# Instruction manual

## Electronic cam control

# InlineCam

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Foreword

This operating manual provides users and OEM customers with all the information necessary for the installation and operation of the product described in this manual.

All details contained in this manual have been checked carefully, however, they do not represent an assurance of product characteristics. No liability can be accepted for errors. DEUTSCHMANN AUTOMATION reserves the right to carry out alterations to the described products in order to improve the reliability, function or design thereof. DEUTSCHMANN AUTOMATION only accepts liability to the extent as described in the terms and conditions of sale and delivery.



Bad Camberg, March 2007

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**P/C: A**

# 1 Introduction

## 1.1 On this manual

This manual documents installation, functions and operation of the Deutschmann unit specified on the cover sheet and in the header.

### 1.1.1 Symbols

Particularly **important text sections** can be seen from the adjacent pictogram.

You should **always** follow this information since, otherwise, this could result in malfunctions or operating errors.

### 1.1.2 Concepts

The expressions ‘InlineCam’, ‘LOCON’ and ’TERM’ are frequently used throughout this manual with no further model specifications. In such cases, the information applies to the entire model series.

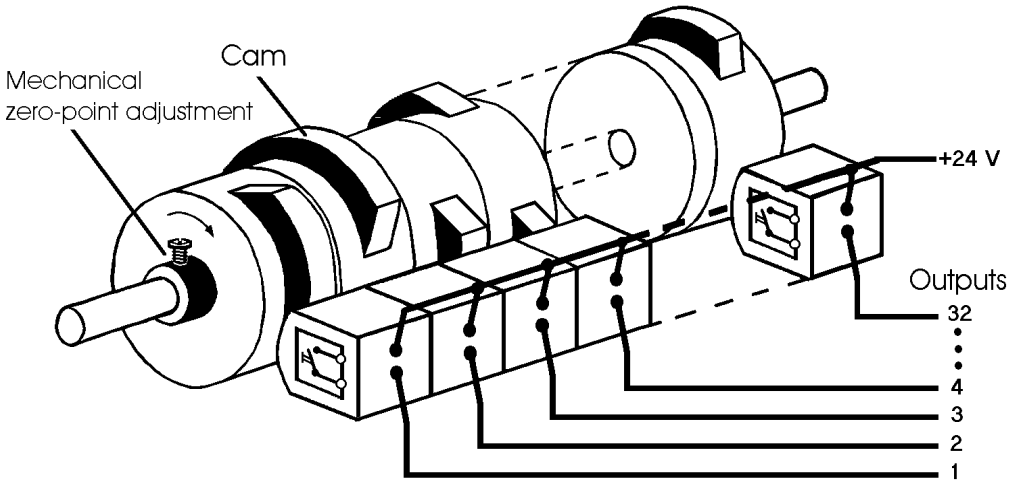
### 1.1.3 Suggestions

We are always pleased to receive suggestions and wishes etc. and endeavour to allow for these. It is also helpful if you bring our attention to any errors.

## 1.2 From the mechanical system to an electronic system

The purpose of electronic cam controls is not only to take the place of mechanical controllers but to render their function more precise and simpler, to provide a universal range of application and to reduce wear.

The mechanical cam control actuates a switch over sections of a circle, and this switch is closed over the length of this section. Such a section is defined as a "cam".
Each switch represents one output. Several circuits arranged in parallel produce the number of outputs.




**Picture 1: Mechanical cam control**

This basic principle has been adopted from the mechanical cam controls. A cam is programmed for an output by entering a switch-on point and a switch-off point. The output is switched on between these points.

Thanks to twenty years of experience, consistent further development and the use of ultra-modern technology, DEUTSCHMANN AUTOMATION has now become one of the leading suppliers of electronic cam controls.

## 1.3 Deutschmann Automation’s range of products

A detailed and up-to-date overview of our product range can be found on our homepage at http://www.deutschmann.de.

# 2 EMC directives for products of Deutschmann Automation

The installation of our products has to be carried out considering the relevant EMC directives as well as our internal instructions.

For more information see ’EMC Directives’ on our homepage at http://www.deutschmann.de.

# 3 Basic unit InlineCam

InlineCam is designed for an installation on a DIN-rail. The programming is carried out either via a Deutschmann terminal or via PC, the process data exchange occurs via the Interbus.

# 4 Mechanical installation instructions Inline

## 4.1 Installation

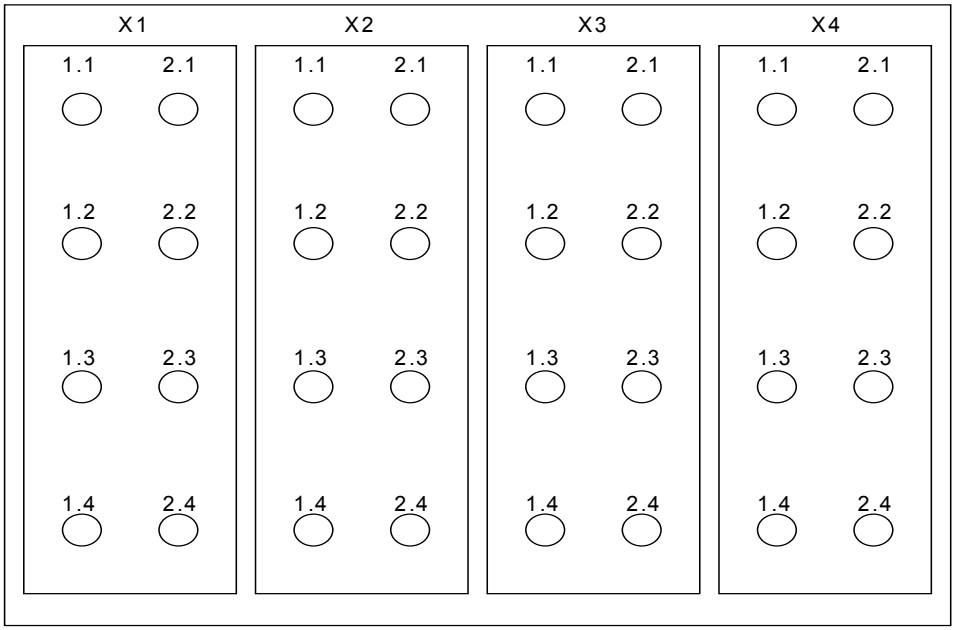
The device is installed like any other Phoenix Contact Inline components. The relevant installation instructions from Phoenix Contact are to be kept to.

InlineCam ist only suitable for the Phoenix Contact series Inline.

# 5 Electrical connections InlineCam

## 5.1 Front view InlineCam

**Inline-connection**




## 5.2 Inline-assignment SSI-encoder

| | X1 | | X2 | | X3 | | X4 | |
|---|---|---|---|---|---|---|---|---|
| 1.1./2.1 | +24V | GND | +24V-Input | GND-Input | Outp1 | Outp2 | Outp9 | Outp10 |
| 1.2./2.2 | SSICLK+ | SSICLK- | Rx-Inline | Tx-Inline | Outp3 | Outp4 | Outp11 | Outp12 |
| 1.3./2.3 | SSIDAT+ | SSIDAT- | IN3 | IN2 | Outp5 | Outp6 | Outp13 | Outp14 |
| 1.4./2.4 | PE | PE | IN1 | IN0+ProgEnable | Outp7 | Outp8 | Out15 | Outp16 |

## 5.3 Inline-assignment incremental encoder

| Pin Nr. | X1 | | X2 | | X3 | | X4 | |
|---|---|---|---|---|---|---|---|---|
| 1.1./2.1 | +24V | GND | +24V-Input | GND-Input | Outp1 | Outp2 | Outp9 | Outp10 |
| 1.2./2.2 | TrackA | Track$\overline{A}$ | Rx-Inline | Tx-Inline | Outp3 | Outp4 | Outp11 | Outp12 |
| 1.3./2.3 | TrackB | Track$\overline{B}$ | Clr- | Clr + | Outp5 | Outp6 | Outp13 | Outp14 |
| 1.4./2.4 | PE | PE | IN1 | IN0+ProgEnable | Outp7 | Outp8 | Out15 | Outp16 |

## 5.4 Pin assignment X1 encoder connection

| **Pin-No.** | **Connection of** | |
|---|---|---|
| | | an incremental encoder |
| 1.1 | +24V-Encoder (max 300mA) | +24V-Encoder (max 300mA) |
| 2.1 | GND-Encoder | GND-Encoder |
| 1.2 | SSICLK + | Track $\overline{A}$ |
| 2.2 | SSICLK - | Track $\overline{A}$ |
| 1.3 | SSIDAT + | Track $\overline{B}$ |
| 2.3 | SSIDAT - | Track $\overline{B}$ |
| 1.4 | PE | PE |
| 2.4 | PE | PE |

## 5.5 Pin assignment X2 Input

| | **Connection of** | |
|---|---|---|
| | | an incremental encoder |
| 1.1 | +24V - Input | + 24 V - Input |
| 2.1 | GND - Input | GND - Input |
| 1.2 | RX-Inline (RS 232) | RX-Inline (RS 232) |
| 2.2 | TX-Inline (RS 232) | TX-Inline (RS 232) |
| 1.3 | IN3 | Clr - |
| 2.3 | IN2 | Clr + |
| 1.4 | IN1 | IN1 |
| 2.4 | IN0+ProgEnable | IN0+ProgEnable |

## 5.6 Pin assignment X3 and X4

| **Pin-No.** | **Significance** | |
|---|---|---|
| | | X4 |
| 1.1 | Output 1 | Output 9 |
| 2.1 | Output 2 | Output10 |
| 1.2 | Output 3 | Output11 |
| 2.2 | Output 4 | Output12 |
| 1.3 | Output 5 | Output 13 |
| 2.3 | Output 6 | Output 14 |
| 1.4 | Output 7 | Output 15 |
| 2.4 | Output 8 | Output 16 |

**Please pay attention to the signal description on the following pages!**

## 5.7 Signal description InlineCam

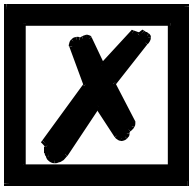
| **Function** | **Significance** |
|---|---|
| Output 1 ... Output 8 | Output block 1<br>Each output 24 V / 0.7 A positive-switching (PNP), short-circuit-proof |
| Output 9 ... Output 16 | Output block 2<br>Each output 24 V / 0.7 A positive-switching (PNP), short-circuit-proof |
| +24V - Input | 24 V output for supply inputs (input 0-3) |
| +24V - Encoder | 24 V output voltage for encoder (max. 300 mA) |
| GND - Input<br>GND - Encoder | Reference potential for +24 V-input and RS232-signals<br>Reference potential for +24 V-encoder |
| TxD-Inline | RS232 transmit line |
| RxD-Inline | RS232 receive line |
| SSICLK+, SSICLK- | RS422 clock line pair for SSI connection |
| SSIDAT+, SSIDAT- | RS422 data line pair for SSI connection |
| PE | Grounding plane of the complete cam control |
| TrackA, Track $\overline{A}$ | RS422-track A-pair of the incremental encoder |
| TrackB, Track $\overline{B}$ | RS422-track B-pair of the incremental encoder |
| Input 0-3 | Logic inputs<br>24 V each input (max. 10 mA)<br>For more details refer to chapter "Logic functions". |
| Clr-, Clr+ | Clear-inputs on operation with incremental encoder |

## 5.8 Status LEDs

### 5.8.1 Front view

| | Significance |
|---|---|
| D | Diagnosis Interbus |
| 1--16 | Outouts 1-16 |

## 5.9 Installation and initiation of InlineCam



**Attention! The plug-connectors of the InlineCams may be unplugged in a voltageless state only!!!**

### 5.9.1 Connection of the supply voltage

#### 5.9.1.1 Supply, encoder

The supply voltage for the encoder (+24 V-encoder) and the logic inputs (+24 V-input) occurs via the cross strap connection from the central 24 V-supply of the Inline-head end.

#### 5.9.1.2 Supply, outputs

The supply voltage of the outputs occurs via the cross strap connection from the segment circle for the periphery.
Therefore the reference of the segment circle has to be used as reference potential for the outputs!

### 5.9.2 Connection of the inputs and outputs

InlineCam features 16 outputs and 4 inputs for 24 V on the module.
Absolute or incremental encoders are used as the machine's signaling devices. These encoders are connected at pins "SSICLK" and "SSIDAT" for SSI encoders or "Inc_Track_A", “Inc Track $\overline{A}$“and "Inc_Track_B", “Inc Track $\overline{B}$“ for incremental encoders.
The encoders' power supply is provided via pins "+24 V encoder" and "GND".

The outputs of InlineCam are positive-switching 24 V, i. e. an active output has a level equal to the supply voltage, an output which has been reset has high impedance.
The outputs are short-circuit-proof and may drive maximum 700 mA.
If more than 700 mA is required per output, it is possible to interconnect several outputs. On a short-term basis the outputs can be loaded up to 1 A.
If several outputs are interconnected, the switch-on points and switch-off points in the InlineCam must be programmed absolutely identically since, otherwise, the short-circuit monitor would respond.

In the event of a sustained short circuit or overload, the corresponding outputs are deactivated and a corresponding error message is shown on the display.

**Free-wheeling diodes must be provided directly on the inductors if switching inductors (coils and valves) (see chapter 'EMC Directives').**

### 5.9.3 Connection of the serial RS232 interface

The RS232 interface is connected via the screw-type plug connector at plug X2.
When connecting, please ensure that the TxD and RxD signals of InlineCam and the connected unit are reversed (e. g.: connect TxD-InlineCam to RxD PC) and that the "GND-input" reference potentials of both units are connected.

# 6 Configurations InlineCam

The following performance characteristics can be configured in the InlineCam via a PC with the WINLOC® software:

## 6.1 Inputs and logic functions

16 inputs (4 hardware inputs, 12 software inputs) for logic gating with outputs. Chapter "Logic functions" contains a detailed description.

## 6.2 SSI interface

The connection of SSI absolute shaft encoders is supported. For the pin assignment of the SSI interface, please refer to chapter "Pin assignment X2 Input" on page 15.

## 6.3 Incremental encoder

Alternatively, an incremental encoder with any resolution can be connected to InlineCam, whereby the limit values specified in the technical data must be observed. 24 V-RS422-incremental encoders with two of each 90°-offset tracks A and B are supported, wired in accordance with the chapter Connection elements (INC_TRACK_A, INC_TRACK_B). Moreover, if using an incremental encoder, the inputs 2 and 3 are interpreted as Clear + or Clear -. Please refer to chapter 'Signal description' for a more precise description of their mode of operation.

## 6.4 Encoder monitoring

A 'genuine' encoder monitoring can be configured. It compares the encoder value read in each cycle with the value read in before and generates an Error 105 if a deviation greater than +/- 3 increments has been detected for a period equal to eight times the cycle time. This procedure reliably detects a defective encoder or a damaged cable, but brief interference on the encoder line does not result in an error message.

Error 100 is not suppressed if the encoder is not connected on units for absolute shaft encoders with a resolution of 360 or 1,000 increments featuring this option.

## 6.5 Mapping

In WINLOC it is possible to map the process data into the Interbus and various parameters from the Interbus into the InlineCam.
For IN- and OUT-mapping 4 bytes each are available.

### 6.5.1 IN-mapping

| Ex-works condition | Parameters that can be mapped |
|---|---|
| IN-byte 1 - actual program | actual program |
| IN-byte 2 - logic input 8 - 15 | error confirmation |
| IN-byte 3 - logic input 0 - 7 | logic inputs 0 - 7 |
| IN-byte 4 - unused | logic inputs 8 - 15 |

All parameters can be distributed to the bytes as desired.

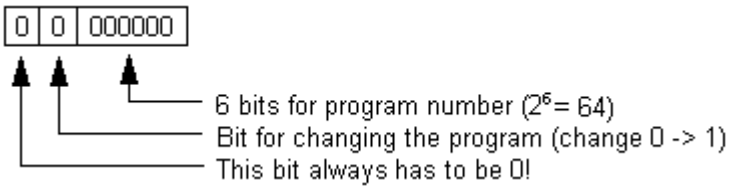
### 6.5.2 OUT-mapping

| Ex-works condition | Process data that can be mapped |
|---|---|
| OUT-byte 1- position 16...9 | position, speed, outputs |
| OUT-byte 2- position 8...1 | actual program, error number |
| OUT-byte 3- output 16...9 | |
| OUT-byte 4- output 8...1 | |

All process data can be distributed to the OUT-bytes as desired.

### 6.5.3 Mapping program changeover

If the program changeover is mapped then the following bit arrangement applies:




## 6.6 Interbus ID

The Interbus ID ist firmly set to 191. The data capacity in the Interbus is 2 words.

## 6.7 Logic functions

16 external hardware outputs of the cam control and 16 internal outputs (markers; 'M' on the display) can be programmed and assigned a switch-off delay time if necessary (outputs 1..8). Each output and marker may consist of a maximum of any three logic operations (AND, OR, NAND, NOR) and 4 operands. The following operands for the logic functions can be used:

- 4 external hardware inputs (E01..E04) and 12 software inputs (E05..E16) via the Interbus.
- 16 internal cam outputs (N01..N16)
- 16 internal markers (M01..M16)
- A 32-bit shift register

The outputs and markers may be inverted.

With WINLOC®, the user can select between 0 and 16 logic inputs for the logic function.
Here the logic inputs 1-4 are read in by the hardware, the inputs 5-16 come from the IBS-process data. For it in turn the 2 bytes (LOGIC-INPUT-LOW and HIGH) can be mapped in the process data of the IBS (see chapter 6.5 ’Mapping’), that are sent to the InlineCam-module.

In the status of delivery (no logic programmed), the external outputs are gated with the related internal cam outputs, i. e. the cam control behaves as if no logic was present.

### 6.7.1 Logic functions and explanation of the used symbols

The following logic functions are available for selection:

| | Symbol represented in the display of a connected TERM 24 |
|---|---|
| UND<br>AND | ∧ |
| | $\overline{\wedge}$ |
| | ∨ |
| | $\overline{\vee}$ |
| | TOFF↑ = 000 |
| Output inverted | a |
| Marker inverted | m |
| Marker | M |
| Cam track (internal output) | N |
| Output | A |
| Shift register | S |

**„Not“ = the corresponding symbol in WINLOC is: „/“.**

**The following applies in the condition as delivered:**

- Ax = Nx
- Mx = Nx

### 6.7.2 Priorities of the logic operations

Execution always takes place from left to right. There are no priorities.

In field 'TOFF', it is possible to enter a time from 0 to 255 ms for outputs 1 to 8 and the edge for triggering can be defined, i. e. the output is switched off only after the entered time. The time starts with the selected edge and is restarted (re-triggered) with each trigger condition.

### 6.7.3 Operation mode of the shift register

The parameters of the shift register “data, pulse and reset“ are firmly assigned to the upper markers.
Here the following assignment applies:

M16 = Shift register - Reset, if 1
M15 = Shift register - Data input
M14 = Shift register - Pulse (leading edge)

#### 6.7.3.1 Example for the use of a shift register

Referring to bottle manufacturing the finished product has to be analyzed for various criterions. Therefore the bottles are handed over to a rotary table. For the examination they are placed in a mechanically fixed position, in order to be driven past the different inspection equipment. The initialization of the test equipment is carried out through the standard outputs of the cam switch unit.

Since it can always happen that no bottle is available when it comes to the supply of the part under test, for instance due to a tailback on the feed belt or when a batch is coming to an end, this would result in an error message of the camera. A possibility to avoid this is to use the shift register integrated in the cam control.would be, to place an approximating pick-up at any test position and to report the existence of a bottle to the test equipment. In order to realize that possibility, one single approximating pick-up at the intake to the rotary table is required. The information about the existence of a specimen is reported from the approximating pick-up through the input of the cam switch unit to the shift register. Each Bit of the shift register corresponds to taking up one bottle in the rotary table. A binary One in the shift register shows the existence of a bottle, whereas a Zero indicates the lack of a bottle. The Bit, that corresponds to the position of the inspection equipment, is now linked to the output of the cam switch unit with an AND-connection, so that the camera belonging to it will only be triggered, in case a bottle for the inspection is actually available.

### 6.7.4 Trigger conditions

| | Significance |
|---|---|
| ↑ | |
| ↓ | |

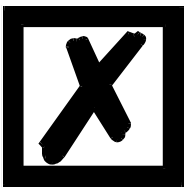
### 6.7.5 Example 1

An example with 3 inputs and a switch-off delay is given below


The above example is displayed on an operating panel TERM 24

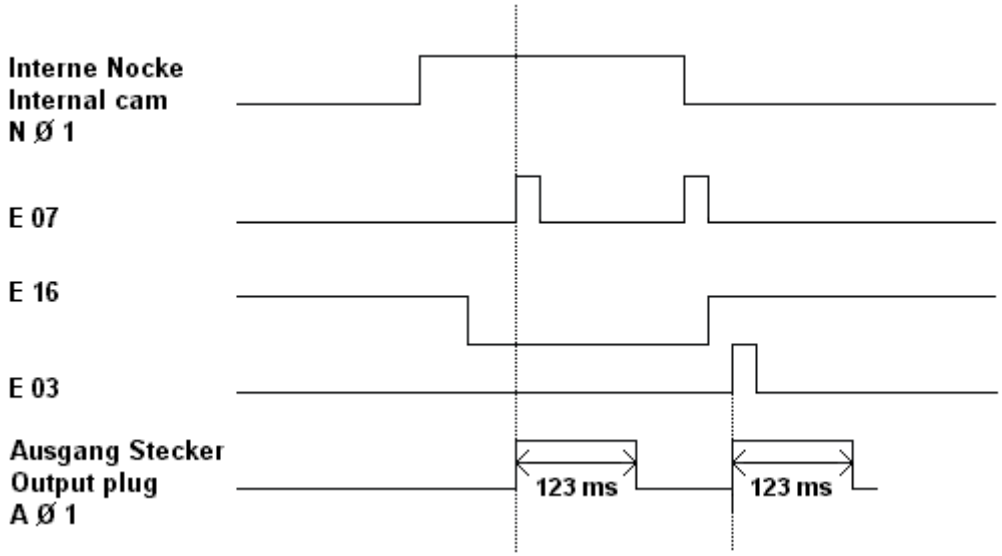
In this example, the status of output 1 results as follows:
The programmed cams of track 1 (N01) are first AND-ed with input 7 (E07) and with the negated input 16 (E16) (NAND). After this, this result is OR-ed with input 3 (E03). This state is then output at output 1 until the switch-off delay has elapsed (see illustration).

Max. 1.5 ms may elapse after an input change until output of the result. The input pulses must be at least as long as the cycle time (see technical data).



**Please note that the programmed switch-off delay time of 123 ms (in this example) which is started with each leading edge ↑ has an even higher priority than the result of the logic operation, i. e. the output remains at 24 V if the delay time has not yet elapsed even if the logic operation would deactivate the output.**

### 6.7.6 Graphical illustration of example 1




**Picture 2: Example, logic operation**

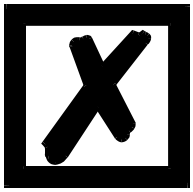
### 6.7.7 Example 2

Following please find an example whose result causes output 8 to blink: (represented on operating panel TERM 24)



### 6.7.8 Cycle time of the units with logic function

The cycle time of LOCON units with logic function increases by 300 µs + 10 µs per logic operation.



**The logic functions can also be programmed with the WINLOC software.**

## 6.8 Direction-cams

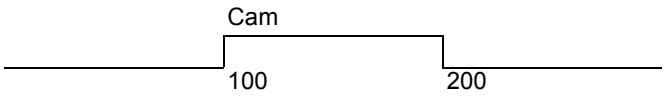
This function allows you to define, for each output, with what direction of rotation the outputs are to be switched. Three options (per output) can be used:

- Switching in both directions
- Switching in positive direction only
- Switching in negative direction only

The evaluation only takes place at the cam's edge, that means, in case the control detects an edge (switch on- or switch off edge) the output is always updated whenever the direction of rotation corresponds to the programmed direction.

**Example:**

**set direction for direction cams →**




| Driving direction | Position | OUT | Comment |
|---|---|---|---|
| → | 100 | HIGH | Edge is detected, direction is evaluated, output switched |
| ‡ | 200 | LOW | Edge is detected, direction is evaluated, output is switched off |
| ? | 199 | LOW | Edge is detected, direction is evaluated, output is not updated |
| ? 99 | | LOW | Edge is detected, direction is evaluated, output is not updated |
| ‡ 100 | | HIGH | Edge is detected, direction is evaluated, output is set |

In the first cycle after switching on the device and after each program change, all outputs are updated (independent of the programmed direction), that means, in this cycle the InlineCam acts like a cam control without direction cams.

Afterwards an update of the outputs only takes place if the encoder's direction of rotation corresponds to the programmed direction of the output and a cam edge (switch on- or switch off-point) is present.

**In the first cycle after switching on the device, it acts like a cam control without direction cams!**

## 6.9 Angle-time cam

InlineCam can be programmed for angle-time cams. The switch-on point depends on the angle, the switch-off point is defined by a time period (1 to 32500 ms).
Please note that an idle time compensation is not possible for this optional adjustment.
Please refer to "Entering angle-time-cam" for a detailed description.

### 6.9.1 Entering angle-time-cam

In case InlineCam is configured to the option W, the first outputs are intended for entering angle-time-cams.

On these outputs as many cams as desired can be entered as angle-/angle or as angle-/time-cams.

The switch-on point is programmed just like angle/angle-cams.

The switch-off time is entered in milliseconds. Values from 1 to 32500 are permissible.

## 6.10 Memory expansion

InlineCam features a memory for 1,000 data records as standard.

## 6.11 Offline programming

It is possible to program the InlineCam offline on a PC without the unit itself having to be connected to the PC when programming.
The program package “WINLOC®“ which runs on any PC with WIN95/98 or WIN-NT is used for this purpose.
After programming, the data can then be transferred to the LOCON via the PC's serial port.
It is also possible to transfer existing programs from LOCON to the PC, change these programs on the PC and then reload them back into the cam control.
The WINLOC program package is available free of charge from our sales agents. You can also download the software from our homepage.

## 6.12 Data backup and documentation on PC

The possibility of a data back up and documentation on a PC is also available. This is a part of the "WINLOC" program package (see above).
This allows you to back up programs of LOCON to a PC's hard disk or floppy disk, to comfortably print and also reload the programs.

## 6.13 Program controller function (encoder simulation)

The LOCON can also be configured as a program controller (timer). In this case, it behaves in the same way as an incremental cam control. However, the count is changed not via an external incremental encoder (see above) but via an internal timebase (which can be set from 1 ms to 65535 ms).

## 6.14 Function Speed limit value

From the firmware version V. 4.3 on InlineCam features the function „Speed limit value“.
In the EEROM now there is a new parameter „Speed limit value“ that can be adjusted with TERM 6. This unit corresponds to the unit that is presented as speed, i. e. normally „rev./min.“.
The set in factory of this parameter is 0.
In case this value is changed (unequal 0) and also the logic is active, then a relational operator is activated, that compares the current speed with this limit value and copies it into the flag M13, that means M13 equals 1 in case the current speed exceeds the mentioned limit value. Otherwise M13 = 0.
Now M13 can further be processed in the logic as desired or it can also be directly connected to an output.

## 6.15 Special versions

Over and above the diverse performance features of the InlineCam described in this manual, we offer customized adaptations and special versions, as is the case with all other models. If necessary, please contact your sales agent or ourselves with your enquiry.

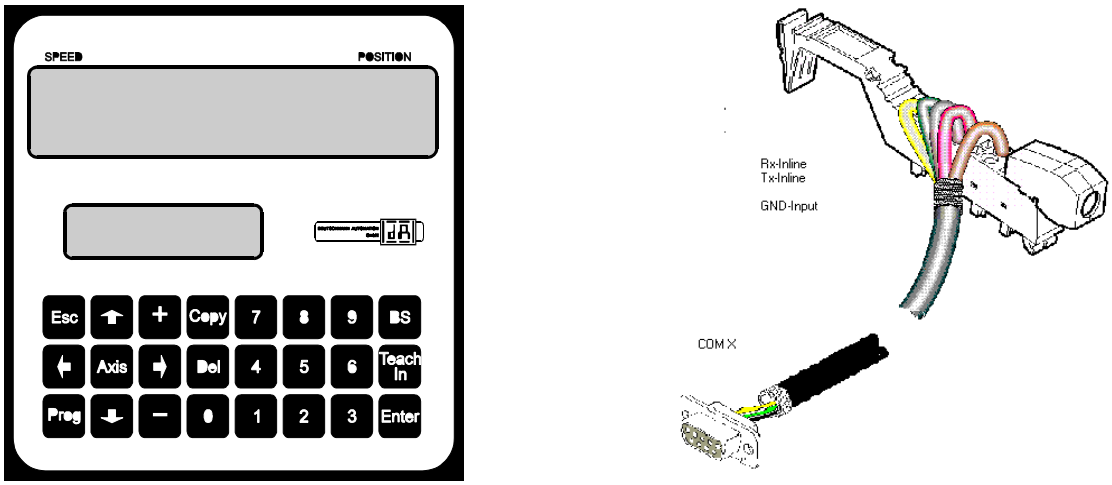
# 7 Connecting terminals and PC to InlineCam

## 7.1 RS232-connection

An RS232 link is always a **point-to-point link for 2 users**.
Here it must be borne in mind that, on connection, the Tx end of one user is connected to the Rx end of the other user and vice versa. Moreover, the device ground potentials must be interconnected.

### 7.1.1 RS232 link Inline - TERM

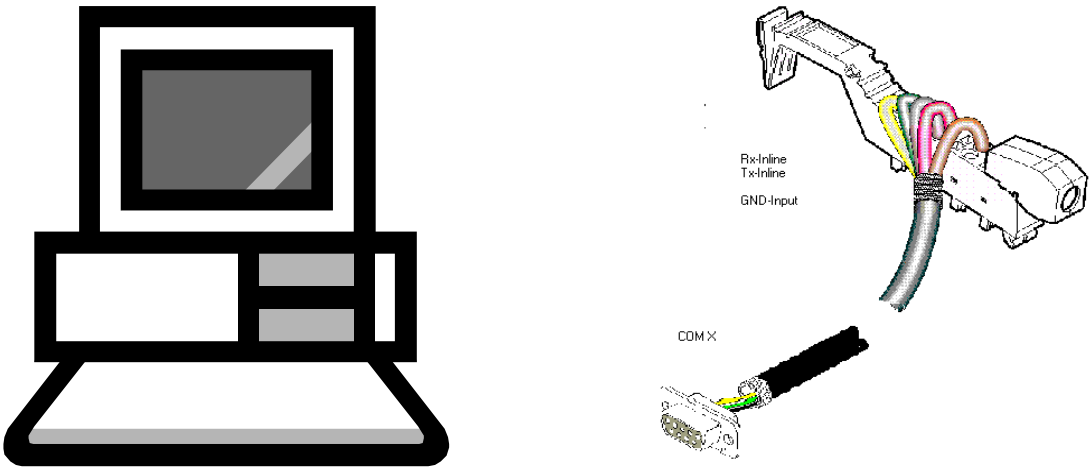
On the RS232 version, only a point-to-point connection between InlineCam and the external operator control panel is possible.
In this case, the Tx Inline line must be connected to the Rx TERM line of the operator control unit and vice versa, as can be seen from the illustration below.
The two ground potentials **must** be connected.




**Picture 3: RS232 link Terminal - InlineCam**

### 7.1.2 Link InlineCam - PC

The connection of an InlineCam to the PC is made via a serial port COM 1-8.




**Picture 4: Link InlineCam - PC**

# 8 Commissioning and self-test

## 8.1 Commissioning of the cam control

The commissioning procedure for the InlineCam is as follows:

1) Connection of the encoder
2) Connection of the status signals if an incremental encoder is used
3) Connection of the outputs used
4) Connection of the serial interface, if required

The InlineCam now conducts the self-test described in the following chapter, then generates the cam tables, after which it is ready for operation, i.e. the program last active (the last time the system was powered down) is executed.
The duration of the power-up phase until the unit is ready for operation depends on the number of programmed cams and may take up to 10 seconds.
A status message together with the software version information is displayed on any optionally connected PC.
If any error conditions which LOCON can detect itself have occurred, a corresponding error number is displayed. Please refer to chapter "Error messages" for the significance of this number and the actions required.

### 8.1.1 Self-test of the cam control

After power-up of the InlineCam, it conducts a self-test which takes a few seconds.
The unit is then ready for operation.

The following tests are conducted during this self-test:

- Test the entire RAM area for defective memory addresses
- Checksum test of the EPROM
- Checksum and plausibility test of the EEROM
- Plausibility test of the cam program

Should errors occur during the self-test, these are displayed on the display if possible (see chapter Error messages).

# 9 Operation InlineCam

Operation of the InlineCam cam can be carried out via a Deutschmann terminal (TERM 6, TERM 24 or TERM 32). For operating information please refer to the instruction manuals for terminals Furthermore, the programming and configuration is also possible via the PC-software WINLOC. This software can be found in the download area on homepage at http://www.deutschmann.de or call us at 0049- (0) 6434-9433-0.

## 9.1 Function, program controller

A unit with the **program controller** function is a normal InlineCam on which a TIMER has been programmed as the encoder type. The cam control then behaves in precisely the same way as an incremental cam control, whereby the incremental pulses are generated internally. The interval between one pulse and the next is referred to as the timebase and can be set by the customer from 1 ms to 65535 ms. All functions (CountEnable, Clear ...) as on the incremental cam control are available. The counting range can also be freely defined. Units with the TIMER function do not have idle time compensation. Moreover, there is no speed display.

## 9.2 Configuration

The parameters specified in the parameter table below can be configured by the user.

**Parameter table InlineCam**

| | Default | Value range |
|---|---|---|
| Counting range | 16777216 (MT)<br>16384 (InlineCam) | For incremental encoder |
| Zero-point offset | 0 | |
| | 0 | 0 = Normal<br>1 = Inverted |
| Language | 0 | 0 = German 5 = Flemish<br>1 = English 6 = Dutch<br>2 = French 7 = Swedish<br>3 = Italian 8 = Finnish<br>4 = Spanish 9 = Danish |
| Factor speed display | 60 | 0 .. 9999 (rev./sec.) |
| Fictitious encoder value | Encoder resolution | Units with absolute shaft encoder:<br><br>2.. 32500<br><br>Units with incremental encoder:<br><br>Max. value = Encoder resolution x 32500<br>16384 (InlineCam) |
| Configuration parameters | | |
| | Configurable | SSI Gray: 360, 720, 1000, 3600, 7200<br>InlineCam: $2^n$ (n=0..14 bit) 2 .. 16384<br>MT: 24 bit<br>Incremental: 2 .. 16777216 (MT)<br>TIMER: Counting range can be set from 1 ms to 65535 ms |
| Idle time compensation ITC | Configurable | |
| Encoder type | Configurable | 2 = Incremental encoder<br>3 = Absolute shaft encoder, SSI, Gray<br>5 = Timer<br>6 = Multiturn |
| Angle-/time-outputs | 0 | |
| | 16 Hardware outputs<br>48 Softwareoutputs | |
| | 4 Hardware inputs<br>12 Software inputs | |
| | No | No, yes |
| Reversal encoder | No | No, yes |

### 9.2.1 Parameter description

#### 9.2.1.1 Reversal encoder

The direction of rotation of the connected encoder (parallel, incremental or SSI) can be inverted with this parameter.
If configuring via the LCD, the reversal can be implemented with key "±" in line "Fictitious encoder value".

#### 9.2.1.2 Encoder type

This parameter defines the encoder type. The following encoders are currently supported:
RS422-incremental encoders, 24 V, see parameter table
Gray-SSI absolute shaft encoders, see parameter table
TIMER (value is generated internally), see parameter table

#### 9.2.1.3 Encoder resolution

This parameter defines the resolution (information items/revolution) of the encoder.
The resolutions currently available are specified in the parameter table

#### 9.2.1.4 Counting range (only in the case of incremental encoders)

By default, a counter overflow occurs if the counting range limit is reached if using an incremental encoder. Example: At 8192 that means after count 8191, the counter counts to 0000 unless an external Clear signal has been issued.
The counting range can be set with this parameter. Please refer to the parameter table for the limited values.

#### 9.2.1.5 Idle time compensation

The term "idle time" means the time which elapses from setting a PLS output through to the actual response of the connected unit (e. g. opening a valve).
This idle time is normally constant.

A PLS must shift a programmed cam as a function of the actual encoder speed in order to compensate for this idle time dynamically. This means that a valve which is to open at position 100 must, for example, already be opened at position 95 at a speed of 1 m/s and must already be opened at position 90 at a speed of 2 m/s.
This function is designated dynamic cam shifting or idle time compensation (ITC).

Idle times may be programmed block-serially, i.e. a set idle time always applies to a block of 8 outputs, or bit-serially, which provides the option of choosing different switch-on and switch-off delay times in the case of block-serial ITC.

The setting is made with the following values:
1 = Block-wise idle time compensation
2 = Bit-wise idle time compensation
3 = Block-wise idle time compensation with separate switch-on and switch-off times

#### 9.2.1.6 Menu Select language

(only of importance when using TERM 24 or TERM 32)
In conjunction with the integrated operator control panel, it is possible to select the menu language with this parameter.

The following assignment applies:

| | |
|---|---|
| 0 = German (default) | 5 = Flemish |
| 1 = English | 6 = Dutch |
| 2 = French | 7 = Swedish |
| 3 = Italian | 8 = Finnish |
| 4 = Spanish | 9 = Danish |

#### 9.2.1.7 Zero-point offset (only for absolute shaft encoder)

The zero-point offset or zero offset is used to synchronize the machine's mechanical zero point (datum) with the zero point of an absolute shaft encoder. It makes it possible for the encoder to be fitted in any position and means that the machine’s mechanical zero point does not have to correspond to that of the encoder.

The programmed zero-point offset value is subtracted by InlineCam from the actual encoder value, i. e. if the absolute shaft encoder supplies the value 100 as the position and if a zero-point offset of 10 is programmed, InlineCam processes the value as if position 90 had been read in.
If an offset towards higher values is to be made, the value to be offset must be subtracted from the encoder resolution and entered as zero-point offset. In the above example, if position 110 is to be processed and an encoder with 1000 information items/rev is connected, a correction value of 990 (1000-10) would have to be entered.
Since zero-point correction generally occurs at the machine datum in practice, it suffices to enter the displayed position value as the correction value (TEACH-IN).

If InlineCam is used with an incremental encoder, zero-point correction is not required.

#### 9.2.1.8 Scaling for speed display

This parameter permits the speed display to be matched to the given application. Scaling in the range 0...9999 revolutions/second is possible.
A value of 60 is preset at the default. This means that the speed in rpm is displayed.

#### 9.2.1.9 Fictitious encoder value (gear factor)

Regardless of the resolution of the encoder actually connected, it is possible to program a "fictitious encoder resolution", thus implementing an electronic transmission. If, for example, an encoder with a real resolution of 360 increments per revolution is used and one complete revolution corresponds to a traverse path of 1,000 mm, a "fictitious revolution" of 1,000 increments must be entered in order to program the cam control in "mm".
Please note that the entry and display are always integers. Floating-point display is not possible. In the case of results with a remainder greater than 0.5, the system rounds up to the next number up.

# 10 Technical data InlineCam

| Characteristics | Basic equipment | Configurable by the customer |
|---|---|---|
| **Data protection** | EEPROM (at least 100 years)<br>Data protection also through WINLOC | |
| **Programs** | 64 | |
| **Number of Cams** | 1000 cams, optionally distributable to channels and programs; cams are interchangeable linewise | Angle-/time-cams<br>Direction cams |
| **Zero-point offset** | Programmable over the entire range | |
| **Position recording** | Absolute encoder Gray-code SSI 24 V to 14 bit | 24 V-incremental encoder, counting range up to 16 mio., RS422-A/B-signal |
| **Outputs** | 16 external outputs, short-circuit proof, 24 V / 0.7 A, on a short-term basis loadable up to 1 A per output, plus-switching | Up to 48 internal outputs can be configured additionally.<br>These outputs are available via the Interbus.<br>Lockable outputs<br>Encoder monitoring |
| **Inputs** | 4 inputs for logic-connection | 12 additional inputs via Interbus |
| **Idle time compensation (ITC)** | 0 ... 999ms bitwise | 0 ... 999ms blockwise<br>Seperate switch-on and switch-off delay at blockwise ITC |
| **Cycle time** | 75µs... 1 ms depending on the model | |
| **Programming** | Via external operating panel TERM 6, TERM 24, TERM 32<br>Offline/online via PC (WINLOC®) | |
| **Display** | Via an external terminal the encoder position, speed and states of outputs can be displayed | |
| **Interface** | RS232 and internally Interbus | |
| **Connection** | Outputs etc via clamping-plug-connector | |
| **Installation** | DIN-rail mounting | |
| **Type of protection** | IP20 | |
| **Current consumption via potential shunter**<br>**- Logic voltage**<br>**- Analog voltage**<br>**- Segment voltage**<br>**- Periphery voltage** | <br><br>7.5 V / 190 mA<br>not required<br>24 V / total current of the outputs<br>24 V / 90 mA | |

## 10.1 InlineCam memory expansion

| Memory size | Number of data records |
|---|---|
| 8 kByte | 1000 data records |

8 bytes are required for each data record. The remaining data records are required by the firmware.

**Data record memory usage:**

| Type | Usage |
|---|---|
| 1 cam | 1 data record |
| 1 idle time | 1 data record |
| 1 logic record | 1 data record |
| 1 output name (max. 30 characters) | 5 data records (6 characters/data record) |

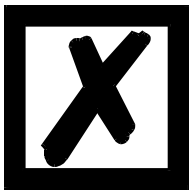
## 10.2 Specification of the input levels

Logical HIGH:> 16 V < 10 mA (typically 5 mA)
Logical LOW:< 4 V < 1 mA

## 10.3 Specification of the output drivers

The outputs used in the InlineCam are short-circuit-proof and can drive maximum 700 mA per output at normal ambient temperature.
If more than 700 mA is required per output, it is possible to interconnect several outputs.
If several outputs are interconnected, the switch-on and switch-off points in the LOCON must be programmed absolutely identically since, otherwise, the short-circuit monitor does not respond.

In the event of a sustained short circuit or an overload, the corresponding outputs are deactivated and a corresponding error message is shown on the display.



**When switching inductances (coils, valves) free-running diodes are to be placed directly at the inductances (see chapter EMV-directives).**

## 10.4 Switching accuracy of the Deutschmann cam controls

The accuracy of cam controls is influenced by four parameters:

1) **Switching delay (SV)**
   This time is constant and results from the computing time required by the cam control from read-in of the encoder value to setting the output driver.

2) **Repeat accuracy (WG)**
   This tolerance band results from asynchronous sampling of the encoder. Ideally, the encoder is scanned directly after a change. Under worst-case condition, the encoder value changes directly after read-out of the cam control.

3) **Resolution**
   This value indicates how long the shortest cam which can still definitely be evaluated by the cam control is.

4) **Idle time resolution (ITR)**
   This error occurs only if an idle time is programmed for the corresponding output. It is specified in ms and represents the sampling time of the encoder speed, serving as the basis of ITC (idle time compensation).

In general, the SV and WG are each shorter than the cycle time of the cam control. This means that the actual switch point lies between instants "Switch-on time + SV" and "Switch-on time + SV + WG", as indicated in the diagram below.
Without idle time compensation, the resolution is 1 increment, provided the maximum encoder speed is not exceeded, i.e. even a cam with a length of 1 increment is still reliably detected and set by the cam control.
If the encoder speed ($V_{encoder}$) is exceeded n-fold, the resolution increases accordingly to n increments.
If you work **with** idle time compensation, the error merely increases by 1 increment since the correction of the ITC is maximum ±1 increment with each change of the encoder position owing to the "dynamic brake" implemented in LOCON.

To summarize, we can state the following formula:

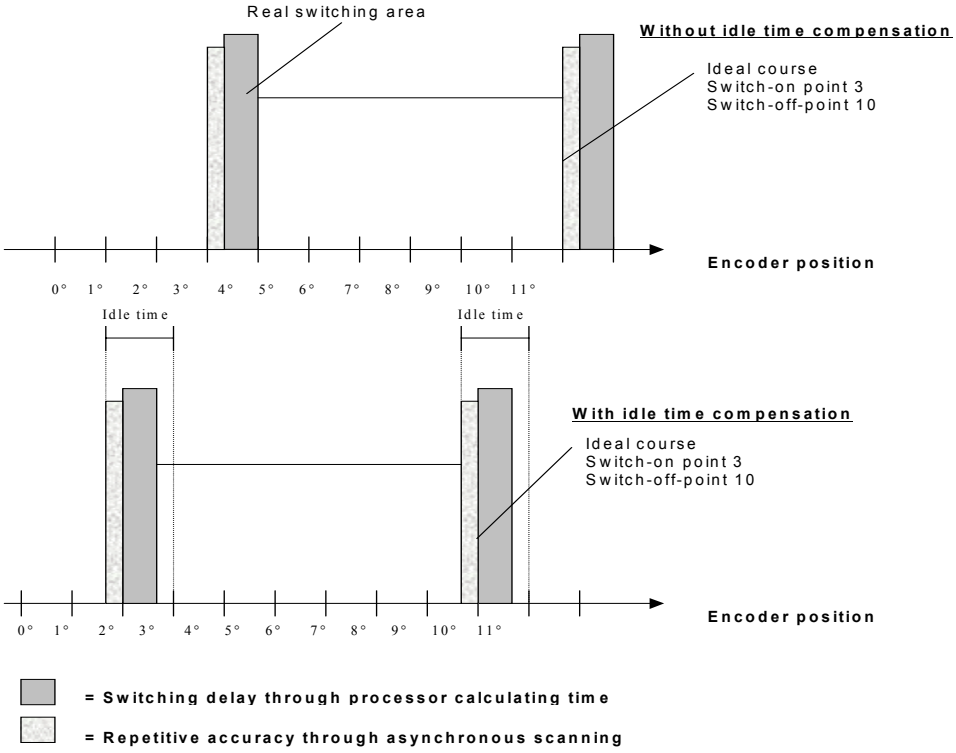
**Without idle time compensation:**
Actual switch point = ideal switch point + SV(const) + WG

SV < cycle time (constant, typically cycle time/2)
WG < cycle time (fluctuating between 0 and cycle time)
Resolution = n increments with $V_{encoder} < n * V_{encoderMax}$

**With idle time compensation:**
Actual switch point = ideal switch point + SV(const) + WG + ITR

SV < cycle time (constant, typically cycle time/2)
WG < cycle time (fluctuating between 0 and cycle time)
TZA = Resolution of the ITC (typically 1 ms)
Resolution = n increments, with $V_{encoder} < n * V_{encoderMax}$, whereby $V_{encoder}$ const.
Resolution= n+1 increments, with $V_{encoder} < n * V_{encoderMax}$, whereby $V_{encoder}$ variable.

### 10.4.1 Timing diagram




**Picture 5: Timing diagram - idle time compensation**

## 10.5 Function of the idle-time compensation

All mechanical circuit components which are usually connected to a cam control (e.g.: floodgates, magnetic valves...) feature idle-time that means, between accessing the circuit component and the mechanical reflex lies a constant time, the idle-time.

The compensation of this idle-time depends on the speed of the cam control.

The following processes of idle-time compensation are possible:

- path-dependent idle-time compensation (standard process in every Deutschmann cam control)
- time-controlled idle-time compensation
- direct idle-time compensation (without dynamics brake)

Each of the above-mentioned methods has advantages and disadvantages and is suitable better or worse for a defaulted application.
All methods have in common, that the required idle-time value is determined again in every cycle of the cam control in dependence of the current speed. In this case, the required idle-time value indicates for how many increments the outputs must be activated earlier in order to compensate the idle-time of the connected circuit component.
If the machine - at which the cam control is operated - is in an acceleration stage, the current computed required idle-time value deviates from the actual idle-time value. In this case, the difference between actual and required value only depends on the acceleration. The following methods now differ in the kind and manner when and how the actual idle-time value is changed.

### 10.5.1 Path-dependent idle-time compensation

With this method the actual idle-time value is adapted for maximal ±1 increment during every item modification. By that it is guaranteed that no cams are skipped over during the acceleration stage of the machine and that during the braking phase no double cams (see time-controlled dead-time compensation) occur. The worse dynamics is disadvantageous in the case of this procedure and therefore combined the fact, that with a brake application, that is more rapid as the adjusted idle-time, the outputs are frozen on a wrong value in the standstill, as only during a machine movement as well as an item modification a change of the idle-time actual value is allowed.

### 10.5.2 Time-controlled idle-time compensation

With this method the actual idle-time value is adapted for maximal ±1 increment in every cycle of the cam control. By that it is guaranteed that no cams are skipped over during the acceleration stage of the machine, but double cams can occur during the braking phase; that means if a complete cam is between the actual encoder position and the encoder position which was slipped by the idle-time compensation, the cam appears twice at the output.

### 10.5.3 Direct idle-time compensation

With this method, the required idle-time value is undertaken in every cycle as an actual idle-time value. Because of this a very high dynamics is achieved but cams can be skipped over during the acceleration and during braking double cams can occur.

### 10.5.4 Optimization of dynamics

In order to achieve an adaptation of the cam shift to a changed speed (high dynamics) as fast as possible, the cam tracks which are idle-time compensated should be placed onto the first outputs (independent of the chosen method of idle-time compensation), as - system-dependently - the **last** compensated output determined the cycle time of the idle-time calculation. In this case, the cycle time corresponds to the last compensated output in mS. If the outputs 10,12,14,15 are idle-time compensated for example, it results an idle-time compensation - cycle time of 15 mS. But if these 4 cam tracks are programmed on the outputs 1..4, a cycle time of 4 mS is achieved.

## 10.6 Environmental specifications of cam controls of the LOCON series

| | |
|---|---|
| Storage temperature: | -25°C.. +85°C |
| Operating temperature: | -25°C .. +55°C |
| Relative humidity: | max. 80% no condensation, no corrosive atmosphere |
| Type of protection: | IP 20 |
| Shock: | IEC 68-2-27 |
| Vibration: | IEC 68-2-6 |
| Weight: | 220 g |

## 10.7 Communication interface

Since different devices (terminals, SPS, ...) repeatedly have to communicate with cam controls, it became necessary to define a standardized interface (communication profile) supported by all cam controls from the DEUTSCHMANN AUTOMATION range.

By making the communication profile an open profile, means that the user is also in the position to communicate with DEUTSCHMANN cam controls and therefore can use existing information (encoder position, speed, ....) for his own applications or operating the cam control via his own terminal.

Through this it is also possible to make the LOCON capable for fieldbuses with Deutschmann UNIGATES (Profibus, Interbus, CANopen, Ethernet, ...).

On request, we are able to supply information on this interface in the form of Manual "Communication profile for DEUTSCHMANN AUTOMATION cam controls".

# 11 Error messages

An InlineCam error message can be seen from the fact that an error code is displayed on the terminal that is optionally connected or in the program WINLOC® and the diagnosis LED flashes quickly (peripheral error).

**All errors must be acknowledged with** Esc if a terminal is connected.

A distinction can be made between the following error types:

## 11.1 Error number 1..19 (irrecoverable error)

These errors are errors occurring during the self-test routine. If one of the errors 1 to 19 occurs, the unit must be returned to the manufacturer. When returning the unit, please provide the information specified in chapter 'Returning a unit'.

## 11.2 Error number 20..99 (warning)

The cam control continues running in the background in the case of all errors of this chapter, i.e. the outputs are still updated as a function of the encoder value in the specified cycle time.

| Error No. | Significance | Remarks |
|---|---|---|
| 20 | Error writing to EEPROM | |
| 21 | Error saving zero-point offset | |
| 22 | Error saving a cam value | |
| 23 | Error deleting a data record | |
| 24 | Error deleting a program parameter | Parameters can be deleted only in program 0 |
| 25 | Error copying a program<br>Error shifting a cam track | |
| 26 | Timeout accessing LCD | Acknowledge error. If the error occurs again, the unit must be returned specifying the information described in chapter ‘Returning a unit’. |
| 27 | Error saving a pattern value | |
| 28 | Error programming an idle time | Only in the case of pattern units |
| 29 | Error in function CLEAR_CAM | X97 only |
| 30 | No programming enable | The program can be modified only if signal ”ProgFreigabe” (Program Enable) is at 24 V on the connector or if parameter ”Lockable outputs” is set appropriately (see chapter ”Program enable”) |
| 31 | Overload switch-off of the output driver | The output drivers are short-circuit-proof. If InlineCam or ROTARNOCK senses an overcurrent for a long period (under certain circumstances, also in the case of incandescent lamps with high power rating), this error message is issued.<br>The corresponding output load must then be reduced and after that the error then be acknowledged.<br><br>Only the overloaded output is switched off. The other outputs continue to operate. |

| | | |
|---|---|---|
| 32 | EEPROM full | All data records in the EEPROM are used. Either you must remove cams no longer required or the unit must be equipped with a higher-capacity memory card (LOCON 32 only). |
| 33 | Duplicate switch-on point | An attempt has been made to program two cams with the same switch-on point at an output (cam track). |
| 34 | Error programming a partial idle time compensation | Unit does not feature the 'Y' partial idle time compensation option |
| 35 | Illegal encoder resolution, no power of 2 | Program a valid value |
| 36 | An attempt has been made to activate the protocol function but no 16k memory card is fitted (LOCON 32 only) | Insert 16k memory card |
| 37 | Reserved | |
| 38 | Error programming an idle time | On LOCON 17 only - idle times are permitted only for outputs 1 to 8 |
| 39 | ERROR NO ITC No ITC possible | e. g. LOCON 7 |
| 40 | DICNET® - transmit error<br>Duplicate error on transmit | Duplicate error on transmit |
| 41 | DICNET® - receive error | Duplicate error on receive |
| 42 | DICNET® - ID error | There is already a user with the same device number (GNR) in the network or the network line is faulty (missing bus termination, line discontinuity or non-twisted lines). |
| 43 | DICNET® bus error | |
| 44 | Overflow of the serial receive buffer | |
| 45 | | External fault signal (X26 only) |
| 46 | Save blank cam | Data record incomplete |
| 47 | | Direction-dependent output update illegal |
| 50 | | Outputs deactivated (Brake cam option only) |

## 11.3 Error number 100..199 (serious error)

All outputs are switched to 0 V until the error has been remedied in the case of errors from this chapter since it is no longer feasible to set the outputs.

| | **Significance** | |
|---|---|---|
| 100 | Error in Gray code | The (clipped) Gray code read in by the encoder is checked for plausibility in each cycle. If an illegal code is detected, this error message is issued.<br>If the error occurs only occasionally, this probably involves a fault on the encoder line, and this fault can be remedied by improved cable shielding or different cable routing.<br>Should the error be repeated frequently or be pending constantly, the encoder and the encoder line must be checked and exchanged if necessary. If the error still persists, the unit must be returned (see chapter ‘Returning a unit’). |
| 101 | Checksum error on the memory card or in EEPROM | If a checksum error on the memory card or in the EEPROM is detected on power-up, you will see the corresponding error message.<br>After acknowledgement by the user, the memory is written with the default configuration data and all user data is deleted. You then have the option of reprogramming or, if the old data has been backed up on a PC, of reloading this data. |
| 102 | Error initializing the cam array | Illegal cams detected. Carry out a general reset |
| 103 | New memory card | |
| | Plausibility error (illegal device configuration) | A device configuration which is illegal has been saved (e.g. absolute encoder with 127 increments resolution). Carry out a general reset |
| 105 | Encoder error (only in the case of ”Special configuration" LOCON 32 option or LOCON 24, 48, 64 units with encoder monitoring option) | An encoder error has been detected. The current encoder value and the last encoder value read in are shown at the top right on the LCD (LOCON 32). LOCON 24, 48, 64, see chapter Options: Encoder monitoring. |
| 107 | DSI Timeout error | |
| | SSI Timeout error | |
| | SSI Gray code error | |

# 12 Order Code

## 12.1 InlineCam

InlineCam can be ordered by article-no. V3000.

## 12.2 Standard accessory

### 12.2.1 Standard accessory of InlineCam

The scope of delivery of the unit includes the accessories described below:

| | |
|---|---|
| | 1 instruction manual |

# 13 Servicing

Should an error message occur, please first take all measures described in chapter Error messages.

Should questions occur that are not covered by this manual, please contact the responsible sales partner (see internet: http://www.deutschmann.de) or contact us directly.

Please keep the following information ready at hand when you call:

| |
|---|
| Serial number (S/N) |
| Item No. |
| Error number and error description (see also following chapter 'Returning a unit') |

You can reach us on the following Hotline number. Lines are open from

Monday to Thursday from 8 am to 12 pm and from 1 pm to 4 pm, Friday from 8 am to 12 pm

Central office & sales department: +49-(0)6434-9433-0
Technical hotline: +49-(0)6434-9433-33

Fax Central office & sales department:+49-(0)6434-9433-40
Fax technical hotline: +49-(0)6434-9433-44

## 13.1 Returning a unit

If you return a unit to us, we require as comprehensive a description of the error as possible. We require the following information in particular:

- What error number was displayed?
- How is the unit externally wired (encoders, outputs, ..)? Please state all connections of the unit.
- What is the magnitude of the 24 V supply voltage (± 0.5 V) with connected InlineCam?
- What were you last doing on the unit (programming, error on power-up, ...)?

The more precise your information and error description, the more precisely we can check the possible causes.
Devices, that are sent in without an error description undergo a standard test. You have to bear the costs for that test even though no defect was found.

## 13.2 Internet

The current software WINLOC is available for download from our Internet-homepage (URL). There you can also find topical information on Deutschmann products, instruction manuals and a list of our distribution partners.

**URL**: www.deutschmann.de