Digital Cam Switch Unit

CamCon DC40

Digitronic Automationsanlagen GmbH

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For your attention

This instruction manual relates to the CamCon DC40 from 5/2006. The company Digitronic Automationsanlagen GmbH reserves the right to make changes which present an improvement of the quality or functionality of the device without prior notice. The instruction manual was created with great care, although it may not be error-proof. We would be grateful for any communication relating to any errors you may have found.

UP-date
You can also obtain this instruction manual on the Internet at **http://www.digitronic.com** in the latest version as PDF file.

Qualified personnel
This device may only be started and operated by qualified staff. By qualified we mean personnel who are entitled to handle, to earth and to lable devices, systems and power circuits in accordance with the technology safety standards.

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Note: We have examined the devices of the CamCon series for year 2000 compatibility and have not found any adverse effects on any functions.

Note: CamCon is a registered trademark of the company Firma Digitronic Automationsanlagen GmbH.

Note: The devices of the CamCon series comply with the standards for electromagnetic compatibility: EN 55011, EN 55022, EN 55024 Part 2, EN 50082 Part 2, ENV 50140, VDE 0843 Part 2, VDE 0843 Part 4, VDE 0871, VDE 0875 Part 3 ("N"), VDE 0875 Part 11, VDE 0877 Part 2, IEC 801 Part 3, IEC 801 Part 2, IEC 801 Part 4, IEC 801 Part 5.

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1. Introduction

Electronic Cam Switch Units have been successfully used in industry for a long time. Experiences collected in close liaison with users over the years have been included in the development of the CamCon series. The result is a compact digital cam switch unit which is user friendly and reliable to a high degree. The following characteristics testify the excellence of the CamCon:

* Tested and reliable hardware
* Short-circuit-proof outputs
* Graphic liquid crystal display with 128x64 pixels in the CamCon DC50,51.
* Large and clearly visible 7-Segment display for program, position and speed on CamCon DC30,33 and 40.
* Any number of cams per output can be programmed.
* Up to 32000 Programs for product administration
* Master, for example: machine cams
* Optimising switch points when machine is in operation
* Compensation of mechanical delay time of switch components for switch-ON and switch-OFF points can be set in steps of 100µs separately (DTC = delay time or Speed Compensation).
* Position - Triggert - Time - Cams
* Power supply 24V DC +/- 20%
* Mounting of suspension rails to EN 50022 on CamCon DC16 and 90
* Switchboard panel standard casing 144 x 144 x 63mm to DIN 43700 on CamCon DC33,40 and 51
* S5 Components group for S5 115U, 135U and 155U on CamCon DC115
* S7 Components group for S7 300 on CamCon DC300
* AB Components group for Control**Logix**Ò 1756 on CamCon 1756-DICAM
* S5 Switch-ON via PG interface with L1 - Bus on CamCon DC16,40,50,51 and 90
* PLC Logic Module (optional)
* Shift register (optional)
* OP - Functions
* Analog outputs (optional)

Cam switch units are used wherever switching operations are periodically repeated. Digital cam switch units are an optimum replacement of mechanical units and offer in addition many other advantages, such as:

* Simplification of mounting and adjustment operations
* Repeatable adjustment facility
* Standardised for almost all areas of application
* Reliability
* High switch speed
* Speed Compensation
* Product administration for quick format change

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2. Operating Pinciples

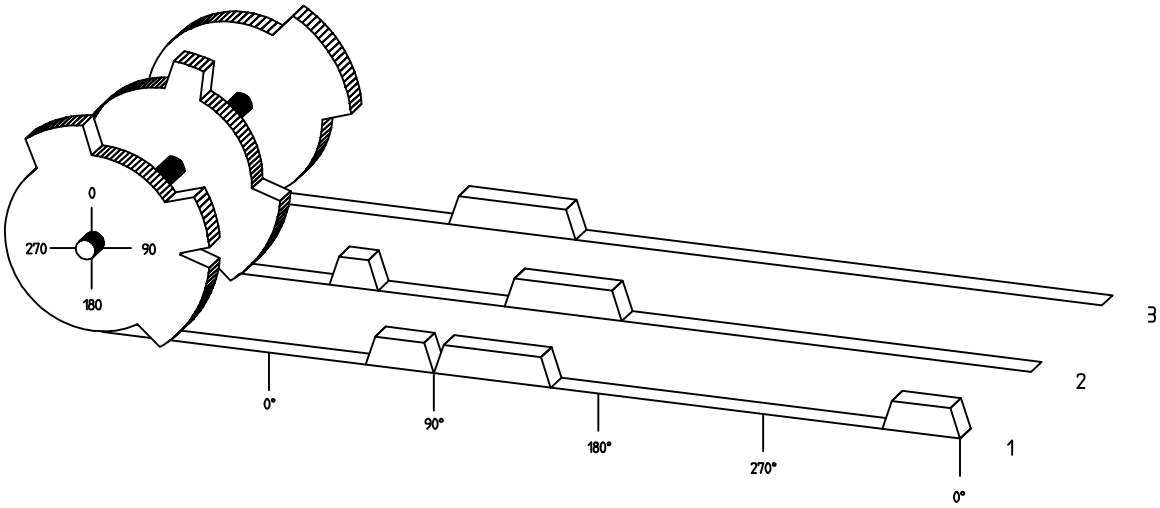

Diagram: Principles of a Cam Switch Unit

A principle for better comprehension of the function of a Cam Switch Unit is here presented. It has 3 outputs with the following cams:

Output 1:	Cam 1:	Switch-ON position	60°	Switch-OFF position	85°
	Cam 2:	Switch-ON position	95°	Switch-OFF position	145°
	Cam 3:	Switch-ON position	325°	Switch-OFF position	355°
Output 2:	Cam 1:	Switch-ON position	5°	Switch-OFF position	20°
	Cam 2:	Switch-ON position	95°	Switch-OFF position	145°
Output 3:	Cam 1:	Switch-ON position	30°	Switch-OFF position	85°

The positions of the output signals, here presented as three tracks, occur when the three cam disks turn anti-clockwise past a sensor, which scans the cams on the 0°-axis.

In a mechanical cam switch unit, the switch interval, i.e. the range between switch-ON and switch-OFF position are determined by the length of the cam. The length and the position of the cam can only be varied marginally and this is mechanically highly demanding and time consuming. With CamCon such adjustments can be realised in a fraction of time; in addition, there can be any number of tracks. A measuring system which is fitted to the device reports the position to the CamCon. The CamCon compares it with the programmed switch-ON and Switch-OFF positions of all outputs. If the position lies in the range of a programmed switch-ON / switch-OFF position (cam), then the respective outputs are active.

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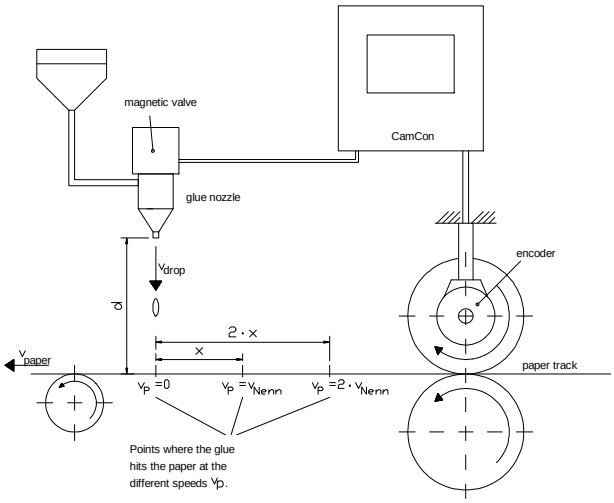
2.1. Speed Compensation

Each mechanical switch component (e.g. shield, magnetic valve) has a delay time, i.e. the time between the start signal and the actual switching of the contacts. In processes where positioning is executed on a moving system, this can cause problems. If such a process is driven with different speeds, different positions are caused. To avoid this happening, new timings for the switch signals of each speed would have to be calculated.

In order to ilustrate the complicated issues surrounding delay time or speed compensation, this will be shown on the example of a packaging machine. In the process shown in the diagram, a glue point has to be placed in an exactly defined spot on a moving paper track.



The system has the following parameters:

v_p	-	Speed of the paper track
v_T	-	Falling speed of the drop of glue
d	-	Distance between the glue nozzle and the paper track
T_{MV}	-	Delay time of the magnetic valve

Without speed compensation the following would happen:

As soon as the measuring system has reached a certain position, the CamCon sends a signal to the magnetic valve. The glue nozzle opens for a short time during which a drop of glue ejects. Between the start of the impulse and the exit of the drop time passes, which is mainly caused by the delay time of the magnetic valve $T_{MV.}$. A further delay is caused by the time which the droplet needs to pass the distance between the glue nozzle and the surface of the paper.
This flight time is calculated as follows:

$$t_{Flight} = \frac{d}{v_T}$$

In total there the delay time is tFlight+$T_{MV.}$ During this time the paper track moves on by a specific distance x.
It would now be possible to move the position, where the magnetic valve is switched on, forward by a specific amount, so that the glue droplet hits the same spot again as during standstill. In this way a speed compensation is created which works only at a specific speed of the paper. As soon as the speed of the device and consequently that of the paper track is, for example, doubled, the hit point of the glue droplet is shifted by the distance x, so that, without any speed compensation, it would move backward by double the distance (2 · x) in total.
The automatic speed compensation of the CamCon makes it now possible to drive processes with variable speed; CamCon registers the speed of the device continuously and adjusts the cams which determine the switch time points "On Line" depending on the speed. This has the effect that the outputs for the switch components are switched ON or OFF earlier. The direction of the movement is of no significance in this instance.

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A small example in figures was designed to eludicate:

Supposing the drive cylinder with the measuring system has a circumference of 360mm, so that one millimeter of the circumference corresponds to exactly one angle degree of the measuring system.

The device has the following parameters:

$v_{droplet}$ = 20m/s
d = 20cm
T_{MV} = 20ms

This results in the following flight time of the droplet:

$$tFlight = \frac{d}{v_T} = \frac{0{,}2m}{20m/s} = 10ms$$

The total delay time is then $Tdead_{, altogether} = T_{MV} + tFlight = 20ms + 10ms = 30ms$

During this time the paper track moves on by the distance $x = v_{paper} \cdot T_{total\ delay.} = 1m/s \cdot 30ms = 30mm$. In order to compensate the delay time, the switch point for the magnetic valve must be moved forward by 30°.

If the speed of the device and consequently that of the paper is doubled v_{paper}, then the distance x is also doubled by the speed of the paper track. In this case the switch point must be moved by 60°.

Note: Please take into account in these explanations that delay time is of a fixed size, which is determined by the mechanical constants of the set and switch components and by the dimensions of the construction and therefore does not change!

If the total delay time of 30ms was programmed into the respective output of CamCon, then the glue droplet would always hit the right spot, regardless of the speed.

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2.1.1. Measuring delay time for Speed Compensation

Several ways of measuring delay time of a relay or valve are available.

2.1.1.1. Measuring delay time through actual differences

First the switch-ON point of a valve or relay is programmed. We assume that the programmed switch point lies at 200 degrees in this case. If the machine is driven with a speed of for example 40 rpm, a shift occurs due to delay time. This shift is then measured and, in this example, will amount to 40 degrees.

Warning: For the calculation of the shift the programmed delay time in the cam switch unit must be set to zero!

The delay time of the switch component is now calculated as follows:

$$\text{Delay time (in sec.)} = \frac{\Delta \text{ way (in °)} * 60 \text{ (sec./min.)}}{\text{speed (in rpm)} * 360 \text{ (°/turn)}}$$

$$\text{Delay time (in sec.)} = \frac{40 * 60}{40 * 360} = 0.1667 \text{ sec.}$$

The resultant delay time is then entered into the cam switch unit.

See Chapter "7.2. Delay time or speed-compensation" an page 31.

2.1.1.2. Measuring delay time by means of different measuring points

First the switch point is calculated at a speed of, for example, 50 rpm. We assume that the programmed switch point lies at 200° in this case. The second measurement is taken at a speed of 80 rpm The necessary switch point must be set to 160°, if the exact switch point is to be also achieved at 80 rpm.

Warning: For the calculation of the two switch points the programmed delay time in the cam switch unit must be set to zero!

The delay time of the switch component is then calculated with the following formula:

$$\text{Delay time (in sec.)} = \frac{\Delta \text{ way (in °)} * 60 \text{ (sec./min.)}}{\Delta \text{ speed (in rpm)} * 360 \text{ (°/turn)}}$$

$$\text{Delay time (in sec.)} = \frac{40 * 60}{30 * 360} = 0.222 \text{ sec.}$$

The resultant delay time is then entered into the cam switch unit.

See Chapter "7.2. Delay time or speed-compensation" an page 31.

Since the entered delay time shifts the switch point, the previously programmed cam must be changed. For the calculation of the exact switch-ON position, the difference to the speed O rpm (here using 50 rpm) must be added to the first measured switch-ON point (here 200°). The difference is calculated with the following formula:

$$\Delta \text{ way (in degrees)} = \frac{\text{dead time (in sec.)} * \Delta \text{ time (in min}^{-1}\text{)} * 360 \text{ (degrees/rotations)}}{60 \text{ (sec./min.)}}$$

$$\Delta \text{ way (in degrees)} = \frac{0.222 * 50 * 360}{60} = 66.6 \text{ degrees}$$

The switch-ON point of the cam is now shifted from 200° by approx. 67° to 267°.

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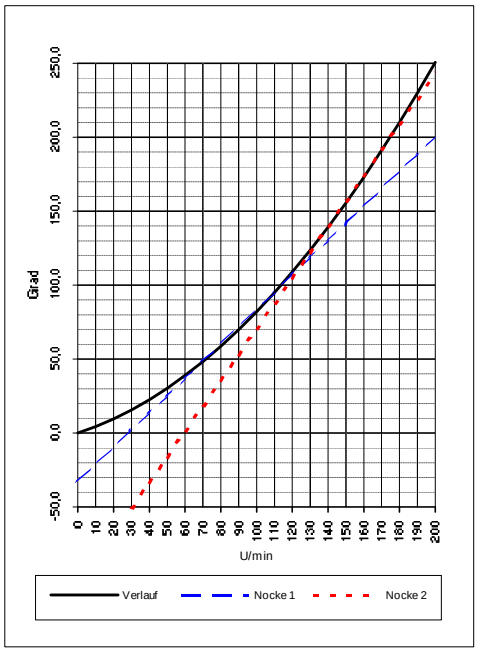
2.1.2. Speed Compensation using off-centre pressure, e.g. brake functions

The Speed Compensation of the CamCon Cam switch unit works using a linear function. If, for example, the speed doubles, then the shift of the compensated cam changes and also moves forward by twice the amount. If the ram on an eccentric press should be brought to a standstill at the exact upper stop point, the brake action of the press under different speeds results in a quadratic function. The Speed Compensation can therefore only find an approximation of the exact switch point for the stopping of the press by adjusting the line of the cam lines to the brake curves in the working range of the press.

In the graphic on the right the curved line represents the brake point of the ram in relation to the speed.



For the calculation of the parameters to be programmed please proceed as follows:

- Define the working range (e.g. 20-50 rpm) and determine two measuring points which have to be specified in the working process (e.g. 30 and 40 rpm).
- Now let the machine run at 30 rpm and program or optimise a cam **without** Speed Compensation so that, at switch-OFF, the ram comes to a halt in top stop. Note the switch-ON point of the cam (e.g. 340°).
- Now let the maching work with 40 rpm and program or optimise one cam **without** Speed Compensation so that, at switch-OFF, the ram comes to a halt in top stop. Once again, note the switch-On point of the cam. (e.g. 332°).
- Now calculate the delay time, taking into account the distance and speed difference, using this formula:

$$\text{Delay time (in sec.)} = \frac{\Delta \text{ way (in °)} * 60 \text{ (sec./min.)}}{\Delta \text{ Speed (in rpm.)} * 360 \text{ (°/turn)}} = \frac{340\text{-}332 * 60}{40\text{-}30 * 360} = 0.133 \text{ sec.}$$

- The calculated delay time is now entered into the cam switch unit.
- Since the switch-OFF point has shifted through the entered Speed Compensation, the previously programmed cam must be changed first. For the calculation of the exact switch-ON position, the difference to the speed 0 rpm (here 30 rpm) must be added to the first measured switch-ON point (first measuring point here 340°) The difference is calculated with the following formula:

$$\Delta \text{ way (in °)} = \frac{\text{delay time (in sec.)} * \Delta \text{ Speed (in rpm.)} * 360 \text{ (°/turn)}}{60 \text{ (sec./min.)}} = \frac{0.133 * 30 * 360}{60} = 23.94°$$

- The switch-ON point of the cam has now shifted from 340° by approx. 24° to 364°.

As a result a cam with a switch-ON point of 4° and a speed compensation of 0.133 sec has been calculated. This is entered in the cam switch unit as switch-OFF cam of the press.

Note: If the degree of accuracy is no longer sufficient when switch-OFF is done with one cam, two or several outputs can be switched in parallel and the cam of those is then adjusted to the required working range. For the calculation of two switch-OFF cams divide the working range in 5 parts with 4 measuring points and then calculate the delay time value and the cam value with the same formula as described above. For the calculation of the first cam, use the measuring points 1 + 2 and for the calculation of the second cam use the measuring point 3 + 4.

Through this association of the linear cam functions to the brake functions it is now possible to switch OFF the cam via the entire working range of the press in the top stop.

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3. Installation

The unit is inserted into a cutout for front plate installation (see chapter "3.1. Dimensions" on page 12). Connect the groundig pins on the back of the encasement as well as the cable cover to a grounding point of the switchboard door in the shortest possible way. All cable connections must be done in a cold state! The connection cables, e.g. for the measuring system or the serial interface, must be wired with covers, and the covers have to grounded on both ends. Analog signals must also be wired with covers, and the covers have to be grounded on one end.

3.1. Dimensions

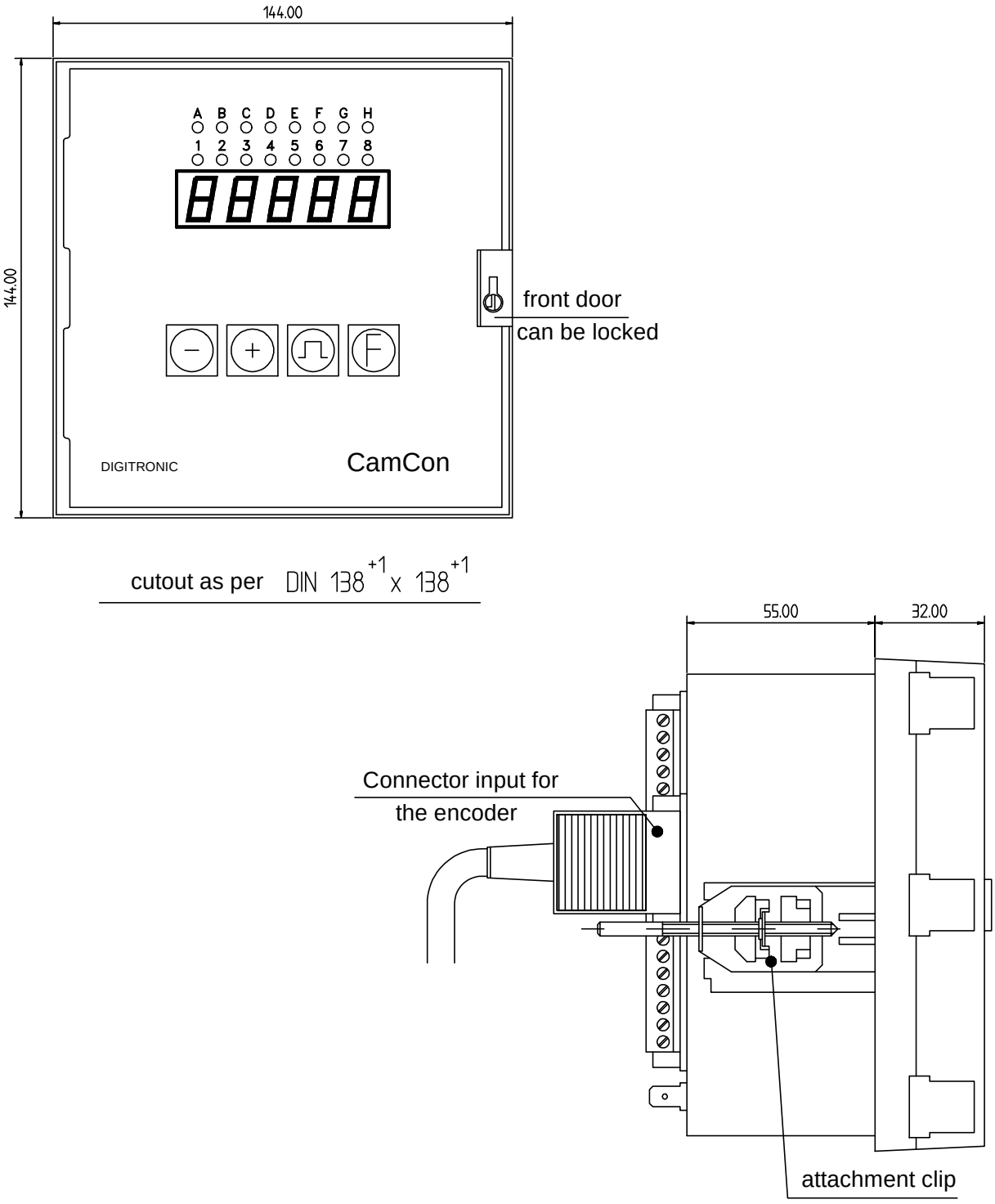

Fig.: Drawing to aid the installation of CamCon

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4. Electrical connections

Before you begin with wiring, please consult the following chapters: "4.3. The outputs" on page 17, "4.4. The inputs" on page 18 and "4.2. The encoder" on page 17.

4.1. Pin allocation of the CamCon

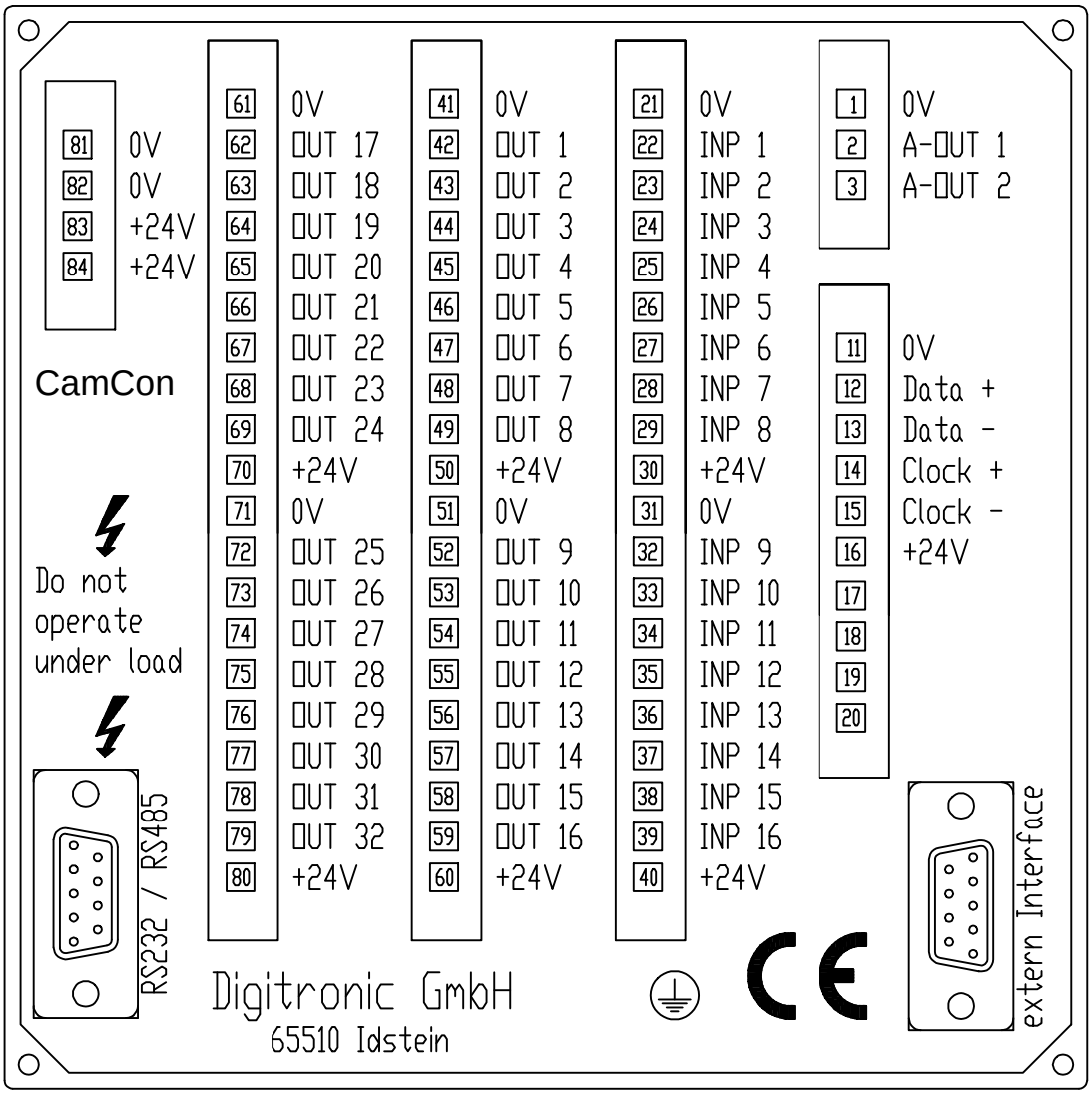

Fig.: Rearview of the CamCon

4.1.1. Pin allocation of the analog output

Pin 1: 0V for the analog output
Pin 2: Analog output 1
Pin 3: Analog output 2

4.1.2. Pin allocation of the SSI measuring system (encoder)

Pin 11: 0V for the SSI measuring system
Pin 12: Data A or +
Pin 13: Data B or -
Pin 14: Clock A or +
Pin 15: Clock B or -
Pin 16: +24V DC for the SSI measuring system

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4.1.3. Pin allocation of the inputs

Pin 21: 0V signal mass for inputs
Pin 22: Input 1
Pin 23: Input 2
Pin 24: Input 3
Pin 25: Input 4
Pin 26: Input 5
Pin 27: Input 6
Pin 28: Input 7
Pin 29: Input 8
Pin 30: +24V DC voltage supply for inputs 1 - 16
Pin 31: 0V signal GND for inputs
Pin 32: Input 9
Pin 33: Input 10
Pin 34: Input 11
Pin 35: Input 12
Pin 36: Input 13
Pin 37: Input 14
Pin 38: Input 15
Pin 39: Input 16
Pin 40: +24V DC voltage supply for inputs 1 - 16

4.1.4. Pin allocation of the outputs

Pin 41: 0V voltage supply for outputs 1 - 16
Pin 42: Output 1
Pin 43: Output 2
Pin 44: Output 3
Pin 45: Output 4
Pin 46: Output 5
Pin 47: Output 6
Pin 48: Output 7
Pin 49: Output 8
Pin 50: +24V DC voltage supply for outputs 1 - 16
Pin 51: 0V voltage supply for outputs 1 - 16
Pin 52: Output 9 (A)
Pin 53: Output 10 (b)
Pin 54: Output 11 (C)
Pin 55: Output 12 (d)
Pin 56: Output 13 (E)
Pin 57: Output 14 (F)
Pin 58: Output 15 (G)
Pin 59: Output 16 (H)
Pin 60: +24V DC voltage supply for outputs 1 - 16

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Pin 61: 0V voltage supply for outputs 17 - 32
Pin 62: Output 17 (I)
Pin 63: Output 18 (J)
Pin 64: Output 19 (K)
Pin 65: Output 20 (L)
Pin 66: Output 21 (M)
Pin 67: Output 22 (N)
Pin 68: Output 23 (O)
Pin 69: Output 24 (P)
Pin 70: +24V DC voltage supply for outputs 17 - 32
Pin 71: 0V voltage supply for outputs 17 - 32
Pin 72: Output 25 (Q)
Pin 73: Output 26 (R)
Pin 74: Output 27 (S)
Pin 75: Output 28 (T)
Pin 76: Output 29 (U)
Pin 77: Output 30 (V)
Pin 78: Output 31 (W)
Pin 79: Output 32 (X)
Pin 80: +24V DC voltage supply for outputs 17 - 32

4.1.5. Pin allocation of the voltage supply

Pin 81: 0V voltage supply for the CPU
Pin 82: 0V voltage supply for the CPU
Pin 83: +24V DC voltage supply for the CPU
Pin 84: +24V DC voltage supply for the CPU

Attention: Pins 30, 40, 50 and 60 are internally connected.
Pins 1,11, 21, 31, 41, 51, 61, 71, 81, 82 are internally connected.

4.1.6. Pin allocation of the serial interface

You have to specify the type of serial interface of the CamCon with your order (either RS232 or RS548). The pin allocation depends on the type of interface used.
Please also note: chapter 7.1.26. Setting the serial interface on page 29.

4.1.6.1. Pin allocation of the serial RS232 interface

DSUB 9 socket: RS232 interface for PC - connection (maximum cable length 15m)

Pin 1,4 **may not be allocated !!**
Pin 2 TxD
Pin 3 RxD
Pin 5 GND
Pin 6-9 not allocated.

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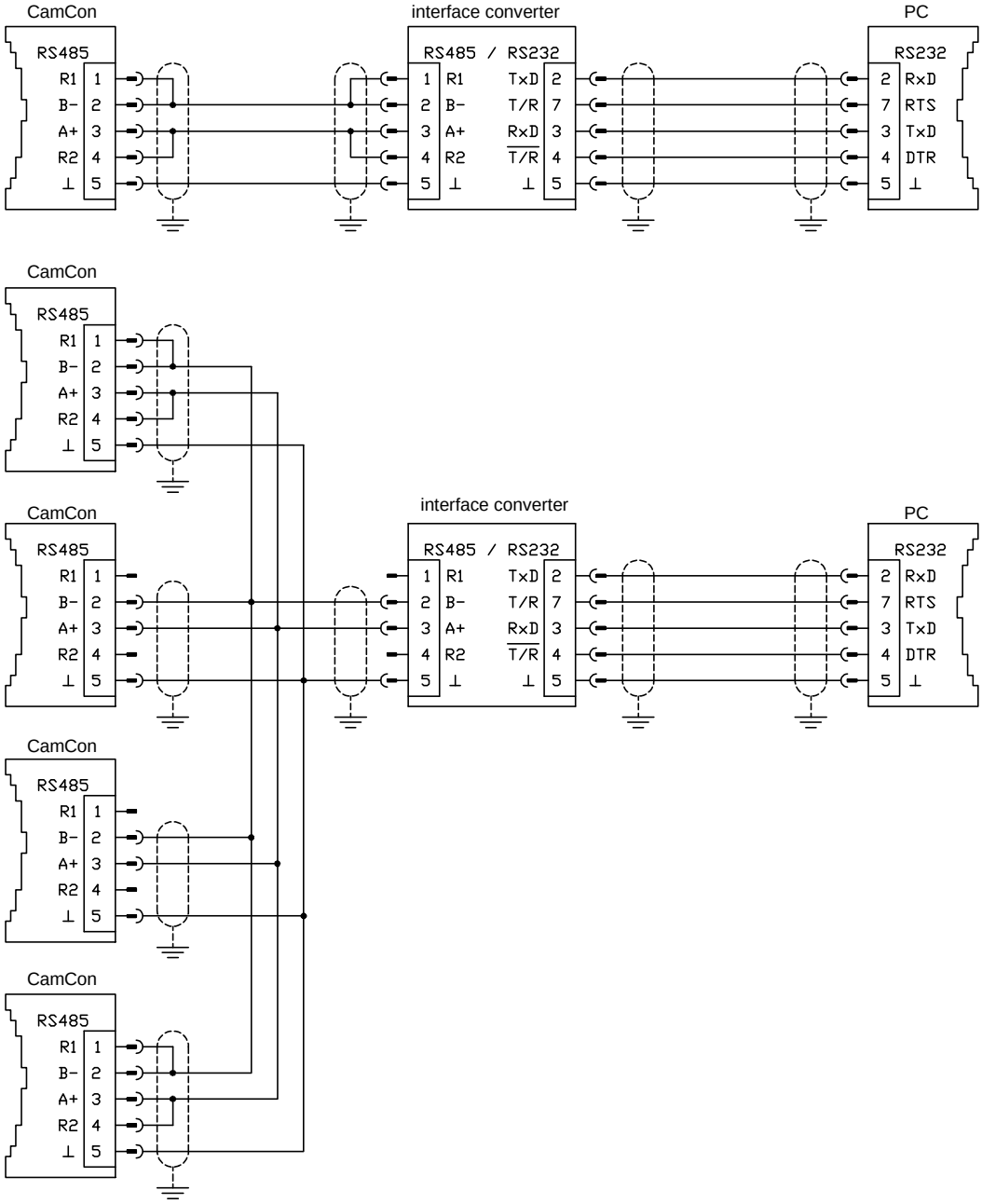
4.1.6.2. Pin allocation of the serial RS485 interface

DSUB 9 socket: RS485 interface for PC - connection or linking several devices (maximum cable length 1000m)

Pin	1,4	closedown resistors
Pin	2	B (-)
Pin	3	A (+)
Pin	5	Mass
Pin	6-9	not allocated.



Please note: With an RS485 interface the connection plugs of the first and the last unit of a linked chain, pins 1 and 2, as well as pins 3 and 4 have to be bridged to close off the data and the input cable. Herefore the device has closedown resistors at pins 1 and 4.

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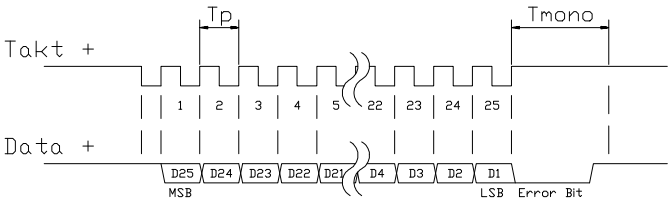
4.2. The encoder

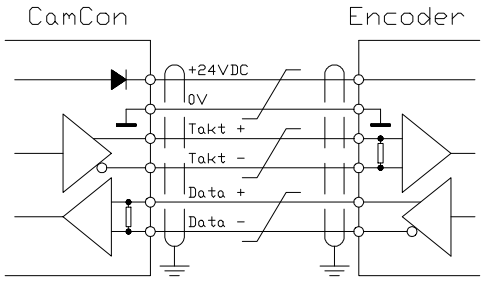
The encoder is used for getting the actual position, necessary for the cam controller. Only encoders with an SSI interface can be connected to CamCon DC40. The SSI interface is a common interface for absolute single and multiturn encoders. The CamCon supplies the measuring system with 24Volt via this interface. To read the data, CamCon sends a clock signal with an RS422 level to the encoder. The encoder the answers synchronously with the output (data) of the position in Gray code. The frequency of the clock signal depends on the length of the cable connecting ecoder and CamCon. The cable length can be set at the CamCon DC40.

Note: The data protocol corresponds with the Stegmann SSI Norm.



Tp = clock impulse

Tmono = mono flop time 25µs



Attention:
Use only a covered double entwired connection cable. The wiring should not be near power current lines. Ground the covers at both sides.

4.3. The outputs

The CamCon can have up to 32 short circuit proof outputs, depending on its version. They emit 24Volt high active signals and are not potentially free. Outputs 1 to 16, as well as outputs 17 to 32 of the unit have to be supplied with 24Volt, since the supply of the outputs has been divided for a better distribution.

4.3.1. The 40mA outputs (only CamCon device with aluminium back wall)

If all outputs are activated, not more than 40 mA permanent current in the complete temperature range should be extracted per output, else the unit will deactivate with an error message. If a higher starting performance is required, one has to know that the outputs are combined in 4 groups, each group consisting of 8 outputs. Within each group, 480 mA permanent current at a surrounding temperature of 50°C, and at a surrounding temperature of 25°C even 700mA permanent current is available. This permanent current can be dirtributed freely within a group, as long as the single output current of 300 mA is not overshot (see chapter "7.1.15. Number of outputs" on page 27).

4.3.2. The 500mA outputs

At a surrounding temperature of 25°C even 500mA permanent current is available for each output. If your outputs are overloaded or short-circuited the unit will deactivate with an **"out-err"** message (see chapter "7.1.15. Number of outputs" on page 27).

Attention: *With inductive loads the outputs have to be switched with free wheeling diodes.*

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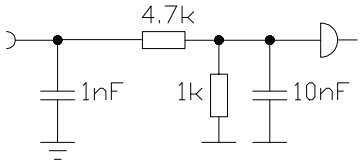
4.4. The inputs

The CamCon has, concerning each upgrading level, up to 16 inputs. These inputs work with high externally active 24Volt signals and are not potentially free towards the CPU.

The input wiring:

The input resistance is about 5.7 KOhm.



The inputs of the CamCon have not been covered with functions by the factory. The user would have to do this himself in the process of setting system data of the CamCon depending on his requirements. See chapter "7.1.14. Number of inputs" on page 27, chapter "7.1.2. The encoder resolution" on page 23, chapter "7.1.20. Setting of the external program selection" on page 27 and chapter "7.1.17. Keyboard lock" on page 27.

4.5. Precautionary measures for welding work

Attention: *For the duration of welding operations carried out at the machine, the connecting wires concerning the data exchange from the measuring system to the CamCon and the power supply as well as the grounding connections and inputs and outputs have to be separated from the CamCon.*

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5. Outline of the operator terminal

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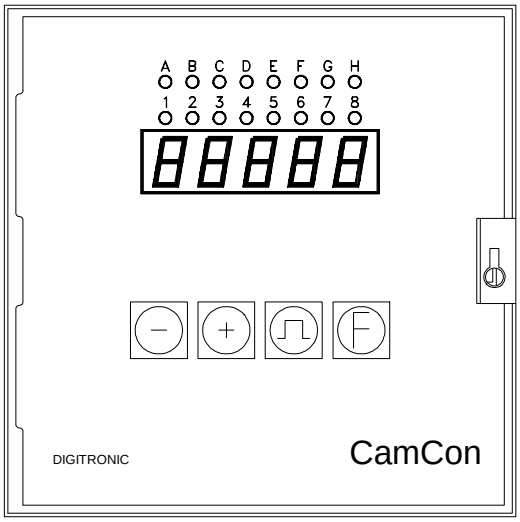
5.1. Frontview CamCon DC40



5.2. The LED - output display

The output display shows the current state of the first 16 outputs (outputs 1-8 and A-H = 9-16), or outputs I-P = 17-24 and Q-X = 25-32. If a LED is lit, the corresponding output is active. To switch through the display range, press the [+] key. While viewing outputs I-P or I-X, the display shows the message I – P (for outputs I-P), or I – II (for outputs I-X).

5.3. The seven-segment display for position and speed (Standard display)

After the activation the seven-segment display always shows the current angular position (when the encoder is standing still). If the encoder is put into a slow rotation, the display shows the actual position. With increasing speed, the display switches to display the current speed in rotations/minute. This switching point is at 5% of the set maximum speed of the analog speed output. Additionally, 5 decimal popints of the 7 segment-display are switched on, while beeing in the current speed mode.
Optimizing the speed display is done during initialisation for the input of system registers (see chapter 7.1. Initialization of the system registers on page 22). This enables psetting a factor to the actual speed display or to prevent the display from switching from speed to position and vice versa.

Also, you can check the set program number by pressing the [⎍] key, e.g. P.A. . .0. .

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5.4. The keyboard

The foil-covered keyboard resists dirt and can be cleaned with solvents. The keys have a pressure point that can be felt, as well as an accoustic input confirmation. See also chapter 7.1.17. Keyboard lock on page 27.

5.4.1. Outline of key functions

[+] = is used to increase the input values by 1 during programming and initialization. Keeping the key pressed (for about 2 sec.) causes the the values to increase automatically until released. The speed of the increasing process also increases; this is indicated by a tone that becomes higher as the speed increases.
You can switch through the output display in the standard display. Here you can switch through the range of outputs, displayed on the LEDs (only with more than 16 outputs).

[−] = serves for decreasing of input values by 1 during programming or initialization. Pressing this key for more than two seconds reduces the input values automatically. The longer this key is pressed, the faster will the input values reduce. The sound that the unit emits will become higher to reflect the increase of speed.
By pressing this key for about 2 seconds in the standard display, you can call up a complete outline of the system registers.

[⎍] = initializes the cam programming and switches the input type during the cam programming. Pressing and releasing this key in the standard display shows the current program number.

[F] = starts initialization and selects system registers during the initialization, or displays an outline of all system registers.
By keeping this key pressed (about 2 sec.) in the standard display, you switch to the input of the dead time programming

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6. Commissioning

Before activating the device for the first time please check the wiring of the device (siehe Kap. 4. Electrical connections).

Attention: *With induced loads the outputs have to be switched with a freewheeling diode. Covers or inductivities very close to the device inside the switchboard have to be switched with a deletion unit as do those that are wired to or influence the wiring of the device.*

After the activation of the CamCon, the device reports with a high pitched tone and the display message CHECK, i.e. an internal system check starts and the system is run up (e.g. the proof total of the EEPROM and the EPROM is calculated). This process takes several seconds. After a successful installation of the system the standard display is shown, i.e. either the current position, the current speed or an error message is displayed. If the system registers are adjusted to the measuring system, no error message should be display (with a correct wiring).

After the first activation of the supply voltage, the program memory is in an undefined state. Because of this you have to start a complete deletion before commissioning

If the complete deletion is finished, you can start with the programming of the CamCon
(see chapter 7. Programming on page 22).

6.1. Complete deletion

1. Activate the device (supply with voltage, +24V DC).
2. Wait until the display shows either a number or an error message, e.g. Err2.
3. Press the [−] key four times.
4. Press the [+] key four times.
5. Press the [F] key (about 2sec.), until S. 360 is displayed.
6. Press the [⎍] key (about 2sec.), until CLEAr is displayed.
7. Release the [⎍] key.

After a short while the standard display is reactivated. This waiting time depends on the size of the EEPROM used, since the memory has to be formated. When using a 32k - EEPROM, it increases e.g. to 2 min. After this, the complete deletion is finished. All cams are erased, and all system registers have the standard value.

Attention: *Erased memory cannot be restored.*

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7. Programming

Starting point of the programming is always the standard display (position or speed display).

For your CamCon to be able to function, you have to adjust the system registers of the unit to your maschine. This is described in the following chapters. If you have entered the inputs of the system registers, the CamCon is ready for cam programming and should display no further error messages.

7.1. Initialization of the system registers

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7.1.1. User keys for system registers

In order to be able to program the system registers, the following key sequence must be maintained:

1. Press the [−] key four times.
2. Press the [+] key four times.
3. Keep the [F] key pressed for about 2 seconds, until the display shows S. 360.

To select the different system registers one by one, press the [F] key once. The selection of the system registers is only possible in increasing order. If you have somehow skipped a register, you have to leave the initialization and repeat the entire process. Your previously entered values are still there, however.

When you reach the last system register e.g. AAUS. 1 or A2= 10, you leave the initialization after pressing the [F] key, and you return to the standard display (position or speed display) mode.

The initialization can be left at any time by pressing the [⎍] key, but all changes made are saved.

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7.1.2. The encoder resolution

The display S. 360 shows the resolution of the encoder in steps per rotation. The CamCon operates with a standard encoder with a resolution of 360 steps per rotation. In this case, an adjustment of the input value is not necessary. Otherwise, CamCon can be adjusted to the encoder with the [−] or the [+] key. You can choose between several set resolutions that all correspond with common encoders: 256, 360, 512, 1000, 1024, 2048, 4096 and 8192 steps. If values in the high range of the resolution cannot be adjusted, there is not enough available memory. Should this be the case you need to upgrade the device by extending the memory.
Please note the chapter 11. Calculation the RAM storage-requirement for !

Attention: If the display shows Sondr. instead, a speacial measuring system was activated by a PC. In this case you can only change the encoder resolution with the PC

Please note ! *If the [⎍] key is pressed too long (while the display is showing the encoder resolution), you initiate a complete deletion !*

7.1.3. The electronic gear

After having pressed the [F] key the display shows G. 360. Here the display shows the effective (the one visible for the user) measuring range of the encoder. Because of this the process with the electronic gear is a transformation of the measuring range. The standard translation is that of 1:1 , i.e. at the encoder resolution of 360 steps, the gear is set to G. 360. By pressing the [−] or the [+] key, you can change this translation.

Example: At a full rotation of an encoder with a resolution of 360 steps, a machine covers 1000mm. After the adjustment of the gear to G. 1000 the display of the position is no longer in (angular) degrees, but in mm. The display will no longer change in steps of 1, since the resolution of the encoder remains unaffected.
If you select e.g. G. 100 , the actual position is calculated down to a measuring range of 100. The position display is now done in cm, but a floating-point representation is not possible.

7.1.4. The actual position hysteresis

By pressing the [F] the display shows hy. 0. This value is needed to prevent the flashing of the outputs at unexact acquisition of the actual position. The exact value can only be determined through experiments, but it should be as low as possible or always 0. By pressing the [−] or the [+] key, the hysteresis can now be set to a value between 0 and 1/4 of the total resolution. The hysteresis can have a maximum value of 255 impulses.

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7.1.5. Measuring system control

By pressing the [F] the display shows U. 0.. This value is needed to prevent the maximum speed for measuring system control (Impulses per cycle) The value to be entered is calculated from the actual cycle time of the CamCon, from the physical solution of the measuring systems and the speed of the machine.

Note: The resolution must be set as a physical value. If e.g. a measuring system with 4096 impulses is set and the displayed value is transformed to 3600 impulses by the gear, you must set the "resolution"-value of the formula to 4096.

Example: Cycle time = 0.5ms / solution = 360 / speed of the machine = 180 min^{-1}.

$$\text{Value} = \frac{\text{Resulution} * \text{machine speed}}{60 * 1000} * \text{cycle time} + \text{safety reserve}$$

$$\frac{360 * 180}{60 * 1000} * 0.5 + 5 = 5.54 \approx \mathbf{6}$$

The result is rounded up and entered. If the CamCon now registers an actual value jump of more than 6 impulses, an error message **"Pos-Err:5"** is created.

If a zero is entered, the control is switched off. The maximum value is 9999 impulses.

7.1.6. Changing the rotation direction

Press the [F] key and rich 0 appears on the display. The message rich 0 shows that the encoder, in respect to the wave of clockwise movement, counts upwards. By pressing the [−] key or the [+] key you can reverse the encoder' s direction of rotation. The display then shows rich 1.

7.1.7. The zero point correction

If you press the [F] key, the display shows e.g.: 0 123. **123** represents the current angular position of the encoder. After having positioned the drive to mechanical **"0"**, you can also shift the current angular position to **"0"** by pressing the [−] key or the [+] key, so that the mechanical and the electronic zero point coincide. The display shows 0 0.

7.1.8. The speed factor

After pressing the [F] key, the display shows e.g.: U 0.166. Here you enter the factor for the calculation of the speed. By pressing the [−] or the [+] key you can in- or decrease this value in the range of 0.000 to 9.999.

Normally the speed is displayed through the number of increments or impulses per second. If you want the speed displayed e.g. in rotations per minute or in the number of pieces per minute, you have to enter a randomizing factor. This factor is multiplied with the calculated speed value, and that result is seen on the display.

Example 1: A rotation encoder with 512 steps supplies 512 increments per minute, which means that the gear runs with 1 rotation per minute. The CamCon measures 512/60 = 8,533 increments per second.
To receive a display in rotations per minute enter the factor 1/8,533 = 0,117.

Example 2: A rotation encoder with 360 steps supplies 360 increments per minute, which means that the gear runs with 1 rotation per minute. The CamCon measures 360/60 = 6 increments per second.
Enter a factor of 1/6 = 0,166 to have the display remain in rotations per second.

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7.1.9. Adjusting the range of the speed display

Press the [F] key, and the display shows e.g.: I□□□□. In this system register you enter the maximum rotation speed of your gear or the speed of the movement. The input serves the adjustment of the speed display. By pressing the [−] or the [+] key, you can set this value in the range of 0 to 9999. This value controls the speed, at which the position display switches to the speed display. This switching always occurs at 5% of the value entered here, so with 1000 min $^{-1}$ it switches at 50 min $^{-1}$.

If your device has an analog output, through which an analog signal is emitted, that is proportional to the speed, this value is used for the calculation of the output voltage. An input of e.g.: 1000 min $^{-1}$ means that at +/-1000 min $^{-1}$ the analog output voltage has reached its maximum value (100%) of +/-10V.

7.1.10. Accuracy of the speed display

By pressing the [F] key, the display shows e.g.: I.□□I. During operations the speed display usually fluctuates a little. These fluctuations are accounted for in the measuring priciple for the speed, since it is a scanning system. In this system register you can limit these fluctuations to a maximum value. It is a damping through a low pass that results in a smoothing of the display, which means that an averaging process is put into operation. The lower the input value is, the quieter is the speed display. In practice, you will always find a compromise between the dynamics of the display and its readability. By pressing the [−] or the [+] key, this value can be set from 0.01 to 9.99.

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7.1.11. Display type

By pressing the F key, the display shows e.g.: d.AUto. If you do not want your display to switch at 5% of the maximum speed value, you can set this option in this system register by pressing the − or the + key. You can choose among three display types.

d.AUto	When the speed value reaches 5% of the maximum rotation value, the position display switches automatically to the speed display.
d.SPEE.	The display only shows the speed.
d. Pos.	The display only shows the position.

Pressing the F key again makes the display show e.g.: dE. 0. In this system register you can set an input, with which the display can be switched from speed display to position display. With the − key or the + key, you can select the desired input number. You can only select this option, if you chose the display types d.SPEE. or d. Pos. . Activating an input signal e.g. with the d.SPEE. display type switches the display to the speed display. If no inputs are available, this function is not possible.

7.1.12. Setting the cable legth

Press the F key; the display shows L 30 . Using the keys − and + you can set the conduction length between the encoder and the CamCon, in meters. This is necessary, since the cable length determines the maximum possible speed of serial data transmission. The larger the set cable length, the larger is the cycle time of the transmission and the slower is the data traffic. The cable length can be set to a maximum of 1000m.

Attention: *With cables exceeding 300m in length, use an encoder that is adjusted correspondingly.*

7.1.13. Setting the cycle time

Press the F key again and the display shows 0H. . This indicates that the device is operating with the shortest possible cycle time. Using the keys − and + you can change this cycle time, e.g. when you are programming a large number of outputs with delay time or with a high encoder resolution and need longer single delay times. These depend on the available memory and the cycle time (see chapter 11. Calculation the RAM storage-requirement for). A noticable change occurs only when the set value lies above the current cycle time.

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7.1.14. Number of inputs

By pressing the key [F], the display shows e.g.: E 16. Here you enter the number of inputs of the cam switch unit. You can modify the input number with the keys [−] and [+]. The CamCon DC40 can manage a maximum of 16 inputs. The number of inputs should always excactly meet the number of electrcal inputs since the CamCon's short-circuit-detection reacts ocxorresponding to the number of inputs.

7.1.15. Number of outputs

By pressing the [F] key, the display shows e.g.: A 24. Here you can enter the number of outputs of the CamCon. You can modify this value with the keys [−] and [+]. The CamCon DC40 can manage 8,16,24 or 32 outputs.

7.1.16. Number of outputs with speed compensation

By pressing the [F] key, the display shows e.g.: EA 24. Here you can enter the number of outputs (of the CamCon) with dead time compensation. This value can also be modified with the keys [−] and [+].

7.1.17. Keyboard lock

By pressing the [F] key, the display shows e.g.: rL 0. Here you may define an input that locks the keyboard to prevent unauthorized programming. You can enter the input for the keyboard lock with the [−] and [+] keys. A zero means the keyboard cannot be locked. This function is only possible if an input is available.

7.1.18. Input for error reset

With the positive edge (+24V DC) on this input e.g.: E9. 0., the CamCon resets an Pos-Err:1,2,3 and 5 but **not** an "Out-Error".

7.1.19. Enable input

By pressing the [F] key, the display shows e.g.: E1. 0. Here you may define an input that lock or unlock and/or enable the outputs. A signal of +24V DC on this input enable the cam output, a signal of 0V lock and/or disenable the outputs. If the input number is "**0**", this function is switch off and the outputs are always enabled.

7.1.20. Setting of the external program selection

By pressing the [F] key, the display shows e.g.: 11 1. Here you can set the number of programs you can select externally. You can modify the number of programs with the keys [−] and [+]. CamCon DC40 offers you the possibility to manage up to 999 programs.
By pressing the [F] key, the display shows e.g.: 11E 0. In this system register you have to define an input, used as a take-over-impulse. It has to be selected with regard to the fact that there have to be enough free inputs to be able to send the program number. The program number is a binary number, which is sent at the inputs after the take-over-impulse, whereas the LSB is the input after the take-over-impulse. Thus the inputs for the program selection are flexible. By pressing the [−] or the [+] key, you can now set the desired input number. This input is only possible if an input is available.

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7.1.21. Actual position preset or external shifting of the zero point

By pressing the F key, the display shows e.g.: P. 0. Here you have the possibility to set the actual position to a previously set value (Preset) by activating an input. By setting the preset value to zero, you can generate an external zero signal, e.g. to synchronize the position of the maschine with the actual position of the CamCon DC40. You can set the desired preset with the − and the + key. You then enter the input of the input number that activates the preset by pressing the F key. The display shows e.g.: PE. 0. Enter the desired input number with the keys − and + . If no inputs are available, this input, as well as the preset function, is not possible. By pressing the F key again, you enter the input of the preset type. The display now shows e.g.: PrY.rA.. You can choose between the two preset types with keys − and + . There are two options available:

PrY.rA. "RAM" storage.
The preset value is only copied into the RAM memory of the device, so after switching the device off and activating it again, your preset value will be gone.

PrY.EE. "EEPROM" storage.
The preset value is copied into the RAM memory as well as the EEPROM memory of the CamCon, protecting the value from voltage failures

Attention: *Storage in the EEPROM memory should only be used, if you activation of the preset does not occur often and is absolutly necessary. This is because an EEPROM only has a limited number of writing cycles (100000). Exceeding this maximum number of writing cycles leads to the destruction of the EEPROM and loss of the program data.*

7.1.22. The security or SI output

To be able to watch over the CamCon, e.g. during short cuircuits at the output channels or at errors with the calculation of the actual position, you have the possibility to program a cam for a specific output, that means this output is active for all angular positions. After pressing the F , the display shows the message SI 0. By pressing the − or the + key, you can select an output number, that will function as an SI output. A '0' means, that no security output has been programmed.

Please note: The SI output is reset for a short time at program changes.

7.1.23. The rotation direction or FR output

By pressing the F key, the display shows e.g.: _Ir 0 . Here you can select an output that displays the direction of the encoder rotation. You can select the output number with the keys − and + . The output is activated at a positive rotation direction and deactivated with a negative rotation direction. If this value is set to '0', there is no FR (forwards - reverse) output.
(see also chapter 7.1.25. The speed hysteresis on page 29)

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7.1.24. The standstill or V0 output

By pressing the F key, the display shows e.g.: U0 0. Here you can select an output that is active while the encoder is moving and deactivates when the encoder stops. You can select the output number with the keys − and + . The output is activated at a positive rotation direction and deactivated with a negative rotation direction. If this value is set to '0', there is no V0 output. (see alsochapter 7.1.25. The speed hysteresis below)

7.1.25. The speed hysteresis

To be able to used the option of the rotation direction control, you have to set the hysteresis. This value is needed to prevent the flashing of the outputs at small changes in speed. The exact value can only be determined through experiments, but it should be as small as possible.
By pressing the F key, the display shows e.g.: 0HY. You can enter the hysteresis value with the keys − and + .

7.1.26. Setting the serial interface

After the F key was pressed, the display shows e.g.: StAnd. By pressing the − and/or + keys you are able to select the serial interface's comuication mode. You are able to choose between 4 modes of operation, these are: 1. = "Cam-BUS", 2. = "Standard", 3. = "Multiuser" and 4. = "S5-L1". If a particular mode was set, you ahve ensure yourself of the fact that every device with which a contact shall be established, also supports the selected comunication mode. Please regard that you have the possibility to select the type of interface in your order chosing between RS232 or RS485. All four comunication modes work as well in the RS232 point-to-point comunication as in the 485 BUS comunication. See also chapter 4.1.6.2. Pin allocation of the serial RS485 interface on page 16 and chapter 7.1.27. Setting of the unit number on page 30 as well as chapter 4.1.6.1. Pin allocation of the serial RS232 interface on page 15.

Note: The Ser.Mode is set to **"Multiuser"** and the devicenumber to **"0"** by the factory.

7.1.26.0.1. The "Cam-BUS" comunication mode

C-bUS You have to select this setting, if you have to program or display one or several devices from several different locations through an RS485 interface (e.g. via programming device type: DC51/T4 and daughter display CD10).

Attention: **All** devices using this setting (as well as the PC) have to be equiped with an RS485 interface and a software from at least August 1996 or later

7.1.26.0.2. The "Standard" comunication mode

StAnd Standard operation commences only in connection with an interface of the type RS232 and is a point to point communication, i.e. you can only connect a maximum of 2 devices (DC40 to the PC). Because there is not protocol safeguarding in this mode, it should only be used for testing purposes.

7.1.26.0.3. Der "Multiuser" Kommunikationsmode

MULtI This setting only works in connection with an RS485 interface. Unlike the "Cam-BUS" mode, it is "**not**" possible to run several display devices
(e.g. progr. device type: DC51/T4 and daughter display CD10) and several PCs at the RS485 BUS
(factory-preset).

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7.1.26.0.4. The "S5 - L1" comunication mode

S5-L1 This setting is necessary to connect the CamCon to a Siemens S5 PLC with L1 BUS. This is a so-called point to point communication, which means that only the CamCon and the Siemens S5 CPU can be connected to each other. If ypou want to save the CamCon's data at a PC, the connection to the S5 CPU has to be interrupted. To the S5 - L1 comunicationmode a connection-set with TTY-cable, handling component and manual can be ordered (Order No. PC40/S5-L1).

Attention: The interface type has to be specified with your order of the CamCon.

7.1.26.0.5. The "3964(R)" comunication mode

3964r This setting is necessary, if you want to program the CamCon device via the serial interface with an RK512 procedure. This is a so-called point to point communication. A manual with the order No. H-RK512e is avaiable for this procedure.

7.1.27. Setting of the unit number

In the Cam-BUS, Multiuser and S5-L1 modes, you have assign unit numbers to all devices linked. After having pressed the [F] key, the display shows e.g.: GNr. 0. You can select a number between 0 and 63 with the [−] and [+] keys. Each unit number may only be assigned once, so it is necessary to speratly select the unit number and the communication mode for every device before connecting the serial interfaces.

7.1.28. Selecting the programming mode

After having pressed the [F] key, the display shows e.g.: PLYP0. Here you can set the mode for the cam programming. By using the [−] or the [+] key, you switch from programming mode 0 into programming mode 1. Programming mode 1 is easier to use than programming mode 0, but it is not possible to program several cams on a single output in programming mode 1.

7.1.29. Analog speed-output

After having pressed the [F] key, the display shows e.g.: AAUS0. Here you can define an analog speed-output for version 38 or later (requiring aditional analog hardware). By pressing the keys [−] and [+] the analog speed output is switched on (=1) - respective off (=0). If it is switched on, the analog output has to be equalized as shown in the following chapters.

7.1.29.1. Offset match for analog output 1

Note: This is not longer necessary or possible with the device edition DC40/S**5**..

Press the [⎍] key for about two seconds, until the display shows A1= 0. In this configuration, you are able to eveluate the zero-point of analog-ouput 1. Connect a voltmeter to analog output 1and correct the voltage using the [−] and [+] key, until the voltmeter displays a value as exact to 0V as possible.

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7.1.29.2. Amplification match for analog output 1

Note: This is not longer necessary or possible with devices edition DC40/S**5**..

After having pressed the F key for a short time, the display shows e.g.: A 1= 10. Here you can enter (or match) the amplification factor for analog output 1. The maximum of analog output voltage is ±10V. If you desire a shorter voltage range, you can adjust maximum voltage with the − and + keys. In this setting the CamCon already offers the maximum of positive output voltage. For adjustments, connect a voltmeter to analog output 1, and use the two keys until the measuring device shows the correct voltage.

Please note: An adjustment of the speed display via the amplification match is not recommendable ! see chapter "7.1.9. Adjusting the range of the speed display" on page 25.

7.2. Delay time or speed-compensation

Keeping the F key pressed (for about 2 sec.) in the standard mode lets the display show t 1. 0. Here you can enter the delay time for output 1 in the range of 0ms to 999ms. By pressing the − key or the + key, you can change this value in steps of 1 ms. By pressing the F key shortly, you can proceed to the next output, and so on. The display shows e.g. t 2. 0. This way you can enter time factors for every single output, so that they are (de)activated earlier. If you have already configured an output as a SI-output, it is no longer possible to enter a dead time for this output. You can abort the programming of the dead time compensation at all times by pressing the ⎍ key.

7.3. Cam programming in programming mode 0

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7.3.1. Program selection

The cam programming and the program selection are initiated as follows:
Press the ⎍ key for about 2 seconds, until the display shows e.g.: PA 0. PA 0 indicates that e.g. program 0 is currently selected. By pressing the − key or the + key you have the possibility to select a program number from 0 to 999. When the desired program number is set, you can exit the 'Cam programming' mode by pressing the F key.
By pressing the ⎍ key you can check the selected program number; the display shows P.A. . .0. .

7.3.2. Output selection

To initiate cam programming press the ⎍ key during the program selection for about 2 seconds, until the display shows e.g.: 1 0. _ _ _ . This indicates that there is no programmed cam on output 1 in the 'Output selection' mode. By pressing the − key or the + key you can now select the output on which you want to program cams. Automatically scrolling through the the outputs during output selection is not possible.
If you already selected an output as a special output, you cannot program any cams on this output.

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7.3.3. Searching for cams

By pressing the [⎍] key you leave the 'Output selection' mode | □. _ _ _ and enter the mode 'Cam search' | ⊓ _ _ _ . In the 'Cam search' mode | ⊓ _ _ _ you can search for the cam activation points by pressing the [+] key. Every time the [+] key is pressed, CamCon searches the memory for activation points of the cams on the corresponding output. If no cam has been programmed, | ⊓ _ _ _ is displayed.

7.3.4. Setting the preset value

You leave the 'Cam search' mode | ⊓ _ _ _ and enter the 'Preset' mode | ı ı □ by pressing the [⎍] key. By pressing the [−] or the [+] key you can now select a value, e.g. 100. This value is the originator from which cams may either be reconstructed or erased by changing the activation and the deactivation points.

7.3.5. Shifting the activation point

By pressing the [⎍] key you leave the 'Preset' mode | ı ı □ and enter the 'Activation point' mode | ⌐ □ . A pressing of the [−] key or the [+] key shifts the activation point by one step. This is done according to the following system:

A short single pressing of the [+] key will erase the activation point at the previously displayed preset value, e.g. 100, and then the preset value is increased by 1, e.g. to 101. A short pressing of the [−] key will lower the preset value (100 in our example) by 1 and then set a new activation point at 99.

7.3.6. Shifting the deactivation point

Pressing the [⎍] key once more leads you from the 'Activation point' mode | ⌐ □ into the 'Deactivation point' mode | ⌙ □ . CamCon will first search for the deactivation point of the current cam (e.g.: | ⌙ | □ □). By pressing the [−] or the [+] key the deactivation point is shifted by one step. This is done according to the following system:

A single short pressing of the [+] key will set a new switching point at the previously displayed preset value, e.g. 100. Then the preset value is increased by one, e.g. to 101. A short pressing of the [−] key will lower the preset value, e.g. 100, by 1 and then delete the switching point 99. The new deactivation point is then 99. A further pressing of the [⎍] key brings you back to the 'Output selection' mode | □. _ _ _ .

7.3.7. Leaving cam programming

No matter in which programming mode you are, you can always leave cam programming by pressing the [F] key and return to the standard display.

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7.3.8. Examples for cam programming in the programming mode 0

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7.3.8.1. Programming the first cam

Task:
After a complete deletion of the program memory and a successful initialization of the system, a cam shall be programmed in program 0 for output 2 from 100 to 200.

Solution:

1. Press the [⎍] key (for about 2 sec.), until you enter the 'Program selection' mode: PA 0.
2. Press the [⎍] key, you enter the "programing mode" 1 0. _ _ _.
3. Press the [+] key to select output 2, 2 0. _ _ _.
4. Press the [⎍] key, you enter the 'Cam search' mode 2 ⊓ _ _ _.
5. Press the [⎍] key, for the input of the preselection 2 ıı 1.
6. Press the [+] key and keep it pressed until 2 ıı 100 is displayed.
7. If you have released the [+] key too early or too late, you can adjust the preselection to 100 with the [−] or the [+] key.
8. Press the [⎍] key, the activation point is displayed.
9. Press the [⎍] key to program the deactivation point.
10. Press the [+] key and keep it pressed until the display shows 2 ⌊ 200.

CAUTION! Do not keep the key pressed too long. It is best to keep the [+] key pressed until 190 and then adjust to 200 step by step.

11. Press the [F] key. You return to the standard display.

Please Note:

When programming the activation and the deactivation points you are working "on line", i.e. if you keep the [+] key pressed for too long, the cam will be programmed too long. Although you can correct this subsequently with the [−] key, the range between the desired end of the cam and cams entered in excess is erased. All cams already programmed in this range are lost.

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7.3.8.2. Programming additional cams on an output

Task:
A cam shall be programmed in program 0, on output 2 from 300 to 330 in addition to an already existing cam, e.g. from 100 to 200.

Solution:

1. Press the [⎍] key (for about 2 sec.), until you enter the 'Program selection' mode: PA 0.
2. Press the [⎍] key, you enter the 'progrming' mode 1o. _ _ _.
3. Press the [+] key to select output 2, 2o. 100. The display also shows the begin of the already programmed cam.
4. Press the [⎍] key, you enter the 'Cam search' mode 2n 100.
5. Press the [⎍] key for the input of the preselection 2ı 100.
6. Press the [+] key and keep it pressed until 2ı 300 appears on the display.
7. If you have released the [+] key too early or too late, you can adjust the preselection to 300 with the [−] or the [+] key.
8. Press the [⎍] key, the activation point is displayed.
9. Press the [⎍] key to program the deactivation point.
10. Press the [+] key and keep it pressed until 2L 330 is displayed.

CAUTION! Do not keep the key pressed too long. It is best to keep the [+] key pressed until 320 and then adjust to 330 step by step.

11. Press the [F] key. You return to the standard display.

Please Note:

When programming the activation and the deactivation points you are programming "on line", i.e. if you keep the [+] key pressed for too long, the cam will be programmed too long. Although you can correct this subsequently with the [−] key, the range between the desired end of the cam and cams entered in excess is erased. All cams already programmed in this range are lost.

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7.3.8.3. Deletion of a particular cam

Task:
You want to delete the cam from 300 to 330 in program 0, on output 2.

Solution:

1. Press the [⎍] key (for about 2 sec.), until you enter the 'Program selection' mode: PA 0.
2. Press the [⎍] key, you enter the 'programing' mode 1o. _ _ _.
3. Press the [+] key to select output 2, 2o. 100. The start of the first cam found is displayed.
4. Press the [⎍] key, you enter the 'Cam search' mode 2n 100.
5. Press the [+] key, the device searches for the start of the next cam. 2n300 is displayed.
6. Press the [⎍] key. The preselection 2ı300 is displayed.
7. Press the [⎍] key to program the activation point. The display shows 2r300.
8. Press the [+] key and keep it pressed until the display shows 2r330.

CAUTION! Do not keep the key pressed too long. It is best to keep the [+] key pressed until 320 and then adjust to 330 step by step.

9. Press the [F] key. You return to the standard display.

Please Note: By shifting the cam activation point to the cam deactivation point the programmed cam is deleted. By shifting the activation point beyond the deactivation point deletes the range after the cam (e.g. from 330 to 350). All cams programmed in this range are deleted. A new cam will be placed between 330 and 350 when you move the activation point back to the desired position of 330 !

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7.4. Cam programming in programming mode 1

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7.4.1. Program selection

The cam programming and the program selection are initiated as follows:
Press the [⎍] key for about 2 seconds, until the display shows e.g.: PA 0. PA 0 indicates that e.g. program 0 is currently selected. By pressing the [−] key or the [+] key you have the possibility to select a program from 0 to the highest program number (configured in the plant). When the desired program number is set, you can exit the 'Cam programming' mode by pressing the [F] key.

7.4.2. Output selection

If you press the [⎍] key during program selection, you enter the mode of the cam programming. The display shows e.g. | □. _ _ _ . This indicates that no cam has been programmed on output 1 in the 'Output selection' mode. By pressing the [−] key or the [+] key you can now select the output on which you want to program cams.

7.4.3. Shifting the activation point

By pressing the [⎍] key you leave the 'Output selection' mode | □. _ _ _ and enter the 'Activation point' mode | ⌐ _ _ _ . A pressing of the [−] key or the [+] key shifts the activation point by one step. This is done according to the following system:
A short single pressing of the [+] key will erase the activation point at the previously displayed preset value, e.g. 100, and then the preset value is increased by 1, e.g. to 101. A short pressing of the [−] key will lower the preset value (100 in our example) by 1 and then set a new activation point at e.g. 99.

7.4.4. Shifting the deactivation point

Pressing the [⎍] key once more leads you from the 'Activation point' mode | ⌐ 0 into the 'Deactivation point' mode | ⌙ 0 . CamCon will first search for the deactivation point of the current cam (e.g.: | ⌙ | 0 0). By pressing the [−] or the [+] key the deactivation point is shifted by one step. This is done according to the following system:
A single short pressing of the [+] key will set a new switching point at the previously displayed preset value, e.g. 100. Then the preset value is increased by one, e.g. to 101. A short pressing of the [−] key will lower the preset value, e.g. 100, by 1 and then delete the switching point 99. The new deactivation point is then 99. A further pressing of the [⎍] key brings you back to the 'Output selection' mode. If no cam has been programmed, the display shows | □. _ _ _ again.

7.4.5. Leaving cam programming

No matter in which programming mode you are, you can always leave cam programming by pressing the [F] key. The standard display appears 0 0 .

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7.4.6. Examples for cam programming in the programming mode 1

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7.4.6.1. Cam programming

Task:
After a complete deletion of the program memory and a successful initialization of the system, a cam shall be programmed in program 0 for output 2 from 100 to 200.

Solution:

1. Press the [⎍] key (for about 2 sec.), until you enter the 'Program selection' mode: PA 0.
2. Press the [⎍] key, you enter the 'programming' mode 1□. _ _ _.
3. Press the [+] key to select output 2, 2□. _ _ _.
4. Press the [⎍] key for the programming of the activation point 2⌐ _ _ _.
5. Press the [+] key and keep it pressed until 2⌐ 100 is displayed.
6. If you released the [+] key too early or too late, you can adjust the preselection to 100 with the [−] or the [+] key.
7. Press the [⎍] key to program the deactivation point.
8. Press the [+] key and keep it pressed until the display shows 2⌞ 200.
9. If you have released the [+] key too early or too late, you can adjust the deactivation point to 200 with the [−] or the [+] key.
10. Press the [F] key. You return to the standard display.

7.4.6.2. Deletion of cams

Task:
You want to delete the cam 100 to 200 on output 2 in program 0.

Solution:

1. Press the [⎍] key (for about 2 sec.), until you enter the 'Program selection' mode: PA 0.
2. Press the [⎍] key, you enter the 'Output selection' mode 1□. _ _ _.
3. Press the [+] key to select output 2, 2□. 100. The start of the found cam is displayed.
4. Press the [⎍] key to program the activation point. The display shows 2⌐ 100.
5. Press the [+] key and keep it pressed until 2⌐ 200 is displayed.
6. If you released the [+] key too early, shift the deactivation point to 200 by repeatedly pressing the [+] key. If you released the [+] key too late, do not correct it ! The cam is then already erased. Shifting the activation point backwards programs a new cam in consequence. This cam should be deleted.
7. Press the [F] key. You return to the standard display.

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8. Outline of operations

8.1. Switching the standard display

Press the [+] key	I -II	Display of the output channels I-X

8.2. Initialising the system registers

	33	Standard display position/speed (min $^{-1}$)
Press the [−] key 4 times	33	User key for system registers
Press the [+] key 4 times	I -II	User key for system registers
Hold the [F] key (2 sec).	S. 360	Encoder resolution physically
Press the [F] key	C. 360	Encoder resolution desired.
Press the [F] key	HY. 0	Actual position hysteresis
Press the [F] key	-. 0.	Measuring system control
Press the [F] key	r ich 0	Encoder rotation direction change
Press the [F] key	0 123	Zero point correctionr
Press the [F] key	-0. 166	Speed factor
Press the [F] key	1000	Range adjustment of the speed display
Press the [F] key	100,	Accuracy of the speed display
Press the [F] key	dAut o	Display type
Press the [F] key	dE. 0	Input of the display change
Press the [F] key	L 30	Encoder cable length of the SSI interface
Press the [F] key	0H.	Preset Cycle time
Press the [F] key	E 8	Number of inputs
Press the [F] key	A 32	Number of outputs
Press the [F] key	tA 24	Number of outputs with speed compensation
Press the [F] key	rL 0	Input of the keyboard lock
Press the [F] key	E9. 0.	Input for error reset
Press the [F] key	EI. 0.	Enable input for the outputs
Press the [F] key	II 128	Number of inputs for external program selection
Press the [F] key	IIE I	Take-over input for external program selection
Press the [F] key	P. 0	Value for actual position preset
Press the [F] key	PE. 0	Input for triggering the actual position preset
Press the [F] key	PrY.rA.	Storage of the actual position preset
Press the [F] key	SI 0	Security output (Cycle cam)
Press the [F] key	-r 0	Rotation direction output
Press the [F] key	-0 0	Standstill output
Press the [F] key	0HY	Speed hysteresis
Press the [F] key	C-bUS	Communication protocol of the serial interface
Press the [F] key	Cnr. 10	Unit number
Press the [F] key	PtYP0	Programming mode
Press the [F] key	AAUS. I	Analog output (software version V38)
Press the [F] key	A I= 0	Return to standard display

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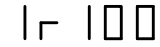
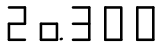
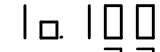
8.3. Delay time programming

		Standard display
Press the F key (about 2 sec.)		speed compensation for output 1
Press the F key shortly		Switch forward to output 2
Press the ⎍ key shortly		Return to standard display

8.4. Cam programming

		Standard display
Press the ⎍ key (about 2 sec.)		Program selection
Press the ⎍ key shortly		Output selection
Press the ⎍ key shortly		Searching for cam activation point (Mode 0 only)
Press the ⎍ key shortly		Enter preset position (Mode 0 only)
Press the ⎍ key shortly		Shifting the activation point
Press the ⎍ key shortly		Searching for and shifting the deactivation point
Press the ⎍ key shortly		Output selection
Press the + key shortly		Select next output
Press the − key shortly		Select previous output
Press the F key shortly		Return to the standard display

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8.5. Display the unit configuration

	33	Standard display (position/speed)
Hold the − key (2 sec)	100 1.4	Software version (Date 10.01.94 or 04)
Press the F key	F. 148	Number of free cams
Press the F key	t. 999	Maximum speed compensation in ms
Press the F key	r. 32K	RAM size in kByte
Press the F key	S. 2K	Size of serial EPROM in kByte
Press the F key	E. 0K	Size of parallel EEPROM in kByte
Press the F key	S. 360	Encoder resolution physically
Press the F key	G. 360	Encoder resolution desired.
Press the F key	hy. 0	Actual position hysteresis
Press the F key	=. 0.	Measuring system control
Press the F key	r inch 0	Encoder Rotation direction change
Press the F key	=0. 166	Speed factor
Press the F key	1000	Range adjustment of the speed display
Press the F key	1.00'	Accuracy of the speed display
Press the F key	d.Auto	Display type
Press the F key	dE. 0	Input of the display change
Press the F key	L 30	Encoder cable length of the SSI interface
Press the F key	1824.	Cycle time in µs
Press the F key	E 8	Number of inputs
Press the F key	A 32	Number of outputs
Press the F key	tA 24	Number of outputs with speed compensation
Press the F key	rL 0	Input for the keyboard lock
Press the F key	E9. 0.	Input for error reset
Press the F key	EI. 0.	Enable input for the outputs
Press the F key	I1 128	Number of inputs for external program selection
Press the F key	I1E 1	Take-over input for external program selection
Press the F key	P. 0	Value for the actual position preset
Press the F key	PE. 0	Input for triggering the actual position preset
Press the F key	PrY.rA.	Storage of the actual position preset
Press the F key	SI 0	Security output (Cycle cam)
Press the F key	=r 0	Rotation direction output
Press the F key	=0 0	Standstill output
Press the F key	0HY	Speed hysteresis
Press the F key	C-bUS	Communication protocol of the serial interface
Press the F key	GNr. 10	Unit number
Press the F key	oP. 0	Options
Press the F key	PtYP0	Programming mode
Press the F key	AAUS. 1	Analog output
Press the F key	33	Return to standard display

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9. Troubleshooting

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9.1. Problem: The display remains dark after activation

Possible cause:
The wiring is probably not correct.
Solution:
Check the wiring.

9.2. Problem: The display shows: EE.Err

Possible cause:
The EEPROM's data wsas erased or damaged by malfunctions. One of the present data storage medias (EEPROM or EPROM) was renewed or is defect.
Solution:
By pressing the F key, all data is erased. During the deletion process the display shows CLEAr.
Please contact your customer's service.

9.3. Problem: The display shows: I.Err 1

Possible cause:
The encoder is connected incorrectly.
Solution:
Check the wiring to the encoder, concerning the manual. When the error is corrected, press the − key to clear the error message.

9.4. Problem: The display shows: I.Err 2

Possible cause:
The encoder is not connected or connected incorrectly
Solution:
Check the wiring to the encoder or the input of the encoders resolution. Regard also the encoder's manual. When the error is corrected, press the − key to clear the error message.

9.5. Problem: The display shows: I.Err 3

Possible cause:
The encoder resolution of the connected encoder is not the encoder resolution set at the device.
Solution:
Check the input of the encoder resolution and the set cable length. Regard also the encoder's manual. When the error is corrected, press the − key to clear the error message.

9.6. Problem: The display shows: I.Err 5

Possible cause:
Measuring system control has triggert. The CamCon detected an inadmissible step of the actual value. The measuring system is possibly wrong.
Solution:
Test the input of the measuring system's preset and the set cable length, or increase the admissive actual value steps. See also chapter "7.1.5. Measuring system control" on page 24 and regard the measuring system's manual. When theerror is corrected, press the − key to clear the error message.

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9.7. Problem: An error happens during operation.

The display shows: I.Err 1, I.Err 2, I.Err 3 or I.Err 5.

Possible cause:
The encoder'Äs connection cable or the encoder itself is defect. A cable without shielding or twin wiring was used. Also the popsition of the connection cable, e.g. next to a strong electro-magnetic interferance point (e.g. high-voltage cable, motor-cable) can cause an I-Error.

Solution:
Check the encoder's wiring or the change the encoder device. Build up covers or lay the connection-cable elsewhere. Please also regard the encoders manual.
When theerror is corrected, press the − key to clear the error message.

9.8. Problem : The display shows: A-Err

Possible cause:
Your outputs are overloaded or have short circuited. Check the wiring and connected power, as well as possible inductive loads that are operated without a free wheel or a deletion unit.
The number of entered inputs is not correct.
At an external interface module (e.g. DC91/IO or DC16/IO) the power supply failed.
Solution:
Check the wiring and the connection-cable as well as possible inductive loads, which are run without a free wheel or a deletion unit.
See chapter 4.3. The outputs on page 17.
See chapter 7.1.14. Number of inputs on page 27.
When the error is corrected, press the − key to clear the error message. During this time the message C − AUS appears for a short time. CamCon tries to reset the outputs during this time.

Attention: *Infavourable cable routing can lead to the deactivation of the outputs, since it builds up a potential that is redirected into the outputs at the closing of a contact. With induced loads the outputs have to be switched with a freewheeling diode. Covers or inductivities very close to the device inside the switchboard have to be switched with a deletion unit as do those that are wired to or influence the wiring of the device.*

9.9. Problem: Outputs do not react

Possible cause:
An error message is displyed.
No power supply is connected to the outputs.
The enable input is not aktiv.
The controll - inputs of the CamCon are locked by an S5 or an S5L1 respective 3964r interface.
Solution:
Check the displayed error-message.
Connect the power supply.
Enable ths Outputs with the enable input, see also chapter 7.1.19. Enable input on page 27
Un-lock the controll-inputs.
See also the S5-L1-coupling's manual.

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9.10. Problem : The display shows: t1.Err

Possible cause:
Every change in the system setting influences the available memory. Your changes of the system parameters (e.g. increasing the encoder resolution) have shifted an already programmed speed compensation above the memory range. At every further pressing of a key, the display shows output numbers concerned.
Solution:
This error can be recovered by changing the corresponding speed compensation or increasing the cycle time.
Please also regard chapter 11. Calculation the RAM storage-requirement for on page 45.

9.11. Problem : The display shows: E.Full

Possible cause:
Too little memory in the EEPROM available for cam programming
Solution:
Please contact your customer service. Also, read the chapter 10. Calculation EEPROM cam storage on page 44.

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10. Calculation EEPROM cam storage

In the CamCon you have the opportunity to extend the **EEPROM** Cam storage. The storage space required for programming is influenced by the following factors:

1. Basic requirement	= 256 Bytes
2. Per cam	= 12 Bytes
3. Per set delay time for Speed Compensation	= 12 Bytes
4. Per name for an output	= 24 Bytes
5. Per set key / code	= 66 Bytes
6. For a special measuring system	= 66 Bytes
7. For direct or ”actual” program selection	= 12 Bytes
8. Per set program name	= 48 Bytes
9. Per line of the OP function	= 72 Bytes

The value is generated by the CamCon with the following formula:

Storage requirements in Bytes	=	Basic needs
	+	Number of cams * 12
	+	Number of delay times for Speed Compensation * 12
	+	Number of output names * 24
	+	Number of user keys * 66
	+	66 when the special measuring system is available.
	+	12 when "on Pos" program selection is set.
	+	48 * number of set program names.
	+	72 * number of set lines of the OP function.

Example 1: The Cam Switch Unit is supposed to have 8 Programs each with 16 cams and Speed Compensation for 16 outputs.

Storage requirement in Bytes = 256 Bytes + (8 Programs * 16 * 12 Bytes) + (16 * 12 Bytes)

Storage requirement = 1984 Bytes

Example 2: The Cam Switch Unit is supposed to have 20 programs each with 16 cams and 16 delay times for Speed Compensation.

Storage requirement in Bytes	=	256 Bytes
	+	(20 Programs * 16 * 12 Bytes)
	+	(16 TZK * 12 Bytes)
	+	(16 Output names * 24 Bytes)
	+	(1 User keys * 66 Bytes)

Storage requirement = 4738 Bytes

Warning: Through alterations in the storage structure of the CamCon software, the extent to which storage capacity is used up can differ from software version to software version!

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11. Calculation the RAM storage-requirement for CamCon

The required **RAM**-main storage (not similar to the constand value - Camstorage or the EEPROM) depends on 7 factors:

1. Standard consumption	(approximately 100000 Byte)
2. Number of outputs	(8 to 200 in steps of 8 outputs).
3. Cycle time	(displayed in miliseconds).
4. Actual value/measuring system resolution	(displayed in impulses)
5. Maximal Speed-compensation	(0 to 9999.9 in steps of 100 microseconds).
6. Mode of program selection	(the double ammount of storage is required). (See also chapter "7.4.1. Program selection" on page 36).
7. Size of the EE-Prom storage	(EE-Prom - storage size in Byte for Cache).

The RAM - storage requirement is calculated by the following formula:

storage requirement in Bytes = standard consumption +

$$\frac{\text{Number of outputs} * \text{IActual value resolution.} * (\text{2 If program Mode not slow})}{8} +$$

$$\frac{\text{max. delay-time} * 4}{\text{cycletime}} + \text{EE-Prom size}$$

Example 1: The camswitch with a resolution of 360°, an EE-Promstorage of 32kByte, 16 outputs, a speed-compensation of 1000ms and a cycletime of 250µs needs:

$$\text{Storage requirement in Bytes} = 100000 + \frac{16 * 360}{8} + \frac{1000 * 4}{0.250} + 32768$$

Storage requirement in Bytes = 100000 + 720 + 16000 + 32768

Storage requirement in Bytes = 149488 = ca. 150kByte

Example 2: The camswitch with a resolution of 8192°, an EE-Promstorage of 48kByte, 64 outputs, a speed-compensation of 500ms and a cycletime of 250µs, needs:

$$\text{Storage requirement in Bytes} = 100000 + \frac{64 * 8182}{8} + \frac{500 * 4}{0.250} + 49152$$

Storage requirement in Bytes = 100000 + 65536 + 8000 + 49152

Storage requirement in Bytes = 222688 = ca. 220kByte

Note: If the required RAM - storage requirement greater than the CamCons total ammount of storage, you need to reduce the measuring system's resolution.

Attention: Changings in the storage-structure of the CamCon software the storage requirement can alternate at different software-versions!

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12. Technical data

Multi functionaal display for programming	7- segment, 5 digits, 13mm
Number of outputs	8, 16, 24, 32.
Analog output	for speed display (optional).
Display of the output states	one LED for each of 16 outputs, can be switched to another 16 outputs
Number of programmable cams	150, optionally 600, 2500, 3700 or 10500, as per size of the EEPROM
Number of programs	999
Cycle time (switching speed)	from 100µs on, is adjusted according to the needs (optimized)
Dead time compensation (DTC)	can be adjusted separately for each output
Adjustment range of the DTC	0 up to 999ms, differs with encoder type and memory
Accuracy of the DTC	+0 to -1 steps
Encoder input	synchronous serial (SSI), parallel data input, gray coded
Measuring system SSI	AAG6007 (standard) AAG612-2048, AAG612-4096, AAG612-8192, AAG626 oder AAG66107.
Zero point correction	electronic adjustment by CamCon
Rotation direction of the encoder	is programmed by CamCon
Length of the connection cable between the encoder and CamCon	300 m
Data security / storage	EEPROM
Supply voltage	24V DC ± 20 %
Encoder supply	24V DC through the supply voltage of the CamCon
Current absorbtion	300mA without encoder and outputs
Output voltage	+24V DC, plus-switching
Output current	500mA per output, short circuit proof permanent current (see chapter 4.3. The outputs)
Connections for:	
Encoder	through plug block pins
Voltage supply	through plug block pins
Cam outputs	through plug block pins
Operating temperature	0°C to +55°C
Cover type for:	
Front plate / full sight gate	IP 67 / IP 55
Cabinet	IP 54
Dimensions	see fig. page 12
Front gate part	138^{+1} x 138^{+1}mm
Cabinet (switch plate cabinet by DIN 43700)	144 x 144 x 63mm (WxHxD)
Cover of front plate	Full-sight gate, can be locked with security key(optional).
Weight	about 1000g

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13. Key word table

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