Kuhnke Electronics

Instruction manual
Posi Control
KUAX 671

E 765 GB

12.05.1993

KUHNKE

Contents

1. General

The KUAX 671, the electronic cam control unit, is intended not only to replace mechanical program controls, but also to execute their functions more precisely, to expand their range of applications and to reduce susceptibility to wear and tear. It gives the operator the possibility of flexible manufacturing with of the shortest possible set-up times. Utilizing modern electronic concepts has simplified operation and programming.

The KUAX 671 can be used wherever control functions are to be executed in accordance with the position of a shaft. To enhance versatility we have separated the cam controller itself from the programming and display unit (the hand terminal). It may thus be installed independently at any convenient location in the switching cabinet.

The hand terminal can, of course, be connected to the cam controller at any time via the interface; this facilitates checking or changing programs right at the machine.

Programming the KUAX 671 is as simple as could be, using the hand terminal. But a personal computer (IBM PC with MS-DOS and compatible computers) may also be used. This makes it possible to store the programs on floppy disks.The cam programs can also be printed as an instruction list or diagram.

Copying programs within the cam controller is possible; and you can also copy from one cam controller to another.

The hand terminal is also designed for front panel mounting; this gives you continuous access to the cam controller.

As encoder systems, wear-free absolute angle encoders are employed with a resolution of 180, 360 and 1000 divisions per revolution.

2. Explanations of the function of the KUAX 671

2.1 The principle

To make it easy to understand operation and programming we have followed the basic principles utillized in a mechanical cam controller in developing the electronic cam controller.

A mechanical cam controller opens and closes contacts as the high sectors of a circular wheel pass by the contacts. This raised profile along the wheel is known as a "cam".

Each wheel represents an "output". The number of wheels mounted in parallel is equal to the number of outputs.

This principle has been adopted in designing the KUAX 671 electronic cam controller. Programming a particular cam thus consists of entering the positions at which the cam is to close or open the contacts. The output is "on" (contacts closed) between these two switching points.

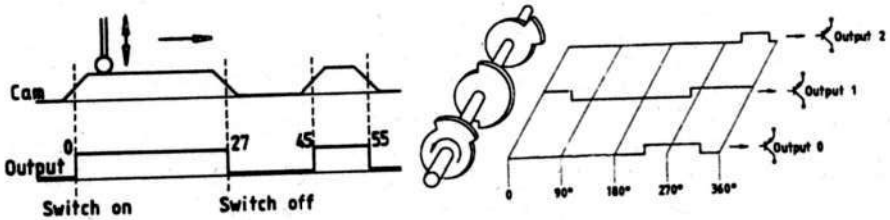


Illustration of the cam controller operation

Moreover, the use of electronics makes the following expansions of the controller functions possible:

- A large number of cams can be programmed in sequence to the same output, each with precise switching points.
- Every programmed cam can easily be changed or deleted.
- If a cam is programmed which overlaps with an existing cam, the two will be "fused" to form a single cam.
- If a new cam is defined within the switching points of an existing cam, the new cam will be ignored.
- The cams can be copied precisely onto other units.

3. KUAX 671 dyn

3.1. Definition of dead-time compensation

When changing the encoder rotation speed, the physical dead-time compensation of mechanical positioning elements (e.g. relays, magnetic valves, rotation magnets etc.) may appear as interference.

In order to compensate this interference, it is necessary to attribute to the switch-on and switch-off values of a cam a constant time factor (dead-time compensation) independent of the rotation speed. Thus, the dead-time compensation of the positioning element is considered a constant factor at any encoder rotation speed.

The KUAX 671 dyn offers four groups of dead-time compensation united into 8 outputs respectively. In each dead-time compensation group the dead-time compensation for the whole group can be set in milliseconds independently of each other. The time range is 1 to 250 ms. The times thus set affect all 8 outputs of the selected dead-time compensation group and are valid for 7 programs.

dead-time compensation group 0 = Outputs 0 to 7
dead-time compensation group 1 = Outputs 8 to 15
dead-time compensation group 2 = Outputs 16 to 23
dead-time compensation group 3 = Outputs 24 to 31

The dead-time compensation can be programmed either via the hand terminal (as from version 3.1 on) using the function key Ctrl-N or by using the PC editor "NOBES".

The maximum encoder rotation speeds are set as follows:

Absolute value encoder 180 steps/rev.: 500 rpm
Absolute value encoder 360 steps/rev.: 250 rpm
Absolute value encoder 1000 steps/rev.: 120 rpm

If the maximum rotation speed is reached, the Parity LED lights up.

Note:
If the rotation speed is increased any further, the function remains active up to ca. 150 % of the maximum rotation speed. Only the resolution is reduced.

You can call the encoder rotation speed up by pressing the *key. It is shown up to 60 % of the maximum rotation speed with the following resolution:

180/360 encoder = 3 rpm
1000 encoder = 1 rpm

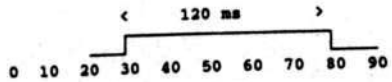
Examples of compensation of the dead-time compensation

In the examples below an explanatory illustration is given. We assume that at a certain encoder resolution and rotation speed the cam closes for an according time.

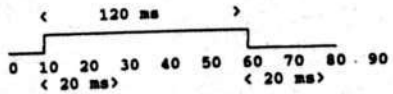
Example:

If, for example, a cam is set for a dead-time compensation of 20 ms, the output always switches on and off 20 ms before the switching-on/-off values programmed before at every encoder rotation speed. In this example, the cam is moved forward at an increasing rotation speed.

Original cam



Dyn cam 20 ms
dead-time compensation



4. Hardware of the KUAX 671

4.1. General

The control electronics of the cam control unit KUAX 671 is mounted in a robust, finished metal housing suitable for industrial applications. The housing can be installed either with a mounting angle or, if desired, using couplers for mounting rails complying with DIN 46277.

4.2 Mechanical design

The electronics comprise two modules:

1. The CPU module with
   - integrated power pack
   - programming interface

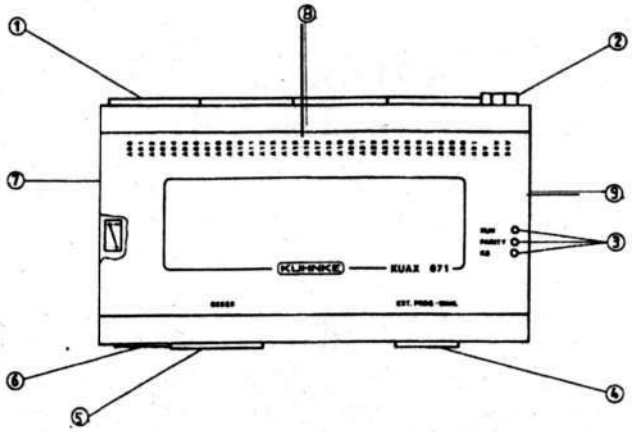
2. Input/output module with
   - connector plug (D-Sub) for the encoder
   - terminal strip for connecting the external program selection device
   - connection terminals for the outputs
   - integrated output LEDs (optional)

A terminal block is used as the attachment point to supply power both to the internal power pack for the cam controller (24 V DC, I ≤ 0.5 A) and to the outputs. This terminal block is located to the right of the output terminal strip. Since the amount of power drawn by the outputs depends on the load, the power pack must be selected so as to be able to deliver the required amount of current.

Three LEDs are provided on the front panel to indicate normal operation and to signal malfunctions:

Display:	RUN	→	Controller is running
	PARITY	→	There is an error in the program
		→	Encoder has reached maximum speed (with dynamic version only)
	SHORT (KS)	→	Short circuit indicator
		→	Flat battery (depending on type)
	Report outputs	→	Short circuits and parity, battery check. (Order No.: 671.022.16 or 32)

4.3. Illustration of the control unit



1 Output terminals 0 to 15 or 0 to 31.

2 24 V DC input for the built-in power supply to the cam controller and to the outputs.

3 Operation and malfunction indicators.

4 Terminal block for the external program selection.

5 25pole D plug for the absolute angle encoder.

6 Plug connector for the hand terminal.

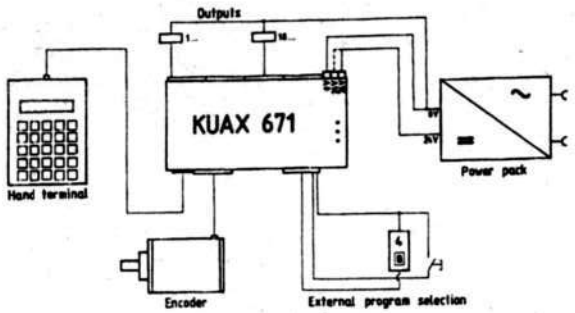
7 Hook switch to reverse the direction of encoder rotation (accessible only after unscrewing the side panel).

8 Output LEDs.

9 Battery compartment for Lithium battery.

4.4. Installation plan

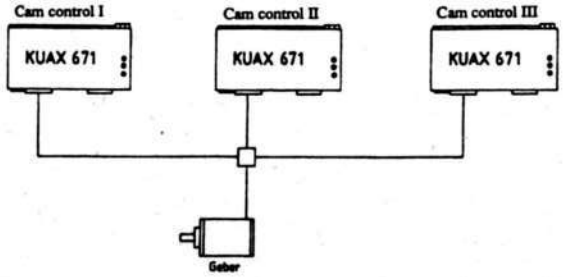
KUAX 671 with hand terminal and external program selection



The supply voltage (24 V DC) must be applied to both connector terminals if more than 16 outputs are utilized.

4.5. Expansion steps

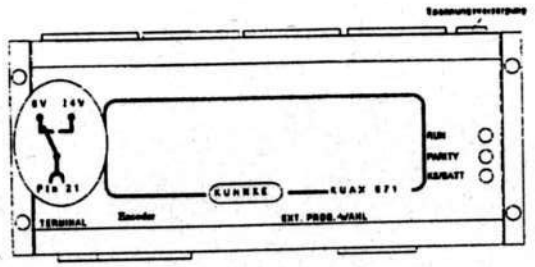
A maximum of three controls can be connected via an adapter. Thus, the number of outputs can be expanded by 16 or 32 to a maximum number of 96 outputs.



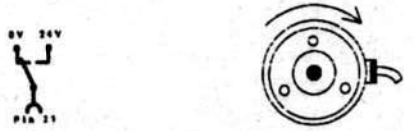
4.6. Counting direction of the rotation encoder

The counting of the rotation encoder can be reversed by a hook switch inside the control (see diagram).

You can decide between: clockwise rotation ---> counting upwards
anti-clockwise rotation ---> counting upwards



Switch positions: Rotation directions



Encoder counts upwards during clockwise rotation

Encoder counts upwards during anti-clockwise rotation

4.7. Plug connectors and pin wiring plans

Output terminals
0 to 15 or 0 to 31 in
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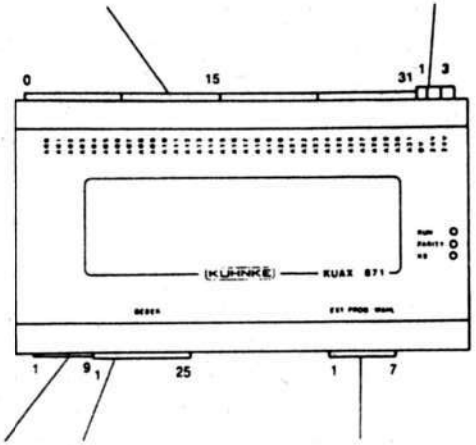
Connector for the power supply
3pol. terminal strip PIN 1GND
PIN 2 24 V DC
PIN 3 24 V DC



Terminal connector
9pole D plug

Encoder connector
25pole D plug

Connection for
external program selection
7pole terminal strip

Pin wiring only
on request 1

see ch. 4.9.

PIN		PIN
Track 1		1 2^0
2	Track 2	2 2^1
3	Track 3	3 2^2
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3. Reporting of error messages. Additionally to the LEDs indicating malfunctions, possible error messages are reported via outputs A00 and A01.

Output A00 a) Short circuit is at one of the outputs
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In the case of an error, the output is switched off and the LED goes out. Depending on the type of error, the appropriate malfunction LED lights up additionally.

Output A01 Control of battery voltage

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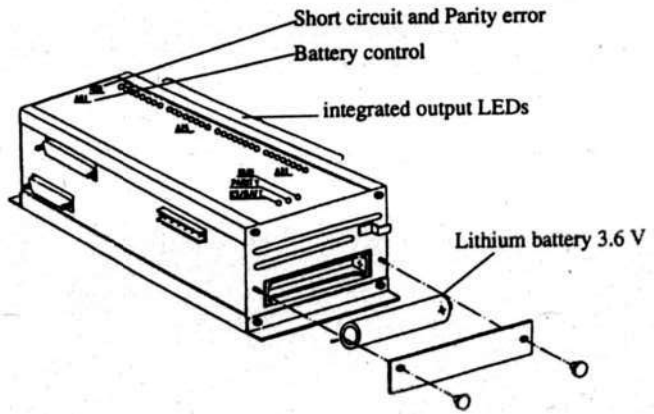

Note: Change battery only while the unit is switched on. After removing the cause of the error the cam controller can be reactivated via the PG 671 hand terminal pressing CTRL 2.

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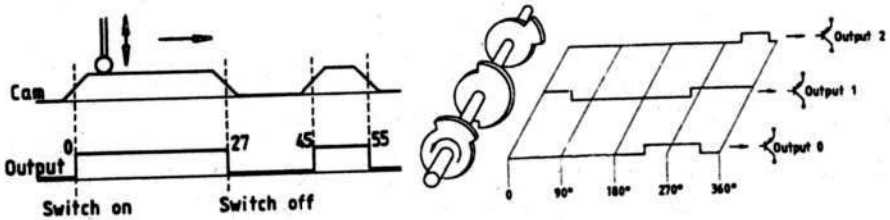

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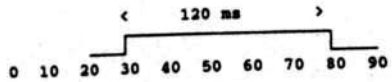
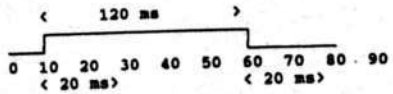


Dyn cam 20 ms
dead-time compensation



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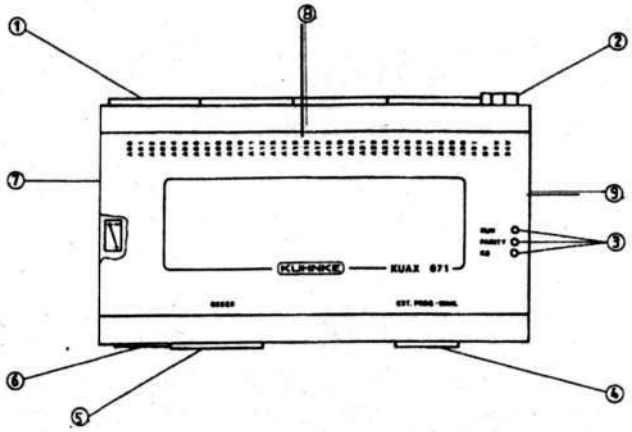

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7 Hook switch to reverse the direction of encoder rotation (accessible only after unscrewing the side panel).

8 Output LEDs.

9 Battery compartment for Lithium battery.

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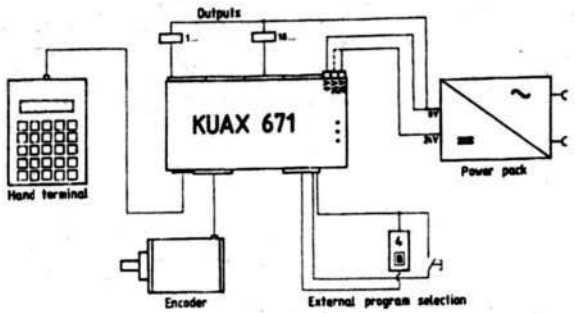
KUAX 671 with hand terminal and external program selection



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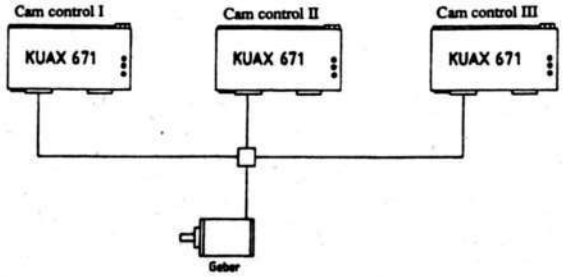

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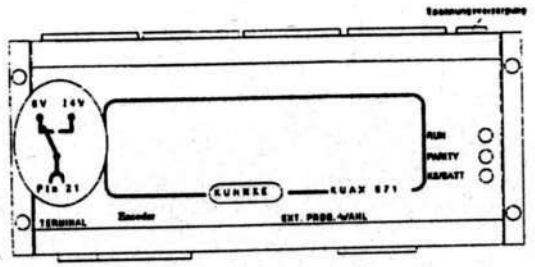
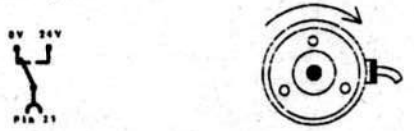
The counting of the rotation encoder can be reversed by a hook switch inside the control (see diagram).

You can decide between: clockwise rotation ---> counting upwards
anti-clockwise rotation ---> counting upwards



Switch positions: Rotation directions



Encoder counts upwards during clockwise rotation

Encoder counts upwards during anti-clockwise rotation

4.7. Plug connectors and pin wiring plans

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0 to 15 or 0 to 31 in
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PIN 2 24 V DC
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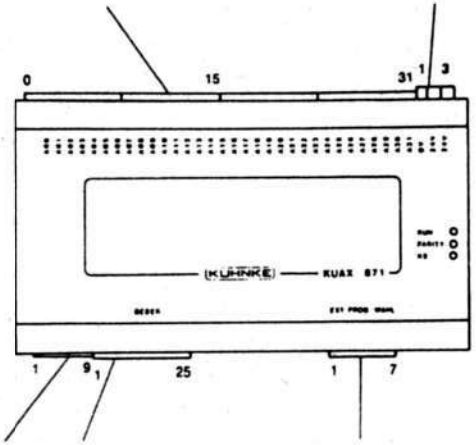

Terminal connector
9pole D plug

Encoder connector
25pole D plug

Connection for
external program selection
7pole terminal strip

Pin wiring only
on request 1

see ch. 4.9.

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6	Track 6	5 Special function
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8	Track 8	7 24 V DC
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10	Track 10 (only for 1000-division encoder button	We recommend using BCD coding switches with a separate start
21	Reversing rotation direction	
23	Shield	
24	24 V DC	
25	GND	

4.8. Posi Control with report outputs

Order No. 671.022.16 or 32

This model has the following special functions:

1. Individual switch-off of outputs in case of a short circuit. Only the output with a short circuit is switched off.
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Output A01 Control of battery voltage

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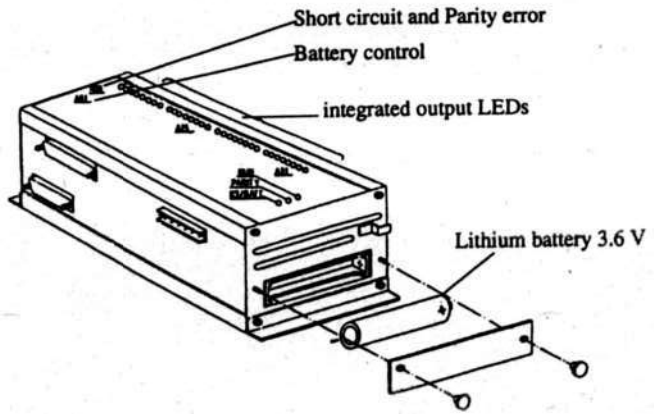
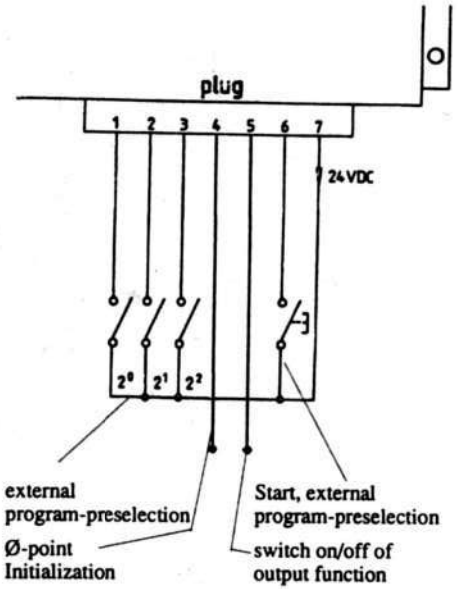


Note: Change battery only while the unit is switched on. After removing the cause of the error the cam controller can be reactivated via the PG 671 hand terminal pressing CTRL 2.

4.9. External program selection

It is possible to set up the system for external program selection in addition to selecting the program at the hand terminal. A terminal strip with supplementary inputs is used for this purpose.
The desired program number can be entered in binary code using three input terminals (pins 1 to 3). The program is then started with a supplementary push-button contact which is connected at pin 6. The 24 V required for the selection routine is available at pin 7.
A key switch should be used to secure the program start button; this will eliminate the possibility of an inadvertent change of programs.
We recommend the use of a BCD switch to encode the program selection.

Note: After switching the power supply on, always the program number selected last is set.



External program-preselection

Program No.	2^0	2^1	2^2
0	—	—	—
1	X	—	—
2	—	X	—
3	X	X	—
4	—	—	X
5	X	—	X
6	—	X	X
7	X	X	X

x = switch closed

4.10. Special functions by external selection

Input Pin 4: Any angle position of the encoder can be initialized as zero point via pin 4 (active 24 V DC) at any time.

Input Pin 5: The outputs can be switched off via pin 5 (outputs active = 0 V DC).

5. The KUAX 671 PG hand terminal

5.1. General

The hand terminal for the KUAX 671 is enclosed in a sturdy and convenient plastic case. The display and control elements are compact but easy to read and use and are arranged for industrial use.

The terminal carries out essentially three functions:

- Program generation
- Calling up the programs thus generated
- Initializing the cam controller when putting the unit into operation

The two-line, 16-character display simplifies programming. The operator is lead through the procedures by menus in most cases.

The program generation is logical and uncomplicated. It is carried out by using a touch-pad key panel. Assigning multiple functions to the keys was avoided wherever possible.

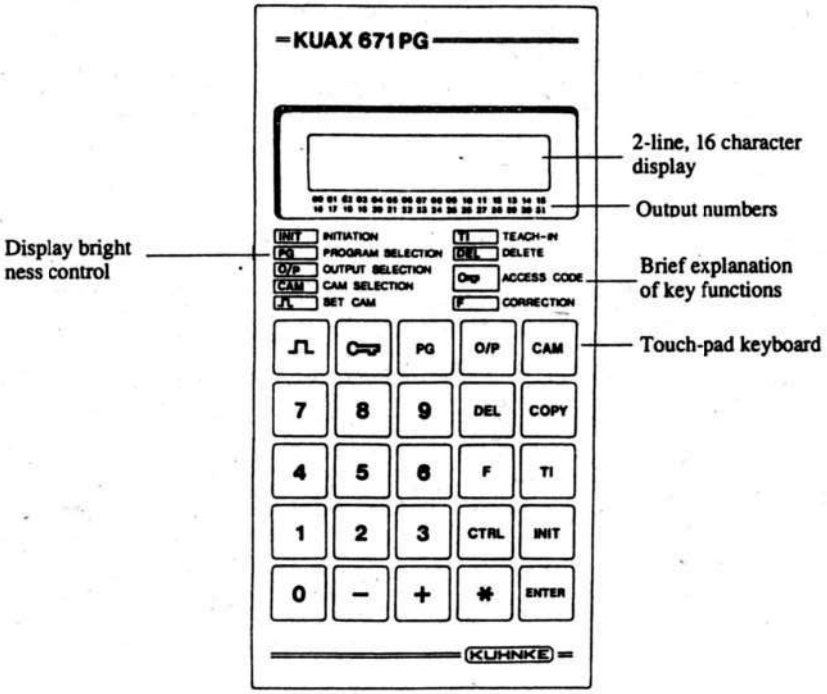
The program number is always shown in the display as well as the encoder position and the status indicators for the outputs.

The hand terminal is fitted with an internally buffered memory so that programs can also be transferred to other cam controllers.

For installing the hand terminal a bracket can be used. A mounting frame makes a front panel fitting possible (cf. ch. 6.2.1.).

A 2.5 meters long cable is used to make the connection to the cam controller.

5.2. Illustration of the hand terminal



5.3. Survey of the control keys on the KUAX 671 PG

Initialization: This key is used when entering information concerning encoder resolution and the desired zero point for the encoder. **INIT**

Programming key: for generating or modifying programs, this key must be used to enter the access code (a number up to max. 255) for the program ming mode. **[key]**

Program number: The number of the program to be modified or run is entered here. **PG**

Output: This button is used to enter the number of the output which is to be modified. **OUT**

Cam: This button is used to check or modify a certain cam of an output; or, in combination with the CTRL key, a dead-time compensation can be entered. **N**

Assign cam: The "on" and "off" points for the cam are entered here. ⎍

Teach-in: Used to "memorize" the machine position. The positions reported by the rotation encoder are entered as the switching point for on and off. **TI**

Delete: This key is used to delete programs, outputs or individual cams. Possibility of correcting accidentally entered erroneous values. **DEL**

Copy function: Makes it possible to copy programs within the cam controller or to copy from one controller to another. **COPY**

Correction: This button is used to stop function. **F**

Control key: This key is used to change the program key code. In combination with other keys, special functions, e.g. the display of the current numerical code, are announced. **CTRL**

Plus correction: Used in conjunction with the function buttons, this key makes it possible to optimize the value displayed, in the "forward" direction. **+**

Minus correction: Used in conjunction with the function buttons, this key makes it possible to optimize the the displayed, in the "reverse" direction. **-**

Enter function: All the entries are terminated and placed in memory when the ENTER button is depresed. **ENTER**

Language selection: In combination with the Ctrl key, the text shown on the display can be shifted to German, English or French. Using this key, the encoder rotation speed can be shown on the display as well. *****

6. Technical specifications of the KUAX 671

Power supply

24 V DC, +20 %/-20 %, residual ripple < 5 %, isolation of potential, safeguards against reversing polarity, resistant to shorts. The power drawn by the cam controller, including the hand terminal and the encoder is I ≤ 0.5 ampere. Total power drawn at the outputs will depend on the number of out- puts and the load applied to them.

Inputs

Input voltage 24 V from the rotation encoder, potentially isolated with optical couplers.

Outputs

16 or 32 (671.022.XX: 14 or 30) outputs; voltage isolated with optical couplers.Driver stage: "open emitter" (the positive lead is switched). 24 V, I = 0.4 A, retant to shorts; all outputs are switched off in case of a short circuit at any output. Reset by switching the supply voltage back on. Integrated diodes for inductive power consumers.

Output voltage

Absolute angle encoder (modified Gray code) with 24 V supply voltage.

8 (encoder type with compensation of dead-time compensation: 7)

Rotation encoder

max. 128,000; may be assigned to the various outputs and programs as desired.

Data protection

PG 671 hand terminal:
Battery buffering for approx. 6 months.

KUAX 671 controller:

a) Battery buffering for approx.

Number of programs:
Number of cams:

b) Lithium battery approx. 10 years.

Exception: If the cam control unit is installed with the battery facing vertically downwards with its positive pole, the buffering time is reduced to approx. 5 years.

Processing time per pulse:	standard type dynamic type	approx. 240 µs approx. 670 µs
Max. rotation speed of the encoders during standard operation:	Absolute angle encoder approx. 1400 rpm	180 pulses/rev.,
	Absolute angle encoder approx. 700 rpm	360 pulses/rev.,
	Absolute angle encoder approx. 250 rpm	1000 pulses/rev.,
Max. rotation speed of the encoders with dead time compensation	Absolute angle encoder approx. 500 rpm	180 pulses/ rev.,
	Absolute angle encoder approx. 250 rpm	360 pulses/rev.,
	Absolute angle encoder approx. 120 rpm	1000 pulses/rev.,
Ambient temperature:	0 C to 55 C	
Protective system:	Cam controller Hand terminal Installed in front panel	IP 20 IP 40 IP 65

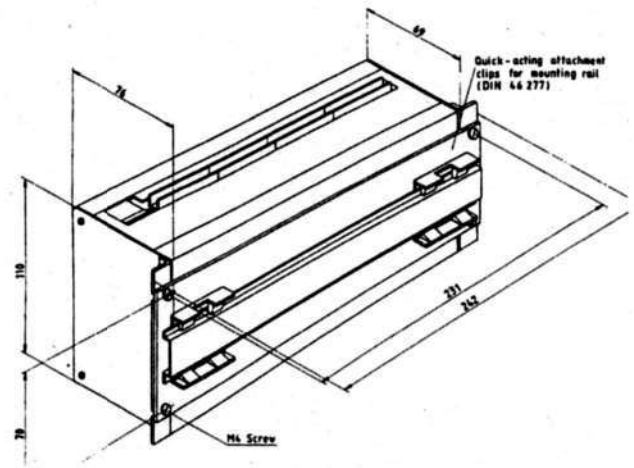
Dimensions :

Device	W	H	D
Cam controller	242	110	69
Hand terminal	102	190	28,8
Encoder	cf. ch. 7.5.		

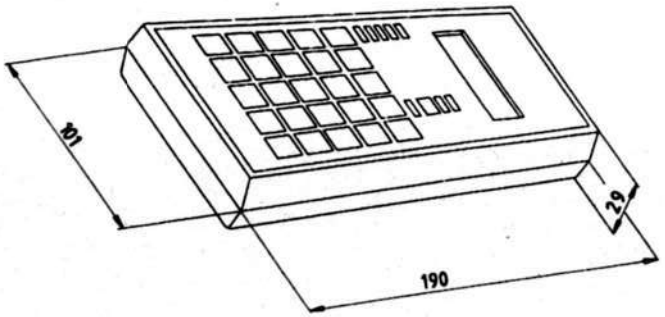
Disposal:
Please dispose of used batteries at the according public authorities or send them back to one of the branches of the Sonnenschein company

Caution: security note
Excerpts from hand- ling instructions and secrurity notes issued by the Son nenschein company concerning the handling of Lithium batteries. There is danger of inflammation, explosion or serious burning in case of incorrect usage. These batteries must not be charged, heated above a temperature of 100 C or burnt; the contents of the batteries must not get into contact with water. The electrolyte is extremely caustic. Therefore never force a battery open, solder or weald it

6.1. Dimensions of the KUAX 671 cam controller

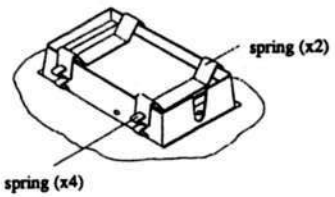


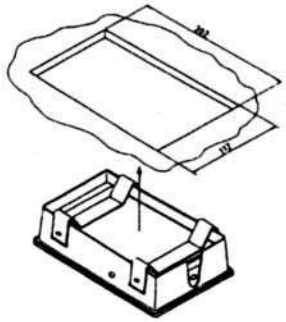
6.2. Dimensions of the KUAX 671 PG hand terminal



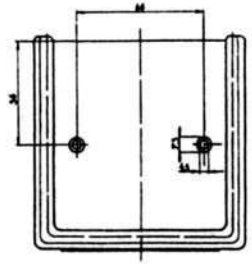
6.2.1. Mounting and front panel fitting

Mounting frame front panel fitting





Mounting frame bracket



7. The absolute encoder systems

7.1. General

The KUAX 671 electronic cam controller requires an absolute angle encoder to sense the absolute position of a cam wheel. This angle encoder must operate with a modified Gray code. Here the level of only a single data line is changed with each pulse. Data transmission is in parallel; nine data lines are used at 180/360 pulses/rev., whereas ten data lines are required for 1000 pulses/rev.

7.2. Selecting the direction of rotation

An additional data line is required to specify the direction of rotation (i.e. whether the unit counts upward during clockwise or anti-clockwise rotation). The change is made with a hook switch installed inside the cam controller (see section 3.3).

Important: The unit must be switched off before changing the setting of the hook switch. If there are several parallel controls, the hook switches **must** always be in the same position.

The 24 V DC operating voltage is supplied to the encoder by the KUAX 671.

The connection cable is available in various lengths and is joined to the KUAX 671 at a 25pole D-SUB plug.

The extension of the connector cable is limited to a maximum length of 20 meters.

7.3. Encoder types

The following encoder types are used for the time being:

Absolute angle encoder,180/360 pulses/rev, Order No.671.359.01
Shifting possible by software (without connecting cable)

Absolute angle encoder, 1000 pulses/rev. Order No. 671.359.03
(without connecting cable)

For Connecting cable and accessories cf. Order Information!!

7.4. Note regarding encoder couplings and gearing

We recommend using an elastic coupling to join the encoder shaft with the drive shaft. This will prevent excess strain on the encoder shaft. Gearboxes (step-up or step-down) may be used to match the shaft speed to the encoder.

Such gearing units may be obtained from:

Euchner & Co., Kohlhammerstraße 16
D-7022 Leinfelden-Echterdingen. 1
West Germany
Telephone: 0711-759000

Gerwah
P.O. Box 6
D-8751 Großwallstadt
West Gemany
Telephone: 06022-2101

7.5. Technical specifications and pin assignments

7.5.1. Absolute angle encoder with screw-in plug connection

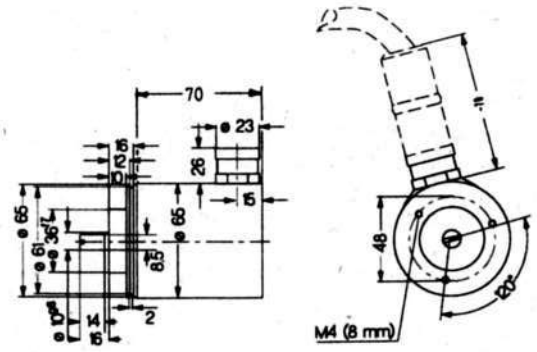
Housing material:	Anodized aluminum
Shaft material:	Hardened stainless steel
Shaft material:	Hardened stainless steel
Shaft diameter:	10 mm
Shaft load, axial:	25 N
Shaft load, radial:	40 N
Mech. rotation speed:	max. 3000 rpm
Torque:	1 Ncm
Installation position:	no restrictions
Protective system:	IP 67
Ambient temperature:	0 to 55 °C
Operating voltage:	24 V DC
Output current:	50 mA
Inner resistance:	22 KOhm
Residual current:	200 µA

Pin assignment at 17pole plug:

Pin	Assignment	Jacket color
1	Track 1	black
2	Track 2	white
3	Track 3	yellow
4	Track 4	green
5	Track 5	violet
6	Track 6	pink
7	Track 7	gray
8	Track 8	red
9	Track 9	white/brown
10	Track 10 (1000 pulse encoder only)	white/green
13	Shield	shield conductor
14	Rotation direction change *	white/blue
15	GND	blue
16	24 V DC	brown

* Cf. ch. 4.6. Counting direction of rotation encoder and ch. 4.7. Plug connectors.

Dimensions:



7.5.2. Absolute angle encoder with cable (discontinued model)

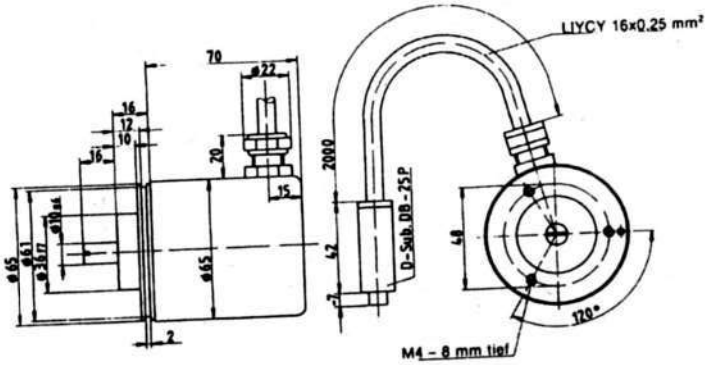
Housing material:	Anodized aluminum
Shaft material:	Hardened stainless steel
Shaft material:	Hardened stainless steel
Shaft diameter:	10 mm
Shaft load, axial:	25 N
Shaft load, radial:	40 N
Mech. rotation speed:	max. 3000 rpm
Torque:	1 Ncm
Installation position:	no restrictions
Protective system:	IP 67
Ambient temperature:	0 to 55 °C
Operating voltage:	24 V DC
Output current:	50 mA

Pin assignment at 25pole plug:

Pin	Assignment	Jacket color
1	Track 1	black
2	Track 2	white
3	Track 3	yellow
4	Track 4	green
5	Track 5	violet
6	Track 6	pink
7	Track 7	gray
8	Track 8	red
9	Track 9	white/brown
10	Track 10 (1000 pulse encoder only)	white/green
.		
.		
.		
21	Rotation direction change *	white/blue
.		
23	Shield	shield conductor
24	24 V DC	brown
25	GND	blue

* Cf. ch. 4.6. Counting direction of rotation encoder and ch. 4.7. Plug connector

Dimensions:



8. Power packs

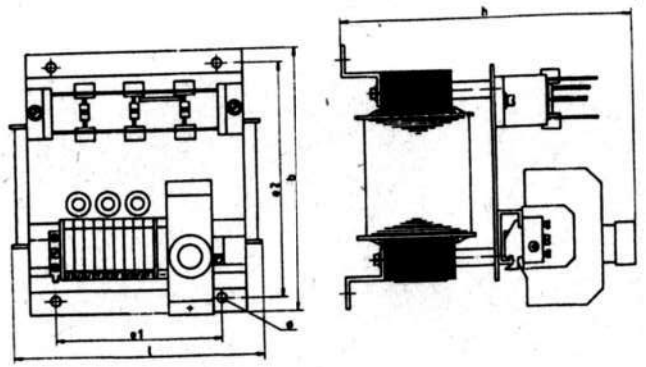
Three 24 V DC power packs of differing capacities are available for use to supply power to the controller, the outputs and downline components. The power packs are mounted on a base plate fitted with attachment brackets in preparation for direct installation in switching cabinets. The primary sides of all power packs are fitted with +/- 5% tapping leads. The L+ lead on the secondary side is fused.

8.1. Technical specifications

Models:	**3 A**	**6 A**	**12 A**
Supply voltage:	220 V AC	380 V AC	380 V AC
Tolerance range:	+/- 10 %	+/- 10 %	+/- 10 %
Tapping leads:	+/- 5 %	+/- 5 %	+/- 5 %
Secondary voltage:	24 V DC	24 V DC	24 V DC
Output current:	3 A	6 A	12 A
Protective system:	IP 00	IP 00	IP 00
Temperature range:	0 °to 55 °C	0 ° to 55 °C	0 °to 55 °C
Order No.:	479.999.06	479.999.07	479.999.08

8.2. Dimensions

Order Number	l	b	h	e1	e2	Ø
479.999.06	96	90	155	84	70	5.8 x 11
479.999.07	150	160	140	100	140	6
479.999.08	150	160	175	100	140	6



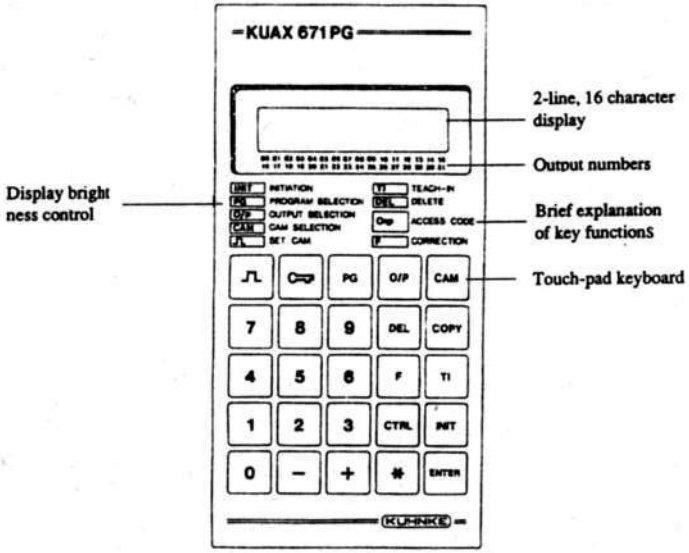
9. Programming using the KUAX 671 PG

9.1. General

The KUAX 671 PG hand terminal together with the KUAX 671 cam controller represent a single operating unit. All the parameters required to generate programs can be entered via the terminal.

The cam controller must be initialized before you start programming. It is necessary to specify the number of pulses which the absolute angle encoder generates for each revolution of the shaft as otherwise the bit pattern in the data will not be interpreted correctly. This will cause the KUAX 671 system to malfunction. The zero point for the encoder can also be determined by using the hand terminal; mechanical adjustment is unnecessary.

Up to eight programs can be written for each cam controller. When utilized to the absolute maximum (32 outputs, 1000 pulses per revolution) a total of 128.000 cams are theoretically possible.



9.2. The operating modes for the KUAX 671 PG hand terminal:

The limited operating mode

This is always started automatically whenever the supply voltage is applied. You can leave this operating mode only by entering a numerical access code, which must be entered via the button marked with the key.

In this limited operating mode it is possible to select a program, however, so that the machine operator can start the required cam programs at any time (cf. ch. 9.3.).

It is also possible to check the cam switching points while in this operating mode. The desired cam must be specified by entering the program number and the output number.

The machine program cannot be modified while in this operating mode; this eliminates the possibility of inadvertently changing the contents of a program.

Neither is it possible to initialize the cam controller (for initial commissioning) while in this operating mode.

The access code is set at 000 at the factory.

The open operating mode

This operating mode is made accessible by entering the numerical code via the button marked with the key. This operating mode is indicated at the terminal with the message "PROGRAMMING MODE".

All the functions required for initialization and program generation are accessible when in this operating mode. A change from one program to another is, of course, still possible.

Leave the open operating mode by depressing first the button marked with the key and then the button labelled "F".

The operating functions and all their details are described on the following pages. The appropriate displays are shown as well.

9.3. Special functions

9.3.1. Changing the program selection

The selection of program numbers via the hand terminal can be changed to the "open operating mode" by software, too. The result is that the change is possible only by using the access key (see Open operating mode).

Program selection only possible when in the open operating mode. | CTRL | PG | 189 |

Program selection also possible when in the limited operating mode (standard setting). | CTRL | PG | 213 |

Note:
It is possible to execute an unauthorized external program selection for example by using a key switch.

9.3.2. Switching off an external output or setting a zero point

This special function allows you to switch off all outputs by using an external 24 V signal (pin 5, plug ext. program selection). The zero point of the absolute angle encoder can also be set at any time by using a 24 V signal at pin 4.

Special function activated | CTRL | OUTP | 999 |

Special function deactivated | CTRL | OUTP | 000 |

Note:
Changing the special functions is only possible when in the "open operating mode".

If the battery buffering of the PG 671 is discharged (after 26 weeks, at the earliest), the standard setting is set automatically.

9.3.3. System information

Using the function CTRL 4 you can have the following information about the system displayed:

Stdrt: =Standard type (no customer specific units)

P_CH on =Parity control is on

P_CH off =Parity control is off

360 P. =Resolution of the initialized encoder resolution

V3.0 =Software status of the control. Controls with a software status below 3.0 are displayed as V0.0.

Example system information:

Entry	Display	Comments
CTRL 4	Stdrt. P_CH off 360 pulse V3.0	Back to standard display format: press button F.

9.3.4. Changing the parity check

There is the possibility of changing a program with or without a parity check. A change of programs without a parity check is very fast (within the range of ms). The operation may make this necessary under certain circumstances.

Example: Parity check activated (standard setting at the factory)

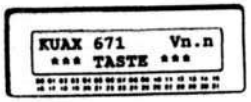
Entry	Display	Comments
CTRL + F	Ctrl	Funtion key plus + key switches the check on, function key plus - key switches it off.

Note:
There is a continuous parity check of the current program during processing independent of a parity check during change of programs.

9.4. Program generation and display

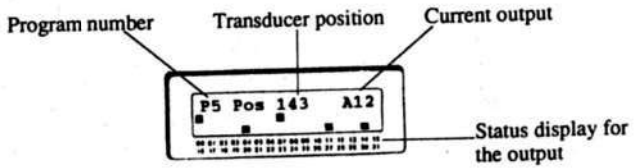
9.4.1. Starting routine

The hand terminal has a starting routine which reports by showing the following display once the unit has been switched on:



Vn.n indicates the version number for the software being used.

After pressing a button the control automatically starts a system check which is shown on the display for a short time. The standard display with the program number, encoder position and current status of the outputs appear after pressing any button. The status information for the outputs is shown in the lower half of the display by means of dots.



9.4.2. Entering the numerical code for the programming mode

To prepare the KUAX 671 PG hand terminal for programming it will be necessary first to enter the numerical access code for the programming mode. Only after entering this code is it possible to generate or modify programs. Any one-, two- or three-digit number (up to a maximum value of 255) may be selected as the code number. "0" is set as the code number at the factory.

An example:

Entry	Display	Comments
<key>	CODE ?	Numerical code, please
9	CODE ? 9	Numerical code has been entered.
ENTER	CODE ?nnnn OK	Access has been given to the < programming mode. Now the standard display will appear.

If the code is erroneous, the following message will appear in the display:

	CODE ERROR ???	The entry can now be repeated.

9.4.3. Changing the numerical code (programming access key)

The user may change the numerical key code as desired. The new code number may not be greater than 255. It is possible to change the numerical code only when in the "open" operating mode.

The new code is entered as follows:

Entry	Display	Comments
CTRL	Ctr.	The function has been activated.
8	new CODE	Enter the new code.
6	new CODE 6	The code may contain one, two or three digits and may not exceed 255.
ENTER	new CODE 6	The new code will be displayed briefly: then the standard dis play will reappear.

9.4.4. Displaying the numerical code (programming access key)

Since it is probable that the programmed numerical code might be forgotten, this code can be displayed for a short time by using a special function. This display can also be called up when in the "limited" operating mode.

CTRL	Ctr.	The function has been called up.
9	Ctr.	Do not use the ENTER button.
CTRL	nnnn	The numerical code will appear briefly at the top left of thedisplay.

9.4.5. Initializing the cam controller

It will be necessary to set the cam controller to correspond with the absolute angle encoder being used; this must be done prior to starting to program cams. Both the number of pulses per revolution (180, 360 or 1000) and the zero point must be specified here.

Example for the encoder with 360 pulses/rev:

Entry	Display	Comments
INIT	Controller Stop? Yes=Enter No =F	Attention: if the answer is no, the standard display will appear.
ENTER	INIT: 180 pulse ? Yes=Enter No=F	Query as to the encoder model
F	INIT: 360 pulse ? Yes=Enter No=F	If F (for No) is pressed, the next question will be for the 1000-pulse encoder. If ENTER (for Yes) is pressed, the 360-pulse encoder will be set.
ENTER	INIT: Zero ? Yes=Enter No=F	The 360-pulse encoder is now initialized. The unit will now ask if the encoder is at the zero point.
ENTER	PO Pos 000 A15	By depressing the ENTER button the current encoder position will be defined as the zero point. The standard display will now appear.

9.4.6. Changing an output

Any desired number of cams may be programmed for each output. The maximum number of cams is limited only by the resolution of the rotation encoder.

Example for selecting an output:

OUTP	Outp is 15 select _	The current output is displayed; any other desired output number can now be entered.
5	Outp is 15 select 5	A value from 0 to 15 or 0 to 31 may be entered, the range depending on the configuration being used.
ENTER	P1 Pos nnn A5	The new output number appears in the standard display format.

9.4.7. Changing the program number

Before programming a cam, the program number and the according output number have to be entered. Eight programs (No.s 0 to 7) are possible. Units with dead-time compensation compensation (671.030.XX) have 7 programs (0-6). Cf. ch. 9.3.1. Changing the program selection.

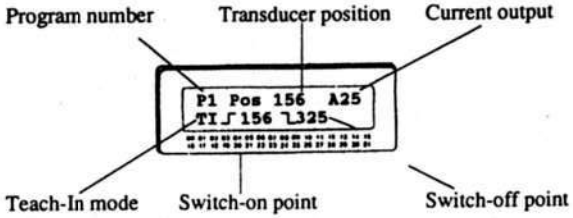
Note:
Changing the program number while the machine is running may lead to the machine's destruction.

Example for program selection:

Entry	Display	Comments
PG	prog is 0 select _	The number of the program which is currently activated is shown. Any other program number can be entered.
1	prog is 0 select 1	Enter a digit from 0 to 7.
ENTER	P1 Pos nnn A15	The new program number appears in the standard display format.

9.4.8. Using the TEACH-IN feature to set cams
(memorizing the encoder position)

The TEACH-IN function makes it possible to "memorize" the switching points - both "on" and "off" - simply by reading the momentary position of the encoder.



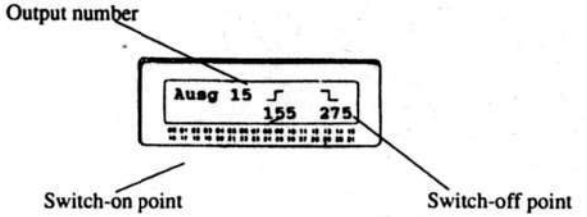
Example:

Entry	Display	Comments
TI	P1 Pos 156 A25 TI⌐ ?	Move the transducer into the desired position for switching on the output.
ENTER	P1 Pos 156 A25 TI⌐156 ?	The switching point can be optimized with the "plus" or "minus" button.
ENTER	P1 Pos 156 A25 TI⌐156 ?	The switch-on point has been entered. The transducer can now be moved into the desired position for switching the output off.
ENTER	P1 Pos 312 A25 TI⌐155 ⌙ 312?	Now the switch-off point can be optimized using the "plus" or "minus" button.
ENTER	P1 Pos 312 A25	The switch-off point is entered. The standard format now appears in the display.

The **TI** button must be pressed again to define further cams.

9.4.9. Using the 10-key pad to set cams

Once the output has been determined the 10-key pad can be used to define the switching points for "on" and "off". Values which are entered erroneously can be corrected using the **DEL** button.



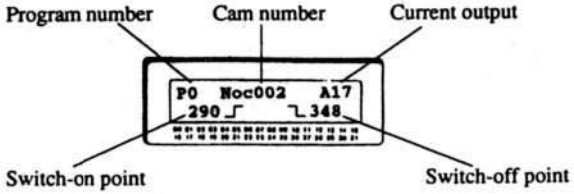
Example:

Entry	Display	Comments
⌐⌙	OUTP 15 ⌐ _ ⌙	The switching on and switching off points for the cam can now be defined.
155	OUTP 15⌐ ⌙ 155	Defining the switch-on point (three buttons in sequence to enter 155).
ENTER	OUTP 15⌐ ⌙ 155 _	The switch-on point is entered.
275	OUTP 15⌐ ⌙ 155 275	The switch-off point is defined at 275 (three buttons).
ENTER	P1 Pos nnn A15	The switch-off point is entered; the unit automatically returns to the standard display format.

The ⌐⌙ button must be depressed again to set additional cams.

9.4.10. Displaying the cam data

The hand terminal offers the option of displaying the switch-on and switch-off points for the cams which have already been defined. It is also possible to modify the cam specifications when in this mode. The desired output is to be selected before activating this function.



An example for displaying cam data:

Entry	Display	Comments
N	cam ?_	The machine asks for the cam number within the particular output.
1	cam ? 1	Enter the number for the cam which you wish to have display ed.If the ENTER button is depressed instead of a digit or digits the first cam for that output wil; be displayed.
ENTER	P0 Noc001 A17 155 245	If there is no cam which corres ponds to the number you have entered, dots will be shown instead of numerical values.
+	P0 Noc002 A17 290 348	The next cam in sequence can be called up simply by pressing the "plus" key. Press the "minus" key to move back to the cam just before.
F	P0 Pos nnn A17	Return to standard display format.

9.4.11. Optimizing the cams

The switch-on and switch-off points for each previously determined cam can be optimized step by step by using the "plus" or "minus" keys. The machine may remain in operation while doing so. The optimized switching points are entered into the program after displaying them.

Example for optimizing a cam:

Entry	Display	Comments
N	cam ?_	The machine asks for the number of the cam at the particular output.
1	cam ? 1	Enter the number for the cam which you wish to optimize. The first cam at this output will appear if you depress the ENTER button immediately instead of one or more numeric keys.
ENTER	P0 cam001 A17 155 245	If there is no cam which corres ponds to the cam number which you have entered, dots will be shown instead of numerical values.
⎍	P0 Noc002 A17 290 348	The switch-on point can be opti-mized step by step.
+	P0 Noc nnn A17 291 345	The + or - key is used for optimi zation.
ENTER	P0 Noc nnn A17 291 345_	Advance to the switch-off point.
-	P0 Noc nnn A17 291 344	The + or - key is used for optimi zation. The value displayed is entered in the program immedi-ately.
ENTER	P0 Nos nnn A17 291 344	The optimization routine is now finished. Depress "F" to return to the standard display format.

9.4.12. Deleting a cam

The DEL function must be used if a cam is to be eliminated entirely. If there are several cams programmed for a given output and if one of the cams is deleted, the number of each of the subsequent cams will be reduced by one to fill the gap.

Note:
Deleting a cam while the machine is running may lead to the machine's destruction.

Example for deleting a cam:

N	cam	The machine asks which cam is affected.
2	cam ? 2	The 2nd cam is called up.
ENTER	P0 Noc002 A15 300 ⌐ ¬ 350	The switch-on and switch-off points are shown in the display.
DEL	P0 Noc002 A15 delete	Deleting the cam shown in the display: Yes = ENTER No = F
ENTER	P0 Noc002 A15 300 ⌐ ¬ 350	All the subsequent cams move up by one cam number. If there is no cam with a higher number then all the cam values will be represented by dots. Depress "F" to return to the standard display format.

9.4.13. Deleting an output

This function offers you the capability of deleting all the cams at a particular output. The program number and the output must be specified before making the deletion.

Note:
Deleting an output while the machine is running may lead to the machine's destruction.

Example for deleting an output:

Entry	Display	Comments
DEL	DEL PG or OUTP	Is the program or the output to be deleted? In this case we will delete the output.
OUTP	Outp.015 delete Yes=ENTER No=F	It is possible to delete output 15 in its entirety. The deletion routine may, however, be aborted here by depressing button "F".
ENTER	P0 Pos 333 A15	The output has been deleted. The standard display format reappears.

9.4.14. Deleting a program

This function deletes all the cams in a particular program. The desired program must be selected and then rechecked and verified in the display before making the deletion.

Note:

Deleting a program while the machine is running may lead to the machine's destruction.

Example for deleting a program:

DEL	DEL PG or OUTP	Is the program or the output to be deleted? The program in this case.
PG	prog 0 delete Yes=ENTER No=F	The program can be erased in its entirety. The deletion routine may, however, be aborted here by depressing button "F".
ENTER	OK	The program has been deleted. The standard display format appears.

9.4.15. Copying a program

In the interest of making programming as efficient and easy as possible, the KUAX 671 cam controller, in conjunction with the KUAX 671 PG hand terminal, gives you the capability to copy a program from one number to another. This is a considerable advantage when the operation of the machine will require several programs with only minor changes from one program to the next. After copying the entire program the changes can be made simply and easily.
The copy function can be called up while in any other program. In spite of this there is no restriction on which program you select for copying; all eight (numbers 0 to 7) can be copied. The existing program will be written over if there is already a program in storage at the program number which you designate as the destination.
The hand terminal is also equipped with a buffered program memory; it is assigned program number 8. This was originally intended for use when transferring a program from one cam controller to another, but can also be used as a back-up for one program.

Example for copying a program:

Entry	Display	Comments
COPY	Copy from _	The machine asks for the number of the program to be copied.
0	Copy from 0.	The number of the program to be copied is entered.
ENTER	Copy from 0 to _	The machine asks for the number under which the program is to be copied (destination).
5	Copy from 0 to 5	The destination program number is entered. (The buffered memory in the hand terminal is activated by entering program number 8).
ENTER	from 0 to 5 ? Yes=ENTER No=F	IMPORTANT! This is a verification question; if there is already a program stored under program number 5, the program from 0 will be written over the existing program.
ENTER	P0 Pos nnn A15	The standard display format will reappear after a brief period of time. The copying routine is complete. If you copy into the memory in the hand terminal, the blocks which are copied will be shown in the display.

9.4.16. Program transfer

As described above, the KUAX 671 PG hand terminal is fitted with a program memory which is buffered with its own rechargeable battery. This program memory is accessed with program number 8. A program which is then copied into the terminal will be maintained even after the connector cable is detached.
To make the program transfer to another cam controller you need only attach the connector cable and call up the copy function. This technique makes it possible to transfer a program, once it has been written, to any desired number of cam controllers.

Important: The outputs are disabled during the transfer procedure.

Example for program transfer:

Entry	Display	Comments
COPY	Copy from _	The machine asks here for the number of the program to be copied.
0	Copy from 0	The number of the program to be copied has been entered.
ENTER	Copy from 0 to _	Here the machine asks for the new program number (destination).
8	Copy from 0 to 8	The destination number has been entered. The buffered memory in the hand terminal is activated by program number 8.
ENTER	from 0 to 8 ? Yes=ENTER No=F	IMPORTANT! This is a verification question, since a program which has already been copied at program 8 in the terminal will be written over during the copy procedure.
ENTER	controller STOP Yes=ENTER No=F	The outputs are disabled. Abort the routine by pressing "F".
ENTER	nnn blocks v.32 nnn	The standard display format will reappear after the transfer of the 32 blocks.

The program is now in storage of the hand terminal. If you wish to transfer this program to a secound cam controller you must first attach the connector cable and then enter the numerical key code giving access to the programming mode. The copy function can now be called up. The operating sequence is as described above; the transfer, however is made from program number 8 (in the hand terminal) to the cam controller.

copy from 8 to n

9.4.17. Dead-time compensation Order No. 671.030.16 or 32

The KUAX 671 dyn offers four groups of dead-time compensation united into 8 outputs respectively. In each dead centre time group the dead centre time for the whole group can be set in milliseconds independently of each other. The maximum value is 250 ms. The times thus set affect all 8 outputs of the selected dead centre time group.

dead-time compensation group 0 = Outputs 0 to 7
dead-time compensation group 1 = Outputs 8 to 15
dead-time compensation group 2 = Outputs 16 to 23
dead-time compensation group 3 = Outputs 24 to 31

Important: The outputs are deactivated during the transfer.

Example for compensation of dead-time compensation:

Input	Display	Comments
CTRL	Ctr	Function is called up
N	T-input = N T-aktive = *	Key N leads on to input of dead-time compensation. Key * leads on to activate/deactivate dead-time compensation.
N	group (0 - 3)	A dead-time compensation group can be selected.
1	(group 0 - 3) 1	Input of group number
ENTER	Dead-time 000 select:	Input of dead-time compensation (max. 250 ms) demanded
35	Dead-time 000 select: 35	dead-time compensation = 35 ms
ENTER	T-aktive = ENTER inaktive = F	Activate or deactivate dead centre time? Subsequently back to standard display format. If "deactivate" is selected, "!" will be displayed.

9.4.18. Language selection

As from version 2.1 on (shown in the display), the PG 671 hand terminal offers the possibility of selecting a language for the operation guide. You can choose between German, English or French. Each language is assigned a numerical code.

0 = German 1 = French 2 = English

Example for language selection:

Input	Display	Comments
CTRL	Ctr	Function is called up
*	Ctr	Code
CTRL	language? 0=D 1=F 2=E	A number is asked for
0	language ? 0 0=D 1=F 2=E	Input of language number
ENTER	P0 Pos nnn A01	The selected language is set by pressing ENTER. Subsequently the standard display appears.

10. Using a personal computer to generate programs

General

It is also possible to write programs for the KUAX 671 cam controller on an IBM personal computer (with MS-DOS operating system) or a compatible computer. A menu-type program is used to assist the operator. The documentation is on a project disk or hard disk respectively. The program may also be printed as instruction list or diagram.
The cam controller itself need not actually be present to generate the cam simulation programs. The program is transferred to the cam controller via the V.24 interface and an adapter.

Detailed instructions for use are included with the software.

Cf. ch. 13.3. for the order no.

11. Operation and malfunction indicators

11.1. Self-test

The KUAX 671 hand terminal is equipped with a self-test routine. This is called up with the **CTRL 3** function. The display, the keypad and the program memory in the hand terminal are tested during this routine.

The display test is carried out first; it is completely automatic. Then follows the keypad test. The user must depress all the buttons once, in series, from the top left to the bottom right. The row and column of each button will be shown in the display.

The RAM test will run automatically once the keypad test has been finished. Here the blocks which have been checked are shown in the display.

11.2. Malfunction indicators

The KUAX 671 cam controller is equipped with three indicator LEDs to signal malfunctions with the following meanings:

11.2.1. **RUN indicator** (green LED)

The green LED lights up to indicate the "control running" status. It goes out if one of the following malfunctions occurs:

- No voltage supply to the cam controller.
- Short circuit at the outputs.

11.2.2. KS/BATT (short-circuit) indicator (red LED)

The short-circuit indicator for the outputs will normally not be lit up.

If there is a short at one of the outputs, however, this is indicated by this LED blinking. The cam controller will be switched off and the RUN indicator light goes out.

The short-circuit control light will also blink if the supply voltage to the electronic cam controller falls below the acceptable minimum level.

Once the problem has been eliminated the RUN lamp will light again when the supply voltage is switched on.

Models with a Lithium battery check the charge of the battery. If the battery is too discharged, this is indicated by the permanently lit up LED. In this case the battery must be replaced by a new one without switching the control off.

11.2.3. Parity check (red LED)

The parity check indicates errors in the program memory. The red LED lights up if an error is detected in the program currently being run. The outputs are being switched off. The fault indicator stays on even if you change to another program. The fault indicator is reset with the **CTRL 2** function.
The KUAX 671 PG hand terminal offers you the capability to have the parity error displayed (see Malfunction messages at the hand terminal).

If a parity error occurs, the according program has first to be deleted using the "DEL" key and then must be reprogrammed or existing programs have to be copied respectively.

11.2.4. Malfunction indicators overview

LED signal		Cause	Reaction of the control
KS/Batt	Parity		
blinks * A00 = deactivated	-	Short circuit at output	All outputs are switched off. The green RUN-LED goes out. Measure: remove cause; switch deactivated control back on.
blinks	-	Low voltage at supply voltage	All outputs are switched off. The green RUN-LED goes out. Measure: remove cause; switch control back on.
lit permanently	-	Buffer battery not charged	The LED is a warning. The battery has to be replaced by a new one within 4 weeks. The LED then goes enoughout automatically.
-	lit permanently	Error in current program	All outputs are switched off. The green RUN-LED stays on. Measure: delete current program and load a new one.
-	lights with increasing rotation * A01 = deactivated	Encoder rotation speed too high.With speed dyn. models only.	The function remains active up to 150 % of the rotation speed allowed; the resolution is reduced, however.

* Only valid for models with report output (671.022.XX).

11.3. Malfunction messages at the hand terminal

The following malfunction indication messages are shown independently on the hand terminal display:

P■ General error message for short circuit, parity error or low voltage at the control.

Interface ERROR Defect in the transfer routine. Restart by depres sing button "F" several times.
If this error message appears repeatedly it may be an indication that the encoder rotation speed is too high. If this is not the case and if the error message still appears repeatedly, the KUAX 671 system will have to be taken in for service to the Kuhnke company. Please include exact description of malfunction if possible.

Malfunction messages on command at the hand terminal:

The error point in the display (see above) signals a malfunction of the system. After pressing CTRL F function and malfunction messages are explained in more detail.

The following messages may appear in the upper line:

RUN Control is in RUN operation

STOP Stop of program. This message is always displayed with an error message in the lower line.

RUN/Batt! Battery is discharged; replace within 4 weeks at the latest.

The following messages may appear in the lower line:

P/CS-ERR A parity or check-amount error was detected in the current program.
If a parity arror occurs, the program affected has to be deleted by pressing "DEL". Then the program has to be rewritten or replaced by copying existing programs.

KS/24V Short circuit at the output or low voltage at the voltage supply.

Note:
If this hand terminal is run on a control with a smaller software status than version 3.0 (V3.0) and the parity check is activated, the error point is displayed on the terminal after changing programs. The explanation shown (after pressing CTRL F) is KS/V24. The control stays in RUN operation, however; there is indeed no error. The wrong message can be deleted by pressing CTRL 2.

12. Handling and installation instructions for the KUAX 671

12.1. Handling instructions

- Storage temperature: - 25 °C to + 85 °C
- The usual precautions are to be observed to protect against the effects of static electricity.

12.2. Installation instructions

- The KUAX 671 cam controller is to be installed in such a way that heat will not accumulate.
- The maximum permissible ambient temperature of 55 °C may not be exceeded.
- The shielding must always be connected (pin 23 at the 25pole D-sub plug) when lengthening the transducer cable.
- Only a single conductor may be connected at each terminal.
- Operating voltage and the control line (24 V DC) are to be routed separately within the switching cabinet. Use separate cables outside the switching cabinet.
- The outputs are equipped with diodes to suppress inductive voltage peaks. If, however, there is a switch between the outputs and the using unit the latter must also be fitted with a diode.
- No outside voltages may be applied to the outputs.
- The user must always observe the VDE-recommendations and other applicable regulations when working with or on the system.