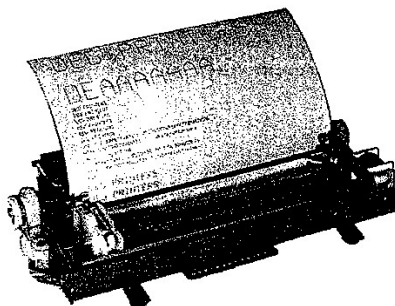


## DPG SERIES BALL POINT PRINTERS



- \* Ball Point Pen Recording for High Quality Printing
- \* Single Colour and 4 Colour Versions
- \* Variable Characters per Line up to 80
- \* Complete Plotting Ability including Reverse Paper Feed
- \* Red, Green, Blue, Black Colours
- \* Small Size
- \* Low Power Consumption
- \* High Reliability
- \* Low Cost

**DED**

DED Mill Road Lydd Kent TN29 9EJ

Tel: Lydd (0679) 20636

## GENERAL

The DPG Series of printer mechanisms use ball point pens for high quality printing.

The DPG21 has a single pen. The DPG23 has four colours which can be automatically changed as required. Both use standard paper 114mm wide. Up to 80 characters per line can be printed.

Two stepper motors accurately control paper and pen movements in both forward and backward directions enabling the DPG Series to be used for graphics and plotting with a resolution of 0.2mm.

Installation is simple as the printers are lightweight, small size and use a single +5V dc supply. An unusual feature is that one character at a time can be printed rather like a typewriter, rather than complete lines.

The print speed is not particularly fast as it is only 12 characters per second maximum.

The high quality, quiet, multi-coloured printer/plotters have many applications in industrial measurements, computer graphics and general printing.

Full details on driving the mechanisms are included. Alternatively ready made interfaces and an interface driver chip are available.

## VERSIONS

DPG21	single colour mechanism
DPG23	four colour mechanism
DPG24	control IC

f: 324, =  
f: 325, =  
104, =

10 steps  
10 steps

## ACCESSORIES

These and other items are in our general catalogue. Please ask for our latest edition.

Paper:	Part No: 552-114
Set of 4 Ballpoint Pens:	One each of black, blue, green, red. Part No: 553-001
Single Chip Controller:	Part No: DLG1202
Interface Board:	Centronics Parallel and RS232C Serial, available second quarter 1983.

## SPECIFICATION

Printing Systems:	Ballpoint pen recording.
Drive Unit:	Drum type X-Y plotter.
Characters per Line:	Variable, typically 40 characters per line. 80 characters per line easily legible but of small size.
Print Speed:	Typically 12 characters per second on 80 character per line size Typically 6 characters per second on 40 character per line size (Print speed is dependent on number of steps to build particular characters).
Plotting Speed:	260 steps per second.
Step Length:	0.2mm along X axis. 0.2mm along Y axis.
Line Drawing Speed:	52mm/sec along X and Y axes 73mm/sec along 45° vector
Paper Feed Speed:	52mm/sec (at 40 characters per line size approx 6 lines per sec).

Paper Roll Tension: 10g minimum.  
Retention Force: 40g minimum.

Alpha-Numeric Character Size:  
(80 Characters per Line) Height: 1.45mm.  
Width: 1.05mm.

Line Spacing:  
(80 Characters per Line) 2.4mm.

Printing Area: X direction: 96mm (in 480 steps).  
Y direction: As required.

Printing Directions: Left and right in X direction.  
Up and down in Y direction.

Y Axis Error: Paper position may deviate by up to 1mm as it is fed along  
the Y axis.

Repeat Accuracy: 0.2mm maximum.

Distance Accuracy: 0.5% max. error along X axis.  
1% max. error along Y axis.

Colour Position Accuracy: 0.2mm maximum each colour.

Power Supply Voltage: 4.85  $\pm 0.65$  V dc  
-0.35  
Current: 0.5A average while printing

Pen Up-Down Solenoid Type: Self-supporting  
Operating Voltage: 4.85  $\pm 0.65$  V (across solenoid only)  
-0.35  
Coil Resistance (20°C):  $5 \pm 0.5\Omega$   
Peak Current: 0.47A at 4.85V  
1.32A at 5.5V  
Pulse Width: 5mSec minimum  
5mSec typical  
Surge Voltage: 25V maximum during power off

Motor: Number: 2 (1 to drive paper, 1 to drive pen  
carriage)  
Operating Voltage: 4.85  $\pm 0.65$  V (across motor only)  
-0.35  
Type: 4 phase stepper-motor with 2 phase  
excitation  
Coil Resistance: X axis Y axis  
30  $\pm 3\Omega$  25  $\pm 2.5\Omega$   
Peak Current (per phase):  
4.85V 0.16A 0.19A  
5.5V 0.23A 0.27A  
Average Current (per phase):  
4.85V 0.12A 0.13A  
5.5V 0.16A 0.18A

Colour Position Detector (4 colour version only):  
Type: Leaf switch  
Output: 0.1A 24V max.

PAPER	Type:	Ordinary paper or non-carbon paper
	Width:	114.5 $\pm$ 0.2mm (4 $\frac{1}{2}$ inch)
	Roll Diameter:	70mm maximum
	Thickness:	0.07mm recommended
	Weight:	52gsm recommended
	Part No:	552-114

PENS	Colour:	Black, blue, green, red
	Size:	5mm dia x 23.3mm length
	Ink:	Water ink
	Life:	250 metres minimum
	Pen Spec. No:	DSG x 1 or DSG x 2
	Part No:	553-001

Connector:	Type:	Printed circuit board
	Pitch:	0.1"
	Hole Dia:	1mm

Weight:	215 grams
---------	-----------

Size:	151mm (W) x 25mm (H) x 69mm (D)
-------	---------------------------------

Temperature:	Operating:	0 to +50°C
	Storage:	-25 to +70°C

Relative Humidity:	Operating:	30 to 85%
	Storage:	5 to 90% maximum non condensing

Reliability:	Printer MTBF:	>6.5 million characters
	Ink Life:	>250 metres

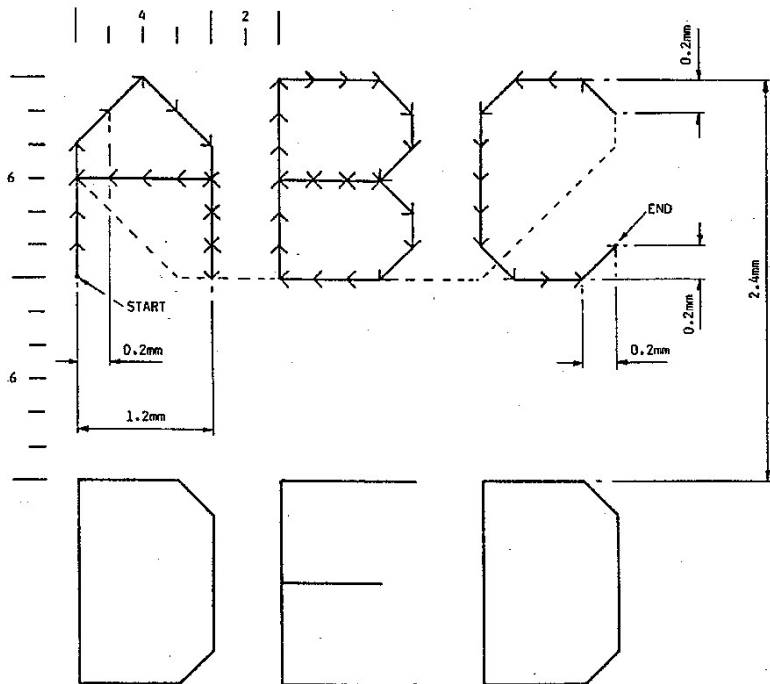
#### MOUNTING AND GENERAL NOTES

- 1) Fixing is by two mounting ears at the front which are fitted with grommets to reduce noise and vibration. Two lugs at the rear are also covered by rubber housings.
- 2) Suitable for horizontal or vertical mounting.
- 3) Take care not to distort the printer chassis when fixing.
- 4) Ensure paper roll holder cannot jam the paper.
- 5) Do not store or operate in direct sunlight, dusty, oily, damp or humid conditions for best results.
- 6) Keep away from metal particles.
- 7) Do not operate without paper.
- 8) The pens should have their caps replaced to prevent drying up if they are not to be used for a long period of time.

# CHARACTER FORMATION

The smallest line which can be drawn is 0.2mm. If a format for a character of 6 units high by 4 wide with 2 for spacing is adopted then 80 characters per line can be printed.

A feature of most programs is that expanded characters can be easily printed by increasing the basic unit. If each unit is 0.4mm then 40 characters per line is printed.



## PLOTTING

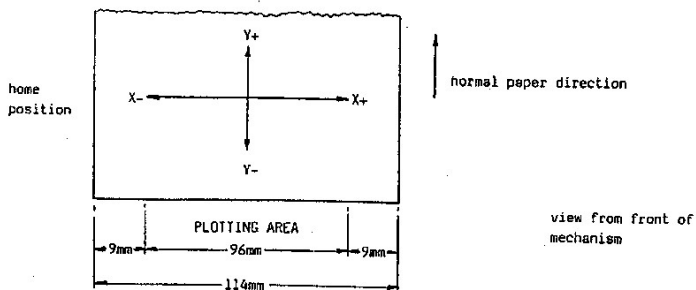
### DIRECTION

If the pen carriage moves to the left this is taken as X-. To the right X+. If the paper is fed forward this is taken as Y-. Fed backward Y+.

### AREA

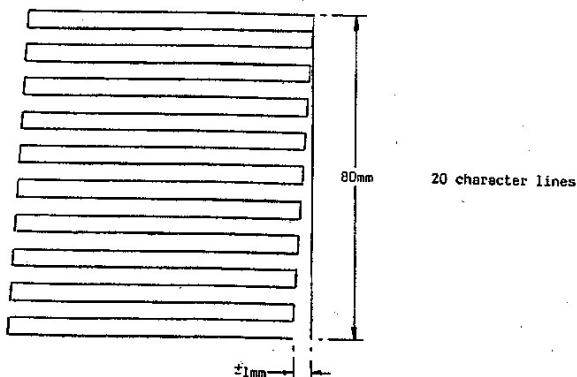
X axis: 96mm, 480 steps of 0.2mm

Y axis: as required, in steps of 0.2mm



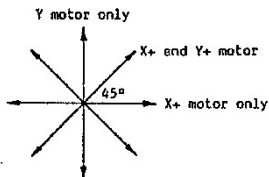
### Y axis deviation

As paper is fed along the Y axis by friction between the paper and roller, the position may vary. This is a maximum of  $\pm 1\text{mm}$  over 80mm (typically 20 character lines) if the paper roll is held accurately.



## PRINTING OPERATION

The X motor moves the pen carriage in the horizontal direction. The Y motor moves the paper forward and backward. By operating one motor only forward or backward and by using both motors eight directions of print can be obtained giving a resolution of  $45^\circ$  on the paper.



To obtain a line in X+ direction. The X motor is used. The paper (Y motor) remains still. Characters are formed by lifting the pen and lowering as required.

## STEPPER MOTOR OPERATION

Each of the two stepper motors has 4 inputs A, B, C and D. By activating two of these four inputs the stepper motor output shaft rotates in one direction by  $18^\circ$ . This is translated by the printer mechanics into either a 0.2mm movement of the pen (X motor) or a 0.2mm movement of the paper (Y motor). If next two other of the 4 inputs are activated the stepper motor rotates a further  $18^\circ$  producing a further 0.2mm movement. Alternatively the two inputs to be activated could be chosen to rotate the motor in the reverse direction which would cause the pen or paper to be moved 0.2mm in the reverse direction.

For each movement of 0.2mm two of the four inputs to the stepper motor must be activated. Only four combinations of A,B,C,D are allowed and they must go from one to an adjacent one. AC, AD, BD, BC are valid.

AC → AD → BD → BC → AC → AD →

This produces X+ direction or Y+ direction  $6 \times 0.2\text{mm} = 1.2\text{mm}$

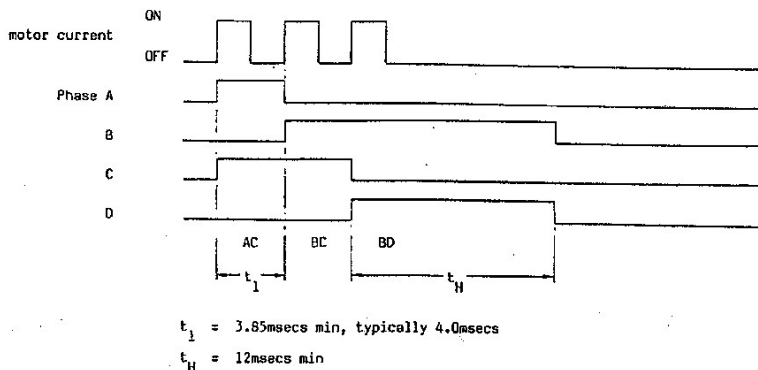
AD → BD → BC → AC → AD

This produces X- direction or Y- direction  $6 \times 0.2\text{mm} = 1.2\text{mm}$

Upon power up assume the motors are in phase AD. Hence phases AC or BD should be operated next time movement is required.

## STEPPER MOTOR TIMING

The stepper motors require pulses of 3.85msecs or longer to cause rotation. The pulses can be turned off while X and Y motors are stationary to conserve power. However on the last pulse of a sequence a hold time of 3 pulses or 12msecs minimum is required to suppress motor vibration.



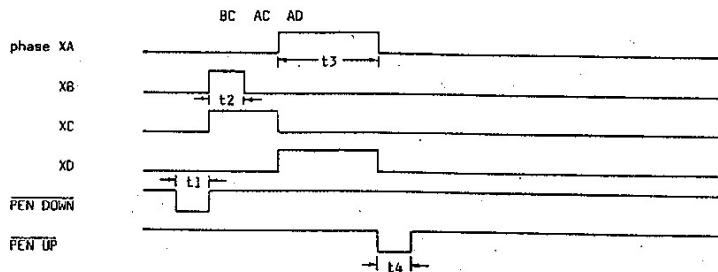
The above three pulses produce  $3 \times 0.2\text{mm}$  in a negative direction.

## SOLENOID AND STEPPER MOTOR TIMING EXAMPLE

To draw a line 0.6mm long in X+ direction:

YD, YC, YB, YA are all at 0V.

Suppose the present phase of the X stepper motor is BD.



The pen is first lowered  $t_1 = 5\text{msecs}$   
 Basic stepper pulse  $t_2 = 4\text{msecs}$   
 Holding time for last pulse  $t_3 = 12\text{msecs}$   
 Pen up pulse  $t_4 = 5\text{msecs}$



## POWER INITIALISATION

The program must first ensure the pen carriage is at a definite position. Upon power up apply a pen up pulse and then 556 steps in the X- direction. Assume the stepper motors are at phase AD. After 556 steps the pen is assumed to be at the left hand edge. If the pen was at or near the left hand side a buzzing sound is emitted once the left hand edge is met.

### • Single Colour Mechanism

Move the pen 20 steps in the X+ direction. This is the 'HOME' position. A trial plot of at least 20mm is recommended to activate the pen. At the conclusion of the trial plot return to the 'HOME' position.

### • Four Colour Mechanism

Move the pen 30 steps in the X+ direction and then 30 steps in the X- direction. This causes the pen carriage to rotate. Check the 'colour detect sensor'. If OFF then repeat the 30 steps movement in the X+ and X- movement until it is ON.

Colour number 1 is now selected.

Move the pen 62 steps in the X+ direction. This is the 'HOME' position. A trial plot of at least 20mm for each colour is recommended to activate the pens. At the conclusion of the trials return to the 'HOME' position.

## COLOUR CHANGING (4 colour versions only)

Each time the pen carriage is moved 30 steps in the X+ direction from the left hand side and returns 30 steps in the X- direction the pen carriage is rotated. For every three times this is done a different colour is selected. In one of these 12 positions a magnetic strip comes in contact with a relay which is activated to form a 'colour detect signal'.

## PAPER FEED

To ensure the pen does not touch the paper when an external paper feed button is used it is preferable to move the pen 11 steps in the X- direction beyond the 'HOME' position and then advance the paper. This is not necessary if single line feeds are required.

## PRINTING

The operating program should ensure the pen is down only in the plotting area (96mm along X axis).

## PEN CHANGING

### SINGLE COLOUR MECHANISM

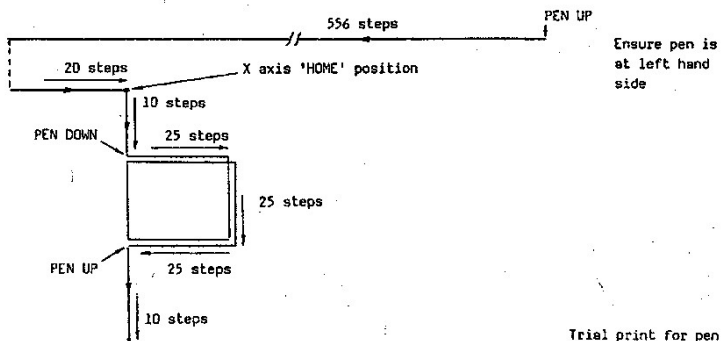
A pen lift arm is positioned on the pen carriage. When pulled forward the pen is lifted.

### FOUR COLOUR MECHANISM

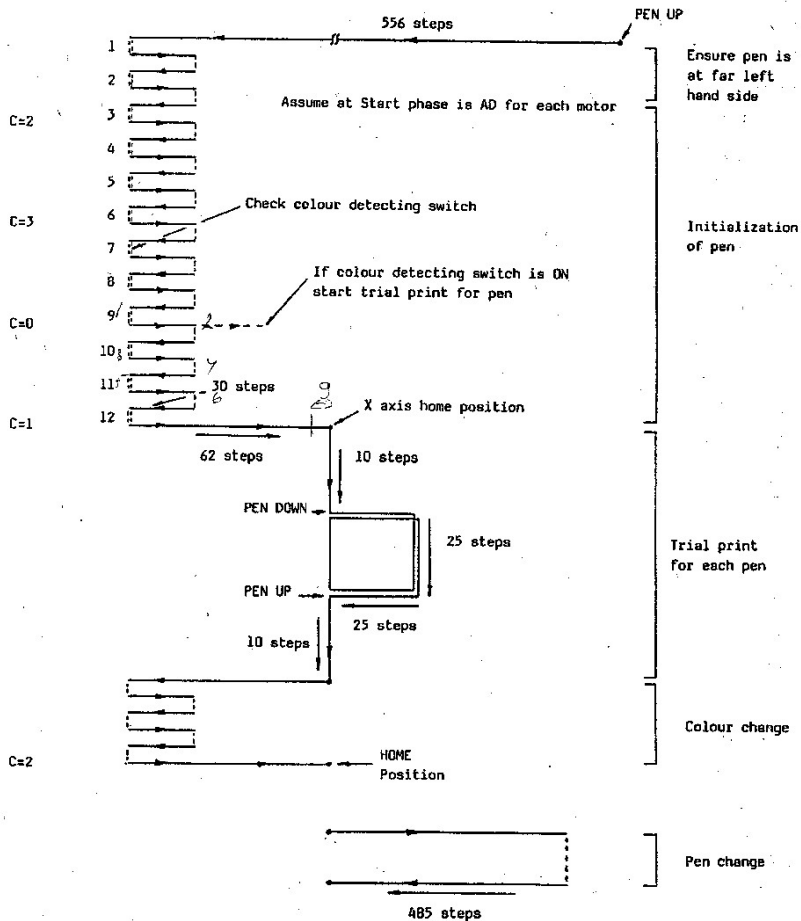
Move the pen 485 steps from the 'HOME' position in the X+ direction. A pen lift arm is positioned at the right hand side of the mechanism, when pulled forward the pen selected is lifted.

# SINGLE COLOUR MECHANISM MOVEMENT UPON POWER UP

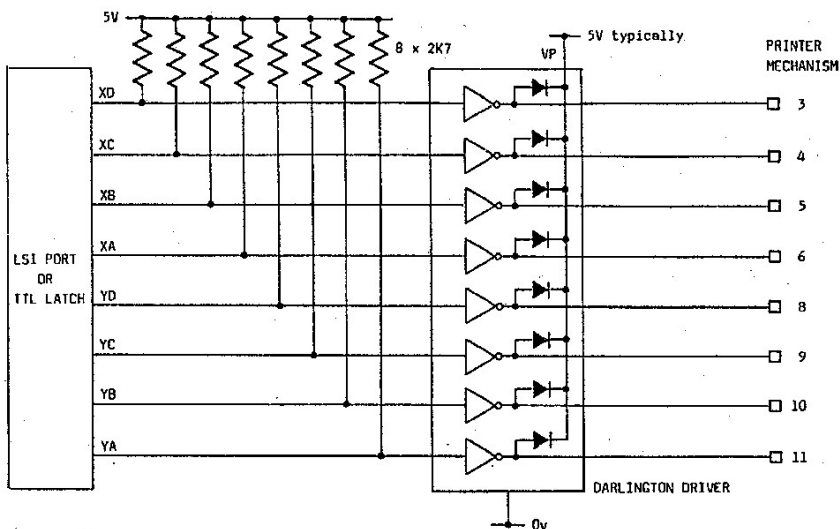
Assume at start phase is AD for each motor



# FOUR COLOUR MECHANISM MOVEMENT UPON POWER UP



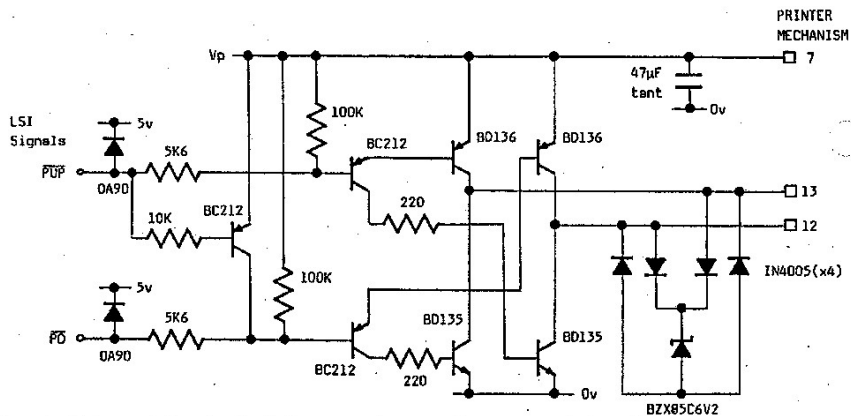
# TYPICAL STEPPER MOTOR DRIVE CIRCUIT



Octal Darlington drive RS no. 303-422  
or Sprague ULN 2801A

If alternative devices are used ensure silicon diodes are across each phase of the motors.  
The VCE sat of the drive transistor should be <0.2V at IC = 0.2A.

## PEN UP/DOWN SOLENOID DRIVER

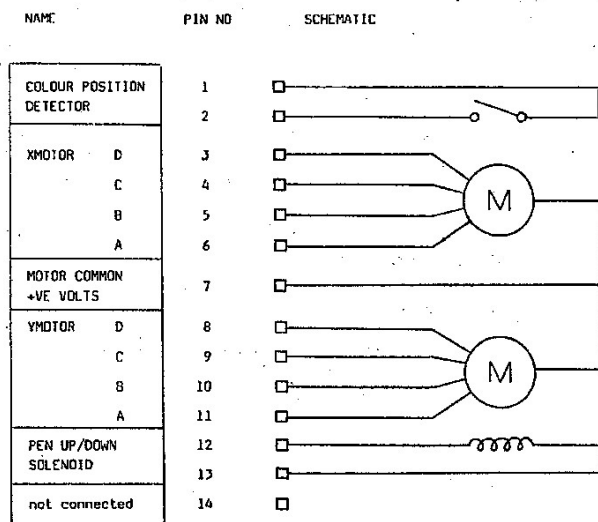


When pin 13 is + relative to pin 12 the pen is lifted off the paper. PUP and PD are normally at +5V. To activate pen up/down solenoid PUP or PD should be taken to 0V for 5msecs or longer.

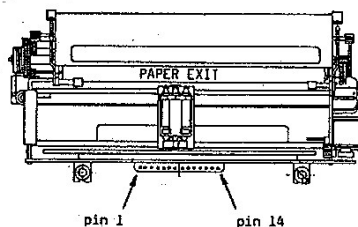
# POWER CONSUMPTION

PRINT OPERATION	CHARACTERS/LINE	VOLTAGE	CURRENT (MA)
Character set	80	4.8V	500 - 550
Character set	40	4.8V	400 - 450
	40	4.2V	340 - 370
	40	5.8V	500 - 580
Paper Feeding		4.8V	260
45° Line		4.8V	490
Dotted Line at 45°		4.8V	790

# CONNECTIONS

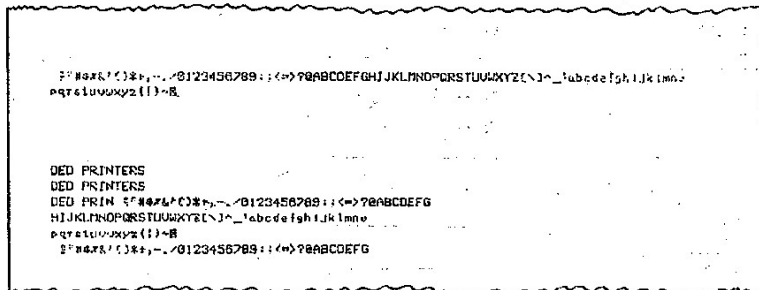


Notes: The colour position detector is missing on the single colour versions.  
The motor common is at positive volts.  
If pin 13 is taken positive relative to pin 12 the pen is lifted.

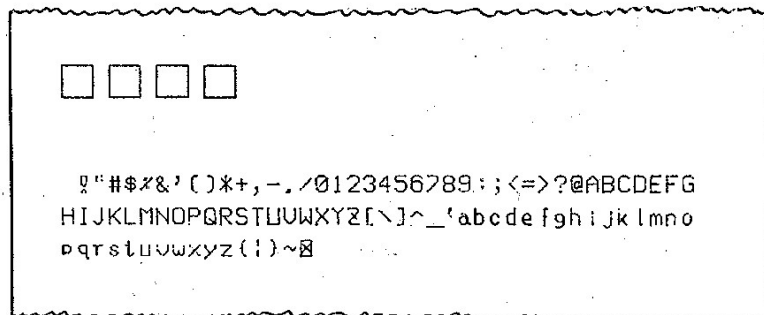


# PRINT EXAMPLES

80 characters per line



40 characters per line



12 characters per line



# OUTLINE DRAWING

