option: "6 xxxxxx1"	

#### Parameter "Min" P[120] ... P[123]

Definition of minimum input value

#### Parameter "Max" P[124] ... P[127]

Definition of maximum input value

#### Parameter "Multiplier" P[378] ... P[381]

Multiplies the value of the thumbwheel set

option: "0 x1"

option: "1 x10"

option: "2 x100"

## **4.23 Linearization**

The linearization function allows to display and process nonlinear motions. The actual display position (sensor) position, actual velocity or actual value of the analog input is converted into an additional value "Actual linearization". This additional value can serve as a source for the cams function and analog output.

### Parameter "Source" P[246]

optie **"0 Inactive"**  
optie **"1 Actual position"**  
optie **"2 Actual speed"**  
optie **"3 Actual onalog input (AWE) "**

The linearization function works with a tabel of max. 30 points (P1...P30). Every point has a X (Pn-X) and Y (Pn-Y) value. The X value represents the actual (sensor) position or velocity and the Y value represents the desired actual (sensor) position or velocity called "Actual linearization". Interpolation takes place between these points

Parameter P[247] determines the number of active points and can be programmed with a value of 2 ...30 points. The value of the actual linearization can be displayed in the monitor function. P[248] determines the number of decimals shown.

For linearization 3 modes are available.

### Parameter "mode" P[241]

optie **"0 4-Quadrant "**  
optie **"1 Mirror Y-axis"**  
optie **"2 Mirror XY-axis"**

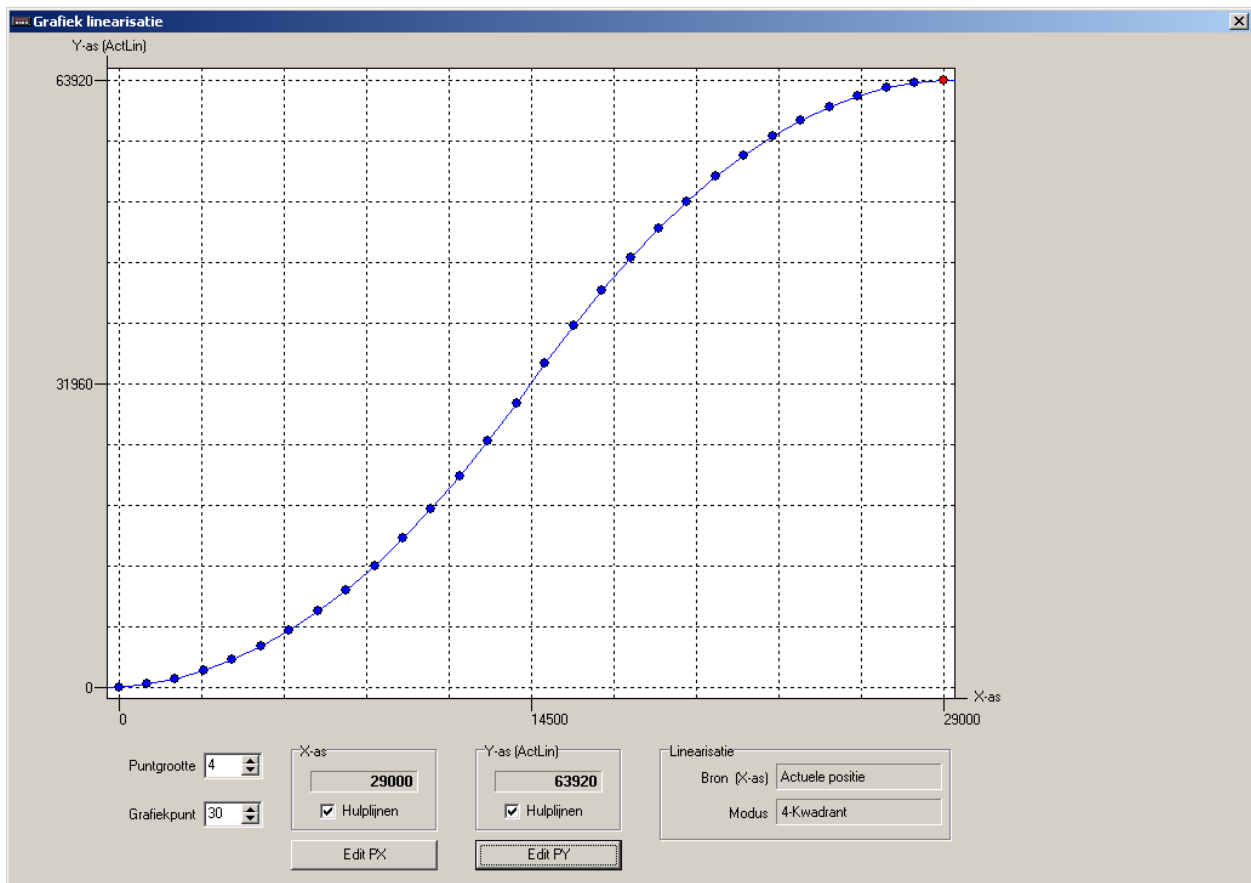


### 4.23.1 mode 0 “4-Quadrant”

This is the standard mode which can build every possible curve. Both the X-axis and the Y-axis may contain negative values.

Condition:

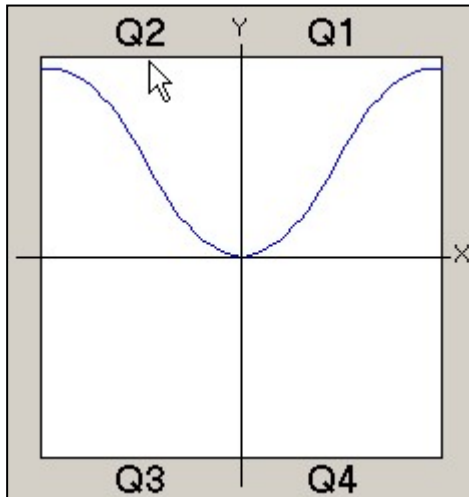
$P1-X < P2-X < P3X < \dots < P30-X$



Screenshot from PC programm DST2

### 4.23.2 mode 1 “Mirror Y-axis”

In this mode, the entered curve is mirrored and copied over the Y-axis, so that this curve is the same for the negative X-axis values. Q1 is the entered curve.



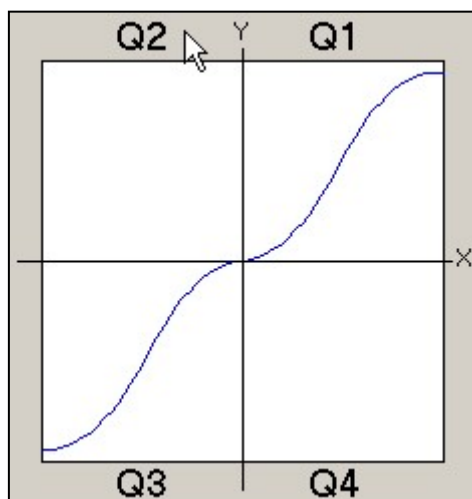
Conditions:

$$P1-X < P2-X < P3X < \dots < P30-X)$$

$$P1-X = 0$$

### 4.23.3 mode 2 “Mirror XY-axis”

In this mode, the entered curve is mirrored and copied over the X-axis and Y-axis, so that this curve is the same for the negative X-axis and Y-axis values. Q1 is the entered curve.



Conditions:

$$P1-X < P2-X < P3X < \dots < P30-X)$$

$$P1-X = 0$$

$$P1-Y = 0$$

## 5 Parameters

General lay-out:

PAR.	PAR Nr:	Possible values (bold is the standard value)
Basic description		
Description of possible values		

### 5.1 Menu 1 Config

PAR: 1.0.1	P[200]	<b>0</b> ... 6
Basic function		
0 = standard		
1 = Hold/Reset K0 L → H (rising edge)		
2 = Hold/Reset K0 H → L (falling edge)		
3 = Hold/Reset start/stop H		
4 = Hold/Reset start/stop L		
5 = Hold/Reset start/stop L → H (rising edge)		
6 = Hold/Reset start/stop H → L (falling edge)		
(1 ... 6 only possible for counter and frequency)		

PAR: 1.0.2	P[201]	<b>0</b> ... 4
Input for actual position		
0 = Counter		
1 = SSI		
2 = Internal frequency		
3 = Analog		
4 = CAN-bus AP-Link		
5 = Start/Stop		

PAR: 1.0.3	P[088]	0 ... <b>40</b> ... 2500
Measuring time velocity [AWE/s] (equal to refreshment time display)		
X.XXX (sec) input 0 .. 1.000s		

PAR: 1.0.4	P[202]	0 ... <b>10</b> ... 20
Integrator velocity		
Actual velocity is the average from the number of measurements		
0 = not active		
1...20 number of measurements		

PAR: 1.0.5	P[203]	0 ... 6
Number of decimals		
0 = none		
1 = X.X		
2 = X.XX		
3 = X.XXX		
4 = X.XXXX		
5 = X.XXXXX		
6 = X.XXXXXX		

PAR: 1.0.6	P[204]	0 ... 1
Store function		
0 = no function		
1 = only display		

PAR: 1.0.7	P[205]	0 ... 2
Store signal		
0 = high active		
1 = low active		

PAR: 1.0.8	P[206]	0 ... 1
Power failure protection (no function when Hold/Reset is active (P[200]))		
0 = not active		
1 = active		

PAR: 1.0.9	P[207]	0 ... 123
Service functions		
Only possible to activate through keyboard AP40		
Value is automatically set to 0 after executing the service function		
0 = not active		
123 = set default parameters		
111 = adjusting absolute sensors or preset function counter and freq.		

PAR: 1.0.10	P[208]	0 ... 4
Default monitor function		
Determines the default which is visible after start-up.		
0 = Actual position		
1 = Actual velocity		
2 = Actual value AD (analog input)		
3 = Actual value DA (analog output)		
4 = Actual linearization		

PAR: 1.0.11	P[222]	0 ... 1
Function velocity measurement		
0 = standaard		
1 = 1/f time measurement		

PAR: 1.0.12	P[116]	0 ... 99999999
1/f Frequency AWE/s		
Velocity where display value P[117] is displayed		
XXXXXXXXX (AWE/s)		

PAR: 1.0.13	P[117]	0 ... 99999999
1/f Display		
Display value for velocity P[116]		
XXXXXXXXX (AWE)		

PAR: 1.0.14	P[223]	0 ... 6
1/f Display format		
Format for display		
0 = Standaard dp als P[203]		
1 = geen dp		
2 = XXXXXXXX.X		
3 = XXXXXXXX.XX		
4 = XXXXXX.XXX		
5 = XXXXXXXX.XX (min.sec of h.min)		
6 = XXXXXX.XX.X (h.min.sec)		

PAR: 1.0.15	P[398]	0 ... 3
Display multiplier		
For display value actual position + actual velocity		
0 = no function		
1 = actual position + actual velocity x 0,1		
2 = actual position + actual velocity x 0,01		
3 = actual position + actual velocity x 0,001		

## 5.2 Menu 2 Actual

### 5.2.1 Submenu 2.1 Counter

PAR: 2.1.1	P[210]	0 ... 1
Signal type and edge multiplication		
"S-signal X2": K2 is counter and K1 is direction		
0 = V-signal X4		
1 = S-signal X2		

PAR: 2.1.2	P[211]	0 ... 1
Counting direction		
0 = no reverse		
1 = reverse		

PAR: 2.1.3	P[000]	0 ... 10000 ... 16777215
Multiplier numerator		
XXXXXXXX		

PAR: 2.1.4	P[001]	0 ... 10000 ... 16777215
Multiplier denominator		
XXXXXXXX		

PAR: 2.1.5	P[212]	0 ... 5
Reference fine (input K0)		
0 = no function		
1 = rising edge		
2 = falling edge		
3 = front keys		
4 = rising edge (reference value thumbwheel-1)		
5 = falling edge (reference value thumbwheel-1)		
6 = rising edge input (1...4)		

PAR: 2.1.6	P[213]	0 ... 2
Reference coarse		
0 = no function		
1 = high signal		
2 = low signal		

PAR: 2.1.7	P[209]	0 ... 2
Counting direction for setting reference value		
0 = independant from direction		
1 = when counting in positive direction		
2 = when counting in negative direction		

PAR: 2.1.8	P[003]	-9999999 ... 0 ... 99999999
Reference value 1		
-XXXXXXXX (AWE)		

PAR: 2.1.9	P[004]	0 ... 99999999
Counting range (no function when Hold/Reset is active (P[200]))		
XXXXXXXX (AWE)		

PAR: 2.1.10	P[102]	-9999999 ... 0 ... 99999999
Reference value 2		
-XXXXXXXX (AWE)		

PAR: 2.1.11	P[233]	0 ... 48
Source for counting range		
0 = parameters counting range P[004]		
1...48 = nominal value 1...48		

### 5.2.2 Submenu 2.2 SSI

PAR: 2.2.1	P[214]	0 ... 1
SSI code		
0 = gray		
1 = binary		

PAR: 2.2.2	P[211]	0 ... 1
Counting direction		
0 = no reverse		
1 = reverse		

PAR: 2.2.3	P[216]	0 ... 24 ... 30
Number of SSI clockpulses		
XX		

PAR: 2.2.4	P[217]	0 ... <b>24</b> ... 30
Number of SSI databits		
XX		

PAR: 2.2.5	P[000]	0 ... <b>10000</b> ... 16777215
Multiplier numerator		
XXXXXXXXX		

PAR: 2.2.6	P[001]	0 ... <b>10000</b> ... 16777215
Multiplier denominator		
XXXXXXXXX		

PAR: 2.2.7	P[218]	<b>0</b> ... 7
Adjustment		
0 = no function 1 = rising edge (K0) only temporary in RAM (on interrupt) 2 = falling edge (K0) only temporary in RAM (on interrupt) 3 = set with parameter adjustment value 4 = rising edge (K0) permanent in EEPROM (not on interrupt) 5 = front keys 6 = rising edge (K0) reference value thumbwheel-1 7 = falling edge (K0) reference value thumbwheel-1 8 = rising edge input (1...4)		

PAR: 2.2.8	P[213]	<b>0</b> ... 2
Reference coarse		
0 = no function 1 = high signal 2 = low signal		

PAR: 2.2.9	P[209]	<b>0</b> ... 2
Counting direction adjustment		
0 = independant from direction 1 = when counting in positive direction 2 = when counting in negative direction		

PAR: 2.2.10	P[002]	-9999999 ... <b>0</b> ... 99999999
Offset		
-XXXXXXXXX (AWE)		



PAR: 2.2.11	P[005]	-9999999 ... <b>0</b> ... 99999999
Adjustment value		
-XXXXXXXX (AWE) input 0 means function inactive		

PAR: 2.2.12	P[006]	1 ... <b>50</b> ... 99999
Monitoring delta-SSI per cycletime (250 µs)		
Unprocessed SSI-value, only depending on number of active SSI-databits P[217]		
XXXXX		

PAR: 2.2.13	P[220]	0 ... <b>2</b> ... 9
Maximum number of SSI errors to set external SSI-error. At every SSI-error the actual value is determined by interpolation of the last valid value		
X		

PAR: 2.2.14	P[221]	0 ... <b>3</b>
SSI monitoring		
0 = not active		
1 = only wiring		
2 = only Delta SSI monitoring		
3 = wiring + Delta SSI monitoring		

### 5.2.3 Submenu 2.3 Internal frequency

PAR: 2.3.1	P[224]	<b>0</b> ... 3
Timebasis		
0 = 78,125 kHz		
1 = 625 kHz		
2 = 5 MHz		
3 = 10 MHz		

PAR: 2.3.2	P[211]	<b>0</b> ... 1
Counting direction		
0 = positive		
1 = negative		

PAR: 2.3.3	P[000]	0 ... <b>10000</b> ... 16777215
Multiplier numerator		
XXXXXXXX		

PAR: 2.3.4	P[001]	0 ... <b>10000</b> ... 16777215
Multiplier denominator		
XXXXXXXXXX		

PAR: 2.3.5	P[212]	<b>0</b> ... 2
Reference fine (input K0)		
0 = no function		
1 = rising edge		
2 = falling edge		

PAR: 2.3.6	P[213]	<b>0</b> ... 5
Reference coarse		
0 = no function		
1 = high signal		
2 = low signal		
3 = front keys		
4 = rising edge (K0) reference value thumbwheel-1		
5 = falling edge (K0) reference value thumbwheel-1		
6 = rising edge input (1...4)		

PAR: 2.3.7	P[209]	<b>0</b> ... 2
Counting direction for setting reference value		
0 = independent from direction		
1 = upwards counting		
2 = downwards counting		

PAR: 2.3.8	P[003]	-9999999 ... <b>0</b> ... 99999999
Reference value 1		
-XXXXXXXXX (AWE)		

PAR: 2.3.9	P[004]	<b>0</b> ... 99999999
Counting range (no function when Hold/Reset is active (P[200]))		
XXXXXXXXX (AWE)		

PAR: 2.1.10	P[233]	<b>0</b> ... 48
Source for counting range		
0 = parameters counting range P[004]		
1...48 = nominal value 1...48		

### 5.2.4 Submenu 2.4 Analog

PAR: 2.4.1	P[005]	-9999999 ... 0 ... 99999999
Adjustment absolute value		
XXXXXXXXXX		

PAR: 2.4.2	P[219]	0 ... 7
Adjustment		
0 = no function		
1 = rising edge (K0) only temporary in RAM (on interrupt)		
2 = falling edge (K0) only temporary in RAM (on interrupt)		
3 = set with parameter adjustment value		
4 = rising edge (K0) permanent in EEPROM (not on interrupt)		
5 = front keys		
6 = rising edge (K0) reference value thumbwheel-1		
7 = falling edge (K0) reference value thumbwheel-1		
8 = rising edge input (1...4)		

PAR: 2.4.3	P[213]	0 ... 2
Reference coarse		
0 = no function		
1 = high signal		
2 = low signal		

PAR: 2.4.4	P[227]	0 ... 1
Min/max function		
0 = no function		
1 = min/max		

PAR: 2.4.5	P[113]	-9999999 ... 0 ... 99999999
Min. Value		
-XXXXXXXXX (AWE)		

PAR: 2.4.6	P[114]	-9999999 ... 0 ... 99999999
Max. value		
-XXXXXXXXX (AWE)		

### 5.2.5 Submenu 2.5 CAN AP-Link

PAR: 2.5.1	P[103]	0 ... 999999999
Display counting range		
XXXXXXXXX (AWE)		

PAR: 2.5.2	P[079]	0 ... 9999
Time-out in 0,01 s units		
XX.XX (sec) input 0: inactive		

PAR: 2.5.3	P[215]	0 ... 1
Time-out reset		
0 = auto reset (reset when new value has been stored)		
1 = reset by using an input		

### 5.2.6 Submenu 2.6 Start/Stop

PAR: 2.6.1	P[115]	0 ... 280000 .. 999999
Gradient		
Actual signalspeed sensor internal in m/s		
(0 = 2800.00 m/s)		
XXXX.XX (m/s)		

PAR: 2.6.2	P[118]	0 ... 6000 ... 29999
Measuring length sensor		
XXXXX mm		

PAR: 2.6.3	P[211]	0 ... 1
Counting direction		
0 = no reverse		
1 = reverse		

PAR: 2.6.4	P[000]	0 ... 10000 ... 16777215
Multiplier numerator		
XXXXXXXXX		

PAR: 2.6.5	P[001]	0 ... 10000 ... 16777215
Multiplier denominator		
XXXXXXXXX		

PAR: 2.6.6	P[219]	0 ... 7
Adjustment		
0 = no function		
1 = rising edge (K0) only temporary in RAM (on interrupt)		
2 = falling edge (K0) only temporary in RAM (on interrupt)		
3 = set with parameter adjustment value		
4 = rising edge (K0) permanent in EEPROM (not on interrupt)		
5 = front keys		
6 = rising edge (K0) reference value thumbwheel-1		
7 = falling edge (K0) reference value thumbwheel-1		
8 = rising edge input (1...4)		

PAR: 2.6.7	P[213]	0 ... 2
Reference coarse		
0 = no function		
1 = high signal		
2 = low signal		

PAR: 2.6.8	P[209]	0 ... 2
Counting direction adjustment		
0 = independant from direction		
1 = when counting in positive direction		
2 = when counting in negative direction		

PAR: 2.6.10	P[002]	-9999999 ... 0 ... 99999999
Offset		
-XXXXXXXXX (AWE)		

PAR: 2.6.11	P[005]	-9999999 ... 0 ... 99999999
Adjustment value		
-XXXXXXXXX (AWE) input 0 means function inactive		

**5.3 Menu 3 CAN-bus****5.4 Submenu 3.1 Config**

PAR: 3.1.1	P[228]	0 ... 5 ... 7
Baudrate		
0 = 20 kbit/s		
1 = 50 kbit/s		
2 = 100 kbit/s		
3 = 125 kbit/s		
4 = 250 kbit/s		
5 = 500 kbit/s		
6 = 800 kbit/s		
7 = 1 Mbit/s		

**5.5 Submenu 3.2 Obj1/PDO1 In**

PAR: 3.2.1	P[089]	0 ... 1 ... 127
CAN adress Obj/PDO1 In		
XXX		

PAR: 3.2.2	P[229]	0 ... 4
Function Obj/PDO1 In		
0 = not active		
1 = AP-Link (reading actual position and velocity)		

**5.6 Submenu 3.3 Obj1/PDO1 Out**

PAR: 3.3.1	P[090]	0 ... 1 ... 127
CAN adress Obj/PDO1 Out		
XXX		

PAR: 3.3.2	P[230]	0 ... 4
Function Obj/PDO1 Out		
0 = not active		
1 = AP-Link (sending actual position and velocity)		

## 5.7 Menu 4 Serial

### 5.7.1 Submenu 4.1 Config

PAR: 4.1.1	P[236]	0 ... 31
Unit address		
XX		

### 5.7.2 Submenu 4.2 Ser-1 (RS232)

PAR: 4.2.1	P[237]	0 ... 1 ... 4
Baudrate		
0 = 9600		
1 = 19200		
2 = 28800		
3 = 38400		
4 = 57600		

PAR: 4.2.2	P[238]	0 ... 1
Number of stopbits		
0 = 1 Stopbit		
1 = 2 Stopbits		

PAR: 4.2.3	P[239]	0 ... 2
Parity		
0 = none		
1 = odd		
2 = even		

PAR: 4.2.4	P[240]	0 ... 1
Protocol		
0 = no function		
1 = ASCII		

## 5.7.3 Submenu 4.3 Ser-2 (RS422/485)

PAR: 4.3.1	P[242]	0 ... 1 ... 4
Baudrate		
0 = 9600		
1 = 19200		
2 = 28800		
3 = 38400		
4 = 57600		

PAR: 4.3.2	P[243]	0 ... 1
Number of stopbits		
0 = 1 Stopbit		
1 = 2 Stopbits		

PAR: 4.3.3	P[244]	0 ... 2
Parity		
0 = none		
1 = odd		
2 = even		

PAR: 4.3.4	P[245]	0 ... 1
Protocol		
0 = no function		
1 = ASCII		



## 5.8 Menu 5 Input

### INPUT-1

PAR: 5.0.1	P[249]	0 ... 18
Function input-1		
0 = no function		
1 = coarse		
2 = store		
3 = enable		
4 = error reset SSI		
5 = start/stop cams		
6 = start cams		
7 = stop cams		
8 = Hold/Reset start/stop		
9 = Hold/Reset start		
10 = Hold/Reset stop		
11 = lock input nominal values		
12 = lock input parameters		
13 = lock input nominal values + parameters		
14 = reset time-out AP-Link		
15 = DAC Set Smin		
16 = DAC Set Smax		
17 = select reference value 1 or 2 (low = 1)		
18 = read external thumbwheel sets		
19 = SetRef/Adjustment		

### INPUT-2

PAR: 5.0.2	P[250]	0 ... 18
Function input-2		
XX (see input-1)		

### INPUT-3

PAR: 5.0.3	P[251]	0 ... 18
Function input-3		
XX (see input-1)		

### INPUT-4

PAR: 5.0.4	P[252]	0 ... 18
Function input-4		
XX (see input-1)		

## 5.9 Menu 6 Output

### 5.9.1 Submenu 6.1 – 6.4 Op1...4

#### OUTPUT 1...9

PAR: 6.x.1	P[389]...P[397]	0 ... 9
Function output-1		
0 = cam		
1 = cam inverted		
2 = SSI error (high = no error)		
3 = reference/adjustment		
4 = cams active		
5 = Hold/Reset started (only when P[200] = 3 ...6)		
6 = time-out AP-Link (high = no time-out)		
7 = ASCII protocol		
8 = Counting direction (high = downwards counting)		
9 = Start/Stop error (no magnet or time-out)		

PAR: 6.x.2	P[094]...P[102]	0 ... 5000
Dynamic cams (only when output = cam and source = actual position)		
X.XXX (sec) input 0 = no function		

## 5.10 Menu 7 Analog input

### 5.10.1 Submenu 7.1 Config

PAR: 7.1.1	P[226]	0 ... 1
Selection AD input		
0 = voltage		
1 = current		

### 5.10.2 Submenu 7.2 AD-U (voltage)

PAR: 7.2.1	P[105]	-100000 ... 99999
U1 AD		
-XX.XXXX (V)		

PAR: 7.2.2	P[106]	-99999 ... 100000
U2 AD		
-XX.XXXX (V)		

PAR: 7.2.3	P[107]	-9999999... -100000 ... 99999999
S1 AD		
-XXXXXXXXX (AWE)		

PAR: 7.2.4	P[108]	-9999999 ... 100000 ... 99999999
S2 AD		
-XXXXXXXXX (AWE)		

PAR: 7.2.5	P[104]	0 ... 10 ... 100
Measuring time analog input		
X.XX (sec) input 0 is 1.00s		

PAR: 7.2.6	P[225]	0 ... 5 ... 50
Integrator analog input		
Actual value is the average from the number of measurements		
0...50 (number of measurements) input 0 = 1		

### 5.10.3 Submenu 7.3 AD-I (current)

PAR: 7.3.1	P[109]	-200000 ... 199999
I1 AD		
-XX.XXXX (mA)		

PAR: 7.3.2	P[110]	-199999 ... 200000
I2 AD		
-XX.XXXX (mA)		

PAR: 7.3.3	P[111]	-9999999... -200000 ... 99999999
S1 AD		
-XXXXXXXXX (AWE)		

PAR: 7.3.4	P[112]	-9999999 ... 200000 ... 99999999
S2 AD		
-XXXXXXXXX (AWE)		

PAR: 7.3.5	P[104]	0 ... 10 ... 100
Measuring time analog input		
X.XX (sec) input 0 is 1.00s		

PAR: 7.3.6	P[225]	0 ... 5 ... 50
Integrator analog input		
Actual value is the average from the number of measurements		
0...50 (number of measurements) input 0 = 1		

## 5.11 Menu 8 Analog output

### 5.11.1 Submenu 8.1 Config

PAR: 8.1.1	P[388]	0 ... 2
Selection DA output		
0 = inactive		
1 = voltage		
2 = current		

PAR: 8.1.2	P[383]	0 ... 4
Selection DA source		
0 = actual position		
1 = actual velocity		
2 = analog input (AWE)		
3 = actual  velocity  abs		
4 = actual linearization		

### 5.11.2 Submenu 8.2 DA-U (voltage)

DA PAR 8.2.1...8.2.4 = 0: DA not active

PAR: 8.2.1	P[080]	-100000 ... 99999
Umin DA		
-XX.XXXX (V)		

PAR: 8.2.2	P[081]	-99999 ... 100000
Umax DA		
-XX.XXXX (V)		

PAR: 8.2.3	P[082]	-9999999... -100000 ... 99999999
S-Umin DA		
-XXXXXXXXX (AWE)		

PAR: 8.2.4	P[083]	-9999999 ... 100000 ... 99999999
S-Umax DA		
-XXXXXXXXX (AWE)		

PAR: 8.2.5	P[234]	0 ... 1
Source for Smin		
0 = parameter Smin		
1 = teach by input		

PAR: 8.2.6	P[235]	0 ... 1
Source for Smax		
0 = parameter Smax		
1 = teach by input		

### 5.11.3 Submenu 8.3 DA-I (current)

DA PAR 8.2.1...8.2.4 = 0: DA not active

PAR: 8.3.1	P[084]	-200000 ... 199999
Imin DA		
-XX.XXXX (mA)		

PAR: 8.3.2	P[085]	-199999 ... 200000
Imax DA		
-XX.XXXX (mA)		

PAR: 8.3.3	P[086]	-9999999 ... -200000 ... 99999999
S-Imin DA		
-XXXXXXXXX (AWE)		

PAR: 8.3.4	P[087]	-9999999 ... 200000 ... 99999999
S-Imax DA		
-XXXXXXXXX (AWE)		

PAR: 8.3.5	P[234]	0 ... 1
Source for Smin		
0 = parameter Smin		
1 = teach by input		

PAR: 8.3.6	P[235]	0 ... 1
Source for Smax		
0 = parameter Smax		
1 = teach by input		

## 5.12 Menu 9 Cam

### 5.12.1 Submenu 9.1 ... 9.24 CA1...24

#### CAM-1...24

PAR: 9.x.1	P[256]...P[279]	0 ... 3
Cam function		
0 = no function		
1 = range		
2 = actual position $\geq$ limit value		
3 = actual position $\leq$ limit value		

PAR: 9.x.2	P[280]...P[303]	0 ... 4
Source		
0 = actual position		
1 = actual velocity		
2 = analog input (AWE)		
3 = Thumbwheel-1 actual position (relative cams)		
4 = Thumbwheel-2 actual position (relative cams)		
5 = actual linearization		

PAR: 9.x.3	P[304]...P[327]	0 ... 52
Source cam begin / limit value (limit value if cam function = 2 or 3)		
0 = parameters cam begin		
1...48 = Nominal value 1...48		
49...52 = Thumbwheel sets 1...4		

PAR: 9.x.4	P[328]...P[351]	0 ... 52
Source cam end		
0 = parameters cam end		
1...48 = Nominal value 1...48		
49...52 = Thumbwheel sets 1...4		

PAR: 9.x.5	P[007]...P[030]	-9999999 ... 1000 ... 99999999
Cam begin / limit value (limit value if cam function = 2 or 3)		
-XXXXXXX		

PAR: 9.x.6	P[031]...P[054]	-9999999 ... <b>2000</b> ...99999999
Cam end		
-XXXXXXXX		

PAR: 9.x.7	P[055]...P[078]	<b>0</b> ... 999999
Hysteresis cam		
XXXXXX		

PAR: 9.x.8	P[352]...P[375]	<b>0</b> ... 4
Assign cam to output		
0 = no output		
1...4 = output 1-4		

## 5.13 Menu 10 External thumbwheel sets

### 5.13.1 Submenu 10.1 Config

PAR: 10.1.1	P[376]	<b>0</b> ... 4
Number of thumbwheel sets		
0 = inactive		
1 = DW1		
2 = DW1+DW2		
3 = DW1+DW2+DW3		
4 = DW1+DW2+DW3+DW4		

PAR: 10.1.2	P[377]	<b>0</b> ... 1
Reading		
0 = auto (every 100ms)		
1 = on ext. input		



### 5.13.2 Submenu 10.2 ...10.4 Set-1...4

PAR: 10.x.1	P[130]...P[133]	0 ... 12
Format		
0 = 7654321 (without sign)		
1 = x654321 (without sign)		
2 = xx54321 (without sign)		
3 = xxx4321 (without sign)		
4 = xxxx321 (without sign)		
5 = xxxxx21 (without sign)		
6 = xxxxxx1 (without sign)		
7 = -654321 (with sign)		
8 = x-54321 (with sign)		
9 = xx-4321 (with sign)		
10= xxx-321 (with sign)		
11= xxxx-21 (with sign)		
12= xxxxx-1 (with sign)		

PAR: 10.x.2	P[120]...P[123]	-999999 ... 9999999
min		
Definition of minimum value.		
-XXXXXXXX		

PAR: 10.x.3	P[124]...P[127]	-999999 ... 9999999
Max		
Definition of maximum value.		
-XXXXXXXX		

PAR: 10.x.4	P[378]...P[381]	0 ... 2
Factor		
0 = x1		
1 = x10		
2 = x100		

## 5.14 Menu 11 Linearization

### 5.14.1 Submenu 11.1 Config

PAR: 11.1.1	P[246]	0 ... 2
Source		
0 = inactive		
1 = Actual position		
2 = Actual velocity		
3 = Actual analog input (AWE)		

PAR: 11.1.2	P[247]	2 ... 10 ... 30
Number of points		
XX		

PAR: 11.1.3	P[248]	0 ... 6
Number of decimals for actual position linearization		
0 = geen		
1 = X.X		
2 = X.XX		
3 = X.XXX		
4 = X.XXXX		
5 = X.XXXXX		
6 = X.XXXXXX		

PAR: 11.1.4	P[241]	0 ... 2
Mode		
0 = 4-Quadrant		
1 = Mirror X-as		
2 = Mirror XY-as		

### 5.14.2 Submenu 11.2 ... 11.31 P1...P30

P1...30 → x = 2...31

PAR: 11.x.1	P[140]...P[169]	-9999999 ... 0 ... 99999999
P1-X		
-XXXXXXXX		

PAR: 11.x.2	P[170]...P[199]	-9999999 ... 0 ... 99999999
P1-Y		
-XXXXXXXX		

**5.15 Overview parameters**

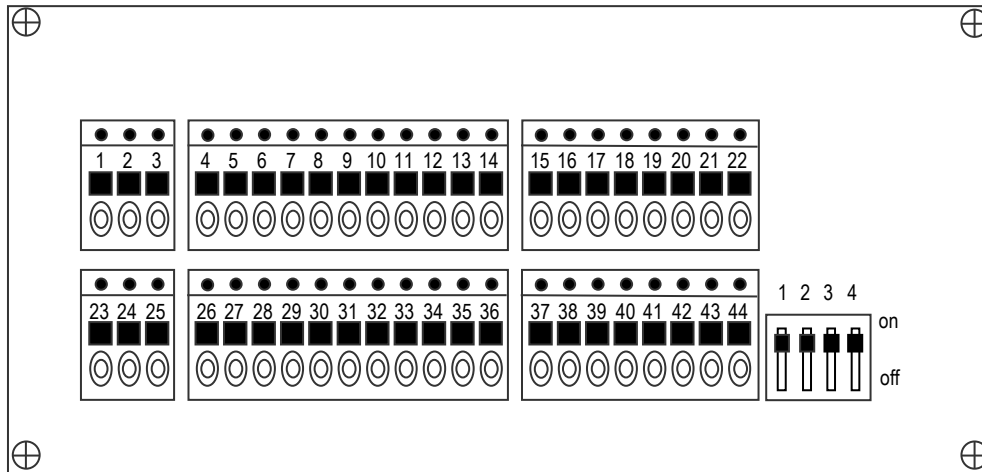
<b>No</b>	<b>Description</b>	<b>Menu</b>
[000]	= Multiplier numerator	2.1.3/2.2.5/2.3.3/2.4.4/2.6.4
[001]	= Multiplier denominator	2.1.4/2.2.6/2.3.4/2.4.5/2.6.5
[002]	= Offset	2.2.10/2.4.6/2.6.9
[003]	= Reference value 1	2.1.8/2.3.8
[004]	= Counting range	2.1.9/2.3.9
[005]	= Adjustment value	2.2.11/2.4.7/2.6.10
[006]	= Delta-SSI monitoring per cycle	2.2.12
[007]...[030]	= Cam begin / limit value	9.1.5...9.24.5
[031]...[054]	= Cam end	9.1.6...9.24.6
[055]...[078]	= Hysteresis cam	9.1.7...9.24.7
[079]	= Time-out in 0,01s units (APLink)	2.5.2
[080]	= Umin DA	8.2.1
[081]	= Umax DA	8.2.2
[082]	= S-Umin DA	8.2.3
[083]	= S-Umax DA	8.2.4
[084]	= Imin DA	8.3.1
[085]	= Imax DA	8.3.2
[086]	= S-Imin DA	8.3.3
[087]	= S-Imax DA	8.3.4
[088]	= Measuring time velocity	1.0.3
[089]	= CAN address Obj/PDO1 In	3.2.1
[090]	= CAN address Obj/PDO1 Out	3.3.1
[091]...[093]	= no function	
[094]...[97]	= Dynamic cam output 1...9	6.1.2...6.9.2
[098]...[101]	= no function	
[102]	= Reference value 2	2.1.10
[103]	= Display counting range ( APLink)	2.5.1
[104]	= Measuring time analog input	7.2.5/7.3.5
[105]	= U1 AD	7.2.1
[106]	= U2 AD	7.2.2
[107]	= S1 AD	7.2.3
[108]	= S2 AD	7.2.4
[109]	= I1 AD	7.3.1
[110]	= I2 AD	7.3.2
[111]	= S1 AD	7.3.3
[112]	= S2 AD	7.3.4
[113]	= min. value AD	2.4.5
[114]	= max. value AD	2.4.6
[115]	= gradient Start/Stop sensor	2.6.1

<b>No</b>	<b>Description</b>	<b>Menu</b>
[116]	= 1/f Frequency	1.0.12
[117]	= 1/f Display	1.0.13
[118]	= measuring length Start/Stop sensor	2.6.2
[119]	= geen functie	
[120]...[123]	= min value thumbwheel sets	10.2.2...10.5.2
[124]...[127]	= max value thumbwheel sets	10.2.3...10.5.3
[128],[129]	= geen functie	
[130]...[133]	= format thumbwheel sets	10.2.1...10.5.1
[134]...[139]	= geen functie	
[140]...[169]	= Pn-X (linearization)	11.2.1...11.31.1
[170]...[199]	= Pn-Y (linearization)	11.2.2...11.31.2
[200]	= Basic function	1.0.1
[201]	= Input for actual position	1.0.2
[202]	= Integrator velocity	1.0.4
[203]	= Number of decimals	1.0.5
[204]	= Store function	1.0.6
[205]	= Store signal	1.0.7
[206]	= Power failure protection	1.0.8
[207]	= Service functions	1.0.9
[208]	= Default monitor function	1.0.10
[209]	= Counting direction ref. / zero-p. adjustment	2.1.7/2.2.9/2.3.7/2.6.8
[210]	= Input type and edge multiplication	2.1.1
[211]	= Counting direction	2.1.2/2.2.2/2.3.2/2.4.2/2.6.3
[212]	= Reference fine (input K0)	2.1.5/2.3.5
[213]	= Reference coarse	2.1.6/2.2.8/2.3.6/2.6.7
[214]	= SSI code	2.2.1
[215]	= Time-out reset (APLink)	2.5.3
[216]	= Number of SSI clockpulses	2.2.3
[217]	= Number of SSI databits	2.2.4
[218]	= adjustment (SSI)	2.2.7
[219]	= adjustment (Start/Stop)	2.6.6
[220]	= Maximum number of SSI errors	2.2.13
[221]	= SSI monitoring	2.2.14
[222]	= no function	
[223]	= 1/f Display format	1.0.14
[224]	= Time basis (internal frequency)	2.3.1
[225]	= Integrator analog input	7.2.6/7.3.6
[226]	= Selection AD input	7.1.1
[227]	= min/max function AD	2.4.4
[228]	= Baudrate (Canbus)	3.1.1
[229]	= Function Obj/PDO1 In	3.2.2

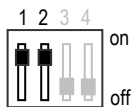
<b><u>No</u></b>	<b><u>Description</u></b>	<b><u>Menu</u></b>
[230]	= Function Obj/PDO1 Out	3.3.2
[231]	= no function	
[233]	= Source for counting range	2.1.11/2.3.10
[234]	= Source for Smin DA	8.2.5/8.3.5
[235]	= Source for Smax DA	8.2.6/8.3.6
[236]	= Unit adress	4.1.1
[237]	= Baudrate (RS232)	4.2.1
[238]	= Stopbits (RS232)	4.2.2
[239]	= Parity (RS232)	4.2.3
[240]	= Protocol (RS232)	4.2.4
[241]	= Mode linearization	11.1.4
[242]	= Baudrate (RS422/485)	4.3.1
[243]	= Number of stopbits (RS422/485)	4.3.2
[244]	= Parity (RS422/485)	4.3.3
[245]	= Protocol (R422/485)	4.3.4
[246]	= Source (linearization)	11.1.1
[247]	= Number of points (linearization)	11.1.2
[248]	= Number of decimals (linearization)	11.1.3
[249]...[252]	= Function input 1...4	5.0.1...5.0.4
[253]	= no function	
[256]...[279]	= Camfunction	9.1.1...9.24.1
[280]...[303]	= Source cam	9.1.2...9.24.2
[304]...[327]	= Source for cam begin/limit value	9.1.3...9.24.3
[328]...[351]	= Source for cam end	9.1.4...9.24.4
[352]...[375]	= assign cam to output	9.1.8...9.24.8
[376]	= number of thumbwheel sets	10.1.1
[377]	= reading thumbwheel sets	10.1.2
[378]...[381]	= factor thumbwheel sets	10.2.4...10.5.4
[382]	= geen functie	
[383]	= Selection DA source	8.1.2
[384]...[387]	= no function	
[388]	= Selection DA output	8.1.1
[389]...[392]	= Function output 1...4	6.1.1...6.4.1
[393],[397]	= geen functie	
[398]	= Display multiplicator	1.0.15
[399]	= geen functie	

## 6 Connections

### Connections on the rear

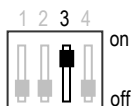


#### RS 422/485



If the AP40 is the last device, the DIP-switches 1 and 2 should be set to on.

#### CANbus



If the AP40 is the last device in a CANbus network, DIP-switch 3 should be set to on.

#### Analog input



When using the analog input as a current input, DIP-switch 4 should be set to on.

## **6.1 Overview clamp connections**

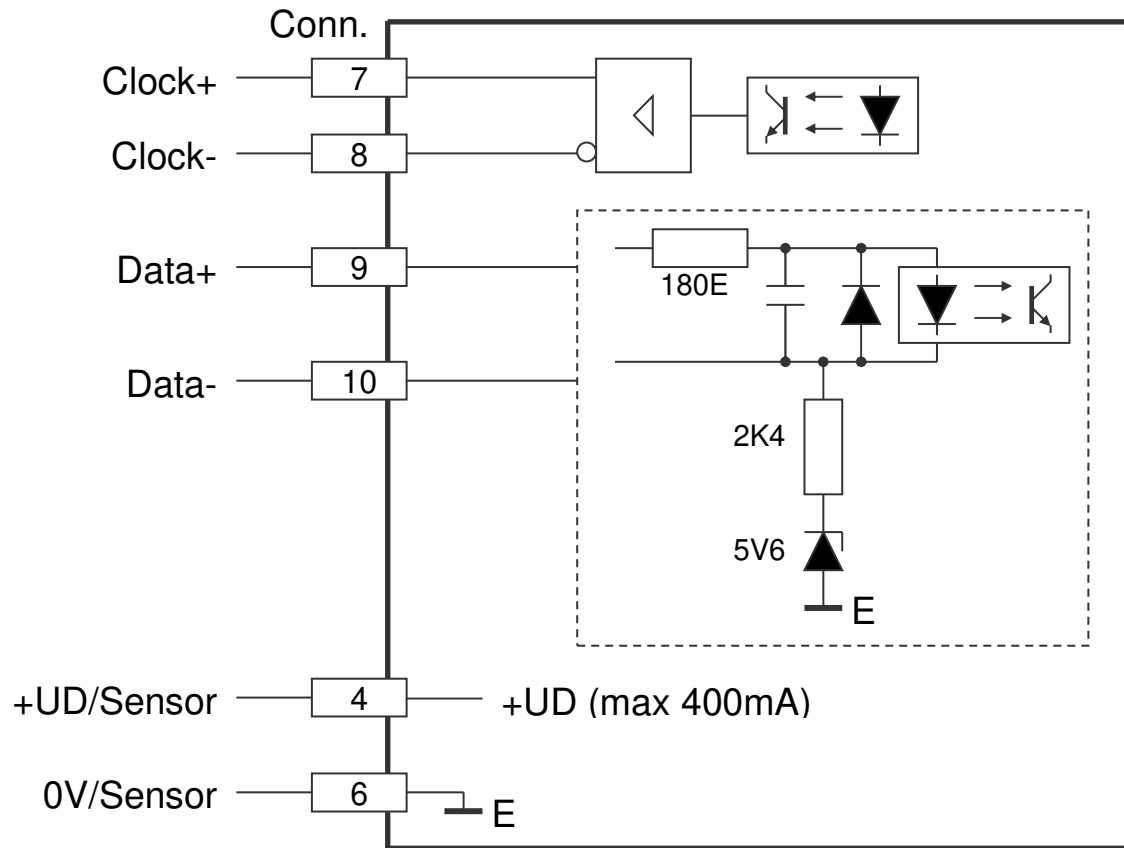
1. +10...+35V supply
2. 0V supply
3. PE supply
  
4. +10...35V DC supply output for sensor
5. +5V DC supply output for sensor
6. 0V for sensor
7. SSI-Clock+ or start+ signal Start/Stop sensor
8. SSI-Clock- or start- signal Start/Stop sensor
9. K1 or counting dir. or SSI-Data+ or stop+ signal Start/Stop sensor
10. /K1 or counting dir. or SSI-Data- or stop- signal Start/Stop sensor
11. K2 or counting pulse
12. /K2 or counting pulse
13. K0
14. /K0
  
15. +Analog in
16. –Analog in
17. 0V analog
18. U-Uit (0V is clamp 17)
19. I-Uit (0V is clamp 17)
20. CAN+ (0V is clamp 22)
21. CAN- (0V is clamp 22)
22. 0V Communication
  
23. +10...+35V supply (conected with clamp 1)
24. 0V supply (conected with clamp 2)
25. 0V supply (conected with clamp 2)
  
26. +U for outputs
27. 0V for outputs
28. Output-1
29. Output -2
30. Output -3
31. Output -4
32. Input-1
33. Input-2
34. Input-3
35. Input-4
36. common for inputs (0V)

- 37. Tx+
- 38. Tx-
- 39. Rx+
- 40. Rx-
- 41. 0V Communication
- 42. TxD
- 43. RxD
- 44. 0V Communication

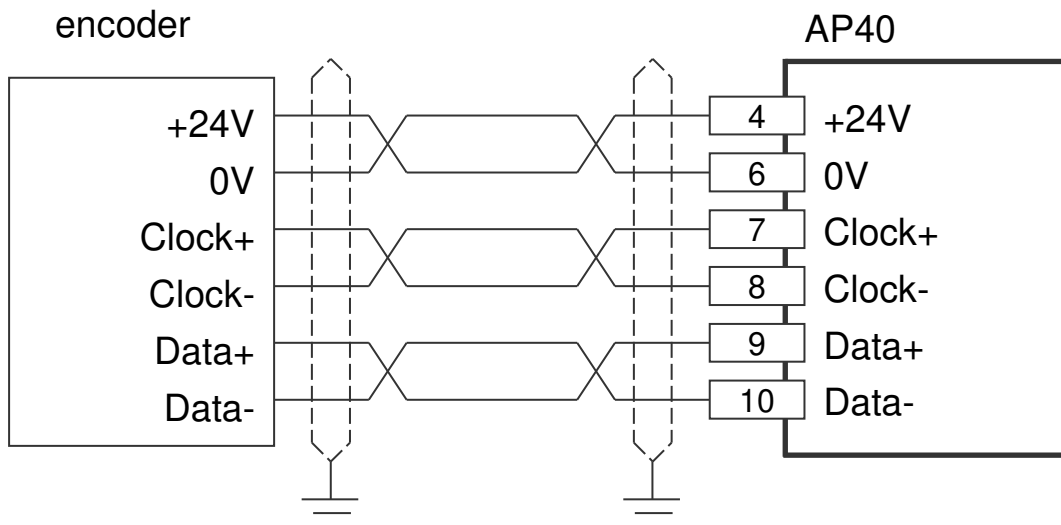




### 6.3 SSI input

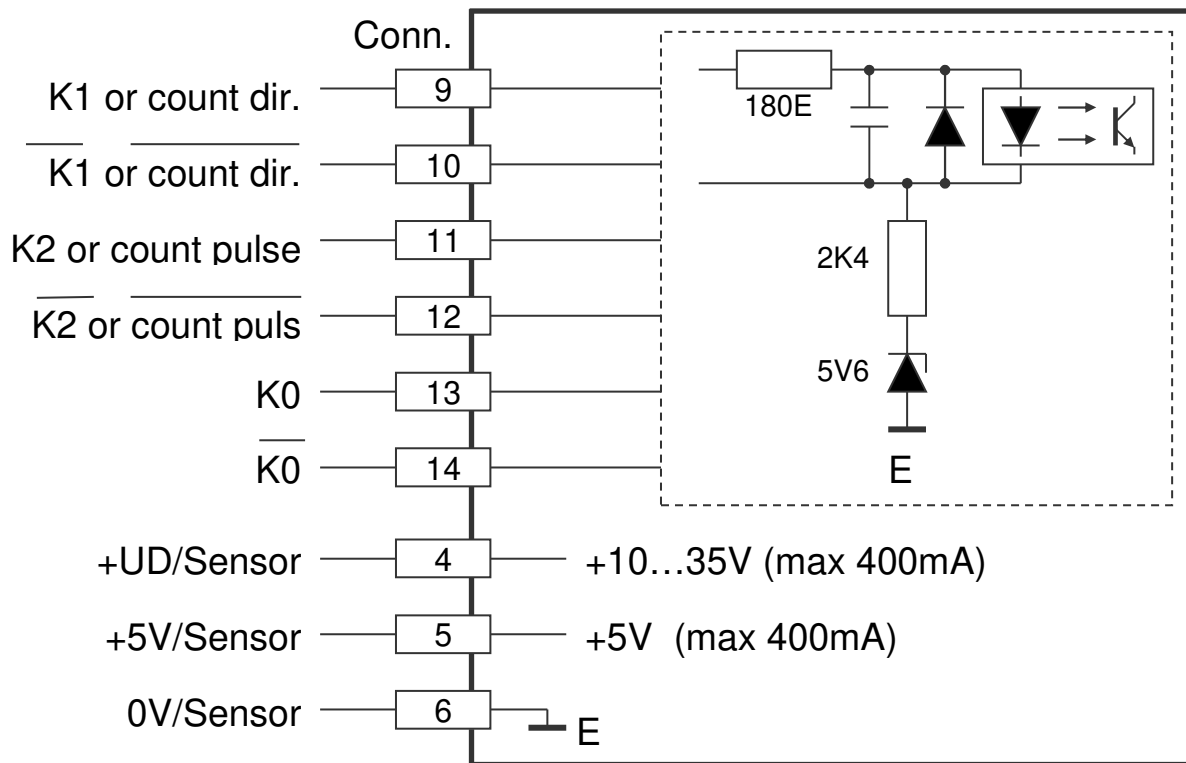


### 6.4 SSI encoder 24V



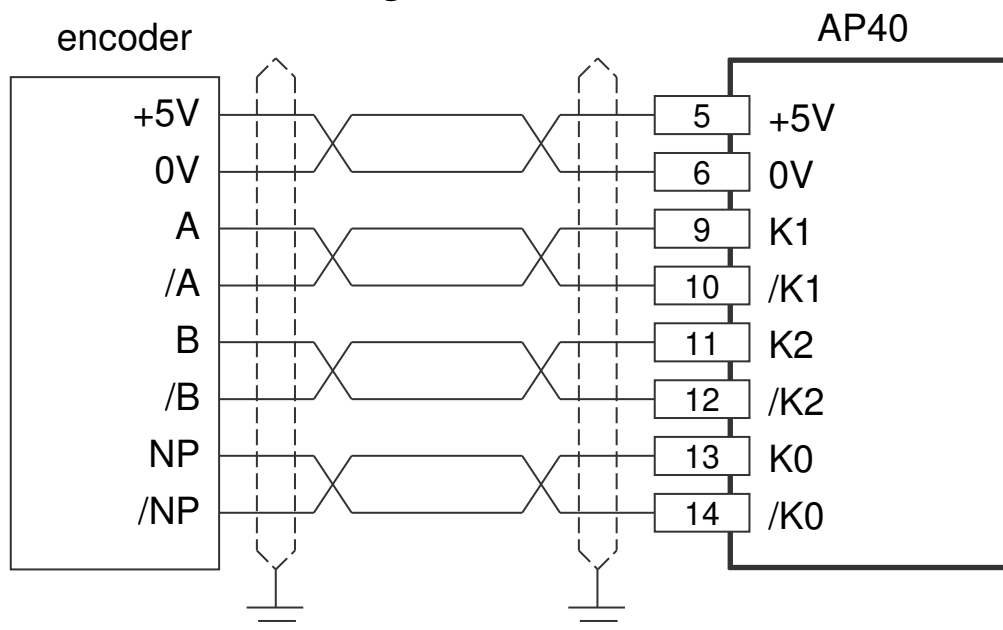
Supply voltage AP40 clamp 1 and 2 is 24V DC

## 6.5 Counting input

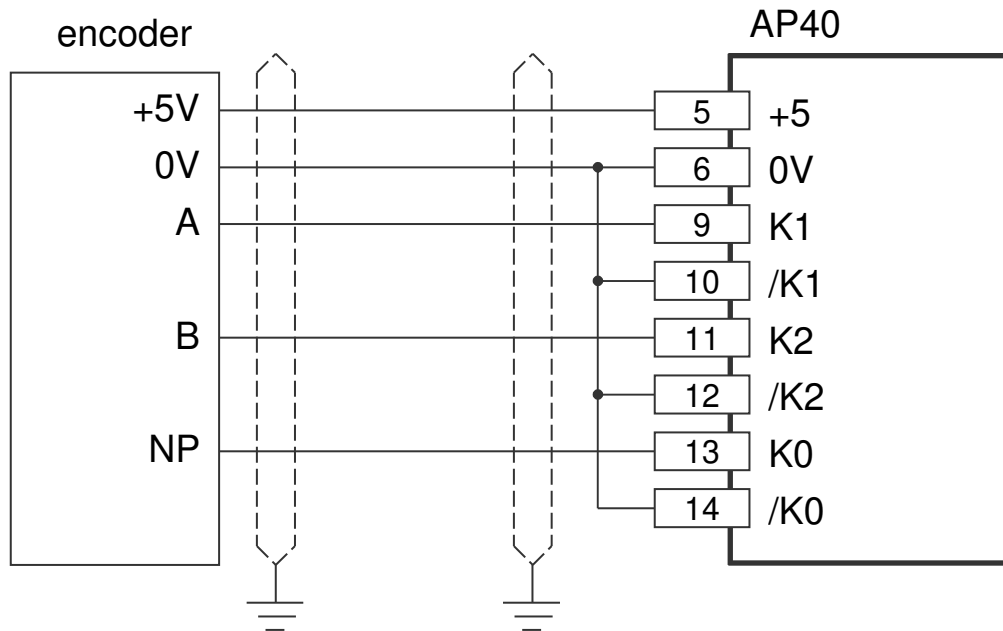


It is possible to use different voltage signals for K0 and K1, K2. For example: encoder signals (K1/K2) with a level of 5V and a reference fine (K0) with 24V level.

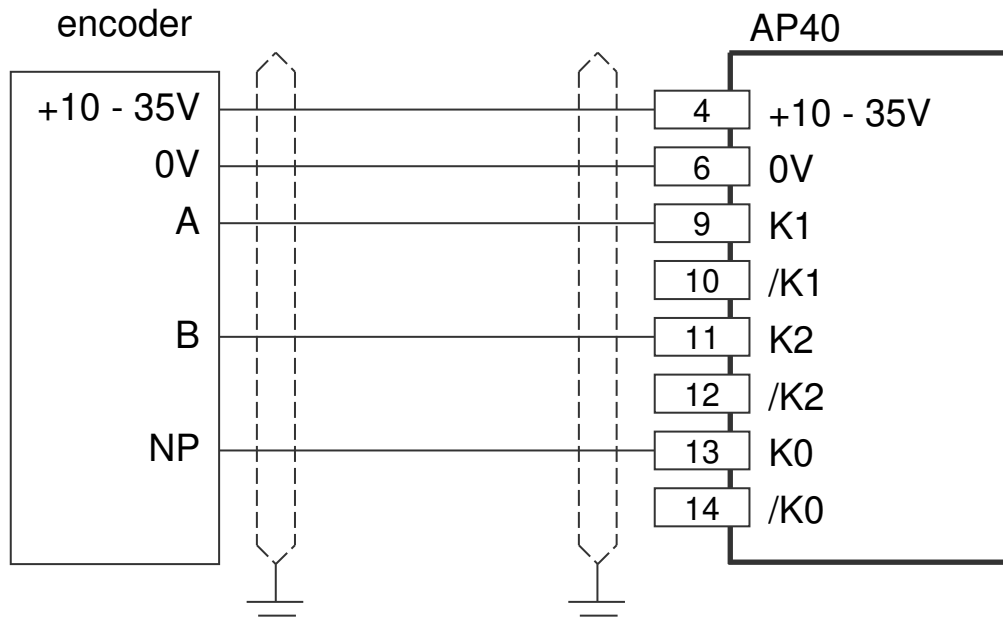
## 6.6 Encoder 5V with inverted signals



## 6.7 Encoder 5V without inverted signals



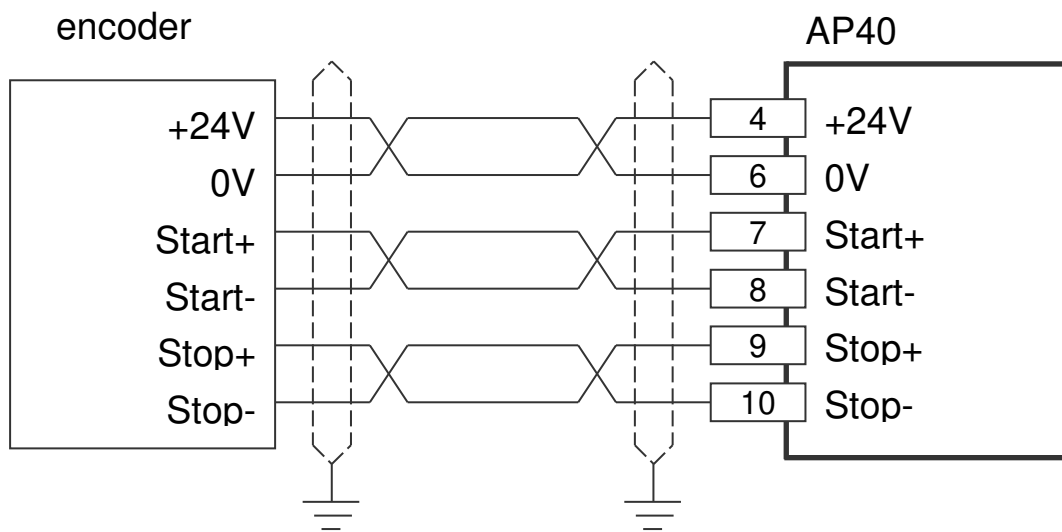
## 6.8 Encoder 10 – 30V



### CAUTION!

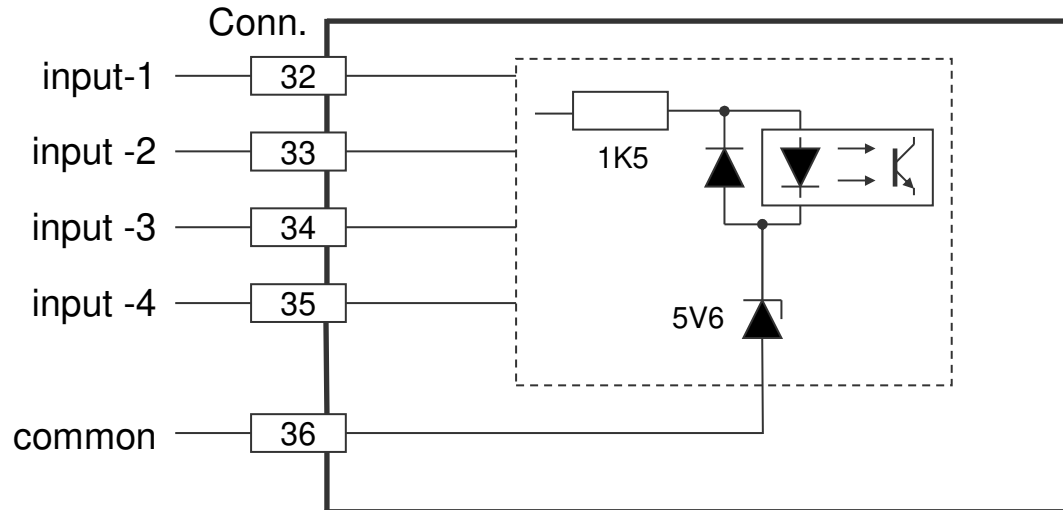
When using 24V encoders don't connect terminal 10,12 and 14.

## 6.9 Start/Stop sensor

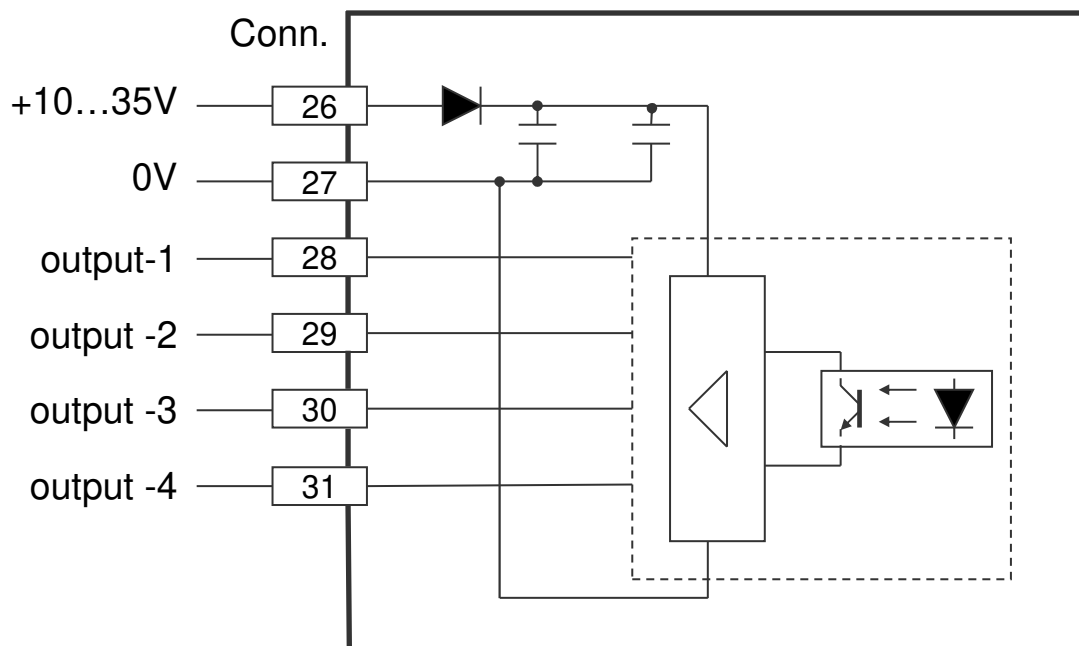


Supply voltage AP40 clamp 1 en 2 is 24V DC

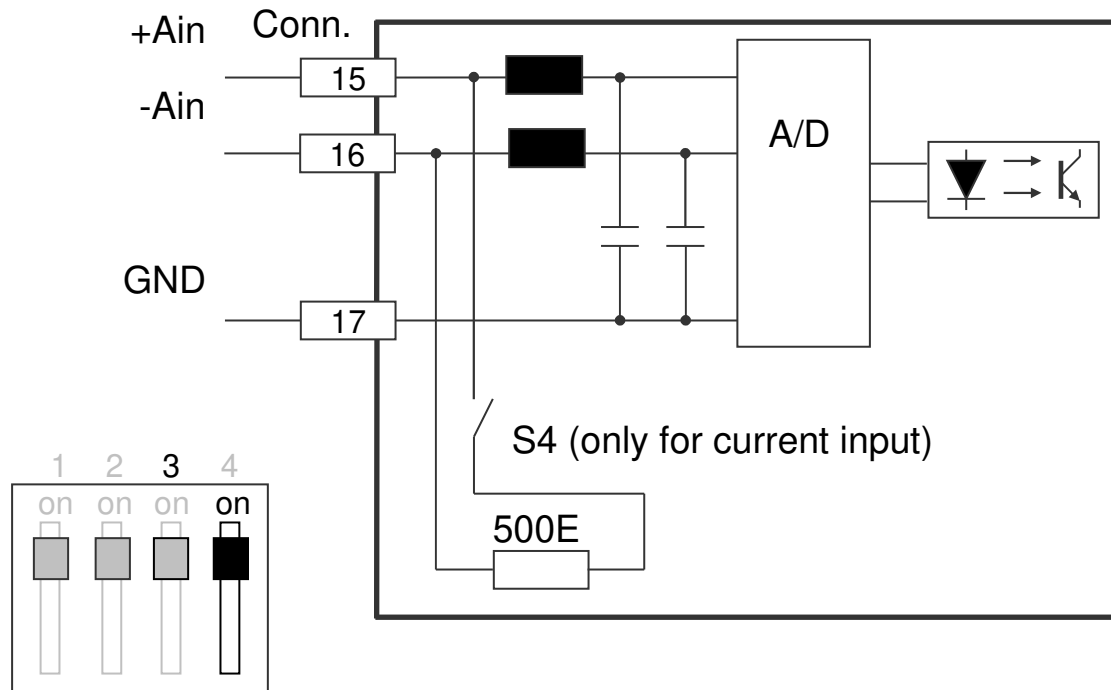
## 6.10 Digital inputs



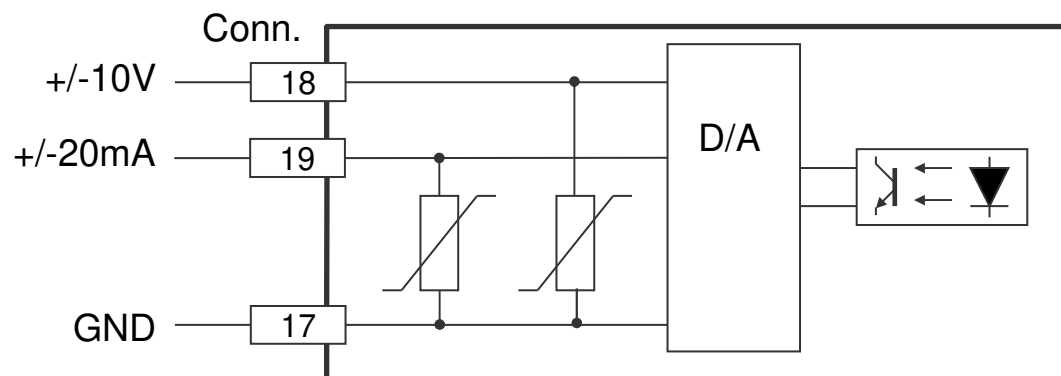
## 6.11 Digital outputs



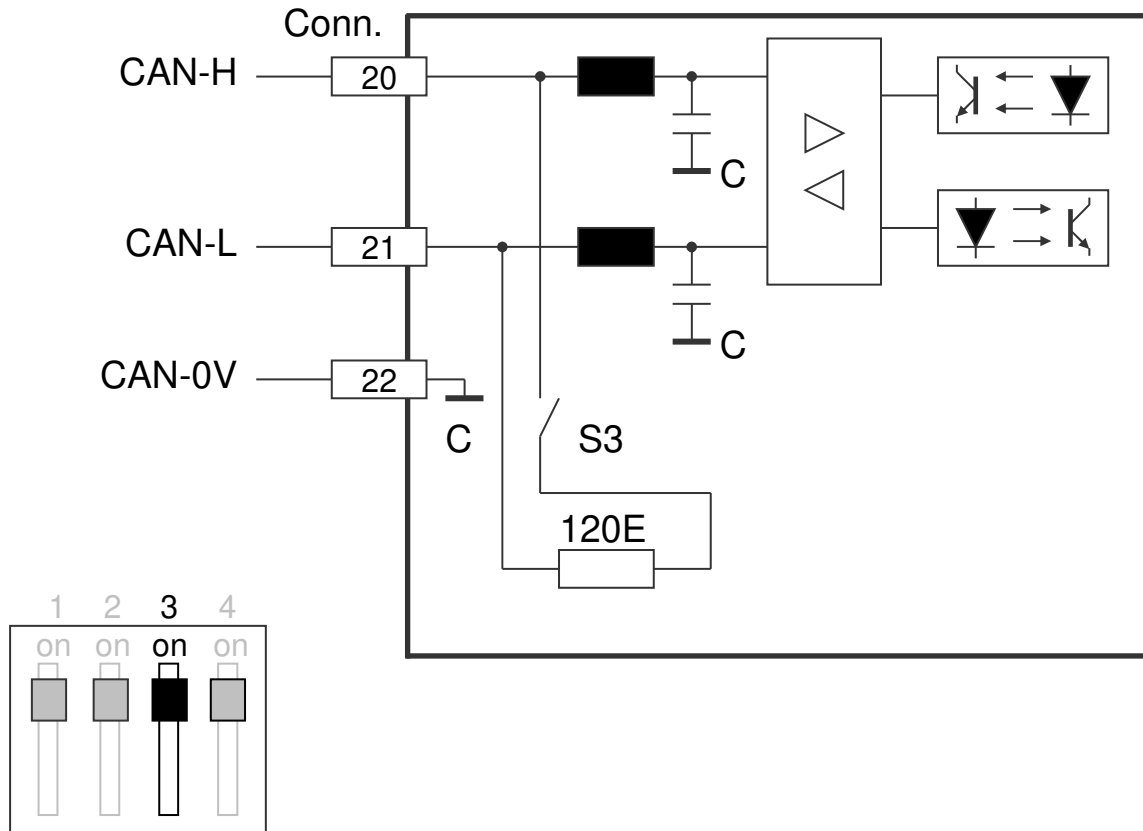
## 6.12 Analog input



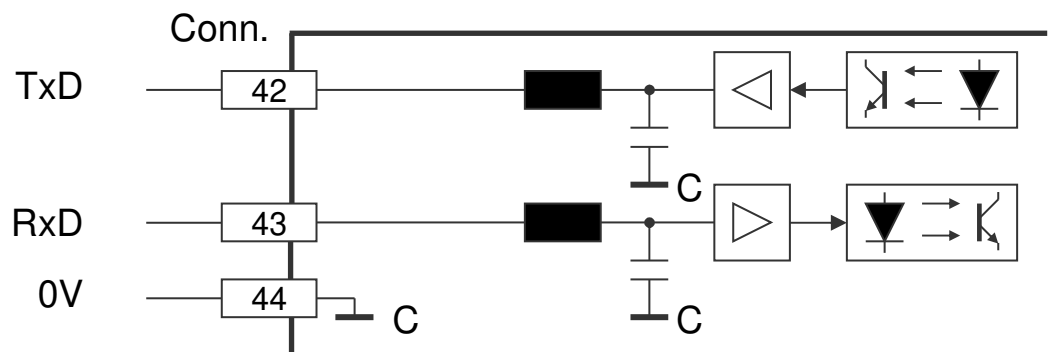
## 6.13 Analog output



## 6.14 CAN-bus

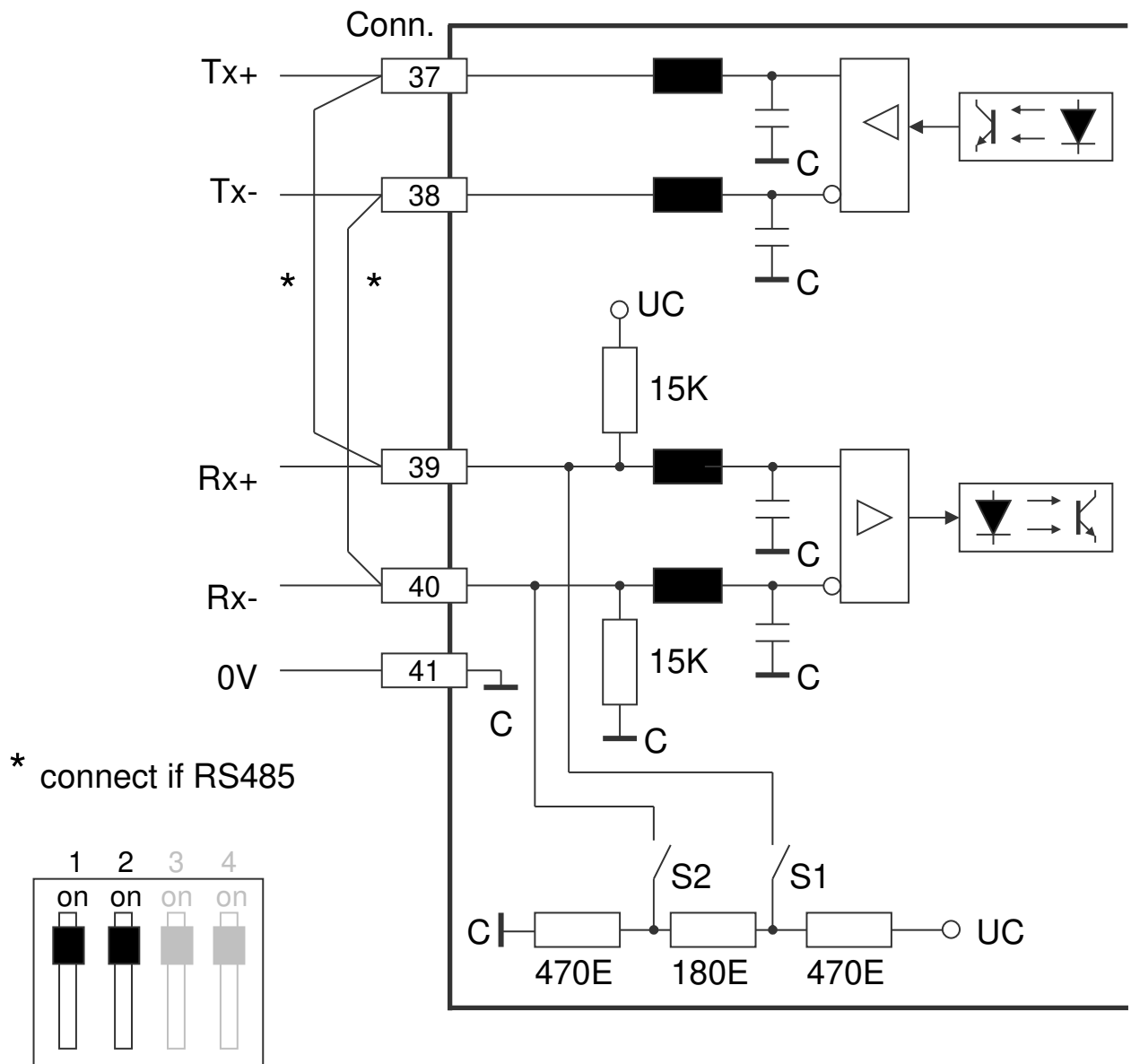


## 6.15 RS232 Ser-1





### 6.16 RS422/485 Ser-2



## 7 Technical specifications

### 7.1 Specifications

- Supply voltage	10...35V DC (power failure not active) 16...35V DC (power failure active)
current consumption	< 150mA
- Output voltage	for external encoder
+UD	max 400mA depending on supply voltage
+5V	max 400mA
- Processor	
μController	XC167
Data memory	EEPROM
Cycle time	250μS (fixed)
Counting range	-9999999...+99999999
- Counting input	optically isolated
signal level	low (5V): 0...+0.8V high (5V): +2.8V...+5V low (24V): 0...+5V high (24V): +15V...+35V
voltage output	5,3V max. 350mA
input resistor	appr. 3kOhm at 24V appr. 0.35kOhm at 5V
input frequency	max. 150 kHz
impulswidth K0	min. 2μ S
- SSI	optically isolated
data-input	low 0...+0,8V high +2,8V...+5V
clock-output	driver (RS422)
clock-frequency	125 kHz (138,9 kHz if > 26 bit encoder signal)
- Start/Stop	optically isolated
stop-input	low 0...+0,8V high +2,8V...+5V
start-output	driver (RS422)

- Digital inputs 1...4	optically isolated low: 0...+5V high: +10V...+35V appr. 1.8kOhm at 24V
input resistor	
- Digital outputs 1...4	optically isolated, N FET, short-circuit proof
Imax	500 mA (min load 200 µA)
Supply voltage	35V max.
- Voltage input	galvanically isolated
range	max. -10V ... +10V
resolution	305 µV
offset-temp. coeff.	< 20 ppm/ °C
Rin	30 Kohm
- Current input	galvanically isolated
range	max. -20mA ... +20mA
resolution	610 µA
offset-temp. coeff.	< 20 ppm/ °C
Rin	500 Ohm
- Voltage output	galvanically isolated
range	max. -10V ... +10V
resolution	305 µV
offset-temp. coeff.	< 20 ppm/ °C
Imax	+/-12mA
- Current output	galvanically isolated
range	max. -20mA ... +20mA
resolution	610 µA
offset-temp. coeff.	< 20 ppm/ °C
Rmax	550 Ohm
- Serial communication	
Ser-1	RS232 C
Ser-2	RS422/485
- CAN-bus	
protocol	AP-Link
input objects (PDOs)	1 (each 64 bit data width)
output objects (PDOs)	1 (each 64 bit data width)

- Display  
digit height                      8 decades 7-segments LED  
   14 mm
- Temperature range              0...50°C
- Connection diameter            0,5 mm<sup>2</sup> (raster 2,5mm)
- Electromagnetic  
compatibility                      in accordance with guideline  
emission                            2004/108/EC  
immunity                            NEN-EN-IEC61000-6-3:2007  
   NEN-EN-IEC61000-6-3:2005
- Weight                            < 0.4 kg
- Sealing                            front IP50, with protective hood IP54  
   rear IP20

## 7.2 Typekey

AP40- C X



### Analog output

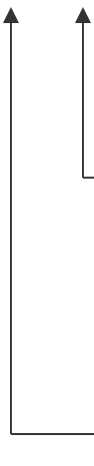
0 = no analog in- and output  
A = analog in- and output

### Serial communication

C = RS232, RS422/485 and CANbus

## 7.3 Typekey Thumbwheel sets

APD- X X



### Number of decades

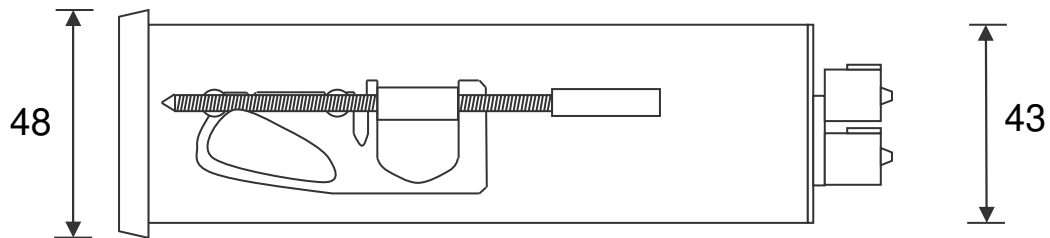
4 = 4 decade  
5 = 5 decade  
6 = 6 decade  
7 = 7 decade (no sign possible)

### Sign

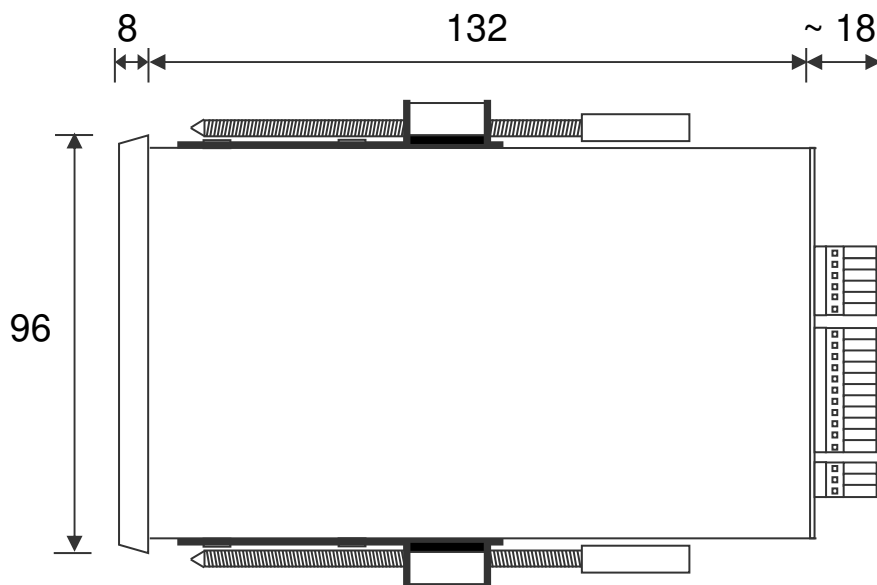
0 = no sign  
T = with sign

## 7.4 Dimensions AP40

Side view

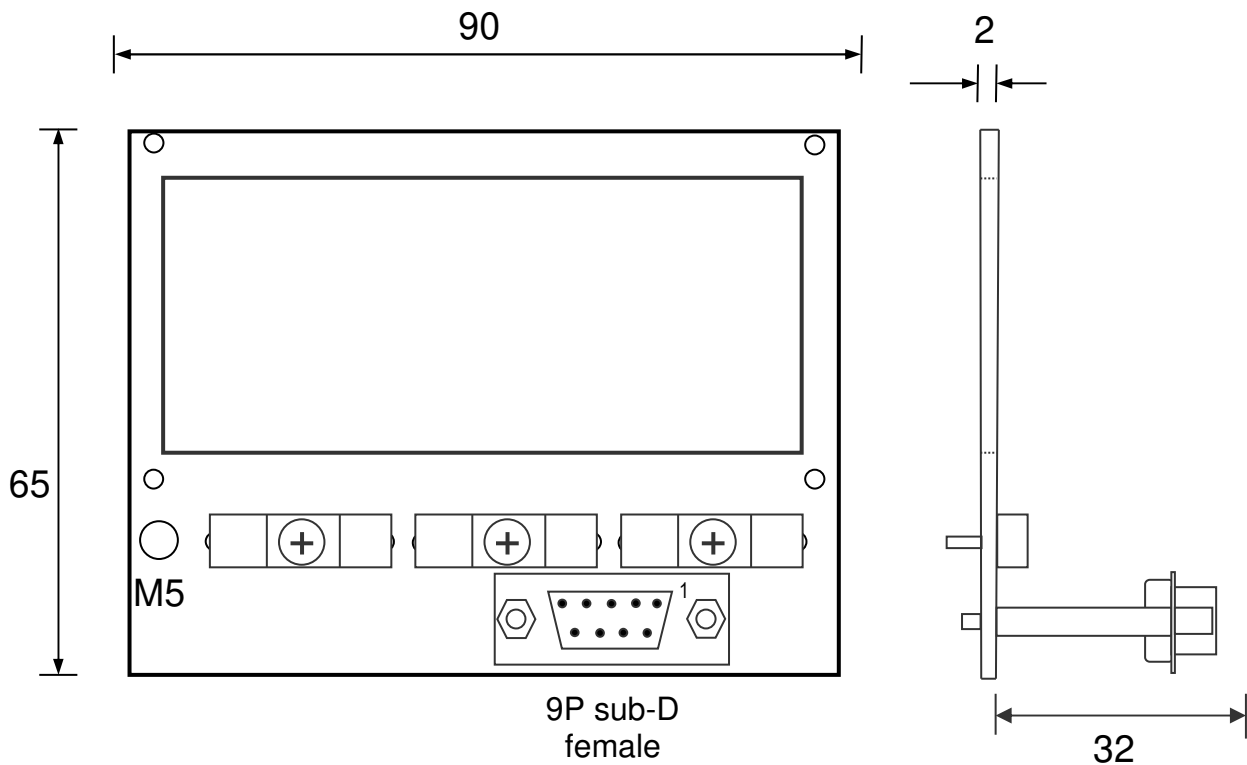


Top view

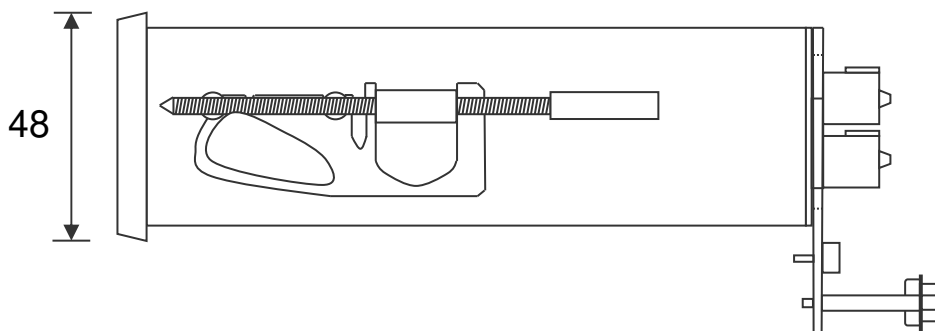


## 7.5 Dimensions EMC bracket type EMC-B04

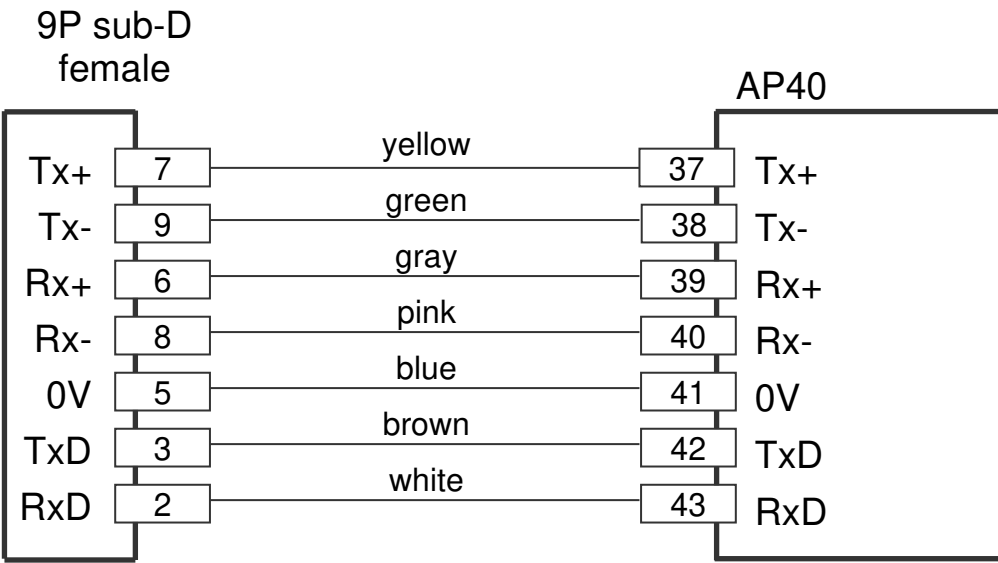
With RS232 and RS422/485 (9P sub-D) on EMC bracket



Side view EMC bracket

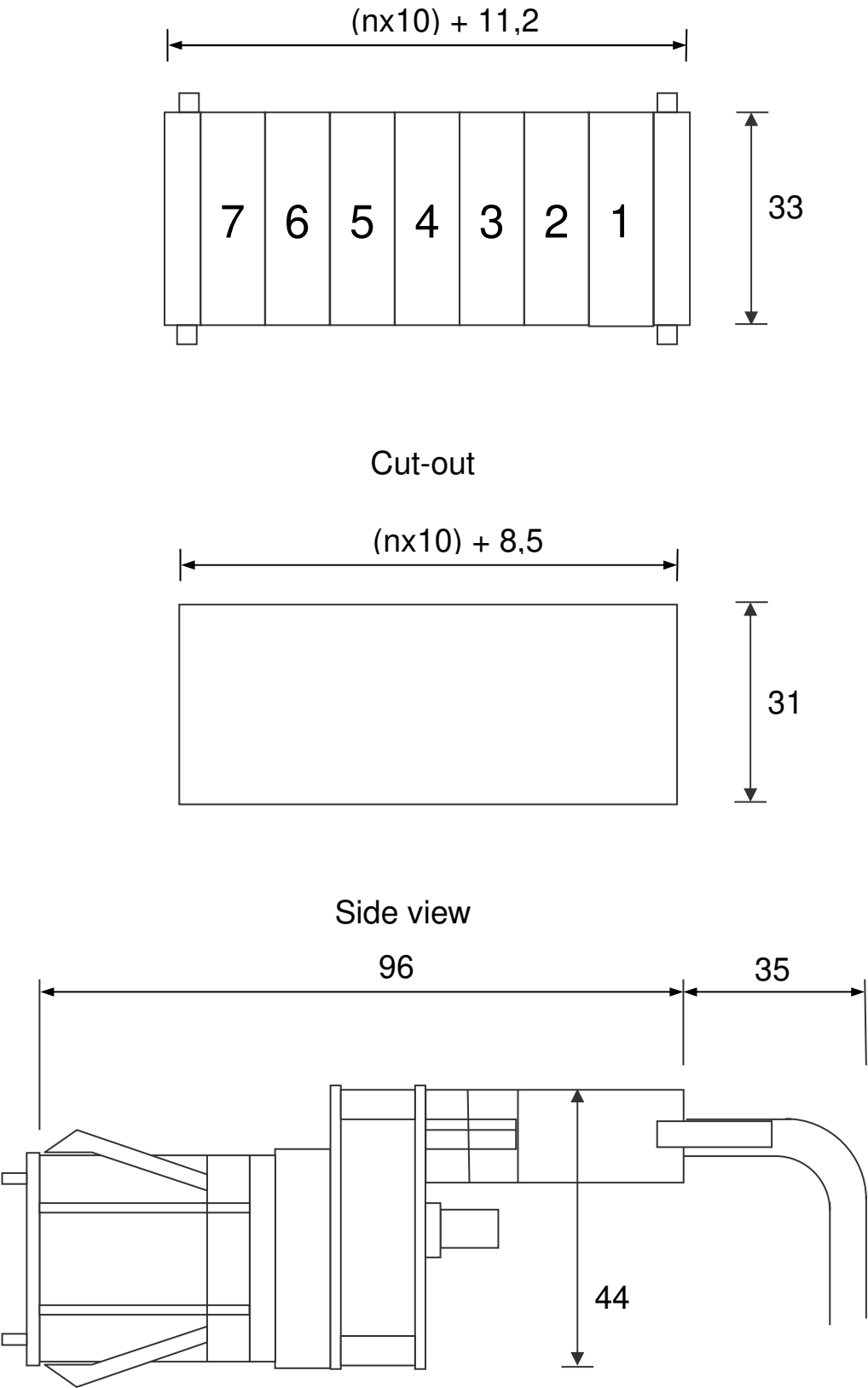


7.5.1 Connections RS232, RS422/485 on 9P sub-D connector





7.6 Dimensions thumbwheel switches APD-xx



7.7 Dimensions protective hood type CDS-B02

