

INSTRUCTION MANUAL

MODEL PR-5

PRESET COUNTER



NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

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SECTION I

INTRODUCTION AND DESCRIPTION

1-1. GENERAL.

1-2. The Model PR-5 Preset Counter is a five-digit counter with a five-digit preset capability built into the unit. Provision is included to accept additional external presets as desired. The unit can count either up or down. Input pulses to the counter are totalized and when the count reaches the preset value, an output is provided indicating coincidence of the count with the preset number. Two outputs are provided at coincidence. One output is a voltage level change at coincidence and remains changed until coincidence no longer exists. The second output is a voltage level change which stays changed until the counter is reset.

1-3. The PR-5 is designed to accept either a contact-closure count input or an electronic pulse input. For fast counting of electronic pulses, a component removal permits operation to 500 kHz.

1-4. Several additional features are standard on the PR-5. Among these are: multiplexed BCD output, decimal point position selection, input count inhibit, display storing, loadable counter and leading zero blanking. Also, to provide a standby power source in the event of primary power failure, a separate instrument - the PR-5B - is available. This unit contains an internal battery pack which will automatically provide a standby power source (without loss of count) for a period of approximately one hour.

1-5. The PR-5 operates from a single power source and draws less than 2.5 watts from the source. Display is by a red light-

emitting diode (LED) for each decade. The PR-5 is easily panel-mounted and the preset number easily set in by the five front-panel switches. The small size of the PR-5 is made possible by the use of solid-state LSI circuitry and state-of-the-art engineering.

1-6. SPECIFICATIONS.

No. of Digits: Five

No. of Presets: One (5 digits); additional external as required.

Input Counting Speed:

Contact Closure: 0 - 300/second nominal

Electronic Pulse: 0 - 500 kHz (Requires removal of capacitor to go above 300/second.)

Input Signal Amplitude:

Contact-Closure : To ground

Electronic Pulse:

Amplitude - 0 - +3V minimum; 0 - +30V maximum.

Duration - 1 μ Sec minimum.

Input Impedance: 40 k Ω

Reset: 1. Front panel pushbutton switch.

2. Contact-closure to B+ (+10V to +12V).

3. Electronic pulse of +10V to +12V for 2 μ Sec minimum.

Decimal Location: Positioned by jumper on connector to any of five locations - . X.X.X.X.X

Outputs:

Equal: 1. A signal only when count equals preset register number.

2. A latched signal, when count equals preset register number signal and when energized by coincidence, remains until counter is reset.

BCD: Multiplexed BCD (1-2-4-8)

General:

Size: 2.25"H x 3.25"W x 4"D (57mm x 82.5mm x 101.6mm)

Weight: 4.75 oz (135g)

Operating Temperature: 0°C to +50°C

Power Requirements: +12 vdc ($\pm 5\%$) @ 200 mA maximum

Display: 0.3" high LED, 5 digits - 7 segments

1-7. OPERATING PRINCIPLES.

1-8. The PR-5 is shown functionally by the block diagram in figure 1-1. The up/down counter accumulates all of the input pulses presented at the count input. Inputs are to be additive unless the up/down control input is set to subtract input counts. The counter can be reset either by the pushbutton on the front panel or externally. A preset count can be entered using the front-panel preset switches. This feature enables the user to count down from a preset number to zero. When the counter reaches zero, an output indication is provided. When the "load counter" input is enabled, the number on the preset switches is entered into the counter. Similarly, when the "load register" input to the 5-digit register is enabled, the number

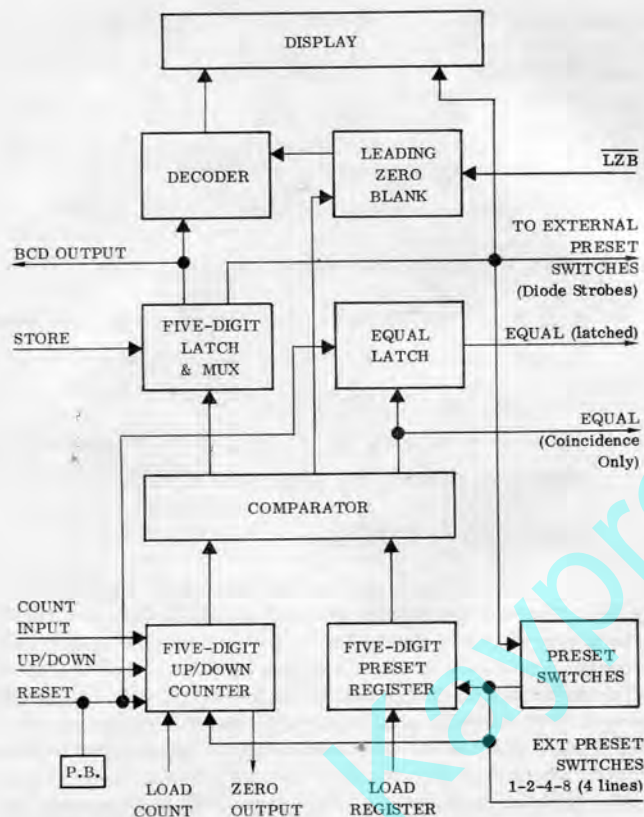


Figure 1-1. Block Diagram - PR-5 Preset Counter

on the preset switches is entered into the register. Additional preset switches can be added externally to permit easy selection of different batch counts.

1-9. Both the counter and the register provide outputs to the comparator. The comparator detects when the counter number equals the number in the preset register and provides an electronic output when equality exists. It is because of the high speed capability that an electronic level change output is used. A relay output is not fast enough to respond precisely at the preset number desired. This equal output also drives the latch whose output on coincidence holds until the counter is reset (00000).

1-10. The five-digit latch is used to store the number of counts in the counter and to track it as it counts. If desired, however, the "store" input can be enabled so that the count at that instant will be held by the five-digit latch and drive the display.

1-11. The multiplexer (MUX) scans the decade output of the latches and outputs the BCD data to the decoder sequentially from most significant digit to least significant. The decoder decodes the BCD data to seven-segment outputs for the display. The appropriate LED decade is strobed at the time its seven-segment data is valid. An input, LZB, is provided for leading zero suppression, if desired.

1-12. From this brief discussion of the basic operation of the PR-5, it can be seen that the instrument can be used not only for batch counting but for count-down and for rate-limiting.

SECTION II
PREPARATION FOR USE

2-1. INSTALLATION.

2-2. Connector and connector pin location information, the panel cutout pattern and mounting dimensions for the PR-5 are shown in figure 2-1. To install, simply insert the rear of the instrument through the opening from the front of the panel and attach to the panel at the four corners of the panel-mount flange with the hardware provided.

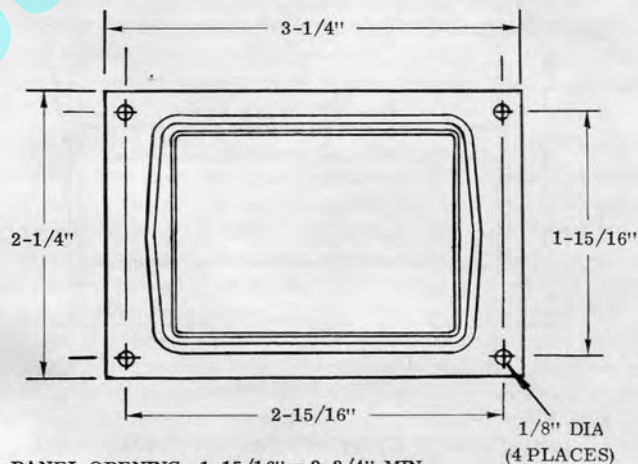


Figure 2-1. Connectors and Mounting Data (Sheet 1 of 2)

2-3. MATING CONNECTOR WIRING.

2-4. Thoroughly review Section III (Operation) of this manual to determine how the two mating connectors of the PR-5 should be wired. Some features of the instrument may or may not be desired and the explanation provided in Section III will enable the user to obtain from the PR-5 those functions required to meet his application.

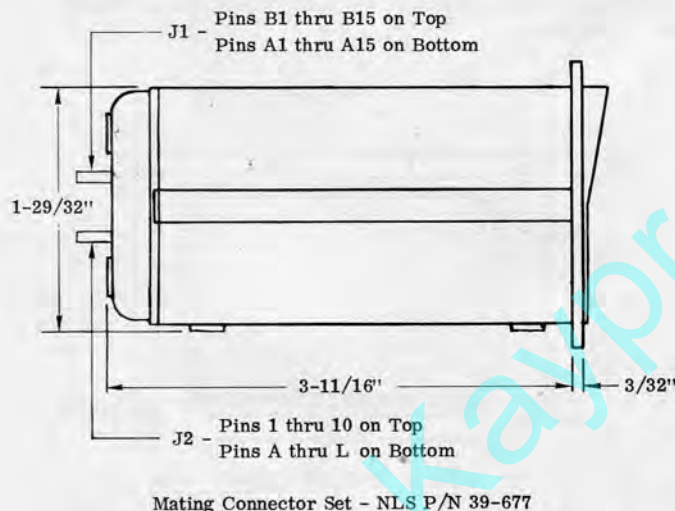


Figure 2-1. Connectors and Mounting Data (Sheet 2 of 2)

SECTION III

OPERATION

3-1. CONNECTORS.

3-2. Refer to figure 2-1 (Sheet 2 of 2) for connector and connector pin location information and refer to table 3-1 for connector pin functions.

3-3. OPERATING FUNCTIONS AND PIN CONNECTIONS.

3-4. **POWER SUPPLY.** Connect the negative side of a +12 vdc power supply (power ground) to pin 10 of J2 and the positive side to Pin A of J2. Pin A1 of J1 provides a +11 vdc output for auxiliary use; the corresponding ground connection is pin A13 of J1. A connection from pin 1 to pin 8 of J2 is also required if the instrument is a PR-5B, i.e., having the standby battery operation feature.

3-5. **COUNT INPUT.** Connect the count input to pin A8 of J1. If a shielded lead is used, connect the shield to the power ground on pin 10 of J2. The PR-5's input impedance is 40 kilohms. Counting occurs on the negative going transition of the input signal for an electronic pulse input. For a contact-closure input, the count occurs on closure to ground. The standard PR-5 will accept either contact-closure or electronic pulses. Up to 300 counts per second can be accepted with contact-closure inputs. If it is desired to exceed this rate, electronic pulses must be input and a capacitor must be removed from the board with the LED display attached. (See Section V for capacitor removal instructions.) With this capacitor removed, the maximum count rate is 500 kHz and the minimum pulse width is one microsecond. Operation on an electronic pulse input requires a pulse of from +3V to +30V in amplitude.

Table 3-1. Connector Pin Data

Connector J1

| A (Bottom) | B (Top) |
|------------------------------|---------------------------|
| 1 +11V (logic supply output) | 1 $\overline{\text{LZB}}$ |
| 2 N/C | 2 SET |
| 3 Up/Down | 3 Zero Output |
| 4 Spare | 4 N/C |
| 5 Spare | 5 Count Inhibit |
| 6 Spare | 6 Store |
| 7 Spare | 7 Equal Output |
| 8 Count Input | 8 BCD Output "4" |
| 9 Spare | 9 Latched Equal Output |
| 10 BCD Output "1" | 10 BCD Output "2" |
| 11 BCD Output "8" | 11 Decimal Point Common |
| 12 N/C | 12 N/C |
| 13 Ground | 13 N/C |
| 14 N/C | 14 Load Register |
| 15 Load Counter | 15 Clear |

Connector J2

| Pin No. (Top) | Pin Letter (Bottom) |
|--------------------------|----------------------------|
| 1 +3.6V (Battery) | A +12V (power input) |
| 2 10^0 | B N/C |
| 3 10^1 } Decimal Point | C 10^0 } |
| 4 10^2 } Select & BCD | D 10^1 } |
| 5 10^3 } Data Strobe | E 10^2 } Internal Preset |
| 6 10^4 } | F 10^3 } Select Input |
| 7 "8" | H 10^4 } |
| 8 DC/DC Input | J "4" |
| 9 N/C | K "2" |
| 10 Ground | L "1" |

3-6. COUNT INHIBIT. The PR-5 has a count inhibit input which controls whether or not contact-closures or pulse inputs are counted. An open circuit on pin B5 of J1 will not inhibit the count input. A contact-closure to +10V to +12V or voltage level change from $\leq +2.2V$ to $\geq +10V$ input will inhibit further counting until released. Set-up (delay) time for the count inhibit function is zero.

3-7. UP/DOWN COUNTER CONTROL. The PR-5 Counter can count up or down. For either up-counting or down-counting (subtractive), the input remains on pin A8 of J1. The standard PR-5 will count up unless a count down input is received on pin A3 of J1. To count down, a contact-closure or zero ($< 2.2V$) voltage must be applied to this pin at least one microsecond before the count input closure or negative-going edge of the pulse to be subtracted is applied.

3-8. LOAD COUNTER. The counter can be preloaded with any desired number using the front-panel preset switches. To do so, set in the desired number on the switches and then apply +10V to +12V to pin A15 of J1 by either contact-closure or electronic level. The counter is loaded digit-by-digit using the digit strobe lines. Counter input is inhibited while the load counter input is high (+10V to +12V). When loading the counter, the load counter input must be high for a period of at least five milliseconds.

3-9. RESET. To reset the counter, a pushbutton switch is provided on the front panel of the PR-5. In addition, an external pushbutton or voltage level change can reset the counter. Application of +10V to +12V to pin B15 of J1 will cause reset of the counter and the equal latch. Reset does not effect the preset register or the 5-digit latch.

3-10. ZERO OUTPUT. The zero output, pin B3 of J1, goes high (+9.6V to +12V) whenever all decades of the counter contain zero. The zero output is inhibited during "load counter" operation.

3-11. **LOAD REGISTER.** To load the preset register with a number, set the desired number in on the front-panel preset switches. This number will then be loaded into the preset register upon bringing the "load register" input, pin B14 of J1, high ($+10V$ to $+12V$) by either electronic pulse input or contact-closure. The preset register is loaded with the BCD data from the preset switches digit-by-digit. The "load register" must remain high for a minimum of five milliseconds.

3-12. **EQUAL OUTPUT.** The count in the counter is continuously compared with the number in the preset register. When coincidence occurs, an output signal is provided on pin B7 of J1. This output will occur two microseconds after coincidence and will remain high for one and one-half microseconds after the next count. Output voltage is $\leq 2.4V$ normally and $\geq 9.6V$ at coincidence. Maximum load on the equal output is one milliamper.

3-13. **LATCHED EQUAL OUTPUT.** The equal output is used to drive a latch which stores and outputs the fact that a coincidence has occurred. Reset of the counter will reset this latch. This output (pin B9 of J1) is a grounded emitter transistor whose collector has a 10 kilohm resistor to the $+12V$ supply. The latched equal output occurs at two and one-half microseconds after coincidence.

3-14. **STORE.** The store input permits the holding of a count at any time. The five-digit latch will track the counter when this input (pin B6 of J1) is low, $\leq +2.2V$, or open. Bringing the input high, $\geq +10V$, will cause the count at that time to be held and displayed. Store can be changed simultaneously with the negative-going transition of the count input. While storing a reading, the counter is not inhibited; all input counts are totaled. When store is returned to low, the contents of the counter will be displayed. The counter can be reset while store input is high without effecting the display.

3-15. **LEADING ZERO BLANKING.** If desired, all zeros to the left of the least significant digit can be blanked. This is accomplished by using the LZB input (pin B1 of J1). The LZB input is normally $\geq +10V$ and zeros are not suppressed. To suppress the zeros, bring the input to $\leq +2.2V$, either by contact-closure or voltage level.

3-16. **DECIMAL POINT SELECTION.** The decimal point can be positioned to the left of any of the five digits. To position it at the desired place, connect the decimal point common (B11 of J1) to pin 2, 3, 4, 5 or 6 of J2, see below:

| | | | | | | | | | | |
|------------------------|---|---|---|---|---|---|---|---|---|---|
| Decimal Point Location | . | X | . | X | . | X | . | X | . | X |
| Pin No. (Connector J2) | 6 | | 5 | | 4 | | 3 | | 2 | |

3-17. **DISPLAY BLANKING.** An input is provided to blank the display (SET) whenever desired. This input (pin B2 of J1), when grounded or brought at $\leq +2.2V$, will cause the display to be turned off. Normal operation of the display occurs when this input is open or brought high ($\geq +10V$).

3-18. **BCD OUTPUT.** The PR-5 has a binary coded decimal output. This output is a multiplexed, bit parallel for a digit and serial digits. In a repeating continuous cycle, digit data is presented from most significant digit (MSD) to least significant digit (LSD). The 1-2-4-8 bit parallel outputs are on pins A10, B10, B8 and A11 respectively of J1. The digit strobes for digit identification are on pins 6, 5, 4, 3 and 2 of J2, the same pins that drive the decimal point. These lines represent MSD and LSD in that order. BCD data is not valid when the display is blanked but the leading zero blanking, when enabled, will effect the display but not the multiplexed BCD output. Outputs are compatible with CMOS input.

3-19. PRESET CONNECTION. The PR-5 is wired to permit use of the group of five preset switches on the front panel or an external group or groups of preset switches or a combination of internal and external groups. If no external preset switches are required, jumpers must be added between pin 2 and pin C, between pin 3 and pin D, between pin 4 and pin E, between pin 5 and pin F and between pin 6 and pin H, all on J2.

3-20. EXTERNAL PRESET SELECTORS. To meet the needs of those who require additional presets, a provision in the PR-5 permits the use of multiple external preset switches to select a desired preset number for insertion into the preset register. If such is desired, do not wire pins 2, 3, 4, 5 and 6 of J2 to pins C, D, E, F and H of J2 respectively. For external multiple preset capability, each set of switches must provide four bussed wires representing 1-2-4-8 bit digit lines from each group of five preset switches (figure 3-1). The four from each group are in turn bussed and connected to pins L, K, J and 7 of J2 and representing bits 1, 2, 4 and 8 respectively. Wires from pins 2, 3, 4, 5 and 6 of J2 must be wired to the arm of five levels of an external rotary switch. This switch selects which group of five preset switches is to be used to load the preset register. The switch must have as many positions as there are groups of preset switches. From the switch the five contacts at each position are then wired to the five preset switches in a group. If it is desired to use one position of the external rotary switch, the preset selector, for selecting the group of preset switches within the PR-5, then five wires from the rotary switch position contacts must go to the PR-5 on pins C, D, E, F and H of J2 (position 6 of rotary selector switch, figure 3-1). These must connect respectively, by rotary switch positioning, to the wires from pins 2, 3, 4, 5 and 6 of J2 respectively. Pin 2 is the least significant decade wire and pin 6 is the most significant.

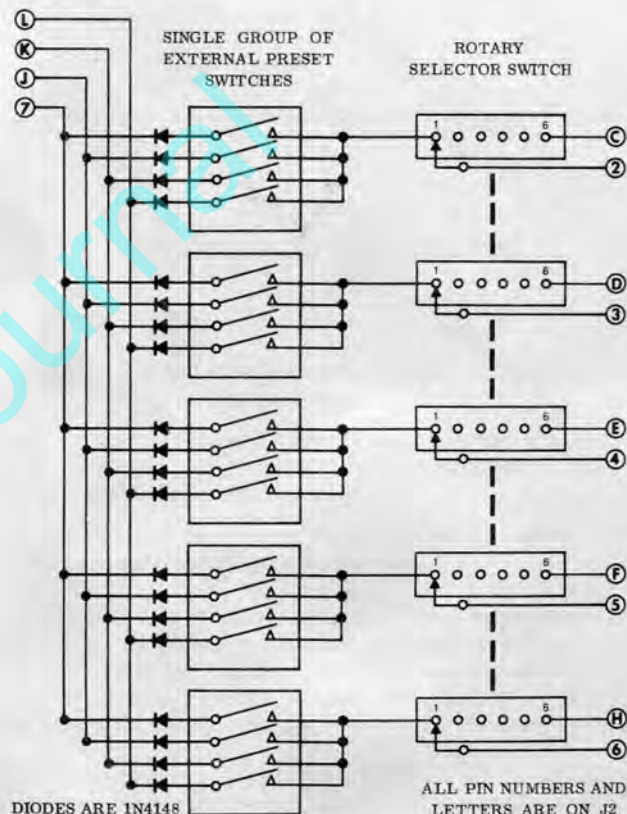


Figure 3-1. External Preset Switch Connections

SECTION IV
CALIBRATION

- 4-1. The PR-5 Preset Counter does not require calibration.

SECTION V
MODIFICATION OF COUNTING SPEED

5-1. PROCEDURE.

- 5-2. To change the PR-5 to count electronic pulses at rates up to 500 kHz, perform the following steps:

a. Snap off the rear cover of the instrument with the blade of a small screwdriver or pen knife. Two small slots on each side have been provided for this purpose.

b. Remove the assembly from the case by gently pushing on the front panel toward the rear.

- 5-3. The internal assembly consists of two printed circuit board assemblies. These boards are separable, although it is not recommended that they be separated. In the event that they have been separated, great care should be taken to ensure that all pins which interconnect the boards are properly inserted into their sockets.

CAUTION

If for any reason it is necessary to separate the board assemblies, remove nomenclature plate prior to separation or damage to reset switch may occur.

5-5. To install the PR-5 in the case, be sure that the pressure switches are closest to the bottom side of the case. Note that there are two sets of tracks in the sides of the case; the two printed circuit boards should slide on these tracks until the assembly is fully within the case. Do not force the assembly into the case; use gentle pressure. The rear cover can be installed only one way since the openings in the cover are of different sizes; the largest opening will be nearest the bottom of the case.

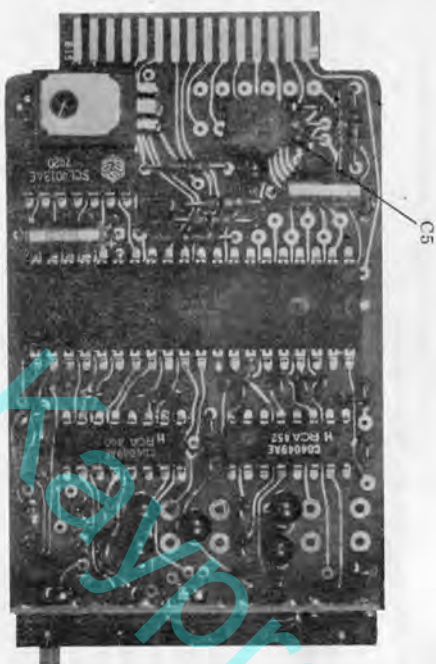


Figure 5-1. Location of Counting Speed Capacitor

warranty

Non-Linear Systems, Inc. warrants each new instrument against defects in material or workmanship for a period of one year from date of delivery of the equipment to the original customer and agrees to replace or repair any such defects, without charge, when the complete instrument is returned to Non-Linear Systems, Inc., 533 Stevens Avenue, Solana Beach, California 92075, transportation charges prepaid. This warranty is in lieu of all other warranties implied or expressed and no responsibility is assumed for consequential damage nor for damage due to accident, abuse, lack of reasonable care, loss of parts, or subjecting the instrument to any but the specified voltages.

