# ELLIOTT 903

Volume 3:     OPERATING INSTRUCTIONS

Part    4:     PERIPHERAL EQUIPMENT

Section 3:     DIGITAL PLOTTER

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OVERALL VIEW
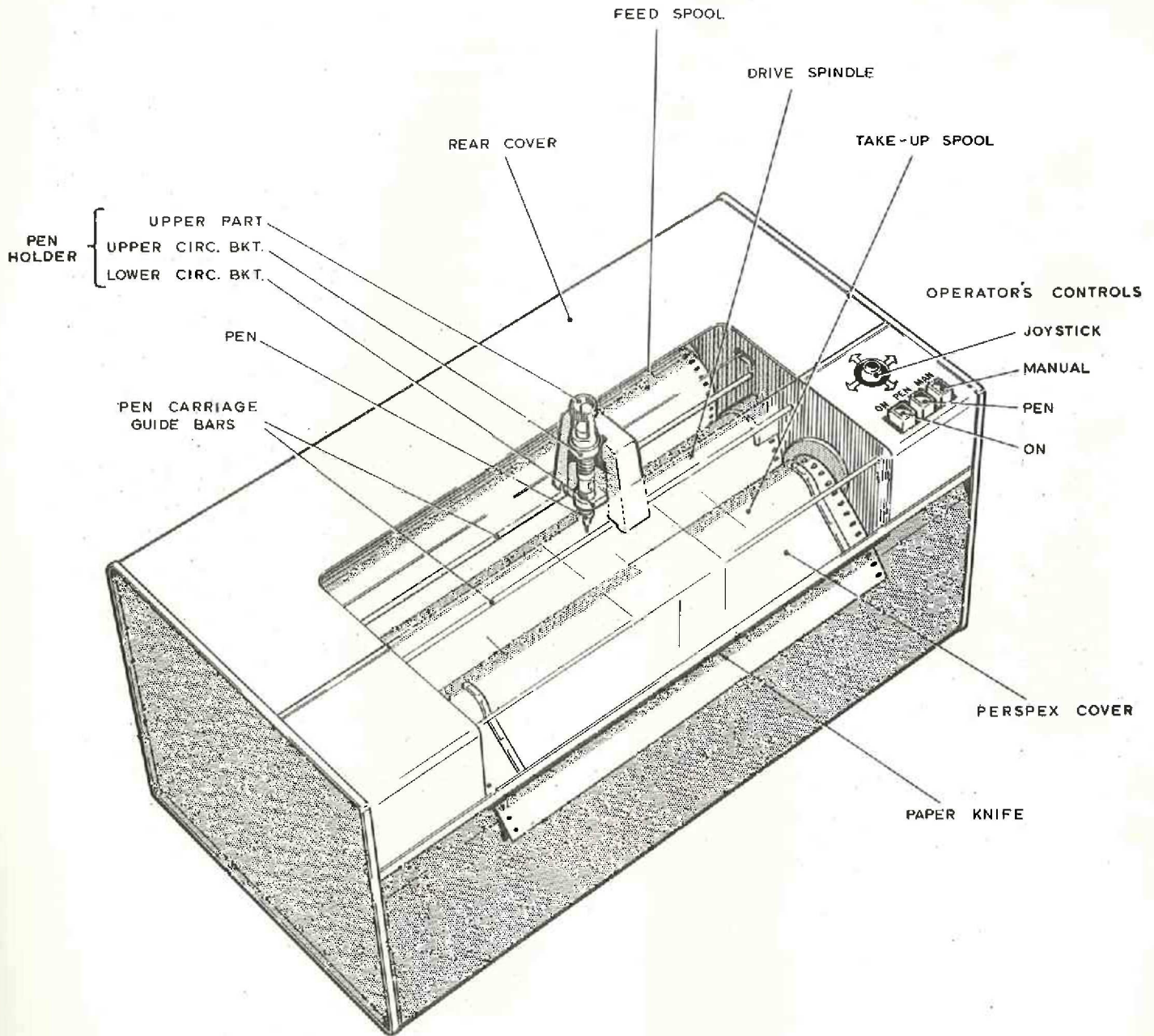
Chapter 1:     INTRODUCTION AND OPERATING INSTRUCTIONS

1.1     Introduction

These operating instructions refer to digital plotters for use with the Elliott 903 Computer  (see Fig.A).   The models are essentially similar and differ mainly in respect of step size and plotting width.   The user is, therefore, able to select the equipment most suited to his requirements. The physical characteristics and essential differences between the different models of digital plotter are given in Volume 1, Section 1.4.3,  Para.6.2.

The plotter enables output data from the 903 computer to be presented in the form of a permanently recorded graph, chart or diagram complete with scale markings, where required.   This is achieved by moving either the pen, the plotting paper or both in steps.   The range of movements possible is such that lines can be drawn in any one of the eight directions shown in Fig.B below.



Fig B     DIRECTIONS OF INCREMENTAL STEPS
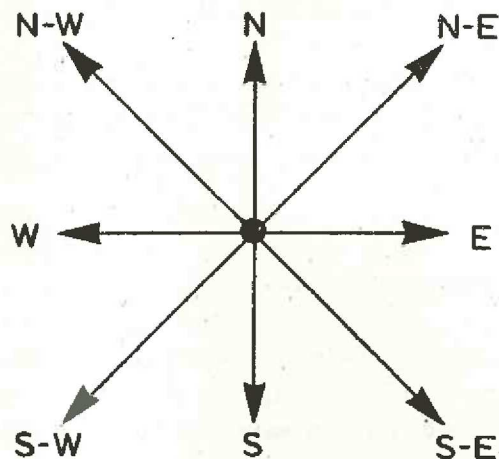
Sideways movement of the pen carriage along the guide bars produces lines in the East or West direction, and forward or backward movement of the paper by the drive spindle produces lines in the North or South direction.   Movement of both pen and paper together produces lines in the four other directions shown.   The pen can also be raised off the paper to move from one line to another.

Apart from operating the equipment, the operator may be responsible for the following duties:-

(1)    Carrying out regular maintenance as detailed in Chapter 2.

(2)    Ensuring that adequate supplies of plotting paper, pens, ink, adhesive tape and at least one spare take-up spool, are available.

(3)    Loading the plotting paper and, where necessary, fitting a take-up spool (as detailed in Para.1.4.1 and 1.4.2).

(4)    Filling the pen with ink and fitting it into the equipment (as detailed in Para.1.4.3).

(5)    Running the test program as detailed in Chapter 3.

(6)    Storage of all tapes.

1.2    Brief Physical Description

Each of the models of digital plotter is mounted on a specially designed mobile stand. Two interface cables run from the equipment to the computer; a separate mains lead runs from the plotter itself to a mains supply socket.

1.3    Operator's Controls

All the operator's controls for the plotter are mounted on the plotter itself, and are shown in Figure A. With the exception of the ON button, the controls are only operative when the plotter is set to Manual operation. The controls are used mainly to move the pen to the correct starting position on the paper, before passing control over to the program, and also for performing the daily functional checks. Each control is described separately below.

1.3.1    ON Button

This push-button is a combined switch and indicator and is used to switch the mains supply on or off. If the plotter is initially off, depressing the ON button will connect the mains supply to the plotter and cause the green lamp in the button to light. A second depression of the button will disconnect the mains supply and extinguish the lamp.

### 1.3.2    MAN Button

The MAN button is a combined switch and indicator and is used to transfer the plotter from Auto to Manual operation, or vice versa. If the plotter is initially set to Auto, depressing the button will set the plotter to Manual and cause the yellow lamp in the button to light.   A second depression of  the button will return the plotter to Auto operation and extinguish the lamp. When the plotter is set to Manual, the button is in the down position;  when set to Auto the button is returned to the up position.

When the plotter is in the Auto mode, it can be controlled by program from the central processor but the PEN and Joystick controls are inoperative.   When the plotter is in the Manual mode it cannot be controlled by program, but the PEN and Joystick controls are now operative.

### 1.3.3    PEN Button

This push-button is used to raise or lower the pen holder.   Depressing the button raises the pen off the plotting paper if it was in the down position, or vice versa.

### 1.3.4    Joystick Control

This control enables the operator to move the pen and/or paper in any one of the eight possible directions.   Moving this control in any one of the directions shown in Figure B will produce a corresponding movement of the pen relative to the paper.   It should be noted that, because of this, when the control is moved towards the rear of the plotter, paper is fed forward and when the control is moved forward, paper is fed backward.

Moving the Joystick without depressing it produces a step rate of two increments per second.   If the Joystick is also depressed the step rate increases to 250 increments per second.

### 1.4    Operating Procedure

Before the equipment can be operated, the following procedure must be followed:-

(1)    Fit a take-up spool if necessary (Para.1.4.1). The normal arrangement is for the paper to be fed out of the slot in the front of the plotter.  If required, however, the paper can be collected

on a take-up spool.   In this case the normal
sprocketed take-up spool must be replaced by
an unsprocketed spool (Part No. B4600-030/B).

(2)     Load the paper (Para. 1.4.2).

(3)     Fit a pen into the plotter unit (Para. 1.4.3).

### 1.4.1    Fitting the Take-up Spool

If the paper is required to be collected on the take-up
spool an unsprocketed spool must be fitted in place of the sprocketed one.
This is fitted in the following way:-

(1)     Hinge the front perspex cover forward to its
rest position.

(2)     Remove the sprocketed spool by pushing it to
the right to disengage it from the drive cheek;
then lift it clear.

(3)     Insert the right-hand end of the unsprocketed
spool into the spring-loaded cheeck and push
to the right.

(4)     Fit the left-hand end of the spool on to the drive
cheek, taking care to engage the slot on the
spool with the key on the cheek.

### 1.4.2    Loading the Plotting Paper

If paper is already loaded, before beginning a program
the operator should check that it is of the correct type, and that there is
sufficient for the program.

Paper loading can be carried out with the plotter switched
on, and with the pen still in position in its holder.

(1)     Set the plotter to Manual operation;  in this
state the yellow lamp in the MAN button is lit.

(2)     Hinge the front perspex cover forward to its
rest position.

(3)     Using both hands, lift and hinge back the rear
cover to its rest position.   Safety interlocks
now automatically stop the fan and paper take-up
drives.

(4)  Remove the old feed spool by pushing it to the
right to disengage it from the drive cheek;
then lift it clear.

(5)  Hold the new feed spool so that the paper will
unwind upwards from its rear.   Insert the
right-hand end of the spool into the spring-loaded
cheek and push it to the right.

(6)  Fit the left-hand end of the spool on to the drive
cheek, taking care to engage the slot on the
spool with the key on the cheek.

(7)  If the paper is to be fed out of the front of the
plotter proceed as follows:-

Pull a suitable length of paper forward over the
drive spindle and take-up spool, and feed it out
through the slot under the perspex cover.
Ensure that the sprocket pins on the take-up
spool correctly engage with the sprocket holes
on the paper.   Without winding in the paper
outside the plotter, make loops of paper three
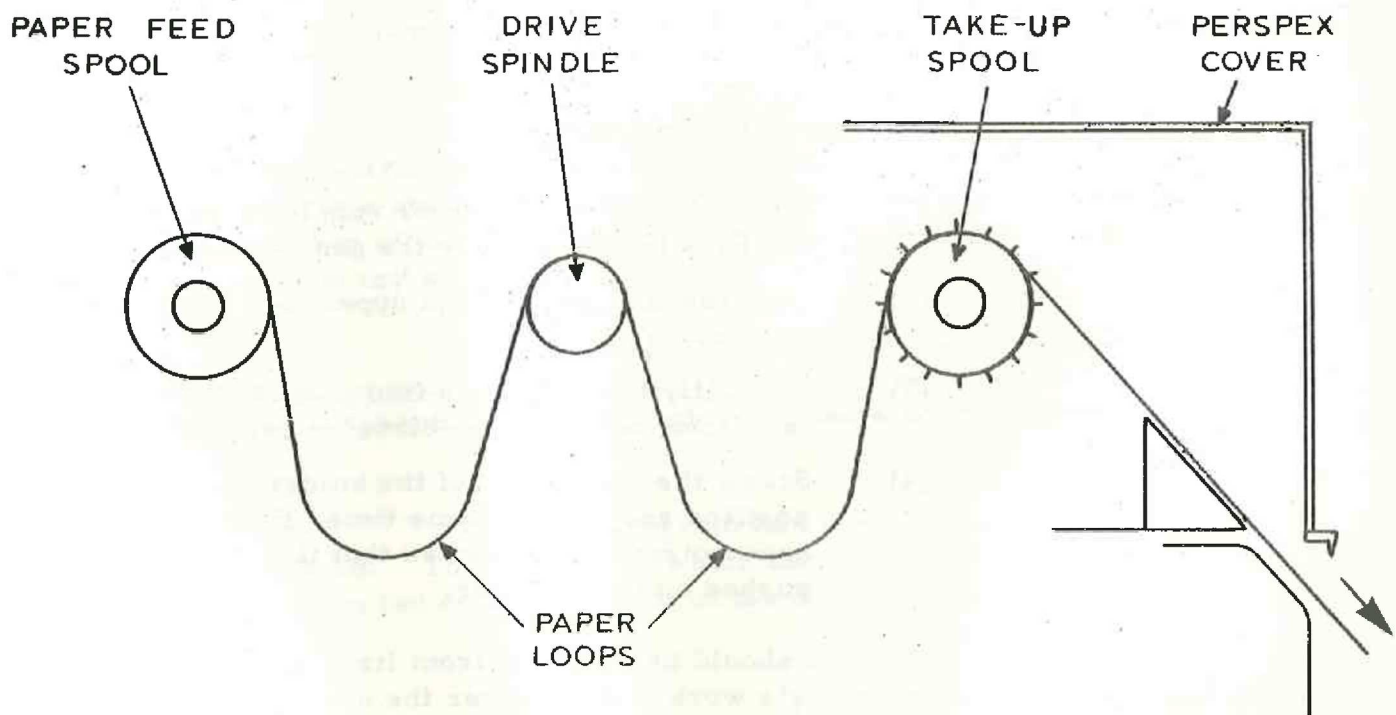to four inches deep on each side of the drive
spindle, as shown in Figure C.

PAPER  FEED          DRIVE              TAKE-UP         PERSPEX
SPOOL                SPINDLE            SPOOL           COVER

PAPER
LOOPS

Fig. C    PAPER ROUTE

(8)    If paper is to be collected on the take-up spool (Para. 1.4.1) proceed as follows:-

Pull a suitable length of paper forward over the drive spindle and secure its front edge to the top of the take-up spool with adhesive tape. Wind a few turns of paper on to the take-up spool and check that the paper is being fed squarely to the spool. Without unwinding the paper on the take-up spool, make loops of paper three to four inches deep on each side of the drive spindle, as shown in Figure C.

(9)    Close the rear cover and then the front perspex cover. With the rear cover closed the fan and paper loop control servos will be energised and will automatically maintain the paper loops at the correct depth.

### 1.4.3    Fitting the Pen

Before fitting the pen the operator should first check its ink supply and writing quality. To clear the nib and allow a free flow of ink it is usually only necessary to shake the pen two or three times.

If a pen is already fitted, the operator should check that it is fitted with a nib of the correct size and that the ink is of the required colour.

The pen is fitted as follows:-

(1)    If the plotter mains power supply is on, depress the PEN button to raise the pen holder.

(2)    Unscrew and remove the upper part of the pen holder.

(3)    Carefully lower the pen into position so that it is resting on the lower circular bracket.

(4)    Screw the upper part of the holder back into position and, at the same time, firmly hold the upper circular bracket so that the pen nib is not pushed on to the paper.

The pen should be removed from its holder, and stored in its box, at the end of each day's work and whenever the plotter is not used for at least half an hour. The pen is removed from its holder by unscrewing and removing the upper part of the holder and lifting the pen clear.

NOTE: The utmost care and cleanliness is

required when handling pens.

Full instructions for filling and cleaning the pen are given in the manufacturer's leaflet supplied with each one.

## 1.4.4    Operating the Equipment

The operator should ensure that the grill on the underside of the plotter is clear of any obstruction which might prevent the free exit of air.    The pen and paper may now be placed in the correct starting position before passing control over to the program.    This should be done as follows:-

(1)    Set the plotter to Manual operation;  in this state the yellow lamp in the MAN button is lit.

(2)    If the pen is in the down position, depress the PEN button in order to raise the pen holder.

(3)    Move the pen to the starting position by means of the Joystick control.    Initially, position the pen approximately using the Joystick's fast step rate and then use the slow step rate to position it accurately.

(4)    If it is desired to mark the starting position, this can now be done by depressing the PEN button, in order to lower the pen onto the paper. Depress the PEN button again, in order to raise the pen off the paper.

The plotter can now be put under the control of the program in the central processor.    This is done by setting the plotter to Auto operation.    (In this state the yellow lamp in the MAN button is extinguished.) During the running of the program the operation of the plotter should not be interfered with in any way.

If any incident occurs which affects the operation of the plotter during a program, the details should be reported to the Maintenance Engineer.    It is essential that a report of the facts accompanies the finished work.

When the program has been run, the finished work should be removed.    The manner in which this is done depends on whether the paper has been fed out of the front of the plotter or has been collected on the take-up spool.

        If the paper has been fed out of the front of the plotter, proceed as follows:-

(1)     Set the plotter to Manual operation; in this state the yellow lamp in the MAN button is lit.

(2)     If the pen is in the down position, depress the PEN button in order to raise the pen holder.

(3)     Depress the Joystick and move it backwards until all paper containing output has been fed out of the plotter.

(4)     The paper can now be removed either by using a razor blade, scissors or by means of the paper knife at the front of the plotter.

        If the paper has been collected on the take-up spool, proceed as follows:-

(1)     Set the plotter to Manual operation; in this state the yellow lamp in the MAN button is lit.

(2)     If the pen is in the down position, depress the PEN button in order to raise the pen holder.

(3)     Depress the Joystick and move it backwards until all paper containing output has been wound on to the take-up spool.

(4)     Hinge open the front perspex cover.

(5)     Using either a razor blade or scissors, cut the paper between the drive spindle and the take-up spool.

(6)     Remove the take-up spool by pushing it to the right to disengage it from the drive cheek; then lift it clear.

(7)     Fit an empty take-up spool.  If there is sufficient paper in the plotter for the next program, secure its front end to the take-up spool as described in Para. 1.4.2 (8).

1. 5        Materials Required for Operation

Liquid-ink Pens

| Nib sizes available | Part No. |
|---|---|
| Rapidograph 0. 2 mm | BL54561 |
| Rapidograph 0. 3 mm | BL54562 |
| Rapidograph 0. 4 mm | BL54563 |
| Rapidograph 0. 5 mm | BL54564 |
| Rapidograph 0. 6 mm | BL54565 |
| Rapidograph 0. 8 mm | BL54566 |
| Rapidograph 1. 2 mm | BL54567 |

Ink

| Colours | Benson-Lehner Part No. | James Scott Part No. |
|---|---|---|
| Recorder Black | BL54501 | 18459/B Black |
| Recorder Green | BL54502 | 18459/B Green |
| Recorder Red | BL54503 | 18459/B Red |
| Rotring H5911 Black | BL54570 | |

Chart Paper

The chart paper is supplied in the form of 48. 8 m (160 ft) rolls and is available either plain or graph.

| Plotting Width | Chart Paper Type | Part No. |
|---|---|---|
| $13^3/_8$ in | Plain | BL54583 |
| | Graph | BL54584 |
| 34 cm | Plain | BL54585 |
| | Graph | BL54586 |

1.5     Materials Required for Operation

Liquid-ink Pens

| | Nib sizes available | Part No. |
|---|---|---|
| Rapidograph. | 0.2 mm | BL54561 |
| " | 0.3 mm | BL54562 |
| " | 0.4 mm | BL54563 |
| " | 0.5 mm | BL54564 |
| " | 0.6 mm | BL54565 |
| " | 0.8 mm | BL54566 |
| " | 1.2 mm | BL54567 |

Ink

| Colours | Benson-Lehner Part No. | | James Scott Part No. | |
|---|---|---|---|---|
| Black | BL54501 | Recorder. | 18459/B | Black |
| Green | BL54502 | " | 18459/B | Green |
| Red | BL54503 | " | 18459/B | Red |
| Rotring H5911 Black. | BL54570 | | 18459/B Ink Filler | |

Chart Paper

The chart paper is supplied in the form of 48.8 m (160 ft) rolls and is available either plain or graph.

| Chart Width | Chart Paper Type | Part No. |
|---|---|---|
| 12 in | Plain<br>Graph | BL54581<br>BL54582 |
| 14 in | Plain<br>Graph | BL54583<br>BL54584 |
| 34 cm | Plain<br>Graph | BL54585<br>BL54586 |
| 36 in | Details will be provided by Newsletter when available. | |

All the above materials are available from

> Benson-Lehner Ltd.,
> West Quay Road,
> SOUTHAMPTON,
> Hampshire.

In addition, ink is available from

> James Scott Manufacturing Co.,
> Warren Row,
> WARGRAVE,
> Berks.

Pens and Ink are available from commercial stationers.

(6)     Repeat (5) with the Joystick operated to feed paper to the rear of the plotter.

(7)     Use the Joystick in its fast mode to move the pen almost to one edge of the paper.

(8)     Use the Joystick in its fast mode to move the pen back along the width of the paper, at the same time rapidly operating the PEN button.

(9)     Check that this produces a clearly defined interrupted line with a free flow of ink.

(10)    Using the PEN button and the Joystick in its slow mode\ draw the four possible 45° lines, i.e. N-E, S-E, S-W and N-W (see Figure B). Check that the lines are smooth and straight.

(11)    Repeat (10) using the Joystick in its fast mode.

(12)    Set the plotter to Auto operation by depressing the MAN button; the yellow lamp in the button should be extinguished. Check that the PEN button and Joystick are ineffective.

(13)    Check that with the rear cover in position, the fan is rotating. Ensure that the fan is switched off when the rear cover is raised. (It should be noted that it takes about two minutes for the fan to stop from full speed)

2.3.2   Cleaning

The operator should carry out the following cleaning procedure.

2.3.2.1     Weekly

(1)     The pen should be cleaned regularly; full instructions are given in the manufacturer's leaflet supplied with each pen. (It is suggested that the pen should be cleaned once a week, but the operator will find by experience how often the pen needs to be cleaned to operate satisfactorily).

2. 3. 2. 2     Daily

Clean the pen carriage guide bars with a clean lint free cloth moistened in non greasy white spirit.  The white spirit should be obtained by local purchase.

2. 3. 2. 3     Monthly

Clean the front perspex cover and all other covers with a clean damp cloth.

2. 4     Test Program

The test program X52 checks the operation of the digital plotter and must be run daily after the other maintenance has been completed.  The procedure is detailed in Chapter 3.

2. 5     Computer Records

Entries should be made in the computer log book to record the following events:-

(1)     Times of fault occurrences.

(2)     Nature and suspected location of fault.

2.3.2.2          Monthly

(1)     Clean the pen carriage guide bars with a clean,
        dry fluffless cloth.

(2)     Clean the front perspex cover and all other covers
        with a clean damp cloth.

2.4     Test Program

        The test program X52 checks the operation of the digital
plotter and must be run daily after the other maintenance has been completed.
The procedure is detailed in Chapter 3.

2.5     Computer Records

        Entries should be made in the computer log book to
record the following events:-

(1)     Times of fault occurrences.
(2)     Nature and suspected location of fault.

Chapter 3:     OPERATOR'S TEST PROGRAM

    3.1     Introduction

        This chapter describes the test program X52 that should be run daily by the operator.   It should be run after the maintenance procedure detailed in Chapter 2 has been completed and before the equipment is used. The operator should ensure that sufficient copies of the master tape supplied are available for this purpose.   The master tape itself should never be used.

        The program is not intended to be used by the operator for the precise diagnosis of a fault.   If any of the tests fail and the repair of the fault is not within the scope of the operator's duties, the maintenance engineer should be informed.

    3.2     Method of Use

        3.2.1   903(a) System (central processor, 8K core store, teleprinter and control unit)

(1)     Set the Mode switch on the control unit to operate.

(2)     Set the Address keys to 8181 (111111110101).

(3)     Set the SELECT INPUT and SELECT OUTPUT switches on the computer to AUTO.

(4)     Depress the ON button on the control unit.

(5)     Depress the RESET button.

(6)     Load the program/pattern tape into the printer reader (see Volume 3, Section 3.1.3, Para.1.4.3).

(7)     Depress the JUMP button and wait for the DEMAND lamp to light.

(8)     Set the START/STOP/FREE switch to START; the tape will be read in.

(9)     Set up the Address keys for the required pattern size and depress the JUMP button again.

3.2.2      903(b) and 903(c) Systems (903(b) - central processor, 8K core store, tape reader, tape punch and control unit; 903(c) - as 903(b) plus teleprinter)

(1)      Set the Mode switch on the control unit to OPERATE.

(2)      Set the Address keys to 8181 (111111110101).

(3)      Set the SELECT INPUT and SELECT OUTPUT switches on the computer to AUTO (if fitted).

(4)      Depress the ON button on the control unit.

(5)      Depress the RESET button.

(6)      Load the leading blanks of the program/pattern tape into the reader.

(7)      Depress the READ button.

(8)      Depress the JUMP button; the tape will be read in.

(9)      Set up the Address keys for the required pattern size (see below), and depress the JUMP button again.

NOTE:      Each size of pattern has a separate entry point as shown in Table 1; the operator may carry out the tests in any order.

Table 1            PATTERN SIZE ENTRY POINTS

| Pattern Size | Addressing Key Setting | Entry Point |
|---|---|---|
| 1X | 0000000010101 | 21 |
| 4X | 0000000010110 | 22 |
| 6X | 0000000010111 | 23 |
| 8X | 0000000011000 | 24 |
| 10X | 0000000011001 | 25 |
| 15X | 0000000011010 | 26 |
| 20X | 0000000011011 | 27 |
| 22X | 0000000011100 | 28 |

### 3.3    Output Pattern

The basic output pattern (Figure D) covers an area 50 steps square; the size of any pattern produced is a multiple of this basic size. To facilitate the description of the pattern, the basic area may be considered to be divided into 50 rows and columns (row 1 is at the top of the pattern whilst column 1 is at the left-hand side of the pattern).

The plotter reproduces the pattern in the following manner:-

(1)    The pen is moved to the left-hand edge of the paper.

(2)    A horizontal saw-tooth waveform is drawn in row 1 from column 1 to column 24.

(3)    A horizontal square waveform is drawn in row 7 from column 1 to column 24.

(4)    A criss-cross square is drawn in columns 3 to 22 and rows 13 to 32.

(5)    In row 45 a U is drawn in each of columns 1 to 24 (forming a shape similar to that of a comb)    A line is then drawn across the top of the 'comb'

This completes columns 1 to 24.

(6)    The saw-tooth and square waveforms in rows 1 and 7 respectively are extended to column 50

(7)    A set of inset octagons are drawn in columns 27 to 48 and rows 12 to 33.

(8)    The waveform in row 45 is continued across to column 50.

At the end of this pattern the pen is moved across to the left-hand edge of the paper and the latter is moved down so that the next pattern is drawn directly above the previous one.    This process will continue until the operator stops the program by depressing the STOP button.    Another pattern size may then be selected by setting the Address keys to the appropriate entry point.

The patterns displayed must be checked by the operator for errors, as no error messages are produced.