MC 16B OPERATING MANUAL

GOODWIN ELECTRONICS
6 Lumina , Martindale Road
Croft Business Park
Bromborough
Wirral
CH62 3PT ENGLAND

Tel. +44 (0) 151 33 44 555
Fax. +44 (0) 151 334 1616

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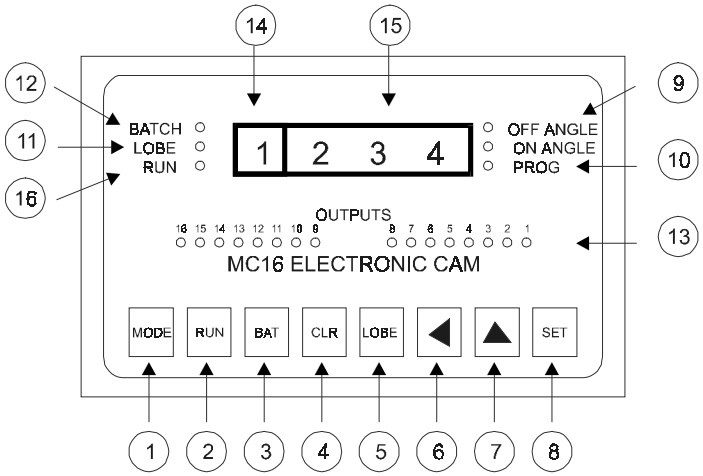
The contents of this manual are designed to give the reader an understanding of how the MC 16 electronic cam operates. The product described is subject to continuous development and improvement. All information of a technical nature and particulars of the product and its use are given by Goodwin Electronics in good faith. However, it is acknowledged that there may be errors and omissions in this manual. We shall not be liable for loss or damage whatsoever arising from the use of any information or particulars in, or any omissions from, this document.

INTRODUCTION

The MC 16 electronic cam unit is designed and manufactured by Goodwin Electronics. It is a compact and rugged product. and is ideal for use by high volume users and system builders. The MC 16 is enclosed in a panel mounted case to give it adequate protection against abuse on the shop floor. The keypad is reverse screen printed such that the legends do not wear off with time, and the click disc buttons give tactile feedback when pressed. The clear red seven segment LED displays provide a good user friendly interface when programming and setting up.

As with all our products, the programming has been made as simple as possible. There is no need to learn complex programming languages. This manual explains the installation and programming techniques. It should be used as a reference manual once initial familiarisation is complete.

FACIA DESCRIPTION



1 **MODE KEY**

this key is used to switch the MC 16 between the 3 available modes; angle display mode, rpm display mode and program mode.

2 **RUN KEY**

this key is used to switch the MC 16 in and out of cycle. It is inoperative when the unit is in the PROGRAM mode and if the unit is configured to types 4 or 5. When in cycle all outputs are active and will switch on or off according to the programmed data that has been entered for the selected batch.

3 **BATCH KEY**

this key selects and deselects the BATCH digit and allows the user to change the selected BATCH. This key is disabled when the unit is in-cycle.

4 **CLEAR KEY**

this key only functions in the program mode and it is used to clear the currently the data from the currently selected batch prior to entering new data. The key is deactivated whilst in MC 16 is in-cycle.

5 **LOBE KEY**

this key allows the program for the lobes of the selected output to be viewed or programmed. This key is also inhibited when the external program inhibit is active.

6 **FUNCTION KEY 1**

this key moves the selected digit one place to the *left*

7 **FUNCTION KEY 2**

this key increments the selected digit by 1.

8 **SET KEY**

this is a dual function key. When the unit is not in the program mode a double press on this key will activate the self test program which tests each display digit and led used on the front panel. In the program mode this key will save the displayed data to the internal memory of the MC 16 and if the OFF angle is being displayed the unit will advance the output being programmed by one.

9 **ON/OFF LEDS**

these leds indicate the status of the programmed point being displayed in both program mode. If the **ON** is illuminated it indicates that the angle at which the output switches on is being displayed. If the **OFF** led is illuminated it indicates that the angle at which the output switches off is being displayed.

10 **PROG LED**

if this is illuminated then the MC 16 is in the program mode.

11 **BATCH LED**

if this is illuminated then the BATCH number is being displayed in digit 1 the display.

12 **LOBE LED**

if this is illuminated then the LOBE number is being displayed in digit 1 of the display.

13 **OUTPUT LED's**

these 16 leds show the status of each output when in the unit is in the RUN mode When in program mode these leds indicate which output is being programmed.

14 **MESSAGE WINDOW**

This window displays,

- r to indicate the data displayed is the encoder rpm
- A to indicate the data displayed is the current encoder position
- b to indicate the data displayed is the currently selected batch number
- 1 - 8 to indicate which lobe data is being displayed (Program mode only)
- 1 -4 to indicate which parameter page data is being displayed (Configure mode only)

15 **DATA WINDOW**

This window displays,

- the encoder rpm when the message window indicates r
- the encoder angular position when the message window indicates A
- the selected batch number when the message window displays b
- the programmed ON angle for the lobe number indicated in the message window when the ON led is illuminated. (Program mode only)
- the programmed OFF angle for the lobe number indicated in the message window when the OFF led is illuminated. (Program mode only)
- the value of the configured parameter when in the configure mode
- the software version number when initially powered on

16 **RUN LED**

if this is illuminated then the outputs will be active and will switch ON/OFF according to the current angle and the program data. The unit is in the RUN mode when illuminated and it can be switched in and out of run mode using either the RUN key or via the external input RUN line.

INSTALLATION AND COMMISSIONING

The MC 16 has complete opto isolation of all I/O. For ac powered models the rotary encoder is powered from a transformer winding that is isolated from the CPU winding. These features help to make the unit very noise resistant. However, as with all microprocessor based products, special attention should be made to guard against abnormal electrical noise penetrating the system we have provided. The following suggestions will help to ensure a good installation:

A) Choose a panel mounting location that allows the signal cables to reach the cam without having to come close to noisy control cables. Also the cabinet should have only light switchgear i.e. no contactors if possible

B) Use correctly screened cable for the encoder connections. Connect the screen at the cam end only (to the earth terminal), unless the encoder is isolated from your machine, in which case connect the screen at both ends. Take care when routing the encoder cable to avoid electrically noisy equipment such as motors, arcing heater controls etc. If the encoder cable is laid next to or even along side cables that control this type of equipment, then there is a possibility that noise could be picked up through electromagnetic or capacitive coupling.

C) Relays and contactors switching heavy inductive loads located close to the system should be suppressed.

D) Connect the supply voltage corresponding to that marked on the rear panel. Ensure the supply is well filtered.

E) Check that the encoder supply voltage from the cam conforms to the encoder specifications and take care to install the encoder in accordance with the encoder manufacturers recommendations. Use a flexible coupling to attach the encoder to the drive shaft. Check the encoder installation to ensure that there is no possibility of slippage of the encoder shaft relative to the drive shaft. ***NOTE:*** The encoder provides information to the cam upon which it will react according to the programmed data. If the encoder installation is poor, false information will be given to the MC16 and the system will malfunction.

F) Ensure that the input and output leads are properly screened and terminated in accordance with the details in the rear of this manual. Only connect screens to the earth at the cam end of the cable. As with the encoder cable take care when routing the cable to avoid electrically noisy equipment. If for any reason it is impossible to run cables on a noise free route, please consult your supplier for information on alternative interfaces and line driven encoder systems.

G) The MC 16 system is now installed and ready for power up.

When switched on the MC16 will be in either the RPM or angle mode (depending on which mode it was in when it was powered down) and will display the previously selected batch number. The MC16 will power up in cycle if it was switched off in cycle. To indicate a power up the decimal point in the BATCH display window will flash. This can be canceled by pressing any key.

If this does not occur then check the supply to the unit. If the supply is present then check fuse 1 , (which is mounted internally behind the rear panel on printed circuit board GEMS 1234). Replace with a similar 1 A Euro TR5 quick blow fuse if necessary.

Once the system has powered up successfully the mode can be changed using the mode key. Select angle mode and check that the encoder is working correctly. The system should now be datumed at the appropriate angular position. This can be done by moving the machine manually to the "machine datum" and then activating the external datum line. This will store the current encoder position as an offset and all displayed angles will subtract this offset from the encoder angle. Thus, at the datum position the display will read zero. All programmed data will now be referenced from this point.

PROGRAMMING.

Ensure that the external program inhibit line is not active otherwise the program mode cannot be entered.

Press the Mode key until the PROG LED illuminates. On entering the program mode OUTPUT 1 will be selected and the ON angle for LOBE 1 will be displayed. The front panel leds will indicate all of these details. If no data has been programmed the display will be showing **"CCC"** (i.e. Clear).

Before starting to program the unit, first select the BATCH that is going to be programmed. There can be up to 99 batches (or programs), each of which can be programmed completely separately. Each batch can have up to 16 outputs and each output can be programmed to switch on and off up to 8 times (Lobes) during one rotation. The number combination of batches, outputs and lobes will depend on how the unit is configured (see Parameter Configure Mode),

To select a batch, first enter the BATCH mode using the BATCH key. The letter b will appear in the message window and the BATCH led will illuminate.
Using Function 1 and function 2 keys enter the batch number required.
Deselect BATCH mode using the BATCH key and if the MC16B is in the program mode the programmed data for batch 1 output 1 and lobe 1 will be displayed.

To clear out any data that is already in the batch, press the **CLEAR** key twice within 1/4 of a second.
This will remove any data that is currently stored and display **"CCC"**. The requirement of a double press of the **"CLEAR"** key prevents the accidental clearing the program data .

The MC 16 is now ready to program, starting with OUTPUT 1 AND LOBE 1. The **ON** led will be on to indicate that the angle at which output one is to be switched on, is to be entered and the least significant digit of the angle value will be flashing. Set this digit to the required value and then using the FUNCTION 1 key select the next digit to be programmed and set it to the required value. Repeat once more for the third digit. The value now displayed will be the ON angle.

If a value greater than 359 degrees is keyed into the ON angle the digit being programmed will default to 0.
If a value greater than 361 degrees is keyed into the OFF angle the digit being programmed will default to 0.

To save this in memory;

Press the SET key. This will save the data and display the OFF angle resident in memory. Set the OFF angle to the required value using the two function keys and save the data with the SET key. If the data is valid i.e., the OFF angle is greater than the ON angle then the unit will advance to OUTPUT 2, LOBE 1 with the ON angle being displayed.

If invalid data is attempted to be saved the unit will not advance to the next output but will set the OFF angle equal to 000.

To advance the program to the next output number the current output must be programmed, i.e., it must not be in the cleared state with CCC displayed.

If an output is required to be OFF at all times, set the ON and OFF angles to 000.

If an output is required to be ON at all times, set the ON angle to 000 and OFF angle to 360.

Only the number of batches, outputs and lobes specified in the configure mode can be programmed.

Use the programming sheet (Appendix 4) to calculate the program required prior to entering the data. Enter each angle in the manner described above and then press the SET key.

Pressing the **SET** key continuously allows the operator to scan through the programmed values of each of the outputs without changing the data.

Once LOBE 1 has been programmed then lobes 2 to 8 on each output can be programmed in an identical manner. To carry this out return to OUTPUT 1 by using the SET key and then press the LOBE key. ***This works***

in an almost identical fashion to the SET key but instead of advancing the output number when saving the OFF angle it advances the LOBE number.

The required ON/OFF angles are then entered for all the required remaining lobes. To edit any value simply select the required output and lobe number using the appropriate keys and modify the angle value using the two function keys. Store the modified angle in memory by using the SET key.

To eliminate a lobe without clearing all data in the batch, program the same angle for both the **ON** and **OFF** angles.

Programming can be carried out whilst the machine is running, this enables fine tuning of the process. When operating in this manner, great care must be taken not to enter values that will cause damage to the machine.

Programming another batch is achieved by selecting a new batch number and then repeating the programming procedure described above. The **BATCH NO** can not be changed if the MC 16 is in**-**cycle**.**.
To exit the program mode press the **MODE** key.

DO NOT SWITCH OFF THE MC16 WHILST IN THE PROGRAM MODE. IF THIS IS DONE THEN AN ERROR 6 CONDITION WILL BE GENERATED ON THE NEXT POWER UP.

OPERATION AND EXTERNAL INPUTS.

IN-CYCLE MODE

When programming has been completed and the machine is ready to run, press **RUN** on the keyboard or activate the external start/stop terminal (see below).

The RUN led will illuminate to indicate that the outputs are active and as the encoder turns each output will switch on and off according to the manner in which it has been programmed.

If the rpm mode has been selected then the display will indicate BATCH number selected and the revolutions per minute of the encoder. Each OUTPUT led will be illuminated when that output is high (on). The letter **r** in the display indicates that the rpm mode is selected.

To exit the in-cycle mode and deactivate the outputs press the **RUN** key again , or deactivate the external start/stop terminal (see below).

EXTERNAL START/STOP

Activating this terminal is the same as pressing the RUN key. It will put the cam into run mode. This input should be a switch and the unit will respond to the level or to a change of state on this line (see section 7). Depending on the parameter option selected this function can be over-ridden by the front panel key (options 0 , 1 , 8 and 9 will allow this to happen)

EXTERNAL DATUM

Activating this input causes the angle display to be zeroed at the current encoder position. **All switching will occur relative to the displayed angle position**. Normally this procedure will be a manual process, alternatively this can be an automatic function as part of an alignment sequence employing a sensor or microswitch. This input should be active for a minimum of 5 milliseconds.

PROGRAM INHIBT

This external input allows the use of a key switch to inhibit program mode. When the input is active the **PROG** key on the keypad is disabled. All other keyboard operations remain operational.

PARTIAL KEYBOARD INHIBIT

This line allows certain cam functions to be inhibited.

TEST MODE.

The test mode can be entered from the RPM or angle mode by double pressing the SET key. All leds in the display will be activated, in turn by this operation. On completing the test sequence the unit will return to the mode from which the test operation was selected.

ERROR MESSAGES.

The MC 16 has a number of diagnostic facilities which will produce error messages to help the operator. These error codes are as follows;

Error 1 main output (+24 V) supply not present,(only operational on mains powered versions)
Error 2 output fuse F1 for cams 1 to 8 broken.
Error 3 output fuse F2 for cams 9 to 16 broken
Error 4 reserved
Error 5 reserved
Error 6 Check sum error on program data
Error 7 Check sum error on parameter data
Error 8 Memory failure

If error 1 is displayed then check that the external 24V dc supply is connected and functioning correctly.

If error 2 is displayed then remove rear panel of the MC16 and locate fuse F1 on the internal printed circuit board. Replace with a similar 1A Euro TR5 quick blow fuse. **Check output wiring on outputs 1 to 8.**

If error 3 is displayed then remove rear panel of the MC16 and locate fuse F2 on the internal printed circuit board. Replace with a similar 1A Euro TR5 quick blow fuse. **Check output wiring on outputs 9 to 16.**

If errors 6 or 7 are displayed then the programmed data has been corrupted. If this happens check that the external wiring to the MC16 is routed in accordance with good engineering practice, i.e., any external wires connected to the unit are not physically close to other wires carrying large currents. The unit must be reprogrammed before reuse.

PARAMETER CONFIGURE MODE.

This mode **CANNOT** be selected if the unit is incycle

The parameter configure mode can be entered by pressing and holding down both the SET and FUNCTION KEY 2 as the power to the MC 16 is switched on. The most significant digit will display C and the lowest digit will display a number between 0 and 9. The number can be changed by using FUNCTION KEY 2 to increment the displayed value by 1. To exit the parameter mode press the set key. The following list indicates the parameters selected,

Parameter Page 1

0 The encoder counts **DOWN** when rotated clockwise
1 The encoder counts **UP** when rotated clockwise**.**
2 The encoder counts **DOWN** when rotated clockwise and the keyboard RUN key will be disabled******
3 The encoder counts **UP** when rotated clockwise and the keyboard RUN key will be disabled******
4 Reserved
5 Reserved
6 Reserved
7 Reserved
8 No internal datum used for angle calculation. The angle display is the true encoder position
9 No fuse checks are made. The program inhibit lines are also ignored.

** In this setup the external STOP/START line responds to a level and NOT an edge.
To exit this parameter page press the SET key.

Parameter Page 2

The lower 2 digits will display a number between 12 and 99 and this value determines the number of batches serviced by the MC16B. A larger number of batches results in fewer outputs and lobes being available.
The following table indicates the options available,

BATCHES	OUTPUTS	LOBES
99	16	1
99	8	2
99	4	4
50	16	2
50	8	4
50	4	8
25	16	4
25	8	8
25	4	8
12	18	8
12	8	8
12	4	8

Pressing the F1 key scrolls the user around the selections available. Once the required number of batches is selected, press the SET key to advance to the next parameter page.

Parameter Page 3

The lower 2 digits will display a number between 4 and 16 and this value determines the number of outputs serviced by the MC16B. A larger number of outputs results in fewer lobes being available, refer to table above. Pressing the F1 key scrolls the user around the selections available. Once the required number of outputs is selected, press the SET key to advance to the next parameter page.

Parameter Page 4

The lowest digit will display a number between 1 and 8 and this value determines the number of lobes serviced by the MC16B. Pressing the F1 key scrolls the user around the selections available. Once the required number of outputs is selected press the SET key to advance to the next parameter page.

Parameter Page 5

The lowest digit will display the number 1 or 2 and this value indicates the interrupt time in milliseconds. Pressing the F1 key scrolls the user around the selections available. Once the required number of outputs is selected, press the SET key to exit the parameter mode.

APPENDIX 1

Encoder Connection (Absolute) 12 pin round connector

Terminal No.	
1	Encoder +12V sourced from the MC16
2	2^0 - LSB
3	2^1
4	2^2
5	2^3
6	2^4
7	2^5
8	2^6
9	2^7
10	Encoder 0 V
11	Screen
12	2^8 - MSB

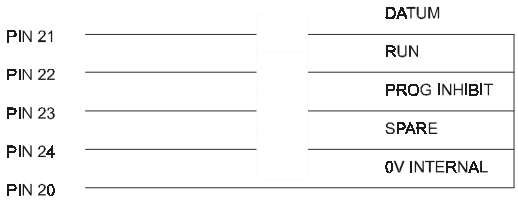
APPENDIX 2

Input/Output Connections (25 way D connector)

Terminal No.	
1	PNP Output 1
2	PNP Output 2
3	PNP Output 3
4	PNP Output 4
5	PNP Output 5
6	PNP Output 6
7	PNP Output 7
8	PNP Output 8
9	PNP Output 9
10	PNP Output 10
11	PNP Output 11
12	PNP Output 12
13	PNP Output 13
14	PNP Output 14
15	PNP Output 15
16	PNP Output 16
17	0V dc external supply required
18	+24 V dc external supply required
19	NC
20	0V dc internal only
21	External DATUM
22	External RUN/STOP
23	Program Inhibit
24	Partial Program Inhibit
25	Screen

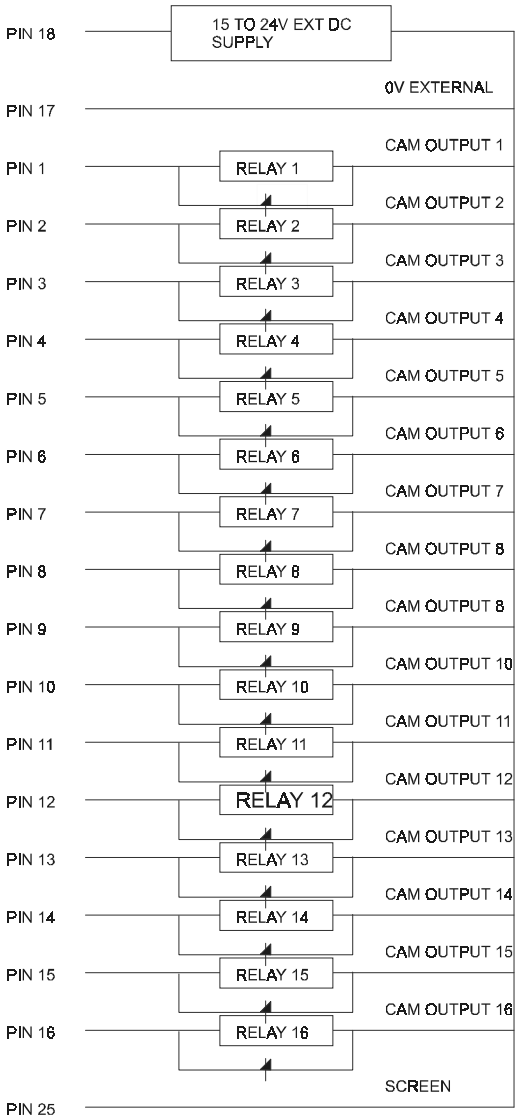
EXAMPLE OF TYPICAL WIRING DIAGRAM

PNP INPUT CONNECTIONS



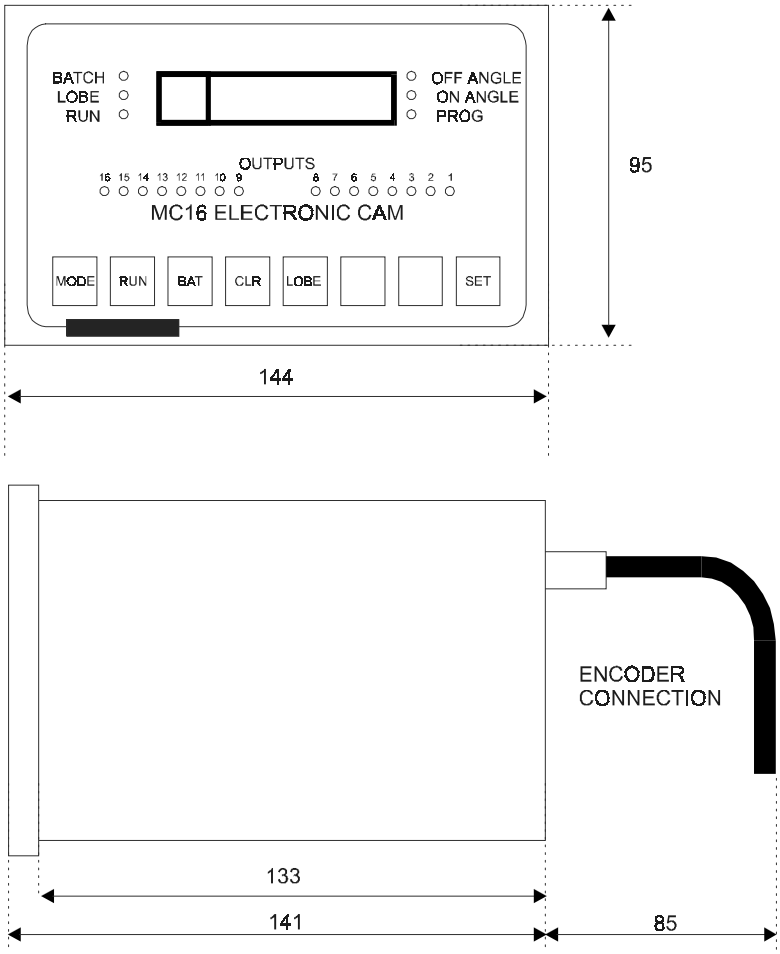
PNP OUTPUT CONNECTIONS

Each output is rated at 60mA at 30V max. Maximum output lead length is 4 m, Cable must be screened



APPENDIX 3

INDUSTRIAL PANEL CASE



APPENDIX 4

MC 16 MODEL ALLOCATION CODE

MC 16 Model Allocation Code

			ORDERING CODE
Unit	**MC16**	Programmable Electronic Cam	**MC16**
Software	**A**	16 cams 4 batches and 7 lobes	**A**
	B	CONFIGUREABLE TO EITHER 16 cams 99 batches and 1 lobe 16 cams 50 batches and 2 lobes 16 cams 25 batches and 4 lobes 16 cams 12 batches and 8 lobes	
Mounting	**P**	Panel or **S** Standalone	**P**
Supply Voltage	**1**	100/240 Vac or **3** 24V dc	**3**
Serial Coms.	**C**	RS485	**0**
	0	no comms	
Encoder Type	**09G**	**9 bit gray code**	**09G**
Encoder Supply Voltage	**1**	**24V PNP**	**4**
	4	**12V NPN**	
Outputs	**1**	PNP	**1**

APPENDIX 5

SPECIFICATIONS

SUPPLY VOLTAGE: 110/120 AC 50/60Hz or 24 V dc.

POWER CONSUMPTION: Max 12VA

OUTPUTS: Opto isolated PNP, 24v DC (+/- 4). External power supply required

MAX OUTPUT SWITCHING 60 mA

OUTPUT CONFIGURATION: 16 outputs with 7 lobes that can be configured in 4 different batches

ENCODER POWER SUPPLY: 12V DC 160 mA

ENCODER TYPE: 9 bit gray code excess 76

EXTERNAL INPUTS:** External start /start
External stop
Datum
Program inhibit

APPROX SCAN TIME: 3 milliseconds

MEMORY AT POWER OFF: Non volatile ram memory.. Minimum retention 11 years

DATUM METHOD: Via external input

RESOLUTION: Programmable to 1 degree

WEIGHT: Approx 2.5 Kg

WORKING TEMPERATURE: 0 degrees C to + 55 degrees C

DIMENSIONS: DIN standard 437000
Overall size Width 144mm, Height 95mm and Depth 141mm

MOUNTING: Panel mounting cut out Width 137mm and Height 90 mm

OPTIONS: Lockable front panel cover

ENVIROMENTAL SEALING

ENCODER	IP66
CAM UNIT	IP65 when mounted on a panel with sealing gaskets (optional)

** *All inputs are via opto isolated inputs* with volt free contacts switching to 0V

APPENDIX 6.

INSTALLATION INSTRUCTIONS FOR THE GOODWIN SPC B1247 02 ENCODER

Goodwin absolute encoders are precision items. Each one is manufactured and individually tested to the highest standards. Careful handling and installation are essential in order to ensure a long trouble-free life and to obtain the required measuring accuracy.

The following recommendations are to assist the first time user in avoiding major pitfalls. If in doubt, please contact us.

1. When installing the encoder, it should be properly centered so as to avoid bearing loading due to misalignment.
2. Avoid shock loading the encoder shaft.
3. In order to maximise bearing life, minimise the axial and radial shaft loads (max loads; 10 N axial and 20 N.cm radial).
4. Use flexible couplings and secure them to the shaft using minimal force. At high rotational speeds they may need to be dynamically balanced. The choice of coupling is determined by the speed, the accelerating torque and the angular and radial misalignment.
5. Carry out datumming in accordance with the MC16 instructions.
6. The following minimum cable bending radii should be observed:
   for permanent cable runs : 100mm
   once only : 40mm
7. Switch the power supply off before connecting or disconnecting plugs and sockets.
8. Make electrical connections according to the pin-out diagram. The supply cable cross-section should be chosen according to the cable length and the encoder's current consumption.
9. The performance of the encoder, even when correctly installed, can be adversely affected by electrical interference and voltage spikes which can cause intermittent faults. This may be due to power supply switching, pulse mode controllers or motors. Interference protection can be achieved by using cables with better shielding or an appropriate filtering network.
10. Under hostile conditions, such as water spray or solid particle impact, it may be necessary to provide additional encoder protection.
11. Finally, please note that any attempt to open or alter the encoder invalidates the factory guarantee.

APPENDIX 7.

POWER CONNECTIONS.

1. 110/120 V AC supply is via a standard European IEC 320 connector

2. 24V dc supply is via a 4 pin HARTING connector,
   pin 1 +24 V dc
   pin 2
   pin 3 0 V line
   ground

3. **For 24V powered MC16 units the 25 way D connector must have +24V applied to pin 18 and 0V to pin 17 for the encoder to operate. This 24 V supply can be a separate supply from the supply that is connected to the Harting connector.**

The encoder and output switching circuits are internally opto-isolated from the supply connected to the Harting connector.

MC 16 PROGRAMMING SHEET

Batch Number

OUTPUT N0		LOBE 1	LOBE 2	LOBE 3	LOBE 5	LOBE 6	LOBE 7	LOBE 8	COMMENTS
1	ON								
	OFF								
2	ON								
	OFF								
3	ON								
	OFF								
4	ON								
	OFF								
5	ON								
	OFF								
6	ON								
	OFF								
7	ON								
	OFF								
8	ON								
	OFF								
9	ON								
	OFF								
10	ON								
	OFF								
11	ON								
	OFF								
12	ON								
	OFF								
13	ON								
	OFF								
14	ON								
	OFF								
15	ON								
	OFF								
16	ON								
	OFF								