PB-507

Advanced Analog & Digital Electronic Design Workstation

Instruction Manual

Revision: 2/2014

1 FEATURES & APPLICATIONS

The PB-507 Advanced Analog & Digital Electronic Design Workstation is a versatile electronics trainer used in all levels of electronics instruction and design. The PB-507 enables the designing of digital and analog circuits in a fun, simple, easy-to-visualize manner. Utilizing the PB-507, students will learn valuable hands-on breadboarding techniques and build a solid foundation in circuit experimentation, construction and analysis. Making it easy for novices to learn series and parallel circuits, experienced designers also find the PB-507 an invaluable instrument, providing a reliable platform for the most advanced and demanding design applications like multi-stage microcomputer circuits.

The PB-507 Trainer contains the following modules:

- DC Power Supplies
- AC Power Supplies
- Function Generator
- Pulse Generator
- Frequency Counter
- Logic Indicators
- Logic Probe
- Hex to 7 Segments Decoder
- Debounced pushbuttons
- Logic switches
- SPDT switches
- BNC connectors
- Potentiometers
- Speaker

2 ABOUT GLOBAL SPECIALTIES

Since 1973, Global Specialties has been the recognized leader in innovative electronics training solutions for education and industry. Basing its product offerings on the concept of *Education Through Application*, Global Specialties believes that relevant scientific and technical education is best when it permits students to learn by doing.

Global Specialties' prototyping and trainer systems set the worldwide standard for reliability, durability and long life, designed to take the sustained use of educational, research and product testing environments. Global Specialties' test & measurement instruments continue to set high standards in quality and innovation with power supplies, function generators, digital multimeters and logic analysis products that support its training and prototyping offerings.

A leader in the development of integrated teaching systems, Global Specialties offers completely packaged courses including everything required for effective instruction. Comprehensive textbooks, laboratory manuals and instructor guides have been written in a comfortable, non-intimidating style by experienced professional educators, specifically for use with our equipment. Each course is designed to make selections appropriate for a variety of educational levels and course goals. These systems have found success in secondary schools, technical schools, universities, and labs throughout the world.

Global Specialties' products are available from electronics distributors worldwide.

Please visit *globalspecialties.com* to explore the many options available for the PB-507, such as courseware, pre-formed jumper wire kits, test probes and prototyping accessories.

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3   SPECIFICATIONS

Power	3-wire AC Input with 110V/220V Selector Switch
Power Supplies	Fixed 5VDC @1A Variable DC - Positive: 0V to +20V @0.5A Variable DC - Negative: 0V to -20V @0.5A Fixed AC - 12.6V Center-tapped @ 100mA
Computer Interface	USB Connector with pin-outs available on Main PCB
Function Generator	0.1Hz to 1MHz selectable in 7 ranges Output Voltage: 0 to + 10V (20Vp-p) Output Impedance: 600Ω Output Waveforms: Sine, Square, Triangle, TTL
Pulse Generator	Frequency Range: 1Hz to 1MHz in 6 ranges Output Output Mode: TTL or CMOS (switch selectable) Output Voltage: 0 to 15Vp-p
Frequency Counter	Frequency Range 0 - 1MHz
LCD Display	LCD Display: Reads Volts, Amps & Frequency
7 Segment Display	(2) BCD to 7 Segment Display Circuits
Logic Indicators	9 Red (High) and 8 Green (low) buffered LEDs
Logic Probe	

	TTL/CMOS compatible Logic Probe
Logic Switches	(8) Individual Logic Switches
Speaker	0.25W, 8Ω
Debounced Pushbuttons	(2) Open Collector Output Pulsers
Switches	(2) Single Pull Double Throw (SPDT)
BNC Connector	(2) BNC Connectors
Potentiometers	1K & 10K Uncommitted
Breadboard	4150 Tie Points, removable
Voltage Distribution Bus	Tied directly to Power Supply Outputs
Dimensions	5.5" x 16.5" x 12.75" (H x W x D)
Weight	14.5 lbs
Warranty	Limited three-year warranty
	Specifications subject to change without notice. Go to **_globalspecialties.com_** for the latest update.

4 INTRODUCTION

The PB-507 Advanced Analog & Digital Electronic Design Workstation, is a powerful, versatile tool for circuit designers, engineers, engineering technicians, students, and hobbyists. All digital controls, USB port, and a wide choice of built-in circuit accessories allow rapid and accurate construction of virtually any type of analog or digital circuit.

New on the PB-507 is a LCD screen that displays the settings for each of the modules. Simply touch a control switch on any module, and the LCD switches to report the settings from that module. Use the USB connection on the back of the PB-507 and you can control or view the Workstation from a PC. Using this feature you can project the controls to a large viewing area for an entire classroom to observe the changes being made.

The PB-507 has a powerful 1 MHz bandwidth Function Generator with sine, triangle, and square wave output for analog circuits. A Pulse Generator operates like a second, independent Function Generator with the additional feature that you can modify the duty cycle to any percentage you like. Use the Counter module to report on the frequency output of your own specially designed circuits.

Choose your power source: 6.3 /12.6V AC power, 5v DC or variable ±20V DC. Draw power from the typical banana plug connections or simply tie in to the additional tie-point power supplies above each breadboard bus strip.

The circuit breadboard area includes over 4100 contact points and is flush mounted with the unit as are most all switches and controls. The breadboard area is removable for easy replacement or classroom demonstration.

A built-in speaker may be used for analog output. Outputs also include two debounced pushbutton switches and a bank of eight logic switches. Eight logic indicators may be used to display high and low logic levels. A built-in logic probe is useful in circuit troubleshooting and a hexa 7 segment LED display may be used in circuit designs.

Two built-in potentiometers and two SPDT switches are provided for circuit control and adjustment. Connections to external test equipment or a signal source may be made using the two BNC connectors.

The PB-507 eliminates the clutter and confusion that often results when constructing sophisticated circuits. Alligator clips and similar connectors are seldom needed. Sockets on the PB-507 allow insertion of components of wires of up to 20 gauge.

The PB-507 is designed to withstand the toughest treatment. It is constructed with the highest quality components available. Most components including the breadboard are flush with the surface giving greater protection. Reliable digital circuitry is used throughout.

A detailed panel layout and description of the PB-507 is given in the section "Description of Individual Features".

5 START UP

At power on the PB-507 Trainer displays the Global Specialties logo and the "Initializing…" message. Initialization takes a few seconds, after which the current configuration ("Loading default config…" or "Loading last state…") and an information message about the system errors is displayed:
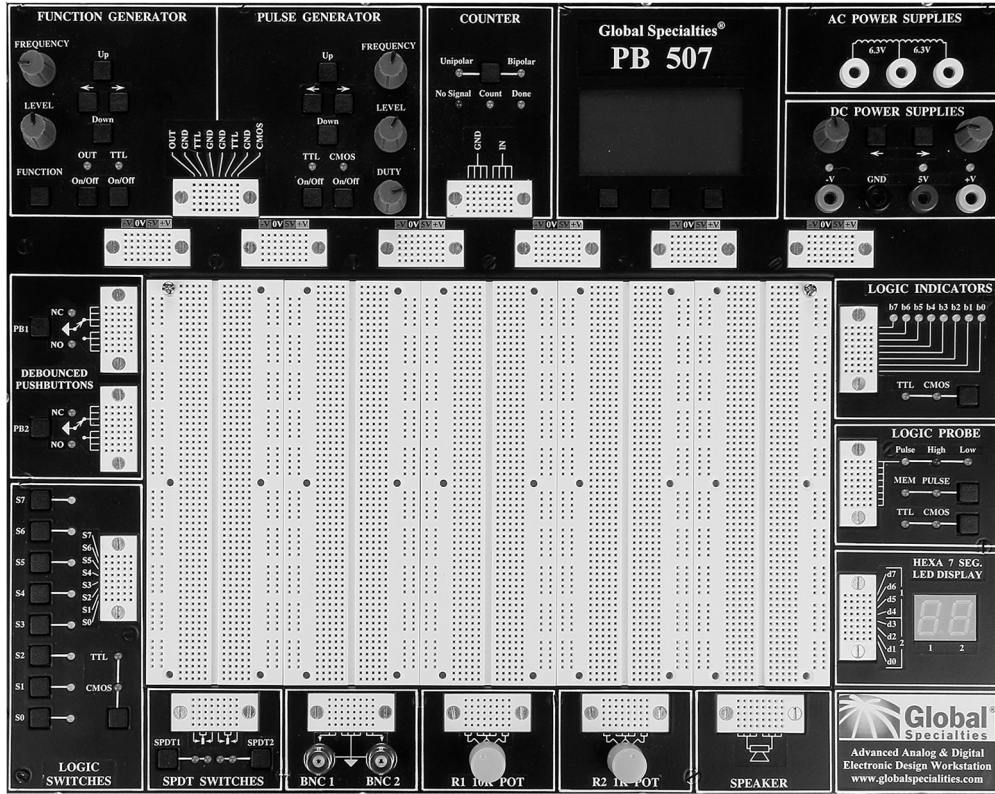
Figure 1

A power-on self test occurs automatically whenever you turn on the PB-507 Trainer. If the self test passed, the "No errors found" message is displayed on the bottom of the screen. If the self test failed, the "Errors found" message is displayed on the bottom of the screen. You can view the error message queue anytime by selecting the **Service→Error log** option from menu.

After the power up sequence one of the following four panels is loaded: Function Generator, Pulse Generator, Frequency Counter or DC Power Supplies. You can navigate through these four panels using the soft keys below the display. If PB-507 is set to load the last saved state, then the last panel used before powering off the device will be loaded at next power on. If PB-507 is set to load the default configuration, then the Function generator panel will be loaded.

Three soft keys are located below the display. The function of each button is always shown on the bottom of the screen. These buttons are used to navigate through panels and menus.

6 DESCRIPTION OF INDIVIDUAL FEATURES

In order to properly use the full capabilities of the PB-507 it is highly recommended that the user become familiar with the panel layout and the features of the components.

6.1 Function Generator

Front-panel controls

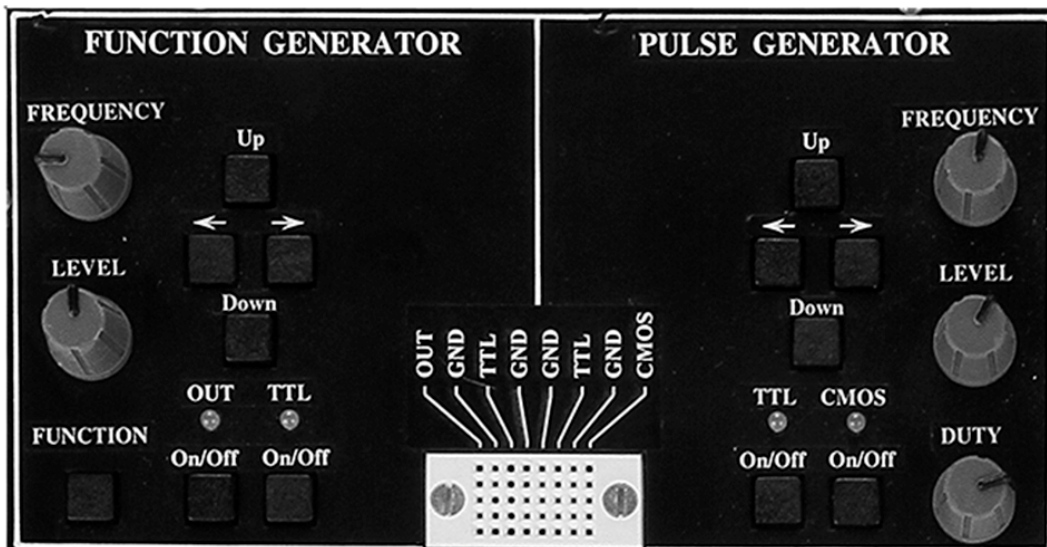*Figure 2* shows the Function Generator and Pulse Generator controls on the front panel of the trainer.

Figure 2

Frequency knob: changes the value of frequency between 0.1 Hz and 1.000MHz.

Level knob: changes the value of the level in the range between 0.1 Vpp and 10.0 Vpp into 600 Ω load (0.2 to 20.0 Vpp in open circuit).

← → buttons: move the cursor from one digit to another inside a field or to the next field.

Up and **Down buttons**: change the frequency range. 7 frequency ranges are available.

Function button: changes the waveform of the output signal. The waveform can be sine, triangle or square.

Out On/Off button: enables or disables the output signal (OUT) for the function generator. When OUT is enabled, the OUT LED is turned on, and when OUT is disabled, the OUT LED is turned off.

TTL On/Off button: enables or disables the TTL signal for the function generator. When TTL is enabled, the TTL LED is turned on, and when TTL is disabled, the TTL LED is turned off.

Display Area and Screen Interface
Figure 3 shows the trainer's screen displaying the function generator panel.

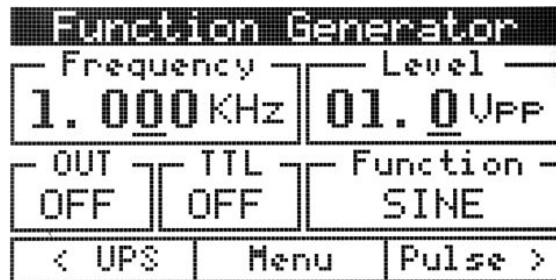| Function Generator	
┌ Frequency ┐ ┌ Level ┐	
1.000KHz	01.0 Vpp
OUT | TTL | Function	
OFF | OFF | SINE	
< UPS | Menu | Pulse >	

Figure 3

Changing the parameters

Frequency
In order to cover the entire frequency range from 0.1 Hz to 1.000 MHz, 7 frequency ranges are used. Range Up and Range Down buttons change the range. The 7 ranges are defined as follows:

- 0.1 Hz - 0.9 Hz
- 1.0 Hz - 9.9 Hz
- 10.0 Hz - 99. 9 Hz

- 100.0 Hz - 999.9 Hz
- 1.000 KHz – 9.999 KHz
- 10.00 KHz – 99.99 KHz
- 100.0 KHz – 999.9 KHz
- 1 MHz.

By pressing Range Up button the frequency value will be multiplied by 10 and by pressing Range Down button the frequency value will be divided by 10. The displayed number and the cursor position will not change.
For example, if 100.0 Hz is set and Range Up is pressed several times, the following sequence will be achieved: 100.0 Hz → 1.000 KHz → 10.00 KHz → 100.0 KHz → 1.000 MHz.

Turn the Frequency knob to change the frequency value. The underscored digit will be changed and it will be displayed in white type inside a black box indicating that the frequency field became active:

Use the arrow keys to move the selection. If the cursor is moved outside of the Frequency field limits the Level field will become active. If the cursor is moved further, the frequency field will be selected again and so on. Selection of the active field can be done in two ways:

- Automatically by turning the appropriate knob (Frequency or Level), or
- Moving the cursor from one field to another.

If the frequency value is at the end of a range and the frequency knob is turned, frequency value will switch to the next range:

- Increasing the frequency value, the cursor is moved one step to the right (if it is possible). For example: 90.00 KHz --> 100.0 KHz or 900.0 KHz --> 1.000 MHz,
- Decreasing the frequency value, the cursor is moved one step to the left (if it is possible). For example: 100.0 KHz --> 90.00 KHz or 1.000MHz --> 900.0 KHz.

Level
Level is changed in the same manner as frequency. The Level knob changes the amplitude of the output signal. The arrow keys can be used to change the digit selection when the Level field is active. If the cursor is moved outside of the Level field limits, the Frequency field will become active.
The level field displays the value corresponding to 600 Ω nominal load.

Waveform

The Function button can be used to select the output function in the following order: - Sine - Triangle - Square - Sine - The current waveform is displayed on the screen.

Enabling the output signal
Pressing Function On/Off button enables/disables the output signal. In order to enable/disable the TTL output, the TTL button must be pressed. The corresponding LED is turned on. Output and TTL states are displayed on the screen. See *Figure 3.*

6.2 Pulse Generator

Front-panel controls
Figure 2 shows the Pulse Generator controls on the front panel of the trainer.

Frequency knob: changes the value of frequency between 0.1 Hz and 1.000MHz.

Level knob: changes the value of the level in the range between 1.0 Vpp and 15.0 Vpp in open circuit.

Duty cycle knob: changes the value of duty cycle in a percentage between 10% and 90%.

← → **buttons:** move the cursor from one digit to another inside a field or to the next field.

Up and **Down buttons**: change the frequency range. 7 frequency ranges are available.

CMOS button: enables or disables the CMOS signal for the pulse generator. When CMOS is enabled, the CMOS LED is turned on, and when CMOS is disabled, the CMOS led is turned off.

TTL button: enables or disables the TTL signal for the pulse generator. When TTL is enabled, the TTL LED is turned on, and when TTL is disabled, the TTL led is turned off.

Display Area and Screen Interface
Figure 4 shows the trainer's screen displaying the pulse generator panel.

Figure 4

Changing the parameters

Frequency, Level
See description from function generator. The same rules are applied for the pulse generator too. Level field displays the CMOS level of the pulse generator signal. The value with no load is displayed.

Duty cycle
The duty knob changes the duty cycle of the output signal between 10% and 90%, minimum step being 1%. The arrow keys can be used to change the digit selection when the Duty cycle field is active. If the cursor is moved outside of the Duty cycle field limits, the Frequency or the Level fields will become active.

Enabling the output signal
Pressing CMOS button enables/disables the CMOS signal. In order to enable/disable the TTL output, the TTL button must be pressed. The corresponding LED is turned on. CMOS and TTL states are displayed on the screen. See *Figure 4.*

6.3 Frequency counter

Front-panel controls
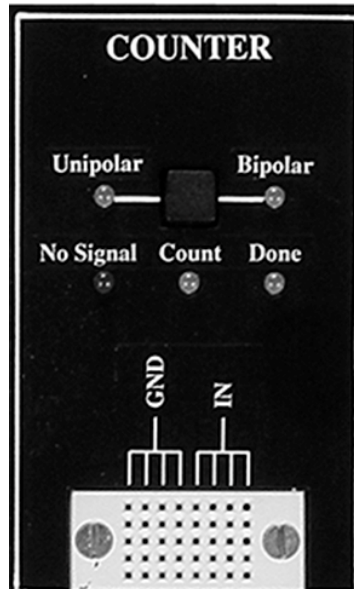*Figure 5* shows the Frequency Counter controls on the front panel of the trainer.

Figure 5

Unipolar/Bipolar button: The type of the input signal can be changed anytime by pressing the Unipolar/Bipolar button.

Description
The Frequency counter module can measure the frequency of bipolar or unipolar signals. The term unipolar indicates that the signal swings from zero (ground) or a positive voltage to a higher voltage, and bipolar indicates that the signal swings above and below zero (ground).

If Counter mode (configured in menu) is set to "Automatic", the input signal type is detected automatically, but the first measurement may take more time in this case.
The measurement of low frequency signals requires a long time (for example, to measure Fin = 0.2Hz, is required at least 10s for the first measurement).

The Frequency counter operation is signaled by three LEDs:
- No signal: signal not detected
- Done: a valid frequency is displayed on the screen. The first measurement is not precise.
- Counting: a new measurement is in progress.

Display Area and Screen Interface
Figure 6 shows the trainer's screen displaying the Frequency counter panel.
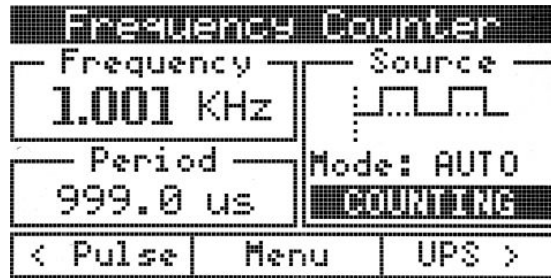
Figure 6

The following information is displayed in the counter panel:

- The measured frequency and the corresponding period
- The type of the input signal
- Counter mode: AUTO or MAN
- The current state of the counter: NO SIGNAL or COUNTING.

6.4 DC Power supplies

Front-panel controls
Figure 7 shows the DC Power Supplies controls on the front panel of the trainer.

Figure 7

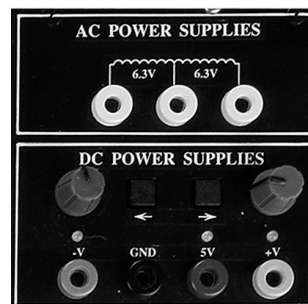**Positive voltage knob:** changes the value of the +V DC power supply between 0V and 20V.

Negative voltage knob: changes the value of the -V DC power supply between -20V and 0V.

← → **buttons:** move the cursor from one digit to another inside a field or to the next field.

Display Area and Screen Interface
Figure 8 shows the trainer's screen displaying the DC power supplies panel.
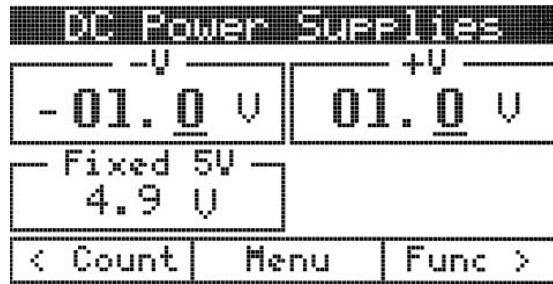
Figure 8

Changing the parameters

+V, -V
Turn the +V knob to change the +V value. Turn the –V knob to change the –V value. The underscored digit will be changed and it will be displayed in white type inside a black box indicating the active field.
Use the arrow keys to move the selection. If the cursor is moved outside of +V field limits, the –V field will become active and vice versa. Selection of the active field can be done in two ways:

- Automatically, by turning the appropriate knob (+V or –V) or
- Moving the cursor from one field to another.

Note: When +V or –V is modified by the user, the programmed voltages are displayed for about 3 seconds.

Monitoring the output voltages

- +V, -V and the 5V voltages are continuously measured. While +V, -V and 5V voltages are between the specified tolerance the corresponding LEDs will light green.
- The fixed 5V voltage measurement is displayed continuously on the screen. If the output accuracy is out of the specified tolerance (± 200mV), the corresponding LED will light red.
- The +V and –V voltage measurements are continuously compared to the programmed values. If the output accuracy is out of the specified tolerance (± 100mV), the corresponding LED will light red.

6.5 Debounced pushbuttons

Front-panel controls
Figure 9 shows the Debounced pushbuttons controls on the front panel of the trainer.

Figure 9

Description
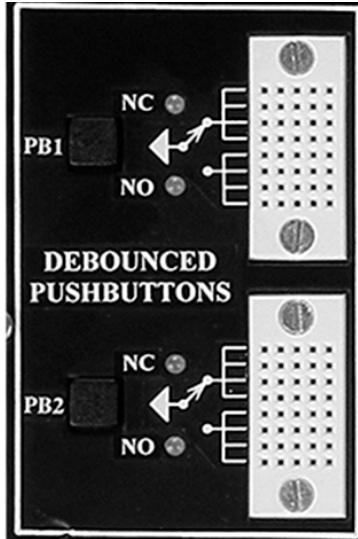PB-507 provides two open-collector output pulsers, each with 1 normally-open (NO) and 1 normally-closed (NC) output. When the pushbutton is released, the circuit is in NC state, and when the pushbutton is pressed, the circuit is in NO state. The corresponding green led will light.

6.6 Logic switches

Front-panel controls
Figure 10 shows the Logic switches controls on the front panel of the trainer.
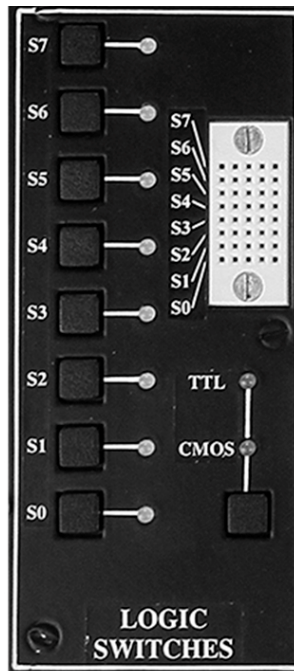
Description

PB-507 provides 8 logic debounced outputs with 2 user selectable logic families: CMOS and TTL. Each of the logic switches can be switched separately between logic high (red) and logic low (green) by pressing the buttons S7…S0. When CMOS is selected, the high level is determined by the +V voltage set for the DC power supply.

The logic family (TTL or CMOS) can be selected using the TTL/CMOS button.

6.7 SPDT switches

Front-panel controls

Figure 11 shows the SPDT switches controls on the front panel of the trainer.

Figure 11

Description

Two single pole, double throw (SPDT) switches are provided for general switching functions. Two LEDs for each switch are used to signal the current state of the switch.

6.8 Logic indicators

Front-panel controls

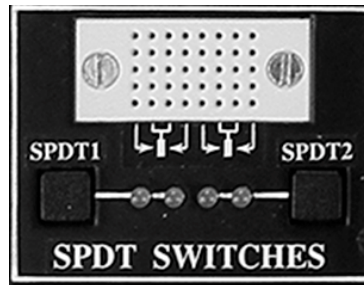*Figure 12* shows the Logic indicators controls on the front panel of the trainer.
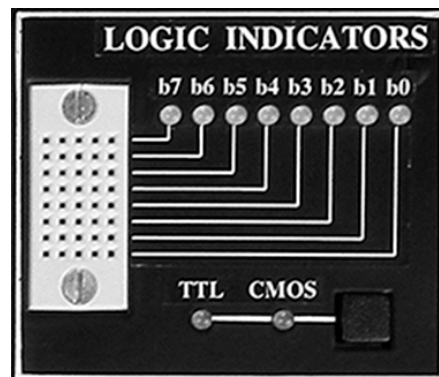
Figure 12

Description

- Eight bicolor LEDs (b7…b0) are used to indicate logic high (red) or low (green) for eight digital inputs.
- The TTL or CMOS input switching levels can be selected by pressing button TTL/CMOS. The High and Low thresholds for CMOS depend on the positive voltage set in the DC Power supplies module.
- The LEDs will light red when the inputs are 2.0V or higher when TTL is selected, or 70% of the +V voltage or higher when CMOS is selected.
- The LEDs will light green when inputs are 0.8V or less when TTL is selected, or 30% of the +V voltage or less when CMOS is selected.
- In the case of an unconnected input or an input not at valid logic level the corresponding LED will turn off.
- If CMOS input is selected and +V voltage is less then 1V, the Logic indicators module will not work. In this case the CMOS LED will flash.

6.9 Logic probe

Front-panel controls
Figure 13 shows the Logic probe controls on the front panel of the trainer.
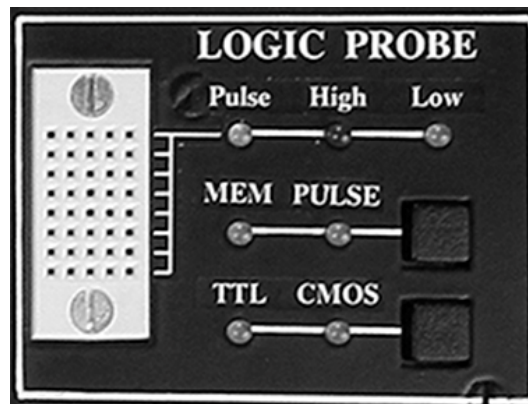

Figure 13

Description

- The Logic probe is a logic troubleshooting instrument that detects Logic High (red LED), Logic Low (green LED) and single shot events (yellow LED).
- Two operation modes are provided: Memory or Pulse. The operation mode can be set by pressing the MEM/PULSE button.
- PULSE mode is the normal operation mode for pulse and level detection.

- MEMORY mode detects single shot events and holds indication until Pulse/Mem switch is toggled.
- The TTL or CMOS input switching levels can be selected by pressing button TTL/CMOS.
- The High and Low thresholds for CMOS depend on the positive voltage set in the DC Power supplies module. A Logic High level will be detected when the inputs are 2.0V or higher when TTL is selected, or 70% of the +V voltage or higher when CMOS is selected. A Logic Low level will be detected when inputs are 0.8V or less when TTL is selected, or 30% of the +V voltage or less when CMOS is selected.
- If CMOS input is selected, the Logic probe module will not work if +V voltage is less then 1V. In this case the CMOS led will flash.

6.10 Seven segment displays

Front-panel controls
Figure 14 shows the Hex to 7 segment LED display module on the front panel of the trainer.
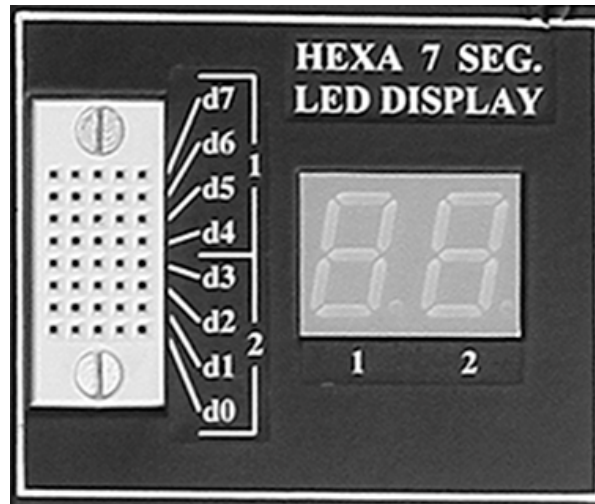

Figure 14

Description
The Hex to 7 segment decoder can display all hexadecimal characters (0-9 and A-F) on the seven segment display. The Hex to 7 segment decoder uses an 8 bit input to display the characters on two 7 segment displays.

The following table shows the characters displayed on 7 segment display:

Input (S7…S4 or S3…S0)	7 segment display
0000	0

0001	I
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	b
1100	C
1101	d
1110	E
1111	F

Table 1

7 MENU SYSTEM

This section describes the menus and operating details for each menu option. The soft keys situated below the display are used to navigate inside the menus. The function of each soft key is always shown at the bottom of the screen. The user can enter into the PB-507 main menu by pressing the "Menu" soft key. The menu will be exited automatically if no action had been present for about 60 seconds.

The menu system has the following structure:

- **Exit –** Select this option to exit the main menu.
- **Configuration –** Select this option to set different settings on the PB-507 trainer.
- **Memory –** Select this option to store, recall or delete PB-507 states. Up to 10 states can be saved in the non-volatile memory.
- **Service –** Select this option to view errors, USB connection status, software information or to perform calibrations or firmware upgrades.

7.1 Configuration menu

Table 2 shows the Configuration menu.

First level	Second level	Third level	Description
Back			Go **Back** to the PB-507 main menu
Display settings	Back		Go **Back** to the first level
	Contrast adjustment		Select **Contrast** to change the trainer display contrast.
	Video mode	Normal Inverse	Select **Normal** to set display to white background. Select **Inverse** to set display to black background.
Counter mode	Automatic Manual		Select **Automatic** to let the trainer to detect the input signal type automatically for the frequency counter. Select **Manual** to set the input signal type manually.
Automatic save	On Off		Select **On** to turn on the automatic save Select **Off** to turn off the automatic save
Power on	Default config Last saved state		Select **Default config** to load the factory default configuration on power-on Select **Last saved state** to load the last saved state on power-on
Front keys	Unlock Lock		Select **Unlock** to unlock the front-panel keys Select **Lock** to lock the the front-panel keys
Page scrolling	Manual Auto Jump		Select **Manual** to change the active panel using the soft keys Select **Auto** to switch to the working panel for 3 seconds and then return to initial panel Select **Jump** to switchto the working panel
Security			Select **Security** to unsecure or secure the trainer
Load default config			Select **Load default config** to load the factory default configuration

Table 2

In the Configuration menu the current setting is displayed between "[ ]" brackets for the following settings: Counter mode (AUTO or MAN), Automatic save (ON or OFF), Power on (DEFAULT or LAST), Front keys (UNLOCKED or LOCKED), Page scrolling (MAN, AUTO or JUMP).

The settings in the Configuration menu are not saved on a **Store state** command.

7.1.1 Contrast adjustment

To optimize the readability of the display, you can adjust the contrast setting. The contrast value can be modified from 0% to 100%. The default value is 59%. The contrast setting is stored in non-volatile memory and it does not change after power off. An info message displaying "Contrast saved." will appear on the display when the contrast setting has been saved in the memory.

7.1.2 Power-on setting

You can select the PB-507 settings that are restored when the instrument is powered on. By default, the PB-507 Trainer is set to restore the default-setting at power-on. To change the power-on settings, use the **Configuration → Power on** option. To restore the last powered-off settings for the next time you power on the trainer, select **Last saved state**.

You can turn on or off the automatic save of the current states. To turn on the automatic save use the **Automatic save → On** setting from the Configuration menu. To turn off the automatic save use the **Automatic save → Off** setting from the Configuration menu. When automatic save is turned on, the following parameters will be saved in the non-volatile memory after 3 seconds from the last modification of that parameter:

- Function generator: frequency, level, waveform, output On/Off, TTL On/Off
- Pulse generator: frequency, level, duty cycle, CMOS On/Off, TTL On/Off
- Frequency counter: input signal type
- DC power supplies: positive voltage, negative voltage
- Logic switches: state, TTL/CMOS
- SPDT switches state
- Logic indicator TTL/CMOS
- Logic probe: TTL/CMOS, PLS/MEM
- Current panel: Function generator, Pulse generator, Frequency counter or DC Power supplies

7.1.3 Security

This feature allows you to enter a security code to prevent accidental or unauthorized calibrations or firmware updates of the PB-507 Trainer. When you first receive your PB-507 Trainer, it is secured. First you must unsecure the PB-

507 by entering the correct security code, which allows you to perform a calibration or firmware update.

The default security code is **PB507**.
The security code may contain up to 15 characters.

Unsecure the PB-507 Trainer
Select the **Security** option from the Configuration menu. Press the "Yes" soft key when you are asked "You want to enter the security code to unsecure the device?". The following screen will appear:

Figure 15

Use the arrow soft keys to select a character in the security code box ("Code: ").

Press the "Set" soft key to insert a character in the security code. Use the arrow keys to move the selection.
Use the "CAPS" option to switch between upper-case and lower-case.
Use the " " option to delete a character in the security code.

To enter the desired character, press the "OK" soft key.

When the security code is specified, move the cursor to "Code" field and press "Enter". The message "Device unsecured." appears if the security code was correct, otherwise the message "Invalid security code." will appear on the screen.

Unsecure the PB-507 Trainer by jumper
If you forget your security code, you can unsecure the device by placing the provided jumper inside the instrument. The trainer being unsecured, you can enter a new security code.

- Disconnect power cord and all input connections.
- Disassemble the instrument.
- Apply the jumper on the main board as shown on the pictures below:
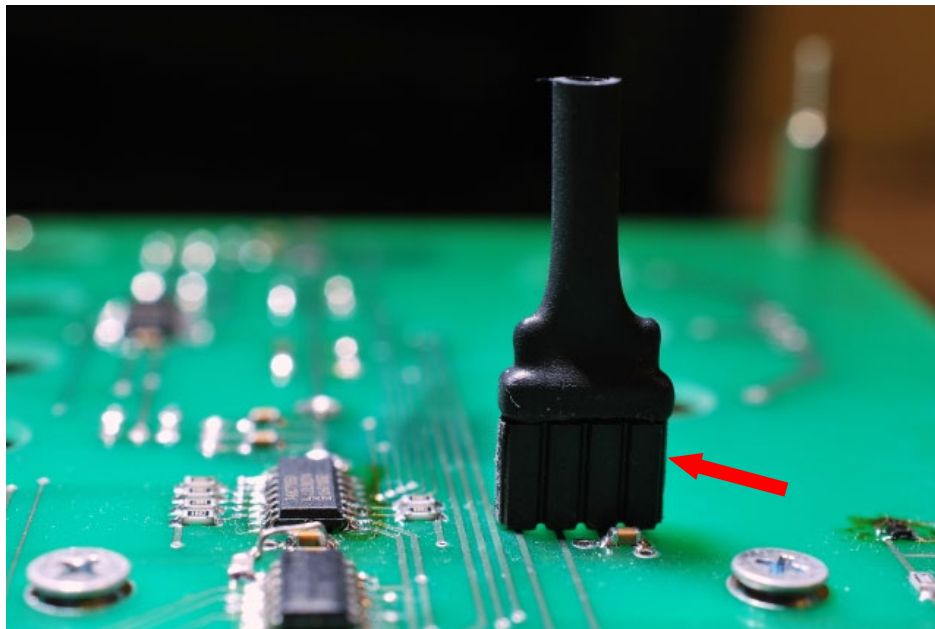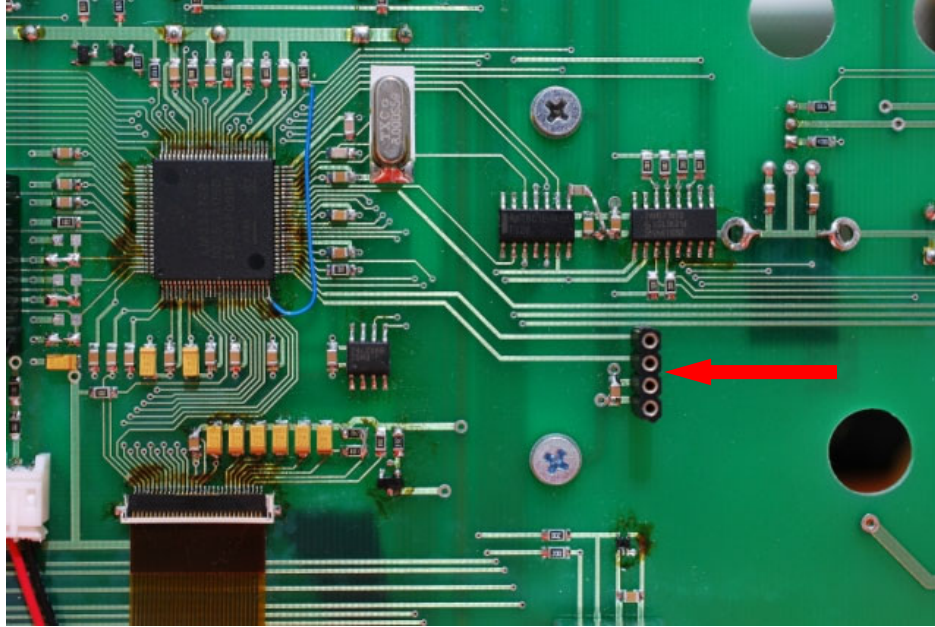
- Attach power and turn on the instrument.
- While the jumper is applied, the device is unsecured. Enter a new security code as described in section **Secure the PB-507 Trainer**, and record the security code in a safe location.

- Turn off the trainer, remove the jumper, and remove power cord.
- Reassemble instrument.

Secure the PB-507 Trainer

Select the **Security** option from the Configuration menu. Press the "Yes" soft key when you are asked "You want to enter the security code to secure the trainer?". The steps required to secure PB-507 are identical to those described at section **Unsecure the PB-507 Trainer**.

Change the security code

To change the security code, you must unsecure the device. Then you can enter a new security code**.**

7.1.4 Lock or Unlock front-panel keys

You can lock or unlock the front panel keys by **Service → Front keys** option. Locking the front-panel keys will disable all buttons and encoders on the PB-507 front-panel, excepting the soft keys. When the front-panel is locked, the modules of the PB-507 Trainer can be controlled only through remote interface.

7.1.5 Page scrolling

This feature allows you to navigate between the panels (Function generator, Pulse generator, Frequency counter, DC power supply) in three ways:

Manual: with this setting you can change the active panel using the soft keys
Auto: if a button or an encoder from a module other than the one displayed is pressed, the panel of that module will be displayed for 3 seconds, and then PB-507 will return to the initial panel
Jump: if a button or an encoder from a module other than the one displayed is pressed, the panel of that module will be displayed for 3 seconds, and PB-507 will **not** return to the initial panel

Note: If power-on option is set to **Last saved state**, the active panel is saved in the non-volatile memory. The saved panel will be loaded at next power-on.
If power-on option is set to **Default config**, the Function generator panel is loaded at next power on.

7.1.6 Factory default configuration

You can reset the PB-507 Trainer to its factory default state by selecting the **Load default config** option. Press the "Yes" soft key when you are asked "You want to load the factory default configuration?". The info message "Default configuration loaded" will appear on the display when the factory default configuration has been restored.

In the following table is summarized the factory default settings of the PB-507 Trainer:

Parameter	Factory setting
Function generator	
Frequency	1.000 KHz
Level	1.0 Vpp
Waveform	Sine
Output On/Off	Off
TTL On/Off	Off
Pulse generator	
Frequency	1.000 KHz
Level	1.0 V
Duty cycle	50 %
CMOS On/Off	Off
TTL On/Off	Off
Frequency counter	
Input signal type	Bipolar
Counter mode	Automatic
DC power supplies	
Positive voltage	1.0 V
Negative voltage	- 1.0 V
Logic switches	
8 logic switches state	Logic Low
Logic family	TTL
SPDT switches	
SPDT1	State 1
SPDT2	State 1
Logic indicators	
Logic family	TTL
Logic probe	
Logic family	TTL
Operation mode	PULSE
System-related settings	
Contrast adjustment	59%
Video mode	Normal
Automatic save	On
Power on	Default
Front panel keys	Unlocked
Page scrolling	Manual
Panel displayed after power-on	Function Generator
Security	Secured

Table 3

Note: If the PB-507 Trainer was previously unsecured, loading the default configuration will secure the device with the last saved security code.

7.2 Memory menu

The *Table 4* shows the Memory menu.

First level	Second level	Third level	Description
Back			Go **Back** to the PB-507 main menu
Store state	Back		Go **Back** to the first level
	The states numbered from 1 to 10	Back	Go **Back** to the second level
		Enter name	Select this option to Enter a name for the selected state.
		Save state	Select this option to save the selected state
Recall state	Back		Go **Back** to the first level
	The states numbered from 1 to 10		Recall the selected state
Delete state	Back		Go **Back** to the first level
	Delete all		Select **Delete all** to delete all states
	The states numbered from 1 to 10		Delete the selected state

Table 4

7.2.1 State storage

The PB-507 Trainer has ten storage locations in non-volatile memory to store states. The locations are numbered from 1 to 10.

You can store a state in any of the ten storage locations, but you can only recall a state from a location that contains a stored state. "Empty location." message will appear if you try to recall a state from a location that not contains a saved state.

The storage locations are not affected by the **Load default configuration** command. Once a state is stored, it remains until it is overwritten or specifically deleted. You can delete all the states at once by selecting **Delete state → Delete all** option.

To save the current state, go into **Store state** menu, select a location from 1 to 10, and select **Save state** option from the menu. The message "State stored." will appear.

The following settings are saved:

- Function generator: frequency, level, waveform, output On/Off, TTL On/Off

- Pulse generator: frequency, level, duty cycle, CMOS On/Off, TTL On/Off
- Frequency counter: input signal type
- DC power supplies: positive voltage, negative voltage
- Logic switches: state, TTL/CMOS
- SPDT switches state
- Logic indicator: TTL/CMOS
- Logic probe: TTL/CMOS, PLS/MEM

7.2.2 State name

You can assign a custom name to each of the ten storage locations. The name can contain up to 15 characters. You can assign the same custom name to different storage locations.

To assign a name to the selected location select the **Enter name** option. The following screen will appear:

Figure 16

Use the arrow soft keys to select a character in the name box ("1: No name").

Press the "Set" soft key to insert a character in the name box. Use the arrow keys to move the selection.
Use the "CAPS" option to switch between upper-case and lower-case.
Use the " " option to delete a character in the name box.

To enter the desired character, press the "OK" soft key.

When the state name is specified, move the cursor to the number of the state (1 in this case) and press "Back" to go back to the Store state menu.

The name entered for the selected state will be saved only when you save the state in memory by selecting the **Store state** option.

7.3 Service menu

The *Table 5* shows the Service menu.

First level	Second level	Description
Back		Go **Back** to the PB-507 main menu
Calibration	Function generator	Select **Function generator** to calibrate the Function generator module
	Pulse generator	Select **Pulse generator** to calibrate the Pulse generator module
	DC power supplies	Select **DC power supplies** to calibrate the DC power supplies module
USB host status		Select **USB host status** to view the USB connection status
Error log		Select **Error log** to view the errors
Software info		Select **Software info** to view the boot loader and firmware version
Update firmware		Select **Update firmware** to perform a firmware update

Table 5

8 CALIBRATION

This section gives a complete description of the calibration features of the PB-507 Trainer. Three modules can be calibrated: Function generator, Pulse generator and DC power supplies.

In order to perform the calibration procedure, the PB-507 Trainer must be unsecured. If PB-507 is secured, the "Device secured. Unsecure first." message will appear on the display when you want to enter in calibration mode. To unsecure the PB-507 Trainer, please refer to section "Security" in this manual.

8.1 Function generator calibration

Equipment used:

- Oscilloscope with probe set to x10.
- 600 Ohm ± 1% termination.

The precision of the calibration depends on the precision of the oscilloscope used.
To calibrate the Function generator module, 10 steps must be completed.

The following rules are applied:
- The digit displayed in white type inside a black box indicates the active number.
- Use the Level knob from the Function generator module to change the value.

- Use the Range Up and Range Down buttons from Function Generator to switch between the numbers.
- Use the Right and Left arrow keys from Function Generator module to move the digit selection inside the selected number.

8.1.1 Step 1

a. Connect the 600 Ohm termination between OUT and GND. Connect the oscilloscope probe between the OUT and GND terminals of the Function generator module.

b. Select Function generator from the calibration menu. The OUT LED will turn on, the TTL LED will turn off and PB-507 will display:
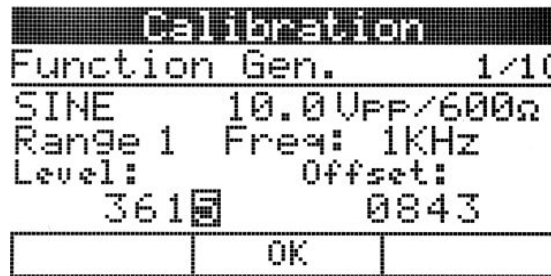


```
           Calibration
Function Gen.            1/10
SINE         10.0Vpp/600Ω
Range 1  Freq:  1KHz
Level:          Offset:
    361█            0843
           |   OK   |
```

Figure 17

c. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 10.0Vpp of the sine signal and the closest offset to zero.

d. Press the OK soft key to finish this step. The message "Step 1 done." is displayed on the screen.

8.1.2 Step 2

a. PB-507 will display:


```
           Calibration
Function Gen.            2/10
SINE          1.0Vpp/600Ω
Range 1  Freq:  1KHz
Level:          Offset:
    049█            3373
           |   OK   |
```

Figure 18

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 1.0Vpp of the sine signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 2 done." is displayed on the screen.

8.1.3 Step 3

a. PB-507 will display:

```
▓▓▓▓▓▓▓ Calibration ▓▓▓▓▓▓▓
Function Gen.           3/10
SINE          1.0Vᴘᴘ/600Ω
Range 2  Freq:  1KHz
Level:         Offset:
    357▓            0833
┌─────────┬─────────┬─────────┐
│         │   OK    │         │
└─────────┴─────────┴─────────┘
```

Figure 19

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 1.0Vpp of the sine signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 3 done." is displayed on the screen.

8.1.4 Step 4

a. PB-507 will display:

```
▓▓▓▓▓▓▓ Calibration ▓▓▓▓▓▓▓
Function Gen.           4/10
SINE          0.1Vᴘᴘ/600Ω
Range 2  Freq:  1KHz
Level:         Offset:
    048▓            3464
┌─────────┬─────────┬─────────┐
│         │   OK    │         │
└─────────┴─────────┴─────────┘
```
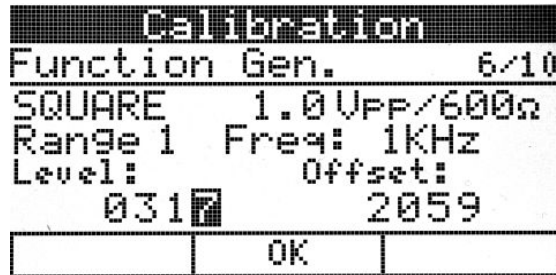
Figure 20

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 0.1Vpp of the sine signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 4 done." is displayed on the screen.

8.1.5 Step 5

a. PB-507 will display:

```
▓▓▓▓▓▓▓ Calibration ▓▓▓▓▓▓▓
Function Gen.           5/10
SQUARE       10.0Vᴘᴘ/600Ω
Range 1  Freq:  1KHz
Level:         Offset:
    328▓            2120
┌─────────┬─────────┬─────────┐
│         │   OK    │         │
└─────────┴─────────┴─────────┘
```
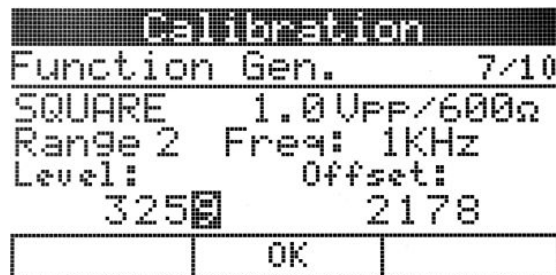
Figure 21

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 10.0Vpp of the square signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 5 done." is displayed on the screen.

8.1.6 Step 6

a. PB-507 will display:

```
       Calibration
Function Gen.          6/10
SQUARE        1.0VPP/600Ω
Range 1   Freq:  1KHz
Level:          Offset:
     031▊            2059
          │   OK   │
```
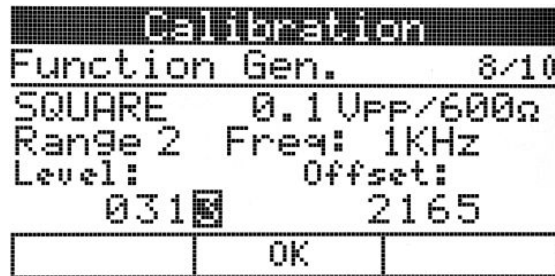
Figure 22

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 1.0Vpp of the square signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 6 done." is displayed on the screen.

8.1.7 Step 7

a. PB-507 will display:

```
       Calibration
Function Gen.          7/10
SQUARE        1.0VPP/600Ω
Range 2   Freq:  1KHz
Level:          Offset:
     325▊            2178
          │   OK   │
```

Figure 23

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 1.0Vpp of the square signal and the closest offset to zero.

c. Press the OK soft key to finish this step. The message "Step 7 done." is displayed on the screen.

8.1.8 Step 8

a. PB-507 will display:

Figure 24

b. Two 4 digit numbers are shown on the display. Adjust the numbers until the oscilloscope indicates the closest value to 0.1Vpp of the square signal and the closest offset to zero.
c. Press the OK soft key to finish this step. The message "Step 8 done." is displayed on the screen.

8.1.9 Step 9

a. Connect the oscilloscope probe to the TTL and GND terminals of the Function generator module.
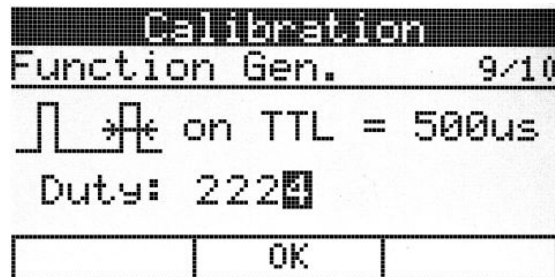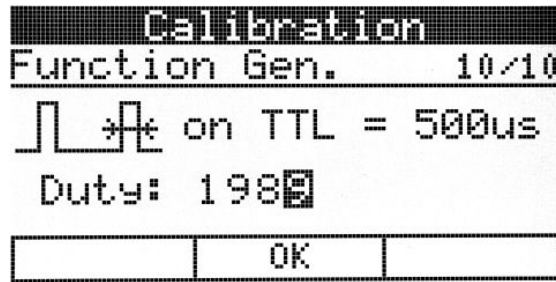b. The OUT and TTL LED will turn on and PB-507 will display:

Figure 25

c. A 4 digit number is shown on the display. Adjust the number until high duration of the TTL signal is the closest value to 500 microsecond.
d. Press the OK soft key to finish this step. The message "Step 9 done." is displayed on the screen.

8.1.10   Step 10

a. PB-507 will display:

Figure 26

b. A 4 digit number is shown on the display. Adjust the number until high duration of the TTL signal is the closest value to 500 microsecond.
c. Press the OK soft key to finish this step. The message "Function calibration done." is displayed on the screen.

8.2 Pulse generator calibration

Equipment used:

- Digital multimeter (DMM)
- Oscilloscope with probe set to x10.

The precision of the calibration depends on the precision of the oscilloscope and DMM used.
To calibrate the Pulse generator module, 4 steps must be completed.

The following rules are applied:

- Use the Level knob from the Pulse generator module to change the displayed value.
- Use the Right and Left arrow keys from the Pulse Generator module to move the digit selection inside the selected number.

8.2.1 Step 1
a. Set the DMM to measure DC voltage. Connect the DMM probe to CMOS and GND terminals of the Pulse Generator module.
b. Select Pulse Generator from the calibration menu. The CMOS LED will turn on, the TTL LED will turn off and PB-507 will display:
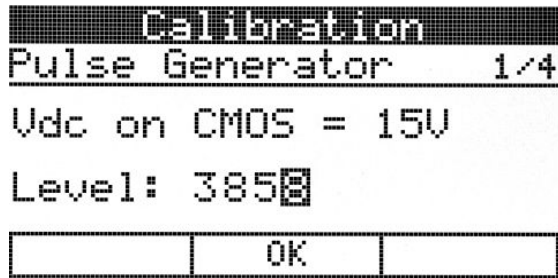
```
▓▓▓▓▓▓▓Calibration▓▓▓▓▓▓▓
Pulse Generator      1/4

Vdc on CMOS = 15V

Level: 3858▓

┌──────┬──────┬──────┐
│      │  OK  │      │
└──────┴──────┴──────┘
```
Figure 27

c. Adjust the number until the DMM indicates the closest value to 15V.
d. Press the OK soft key to finish this step. The message "Step 1 done." is displayed on the screen.
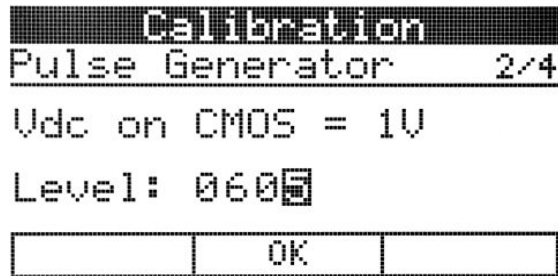
8.2.2 Step 2

a. PB-507 will display:

```
▓▓▓▓▓▓▓Calibration▓▓▓▓▓▓▓
Pulse Generator      2/4

Vdc on CMOS = 1V

Level: 060▓

┌──────┬──────┬──────┐
│      │  OK  │      │
└──────┴──────┴──────┘
```
Figure 28

c. Adjust the number until the DMM indicates the closest value to 1V.
d. Press the OK soft key to finish this step. The message "Step 2 done." is displayed on the screen.

8.2.3 Step 3

a. Connect the oscilloscope probe to the TTL and GND terminals of the Pulse generator module. The TTL LED will turn on, the CMOS LED will turn off and PB-507 will display:
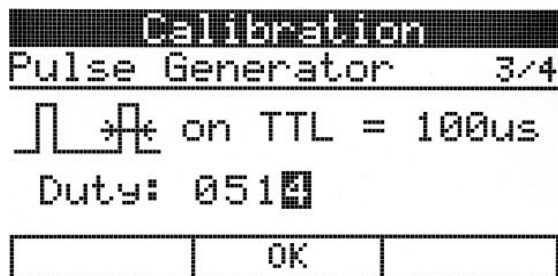
```
▓▓▓▓▓▓▓Calibration▓▓▓▓▓▓▓
Pulse Generator      3/4

∏ ⊢∏⊣ on TTL = 100us

 Duty: 051▓

┌──────┬──────┬──────┐
│      │  OK  │      │
└──────┴──────┴──────┘
```
Figure 29

b. Adjust the number until high duration of the TTL signal is the closest value to 100 microsecond.
c. Press the OK soft key to finish this step. The message "Step 3 done." is displayed on the screen.

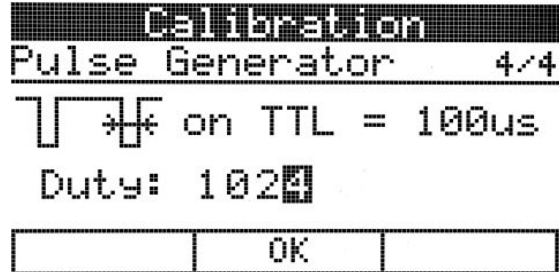### 8.2.4 Step 4

a. PB-507 will display:

Figure 30

b. Adjust the number until low duration of the TTL signal is the closest value to 100 microsecond.
c. Press the OK soft key to finish this step. The message "Pulse calibration done." is displayed on the screen.

8.3 DC Power supplies calibration

Equipment used:
  • Digital multimeter (DMM)

The precision of the calibration depends on the precision of the DMM used.
To calibrate the DC Power supplies module, 4 steps must be completed.

The following rules are applied:
  • Use the +V and -V knobs from the DC Power supplies module to change the displayed value.
  • Use the Right and Left arrow keys from the DC power supplies module to move the digit selection.

8.3.1 Step 1

a. Select DC Power Supplies from the calibration menu. The message "Disconnect all loads" is displayed. Disconnect any loads connected to the trainer and press the "OK" soft key.
b. Set the DMM to measure DC voltage. Connect the DMM probe to +V and GND terminals of the DC Power supplies module. PB-507 will display:
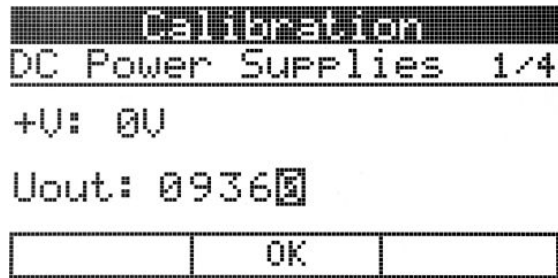
```
                Calibration
DC  Power  Supplies    1/4

+V:  0V

Uout:  09365

        |     OK     |
```
Figure 31

c. Adjust the number until the DMM indicates the closest value to 0V.
d. Press the OK soft key to finish this step. The message "Step 1 done." is displayed on the screen.
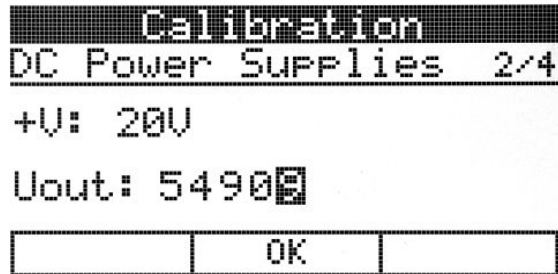
8.3.2 Step 2

a. PB-507 will display:

```
                Calibration
DC  Power  Supplies    2/4

+V:  20V

Uout:  54908

        |     OK     |
```
Figure 32

b. Adjust the number until the DMM indicates the closest value to 20V.
c. Press the OK soft key to finish this step. The message "Step 2 done." is displayed on the screen.
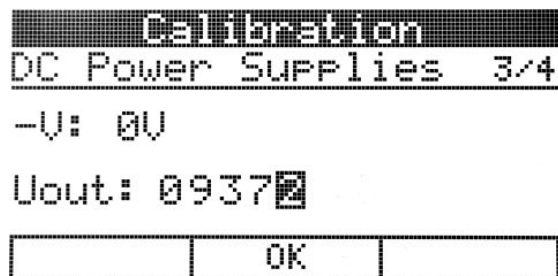
8.3.3 Step 3

a. PB-507 will display:

```
                Calibration
DC  Power  Supplies    3/4

-V:  0V

Uout:  09370

        |     OK     |
```
Figure 33

b. Adjust the number until the DMM indicates the closest value to 0V.
c. Press the OK soft key to finish this step. The message "Step 3 done." is displayed on the screen.

8.3.4 Step 4
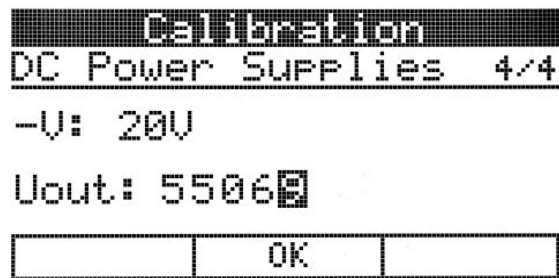
a. PB-507 will display:

Figure 34

b. Adjust the number until the DMM indicates the closest value to -20V.

c. Press the OK soft key to finish this step. The message "DC supplies calibration done." is displayed on the screen.

9   INFO, WARNING, AND ERROR MESSAGES

9.1 Info messages

Info messages are used to inform the user about system-related actions. Info messages are displayed with an "i" in a circle in the top left corner of the window. The following info messages may appear:

- Waiting for host…
- Host present
- Host connected
- Host disconnected
- Function calibration done
- Pulse calibration done
- DC supplies calibration done
- Contrast saved
- Counter mode set to AUTO
- Counter mode set to MAN
- Automatic save enabled
- Automatic save disabled
- Front panel buttons locked
- Front panel buttons unlocked
- Page scrolling set to MAN
- Page scrolling set to AUTO
- Page scrolling set to JUMP
- Default configuration loaded

- Power-on option set to default
- Power-on option set to last save
- State stored
- State recalled
- State deleted
- All states deleted
- Device unsecured
- Device secured
- Video mode set to normal
- Video mode set to inverse

9.2 Warning messages

Warning messages are displayed with an exclamation mark in the top left corner of the window. The following warning messages may appear:

- Errors found. View error log
- Function calibration failed
- Pulse calibration failed
- DC supplies calibration failed
- Device is secured. Unsecure first
- Contrast not saved
- Front-panel buttons locked
- State not stored
- Empty location
- State not deleted
- Invalid security code

9.3 Error messages

PB-507 can display some specific error codes. PB-507 displays the warning message "Errors found. View error log." each time an error is generated. This message is displayed periodically, for approximately 3 seconds in every minute. You may read the error by accessing **Service → View error log** option. Once the error log was viewed, the "Errors found. View error log." message is cleared.

If more than 15 errors have occurred, the last error stored in the queue (the most recent error) is replaced with "Queue overflow". No additional errors are stored. If no errors have occurred when you read the error queue, "No error" is displayed in the error log.

List of errors:

- E01: EEPROM does not respond.
- E02: DAC 0 does not respond.
- E03: DAC 1 does not respond.
- E04: Function generator calibration data checksum error.
- E05: Pulse generator calibration data checksum error.
- E06: Power supply calibration data checksum error.
- E07: Function generator calibration failed.
- E08: Pulse generator calibration failed.
- E09: Power supply calibration failed.
- E10: USB controller initialization failed.
- E11: Unexpected USB packet.
- E12: USB packet ignored.
- E13: USB header error.
- E14: Power supply V+ error.
- E15: Power supply V- error.
- E16: Power supply 5V error.
- E17: Error queue full.

10 COMPUTER INTERFACE

PB-507 has USB 2.0 compatible interface for remote control.
A Mini-B type USB connector is used to connect the PB-507 to a PC.

A companion Windows application, PB-507 Control Program and the required device driver installer are available on the software CD. This application offers full control of the following modules and settings: Function Generator, Pulse Generator, Frequency Counter, DC Power Supplies, Logic indicators, Logic probe, Hex to 7 Segment Decoder, Debounced Pushbuttons, Logic Switches, SPDT Switches, Counter mode, Automatic save, Power-on, Front keys, Page scrolling, Load default configuration.

Note that the USB device drivers for the PB-507 device must be installed prior to running the PC application. To install the drivers, connect the PB-507 Trainer to PC through USB cable. This will cause Windows to prompt for device driver installation.

The following information messages may appear on PB-507 Trainer regarding the USB interface:

- **Waiting for host** – the USB cable is unplugged or if the USB cable is plugged in, the USB device driver is not installed on PC
- **Host present –** the USB cable is plugged in, USB device driver is installed, PB-507 Control program is not connected

- **Host connected –** the PB-507 Control program is connected to the Trainer
- **Host disconnected –** the PB-507 Control program has been disconnected from the Trainer

You can view the USB host state anytime by accessing the **Service → USB host status** option from menu.

10.1 Firmware update

You can use the PB-507 Control application to update the PB-507 Trainer firmware.

In the PB-507 Trainer menu select **Service → Update firmware**.

If PB-507 is secured, the "Device secured. Unsecure first." message will appear when you want to enter in firmware upgrade mode. To unsecure the PB-507 Trainer, please refer to section "**Security"** in this manual.

PB-507 ask you "Are you sure you want to update the firmware?". Press "Yes".

PB-507 will enter in firmware upgrade mode. "PB-507 bootloader is running… You can upgrade the firmware through USB." message will appear on display.

Install the Device Firmware Upgrade USB driver on the host PC. The USB driver needs to be installed only once on your computer, at first time when you run the update.

Run the **Upgrade PB-507 Firmware Wizard** from the PB-507 Control application and follow the instructions.

Once the update starts "Download progress" and "Do not turn off the power" messages will appear on display.

The update process takes approximately 5-15 seconds to complete.

Wait until the PB-507 displays "Download complete." message.

Turn off and then turn on the device.

You can view the firmware version by accessing the **Service → Software info** option.

11 SERVICE AND WARRANTY INFORMATION

For up-to-date product information, please visit *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.

11.1 WARRANTY

Global Specialties warrants the PB-507 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.