GEM 30/40

OPERATOR MANUAL

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1. INTRODUCTION

Goodwin Electronics Digital Position Readout System has been designed to make your machining operations faster and more precise, to reduce scrap, and to help you produce higher quality work. Digital Readout does things automatically that you have done manually for years. It eliminates counting handwheel or dial turns on your machine, adjusting for backlash, and attempting to read worn graduations.

The console displays the position of each of the movements of the machine in bright easy to see L.E.D. numbers. Since the scale or transducer is fitted directly between the bed of the machine and the table/head/apron etc, only actual movement is displayed, no compensation has to be made for leadscrew wear or backlash.

The Digital Readout displays the +/- distance travelled along each axis relative to the point where the unit was last zeroed and the zero position can be crossed any number of times.

The "zero" key sets the digital readout to zero, making the current location of the axis the new zero.

The keyboard brings a number of powerful time saving aids to your machining - direct inch/metric conversion, Incremental/Absolute modes of measurement, the ability to preset complex or repetitive dimensions into the working display, add or subtract tool offsets,and many other useful features.

Scale resolutions of 0.1 mm, 0.01mm, 0.005mm, 0.002mm and 0.001mm are available, all of which are compatible with the Goodwin Console.

Rotary encoders can also be interfaced for special purpose machines.

The product described in this manual is subject to continuous development and improvement. There may be slight variants between your unit and the details in this manual. All information of a technical nature and particulars of the product, and its use are given by Goodwin Electronics in good faith.

1.1. TYPES OF DRO READOUT SYSTEMS

The family of readout systems fall into three categories:
1 Basic readout systems - **GEM 20 SERIES** with 1 or 2 axes and limited keyboard functions.
2 Simple readout systems - **GEM 30 SERIES** with 1, 2 or 3 axes with full keyboard functions.
3 Advanced programmable systems - **GEM 40 SERIES** with 2 or 3 axes with full keyboard functions. .
The basic operation and programming sequence used by all units is common to all of the GEM 30 and 40
range.
A list of features that are available with the different consoles is given below.

FUNCTION	GEM 30	GEM 40	GEMS 20
Display	+/-19999.99	+/-19999.99	+/-99999.99
Scale Resolution (mm)	0.1, .01,.005 .002,.001	0.1, .01, .005 .002,.001	1 to .001
Incremental	Yes	Yes	Yes
Absolute	Yes	Yes	Yes
Presets	Yes	Yes	Yes
Data Storage	No	Yes	No
Battery Backup	Yes	Yes	Yes
Bolthole Facility	32P, 33P	43P, 42P	No
Linear error Comp.	Yes	Yes	Yes (scale factor)
Centre find Facility.	Yes	Yes	No
RAD/DIA.	only 33C	only 43C,42T	No
OPTIONAL FEATURES			
RS232	Yes	Yes	No
Marker Pulse	Yes	Yes	Standard
Edge Probe	Yes	Yes	No
Axis at Zero outputs	Yes	Yes	No
Tool Offset	No	43C.42T	No
Combining Y and Z	33C	43C	No

2. USING THE GEM 30/40 DRO CONSOLES

This operator manual gives information on how to use your console and explains the use of the various keys that allow the instrument to be operated in different modes.
To obtain the full benefit of your Digital Readout System it is important to understand the function of each of the controls and where and when to use them.
The digital display shows the +/- distance travelled along each axis from the point at which the zero reset key was last operated. If the machine is moved back towards zero the console will count down to zero, upon
passing zero the sign will change i.e. either **+** to **- *OR* -** to **+**. The zero key may be operated at any point of the machine travel, to clear the display contents and make that position zero.
All keys can be disabled, if required, see parameter page 5 section 9.

2.1. INCREMENTAL / ABSOLUTE

The ABSOLUTE MODE (ABS) allows an absolute zero or datum to be established that will be retained throughout the machining of a component.
The operator can display either register by using the INC/ABS key,

and the function light indicates which mode is currently selected.
The INCREMENTAL MODE (INC) allows working zeros or datum to be established for carrying out individual operations on that component. When commencing machining on new component carry out operation 4 section 2.7.0 to set the absolute zero and then operation 5 to set the incremental zero. The console is normally operated in the incremental mode and during the machining of a component the display may be re-zeroed any number of times to carry out direct measurement or preset operations. At any point within the machining operation the absolute key may be pressed to display the distance moved from the absolute zero, i.e. original datum, either to move the machine back to that zero point or as a check on the sum of the incremental movements.

2.2. ZERO KEYS X0, Y0 AND Z0

These keys will zero the registers associated with each axis.
It should be noted that there are **TWO** registers associated with each axis. These are the ABSOLUTE and INCREMENTAL registers. The ZERO keys will operate only on the display currently selected. Thus for example if you are in the ABSOLUTE mode and you press **X_{ZERO}** then the *ABSOLUTE X DISPLAY REGISTER* will be zeroed. These keys can be disabled, if required, see parameter page 5 section 9.

2.3. INCH / METRIC KEY

Press MM / INCH key to select the units you wish to work in. The DRO will do direct conversion, converting inches to millimetres and back to inches without loss of data.
The mode of operation is changed by using the mm/inch key with the mm or inch led indicating which mode is selected,

This can be particularly useful when checking a component being machined in say metric with an imperial gauge or micrometer.

2.4. DIA / RAD KEY

This facility allows the X axis to measure diameter. The mode of operation is selected with the **DIA/RAD** key and if DIA mode is selected the DIA led will be illuminated. If the unit is switched off the DIA/ RAD selected state is remembered. If the unit is in the RAD mode and DIA mode is selected then the X registers (both absolute and incremental) values are **doubled** and the scale factor for the X axis registers is also **doubled**.
If the RAD/DIA key is pressed once more and the unit returns to the RAD mode then the X registers (both absolute and incremental) values are **halved** and the scale factor for the X axis registers is that selected in the parameter pages.

2.5. TEST FUNCTION

By rapidly pressing the + and then the _ key the test routine can be selected. This facility cycles the digital readout through a given test routine. This enables the user to identify any faulty display LEDS.

2.6. POWER UP

On switching your console on the display will flash. This is to indicate that there has been a power supply interruption. Press any key (or INC/ABS if requested) to stop the flashing. No position data will be lost as a consequence of this action if the memory back up facility is installed on your console.

2.7. DIRECT MEASUREMENT ON MILLING MACHINES

1.Switch power on to the Console, ensure power switch on rear of console is in the ON position. Then press any key on the key pad (or inc/abs if requested) to stop the display flashing.
2.Position the cutter on the workpiece at the desired datum.
3.Select inches - millimetres as required.
4.Select absolute mode and operate X, Y and Z zero resets to establish an Absolute zero datum.
5.Select incremental mode and again operate X,Y and Z zero resets to establish a working zero datum.
6.The system is now ready to use. As the machine is moved the console will display the distance moved from zero. To make another measurement, X, Yand Z incremental displays may be re-zeroed at any point, by simply pressing the appropriate zero reset key.
In the example shown in Figure 2.1 absolute and incremental zeros have been established at point 'A' subsequently incremental zeros have been set at points B, C and D.

2.7.1. DIRECT MEASUREMENT ON LATHES

1. Switch power on to the Console, ensure power switch on rear of console is in the ON position. Then press any key on the key pad (or inc/abs if requested) to stop the display flashing.
2. Take a first cut off the workpiece then position the tool at the Z axis datum with the tool touching the workpiece.
3. Using a micrometer establish the diameter of the workpiece.
4. Select inches or millimetres as required.
5. Select "absolute" and operate **X ZERO, Y ZERO** and **Z ZERO** keys.
6. Carry out the presetting operation described in section 2.9 with the absolute mode selected such that the diameter is entered into the display. This establishes an absolute datum.
7. Select "incremental" and operate **X ZERO** and **Z ZERO keys.** This establishes a working datum from which measurements can be made.
8. The system is now ready to use. As the machine is moved the console will display the distance moved from the working datum.

NOTE: If in steps 6 and 7 above the absolute zero cannot be reached because of physical restrictions in the machine such as for the X axis of a lathe. The absolute registers can be preset as described in section 2.9.

2.8. +/- SIGN CONVENTION

The drawing in Figure 2.1 applies to a typical turret mill fitted with Y and X measuring scales. Irrespective of whether the table or the cutting tool moves it is always better to think in terms of cutting tool travelling over a stationary workpiece to understand the concept of +/- sign convention.
A series of holes laid out for drilling are shown. The datum is selected as point A (bottom left hand corner) Absolute dimensions for holes B, C and D are shown on the drawing.
The table shows the incremental preset values to be keyed in, such that zero is achieved in the display as the tool arrives over the target hole. Obviously this must be done in the INCREMENTAL mode. The absolute position can be checked at any time by selecting ABSOLUTE mode.

2.9. PRESET OPERATION

There are three keys which allow you to enter data relevant to a given axis. These are known as the preset keys,

The normal method of measuring when operating a machine tool is to set the machine to the point at which machining is to commence, consider that as zero and then move to the specified dimension. The same can be achieved by setting the machine to the point at which machining is to commence, considering this as the specified dimension and then moving the machine to zero.
Preset operation utilises the second method of measurement since zero is an easier number to remember and recognise than a four, six or even greater digit number, particularly when working with two or three axis simultaneously. The machine is at target position when the displays reads zero.

2.9.1. ENTERING PRESET DATA

A First carry out the operations described in sections 2.7.0 or 2.7.1 to datum all DRO incremental and absolute registers.
B. Press the PRESET key on the axis required. Enter the dimensions required using the keyboard into the pre-set memory and then press **+** or **-** key as appropriate to add or subtract the preset memory to the working display. Thus for example to enter a Z preset of 1.40 mm you would proceed as follows,

NOTE: Remember the preset memory is added or subtracted **to** the working display, therefore, the working display must be zeroed first if it is required to transfer the exact content of the preset memory.

Figure 2.2 is a shaft being turned from Stainless Steel. The diameter of the shaft and the distance from the end of the shaft to the shoulder are both complex numbers to remember and made more difficult in that they are similar and could be transposed. By using the preset facility and working down to zero constant reference to the drawing to re-memorise the dimensions is eliminated, thus the chance of error in transposing the dimensions is greatly reduced.

Figure 2.3 is a plate being machined with a series of holes. Three operations are required on each hole, bore, counter bore and ream. On the eight holes detailed the pitch of 80.25 mm will have to be measured 24 times. Using the preset facility 80.25 mm can be entered into the console once via the keyboard and then recalled for each operation.

In this example you will see that moving to zero each time will be found to be a much easier way of working as no numbers need to be remembered.
The exact procedure will be as follows:
1. Use direct measurement operation (section 2.7.0) to establish a datum and position machine to

bore hole 'A'.
2. Bore hole 'A'.
3. Zero the X axis in the INC mode and then using the X preset function enter 80.25 into the preset memory. Pressing the **+** key will then add 80.25 mm to the X working display.
4. Now move the machine until the display reads zero and bore hole 'B'.
5. Press **X** and 80.25 mm will be recalled into the display. Pressing **+** will add it again to the X working display.
6. Again move the machine until the display reads zero and bore hole 'C'.
7. Repeat steps 5 and 6 to bore holes 'D' to 'H'.
8. Upon completing 'H' fit the counterbore tool and counterbore hole 'H'.
9. Now repeat steps 5 and 6, but *subtract* the preset value instead of adding it, using the **-** key, and then move machine to zero before counterboreing hole 'G'.
10. Repeat step 9 to counterbore holes 'F' to 'A'.
11. Upon completing hole 'A', fit reamer and ream hole 'A'.
12. Repeat step 5 and 6 to ream holes 'B' to 'H'.

2.9.2. FURTHER NOTES ON PRESET OPERATION

1. Dimensions can be entered into the preset memory in mm or inches.
2. Dimensions are added or subtracted to the working display. The working display must equal zero prior to adding or subtracting if the exact preset dimensions are required in the working display.
3. Dimensions entered into the preset memory are not affected by movement of the machine, they may be recalled at any time by pressing the appropriate preset key. The console is then returned to the working display by pressing the preset key again. If an addition or subtraction is carried out this automatically returns the machine to its working mode.

2.10. TOOL OFFSETS

The preset facility can be utilised to offset the diameter of a cutting tool, such that machining can be carried out to printed dimensions.
Example:
Figure 2.4 is a plate being machined with a pocket on surface BC. With the absolute mode selected the cutter is datumed against edge 'A' and the cutter radius of 3 mm entered into preset registers of X and Y axes. This value is then subtracted from the X axis register and added to the Y axis register. The readout can be used to work directly to the printed dimensions, ie., you now can take the cutter in the Y direction until it reads 44.00 mm then move the head in the X direction until it reads 60.00mm and then finally lower the head in the Y direction until the Y display reads 28.00mm

2.11. AXIS AT ZERO

A facility to detect a zero or negative value on any of the axes is available. A common application of this facility is in EDM machine applications for the control of the Z axis. If the relay output option has been specified and this mode activated (on Page 3 of the PARAMETER mode set up routine), then whenever the incremental position of an axis is negative or zero the relay output will be activated and the decimal point in digit 6 of the axis display will flash to indicate a zero or negative condition exists. (See section 13 for relay output connections).

In an EDM application the relay output can be wired into the ***spark eroder head retract circuit*** and can be used to cause the head to lift away from the workpiece and return to its home position whenever the Z incremental register is zero or negative.
One possible sequence could be as follows,
1. Select incremental mode and lower the electrode until it touches the work surface. Zero the Z incremental display,

2. If it is required to erode a hole to a depth of 10.00 mm then enter 10.00 mm into the preset and ***add*** it to the Z incremental display,

3. Return the electrode to the home position and start the eroding cycle. The electrode will penetrate the workpiece until the depth of 10.00 mm has been achieved and when this has occured the relay will operate indicating to the external circuitry that the head should retract.

3. REFERENCE MARKER PULSE OPERATION

Five micron ELITE scales have a reference mark every 50mm which allows the machine slide to be precisely "zero datumed" after switch on.
The reference feature is a very powerful facility. It automatically stores and loads the absolute position of the job datum. It can be invaluable in workshops where power failures are likely to occur.
When a job is first put on the machine carry out the procedure described in 'Storing Datum' below and the absolute positions from the work piece datum to the reference mark on the scale will be saved and stored in permanent memory (even when the unit is switched off). Once this step has been carried out it is possible to redatum the machine
If there is a power failure or the job is left over night carry out the procedure described in 'Loading Datum' below, and the datum on your job will be very simply restored.

STORING DATUM

1. Select Absolute mode (i.e. press **INC/ABS** key if in the incremental mode) since the reference function only works in this mode.
2. Move the machine to the datum position of the job (i.e. X, Y and Z axis to display zero)
3. Select the desired axis - if X axis then use the press **X** key.
4. Select the reference mode, press the **REF/PROBE** key. (if you wish to cancel reference mode at this point press **REF/PROBE** again)

The block number display will flash with **rEF 1** or **rEF2**. If **ref 2** is displayed press the axis zero key (**X zero**) and repeat steps 3 and 4 above such that **rEF1** is displayed. The selected axis will be indicated by the decimal point in the +/- digit being flashed.
5. Traverse the selected axis slowly ('X' axis in this case) to find the reference mark on the scale (note the direction of movement).When the reference pulse is detected by the electronic scanning system then the absolute position will be instantly stored in memory and the display will carry on counting in the normal manner. The block display will revert to its normal function.
The stored position has been copied into the axis preset register so it can be viewed, if desired. Changing the preset value will not change the stored reference position.
6. Repeat the above procedure for Y and Z axes using **Y** and **Z** to select the relevant axis.

LOADING DATUM

7. Select the Absolute mode (i.e press the **INC/ABS** key if necessary)
8. Move the machine to the approximate datum position, of the job.
9. Select the desired axis - if X press **X**
10. Select reference as described in (4) above. The block display should have '**ref 2**' in it. If it does not the datum position has not been stored. It is now necesary to repeat steps 1-6 above.
11. Traverse the selected axis (X axis in this example) in the same direction as it was moved in (5) above to find the mark on the scale. When the reference pulse is detected by the electronic scanning system then the absolute position will be instantly loaded into the absolute registers and the displays will carry on counting in the normal way. The block display will revert to its normal function once the reference pulse has been passed.
12. Repeat the above procedure for Y and Z axes using the **Y** and **Z** keys to select the relevant axis

4. RS232 SERIAL LINK PROTOCOL

The RS232 is predominantly a passive communications link i.e. it will only respond to characters sent to it.
The interface is connected via an industry standard 25 way D-type connector, pin out as shown in section 4.2. The data format used is; **8 Data Bits ,Parity Disabled, 2 Stop bits.**
The baud rate is set on page 4 of the configure mode.
All data is sent and received in ASCII CODE and the factory set Baud Rate is 9600.
When the RS232 link is active the message **r232** is displayed in the BLOCK window.
If the RS232 link fails (checksum error) then error 6 is displayed and can be reset by pressing any key.

4.1. APPLICATION NOTES

A floppy disc is supplied with each RS232 system. This disc will run on true IBM XT/AT compatible machines and it is recommended that you copy the file GEM_DRO.EXE onto your hard disc (if one is available) or onto another floppy disc and then run the program from there.
Typing GEM_DRO and pressing ENTER will cause the remote communication software to run. The first time it is run you will probably see a warning message which will indicate that the configuration file DROCON.SYS is not yet present. The program will automatically generate this file if you select 'SYSTEM SET UP, from the main menu.
This menu allows options to be selected that
1. Monitors the positions of the machine.
2. Allows programs to be uploaded and downloaded (on programmable models only).
3. Allows the system configuration to be uploaded and downloaded to the system.

Follow the instructions at the bottom of the screen to select the different options.

4.2. RS232 CONNECTIONS

This option when fitted uses a 25 way D type female connector. It is recommended that the serial line be connected as a standard Null mode cable, as shown below

Function	GEM Pin No		IBM Pin No
Transmit output TXD	2	connect to	3
Recieve input RTXD	3	connect to	2
Clear to send input CTS	5	connect to	20
Ground	7	connect to	7
Data terminal ready output DTR	20	connect to	5
			4,6,8 Connect together

5. GEM 40 PROGRAMMABLE CONSOLES

All these series have an extra mode which is referred to as the PROGRAM or PROG MODE.
This mode is selected and deselected by using the PROG key and PROG function led will indicate if this mode is selected or deselected. Programmed data is always absolute dimension data.
Programmed data is in the form of a number of BLOCKS of data. Each block of data will contain a set of dimensional co-ordinates for each of the axis. In the Tool offset (T) models, the data in every block will also contain a TOOL NO corresponding to a offset for the tool that will be used to carry out the machining operations necessary in that block of data.
There are 190 blocks available in all programmable consoles. Extra memory can be added to provide even more blocks of data, (contact your supplier).

5.1. CLEAR PROGRAM DATA

All data can be removed from memory by using the decimal point key (or CLEAR key if fitted) twice in quick succession,

The displays for all axes will now show zero and the BLOCK NO will be set to 1
NOTE: This action is irreversable and if carried out the data in all block positions will be permenantly lost.

5.2. PROGRAMMING SEQUENCE FOR POSITIONAL DATA.

Data co-ordinates can be programmed by direct entry via the keypad thus if the memory has been cleared then the following data , X = + 1.4, Y = - 2.8 and Z = + 5.95 can be entered for block number 1 by carring out the following key operations;

NOTE: The value of the least significant digit may change as you enter it if the resolution of the system is such that the programmed value is not possible to achieve i.e. If the scale resolution is set as 5 micron and the programmed value is 210.133 mm the console will save the value 210.335 mm as it is impossible to achieve the 3 micron resolution requested.
Repeat the programming sequence above for position 2 (the BLOCK NO display will automatically step on to BLOCK 002 when **X**, **Y** or**Z** is pressed) and continue the programming sequence until all positions have been programmed. All values entered are automatically carried foward to the next block and only any change in value need be entered as new data, (i.e. there may be no movement required on the Z axis in block 3 thus the value entered in block 2 will not be changed).
Only program the required number of blocks - do not generate extra blocks unless there is a good reason for doing so.

5.3. EXAMINING A PROGRAM

To examine your program from BLOCK 003 (for example), select the program mode and proceed as follows:
The programmed contents of Block 003 will be displayed. Each subsequent press of the ENTER key will advance the block number by 1 and display the complete contents of the new block. This can be continued up to and including the last block programmed.

EDITING A BLOCK OF DATA

All editing can only be carried out in the Program Mode. Editing can be done in three ways, namely;

Re-writing a block.
Inserting a block.
Deleting a block.

REWRITING A BLOCK.

Select the block to be edited, say block 001, in the following manner,

If the Z position data is -5.90 and should be -6.90 then it can be changed as follows,

The Z position data has now been changed to the required value.
The same editing procedure can be carried out on any of the progammed blocks of data.
In general the procedure is,

select the block of data to be edited.
change the data to the new values
save the changes with the ENTER key

BLOCK INSERT FACILITY

An additional block of data may be inserted between any 2 of the blocks that are already programmed in the
memory.
Assume that a program of 12 blocks has been programmed and it is necessary to insert one additional block of data between Block No 002 and Block No 003.
First select BLOCK 3 and then press the dual function + key,

The data contained in block 003 is transfered to block 004, block 004 goes to block 005, etc until the end of programmed data is reached. The data that was contained on block 003 is still resident in block 003 and this can now be overwritten using the editing features described above.
If two or more blocks need to be inserted then the above procedure can be repeated at any position in the block sequence.

BLOCK DELETE

Any block of data may be deleted.
Assume that a program of 12 blocks has been programmed and Block No 003 is to be deleted.
First select BLOCK 3 and then press the dual function - key,

The data contained in block 003 is deleted and the data in block 004 is transferred to block 3, block 005 goes to block 004, etc. until the end of programmed data is reached.
If two or more blocks need to be deleted then the above procedure can be repeated at any position in the block sequence.
When you have finished entering your program press the PROG key and return to Default Mode.

5.4. PROGRAMMING DATA USING THE TEACH MODE

This feature is available only on programmable consoles. It enables the co-ordinates of a particular job to be automatically entered into the program blocks as it is being machined. This means that subsequent machining of a similar job can be done without reference to a drawing.
To use the teach facility first clear all programmed data as described in section 5.1 above then press **PROG** again to deselect program mode. Now datum both the incremental and absolute registers as described in section 2.7.0
Machine the first step of the job, this could mean moving just one axis or all three. Once the first step is complete press **TEACH**, the prog LED will flash and either the Teach key should be pressed again to deselect this facility or the enter key pressed to teach the position. This position has now been entered into block No 1 (to confirm this simply press **PROG** the displayed values will be the same as the absolute values - remember to press prog again to deselect program mode) Now carry on with step 2. When this position is reached press **TEACH** and enter again, this time the block number will increment by one. Confirming that the absolute position has been entered into program mode. (NOTE: If the old program has not been cleared out of memory or a block is being edited the block number will not increment automatically. The **BLOCK NO** facility will have to be used to select the next block to be taught before pressing **TEACH**. When the last programmed block is reached the block number will then increment automatically to the extent of the program size). This process can be continued until the job is completed. The data can then be used to produce the next identical component as described below.

5.5. USING THE PROGRAMMED DATA

Once the data co-ordinates have been programmed using either method described above, the following procedure would normally be followed to machine a component from the data:

Datum the axes in incremental and absolute mode to coincide with the datum of the workpiece. Select block 1 (this being the first programmed co-ordinates) by pressing,

The BLOCK NO display will be displaying 001. Select ***incremental mode***
The axis displays will now be showing the distance the machine has to move in each axis to complete the first step. When all axes have been moved such that zero is displayed step 1 is complete and the co-ordinates in block 2 can now be selected by pressing **ENTER**.
The BLOCK NO display will automatically step to 002 and the incremental movement required for each axis is now displayed.
This sequence is repeated until the task is complete.

5.6. BOLT HOLE FACILITY (P MODEL)

The P model is avaliable on both the GEMS 30 and 40 families of digital readout. The benefit and use of the PCD facility is demonstrated by the following example which requires that 8 equally spaced holes be drilled and counter bored on a pitch cirle of 100 mm diameter as shown in Figure 6.1.
To machine these holes with a standard DRO would require an operator to calculate the X. and Y co-ordinates for each hole. Using the PCD facility these calculations are no longer necessary. By simply selecting the PCD mode using the **PCD** key the Digital Readout will take over and carry out all the necessary calculations. Assuming the machine tool is positioned at the centre of the PCD, the DRO will ask what radius is required using messages sent to the LED display.
Having entered the value of the radius through the membrane keypad the console will then go on to ask how many holes are required. Finally it will request you to enter the start angle from X axis at which the first hole must be placed.
(Note in Figure 6.1 this angle is 0 and hole no 1 is **ON** the X axis).

Once these parameters are entered the display will then tell the operator the incremental X, Y movement required to find hole 1. The machine is now moved until the values in the X and Y registers are zero and once this has been achieved the machine is located at the center of hole 1. This hole can now be drilled. Then by pressing the **ENTER** key the position of hole 2 will be calculated and displayed. This can be followed until all the hole positions have been calculated and drilled.If required it will then continue round to give the position of the first hole once again.
Once the procedure has been completed the PCD mode is deselected by pressing the PCD key once more.

5.7. USING THE PCD FACILITY

1. Use absolute or incremental modes to position your machine tool such that the bit is at the centre of your circle.
2, Select incremental mode and then press the PCD key.
3. The DRO will ask you what radius the holes are to be positioned on. Maximum radius of 700 mm (1400 mm PCD). Enter the radius using the key pad and then press ENTER. The '+' led will stop flashing and the number you have entered will be displayed. If it is incorrect press **Y PRE** and re-enter your number.
4. Press ENTER again when the number is correct and this will step the unit on to ask how many holes are to be positioned on the given radius. Any number of holes between 1 and 36 may be entered.
5. When the number is correct press enter again and the unit will ask at what angle the first hole should be positioned relative to the X-axis i.e. 29 degrees in the example shown in Figure 6.2
6. When the angle is correct press enter again and the unit will then calculate the X - Y position of the first hole. This will be displayed in the X and Y displays as incremental values, and the hole number in the top display. When the machining operation is complete press **ENTER** again and the DRO will show the position of the next hole anti-clockwise.
7. After each operation press enter again and the DRO will display the position of the next hole. When all the positions have been displayed,the next press of the enter key will display the position of hole 1 again. Each successive press of the enter key will show the position of the next hole continuously in anti - clockwise position until the PCD mode is deselected by pressing the PCD key again.

Having selected the PCD mode, the Y axis will be flashing and you can enter the data required to execute the task shown in Figure 6.2 as follows,

This will generate the following positions for you to move the drill to,

Ho. 1	- 43.73	- 24.24
Ho. 2	+ 24.24	- 43.73
Ho. 3	+ 43.73	+ 24.24
Ho. 4	- 24.24	+ 43.73

Note: To achieve pitching of more than 36 holes simply add half the angular pitch to the start angle i.e. for 72 holes select 36 hole operation with the required start angle then, after the machining of these 36 holes reselect PCD with 5 degrees added to the start angle.

6. PROBE FACILITY (CENTRE FIND)

This facility only operates in the INCREMENTAL mode and can be used to find the center position between two edges. It can be used with a suitable probe OR by using the ENTER*** key as follows,
1 Select the incremental mode of operation.
2. Select the axis (eg **X**) using the preset keys.
Now press the **REF/PROBE** key. The block display will be flashing and contains the message **Prb.1** indicating that the unit is now searching for the first probe signal. The decimal point in the +/- display of the selected axis will flash.

3. Move the axis until the probe makes contact with an edge. On contact the unit will **zero** the incremental position at the point of contact, say **X1** and the block display will now display **Prb.2** indicating that a search is being made for the second probe contact. If no probe is being used then when the tool is in contact with the edge, press ENTER. This will zero the incremental display.
4. If the centre find option is NOT being used exit the PROBE mode by pressing the REF/PROBE key. If a number of edges are required to be detected repeat steps 2 to 4 until all edges have been detected.
5. Wait approximately 1 sec and then move the axis until the probe or tool makes a second contact with an edge. On contact the unit will record the new incremental position at the point of contact, say **X2** and the block display will now display **Cntr.** If a tool is being used press ENTER when the tool touches the second edge. A calculation will occur and the incremental position displayed will be the centre point between X2 and X1. Move the axis until the incremental display is zero and the tool or probe will be at the centre of the two edges..
6. Deselect the probe facility by pressing any key.
7. If the probe centre find cycle needs to be terminated before completion press the **REF/PROBE** key and begin, from step 1, again if necessary.

The ENTER option for this facility is NOT available on the 43C,42T or 32Z units

7. TOOL NUMBERS AND OFFSETS (GEM 42T and 43C only)

This is a unique function of the T series readout systems. Tool numbers are assigned to a block of data and the dimensional values of each tool are kept in a specially reserved register that is referred to as the **TOOL OFFSET REGISTER** which contains the **TOOL OFFSET VALUES.**
These values are accessed by selecting the TOOL MODE which can be done as long as the unit is NOT in the PROGRAM mode. When selected the TOOL MODE led will be illuminated and the block number will not be displayed.
Upto 9 tool offsets can be programmed. These offsets can be allocated to specific tools, and the values can be adjusted as the tool wears, is sharpened or replaced.
To use this facility it is essential that the machine is equipped with a precision indexing toolpost, or quick change tooling facility.

7.1. ASSIGNING TOOLS TO PROGRAM BLOCK NUMBERS

When programming the console you can assign a tool number to each block of program data according to the job sequence listing. Thus for example if it is necessary to allocate tool 2 for the action being carried out in block number 6, first select BLOCK NO 006 and then enter TOOL NO 2 using the following sequence,

NOTE: After pressing the TOOL NO key the TOOL NO display will flash to indicate that you should enter your tool number. On pressing ENTER it will stop flashing and save the new information in memory.
This procedure is repeated for each block number

7.2. TOOL SETTING MODE

It is necessary to be OUT of the programming mode before this mode can be accessed. It can be entered by the following pressing the TOOL MODE key,

The tool mode led will illuminate and the Tool window will display 1 indicating that the dimensions displayed on the X Y and Z displays are the values previously assigned to this tool number.

Each time **ENTER** is pressed, the Tool No will increment by one, (displaying the tool offset values stored), until TOOL No 9 has been reached.The next press of the ENTER key will return to TOOL NO 1.
By rapidly double pressing the decimal point key all tool data can be cleared (set to .00 mm).
If the TEACH facility is used on these models then *the absolute coordinates are stored into the offsets of the selected tool number*.

7.3. ALLOCATING TOOL OFFSETS TO TOOL NUMBERS

Tool dimensions can either be keyed into memory through the numeric keypad, or they can be "Learnt" from the machine, see below. Tool No 1 offsets are normally allocated zero values, and all other tools dimensions are values relative to this tool. This can then be used to establish absolute zero.
It is important to understand the sign convention used. This is shown in Figure 8.1 for the Z axis;
For a Mill system,

For a lathe system,

Figure 8.1

With tool 1 selected the absolute display is datumed on the surface.
If tool 2 is selected and the quill moved so that it touches the surface then the absolute display would read, - 10.00 mm. and if tool 3 is selected and the quill moved so that it touches the surface then the absolute display would read +25.00 mm.
If the quill for all 3 tools is in the position shown in figure 8.1 then for,

1.TOOL 1 there is no offset required.

2. The absolute display for tool 2 in the position shown would be +10.00 thus the tool offset must be -10.00 mm. The incremental display which is the distance to go to reach the target (the datum surface in this case) must be:-

the current absolute position-

the tool offset ie., ABS - (-10.00) = ABS +10.00 mm.

3. The absolute display for tool 3 in the position shown would be -25.000 thus the tool offset must be +25.00 mm. The incremental display which is the distance to go to reach the target (the datum surface in this case) must be:-

the current absolute position-

the tool offset ie., ABS - (+25.00) = ABS -25.00 mm.`

7.4. KEYING IN TOOL OFFSETS

Enter the TOOL OFFSET mode.
It is assumed that the tool offsets relative to Tool No 1 have been previously established.
Start with Tool No 2 in the display.
Enter the appropriate values for the tool into the X, Y and Z displays using the axes preset and numeric keys as described in section 5.2 and the press the ENTER key. This will automatically save the data and advance the tool number by 1. Repeat this procedure until all the tools you are going to use have been programmed.

7.5. TEACHING TOOL OFFSETS

In order to TEACH the tool offsets, it is necessary to have a setting piece in the lathe chuck. This can be a small bar of steel, which is skimmed on its diameter and end face with the No 1 tool. The diameter is used as the X datum and the end face as the Z datum for the purpose of allocating offsets to the remaining tools. This procedure is carried out in the absolute mode by using TOOL No 1, and zeroing the X , Y (if fitted) and Z absolute registers when the tool is positioned against the end face.

Assuming that the above procedure has been carried out enter the TOOL MODE (using the F1 key), and clear all the tool offset data, (press the decimal point key twice in quick succession). Select and mount tool 2 in the machine. Position the tool so that it lightly touches the datums then select an axis (say X) and then press the TEACH key,

The absoute position of the selected axis will appear in the display and will be used as the tool offset for that axis. Repeat for all other axes appropropriate for that tool. Press ENTER to increment the tool number and repeat for all other tools. These dimensions will be saved to memory and will be used internally to calculate incremental targets when executing the entered program.

To exit from the tool mode mode press the TOOL MODE key with all axes deselected.
Assuming that a program of positional data has been entered as previously described, tools can now be assigned to the relevant block numbers and the tool offsets associated with each tool will be used in calculating the incremental movement required to reach the programmed target. This is done by moving the machine until all axes have an incremental value of zero.

8. PARAMETER CONFIGURE MODE

The block display , (if fitted) will indicate this by displaying the message **ConF.** and none of the top row of leds will be illuminated, ie., mm, inch, inc and absolute leds**.**
The PARAMETER mode consists of 6 pages which store parameters which can be set to tailor the consoles to most applications.
These parameters are stored in a permanent memory within the controller and are preserved even when the power to the unit is removed. Their validity is constantly checked and if an error is detected the controller will generate an Error 1 message in the displays. If this should occur then the parameters **must** be reinstalled within the controller

These parameters can be reset or changed at any time by the user if the appropriate procedure is followed (see below). *For this reason please keep a record of the installed values in the table supplied at the end of this section.*

NOTE: ***In non programmable units (GEM 30 series) use the DIA/RAD key in place of the ENTER key in the instuctions given below.***

PAGE 1. X , Y and Z SCALE RESOLUTION and **COUNT DIRECTION.**
Scale resolutions of .001, .002, .005, .01 and 0.1 mm can be selected

PAGE 2. SCALE FACTOR
This is the scale factor that is applicable to each axis. Any value between 2.9999 and .1000 can be set.
For example if the encoder and mechanical gearing arrangement produce an encoder pulse for a movement of 0.0042 mm and the scale resolution has been set to 0 .005 mm (page 1) then a scale factor of, **0.0042/0.005 = 0.8400** is required**.**

PAGE 3. POWER UP MODE.
This page specifies the measurement mode that the controller is to power up in, ie., metric (mm) or imperial (inch). The unit can also be set to perform a zero or negative test on the incremental values of any axis or combination of axes.

PAGE 4. RS232 BAUD RATE.
This page specifies the baud rate to be used with the RS232 link if fitted. The following values are available,
9600, 7200,3600, 4800, 2400, 1200, 600, 300, 150, 110, 75, and 57 baud.

PAGE 5. ZERO KEYS INHIBIT.
This page specifies when the ZERO keys are active. There are 4 possible selections,

1. Always active in both incremental and absolute modes.
2. Active in incremental mode. Inhibited in absolute mode.
3. Active in absolute mode. Inhibited in incremental mode.
4. Inhibited in absolute and incremental modes.
5. Disable all keys except in Configure mode.

PAGE 6. DISPLAY FILTER SELECTION
This page is only available in the GEM 43C, 42T , 33C and 32Z consoles.
This page allows one of 3 filters to be applied to the displays (both absolute and incremental) of each axis.
The selections are,

0. No filter applied.
1. An averaging time of approx 5 secs is applied.
2. An averaging time of approx 10 secs is applied.

The parameter mode can be accessed ***only*** at switch on in the following manner:
Switch on power to the console whilst holding the following keys depressed,

PROCEDURE FOR ALTERING THE STORED PARAMETERS.

To enter the parameter configure mode,
PRESS AND HOLD BOTH ZERO (0) AND ONE (1) KEYS WHILST SWITCHING ON THE DRO MAIN SUPPLY POWER.

PARAMETER PAGE 1

Each axis may have the following data displayed :

+ **.01**
- **.01**
- **.01**

+ indicates the currently selected encoder count direction.

.01 indicates the currenty selected encoder resolution.

If the DRO happens to be set to10 micron resolution and you wish to change it to 5 micron resolution for the **X** axis then proceed as follows,

The display will now indicate **+ .005**
Repeated use of the ENTER (or TEST) key will step you around all the available resolutions.
When the desired value is displayed deselect the axis using the **X** preset key.
If it is necessary to change count direction for the **X** axis then proceed as follows,

The display will now indicate, **- .005**
Repeat for the **Y and Z** axes as required. To exit this parameter page press the **ENTER** key with no axes selected. This will take you to page 2 of the parameter mode.

PARAMETER PAGE 2
This page allows the user to set the scale factor for each axis.
If the scale factor for the **X** axis is to be set to 1.20000 proceed as follows,

Repeat for the Y and Z axes as required.
To exit this parameter page press the **ENTER** key with no axes selected. This will take you to page 3 of the parameter mode.

PARAMETER PAGE 3
This page allows the user to select the power up mode of the **DRO.** This can be either *mm or inch display modes*.
Having entered page 3 the display may indicate that the unit has been set for inch mode on power up and the X display will indicate, **+ incH**
To change from inch to a mm mode power up condition proceed as follows,

The display will now indicate, **+ mm**
The **DRO** will now power up in the mode that you have selected.
The DRO can be set to produce an output when the INCREMENTAL value of an axis is zero or negative.
To activate this mode press the decimal point with **X** selected. Some combination of the horizontal bars of **digit 6** position will displayed,

no bars displayed no zero/negative test on any axis
top bar ON zero/negative test on X axis
centre bar ON zero/negative test on Y axis bottom bar ON zero/negative test on Z axis top and centre bars ON zero/negative test on X and Y axes
top and bottom bars ON zero/negative test on X and Z axes
centre and bottom bars ON zero/negative test on Y and Z axes
all bars ON zero/negative test on X,Y and Z axes

If a test is selected when you exit page 3 then the appropriate display will flash the decimal point in digit 7 (in both incremental and absolute modes) ,whenever the incremental value of that axis is zero or negative. If output relays are fitted (option) on ordering the DRO then the appropriate output line will reflect the status of the axis incremental position.
To exit this parameter page press the **ENTER** key with no axes selected. This will take you to page 4 of the parameter mode.

PARAMETER PAGE 4
This page allows the user to set the baudrate for the RS232 link (optional).
If the baud rate (shown in the **X** axis display) is to set to 9600 and it is necessary to change it to a different value, first select the X axis and then press ENTER until the appropriate baud rate is displayed.

To exit this parameter page press the **ENTER** key with no axes selected. This will take you to page 5 of the parameter mode.

PARAMETER PAGE 5
This page specifies when the ZERO keys are active. The display will indicate one of the following messages,

d 1. Always active in both incremental and absolute modes.
d 2. Active in incremental mode. Inhibited in absolute mode.
d 3. Active in absolute mode. Inhibited in incremental mode.
d 4. Inhibited in absolute and incremental modes.

To change the selection first select the X axis and press ENTER. Deselect X when the approriate selection has been made.
To exit this parameter page press the **ENTER** key with no axes selected. This will take you to page 6 of the parameter mode.

PARAMETER PAGE 6
This page allows one of 3 filters to be applied to the displays. The display will indicate one of the following messages,

F. 0. No filter applied.
F. 1. An averaging time of approx 5 secs is applied.
F. 2. An averaging time of approx 10 secs is applied.
G.

To change the selection first select the required axis and press ENTER. Deselect the axis when the approriate selection has been made. Each axis can have its own individual filter selection.

To exit the parameter mode press the **ENTER** key with no axes selected. This will take you to normal DRO modes.

REMEMBER to reprogram the DRO data after any changes to the configure pages

TYPICAL DRO PARAMETER RECORD

date 12/04/89 Machine: ABC11/2

PAGE 1				
	X	**+**	**.01**	mm X count direction and display resolution
	Y	**-**	**.02**	mm Y count direction and display resolution
	Z	**-**	**.02**	mm Z count direction and display resolution
PAGE 2				
	X	**+**	**1.00000**	X scale factor
	Y	**+**	**1.12341**	Y scale factor
	Z	**+**	**1.02345**	Z scale factor
PAGE 3				
	X	**+**	**_ mm**	Power up in mm and Z zero/neg test active
PAGE 4				
	X	**+**	**9600**	Baud rate
PAGE 5				
	X	**+**	**d 1**	Zero key selection
PAGE 5				
	X	**+**	**F. 0**	X filter selection
	Y	**+**	**F. 1**	Y filter selection
	Z	**+**	**F. 2**	Z filter selection

DRO PARAMETER RECORD

Machine No: **Date:**

PAGE 1			
X			mm X count direction and display resolution
Y			mm Y count direction and display resolution
Z			mm Z count direction and display resolution
PAGE 2			
X			X scale factor
Y			Y scale factor
Z			Z scale factor
PAGE 3			
X		+	Power up mode and zero/neg test
PAGE 4			
X		+	Baud rate
PAGE 5			
	X	+	Zero key selection
PAGE 6			
	X	+	X filter selection
	Y	+	Y filter selection
	Z	+	Z filter selection

9. ERROR CODES.

If for any reason the parameter data should become corrupted then an error message **Err 1** will be displayed on all axes by the DRO.
The DRO must now be reconfigured to the its original specification, ie all parameter pages must be reentered. For this reason you are advised to keep a copy of the parameters that have been entered on the CONTROL PARAMETER RECORD.

If error 6 code is displayed then there has been an unsuccesful RS232 attempt. Press any key to cancel this code and try the link once more.

10. MAINTENANCE.

1. Ensure that there are no wires left loose or trailing that could foul and cause an electrical fault, or be instrumental in pulling the Console from its mounting.
2. The operating area should be free from damp and excessive humidity. Ambient operating temperature is from - 0 degrees C to + 40 degrees C. While the console has been designed to withstand a certain amount of splash encountered in a machine shop environment, it must be mounted in a position that does not subject it to heavy splashing, even for short periods. Ingress of water, or continual exposure to a corrosive or hostile environment will void the warranty
3. Check label on rear of console to verify A.C. line voltage is as ordered.

SCALES

1. If for reasons of economy, or the limitation of the machine it is mounted on,the travel on the moving part of a particular machine axis exceeds the travel of the Transducer head on the scale, mechanical stops may have been fitted.If these stops are interfered with, and the machine drives the Transducer head to its limit, the scale may be irreparably damaged.
2. It is **not recommended** for users to try and clean contaminated scales. Cleaning the Glass Scale is a delicate operation, and damage done in attempting to clean it may void the warranty.
   Do not use compressed air near the scale enclosure, as this will force contaminates through the seal into the enclosure. *Keep the alignment bracket for the reading head - it must be used each time the scale is dismounted*.

WARNING

Certain cutting coolants are very corrosive to the wires and cables used in the scale reader heads. It is the responsibility of the end user to ensure that all cutting coolants are compatible with the copper and insulation used in the connecting cables.
The coolants designed for modern CNC machines are generally acceptable e.g. EPCENT F by Century Oils.

STANDARD TRANSDUCER/ENCODER CONNECTION DETAILS

(All models)

Pin No	**Function**
A	Signal A
B	Signal B
C	+ 5 volt
D	0 volt
E	Earth
F	Marker Pulse

11. GOODWIN ELECTRONICS WARRANTY

CONSOLES

We undertake to repair or replace, at our discretion, any console that becomes faulty due to defects in parts or workmanship for a period of one year from date of purchase.
Consoles that become faulty due to miss-use, excessive mains voltage or which have not been maintained in accordance with the published maintenance schedule will be repaired, at the prevailing charges, at customers expense.

SCALES

Scale assembly parts are warranted against defects in material and workmanship to the consumer for a period of one year from date of purchase.
It applies only to scales and accessories which have been installed and operated in accordance with instructions in our reference manuals, have not been tampered with in any way, mis-used, suffered damage through accident, over traversed, neglect or conditions beyond our control, and have been serviced only by authorised distributors or service personnel.
Labour to service a defective instrument or accessory at our premises is free of charge for one year from date of purchase.
Goodwin Electronic Measuring Systems Ltd is not responsible for loss in operating performance due to environmental conditions, such as humidity, dust, corrosive chemicals and coolants, deposition of oil or other foreign matter, spillage, excessive swarf build up or other matters beyond our control.
Goodwin Electronic Measuring Systems Ltd shall not be liable under any circumstances for consequential loss or damages.

SERVICE.
Should the need arise for service or repair to either scales or consoles please contact our service department at,

GOODWIN ELECTRONICS
6 Lumina
Martindale Road
Croft Business Park
Bromborough
Wirral
CH26 3PT
Tel. 0151 33 44 555 Fax. 0151 334 1616

In order to assist us with a speedy service response please quote the relevant model and serial number of the console or scale as indicated below,

1. Consoles Rear top left hand side for serial number (6 digit number)
2. Scales Front face left hand side for serial number (6 digit number)

12. RELAY OUTPUT CONNECTIONS

25WAY D TYPE CONNECTOR

1	no connection	14	no connection
2	no connection	15	reserved
3	no connection	16	reserved
4	no connection	17	reserved
5	no connection	18	0V (internal use only)
6	no connection	19	reserved
7	no connection	20	reserved
8	no connection	21	reserved
9	+5V (internal use only)	22	no connection
10	no connection	23	relay normally closed
11	no connection	24	relay common
12	no connection	25	relay normally open
13	no connection		