SECTION 4 - Peripherals

List of Contents

PERIPHERALS

The input/output hardware allows a program to address up to sixty-three peripherals. This Section lists many of the peripheral devices available for the Molecular 18 (enhanced version), together with operating instructions where necessary.

Periodically, new peripherals are added to the Molecular 18 Product Line, and details of these additions will be issued and added to this Manual as soon as they are available.

There now follow brief descriptions of some of the peripherals available with the Molecular 18 :-

PAPER TAPE READER

The high speed paper tape reader has a maximum reading speed of 500 ch/sec. The reader employs photo-electric sensing, which permits high operating speeds and also reduces failures arising from mechanical wear.

The sensing system automatically adjusts for changes in tape parity, lateral tape registration or tape colour, and can read 5 to 8 channel tape. The reader uses a braking system which allows the tape to stop reliably on a single character from maximum speed.

The reader has no Input buffer, but the DATI 1 instruction gives input in the normal manner, character-by-character.

How to Load the Paper Tape Reader

The paper tape reader is normally housed in the same cabinet as the Paper Tape Punch. The tape that is to be read should previously have been wound on a plastic reel, 2" in diameter, specially formulated to fit the dispenser hub of the reader (see diagram below). The first 3ft. of tape must contain sprocket holes only, thus allowing enough manoeuvrability for the tape to be placed on the spooling system and yet still allow the reader to sense the first character of data to be read.

At the other end of the tape there should be at least 6 inches containing sprocket holes only, in order to ensure that the reader operates efficiently.

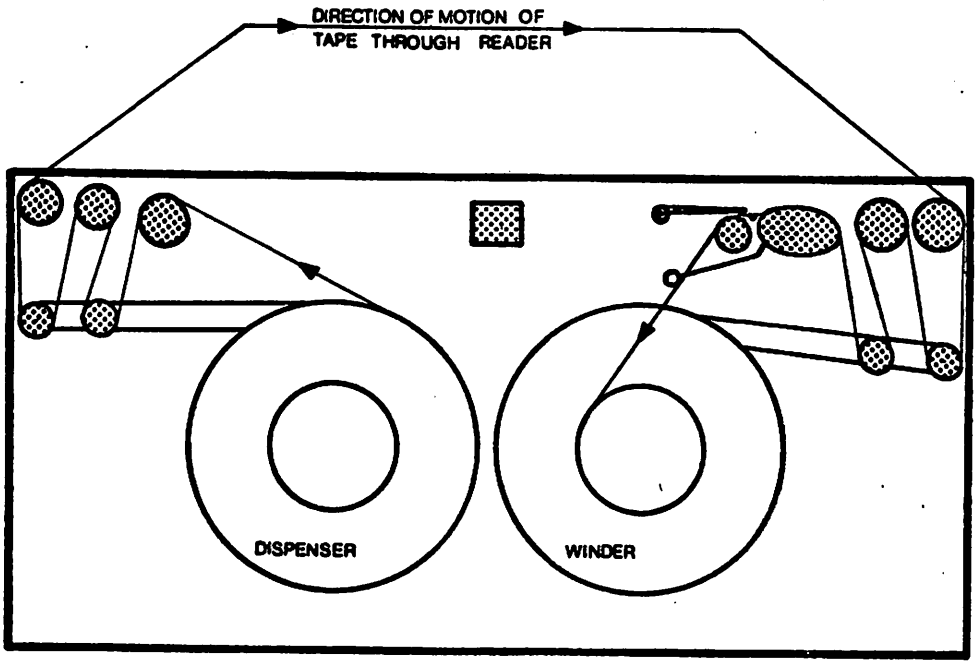


Fig. 4:1

Instructions for Loading the Tape Reader

1) Ensure that the power switch for the spooler is 'off'.

2) Holding the reel of tape so that the sprocket holes (or guide edge) are furthest away, place it on the pliable hub of the dispenser. The tape should now leave the reel in an anti-clockwise direction ; if it does not, the reel will have to be rewound before use.

3) Tighten the hub in a clockwise direction.

4) Pass the tape through the pulleys on the take-up arm on the left-hand side, as shown in the diagram.

5) Lift the reader gate, and pass the tape through the reader. (The guide edge should now be towards the back of the reader. If it is not, the tape has been wound incorrectly, and all data will be misread if the tape is not first rewound).

6) Pass the tape through the pulleys on the take-up arm on the right-hand side exactly as in the diagram, so that the tape passes over the Tape Sensing Arm and then between the flap and roller on the Tape Width Adjustment mechanism.

7) Roll the tape round the winder hub (which should have a plastic reel on it) in the direction shown.

8) Ensure that the hub of the winder has been tightened in a clockwise direction.

9) Manually turn the winder in an anti-clockwise direction several times, to make sure that the tape is secure.

10) Lower the gate on the reader.

11) Put the power switch for the spooling system 'on'.

PAPER TAPE PUNCH

The Paper Tape Punch is normally housed in the same cabinet as the High Speed Reader (see Page 4: 2). It is capable of punching paper, oiled paper or syntosil tapes. No adjustment is necessary to cater for different widths of standard tape, and the design features simple tape insertion. Appendix 14 shows the Standard Tape Dimensions (1" tape).

The punching speed is approx. 70 ch/sec continuous for the fast paper-tape only version, but should it be necessary to punch cards as well as tape there is a slower version which operates at approx. 40 ch/sec continuous.

The punch can be hard-wired for automatic insertion of the parity bit, with a choice of odd or even parity or of no parity. If no parity, then any code can be punched.

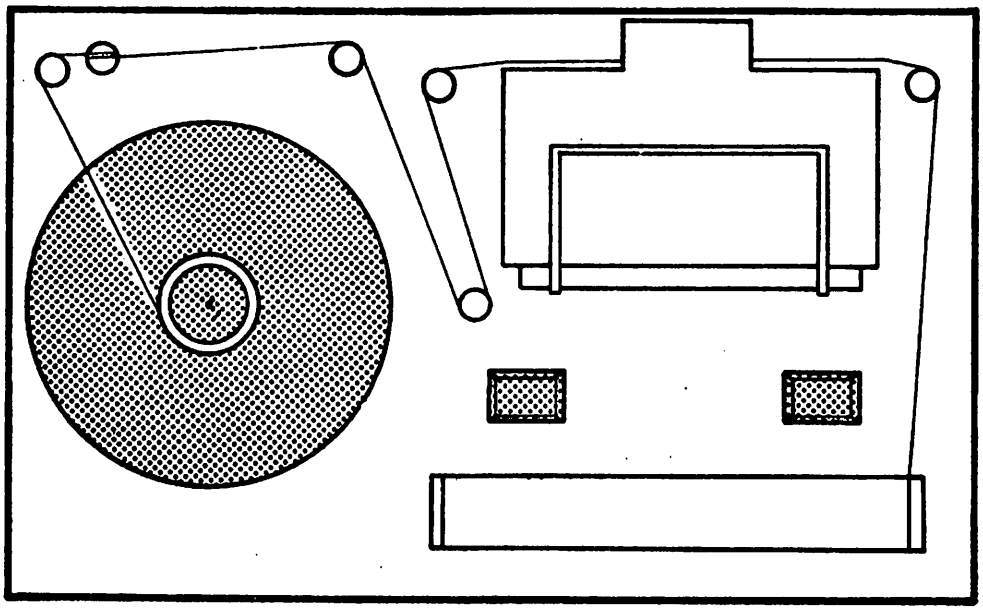


Fig. 4:2

Instructions for Loading the Paper Tape Punch

1) Ensure that the power switch for the punch is in the 'off' position.

2) Pull out the drawer and open the front flap.

3) Place a fresh spool of tape on the turntable so that it is running in a clockwise direction.

4) Pass the end of the tape first round the left-hand tension arm, then over the right-hand pulley and over the end of the drawer.

5) Close the front flap of the drawer (it is held by a magnetic catch), holding the tape carefully so that it still runs freely over the pulley, and push the drawer in.

6) Bring the end of the tape up so that it passes over the right-hand pulley (see diagram) and into the punch, pressing the Tape Insertion button. If there are no sprocket holes present on the tape, the Feed Control lever should be in the '+' position. If there are already sprocket holes, the Feed Control lever should be in the '-' position.

7) Pass the tape over the remaining pulleys and through the tape-lock, as shown in the diagram, Fig. 4. 2, and wind onto the spool, which should already have in place a plastic reel, 2" in diameter, on which to wind the tape.

8) Make sure the tape is secure, tighten the hub and place the power switch for the punch in the 'on' position.

Note

To empty the chad box, just pull it away from the punch and lift it clear.

IBM 735 I/O WRITER

The typewriter is the IBM 735, with 88 printing symbols plus Tab, space, back space, carriage return, vertical space and case shift. The normal electric typewriter functions are present, such as left and right margins, line space adjuster, clutch release, tab set, tab clear, platen adjuster and impression adjuster. The maximum printing speed is 15½ ch/sec.

The IBM can use Netherlands correspondence Golf-balls and other special heads in addition to the normal BCL 'Sterling' head.

An important point to note is that the Tab and Carriage Return Keys on the typewriter are not mechanically connected to the mechanism, therefore if these Keys are depressed during an Input no physical action will be observed - this is a hardware function. Also, when the IBM is in upper case, operation of the Tab or Carriage Return Keys has no effect whatsoever. All other Keys, apart from Function Keys, print simultaneously when depressed. The entire character set for the IBM 735 is listed in the table in Appendix 2. The Operating System ensures that the IBM internal code is converted automatically to and from the ECMA 6 character-code.

The typewriter separates its Input and Output functions and should be regarded as two different devices. Each has its own Device Code, its own Busy, Done and Interrupt Disable flags and its own interrupt priority mask-bit assignment. The IBM Input device includes the Keyboard Lock which has no operational indicators or status. The Keyboard of the typewriter remains locked until the 'Unlock' is programmed.

Unlock is a DATO 2 command to the Input Device, with Bit 2 only set in the specified accumulator.

Lock is a DATO 2 command to the Input Device, with Bit 1 only set in the specified accumulator.

Any parity failure on Input or Output will be shown as a Status Failure in the Status Register - DATI 2 - of the IBM Input device only.

I.B.M. 735,—KEYBOARD

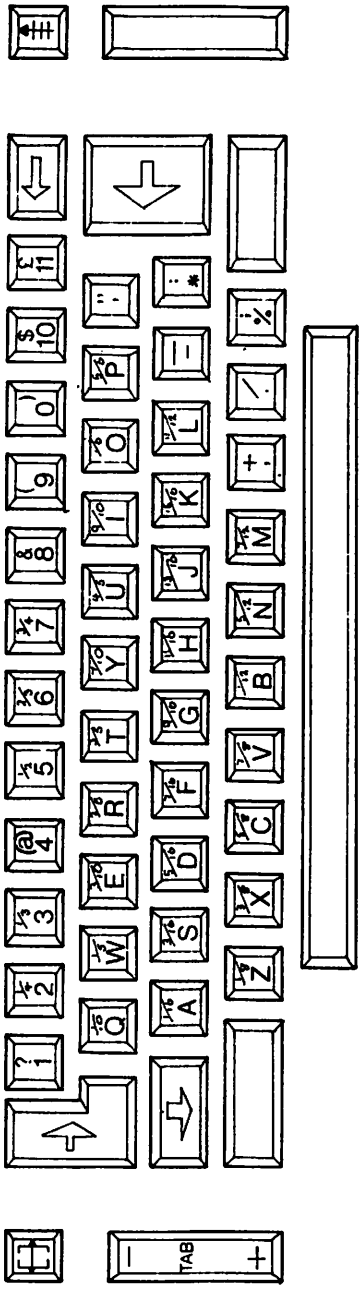


Fig. 4:3

TALLY ROLL PRINTER

Each character is composed of a number of dots - these dots are selected from a 5 x 7 dot matrix, namely 5 columns of 7 dots each. The printing speed is 60 lines per minute, which gives a character rate of 50 ch/sec (20 char/sec. per line). Hard copy paper-roll print-out of data is given and the maximum number of character positions per line can be fixed to give from 18 to 20. There are 64 printing characters available, including Letters A to Z, Numerals Ø to 9 and also various other symbols as shown in the Code Set in Appendix 5. The character size is a maximum of 2.5 mm high and 1.8 mm wide with a minimum of 0.7 mm between one character and the next, giving 2.5 mm pitch. This gives approximately 10 characters to the inch.

The printer accommodates action paper-roll, the maximum width being 60 mm $\pm^{0}_{1}$ (2 5/16th" ± 1/32nd"). The action paper roll is readily replaceable by using a hinged lid at the front and there is a paper-feed push button at the rear of the cover.

Further developement is envisaged to give two action paper print-out, and also a VT command which will index the paper 2", at a rate of 4 lines per second.

The printer has a single character buffer, each character being printed with the print head moving continuously in a serial entry mode. Should the section of data being output include a Carriage Return (C/R) a new line will be initiated, as also occurs after the output of 20 characters. The paper transport is automatic during carrier return after each line of print.

START and DATO 2 initiate the printer cycle, and when the Printer is ready to accept data Done and Interrupt will be set. DATO 1 and START plus data in the normal manner perform the print operations for the current line, and when all characters for that line have been transferred START and DATO 2 are given if another line is to follow. After the print cycle has been initiated, the print head continues to move whether printing or not, and undue delays (i.e. more than 2-3 ms) must be avoided in the output of data.

The 'Bel' Code (which produces a half-second audible alarm) may be output only as the last character of a line :-

i.e. a) Immediately before a C/R

b) As the 20th character of a line

c) As the last character of the whole output

If this code is inserted in any other position the output will cease abruptly and jam the mechanism of the Printer.

TALLY ROLL PRINTER

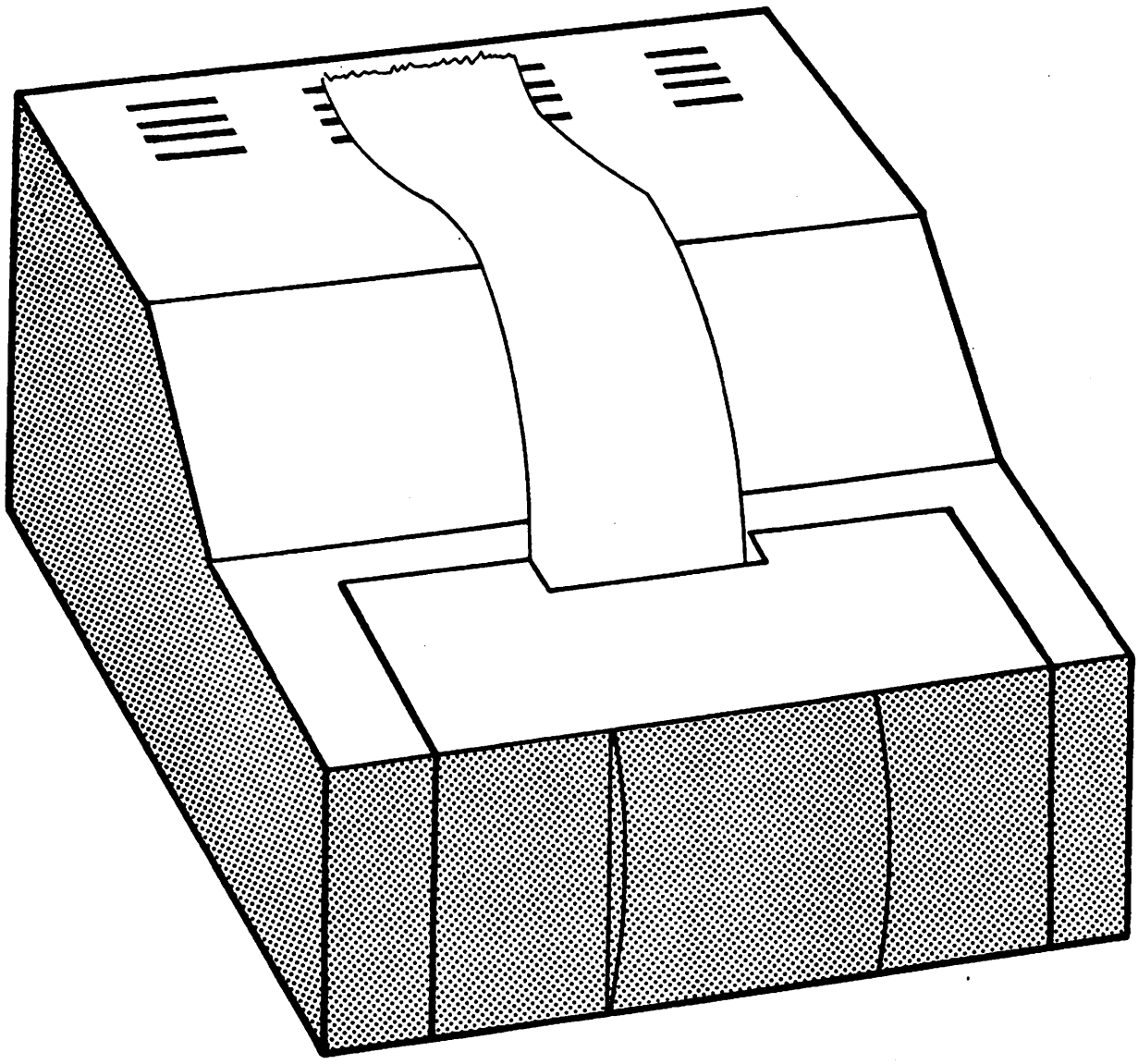


Fig. 4:4

B.C.L. 7 x 5 DOT MATRIX SERIAL PRINTER (PO75/248)

This printer is of the mosaic type, each character being formed by a series of discontinuous points. The mosaic is a matrix of 5 x 7 points, 5 in the vertical plane, 7 in the horizontal plane. The speed of printing is 75 characters per second with synchronous or asynchronous modes of data transfer. The printer handles two sets of continuous stationery and outputs hard copy of 249 characters per line, the printing head tabulating to any position from 1 to 248 both in the forward and reverse direction.

There are 64 printing characters available, including Letters A to Z, Numerals Ø to 9 and also various other symbols as shown in the Code Set in Appendix 3. The character size is 2.54 mm. high and 1.83 mm. wide, with 2.56 mm. pitch. Line spacing is 6 lines to the inch.

The printer accommodates up to six copies of 49 gsm (maximum) using carbon interleaving, or 7 or more if special paper is used. The maximum width of paper overall, either two sets side by side or a single set, is 28", and the minimum width of paper which can be used is 4". Standard perforated (sprocket holed) continuous fanfold stationery (to BS4623-1970) should be used.

The output from the processor to the printer is controlled by the DATO 1 START command, DATO 2 START being used instead whenever a 'Tab' is to be performed. The printer will tab backwards or forwards to the specified position at a speed of 75 ch/sec before printing the next character. Since a TAB is executed at printing speed only, there is no time advantage in using the facility, only a saving in core storage. Spaces may, of course, be used instead of tabs where required, but there is no backspace available. Carriage Returns and Line Feeds may be called where necessary from program in any sequence. The C/R command on its own causes the printer to carriage return at an approximate speed of 220 ch/sec, but does not move the paper up. Should a C/R command be issued whilst the carriage is at the left-hand margin there will be no movement of the carriage. If, through a program error, the PO75 is asked to print more than 249 characters, eventually an automatic CR will be called to prevent the printing head locking up. This facility is only there to protect the hardware and must not be relied upon. LF1 normally refers to the top left-hand tractor and LF2 to the bottom or right-hand tractor.

Controls

There are five push-buttons located on the right-hand side of the cabinet, as shown below :-

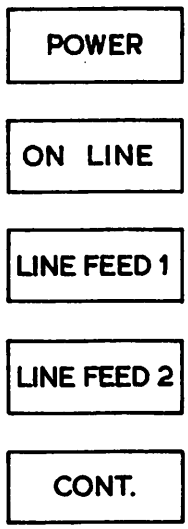


Fig. 4:5

1) Power

This is a red pushbutton control which, when depressed, applies power and also illuminates the switch. Depressing it once again turns the power off, and the illumination is also turned off. When power is first switched on, the P075 automatically performs a C/R.

2) On Line

This is a green pushbutton control which is illuminated when on. Pressing this pushbutton places the printer 'On Line'; that is, causes the printer to respond only to program instructions, disabling the manual controls.

Should the machine be switched 'off-line' while in use, any instruction already in hand will be completed before going 'off-line', when the machine will no longer respond to program instructions.

3) Line Feed 1

This is a yellow pushbutton with no illumination. In the 'off-line' mode, each depression of 'Line Feed 1' will index the top (left-hand) tractor by one line.

4) Line Feed 2

This is a yellow pushbutton with no illumination. In the 'off-line' mode, each depression of 'Line Feed 2' will index the bottom (right-hand) tractor by one line.

5) Cont.

This is a white pushbutton with no illumination. In the 'off-line' mode, if this 'Continuous' button is pressed in conjunction with either 'Line Feed 1' or 'Line Feed 2', the paper will feed continuously until either button is released.

On the top right-hand side of the cabinet there are two forms control Knobs, by means of which the print may be adjusted to correspond to the lines on the paper. These Knobs may be used when the machine is switched off, and the arrangement is such that the range of movement from these two controls is unlimited.

LINE PRINTER

The Line Printer available for use with the Molecular 18 computer is the LP 3000, with a printing speed of 135 lines/min (300 ch/sec.), plus or minus 2%. It outputs hard copy composed of 132 characters per line. 64 printing characters are available, including Letters A to Z, Numerals Ø to 9 and various other symbols as shown in the Code Set in Appendix 4. Each character is .070" wide and .1" high and there are 10 characters per inch. The printer accommodates up to three copies of paper stock from 4" to 14⅞" wide, each form being 11" maximum in length. Spacing is six lines to the inch.

Each printer has a hardware buffer which holds up to 132 characters. To print a line, the program must first load this buffer character-by-character ; once the buffer is full the line of characters is printed automatically. However, when it is not desired to print a full line the program need only send characters, including spaces, as far as the right-most nonspace character ; the giving of a Print command (C/R) at this point initiates a print cycle, with only the filled portion of the buffer producing a print-out. In every print cycle, printing starts automatically in the correct position at the left edge of the paper ; it is not necessary to send a LF instruction unless double spacing is required.

Output to the Line Printer can be controlled in either of two ways, Character-by-Character mode or Data Channel Mode.

In character-by-character mode it is possible to output several lines in one output.

e.g. If an output is made of "Name C/R Address C/R Address C/R" the Line Printer will print out three lines.

It must be emphasised that the printer will automatically output a line either as soon as the buffer (132 chars.) is filled or when a C/R command is encountered, and not under any other circumstances.

The Line Printer may also be used in Data Channel Mode in which case the instruction DATO 2 sets the mode. Then DATO 1 START (with the relevant Accumulator containing the appropriate core buffer address) initiates the transfer to the internal buffer of the Line Printer. Done is set and printing occurs either when this buffer is filled or when it receives a C/R, therefore only one line at a time may be output when in Data Channel Mode. The Line Printer then returns to character-by-character mode.

e.g. If an output is made of "Name, C/R Address, C/R Address, C/R", only the first line, i.e. Name, will be printed if in Data Channel Mode.

The disadvantage of using character-by-character mode is that it uses much more processor time than when in Data Channel mode.

Note :- Any "Line Feed" or "Top of Form" characters contained in a line to be output do not go into the internal buffer of the Line Printer, and are executed before the line is actually printed. (This applies to both modes of output).

e.g. Output of A B L/F CD L/F C/R results in L/F L/F ABCD.

Therefore, as L/F and 'Top of Form' characters do not go into the internal buffer, they do not count towards the 132 characters required to to fill the buffer.

Operating Controls and Indicators for Line Printer

Prior to operating the Line Printer, ensure that :-

a) The paper is loaded

b) The ribbon is installed

c) The Forms Thickness control is set to the required forms thickness

d) The power is switched on.

There are six controls situated on the top right-hand side of the cabinet, as shown in Fig. 4. 6, below :-

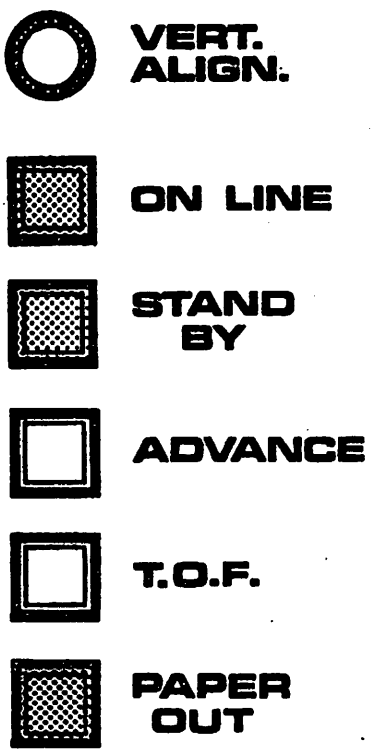


Fig. 4:6

1) VERT. ALIGN. This is a rotary control knob, adjustment of which changes the relationship of the printed line to the paper form. Turning the knob clockwise raises the printed line on the paper form. Turning the knob counter-clockwise lowers the printed line on the paper form. A total adjustment of four lines can be made.

2) ON LINE. This is a green pushbutton control which is illuminated when on. Pressing this pushbutton places the Printer 'On Line'; that is, causes the Printer to operate only under program control. When this pushbutton is illuminated, the Standby pushbutton illumination is turned off.

3) STANDBY. This is a yellow pushbutton control which is illuminated when on. Pressing this pushbutton places the Printer in a Standby position ; it is also activated when power is first applied to the Printer. When in a Standby condition, the On Line pushbutton illumination is turned off, and the Advance and T.O.F. buttons may then be activated for manual control of paper movement.

N.B. When the Printer is to be shut down, the Standby pushbutton should be depressed before switching power off.

4) ADVANCE. This is a white pushbutton with no illumination. Pressing this pushbutton causes the paper to advance one line if the Printer is in Standby mode.

5) T.O.F. This is a white pushbutton with no illumination. Pressing this pushbutton causes the paper to advance to the top of the form (the start of a new printing page form), if the Printer is in Standby mode.

6) PAPER OUT. This is a red pushbutton which is illuminated if the paper runs out. This condition will occur when the forms in the machine are used up, when the Printer automatically goes into Standby mode.

i.e. The Standby lamp is illuminated and the On Line lamp turned off.

At this time there will be approximately six inches of unused form left in the machine. If it is desired to complete the printing on this form, depression of the On Line pushbutton momentarily, will cause one line to be printed. This may be repeated until all lines have been filled, remembering that the Printer will continue to print after the bottom of the form is past if the On Line pushbutton continues to be pressed.

Another use for the Paper Out button, either when On Line or in Standby Mode, is that depression of it rotates the ribbon, thereby enabling a piece of torn or holed ribbon to be by-passed.

Format Tape.

A vertical format unit for either 12 channel or 4 channel IBM compatible format is available for operation with the Printer on an optional basis.

NUMERIC KEYBOARD & DISPLAY

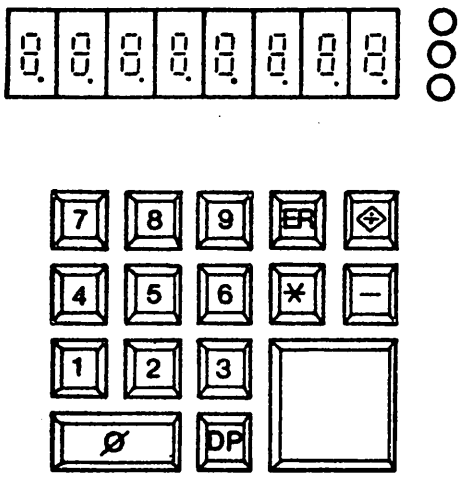


Fig. 4:7

NUMERIC KEYBOARD WITH DISPLAY

The design of the Numeric Keyboard is based upon a 10-key adding machine design, with a raised dot on the '5' key to encourage touch operation. The actual lay-out of the 16 key Keyboard is shown on the opposite page, see Fig. 4. 7.

The unmarked key at the bottom right-hand side is the "Accept" (or End Entry) key. This key produces the "ETB" Code, and should be programmed to give an End Entry function.

Each key produces a Code, as shown in the Code Set in Appendix 7.

The ER key produces the "Can" Code and will normally be programmed to provide "Erase", "Error" or "Cancel"Facilities, and will clear the Display.

The ⊜ key can be programmed to initiate a sub-total Function (either on an invoice, or to display a sub-total of entries made so far), or perhaps to act as a "Divide" key in a straightforward calculator context.

The * key can be programmed to initiate a "Total" Function (either on an invoice, or to display a total of the entries made to date), or perhaps to act as a "Multiply" key in a straightforward calculator context.

The - key produces the "-" Code and will normally be programmed to indicate negative figures. It can also be programmed to alter the arithmetic meaning of fractional digits entered .

i.e. 12.05 = 12 1/20th ordinary decimal entry
12-05 = 12 5/16ths programmed fractional entry of pounds and ounces.

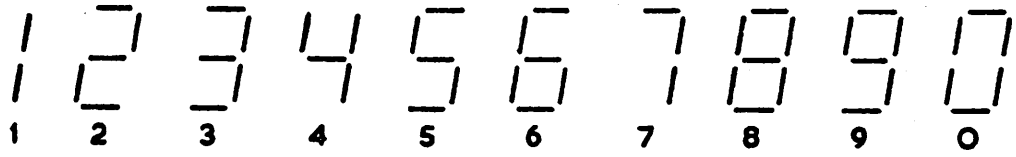
The DP key produces the "period" code, and will normally be programmed for use as a decimal point.

The Accept key, as mentioned previously, produces the "ETB" Code, and should be programmed to give an "End Entry" function.

It should be mentioned that the afore-mentioned keys are not tied by hardware to any particular part or function and, where necessary, one of the keys may be programmed as a "Control" (or Change Meaning) key, so that the combination of this key and a numeric key can give Control Functions to suit particular requirements. This is an easy method of providing Control facilities with very little complication in operation or program.

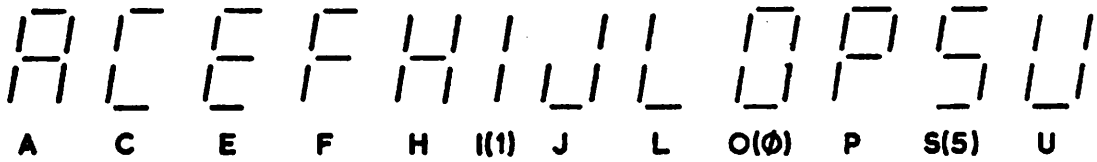
The Keyboard has a single character Input buffer. Associated with the Keyboard is the eight-positional Display, which uses a 7-bar display system. The 7-bar matrix is as follows :-

All numerals can be displayed from the Keyboard or the processor thus :-



also

The numeric display can also display certain alphabetic characters called from the memory by program :-



Characters displayed from memory are called up by the appropriate Codes as follows (and as shown in Appendix 7) :-

	Bits		Bits
1	65...1	E	7...3.1
2	65..2.	F	7...32.
3	65..21	H	7..4...
4	65.3..	I (1)	.65...1
5	65.3.1	J	7..4.2.
6	65.32.	L	7..43..
7	65.321	O(Ø)	.65....
8	654...	P	7.5....
9	654..1	S(5)	.65.3.1
Ø	65....	U	7.5.3.1
A	7....1	.	.6.432.
C	7...21		

This Facility can be used to convey simple messages to the operator. i.e. error indications, type of entry required next, etc.

Where a large number of messages have to be displayed for the operator's attention, one of the best is :-

meaning "refer to Message 36" - this allows as many messages as necessary. Obviously, many other messages can be displayed - some of these are listed on opposite page.

A	LESS
ALL	LIEU
ALLOC	LO
ASSESS	LOOP
CALL	LOSS
CEASE	LULL
CHANGE	OF
CHOICE	OFF
CHOOSE	PASS
CUS	PLEASE
EACH	PLUS
FAIL	POS
FALSE	SAFE
FILE	SALE
FILL	SCALE
HI	SPACE
IF	UP
IS	

The display output from the processor is a programmed DATO 1 command. The program can clear the Display or send a message at any time (the maximum speed of output of messages sent in this way is at the rate of 1 character per 100 μ).

The Display works on the shift register principle, each character entering at the right and all shifting left one place. When programmed to do so :-

It shows a decimal point when the DP key is used
a blank frame when the '-' key is used
a blank frame when the ✱, ⟐ or Accept keys are used.

Operation of the 'ER' key clears the Display.

The Keyboard is also equipped with a series of operator warning lights, which are entirely automatic. When the Keyboard is 'ready', and the CPU able to accept data, the Green light is on, telling the operator to enter a character. Immediately an entry is made the Green light goes off, the Amber light comes on and a buzzer sounds, starting to make a half-second 'bleep' noise, signalling that no more data will be accepted. Immediately the character is processed and the Keyboard is made 'ready' again, the buzzer stops, the Amber light goes off and the Green light comes on again. If the character is accepted straight away, this process is normally so fast that the Amber flicker and bleep will not be noticed by the operator. However, if the Keyboard is not made 'ready' again quickly (i.e. because the Keyboard is Off Line or awaiting access), the amber light stays on and the half-second bleep will be heard. Should the operator press another key while the Keyboard is in this state, the Red light will come on and Status Bit 3 be set (finger trouble). The Red light also comes on for a Parity error, when Status Bit 2 is set. (The Red light is cleared by an I/O Pulse from Software.)

The half-second bleep can also be produced by programming the Code "BEL" (Bits 1, 2 and 3). The Code "CAN" (Bits 4 and 5) clears the Display.

ALPHA/NUMERIC KEYBOARD WITH DISPLAY

The design of this Keyboard is based upon an accepted typewriter (ECMA) configuration with a numeric Keyboard joined to the right-hand side. The actual lay-out is shown on the opposite page, Fig. 4.8.

The design of the Numeric Keyboard is based upon a 10-key adding machine design, with a raised dot on the '5' key to encourage touch operation.

The unmarked key at the bottom right-hand side is the "Accept" (or End Entry) key. This key produces the "ETB" Code, and may be programmed to give an End Entry function.

Each key produces a Code, as shown in the Code Set in Appendix 7. :-

The ER key produces the "CAN" Code, and would normally be programmed to provide Erase, Error, or Cancel facilities, and will clear the Display.

The ÷ key can be programmed to initiate a sub-total function, or perhaps to act as a 'Divide' key in a straightforward calculator context.

The ✱ key can be programmed to initiate a total function, or perhaps to act as a 'Multiply' key in a straightforward calculator context.

The - key produces the '-' code and will normally be programmed to indicate negative figures.

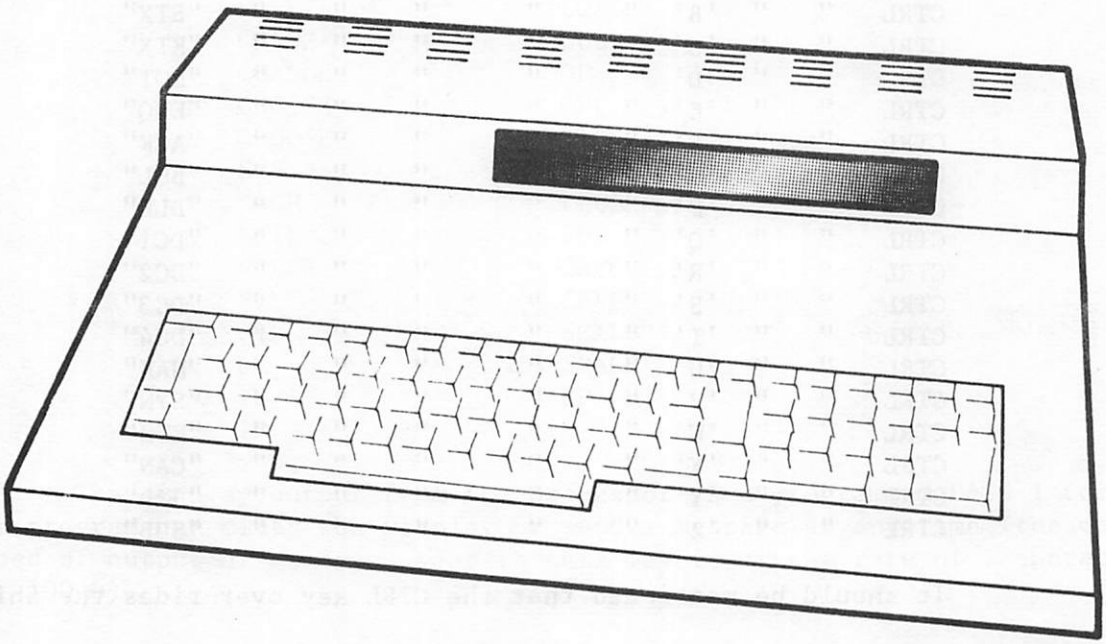
The DP key produces the'period' code, and will normally be programmed for use as a decimal point.

The Accept key, as mentioned previously, produces the 'ETB' Code, and could be programmed to give an 'End Entry' function.

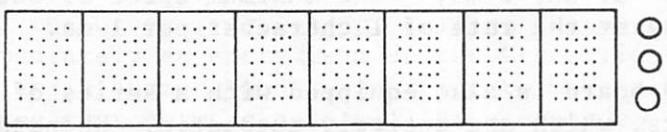
The 'typewriter' portion of the Keyboard produces 68 characters, as well as being equipped with the normal Tab, Carriage Return, Space bar, Shift, Backspace, Line Feed and Vertical Tab. The Control key (CTRL) used on its own has no function, but used in conjunction with certain other keys can produce the ECMA Control Codes. The blank key between the zero of the numeric keyboard and the right-hand shift key is inoperative. The % (per cent) and ‰ (per thousand) keys set next to the numeric portion of the Keyboard may be used to modify calculations only if programmed in this way.

All available Upper Case characters are as depicted on the lay-out on the opposite page. The key with the down-pointing arrow on the left-hand side just above the shift key is the shift lock ; while this is in use, a red light will show in the bottom left-hand corner of the Keyboard. Either shift key can, of course, be used independently of this shift lock.

The BCL 7-bit coded character set for the Keyboard is shown in Appendix 7. Parity is even - Bit 8 is added where necessary.



ALPHA—NUMERIC KEYBOARD & DISPLAY.



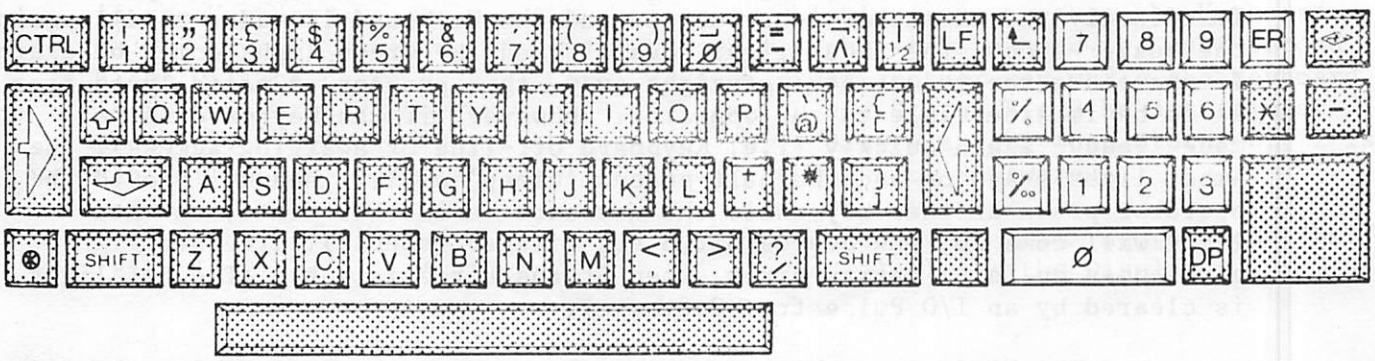


Fig. 4:8

CTRL	plus	the	'@'	key	produces	the	ASCII	Code "NUL"
CTRL	plus	the	'A'	key	produces	the	ASCII	Code "SOH"
CTRL	"	"	'B'	"	"	"	"	"STX"
CTRL	"	"	'C'	"	"	"	"	"ETX"
CTRL	"	"	'D'	"	"	"	"	"EOT"
CTRL	"	"	'E'	"	"	"	"	"ENQ"
CTRL	"	"	'F'	"	"	"	"	"ACK"
CTRL	"	"	'G'	"	"	"	"	"BEL"
CTRL	"	"	'P'	"	"	"	"	"DLE"
CTRL	"	"	'Q'	"	"	"	"	"DC1"
CTRL	"	"	'R'	"	"	"	"	"DC2"
CTRL	"	"	'S'	"	"	"	"	"DC3"
CTRL	"	"	'T'	"	"	"	"	"DC4"
CTRL	"	"	'U'	"	"	"	"	"NAK"
CTRL	"	"	'V'	"	"	"	"	"SYN"
CTRL	"	"	'W'	"	"	"	"	"ETB"
CTRL	"	"	'X'	"	"	"	"	"CAN"
CTRL	"	"	'Y'	"	"	"	"	"EM"
CTRL	"	"	'Z'	"	"	"	"	"SUB"

It should be mentioned that the CTRL key over-rides the Shift Key.

Associated with the Alpha/Numeric Keyboard is the eight-positional Display, which uses a 5 x 7 Matrix Dot System.

The Display works on the shift register principle, each character entering at the right and all shifting left one place (i.e. 'The cat sat on the mat' displays 'THE MAT' at the end of the text).

Any 'displayable' character called from memory by program, using the appropriate code, can be shown on the Display. This facility can be used to convey many types of messages to the operator. The Display Output from the processor is a programmed DATO 1 command. The program can clear the Display or send a message at any time, - the maximum speed of output of messages sent in this way being at the rate of 1 character per 1 ms.

The Keyboard is also equipped with a series of operator warning or indicator lights, which are entirely automatic. When the Keyboard is 'ready', and the CPU able to accept the data, the Green light is on, telling the operator to enter a character. Immediately an entry is made the Green light goes off, the Amber light comes on and a buzzer sounds, starting to make a half-second 'bleep' noise, signalling that no more data will be accepted. Immediately the character is processed and the Keyboard is made 'ready' again, the buzzer stops, the Amber light goes off and the Green light comes on again. If the character is accepted straight away, this process is normally so fast as to be imperceptible to the operator. However, if the Keyboard is not made 'ready' again quickly (i.e. Keyboard off-line or awaiting access), the Amber light stays on and the half-second 'bleep' will be heard. Should the operator press another key while the Keyboard is in this state, the Red light will come on, and Status Bit 3 set (finger trouble). The Red light also comes on for a Parity error, when Status Bit 2 is set. (The Red light is cleared by an I/O Pulse from Software).

The half-second bleep can also be produced by programming the Code "BEL" (Bits 1, 2 and 3). The Code "CAN" (Bits 4 and 5) clears the Display.

THE C.R.T. VISUAL DISPLAY UNIT TERMINAL

The C.R.T. Visual Display Unit Terminal can be used as an on-site device, or as a stand-alone remote terminal communicating with the CPU in a conversational mode, either over a telephone line or by a cable up to 50 ft. long. The current unit is type 92423-10, which is called a 'Block Mode Conversational Display Terminal'.

Three methods of display and conversation with remote devices are possible :-

a) Half Duplex (Conversational Mode)

b) Full Duplex (Echoplex/check)

c) Block Mode

In each case, data coming into the Terminal will take preference over local operations, and the Keyboard will be disabled whenever data transfer is taking place. Received data will display at and continue from the last cursor position, unless programmed to do otherwise.

The 2-position Duplex switch (HALF and FULL), which determines the manner in which Keyboard-entered data is transmitted to the communication system, is on the back of the display terminal, and is normally preset for a particular installation.

Half Duplex setting causes each Keyboard data entry to transmit character-by-character to remote equipment and also to display immediately as a result of key depression.

Full Duplex setting causes each Keyboard data entry to transmit character-by-character to remote equipment, and each entry is not displayed on the view screen unless returned (echoed) from the remote equipment (e.g. the CPU).

Block Mode The Block Mode switch is located above the numeric cluster on the Keyboard. This two-position pushbutton switch activates BLOCK MODE operation only when in the depressed position. Block Mode setting causes each Keyboard data entry to display immediately as a result of key depression. This enables data to be composed on the display before actual transmission. Transmission can be in stages using the 'STX' and 'EOT' keys, or the whole page can be transmitted at once. By exercising control of the cursor on a full page and selective use of 'EOT', the page may be transmitted in separate blocks.

The speed of transmission is determined by the BAUD RATE switch on the back of the display terminal, which is selectable. However, the baud rate is normally preset for the system on which it is used, as required by the Modem or Telephone line when transmitting data. The Modem Coupler to which it is connected in the CPU must be of the correct type for the speed selected.

The complete VDU unit consists of :-

a Keyboard
a C.R.T. internal control memory
modem interface CCITT-V24

The Keyboard

The Keyboard can be described as having three-level or tri-state operations :-

Shift, Unshift or Control.

It has three sections :-

a) A silent electronic data entry Keyboard 'styled' like a standard tele-typewriter layout.

b) A numeric 10-key adding machine cluster, in addition to the basic numeral row.

c) Common tele-typewriter function codes available by 'CNTRL + Key' depression and, in addition, frequently used functions available from their own keys.

The Keyboard is the Input device for the Terminal, using Device Code 50 upwards. The actual lay-out for the 92423-10 is shown on the opposite page. The character repertoire includes the alphabet in upper and lower case, arabic numerals Ø to 9, punctuation marks and special characters, all of which are shown in Appendix 6 .

It is possible to disable the 96 character set and select a 64 character upper-case only sub-set (Columns 2, 3, 4 & 5 of Code Set in Appendix 6.).

The following paragraphs describe operation of the Shift, Lock, Space bar and Rub Out keys and the Repeat key.

Shift and Lock Keys

The two Shift keys and the Shift Lock key allow selection of uppercase letters or the uppercase characters on the double-character keys. They have no effect on the Numeric cluster. Depression of the Shift Lock key will lock the Keyboard in uppercase position. The Lock key is released by depression of the adjacent shift key.

Space Bar

The depression of the Space bar causes a character space to display above the cursor. The cursor will move forward one character position in the normal manner.

C.R.T. VISUAL DISPLAY TERMINAL KEYBOARD. (92423-10)

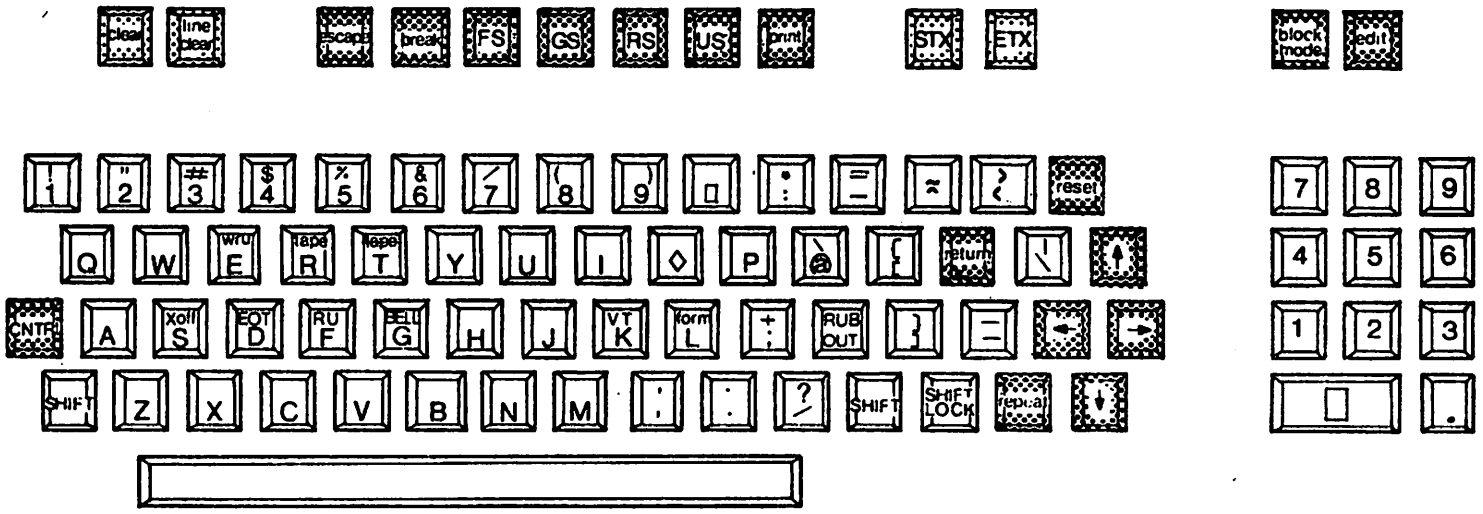


Fig. 4:9

Rub Out

When the terminal is set for Block Mode Duplex operation, depressing this key produces the symbol '■' above the cursor, the cursor then moving forward one character position in the usual way. In either of the other two Duplex modes, depressing this key generates the Rub Out code for transmission only (LOCAL operating mode, of course, prevents transmission). This same symbol '■' could appear within a message received from the CPU. It would indicate that a parity error may have occured in the transmission of the character meant for that position.

Repeat

This is an assigned special function key. Depression of this key in conjunction with any other key or combination of keys causes the particular character or control code for that/those key/s to be generated and/or displayed on the screen at approximately 10 times per second. This key is provided purely as an operator convenience for entering characters which have to be repeated. (e.g. ----------)

Control Function Keys

The terminal Keyboard will generate 32 control function codes commonly used with tele-communications input devices. Appendix 6. shows these codes, and also explains the Keyboard operations required to generate these codes. Note that many often-used communication and edit function codes are available from their own separate keys as well as from the CNTRL + character-key combination, typical of tele-typewriter operations.

Use of the control function keys depends on the communications mode in which the terminal is being operated, and whether it is desired to affect the display only or to transmit control codes to remote receiving devices. Rules governing the use of the control function keys are described in the following paragraphs.

N.B.

All 32 control functions can be generated without using the shift key. However, depression of the Shift key in conjunction with CNTRL + key operation or the separate control function does not interfere with the desired function.

CNTRL + Character Key

Depressing the CNTRL key in conjunction with any data key assigned a control function, generates control codes as follows :-

IF HALF DUPLEX (and not LOCAL) the code is transmitted to the remote device (e.g. CPU) and the display is affected in accordance with the function's purpose.

IF FULL DUPLEX (and not LOCAL) the code is transmitted to the remote device (e.g. CPU) and the display is not affected unless the remote device returns (echoes) a display affecting a control function code or displayable character code to the terminal.

IF BLOCK MODE, the paired lower-case sign on non-operational Control keys is stored (hidden) in the displayed message at the correct cursor position, and appears on the view screen as a blinking character whenever the CNTRL key or the EDIT key is depressed. (This blinking character identifies the control function code stored at that particular point, and will correspond to the appropriate character shown in Columns 4 and 5 of Appendix 6.). The exceptions are :-

1) The SO and SI codes (CNTRL + N and CNTRL + O), which display as their identifying characters (non-blinking ⟨ and ⟩ respectively) and initiate and terminate inverse video display.

2) The ETX code, which always displays a non-blinking '▲'.

Generally, when the terminal is in BLOCK MODE, the CNTRL + key operation should be used only when it is desired to insert a control function in a message to a remote device as part of that message for the receiving device to perform. The separate control function key should be depressed when it is desired either to transmit (STX) or to perform edit functions (CLEAR, RESET, etc.) on the displayed message while your terminal is in Block Mode.

Separate Control Function Key

Depressing separate control function keys (e.g. RESET, RETURN, etc.) generates control codes as follows :-

IF HALF DUPLEX (and not LOCAL) the code is transmitted to the remote receiving device, and also causes display operation as described later under the control function key descriptions.

IF FULL DUPLEX (and not LOCAL) the code is transmitted to the remote receiving device, and the display is not affected unless this remote device returns a display-affecting control function code or a displayable character code to your terminal.

IF BLOCK MODE (or LOCAL) the code causes display operation as described under the control function key description below.

CLEAR Key (or CNTRL + X when not Block Mode)

The CLEAR function removes all data from the display screen and resets the cursor. If the machine is in scroll format mode, the cursor resets to the first character position of the last line. If in page mode the cursor resets to the first character position of the top line.

LINE CLEAR Key (or CNTRL + V when not Block Mode)

When in page mode, the LINE CLEAR Function removes all displayed data from the cursor position to the end of the line. The cursor does not move, and only the line with the cursor is affected.

When in scroll mode a LINE CLEAR cannot be executed, either from Keyboard or by output from program.

RETURN Key (or CNTRL + M when not Block Mode)

The RETURN function causes the cursor to reset to the first character position of the line it is in (Carriage Return). This does not affect data.

RESET Key (or CNTRL + Y when not Block Mode)

The RESET function does not affect displayed data. If in scroll format mode, the cursor will reset to the first character position of the last line. If the machine is in page mode, the cursor will reset to the upper left-hand corner of the display.

The following four keys with arrows give control over the cursor in four directions, for use as a pointer to the next character position which will be affected by input or output :-

BACKSPACE (←) Key (or CNTRL + H when not Block Mode)

The backspace function moves the cursor back one character position without affecting displayed data. If the cursor is in the first character position of a line when the key is depressed, it will move automatically to the last character position in the preceding line. If the cursor is in the first character position of the top line, it moves to the last character position in the bottom line.

SKIP (→) Key (or CNTRL + U when not Block Mode)

The skip function advances the cursor one character position. If the cursor is in the last character position of any line except the last line when the skip function is enabled, it will move automatically to the first character position of the next line. If the cursor is in the last character position of the bottom line when in scroll mode, all data moves up one line position, the top line disappears from the viewing screen and the cursor moves to the first character position of the new blank bottom line. If the cursor is in the last character position of the bottom line when in page mode, the cursor moves up to the first character position in the top line.

Up (↑) Key (or CNTRL + Z when not Block Mode)

The Up function moves the cursor to the same relative position in the next line up, and displayed data is not affected. Should the cursor be in the top line when the up function is enabled, the cursor moves to the same relative position in the bottom line.

Down (↓) Key (or CNTRL + J when not Block Mode)

The Down function (Line Feed) moves the cursor to the same relative position in the next line down. Displayed data is not affected unless scroll mode is active and the cursor is in the last line. In this case all data moves up one line, the top line disappears from view on the viewing screen and the cursor returns to the first character position in the blank bottom line. This operation provides a Carriage Return and Line Feed function when these conditions apply. When the cursor is in the bottom line and page mode is active, the cursor moves to the same relative position in the top line.

Inverse Video (CNTRL + N and CNTRL + O)

The coding CNTRL + N generates inversion of video (black characters on a white back-ground) in certain selected areas of the display. The 'end' inverse video control code is CNTRL + O. The portion of the display between these start and end codes appears as black characters on a white back-ground. There are no limitations as to where, how many, or how much may be inverted. Inverse video fields are bracketed on the display, with the start inverse video symbol '<' and the end inverse video symbol '>'. The start and end codes may also be received from the CPU (see Appendix 6.).

BREAK Key

This is an assigned special function key. Depression of this key when the VDU is in remote operating condition transmits a 'break' signal to the CPU. This is a common tele-communications signal, which drives the Data signal line to "space" condition for 300 millisecs.

If a break condition should occur on the receive data line from the CPU, the display will show two error symbols '■■'.

Start of Text (CNTRL + B)

When in HALF or FULL DUPLEX mode, depression of the CNTRL key in conjunction with the B key transmits the Start of Text control function code to the remote equipment. In FULL DUPLEX, if the remote equipment echoes the code, the terminal disregards the code. In HALF DUPLEX, the display portion of the terminal ignores the code.

When the terminal is in BLOCK MODE, depression of the CNTRL key in conjunction with the B key enters the Start of Text control code at the cursor position in the displayed message. Thereafter, whenever the CNTRL key or Edit key is depressed, this control code will appear on the view screen as a blinking 'B'. This function serves to mark the beginning of multiple messages which an operator may wish to compose on the display screen. After the start of a message has been marked with this function, the end may be marked with the End of Text Function (see ETX description).

End of Text (ETX or CNTRL + C)

When in HALF or FULL DUPLEX mode, depression of the CNTRL key in conjunction with the C key or depression of the actual ETX key, transmits the End of Text Code to the remote equipment. The EXT character (▲) is displayed when in HALF DUPLEX mode, and also when in FULL DUPLEX mode if the remote equipment echoes this code back.

When operating in BLOCK MODE, depression of either the ETX key or CNTRL plus C keys enters the End of Text control code at the cursor position in the displayed message. The code appears on the view screen as the ▲ character. This function may be used to mark the end of the text of multiple messages which are being composed. (This code will not stop message transmission ; only the EOT code will stop transmission before the end of the last display line is reached).

End of Transmission (CNTRL + D)

When in HALF or FULL DUPLEX mode, depression of the CNTRL key in conjunction with the D key (EOT) transmits the End of Transmission code, but the display ignores it.

When the terminal is in BLOCK MODE, depression of the CNTRL key in conjunction with the D key enters the End of Transmission (EOT) control code at the cursor position in the displayed message. Thereafter, whenever the CNTRL key or Edit key is depressed, this control code will appear on the view screen as a blinking 'D'. This function must be used if it is desired to end message transmission at some point before the end of the last display line.

Start of Block Transmission (STX Key)

The STX key allows transmission of displayed messages to remote equipment when operating in BLOCK MODE transmission. When in BLOCK MODE, depression of the STX key locks the data entry keyboard, and the terminal then automatically transfers the message from wherever the cursor is set through the first following EOT code or the end of the last display line, whichever occurs first. Any control codes contained in the message will be transmitted along with the displayed characters. If a carriage return control code is transmitted, any spaces between that carriage return and the next displayable character on that line will not be transmitted, but any other codes will be. The first displayable character, or the end of the line, or the end of the block transfer will disable this space suppression mode of operation.

When operating in FULL DUPLEX or HALF DUPLEX mode, depression of the STX key transmits the Start of Text code, but the display ignores it.

EDIT switch

Above the numeric cluster on the Keyboard is the two position EDIT switch/indicator. In the depressed position, all control functions entered previously by CNTRL plus key operation during messages composed in BLOCK MODE appear as their blinking character identifier.

N.B.

If the CNTRL key is depressed to view location of previously entered control codes (e.g. Start of Text indicator, blinking 'B') so that the cursor can be set to the correct position, on no account may any other keys, such as any of the cursor control keys, be used while the CNTRL key is still held depressed. The CNTRL key must always be released before positioning the cursor on the display, as otherwise control codes will inadvertently be entered into the displayed data. The EDIT switch will be found very useful for the purpose of viewing these hidden control function characters.

The remaining functions :-

FS	(or CNTRL +)	-	File Separator
GS	(or CNTRL +)	-	Group Separator
RS	(or CNTRL +)	-	Record Separator
US	(or CNTRL +)	-	Unit Separator
Escape	(or CNTRL +)	-	Escape

are available for special usage dependent upon the program.

There are four controls and indicators associated with recording data on a hardcopy printer which are not used in the Molecular 18 system. These are the PRTR BSY and PRTR ACT indicators (which are situated among the 6 indicator lights situated on the left-hand side of the operator panel beneath the display), the 'PRINT' key and the "PRINTER REQUEST' push button Switch/Indicator.

DISPLAY

The display portion of the C.R.T. Visual Display Unit Terminal consists of a television display module with a viewing area 8" high and 10" wide. The C.R.T. displays 8 lines of 80 characters (which can be expanded to display 16 lines of 80 characters), and so has a memory of 640 characters. Characters appearing on the display screen are dot formed within a 5 x 9 dot matrix, and they appear nominally 3/32" wide and 3/16" high. A cursor (entry marker) appears on the display screen as a blinking underline dash to indicate the position where the next character entry will display on the screen. Although it is an underline symbol, it is NOT possible to underline messages on the display.

As the cursor advances from the 72nd position of any line to the 73rd or when it starts the bottom line a momentary audible alarm sounds. This audible alarm can also be activated from the CPU to notify an incoming message, or for other programmed usage.

POWER CONTROLS AND INDICATORS

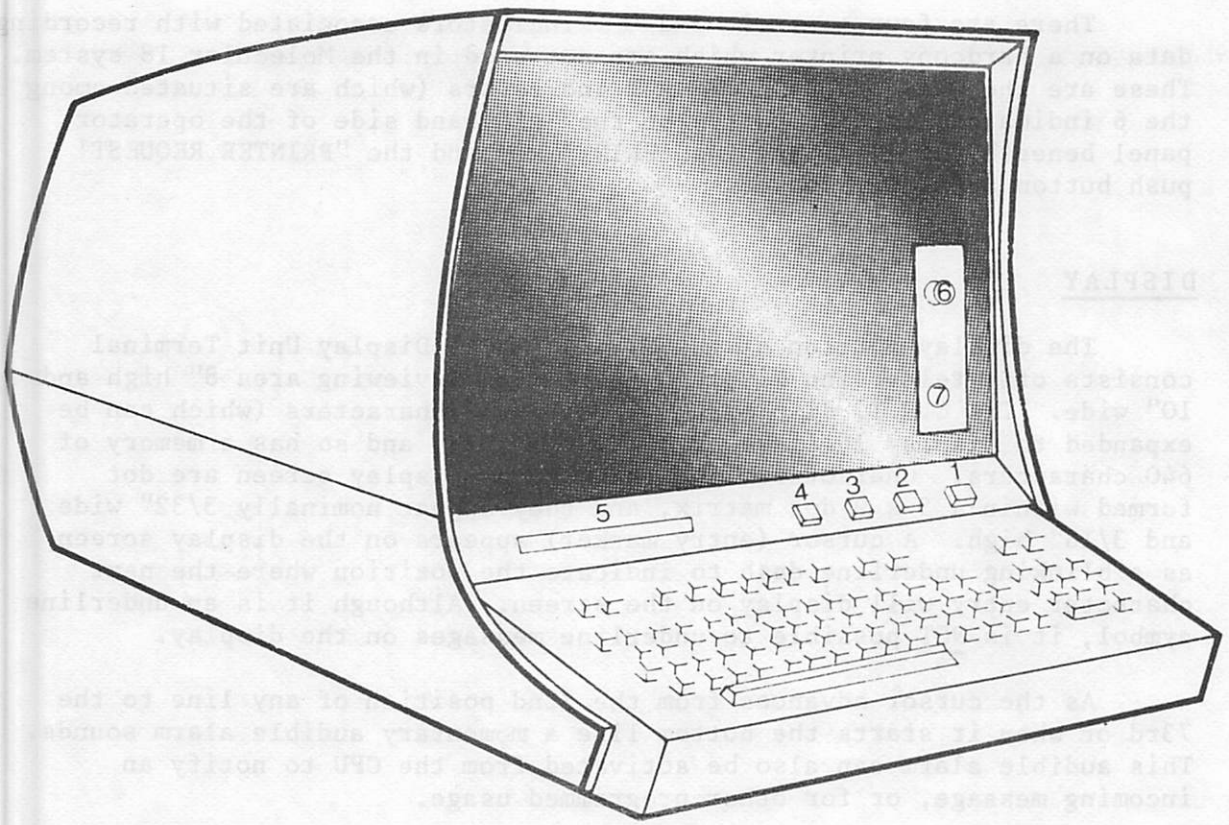
The following section describes the power controls and indicators contained on the C.R.T. as shown in Fig. 4.10.

1) POWER This is a square pushbutton control located on the operator control panel below the display (see diagram on next page). Depressing the switch applies power and also illuminates the switch. Depressing it once again turns the power off and the illumination is also turned off. The cursor should appear on the left-hand side of the display screen within 30 seconds approximately of the power being turned on.

2) PAGE MODE This control provides two display format mode selections, scroll and page. The scroll mode is the normal format used, though the page mode is frequently adopted for display terminal communications. In the scroll mode, data enters the bottom line of the display starting at the left-hand side. When the cursor reaches the last character position

cont/ 4:33

C.R.T. VISUAL DISPLAY TERMINAL



1 to 5 AS SHOWN BELOW
6 INTENSITY CONTROL
7 KEYLOCK SWITCH

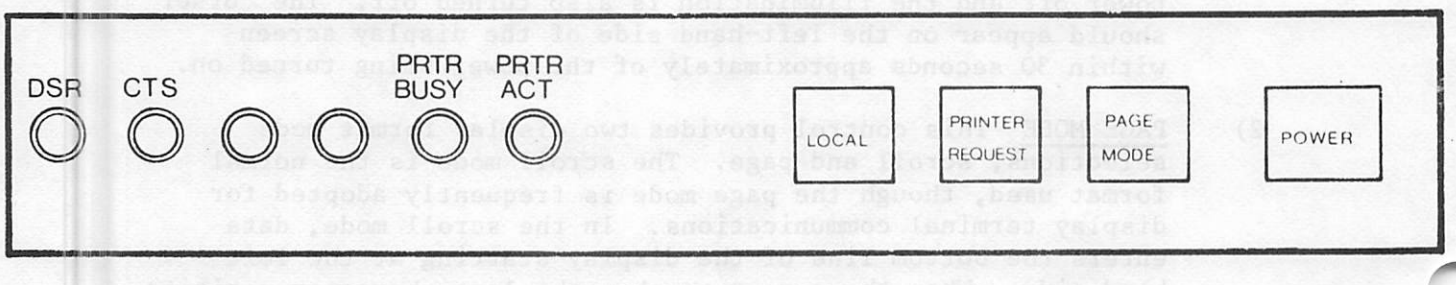


Fig. 4:10

of this line, any additional input of data causes all lines to move up one line space and the cursor to position to the first character position in the bottom line again. The top line disappears from the screen (therefore it should be obvious that one should not use the last character of the last line if 8 lines of information are required to be displayed).

When the PAGE MODE switch is pressed, the indicator is illuminated and scroll format is disabled. The display then operates in the page format mode, meaning that data entry starts at the top left-hand corner of the display and the cursor moves across and down the display screen. When the cursor reaches the last position of the bottom line, any additional input of data positions the cursor to the first character position of the top line, thereafter over-writing the previous data.

3) PRINTER REQUEST Not used.

4) LOCAL This pushbutton switch allows the C.R.T. Visual Display Terminal to be placed off-line from the tele-communications line, and so not transmit any data to the remote party. However, the Terminal will still be able to receive any incoming messages. The switch should be depressed to attain 'Local' condition, when it will be illuminated.

5) There are 6 indicator lights situated on the left-hand side of the operator panel below the display. Only 2 of these are actively used in the Molecular 18 system, to indicate the status of the communications channel between the Terminal and a remote equipment. These are DSR (Data-set Ready) and CTS (Clear to Send).

6) Brightness Control This control should be turned until the required brightness or intensity is reached. Extra high intensity will make any displayed data appear out of focus and will also shorten the life of the display viewing screen.

7) Keylock Switch When the special key is inserted and turned such that the lockout indicator is illuminated, the Keyboard is completely disabled from operator entry. Messages may still be received, but none may be entered by the operator. This control is primarily a protective feature.

There is also a Lockout Indicator which illuminates to indicate that the terminal Keyboard is locked out. This can be accomplished by the Keylock switch and also during data transfer operations.

A Modem Coupler 2100 interface fitted to the Molecular 18 enables data to be transmitted or received serially on one line using the Datel Post Office data transmission service on Public Telephone/Telegraph network or Private circuit (leased lines). The Modem is a free-standing self-contained device connected to a telephone hand-set and the data processing equipment - it is 17" wide x 6.75" high x 14" high. It will be accessed in the normal way, using the same device codes, 50 for Input and 40 for Output. The Modems will all be asynchronous.

THE D1600 & DD1600 DISC

Every disc has 406 circular data tracks on each surface ; a track is divided into 16 Sectors, each of which holds 128 words of data. This gives a total of 12,992 Sectors or 1,662,976 words, which is equivalent to 1600K of core for each disc.

The sectors are numbered Ø to 31277 (Octal). The first 32 sectors (Sectors Ø to 37, the first cylinder) must not be used for permanent data or for vital temporary data, and three cylinders at the end (Sectors 31140 to 31277 inclusive) are reserved for essential routines and contingencies. Sectors 40, 41 and 42 are also reserved, therefore the maximum usable storage available (Sectors 43 to 31137 inclusive) is 12,861 sectors or 1,646, 208 17-bit words. Each word on disc can represent signed or unsigned binary quantities from Ø to 1111111111111111 (i.e. 65,535 decimal), or two character-code Alpha/Numeric characters, or three metacode characters, or four Hexadecimal characters, or an address or a program instruction, etc.

The speed of rotation is 2,400 r.p.m. (25 ms. per revolution). 8 Sectors may be written or read in 12.5 m.secs. once the transfer begins. The average random access time is 49 ms., with the worst being 96.5 ms.

The Disc Controller can control up to 4 disc drives "daisy chained", each able to have 1 fixed and 1 exchangeable disc. Therefore a maximum configuration would give a total of 8 discs, equivalent to a nominal capacity of 12.8 M words on one controller.

There are two boards (2057 and 2058) per controller, mounted in the processor chassis ; the disc drive cabinet contains only the drive, with power packs and air conditioning. The drives incorporate blowers and filters to provide clean air internally as a clean-air environment is very necessary - the heads 'fly' on the boundary layer of air on the disc, and are only loaded when the disc is up to speed.

Bits 15 and 16 in the Status Register specify the Disc Drive (Ø to 3) and, on the DD, Bit 17 is used to specify the Fixed disc. (The DD has the Fixed disc on the same spindle). All discs have the same sector numbering.

Program Functions

Disc transfers occur in Data Channel Mode, therefore the program should address the required disc, specify the 1st buffer core address, specify the Sector Address and whether a Read or Write operation is required.

The Disc System uses several I/O Instructions (see Page 3:35 for correct Assembler mnemonics) :-

DATO 1 (with Device Address)

This loads the Sector address (Ø to 31277 Octal) from Accumulator A or B to Register 1 in the controller and initiates a "seek" - this aligns the read/write heads on the required cylinder. The Sector address will be located, read and checked whether or not START or IOPLS is sent. Register 1 is not cleared at the end of a read or write sequence or when a status error occurs, but will be over-written by a further DATO 1 instruction. Should DATO 1 be sent during a 'seek' it will be ineffective, except that it will set Bit 6 (Address incorrect) in the Status Register. On Auto-Sector Coun (see Page 4:35), the Sector Address in Register 1 will be incremented by the controller, except on the last transfer in each block.

DATO 2 (with Device Address)

This instruction loads the first core address from the specified accumulator into Register 2 in the controller. This address will be incremented automatically after each data-channel transfer by the controller. Note that the core address used must be absolute, rather than the relative address in User Programs. Register 2 is not cleared, but may be over-written by a further DATO 2 instruction.

DATO 3 (with Device Address)

This instruction loads Bits 17 to 10 into Register 3 from the specified accumulator.

Bits 17, 16 and 15 call for the required Drive on a daisy-chain and/or the Fixed disc. These bits are never reset, but may be overwritten by a further DATO 3 instruction.

Bit 17 is "Disc-Select", '1' for fixed or 'Ø' for exchangeable.
Bits 16 & 15 are binary "Drive-Select" (Ø - 3).

Bit 14 is a memory having no operational function, but which may be used as a flag by the program. This bit also is never reset, but may be overwritten by a further DATO 3 instruction.

Bits 13, 12 and 11 A feature has been included which enables the controller to handle multiple sector transfers (up to 8 in sequence, which is equivalent to 1K of words). A counter, in Bits 13, 12 & 11 of Register 3, is loaded on a DATO 3 instruction when multiple sector transfers are required, and will count down to zero as successive sectors are transferred and the Sector Address incremented. On completion, Bits 13, 12 and 11 should be zero and Register 1 should contain the last sector address used. The auto-sector count will be created as follows :-

Bits 13, 12, 11			No. of Sectors
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

thus, if multiple sector transfers are not required and Bits 13, 12 and 11 left blank, the controller will transfer a single sector only.

Any status failure will cause an interrupt and the complete transfer should then be retried. Mixed read/write is not possible. Note that it is inadvisable to inspect (DATI 3) during multiple sector transfers, since the counts are changed during the sector sequence.

The count may be cleared by CLEAR or I/O Reset.

Bit 10-Monitor Should be a temporary fault, such as Logic fault, Off Line, Temperature Limit or RTZ be detected (by DATI 3 inspection), DATO 3 + Bit 10 in the relevant accumulator should be sent. A monitor (Bit 10) will then be set in Register 3, only if the delay condition was still present when the DATO 3 + Bit 10 occured. This monitor, if activated, will provide an interrupt when Busy and the source of delay is removed. Monitor may be inspected on a DATI 3 instruction and, if present, the instruction 'START' sent - if Busy is not set at the time of recovery the Interrupt will occur as soon as it is, unless the monitor has been reset previously. Bit 10 may be reset by CLEAR, I/O Reset, or a valid DATO 1 instruction (but not during seek). When a monitor interrupt occurs, the status fail register (Bits 1-8 inclusive) should be clear.

DATI 1 (with Device Address)

This instruction may be used to read back the Sector Address from Register 1 into Accumulator A or B.

DATI 2 (with Device Address)

This instruction may be used to read back the current Core Address from Register 2 into Accumulator A or B.

DATI 3 (with Device Address)

This instruction may be used to read back the Status from Register 3 into Accumulator A or B. This will include advisory status bits, therefore Bit 1, the common fault bit, must be used to test for a status failure.

All bits except 14,15,16 and 17 may be reset by CLEAR, I/O Reset or a valid DATO 1 (not during seek).

START or Set Busy, Clear Done (with Device Address)

This instruction initiates Read from Disc sequence. Read will not occur until a seek has been completed.

IOPLS or Input/Output Pulse (with Device Address)

This instruction initiates Write to Disc sequence. Write will not occur until a seek has been completed.

Note that DATO 1 may occur with START or IOPLS or may follow later. Alternatively DATO 1 may precede the START or IOPLS by not more than 160 μ secs. for Read/Write to occur ; if more than 160 μ secs. elapse, then Read/Write may or may not occur, therefore this situation should be avoided.

Always send the core address first (DATO 2) followed by the DATO 1 etc., as if a core address is not sent any core address sent previously will continue to increment.

CLEAR or Clear Busy, Clear Done (with Device Address)

This instruction clears Busy, Done, interrupt request memories and Status Bits 1 to 10.

I/O Reset

This instruction clears Busy, Done, interrupt request memories and Status Bits 1 to 10, and also restores the heads to the Zero track.

On completion of the sector (or sectors), the Controller sends an Interrupt, and the Status (DATI 3) must then be inspected to ensure that the transfer was valid.

Register 3 bit allocation

Bit 1 = Common 'fault' bit (indicates that a fault exists).

Bit 2 = Logic fault (indicates that the D1600 logic is unsafe, through power supply failure, etc.).

Bit 3 = Off Line (drive not up to speed or not connected).

Bit 4 = Temp. Limit (drive outside temperature limits ; should not be used).

Bit 5 = Checkword Incorrect (cyclic redundancy check failed on read back).

Bit 6 = Address incorrect (address unobtainable, or DATO 1 sent during seek).

Bit 7 = Data late (data channel not available in time).

Bit 8 = Seek error (address called for unobtainable, or heads failed to move correctly).

Bit 9 = Seeking (seek in progress).

Bit 10 = Monitor active.

Bit 11, Bit 12, Bit 13 = Auto Sector Count.

Bit 14 = Flag.

Bit 15, Bit 16 = Drive select

Bit 17 = Disc select (fixed or exchangeable).

Status fail bits 1 to 8 inclusive are reset by CLEAR, I/O Reset, valid DATO 1, or Monitor active and source of delay removed.

MAGNETIC STRIPED CARD HANDLER

This device is supplied on a modified IBM 735 I/O Writer to provide both front and rear channel card feed ability, with magnetic data-storage stripes on the front card only.

The unit is completely contained inside a removable assembly mounted above the I/O Writer. The size of the unit is :-

23" (584 mm) Wide
9" (228 mm) High
9" (228 mm) Deep

and the weight is 30 lbs. approximately plus the I/O Writer. The complete assembly is mounted on spring clip pivots so that it can be removed easily for transport or service and swung clear of the typewriter. (It must not be carried by the guide carrier tube as it will bend.)

Three visual indicators coloured Red, Yellow and Green are provided on the right-hand side of the unit for information on Operator (or logic) errors. These indicator lights are under software control, and their function is determined by system details.

The guides on the front feed for the magnetic stripe cards are adjustable in steps of 30 mm.

The Left-Hand Guide has two positions only, A and B :-

Position A is such that character position Ø on the IBM will print 31 mm. in from the left-hand edge of the card.

Position B is 30 mm. to the right of Position A.

The Right-Hand Guide can be positioned at 30 mm. intervals, to cater for 4 card widths.

Removable drop-in guides are provided for the plain card in the rear channel. The Left-Hand Rear Sprocket Feed also has positions A or B only, but the Right-Hand Rear Sprocket Feed has 8 positions at 30 mm. intervals to cater for all plain card widths.
(N.B. Sprocket positioning on the Rear feed only cannot be altered easily by the operator.)

The normal card height is 297 mm. (A4 size), the magnetic stripe card having a minimum width of 210 mm. increasing in 60 mm. steps to a maximum width of 390 mm., and the rear plain card having a minimum width of 180 mm.

cont/4:40

MAGNETIC STRIPED CARD HANDLER

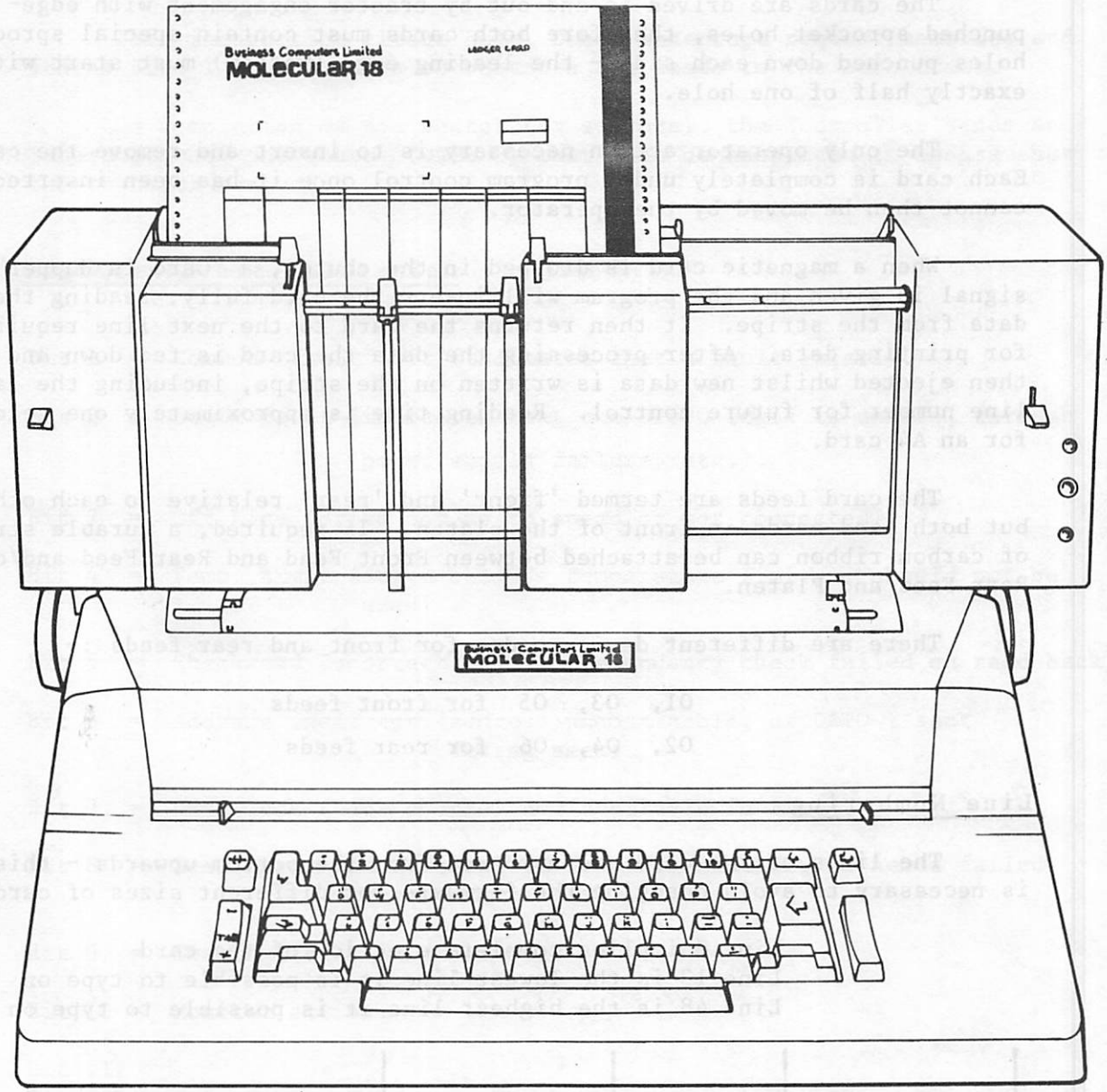


Fig. 4:11

increasing in 30 mm. steps to a maximum width of 390 mm. 31 mm. should be deducted from the width quoted for each magnetic stripe, to obtain the length of the writing line. The stripes must not be written over or printed on. Writing lines are at 6 mm. pitch, therefore the number of lines on an A4 card is 36. The maximum printing speed is 15½ characters per second.

The cards are driven in and out by tractor engagement with edge-punched sprocket holes, therefore both cards must contain special sprocket holes punched down each side - the leading edge (bottom) must start with exactly half of one hole.

The only operator action necessary is to insert and remove the cards. Each card is completely under program control once it has been inserted and cannot then be moved by the operator.

When a magnetic card is dropped in the chutes, a "Card in Hopper" signal is given and the program will insert the card fully, reading the data from the stripe. It then returns the card to the next line required for printing data. After processing the data the card is fed down and then ejected whilst new data is written on the stripe, including the last line number for future control. Reading time is approximately one second for an A4 card.

The card feeds are termed 'front' and 'rear' relative to each other, but both feed cards in front of the platen. If required, a durable strip of carbon ribbon can be attached between Front Feed and Rear Feed and/or Rear Feed and Platen.

There are different device codes for front and rear feeds :-

01, 03, 05 for front feeds

02, 04, 06 for rear feeds

Line Numbering

The lines of the card are numbered from the bottom upwards - this is necessary to avoid changing the firmware for different sizes of card.

Line Ø implies complete ejection of the card
Line 13 is the lowest line it is possible to type on
Line 48 is the highest line it is possible to type on

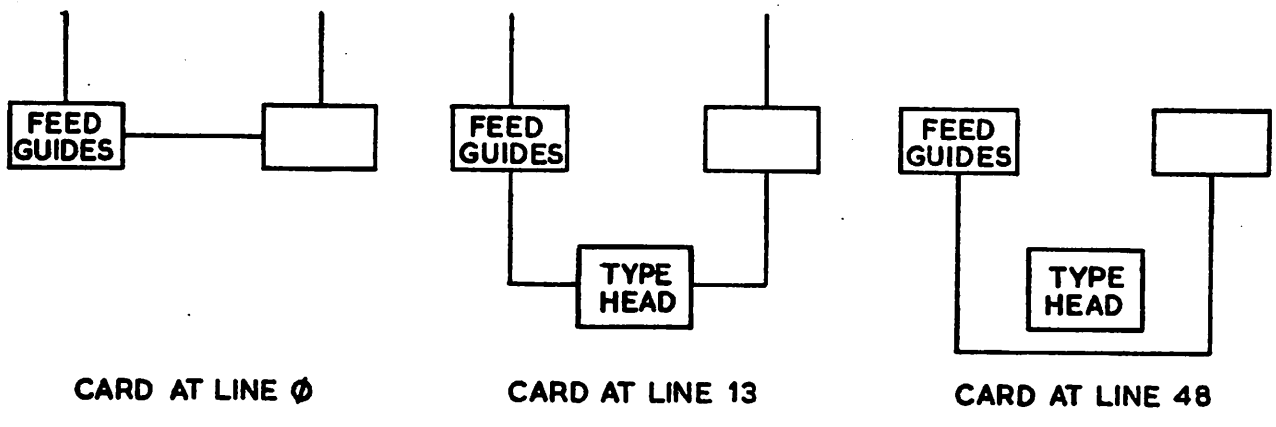


Fig. 4:12

Header and Tail loss :-

Top of card to 1st line	-	72 mm
Bottom of card to last line	-	15 mm

Stripe Formatting

On A4 size (297 mm. high) cards, the stripe format is as follows, from the bottom of the card upwards. (All bytes are 8 bits.)

32 Bytes (alternate "Null" and "All Bits") identifier

1 Byte Preamble (Octal 125)

2 Bytes Hash Total (of Data)

300 Bytes of Data

Only the 300 bytes of data are accessible to the programmer, the other bytes being used for logical and software checks and timing control.

Circuit Description

The BCL - manufactured circuitry is in three parts :-

a) Two small pc boards (2064) which mount inside the unit, replacing the boards number 21314.

b) IO board 2062, which carries control logic for the front (magnetic) card channel, plus circuitry for reading and writing the magnetic stripe.

c) IO board 2063, which carries control logic for two non-magnetic card channels.

FUNCTIONS

The functions available are as follows :-

a) Insert card to Line "N"
b) Eject card to Line "N"
c) Line Feed
d) Read from Magnetic Stripe } Front Feed only
e) Write to Magnetic Stripe }
f) Remove card
g) Light Indicator Lamps

Function (a) - Insert card to Line 'N'

The operation is initiated by DATO 2 + START, with the specified accumulator containing Bit 1 set and also the line number in Bits 9-14 inclusive. Busy is cleared and Done set to signal the completion of the operation.

Function (b) - Eject card to Line 'N'

The operation is initiated by DATO 2 + START, with the specified accumulator containing Bit 2 set and also the line number (which may be zero) in Bits 9-14 inclusive. Busy is cleared and Done set to signal the completion of the operation.

Function (c) - Line Feed

The operation is initiated by DATO 2 + START, with the specified accumulator containing Bit 3 set and Bits 9-14 clear. Busy is cleared and Done set to signal the completion of the operation.

Function (d) - Reading from Mag. Stripe

The Read operation is initiated by the START command, Done being set when the first data word is read into the buffer. DATI 1 then transfers one 8-bit byte from the Read buffer to the specified accumulator, and thus into core.

Function (e) - Writing on Mag. Stripe

Writing is initiated by DATO 1 + START with the first data word in the specified accumulator. START then sets Busy, and when the word has been written Busy is cleared and Done set.

Function (f) - Remove Card

The operation is initiated by DATO 2 + START, with the specified accumulator containing Bit 3 set and Bits 9-14 non-zero. This is a special function designed to give a DONE when the card is removed from its channel or if no card is present. When the card is removed, BUSY is cleared in the usual way.

Function (g) - Indicator lights

The operation of these lights is absolutely independent of all other mag. stripe functions. DATA Bits 1,2, and 3 are used, in conjunction with DATO 3 and the device address. The lights are cleared either when DATO 3 is issued with Bits 1 to 3 of the Accumulator clear, or upon an I/O Reset instruction. No BUSY, DONE or Interrupt is involved.

The indicator lights are controlled only via the Front Feed Device Code (01 etc.).

STATUS BITS (hardware)

Bit 1	Last line
Bit 2	Card jammed
Bit 3	Parity Fail (read only)
Bit 4	Data late (read or write)
Bit 5	Card not in Hopper

Note :-

When inserting/reading a card, it is essential that the IBM Head Carrier is in a position central to the card, in order that the plastic guides do their job.