DOCUMENT
NO. 317

OPERATION & SERVICE MANUAL

FOR

NLS MODEL 155 PRINTER

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
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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 (-1.5 V print, -30 V 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 (-15 V to -30 V, 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:	115 V, 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 35 VA.
DIMENSIONS:	19" wide, 10½" 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 3.

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: YYYYYS$_1$XXXX.Z

FORMAT #2 - For 5-digit digital voltmeters: YYYYS$_1$XXXXX.Z

FORMAT #3 - For 4-digit volt-ohm-ratio meters or voltmeter ratiometers, such as NLS Models V34, V34A, M24, V24: YYYYS$_1$S$_2$XXXX.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 applicable drawing supplied with the instrument.

FORMAT #4 - For 5-digit digital voltmeters and ratiometers such as the Model V35 and Model V35A: YYYS$_1$S$_2$XXXXX.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 utilization since fixed decimal points do not require a separate column, while each floating decimal point position would.

Y	Y	Y	Y	S_1	S_2	X	X	X	X	.Z
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
-	-	-	-	*	~	-	-	-	-	.-

Symbols that can print in each column. 12th position of each print wheel is blank.

Symbol columns S_1 and S_2 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

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.

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 Servicing Manual covering the printing mechanism of the Model 155. This manual is fully applicable to the instrument except as follows:

1. Clutch solenoid rating is 30 volts, 400 ma. Hewlett-Packard stock number is 0491-0007.

2. Pawl magnets are rated at 30 volts, 50 ma. Hewlett-Packard stock number is 9161-0009.

NOTE

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

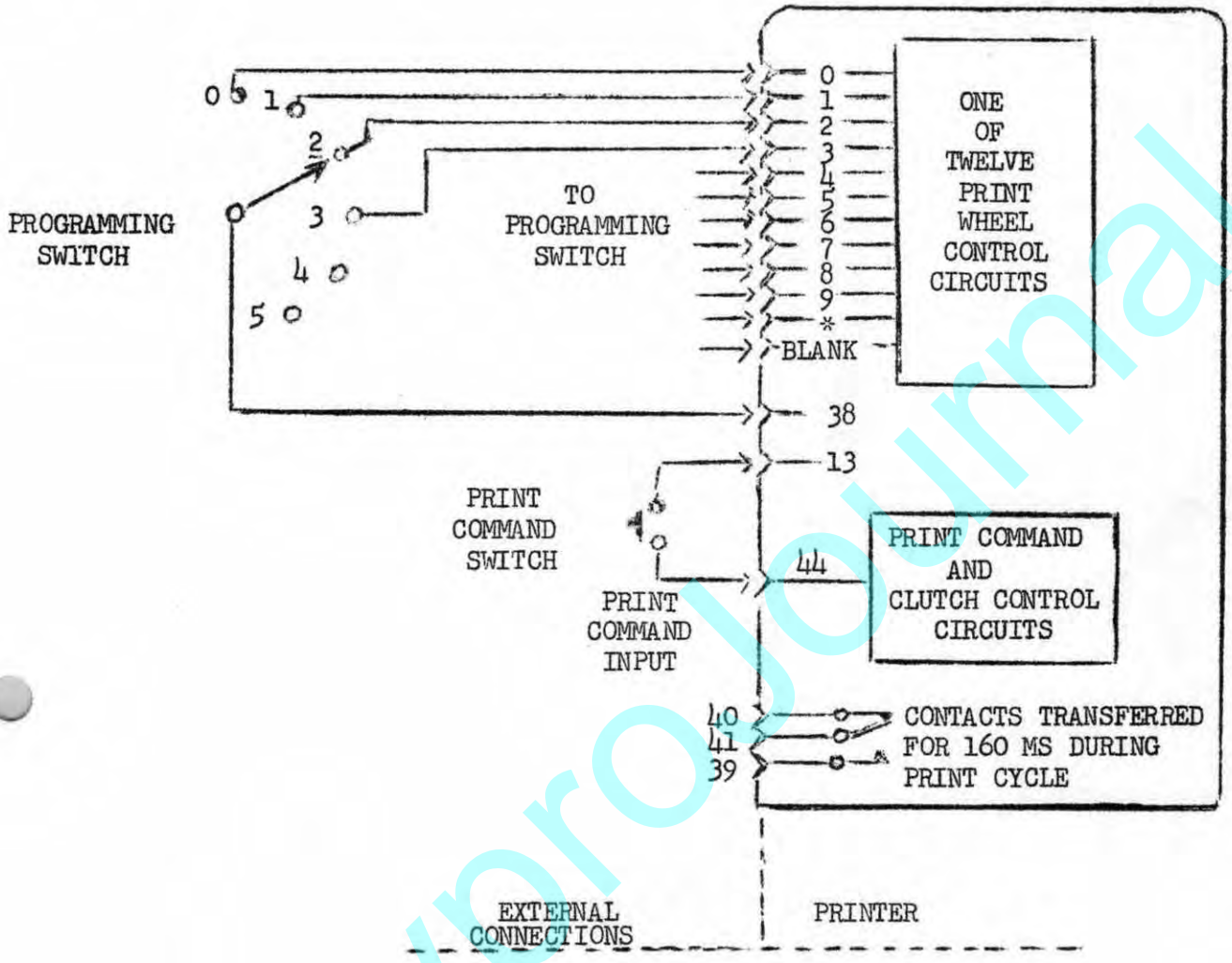

FIGURE 2. EXTERNAL PROGRAMMING

SYMBOLS

COLUMN										
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

	COLUMN										
	11	10	9	8	7	6	5	4	3	2	1
1	50	26	25	1	50	26	25	1	26	25	1
2	49	27	24	2	49	27	24	2	27	24	2
3	48	28	23	3	48	28	23	3	28	23	3
4	47	29	22	4	47	29	22	4	29	22	4
5	46	30	21	5	46	30	21	5	30	21	5
6	45	31	20	6	45	31	20	6	31	20	6
7	44	32	19	7	44	32	19	7	32	19	7
8	43	33	18	8	43	33	18	8	33	18	8
9	42	34	17	9	42	34	17	9	34	17	9
0	41	35	16	10	41	35	16	10	35	16	10
-	40	36	15	11	40	36	15	11	36	15	11
Bk	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.)

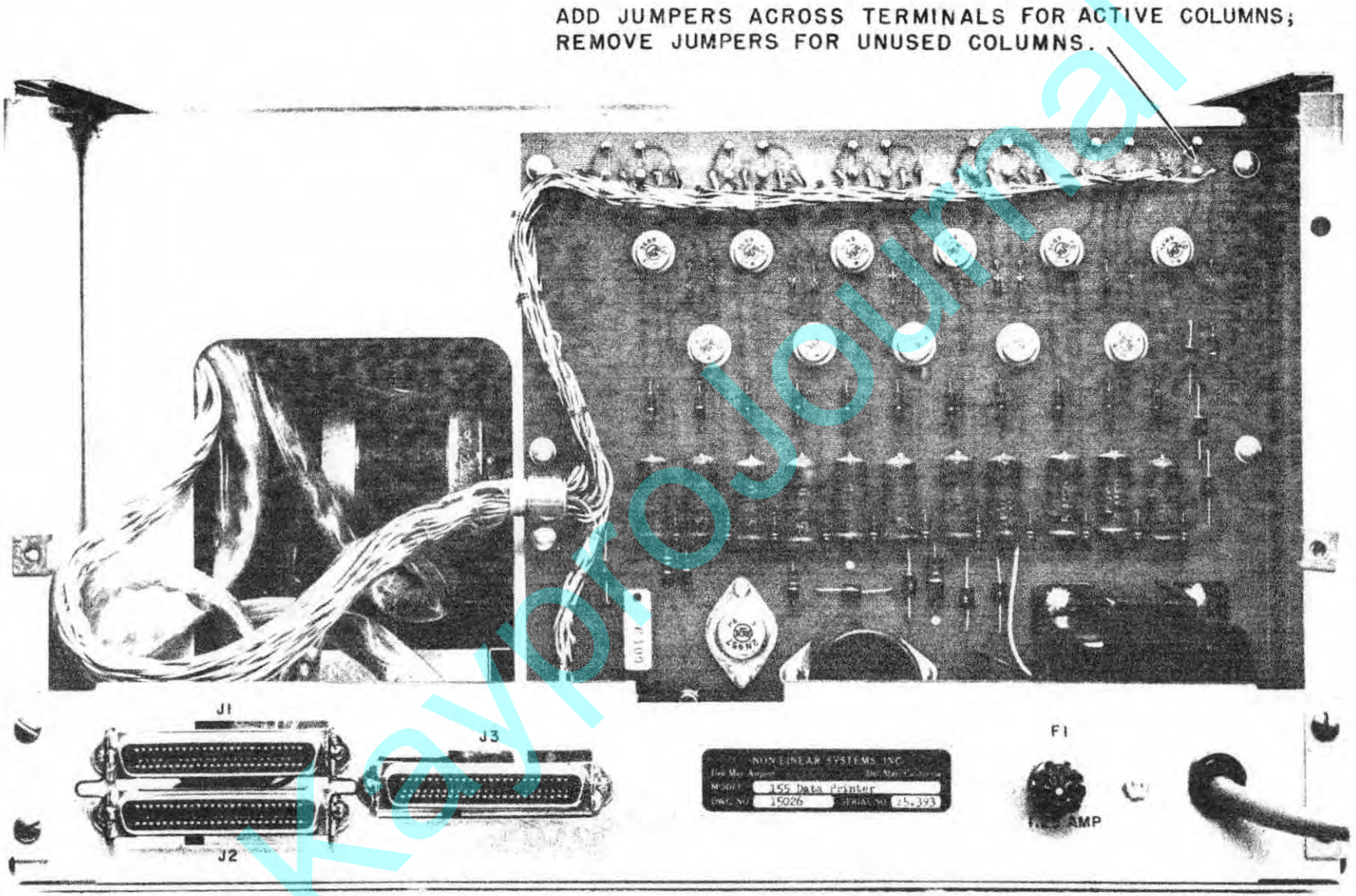

FIGURE 3. PRINTER, REAR VIEW

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL
4	15.361 THRU 15.871	REVISED & REDRAWN WAS C SIZE. 8.2K WAS 15K (11 PLACES)	16 MARCH ARW	HM Soulé
5	15.311, 15.355, 15.372, 15.373, 15.375 THRU 15.396	REVISED TRANSISTOR CIRCUITRY; EFFECT ON ING 4 WAS "15.361 THRU 15.373, 15.376 & SUBS"	19 APR '60 ARW	H Halbert May 8-60
6	15.397 & SUBS.	EFFECT. OF ING 5 WAS "15.378, 15.379, 15.374 & SUBS." ADDED J305, P305, J306, P306 REMOVED R CC ACROSS S302 REMOVED R ACROSS L312 (L312 was L13)	8-3-60 I-M	H Halbert 8-3-60

IN34A
1000
3689
0.47
18K
5600
AMPHENOL 57-30360
P301
REMOVE JUMPER IF DECADE IS NOT USED (TYP)
AMPHENOL 57-40360
J301
J306 P306
L311 L310 L309 L308 L307 L306 L305 L304 L303 L302 L301
PRINT WHEEL SOLENOIDS
600Ω EACH
J305 P305
COMMUTATOR ASSEMBLY
BRUSH BLANK
SEE FORMAT DRAWING SUPPLIED WITH PRINTER FOR PIN CONNECTIONS CORRESPONDING TO PRINTED SYMBOLS
J-2
1-12 COLUMN 4
14-25 COLUMN 5
26-37 COLUMN 6
39-50 COLUMN 7
38 GND
13 -30V
1-12 COLUMN 8
14-25 COLUMN 9
26-37 COLUMN 10
39-50 COLUMN 11
38 GND
13 -30V
J-3
LAM. SWITCH S302
CLUTCH SOLENOID
L312 80 OHMS
RECORD S303
RECORD I301
POWER I302
#1829
82
POWER S304
MOTOR B302
C301 2.0
F305 0.6A
500
2.7
2N651
2N457
1.25 AMP
330Ω
270
56K
6800
115 VAC
AMPHENOL 57-40500 (TYP)
J-1
1-12 COLUMN 1
14-25 COLUMN 2
26-37 COLUMN 3
39 N.O.
41 C.M. } PRINT COMPLETE
40 N.C.
13 -30 V
38 GND
44 PRINT COMMAND
46 CHASSIS GND

15026 SH 2
6

3. CAPACITOR VALUES IN MICROFARADS.
2. RESISTOR VALUES IN OHMS.
1. DIODES ARE SILICON JUNCTION, TEXAS INSTRUMENTS TYPE IN2071 OR EQUIVALENT.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE
DIMENSIONS ARE IN INCHES	K.D. LANGLEY	9-26-58
TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ±	CHECKED BY H. HALBERT	DATE 9-29-58
MATERIAL	APPROVED BY H. CLEMENT	DATE 12-22-58
FINISH		

TITLE: SCHEMATIC— DATA PRINTER
MODEL 155
SCALE | WT.

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA
DRAWING NUMBER 15026
SHEET 2 OF