

OPERATION & SERVICE MANUAL

FOR

NLS MODEL 155 PRINTER

This Manual is to be accompanied by the Hewlett-Packard Printer

Operation & Service Manual

Mechanism Type 130

NON-LINEAR SYSTEMS, INC.

Del Mar, California

NON-LINEAR SYSTEMS, INC.

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	NLS MODEL 155 PRINTER	RELEASE DATE August, 1960	PAGE 2 OF 15

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ADDENDUM:

Hewlett-Packard Printer Mechanism Type 130
Operation and Service Manual
Effective on Printer S/N 155.16 and subsequent.

S P E C I F I C A T I O N S

COLUMN CAPACITY: 11 columns (11 digits per line plus one or more fixed decimal points).

PRINT RATE: 5 lines per second or 3300 characters per minute, maximum.

NUMBER WHEELS: 12 positions having numerals 0 through 9, minus sign, and a blank.

SYMBOL WHEELS: 12 positions, having symbols as required for polarity, function, or external data.

DATA ENTRY: Through individual wires, one for each position of each wheel, brought to female connector. Mating connectors and/or cables are furnished.

DATA SOURCE: Stepping switches, relays, or voltage change (-1.5V print, -30V no print) as in the NLS Series 20 Digital Instruments.

INPUT CURRENT: 2 milliamperes per selected digit.

PRINT COMMAND: An external contact closure, or a negative pulse (-15V to -30V, 1 ma.), 10 millisecond minimum width. Manual control by a momentary contact toggle switch. Print commands during scan and print action have no effect.

PAPER REQUIRED: Standard 3-inch roll or folded paper tape.

LINE SPACING: 6.4 lines per inch. Single space, double space, or no print manually selectable on front panel.

POWER: 115V, 50/60 cps standard. Maximum printing rate is 4/second with 50 cps power. 5/second printing rate with 50 cps power, and other voltages and frequencies available on special order. Power consumption is approximately 35VA.

DIMENSIONS: 19" wide, 10 $\frac{1}{2}$ " high, 16-9/16" deep behind panel. Required rack depth is 19 inches.

NET WEIGHT: 30 lbs.

DESCRIPTION AND INSTALLATION

1.0 GENERAL DESCRIPTION

The NLS Model 155 Digital Recorder is a fast electro-mechanical printer which prints 11 column numerical data at rates up to 5 lines per second. The Model 155 is ideally suited for recording rapidly changing data such as flow rate, pressure, voltage, current, frequency and other information in decimal form. The Model 155 makes a permanent printed record of data furnished by digital voltmeters, stepping switches, relay matrices, and other data-gathering systems using a 10-line code. The print wheels have 12 positions. Formats are explained on Page 6.

Data entry to the 155 is through a separate wire for each print wheel symbol (12 wires per wheel). These wires are brought out to connectors at the rear of the instrument.

In addition to this manual, the following items are included with your 155 Digital Recorder:

1. Printer Mechanism Manual (covering mechanical portion of the 155).
2. Service Kit (packed in storage compartment).
3. Folded paper tape (also packed in storage compartment).
4. Pin for use with rolled paper tape (taped to bottom of paper compartment).
5. Inked ribbon (installed).

2.0 50-CYCLE OPERATION

The 155 will operate from a 50-cycle source at slightly reduced speed. The normal maximum of five prints per second will be reduced to four. A special motor pinion gear is available which corrects for the reduced motor speed from a 50-cycle source. Refer to the Printer Mechanism Manual at the end of this document for modification instructions.

3.0 OPERATION WITH NLS DIGITAL VOLTMETERS AND INPUT SCANNERS

1. Connect the printer to the digital instrument and input scanner, if used, with the cable provided. Be careful not to interchange J-1, J-2, and J-3.
2. Connect the power cord to a source of 115-volt 60 cps (unless a different voltage or frequency has been specified) and turn the POWER switch ON. The POWER indicator lamp should light.
3. After the digital instrument and input scanner have been set to the desired recording mode, as described in the applicable handbooks, turn the printer RECORD switch ON. The RECORD lamp should light, and the printer will print on receipt of a command signal from the digital instrument. A printing may also be obtained manually by momentarily pressing down the RECORD switch.

3.1 Standard NLS Model 155 Printer Formats

FORMAT #1 - For 4-digit digital voltmeters: YYYYS₁XXXX.Z

FORMAT #2 - For 5-digit digital voltmeters: YYYYS₁XXXXX.Z

FORMAT #3 - For 4-digit volt-ohm-ratio meters
or voltmeter ratiometers, such as
NLS Models V34, M24, V24: YYYYS₁S₂XXXX.Z

Since Format 3 is the most frequently used,
its symbols are shown in Figure 1. Users of
other formats will find a copy of the applic-
able drawing supplied with the instrument.

FORMAT #4 - For 5-digit digital voltmeters and
ratiometers such as the Model V35: YYYYS₁S₂XXXXX.Z

3.2 Explanation of Model 155 Printer Formats

Y columns are spares; they can record channel number (if an NLS
Input Scanner is used) or other data in contact closure form.

X columns record digital instrument readings.

Z columns record the power of 10 multiplier
to locate the decimal point: .2 means move
the decimal point two places to the left,
etc. This column extends printer utiliza-
tion since fixed decimal points do not
require a separate column, while each float-
ing decimal point position would.

	Y	Y	Y	Y	S ₁	S ₂	X	X	X	X	.Z
Symbols that	1	1	1	1	+	V	1	1	1	1	.1
can print in	2	2	2	2	-	~	2	2	2	2	.2
each column.	3	3	3	3	A	C	3	3	3	3	.3
12th posi-	4	4	4	4	P	A	4	4	4	4	.4
tion of each	5	5	5	5	T	T	5	5	5	5	.5
print wheel	6	6	6	6	r	H	6	6	6	6	.6
is blank.	7	7	7	7	R	L	7	7	7	7	.7
	8	8	8	8	>	+	8	8	8	8	.8
	9	9	9	9	K	-	9	9	9	9	.9
	0	0	0	0	~	R	0	0	0	0	.0
	-	-	-	-	*	~	-	-	-	-	.-

Symbol columns S₁ and S₂ are normally used for the following information:

FORMATS 1 and 2 -- + or - for DC voltage or ratio
A for AC voltage
K for kilohms

FORMATS 3 and 4 -- +V or -V for DC voltages
+R or -R for ratio
AC for AC voltage
K~ for kilohms

SYMBOLS

C O L U M N										
11	10	9	8	7	6	5	4	3	2	1
1	1	1	1	+	V	1	1	1	1	1
2	2	2	2	-	~	2	2	2	2	2
3	3	3	3	A	C	3	3	3	3	3
4	4	4	4	P	A	4	4	4	4	4
5	5	5	5	T	T	5	5	5	5	5
6	6	6	6	r	H	6	6	6	6	6
7	7	7	7	R	L	7	7	7	7	7
8	8	8	8	>	+	8	8	8	8	8
9	9	9	9	K	-	9	9	9	9	9
0	0	0	0	~	R	0	0	0	0	0
-	-	-	-	*	~	-	-	-	-	-
										Fixed Decimal → ●

PIN CONNECTIONS

C O L U M N										
11	10	9	8	7	6	5	4	3	2	1
50	26	25	1	50	26	25	1	26	25	1
49	27	24	2	49	27	24	2	27	24	2
48	28	23	3	48	28	23	3	28	23	3
47	29	22	4	47	29	22	4	29	22	4
46	30	21	5	46	30	21	5	30	21	5
45	31	20	6	45	31	20	6	31	20	6
44	32	19	7	44	32	19	7	32	19	7
43	33	18	8	43	33	18	8	33	18	8
42	34	17	9	42	34	17	9	34	17	9
41	35	16	10	41	35	16	10	35	16	10
40	36	15	11	40	36	15	11	36	15	11
39	37	14	12	39	37	14	12	37	14	12
J-3 CONNECTOR				J-2 CONNECTOR				J-1 CONNECTOR		

Figure 1. FORMAT #3. (See format drawing supplied with printer for other formats.)

4.0 OPERATION WITH EXTERNAL EQUIPMENT

4.1 Data Programming

To program a print wheel symbol externally, connect Pin 38 of J-1, J-2, or J-3 to the appropriate input terminal as indicated in Figure 2 or the format drawing supplied with the printer. This method may be used with relay matrices, stepping switches, and other contact closure systems. See Figure 2.

4.2 Column Selection

To activate a previously unused column, remove the printer cover and add a jumper across the appropriate terminals on the board at the rear of the printer. Similarly, if an active column is no longer needed, either connect an external jumper from pin 38 of J-1, J-2, or J-3 to the pin corresponding to the blank position of the column in question, or remove the appropriate jumper from the terminals in the rear of the printer and manually set the print wheel to the blank position. See Figure 3.

4.3 Print Command

The external system must provide a print command pulse to initiate the printing cycle each time a number is to be printed. This pulse must be negative, 15 volts or more in amplitude, and ten milliseconds or more in duration. The pulse may be obtained from an external pulse circuit or by momentarily shorting pin 44 of J-1 to pin 13. See Figure 2.

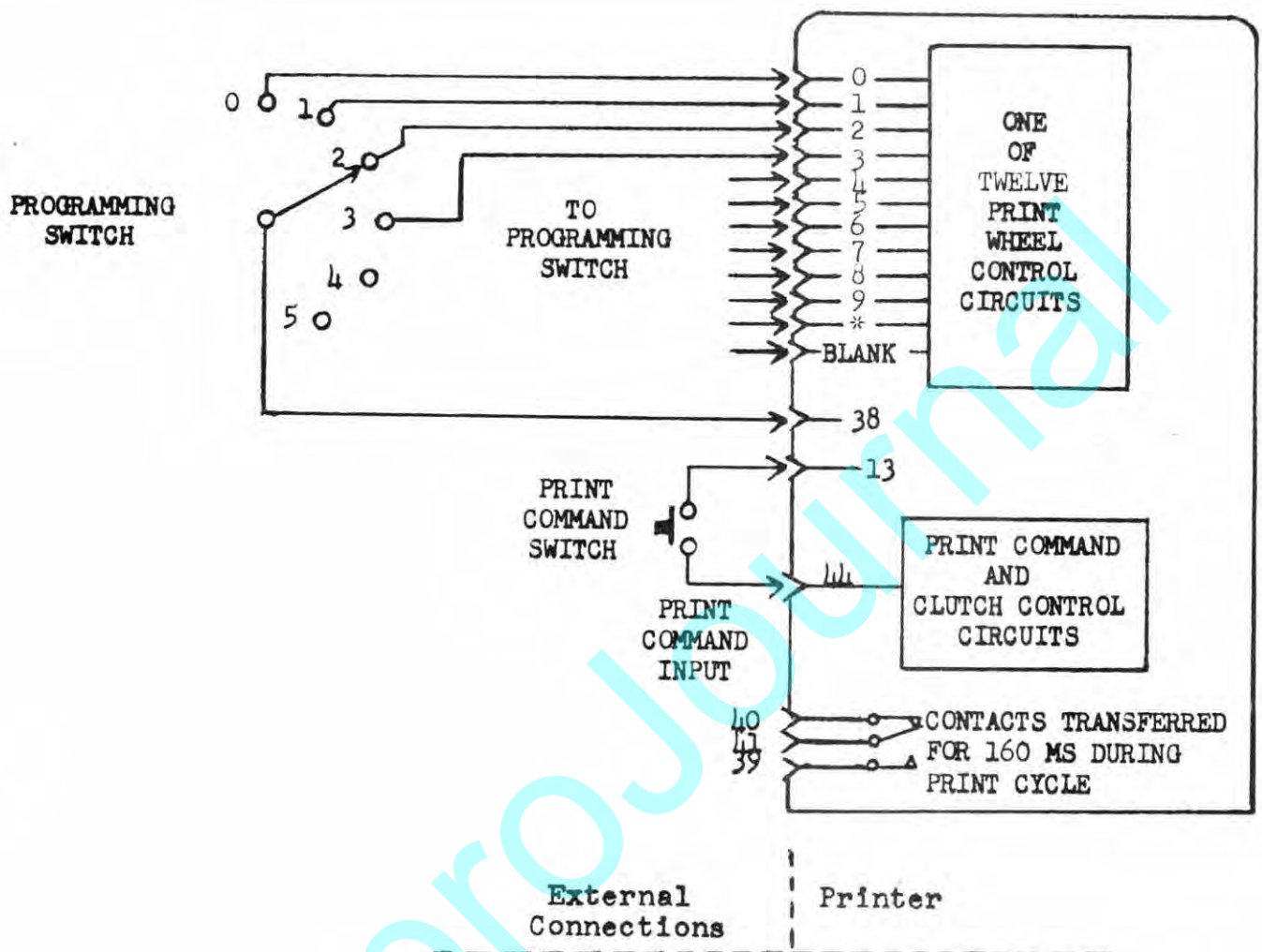


Figure 2. External Programming

4.4 Disable Relay

Accurate print wheel positioning requires that the data source be prevented from changing number selections during the printing cycle. Relay K-1 is included to disable external number selecting circuits. The relay is energized at the beginning of the printing cycle. The external number selecting circuit can be disabled during the printing cycle by connecting its supply voltage through the normally closed contacts of the relay. Terminal numbers are given in Figure 2. This closure also serves as a "print complete" signal to external equipment.

4.5 Multiple Data Sources

Successful data recording from two or more sources requires that the data sources be timed or synchronized in such a way that data from each source is ready for printing when the 155 receives a print command signal.

It is important that the entire system external to the 155 operates so that every data gathering source selects and holds data which is fed to the 155. Each data source must continue to hold its data output until the completion of the 155 printing cycle.

After each data source has presented a fixed data selection to the 155, some element of the external system must provide a print command signal to the 155.

CAUTION

The common line of the Model 155 is a floating ground. It assumes the potential of any source to which it is connected. Use caution when connecting several data sources to the common line.

5.0 THEORY OF OPERATION, AND MAINTENANCE

Accompanying this document is the Hewlett-Packard Operating and Service Manual for the Type 130 Printer Mechanism. This manual is fully applicable to the Model 155 printer except as listed below.

Page 5-1Paragraph 5-2 Ordering.

All parts for the Model 155 Printer may be ordered from Non-Linear Systems, Inc., Del Mar, California. Parts whose numbers are prefixed by 15026- or 15069- may be ordered from NLS only. All other parts may be ordered from NLS or Hewlett-Packard.

Page 5-4, Table 5-2Part Number

<u>First thru</u> <u>Fifth lines</u>	(Printer Mechanism, complete) Delete in entirety.	
<u>Item 1</u>	Panel Handle	Total Quantity is 2.
<u>Item 2</u>	Delete in its entirety and substitute:	
	Main front panel, door only	15026-019A
	Door including hinge pins	15026-019B
<u>Item 5</u>	Panel, paper drawer (less pin and spring)	15026-021
<u>Item 11</u>	Delete and substitute:	
	Upper Panel, standard	15026-022
	Upper Panel with NLS trademark	15026-002
	(used on special units which have digital clock, recorder, or other accessory installed in left side of cabinet)	

Pages 5-8 and 5-9, Table 5-4 and Figure 5-3

Delete. (These parts are not used in Model 155.)

Page 5-10, Table 5-4Part NumberItem 1

Delete and substitute:

Wheel bank assembly:

Printers with serial numbers 15.370 thru
15.373, 15.376 thru 15.514, 155.1 and
subsequent:

Format #1 (See page 6 of Document
No. 317) 15026-112D

Format #2 15026-119D

Format #3 15026-106D

Format #4 15026-109D

Special Formats--add "D" to number
of format drawing supplied with
printer--i.e. Format 15026-108 15026-108D

Printers with serial numbers 15.375, 15.374,
15.369 and previous:

Format #1 15026-112C

Format #2 15026-119C

Format #3 15026-106C

Format #4 15026-109C

Special Formats--add "C" to number
of format drawing supplied with
printer--i.e. Format 15026-108 15026-108C

Item 8

Delete and substitute:

Print wheel and brush (See note below)

X, Y, or Z wheel (See page 6 of Doc. 317) 15026-015-7B

S₁ wheel 15026-015-3B

S₂ wheel 15026-015-6B

Special Wheels--order by symbol arrange-
ment and Format drawing number; i.e.
"Wheel with symbols BCDEFGHJKAML used
in column 11 of Format 15026-107" or
request NLS Drawing 15026-015, which
lists all print wheels used in Model 155
Printers.

Item 10

Delete and substitute:

Commutator Card (See note below)

Printers with serial numbers 15.370 thru
15.373, 15.376 thru 15.514, 155.1 and
subsequent:

Page 5-10, Table 5-4 (cont.)

Part NumberItem 10 (cont.)

Commutator Card, plain	15026-023B
Commutator Card with decimal point	15026-014D
Commutator Card with colon	15026-024D

Printers with serial numbers 15.375, 15.374,
15.369 and previous:

Commutator Card, plain	15026-023A
Commutator Card with decimal point	15026-014C
Commutator Card with colon	15026-024C

Note:

Part numbers given are for the new NLS Gold Plated commutator cards and print wheels, incorporated in production effective in serial number 155.41. When replacing the older rhodium plated parts, both the commutator card and the corresponding print wheel should be replaced; operation of rhodium plated print wheel brushes on gold plated commutator cards, or gold plated brushes on rhodium plated cards, is not recommended.

Item 20

Delete and substitute:

Print wheel gear, 29 tooth	560A-24F
----------------------------	----------

Item A

Set screw, 6-32 x 3/16 in. Total Quantity is 4.

Page 5-12, Table 5-4Item 25

Delete in its entirety and substitute:

Connector assembly (includes 11 connectors and screws, unwired)	15026-020
--	-----------

Items 26
thru 31, and
Items A and B

Delete. (These parts are not used in Model 155.)

Page 5-18, Table 5-7Item 4

Delete "Shutter, scan, Part No. 562A-83A" (This part is not used in Model 155.)

Page 5-20, Table 5-8Part Number

<u>Item 1</u>	(Pawl magnet assembly, complete) Delete.	
<u>Item 6</u>	Magnet Coil	9161-0009
<u>Item 12</u>	Print idler bearing	560A-17Z
<u>Item 24</u>	Spring, Compression (Part number change only, no effectivity)	53M-S-3758
<u>Item 25</u>	Clutch solenoid	0491-0007

(End of differences to H-P 130 Manual)

ELECTRICAL PARTS LIST

<u>Item</u>	<u>Description</u>	<u>Part Number</u>	<u>Total Quantity</u>	<u>Manufacturer</u>
1	Circuit Board Assembly, complete (includes Items 2 thru 20 below)	15026-013	1	NLS
2	Transistor	3689	11	RCA
3	Transistor	2N651	1	
4	Transistor	2N457	1	
5	Rectifier	1N2616	8	
6	Diode	5003-002	11	NLS
7	Resistor, 270 ohm, 10%, $\frac{1}{2}$ W		1	Ohmite
8	Resistor, 1000 ohm, 10%, $\frac{1}{2}$ W		11	Ohmite
9	Resistor, 3300 ohm, 10%, $\frac{1}{2}$ W		1	Ohmite
10	Resistor, 5600 ohm, 10%, $\frac{1}{2}$ W		1	Ohmite
11	Resistor, 6800 ohm, 10%, $\frac{1}{2}$ W		1	Ohmite
12	Resistor, 18K ohm, 10%, $\frac{1}{2}$ W		11	Ohmite
13	Resistor, 56K ohm, 10%, $\frac{1}{2}$ W		1	Ohmite
14	Resistor, 2.7 ohm, 10%, 1 W		1	Ohmite
15	Relay, 2PDT, 28V	RP7641G2 or RP9003G1	1	C.P. Clare
16	Transformer, power	15026-002	1	NLS
17	Capacitor, 500 mfd, 50 V	05RTK500	1	Industrial

ELECTRICAL PARTS LIST

<u>Item</u>	<u>Description</u>	<u>Part Number</u>	<u>Total Quantity</u>	<u>Manufacturer</u>
18	Capacitor, 0.47 mfd, 200 V	MW44M2474	11	Westcap
19	Cable clamp	EC-8	1	
20	Connector	57-30360	1	Amphenol
Items 21 thru 29 are located on the printer mechanism.				
21	Lamp	1829	2	
22	Resistor, 82 ohm, 10%, 2 W		2	Ohmite
23	Fuse, 0.6 Amp	313.600	1	Littelfuse
24	Rectifier	1N2616	1	
25	Connector	57-40360	1	Amphenol
26	Capacitor, 2 mfd, 600 V	17-53	1	H-P
27	Switch, cam-operated	310-208	1	H-P
28	Switch, toggle, "Record"	310-215	1	H-P
29	Switch, toggle, "Power"	310-11	1	H-P
Items 30 thru 33 are located on the rear panel of the printer.				
30	Connector	57-40500	1	Amphenol
30A	Connector (Effective 155.139 and subsequent)	57-20500	2	Amphenol
31	Line Cord	1002-028	1	NLS
32	Fuse Holder	342004	1	Littelfuse
33	Fuse, 1.25 Amp	3131.25	1	Littelfuse

ELECTRICAL PARTS LIST

<u>Item</u>	<u>Description</u>	<u>Part Number</u>	<u>Total Quantity</u>	<u>Manufacturer</u>
	Items 34 and 35 are supplied with, but not attached to, the printer.			
34	Connector	57-30500	3	Amphenol
35	Hood assembly (holds two of Item 34 to fit J1 and J2)	561B-95H	1	H-P

NOTE

The following fold-out page is the schematic diagram of the NLS Model 155 printer. Special features and recent changes, if any, are shown on a separate diagram shipped with the printer.

ADD JUMPERS ACROSS TERMINALS FOR ACTIVE COLUMNS;
REMOVE JUMPERS FOR UNUSED COLUMNS.

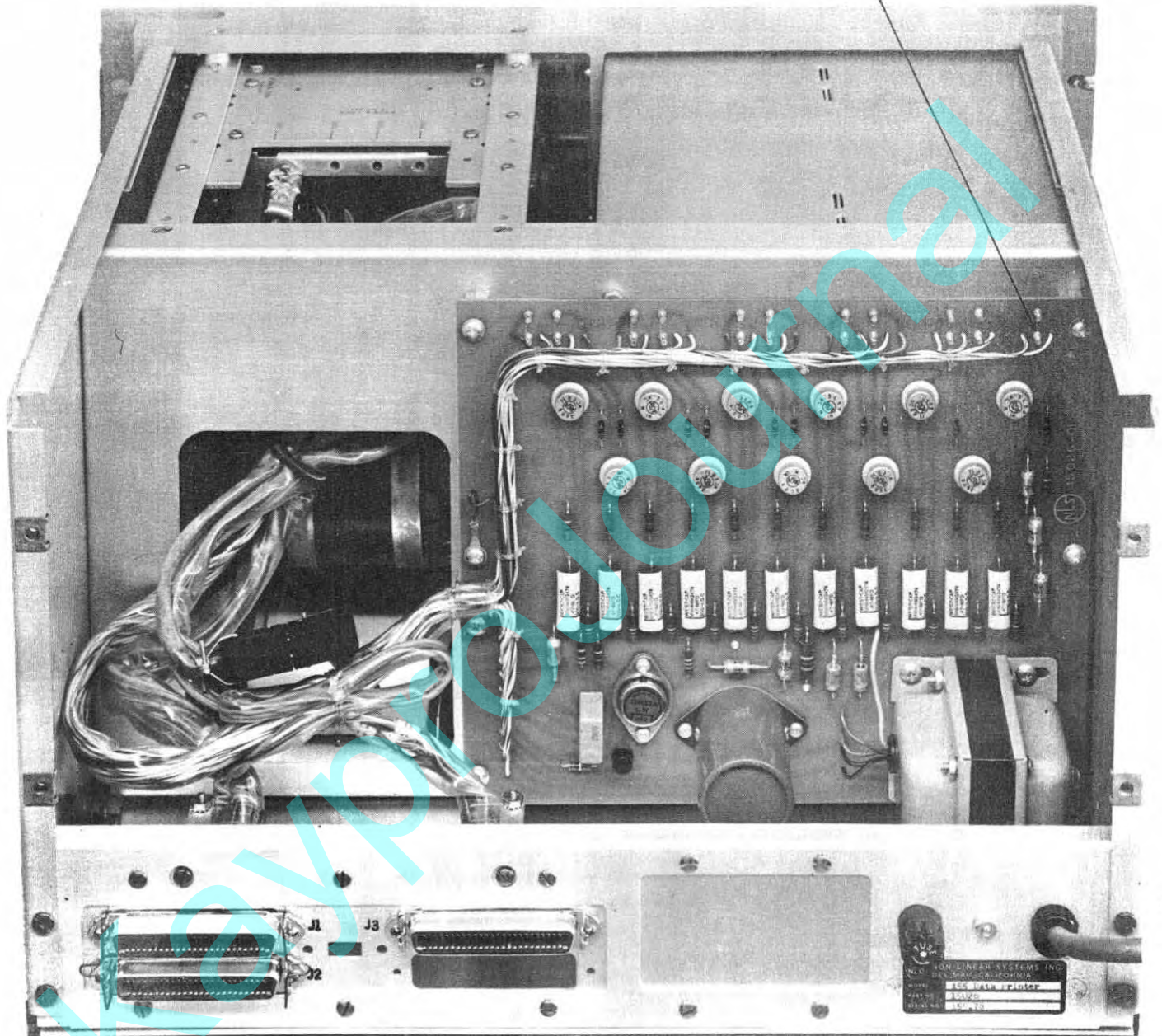


FIGURE 3. PRINTER, REAR VIEW

15026-109

REVISIONS

SYM	EFFECT	DESCRIPTION	DATE	APPROVAL

SYMBOLS

COLUMN										
11	10	9	8	7	6	5	4	3	2	1
1	1	1	+	V	1	1	1	1	1	1
2	2	2	-	n	2	2	2	2	2	2
3	3	3	A	C	3	3	3	3	3	3
4	4	4	P	A	4	4	4	4	4	4
5	5	5	T	T	5	5	5	5	5	5
6	6	6	r	H	6	6	6	6	6	6
7	7	7	R	L	7	7	7	7	7	7
8	8	8	>	+	8	8	8	8	8	8
9	9	9	K	-	9	9	9	9	9	9
0	0	0	~	R	0	0	0	0	0	0
-	-	-	*	~	-	-	-	-	-	-

FIXED DECIMAL

PIN CONNECTIONS

COLUMN										
11	10	9	8	7	6	5	4	3	2	1
50	26	25	1	50	26	25	1	26	25	1
49	27	24	2	49	27	24	2	27	24	2
48	28	23	3	48	28	23	3	28	23	3
47	29	22	4	47	29	22	4	29	22	4
46	30	21	5	46	30	21	5	30	21	5
45	31	20	6	45	31	20	6	31	20	6
44	32	19	7	44	32	19	7	32	19	7
43	33	18	8	43	33	18	8	33	18	8
42	34	17	9	42	34	17	9	34	17	9
41	35	16	10	41	35	16	10	35	16	10
40	36	15	11	40	36	15	11	36	15	11
39	37	14	12	39	37	14	12	37	14	12
J-3 CONNECTOR				J-2 CONNECTOR				J-1 CONNECTOR		

FOR

RBX2601

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED			DRAWN BY H. Hulbert	DATE 1-29-60	TITLE FORMAT #4 PRINTER MODEL 155 SCALE VT
DIMENSIONS ARE IN INCHES			CHECKED BY	DATE	
TOLERANCES ON			APPROVED BY H. Hulbert	DATE 1-29-60	
FRACTION DECIMAL ANGLES			FINISH		
MATERIAL					

 NON-LINEAR SYSTEMS INC.	DEL MAR AIRPORT DEL MAR, CALIFORNIA
DRAWING NUMBER 15026-109	
SHEET OF	