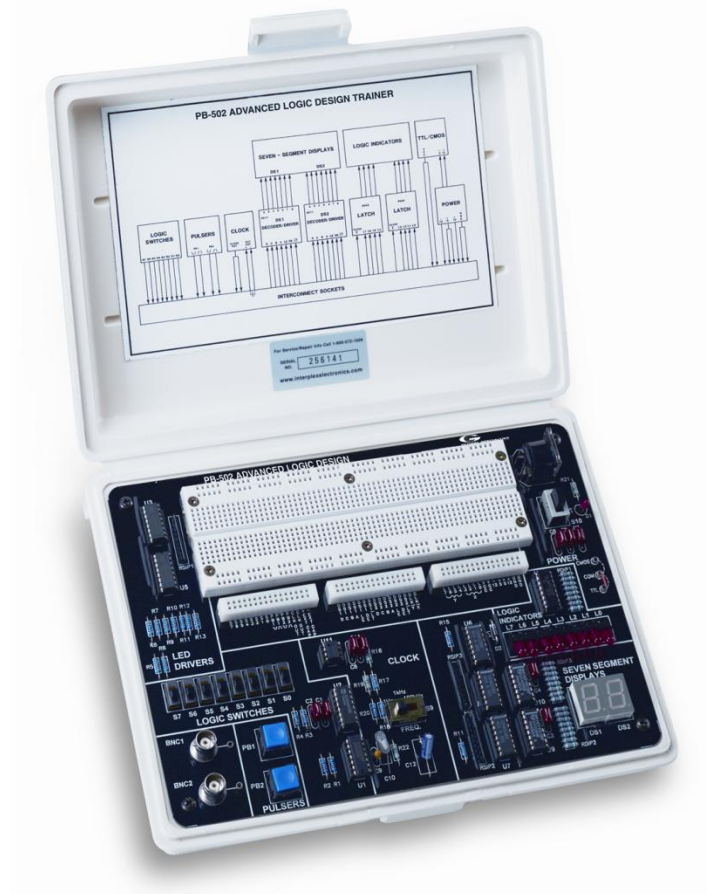


# PB-502

## Advanced Logic Design Trainer Instruction Manual





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Global Specialties specifically warns the user of this instrument that it is intended for use in a classroom or laboratory environment for the purpose of learning and experimentation. When building experimental circuits, it may emit interference that will effect radio and television reception and the user may be required to stop operation until the interference problem is corrected. Home use of this equipment is discouraged since the likelihood of interference is increased by the close proximity of neighbors.

**CORRECTIVE MEASURES:**

Interference can be reduced by the following practices.

- 1) Install a commercially built RFI power filter in the power line at the point where the cord enters the unit.
- 2) Avoid long wires. They act as antennas.
- 3) If long wires must be used, use shielded cables or twisted pairs which are properly grounded and terminated.

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## **PRODUCT DESCRIPTION**

The PB-502 is an instrument capable of satisfying the many requirements arising in the design and study of analog and digital circuitry. The instrument contains three integral power supplies and input/output devices that simplify the construction of a wide range of circuits. Typical circuits that can be built on the PB-502 include, operational amplifiers, comparators, A to D converters, gates and counters. The PB-5022 can even interface directly to a microprocessor.

The PB-502 contains eight LED logic indicators, eight logic switches and two BCD - input seven-segment displays. It also contains a clock with three switch-selectable output frequencies, and three power supplies. The power supplies are +12 volts, +5 volts and -12 volts.

The logic indicators on the PB-502 can serve two functions. They may be used either as eight "real time" logic probes or as two latchable four-bit logic indicators.

All of the PB-502 functions mentioned above are internally connected to three solderless interconnect sockets with two tie points for each signal. In addition, a UBS-100 solderless breadboarding socket is permanently attached to the unit. It provides a convenient work area for the circuitry being designed or studied. All sockets allow insertion of components or wires up to 22 gauge.

A wall adapter type power supply is used to generate the regulated voltages used on the PB-502. Power supply connections to the instrument are made via the five (5) pin DIN connector.

The PB-502 is housed in a durable and attractive case with a hinged protective cover. This makes the unit portable and stackable for storage purposes.

## SPECIFICATIONS

<b>Input Power Source</b>	Regulated wall mount adapter with outputs of +/-12VDC @ 200mA, 5VDC @ 250mA
<b>Selectable Operating Voltage</b>	Select either 5V TTL or 12V CMOS operation via jumper wire connection
<b>Power Supplies</b>	<b>Fixed DC:</b> 12VDC @ 200mA +/- 5% Fixed - (-)12VDC @ 200mA +/- 5% <b>Fixed DC:</b> 5VDC @ 250mA +/- 5%
<b>Clock</b>	Frequency: Fixed at three levels: 1hz +/- 20%, 1Khz +/- 20%, 100khz +/- 20% User variable with use of external capacitor
<b>Pulsers</b>	(2) Fully debounced pushbuttons with logic true and complementary outputs Logic '1" output current 2mA @ 4V min (5V TTL) Logic '1" output current 4mA @ 11V min (12V CMOS) Logic "0" output current 2mA max @ 0.1V max (5V/TTL) Logic "0" output current 5mA max @ 0.1V max (12V/CMOS)
<b>Logic Switches</b>	(8) SPDT switches select output of Vcc or ground (0V). Output current is 200mA max in all cases
<b>Logic Indicators</b>	(8) LEDs buffered by two 4-bit latches with separate enables. Input impedance 100k ohms in all cases

<b>Connectors</b>	(2) BNC – uncommitted
<b>Displays</b>	(2) BCD-input seven segment displays with separate Display Enable (DE), Latch Enable (LE), and Lamp Test (LT) inputs. Input impedance 100K ohms
<b>Breadboards</b>	840 tie points with (8) 25 pin power rails and accommodates up to 8 (14 pin) ICs
<b>Weight</b>	1 lb, 6oz (minus adapter)
<b>Dimensions</b>	10" x 7.5" x 2.6"



## DESCRIPTION OF OPERATING CONTROLS AND MAJOR COMPONENTS

In order to properly use the full capabilities of the PB-502, it is highly recommended that the user become familiar with the controls associated with this instrument.

### Power Receptacle

Five (5) pin DIN type receptacle power supply connection..

### Power Switch

Push power switch S10 up to apply power to the PB-502, move switch back to turn power off. LED DI lights to show power ON condition.

### CMOS/TTL Switch

Selector S8, is made up of three individual breadboarding tie points, and determines the operating voltage of the PB-502 circuitry. For 12 volt operation, install a jumper wire from the center tie point to the upper tie point labeled CMOS. In this condition, the output amplitude of the Logic Switches, Pulsers, Clock, and Vcc tie point is 12 volts, and the input thresholds to the Seven-Segment displays and Logic Indicators are set to 12 volts CMOS levels.

For 5 volt operation, install the jumper wire from the center tie point to the lower tie point labeled TTL. This will cause the output amplitude of the Logic Switches, Pulsers, Clock, and Vcc tie point to be 5 volts, and the input thresholds to the Seven Segment Displays and Logic Indicators to be set to levels usable for TTL or CMOS operating at 5 volts.

### **CAUTION**

*A jumper must be installed selecting either the CMOS or TTL position before power is applied, and power must be removed when it is desired to change the selection.*

### Logic Indicators

The eight LEDs L0-L7, are used for indicating logic states of circuit points. A logic 1 on a logic indicator input will light its corresponding LED. In addition, the logic indications can be latched to freeze the states shown; a high-to-low transition on Clock X will latch LEDs L0 through L3, and a high-to-low transition on Clock Y will latch LEDs L4 through L7. While Clock X or Clock Y remain low, the logic indications will remain latched; bringing these points high will restore the indicators to a real time display.

### Seven-Segment Displays

DS1 and DS2 are two independent seven-segment numeric displays. These are enabled, or turned on, by applying a logic 1 to the Display Enable tie-points DS1DE for DS1, DS2DE for DS2. When enabled, the displays will show a zero if no other inputs are present. Numbers are displayed by applying a logic 1 to the D, C, B and A tie-points in BCD, from 0000 to 1001. Input of 1010 or greater will cause the display to blank. The

number displayed can be latched by a low-to-high transition on the LE (Latch Enable) input. This latched condition will exist as long as a logic 1 is maintained; when LE is returned to a logic 0, or low, the displays will be restored to their real time status. At any time the displays are enabled, a Lamp Test can be performed by applying a logic 0 to the LT tie point associated with the display. This will confirm the proper functioning of each display by lighting all LED segments.

Frequency Switch

The three position frequency switch, S9, is used to select the output frequency of the clock. This output is available as either 1Hz, 1kHz, or 100kHz. The Clock Out amplitude is dependent upon the jumper installed in the CMOS/TTL selector S8, being 12 volts in the CMOS position and 5 volts in the TTL position. Frequency can also be changed by inserting a capacitor in the EXT CAP tie points. Some representative capacitors and their effect on a frequency are shown in Table 1.

**EXTERNAL CAPACITOR**

<b>FREQ SW SETTING</b>	<b>0.001MF</b>	<b>0.01m F</b>	<b>0.1 m F</b>	<b>1.0 m F</b>	<b>10 U F</b>
	1Hz	1Hz	1Hz	0.91Hz	0.5Hz
1kHz	500Hz	90.9Hz	9.9HZ	1HZ	0.1Hz
100kHz	50 kHz	9.09kHz	990Hz	100Hz	10Hz

**RESULTING OUTPUT FREQUENCY**

**Table 1: Output Frequency vs. External Capacitor Value**

Pulsers

Pulsers PBI and PB2 are two fully debounced pushbuttons with true and complementary outputs. These outputs are made available on the tie-point connector as PB1 (trigger low), PB1 (trigger high), PB2 (trigger high) and PB2 (trigger low) . The PB1 output will be at a logic 1 while PB1 is not pressed and will go to a logic 0 when the switch is pressed, and return to a logic 1 when the switch is released. The PB1 (trigger high) provides the complement of the above, that is, the point will be at a logic 0 while the switch is not pressed, will go to a logic 1 while the switch is pressed, and return to a logic 0 when the switch is released. The operation of PB2 is identical. In all cases, the logic 1 value is dependent upon the jumper installed in the CMOS/TTL selector, being 12 volts in the CMOS position and 5 volts in the TTL position.

BNCS

Two additional connectors, BNC 1 and BNC 2, are provided to simplify input and output interfacing to the PB-502. The shells of both BNCs are connected to ground, while the pins of each individual BNC are connected to adjacent single tie points which can be wired to the solderless breadboard using jumper wires.

### Logic Switches

Eight SPDT logic switches S0 to S7 are provided with outputs at the connector tie points. These switches set a logic 1 to corresponding tie points when pushed up, and a logic 0 when pulled back. The logic 1 output voltage is dependent upon the jumper installed in the CMOS/TTL selector, being 12 volts in the CMOS position and 5 volts in the TTL position.

### Connectors

All functions are permanently tied to these three tie point connectors. Each tie point has two solderless connection points.

### Solderless Breadboard

The solderless breadboard, UBS-100 accommodates up to eight 14-pin DIP ICs with 4 tie points per pin plus 8 power rails with 25 tie points each.

## **OPERATING PRECAUTIONS**

The Logic Indicators and Seven-Segment Displays are intended for use only with digital signal inputs having voltage levels of  $V_{cc}$  or ground. It is, therefore, recommended that all interfacing be done with digital circuitry operating from the  $V_{cc}$  tie points. Exceeding  $V_{cc}$ , (12 volts with the CMOS/TTL selector jumpered to the CMOS position, 5 volts with the jumper in the TTL position) at any input will cause circuit damage to the PB-502 as will input voltages below ground. If necessary, input protection can be constructed on the UBS-100 solderless breadboarding socket. This circuit should protect any input over the voltage range of -15 to +20 volts without affecting input thresholds

## **PB-502 CHECKOUT**

To check out the PB-502 the following equipment is required.

1. A dual-trace oscilloscope, 10MHz bandwidth minimum.
2. 3 ½ Digit Digital Volt Meter.

### **CAUTION**

*A jumper must be installed in selector S8 from center tie point to either the TTL or CMOS position before turning on power. Power must also be removed each time the position of this jumper is changed.*

## **Procedure**

Plug 5-pin DIN connector from wall adapter into J1 on the PB-502. Plug wall-mount adapter into outlet. Turn PB-502 Power switch to ON: LED DI will light.

### Step I

Using an oscilloscope or a DMM, measure the power supply voltages present on the tie point connector:

1. +12 should read between +11.4 volts and +12.6 volts.
2. +5 should read between +4.75 volts and +5.25 volts.
3. -12 should read between -11.4 volts and -12.6 volts.
4. Vcc should read between:
  - a) +11.4 volts and +12.6 volts with the CMOS/TTL switch in the CMOS position.
  - b) +4.75 volts and +5.25 volts with the CMOS/TTL switch in the TTL position.
  - c)

### Step II

Using an oscilloscope, measure the output frequency and amplitude of the clock out signal.

1. Set Freq switch to 1Hz.
  - a) Frequency should be between 0.8Hz and 1.2Hz.
  - b) Amplitude should be the same as Vcc levels, that is, +12volts with the CMOS/TTL selector jumpered to the CMOS position, and +5 volts with the CMOS/TTL selector jumpered to the TTL position.
2. Set Freq switch to 1kHz.
  - a) Frequency should be between 800Hz and 1.2kHz.
  - b) Amplitude should be +12 volts in CMOS, +5 volts in TTL.
3. Set Freq switch to 100kHz
  - a) Frequency should be between 80kHz and 120kHz.

b) Amplitude should be +12 volts in CMOS, +5 volts in TTL.

4. In all cases, duty cycle should be between 40% and 60%

### Step III

Use a jumper wire to test the Logic Indicators as follows:

1. Jumper CMOS/TTL selector to CMOS.
2. Observe that all 8 LEDs are off.
3. Connect a jumper wire between the Vcc tie point and the L0 tie point. L0 should light, all other LEDs should remain off.
4. Move the jumper wire from L0 to L1. L1 should light, all other LEDs should remain off.
5. Repeat these steps for L2 through L7.

### Step IV

Use jumper wires to test the Seven-Segment Displays as follows:

1. Connect a jumper between DSIDE and +12 V.
  - a) DS1 should light, showing a 0.
2. Connect a jumper between DS1LT and GND.
  - a) All segments of DS1 should light.
3. Disconnect the jumper between DS1LT and GND.
  - a) DS1 should again display a 0.
4. Jumper between DS1A and Vcc.
  - a) A numeral 1 should be displayed on DS1.
5. Move the jumper from DS1A to DS1B.
  - a) A 2 should be displayed.
6. Move the jumper from DS1B to DS1C.
  - a) A 4 should be displayed.
7. Move the jumper from DS1C to DS1D.
  - a) An 8 should be displayed.
8. Leaving the jumper in DS1D, connect another jumper from DS1LE to Vcc.
  - a) The 8 should remain on.
9. Remove the jumper from DS1D.
  - a) The 8 should remain on.
10. Remove the jumper from DS1LE.
  - a) The display should return to 0.
11. Repeat steps 1-10 for DS2.

### Step V.

Test the Pulsers by jumpering to L7 as follows:

1. Connect a jumper wire from PBI (trigger low) to L7
  - a) Logic Indicator L7 will be lit while Pulser PB1 is not pressed.
  - b) Pressing PB1 causes L7 to extinguish.
  - c) Releasing PB1 causes L7 to relight.
2. Move the jumper wire from PBI  $\bar{U}$  to PBI  $\bar{TL}$ 
  - a) Logic Indicator L7 will not be lit while PBI is not pressed.
  - b) Pressing PBI causes L7 to light
  - c) Releasing PBI causes L7 to extinguish
3. Repeat the above steps for PB2 Step V

### Step VI

Test the Logic Switches by jumpering them to the Logic Indicators as follows:

1. Jumper SO to LO, SI to LI, and so on, through S7 to L7
2. Alternately move switches SO through S7 up and back. The LED corresponding to each switch will light when the switch is up, and extinguish when the switch is down.
3. Leave all jumpers connected for the Latch test which follows.

### Step VII

Test the Logic Indicator Latches as follows:

1. If not already accomplished, jumper the Logic Switches to the Logic Indicators as described in Step VI (1).
2. Move all switches to the up position. All LEDs should light. Connect jumpers from Clock X to GND and Clock Y to GND. All LEDs should remain lit.
3. Move all switches from the up to the down position. All LEDs should remain lit.
4. Remove the jumper from Clock X. LEDs LO through L3 should extinguish. LEDs L4 through L7 should remain lit.
5. Remove the jumper from Clock Y. LEDs LO through L3 should remain out. LEDs L4 through L7 should extinguish.

### Step VIII

Remove all remaining wires except CMOS/TTL selector jumper.

- a) All displays should be extinguished.

### Step IX

Turn the Power Switch OFF.

This completes the checkout procedure.

## **SERVICE AND WARRANTY INFORMATION**

For up-to-date product information, please visit [www.globalspecialties.com](http://www.globalspecialties.com).

For instructions on how to obtain a return merchandise authorization number (RMA), please visit our website, or call our customer service department.

**GLOBAL SPECIALTIES**  
**22820 Savi Ranch Parkway**  
**Yorba Linda, CA 92887**  
**800-572-1028**  
**globalspecialties.com**

Global Specialties will service and repair this instrument free of charge for a period of 3 full years, subject to the warranty conditions below.

### **WARRANTY**

Global Specialties warrants this device to be free from defective material or workmanship for a period of 3 full years from date of original purchase. Under this warranty, Global Specialties is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within 3 full years from date of original purchase.

Units returned to Global Specialties that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Global Specialties, or that have been repaired by unauthorized persons will not be covered by this warranty.

Global Specialties reserves the right to discontinue models, change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Global Specialties is authorized to assume any other obligation in connection with the sale and purchase of this device.

Specifications subject to change without notice.