BNC
Berkeley Nucleonics Corp



User Manual Model 507

High Current Pulse Generator

PRODUCT RESOURCES

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1 INTRODUCTION

This manual is designed to help you quickly and easily learn to use your Berkeley Nucleonics Model 507 current pulse generator. The 507 provides digitally controlled current pulses with currents from 0 - 25 Amps and pulsewidths from 100µs to 100ms. We also offer a long pulse version which holds up to 10A for 10µs - 500ms. Rather than the usual array of knobs and switches, the 507 uses a menu-driven user interface with "on-line" help -- once you learn the basics of operating your 507, you may never need to refer to this manual again.

Since the Model 507 employs a flexible microprocessor-controlled architecture, the 507 can be customized to fit your exact requirements -- contact Berkeley Nucleonics for details.

Technical Support

For questions or comments about operating the 507, contact Berkeley Nucleonics via one of the following methods:

- Phone - (415) 453-9955
- Fax - (415) 453-9956
- Internet - www.berkeleynucleonics.com

Parts List

The following parts are included with the 507 -- contact Berkeley Nucleonics if any parts are missing:

- 507 Pulse Generator
- AC Power Cord
- User's Manual

Warranty

In addition to a 30-day money back guarantee, the Model 507 has a one-year limited warranty from the date of delivery. This warranty covers defects in materials and workmanship. Berkeley Nucleonics will repair or replace any defective unit.

Custom Modifications

The 507 is microprocessor-controlled and employs a flexible and expandable user-interface. New features and operating modes often can be added without hardware modifications by merely modifying the software contained inside the 507 - contact Berkeley Nucleonics for details.

Safety Issues

Normal use of test equipment exposes users to a certain amount of danger from electrical shock because testing must be performed where exposed voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 VDC or RMS AC should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and those that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Do not expose high voltage components needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment. Make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When testing AC powered equipment, remember that AC line voltage is usually present on some power input circuits, such

as the on-off switch, fuses, power transformer etc., any time the equipment is connected to an AC outlet, even if the equipment is turned off.

6. Never work alone. Someone should always be nearby to render aid if necessary. Training in CPR first aid is highly recommended.

2 CONTROLS AND CONNECTORS

This chapter explains the function of each control and connector on the 507.

Front Panel

The front panel contains the most frequently used controls and connectors.

Display

The 507 features a backlit liquid crystal display, which displays menu selections and settings. The left half of the display shows the current menu selection, while the right half shows the current setting of the item associated with that menu.

Control Buttons



Item Button

Toggles between the various items in a menu.



Menu Button

Toggles between the various sets of menus.



Up Button

Increments a number or increments the selection for the current item.



Down Button

Decrements a number or increments the selection for the current item.



Left Button

For numeric items, this button is used to select which digit in a numeric entry is selected for editing. For other items, or when the left most digit is already selected for numeric items, pressing and holding this button down displays a brief description of the current item.



Right Button

For numeric items, this button is used to select which digit in a numeric entry is selected for editing. For other items, or when the right most digit is already selected for numeric items, press and hold this button down to display the range and units for the current item.



Stop Button

Disables output of pulses on all channels.



Run Button

Enables output of pulses.

Output Sections

There are two (2) output sections on the front of the 507; each consists of a pair of banana plugs, a BNC current monitor, a toggle switch, and a charge level indicator. Each output section is independently controlled and isolated from each other. Loads are connected to the banana plugs. The toggle switch allows the user to physically disconnect the output (off position). Disconnecting the outputs is recommended while connecting loads.

Warning: The charge bank voltage is present on the positive (red) output jack; before connecting loads, disconnect bank voltage by placing toggle switch in off position.

The charge level indicator illuminates when the capacitor bank is fully charged. The current monitor is an oscilloscope compatible reference voltage to monitor the current pulse, 1A = 100mV.

External Trigger

Trig In (BNC) -- external signal input to trigger the generation of pulses. Optoisolated input, 3-15V (>3mA). Pressing the RUN button in the external trigger mode arms the system and waits for an external trigger input.

Sync Out

This is a BNC connector which provides a TTL sync output when the instrument is fired. This signal is generated by the internal clock and therefore the actual pulse output will be delayed relative to the Sync Out as specified by the channel delay parameter.

Interlock

A switch is provided to arm/disarm the system. This switch is used with the interlock input on the rear panel to control pulse generation of the system. A READY indicator is provided to indicate that the rear interlock is satisfied and the arm/disarm switch is in the armed position. No pulses will be generated unless the LED is on. When the system is disarmed, a relay disconnects the bank voltage from the output jacks.

Rear Panel

Interlock

This is a BNC connector which must be appropriately connected to allow the instrument to generate pulses. The input must be shorted to satisfy the interlock.

Serial Port

This is a 9-pin D-sub connector for the RS232 interface that comes standard with the 507. It is pinned to be directly connected to a standard IBM-PC serial port -- use a straight-through cable (not a null modem cable) to connect to a PC.

GPIB Port (optional)

The GPIB (IEEE 488) interface is available as an option with the 507.

AC Input

A standard EIC instrument-type cord should be used. The 507 is supplied with a power cord that fits the type of socket used in your country.

Input requirements: 100-240VAC, 1A

3 OPERATING INSTRUCTIONS

This chapter presents detailed instructions on the operation of the 507.

Overview

The 507 provides digitally controlled, single shot, current pulses. The current is provided by a 3700mF capacitor bank charged to approximately 44V. The ability of the instrument to maintain the requested current will be load dependent, limited by the voltage and the stored energy. Thus the output pulse is energy limited by the amount of energy stored on the capacitor bank ($CV^2/2$ = 36.2 Joules). Long pulses or large loads will result in droop at the end of the pulse as the capacitor bank discharges. The table below shows the maximum droop free pulsewidth as a function of resistance and current.

MAXIMUM CONSTANT CURRENT PULSEWIDTH (ms)*				
	CURRENT (A)			
RESISTANCE (ohms)	1	2	5	10
1	1,090	525	190	75
2	1,060	500	160	50
5	990	425	90	--
10	860	300	--	--

The current in the Model 507 is controlled by a high-side power mosfet. Care should be taken when making connections. A switch is provided for each channel to disconnect the load from the capacitor bank.

The 507 uses a single-line LCD to display menu selections. The front panel keys are used to “navigate” through sets of menus to set various options and control the current pulse generator. Some keys are only active at certain times or have different behavior depending on what state the menus are in -- once understood, the menus can be quickly and easily manipulated. The 507 also contains non-volatile memory for storing up to twelve (12) configurations, so you need not go through the entire setup process each time the instrument is used.

Selecting Menu Items

The menu items in the 507 are arranged in a set. Pressing the ↔ key will toggle between sets of menus, while the ↕ key will toggle between menu items within the current set. Hold down the Left arrow key to receive a short description of the current menu item. Pressing and holding the Right arrow key will display the valid range for that item.

Numeric Input Mode

When the current item is numeric, the system enters the Numeric Input mode. In this mode, the Left and Right arrow keys are used to select a digit to edit. The selected digit blinks to identify itself as the active digit. The Up and Down arrow keys are then used to increment or decrement this digit. When the left most digit is active, pressing and holding the Left arrow key will display a brief description of the current item. When the right most digit is active, pressing and holding the Right arrow key will display the range and units for the current item.

Item Edit Mode

When the current item is non-numeric, the Up and Down arrow keys are used to select among different options for the entry. The Left and Right arrow keys are used to display a description of the item.

Main Menu

The Main Menu consists of a set of menus selections used to set the operating mode, time period and frequency of the 507.

MODE - Pulse Modes

There are two (2) different Pulse modes available.

External Trigger Mode

In the External Trigger mode, one pulse is output each time a rising edge occurs on the Trigger input.

Single Shot Mode

During Single Shot operation, one pulse is generated each time the Run key is pressed. The rate at which pulses are produced is totally dependent on how fast the Run key is pressed. The delay of each of the outputs is relative to To (the internal clock).

Channel Menus

This set of menus is used to set enable and set the current, delay, pulse width for each of the output channels.

n: Enable **- T*n:*Enable**

Each of the two (2) channels has independent output control and may be enabled or disabled from the ***n:***Enable menu, where n = 1, 2. When disabled, the channel will not generate a current pulse when the unit is triggered.

***n*:Iamps - T*n*:Iamps**

Each of the two (2) channels has an independent output current setting from the *n*:Iamps menu where *n* = 1, 2. Currents from 00.00 to 25.00A may be selected with a resolution of 10mA. Current is provided from a 3,700mF capacitor bank, which is charged to nominally 44V. The maximum current available will therefore be limited to the bank voltage and the load resistance. (The capacitor bank is charged by an isolated power supply which is current limited and thus takes approximately 15 seconds to charge.) The charge ready LED indicator illuminates when the capacitor bank is fully charged.

***n*:Dly - T*n* :Delay**

Each of the two (2) channels has an independent delay setting which is set from the Tn:Dly menu, where n = 1, 2. Delays from 0 to 99.999999 seconds may be selected with a resolution of 200ns.

When in any mode but External Trigger, the Delay setting sets the delay from the time the internal timer To goes high until a pulse is output on a particular channel.

When in External Trigger mode, the delays are with respect to the active edge of the external trigger input signal.

n:Wid - T*n*:Pulse Width

Each of the two (2) channels has an independent pulse width setting which is set from the Tn:Wid menu, where n = 1, 2. Pulsewidths from 100µs to 100ms may be selected with a resolution of 200ns. *See custom features for Long Pulse option specifications.

The pulse width is used to specify the duration of the output pulse. The setting of the output polarity (the Tn:Pol menu) for a particular channel determines whether the output is high for this duration or low.

Store/Recall/Misc. Menus

The 507 contains non-volatile memory for storing twelve (12) different configurations. The settings for all menu selections are stored and can be quickly recalled.

STORE Configuration

Stores the current menu settings in the specified memory location one (1) - twelve (12).

Note: If you overwrite a particular location, its previous contents are destroyed.

A configuration is stored by using the Up and Down arrow keys to select the memory location number and pressing the Left or Right arrow key. You will be prompted to press the ↔ key to verify that you want to overwrite the existing stored configuration. If you press any other key, the configuration will not be saved.

RECALL Configuration

Recalls a previously stored configuration from the specified memory location. To recall a configuration, use the Up and Down arrow keys to select the memory location number and press the Left or Right arrow key. You will be prompted to press the ↔ key to verify that you want to overwrite the active configuration. If you press any other key, the configuration will not be recalled.

Note: A zero configuration is available for recall. This configuration resets the instrument to the factory default settings.

Shot Counter

The 507 includes a nine (9) digit shot counter. The maximum count displayed is 4,294,967,295 after which the count rolls over to zero. To manually reset the counter to zero, press the Left or Right arrow key. You will prompted to press the ↔ key to verify that you want to zero the counter. If you press any other key, the shot counter will not be reset.

Fmark

The character used as a decimal point can be set to either a "." (period) or a "," (comma). The period is generally used in North America, while the comma is used in Europe.

Volume

The key click volume may be adjusted from 0 (disabled) to 9. The default value is 2.

GPIB:Addr (optional)

For systems with the optional GPIB interface this menu sets the GPIB address. The valid address range is from 0 to 30.

4 COMPUTER INTERFACE

The 507 comes standard with an RS232 serial interface; a GPIB (IEEE-488) interface is available as an option. All menu settings can be set and retrieved over the computer interface using a simple command language.

Serial (RS232) Pinout

The serial port is located on the back of the 507, and uses a 9-pin D-type connector with the following pinout (as viewed from the back of the 507):

1. No connection
2. Tx - Transmit (to computer)
3. Rx - Receive (from computer)
4. DTR - connected to pin 6
5. Ground
6. DSR - connected to pin 4
7. RTS - connected to pin 8
8. CTS - connected to pin 7
9. No connection

The voltage level of the Transmit signal is +/-10V, the Receive signal should be at least +/-5V.

GPIB

An optional GPIB (also known as IEEE-488) computer interface is available for the 507. Before using this interface, the address must be set using the GPIB Address menu item. The same command set is used for both the GPIB and RS-232 interfaces. Both interfaces may be used at the same time. Responses will be made to the most recently used interface.

Command Language

All menu items can be accessed and selected via the computer interface using a simple command language. The command set is the same for both the RS232 and GPIB interfaces.

Command Protocol

All commands have the following syntax:

$<name> <##>CR

where

- **$** indicates a command follows.
- **<name>** is the command name. No spaces are allowed between the **$** and the **<name>**. The name is case sensitive.
- <##> is an unsigned integer associated with the command. A space must be inserted between **<name>** and <##>.
- **CR** is a carriage return character (ASCII value 13).

With echo enabled, all characters sent will be echoed back to the sender before the expected response is sent.

Unidentified commands and most out of range conditions result in the pulse generator ignoring the command. If the command is properly identified, the pulse generator returns an **ok** followed by a carriage return and a line feed (ASCII 13, ASCII 10), otherwise it returns a **?1** (a question mark, followed by the number "one", a carriage return and a line feed). A **?2** is sent if a valid command is received but the parameter is out of range.

Example - send the following command to set the number of cycles:

$MODE 1

The pulse generator will return the following:

Echo Enabled: **MODE 1<cr><lf>**

ok<cr><lf>

Echo Disabled: **ok<cr><lf>**

Only one command will be processed per message. Commands are not processed until the carriage return is sent. If an error is made and identified prior to sending the carriage return, sending a new **$** will reset the input buffer and allow a corrected command to be sent.

To determine the current value of a parameter the syntax is:

$<name> ?CR

where name = a valid command name.

This will return an integer followed by a space, carriage return, and a line feed character (ASCII 10).

Example - the following command would retrieve the current Cycles setting:

$MODE ?

The pulse generator will return the following:

Echo Enabled: **MODE ?<cr><lf>**

100<cr><lf>

Echo Disabled: **100<cr><lf>**

Communication Protocol

Communication parameters are set at 9600 baud, 8 bits, parity = none, and 1 stop bit. To help establish RS232 communications, the pulse generator emits the characters **BNC** approximately every 200 ms after power up and until the 507 receives a **$**. Both the GPIB and the RS232 interface may be used at the same time. The instrument will respond to the port which sent the command.

Command List

The following table summarizes all the commands:

507 Communication Commands		
Command Name	**Parameters**	**Description**
MODE	0 = Single Shot mode 1 = External Trigger mode	Sets the pulse generator mode.
T1:Ena	0 = Disable 1 = Enable	Enable/disable Channel 1
T1:Iamp	0 - 2500	Sets the current level, in 10's of mA (100 = 1A), for Channel 1
T1:Wid	1,000 - 1,000,000	Sets the pulse width, in microseconds*10, for Channel 1.
T1:Dly	0 - 999999998	Sets the delay, in microseconds*10, for Channel 1.
T2:Ena	0 = Disable 1 = Enable	Enable/disable Channel 2
T2:Iamp	0 - 2500	Sets the current level, in 10's of mA (100 = 1A), for Channel 2
T2:Wid	1,000 - 1,000,000	Sets the pulse width, in microseconds*10, for Channel 2
T2:Dly	0 - 999999998	Sets the delay, in microseconds*10, for Channel 2
BEEP	1 - 1000	Beeps the speaker inside the 507 the specified number of times.
RUN	0 = Disable 1 = Enable	Enable / disables the pulse generator output.
RECALL	0 - 12	Recall a stored configuration.
STORE	1 - 12	Store a configuration.
SHOTS	0 = Reset to zero	Resets shot counter. SHOT ? will return the number of shots.
ECHO	0 = Disable 1 = Enable	Enables/Disables the RS232 echo. The result string is always sent back.
Fmark,	0 = , (comma) 1 = . (period)	Sets the character used as a decimal point on the display.
VOLUME	0 - 9	Sets the key click volume level.

45 SPECIFICATIONS

DELAYS

▪ CHANNELS	Two (2) independent outputs, with digitally controlled delay and pulsewidth.
▪ CURRENT	0 to 25A (Bank voltage 44V minimum)
▪ RESOLUTION	10mA
▪ ACCURACY	50mA
▪ DELAY	0 to 99.9999998s
▪ RESOLUTION	200ns
▪ PULSEWIDTH	100µs to 100ms
▪ RESOLUTION	200ns
▪ ACCURACY	100ns + .0001 x delay
▪ TIMEBASE	5MHz, 25PPM crystal oscillator
▪ RMS JITTER	100ns
▪ TRIG DELAY	Ext Trig to To < 10µs

EXTERNAL TRIG / GATE

▪ RATE	Dc to 1/ (75ms + largest delay + period)
▪ THRESHOLD	3VDc (3mA into optoisolator)
▪ IMPEDANCE	1000Ω

INTERNAL RATE GENERATOR

▪ MODES	Single shot, external trigger
▪ RMS JITTER	100ns

OUTPUTS

(T1,T2)

- IMPEDANCE 1.405Ω
- SLEW RATE > 2.5A/μs
- OVERSHOOT < 100mA + 10% of pulse amplitude
- AMPLITUDE 0-25A (loads 1 - 10 ohm)
- PEAK CURRENT 25A per channel
- DC CURRENT LIMIT 150mA (each channel)

COMPUTER INTERFACE

- RS232 9600 Baud. All instrument functions and settings may be controlled over the interface bus.

GENERAL

- STORAGE Twelve (12) complete configurations may be stored and recalled from the front panel or the computer interface.
- WEIGHT 10 lbs.
- POWER < 100W @ 120 or 220VAC

56 MAINTENANCE

Except for fuse replacement, the 507 should require no maintenance.

Replacing the Fuse

A pair of fuses are mounted in the power entry module. To replace fuses, follow the instructions given below:

1. Unplug the 507 from power source and remove power cord from the back panel.
2. Remove the fuse holder by pushing down on the center tab and pulling out.
3. Remove the faulty fuse and replace with one of a similar rating.
4. Reinstall the fuse holder.
5. Reattach the power cord.

67 CUSTOM FEATURES

Long Pulse Option Specifications

-10μs - 100ms @ 10A for the duration of the width.



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