microPulser™
Operations Manual

bladewerx™
Cutting-Edge Technology for Instruments and Measurement Applications

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Overview

The ability to test radiation detection devices without using radioactive material is a very useful tool. The microPulser Plus™ is a test instrument capable of emulating the output of a radiation detector circuit. The microPulser is capable of creating continuous, adjustable amplitude pulses at adjustable frequencies to fit the customer's specific needs, along with measuring the high voltage input from the connected instrument. The microPulser has BNC, MHV and Type-C connectors to accommodate an easy connection—without adapters—for most radiation detection instruments.

The microPulser Plus™ also allows remote control of the microPulser via a PC software application. ASCII commands are processed by the microPulser Plus over a USB serial connection with a PC. Using the microPulser Assistant software the microPulser Plus is capable of generating a customer-defined pulse shape to better fit testing needs. The Assistant software can also run scripts using a text file of command strings, through the software.

The Parts of the microPulser

Digital LCD

Menu/Select
3 Position Rocker

Analog Meter

LED Indicator for
Meter in CPM Units

LED Indicator for
Meter in mV Units

Count Rate Knobs

Amplitude Knobs
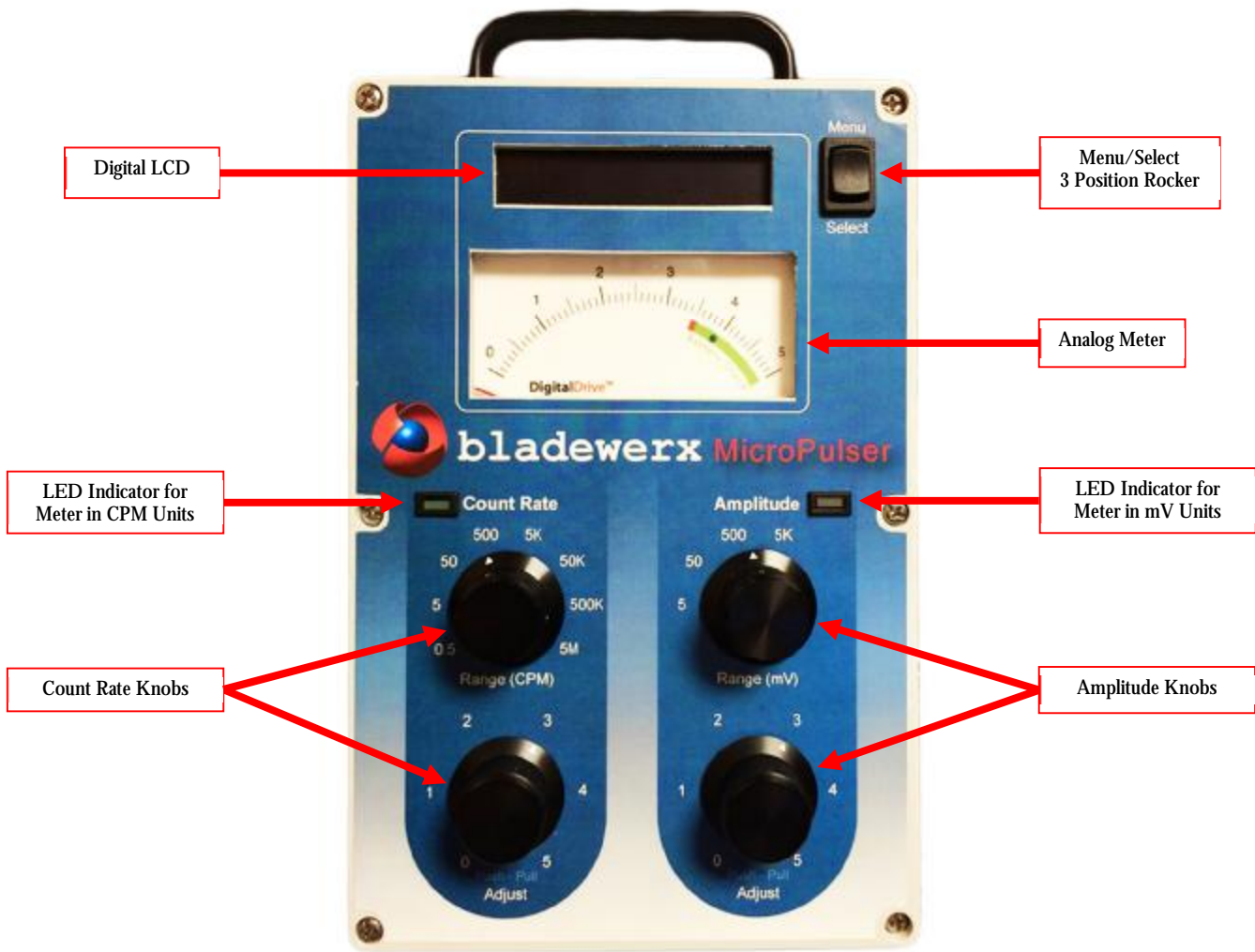
The microPulser consists of an ABS enclosure containing the microPulser electronics. The enclosure is dust-tight and sheds water, but is not waterproof. Six screws hold the front cover on. A handle is located on the top of the enclosure along with four small rubber feet on the bottom of the device for stability.

Four knobs adjust the Count Rate and Amplitude of pulses, as displayed on both the analog meter and digital LCD. A rocker switch controls the menu and settings from the unit, while the USB port can control 0settings from a PC. The right side of the unit mounts 3 input/output connectors, a power button, and charging jack/LED.

Opening the cover should only be done by personnel trained in electrical repair of test instruments.

Digital Display

The alphanumeric display will default to showing the current count rate in counts per minute (CPM) and amplitude in millivolts (mV). Through use of the Menu/Select button, it will display menu options and instructions.

Analog Meter

The meter is used to visually display current count rate or amplitude settings in addition to an initial battery check.

Menu/Select Rocker

When pressed up (Menu) the display will cycle through the different menu options. When pressed down (Select), the currently displayed menu option will be selected and the user will be prompted with further instructions.

LED Indicators

Two LEDs—with alternate illumination—indicate which units are being displayed on the meter: count rate or amplitude. The two will not be lit at the same time. The default display is the Count Rate in CPM. When either of the Amplitude controls are changed, the LED for Amplitude will illuminate and the meter will display the frequency in mV. If the Amplitude knobs are not adjusted for five seconds, the meter automatically switches back to display the Count Rate in CPM units. At that point, the Count Rate LED will illuminate and the Amplitude LED will go out.

Count Rate Knobs

The two knobs on the left control the frequency of the microPulser output. The Count Rate **range** knob (upper knob) displays the high end of the range, adjusting the count rate by a factor of 10 for each clockwise click of the knob. The count rate **adjust** knob (lower knob) not only rotates, but includes an in/out switch. When pushed in, the control adjusts the frequency in steps, by "snapping" to the nearest 0.5 increment greater than 1, and to the nearest 0.2 increment less than 1. When pulled out, the Count Rate is continuously adjustable to any number within the range.

Amplitude Knobs

The two knobs on the right control the pulse height of the microPulser output. The Amplitude **range** knob (upper knob) works the same way as the Count Rate range knob. It displays the high end of the range, increasing the amplitude by a factor of 10 for each clockwise click of the knob. Like the other adjust knob, the Amplitude **adjust** knob (lower knob) also changes incrementally when pushed in and continuously when pulled out. When pushed in, the control adjusts the pulse height in steps, by "snapping" to the nearest 0.5 increment greater than 1, and to the nearest 0.2 increment less than 1. When pulled out, the pulse height is continuously adjustable to any number within the range.
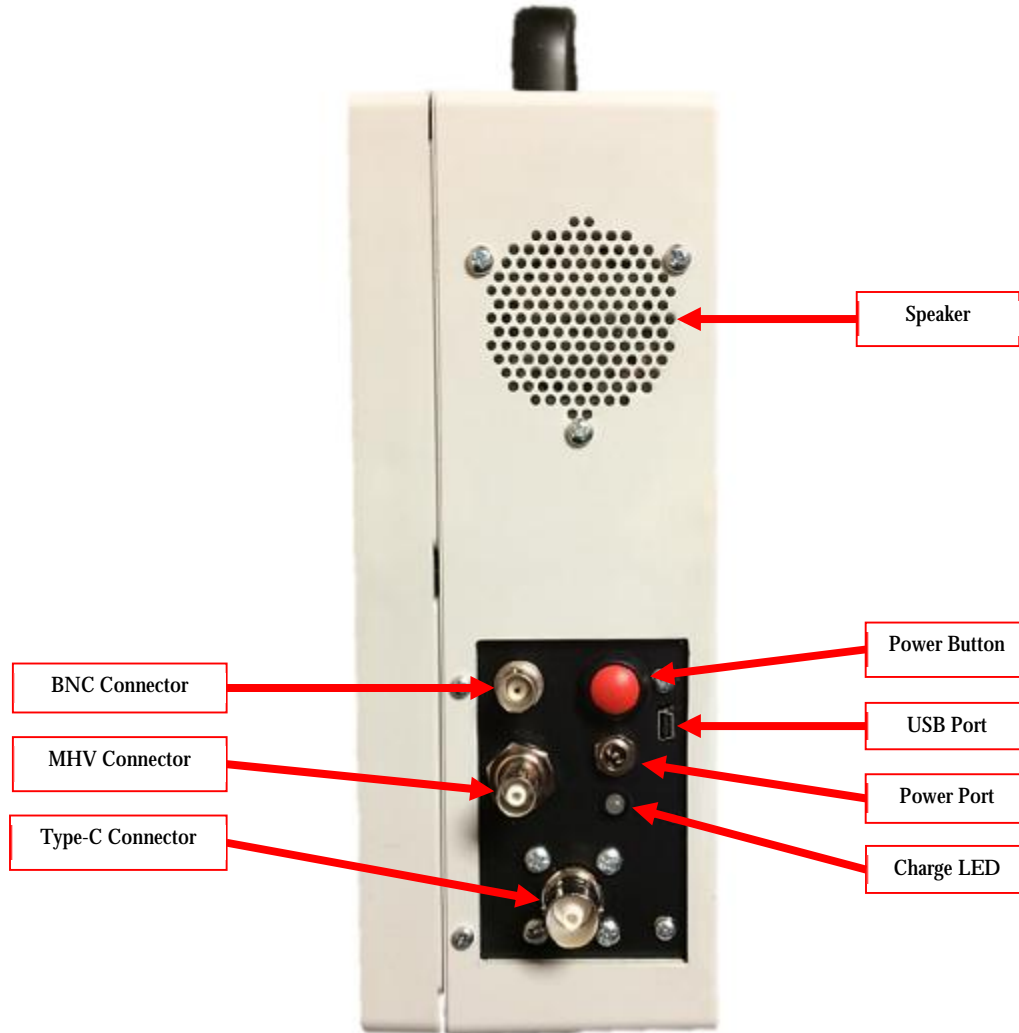
Speaker

The speaker can audibly indicate the current count rate and changes as the count rate is changed. The speaker is enabled/disabled from the Menu and will give a click for each pulse sent. Because of the non-distinguishable frequency, the speaker is disabled on the two highest count rate ranges, 500K and 5M

Power Button & Jack

The red button turns the microPulser on and off. The port is used for charging the unit with the included AC Adapter cable.

Charging LED Indicator

The charging LED indicates the charge status of the microPulser when attached to AC power with the power jack. Red indicates the device is charging but not fully charged and green indicates the device is fully charged. If the microPulser is not connected to power, the LED will be off.

BNC, MHV and Type-C Connectors

The output pulses will be simultaneously transmitted on all three connectors. When more than one connector is in use, the voltage measurement will be from the device with the highest voltage.

Operation

Turning the Unit On

A red button located on the right side of the unit turns on the microPulser. When the power button is pressed, the display will show the device name 'Bladewerx microPulser' and the version number of the main processor firmware. Just after the firmware version is displayed, the microPulser will perform a battery check.
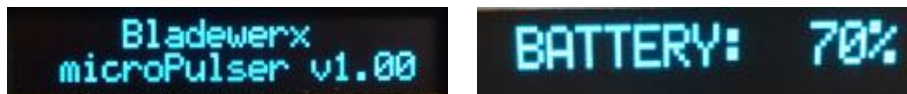
The display will show how charged the battery is in a percentage and the meter will show the user whether or not the battery has enough charge to run the device. If the battery is charged, the meter needle will land in the green area of the battery check portion of the meter display. If the battery is dead, the device will not turn on and should be allowed to charge for at least 30 minutes. The microPulser will show the battery percentage for five seconds during startup, but it may be viewed at any time from the Menu.

Following the battery check, the display will show the current Count Rate (CPM) and the Amplitude (mV) as determined by their current settings. A small "2" or "3" in the upper left corner of the display may appear to indicate that an alternate pulse profile shape is being output. No number in the upper left corner indicates that Profile 1 (default) is in use. Once the meter and screen display the count rate and amplitude, the microPulser has begun its normal operation and is outputting pulses.

Basic Operation

The microPulser generates an output pulse stream that emulates that of a radiation detector.

The pulse frequency, or count rate, is set in CPM using the left count rate knobs on the face of the microPulser. The top indicates the max range incrementing by a factor of 10, while the bottom adjusts the count rate within that range. When the lower knob is pulled out, the count rate adjusts continuously, as opposed to adjusting incrementally when pushed in. The count rate is the default display on the analog meter, as indicated by the lit LED.

The pulse amplitude is set in mV using the right amplitude knobs on the face of the microPulser. The top indicates the max range incrementing by a factor of 10, while the bottom adjusts the pulse height within that range. When the lower knob is pulled out, the amplitude adjusts continuously, as opposed to adjusting incrementally when pushed in. The amplitude is displayed on the analog meter during adjustment, as indicated by the lit LED.

The microPulser is also capable of measuring the high voltage output of an attached instrument. Should more than one be connected to the connectors, only the highest voltage will be measured even though more than one voltage may be generated by the attached instruments.
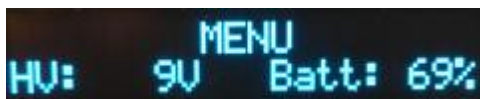
Configuration and Calibration

Pressing the 'Menu' button enters the menu mode and allows the user to view, configure and calibrate different settings on the microPulser. Pressing 'Menu' repeatedly will cycle through all of the menu options and then exits the menu mode and returns to the default display. You may exit the menu mode at any point by holding down the Menu button for two seconds.

The microPulser menu has six options through which the user can scroll. They consist of: the input high voltage and battery percentage, Pulse Profile selection, Speaker Control, Calibrate Meter, Calibrate High Voltage and Calibrate CPM. To scroll through the menu options, press up on the rocker button. When the desired option is found, pressing 'Select' chooses the option to be changed. The menu options are further explained below.

Current HV and Battery Percentage

This menu item is a current reading and is not user editable. The current high voltage reading and the battery percentage are displayed. If no device is connected the voltage reading will fluctuate somewhere below one hundred volts. The battery charge will be displayed in a percentage. When the charge gets to twenty percent, the microPulser will display 'Low Battery'. *When the charge reaches ten percent, the microPulser will turn off.*

Pulse Profile

When selected, the current pulse profile is shown along with a prompt to use the CPM Range knob to set the profile. Simply rotate the top left knob to cycle through one of three different pulse shape profiles. The shape of each profile is user editable via the microPulser Assistant software and is further explained in the microPulser Assistant software portion of this manual.

Speaker Control
When selected, the display indicates the current speaker setting as ON or OFF and prompts the user to alternate as needed using the CPM Range knob. The speaker will not be enabled for the two highest frequency settings—500K and 5M—since the clicks would be undistinguishable.

```
Speaker: OFF
Use CPM Range to set
```
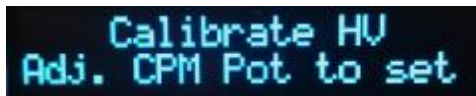
Calibrate Meter
Use this calibration feature if the needle on the analog meter appears inaccurate or does not zero properly after powering on. When selected, the display prompts the user the use the CPM Adjust knob to move the needle until it aligns with the zero marker, in order to calibrate the analog meter.

```
Calibrate Meter
Adj. CPM Pot to zero
```

Calibrate HV
The microPulser high voltage will be factory calibrated before being shipped. When selected, the display initially prompts the user to set the value using the lower left CPM Adjust knob. After the initial prompt, the display then changes to show the current high voltage setting of the microPulser. Rotate the CPM Adjust knob to display the high voltage input of the source (must use a known, accurate HV source).

```
Calibrate HV
Adj. CPM Pot to set
```

Calibrate CPM
The microPulser Count Rate will be factory calibrated before being shipped. When connected to a device that is reading about 5,000 counts per minute (e.g., a frequency counter), the microPulser frequency output can be calibrated to match the reading. The Calibrate CPM menu option works in a similar manner as the Calibrate HV menu option. After the initial prompt, the display then changes to show the current CPM offset of the microPulser. The CPM Offset range is +/- 32. Rotate the CPM Adjust knob, displaying the Offset setting, until the source reads 5,000 CPM (must use a source with accurate count rate).

```
Calibrate CPM
Adj. CPM Pot to set
```

Exiting the Menu
 Pressing the menu button again will return to the default display. The default display will always show the current microPulser settings in units of CPM and millivolts. To exit the menu without cycling through each menu item, hold the menu button down for 2 seconds, or wait for the unit to timeout after 30 seconds.

```
300 CPM
300 mV
```

microPulser Plus Assistant Software

Overview

The microPulser Assistant, available with the microPulser Plus, is a software application to configure the pulses and settings of the unit by using a PC. The software can define custom waveforms for each of the pulse profiles, as well as adjust their polarity, specify pulse amplitude and count rate. The software may be found on the disk accompanying the microPulser Plus and should be installed on a desktop or laptop PC running Microsoft Windows 7 or newer. Run the program from the Start menu or the desktop icon.

When the program first loads, pressing the top left "Connect" button will attempt a USB connection to the microPulser. Should a microPulser not be connected with the supplied USB cable, the status window will display this information.

Upon connecting to the Assistant, the device goes into 'PC MODE', as shown on the display, restricting button and knob use on the front panel. On the PC, a display of the current microPulser settings is shown along with controls to change these settings. The program pulls information from the device and will take roughly ten seconds to update to the status window. Once all settings have been retrieved from, the program is ready to configure the microPulser for user specified settings.

Configuration

The adjustable settings include: Polarity, Speaker, Count Rate, Amplitude, Current Pulse Profile Waveform and customized pulses. The graph displays all three profile waveforms simultaneously in addition to bolding the pulse representing the current profile. If the 'Connect' button has been pressed, the program will continuously attempt to find the microPulser.

Polarity
The selection of either a positive or negative pulse defines the polarity of the pulse output from the microPulser. The profile waveforms are entered using only positive numbers, but a negative polarity selection just inverts the shape. The default selection is a negative pulse shape.

Speaker
The speaker on the microPulser can be controlled from the PC software as well as the unit menu. When enabled, the speaker will produce a click for every pulse. For the two upper Count Rate ranges (500K and 5M), the speaker is permanently disabled, due to clicks being undistinguishable.

Count Rate and Amplitude
There are digital controls for both the Count Rate and Amplitude on the Assistant Software, to be used instead of the unit's four knobs, to control the frequency and height of pulses. The same upper and lower ranges still apply, though a greater degree of accuracy is provided.

Pulse Profile Waveforms
The microPulser supports output of three distinct pulse shapes. These shapes are defined by a string of 16 values which control the analog output. The range of each value is 0 to 255, with the maximum value corresponding to the maximum DAC output. **To produce pulses of the selected amplitudes, at least one profile value must be 255.** Each value controls the output for approximately 1 microsecond. The default profile of 255, 64, 16, 8, 4, 2, 1, 0 defines a typical 4 microsecond detector pulse shape.

It is possible to define a 'double pulse' by repeating a sequence with a few zeroes in between. Any trailing empty slots in the string of 16 values are considered to be '0'. Should more than 16 values be entered, they will not be saved and will have no effect on the waveform.

Apply Settings

Once the new settings have been chosen, the 'Apply' button must be clicked in order to download the new settings to the microPulser. The new settings will take up to 5 seconds to load onto the unit. The new settings will be listed in the status window and visually displayed in the appropriate areas of the program.

Generating On-Demand Pulses

The 'Pulse Now' button sends a command from the PC to the microPulser, which sends a single pulse to the connected instrument. **The specified Count Rate must be zero.** The pulse is sent using the shape of the selected profile at the amplitude shown on the Assistant, thus it does not require the Apply button to be pressed to export these setting to the unit. It acts as a real time command and will send a pulse immediately upon being clicked. A message will appear in the status window to indicate that a pulse has been sent.

Scripting

The Assistant software can run scripts using a text file of command strings, sending a set sequence of commands to the microPulser. The 'Run Script…' button pulls up a file select window to select the text script to run. While running the 'Run Script…' button text is replaced with 'Cancel Script' and the button will end the currently running script. The 'Resume Script' resumes running a script that has used the **pause** command. A full list of commands is given in **Appendix II**.

Update Firmware

To update the microPulser firmware with the Assistant software, select the 'Update Firmware…' option. This will open a file select window. Select the update package from the file system. The microPulser will power down after initiating the transfer. <u>Do not disconnect the microPulser from the USB connection</u>. Turn on the microPulser within a few seconds, and the firmware update will begin.

Permanently Saving Settings

When finished remote control of the microPulser, click the 'Press to Disconnect' button or close the application to disconnect the device. This also saves any changed settings to non-volatile memory on the microPulser.

While the device is disconnected, the only button that will work in the Assistant is the Connect button. Should the device be disconnected improperly, it will remain in PC mode until the thirty second timeout has taken effect.

Remote Host Protocol

Overview

The Bladewerx microPulser Remote Host Protocol (uPRHP) allows a user to control and edit parameters, remotely over a USB link. It is an ASCII protocol and is command based.

Configuration
Communications default to 19200 bps (Baud), 8 data, one stop bit, no parity. The microPulser does not echo received characters.

For testing purposes, the user may connect the microPulser directly to a PC and set up a HyperTerminal (or alternate serial communications application) session configured as described above. Make sure to turn on Local Echo.

Commands
A session begins by sending a Return/Newline ("\r\n" or 0x0a, 0x0d) and receiving a '>' prompt. The microPulser enters a Host Mode where the front panel controls on the microPulser are disabled. The Host Mode ends when the microPulser receives a **Quit** command. The front panel controls will be enabled upon receiving the Quit command. A full list of commands is given in **Appendix II**.

Specifications

Ranges
- § Count Rate: 0 – 3,000,000 CPM
- § Amplitude: 0 – 3,000 mV (3.0 V)

Physical
- § Battery powered: 8.4 V Lithium-Ion, 6.2 A-h
- § Weight: 3.84 lbs (1.74 kg)
- § Dimensions: (W x H x D) 6.5 x 11 x 4 in.
- § Temperature: 0 to 122° F (-17° to 50° C)

Commands

Below are the commands that can be used either in the Remote Host Protocol or in scripts. Only the first 4 characters of commands are matched, so the 'vers' command is the same as the 'version' command.

Command	Description

version	Requests the main processor firmware version
	`>version`
	`microPulser v2.02`

slave	Requests the pulse processor firmware version
	`>slave`
	`uSlave v1.01`

battery	Requests the battery voltage
	`>battery`
	`7831 mV`

voltage	Requests the detector bias voltage generated by the attached instrument. >voltage 653 V
rate	Sets/requests the count rate (0 – 3000000 cpm) >rate 2000 cpm >rate=4000 4000 cpm
amplitude	Sets/requests the pulse amplitude (1 – 3000 mV) >amplitude 40 mV >amplitude=150 150 mV
pulse	Generate a single pulse now
pause	Pauses the execution of a running script.

config	Sets/requests the bit-mapped pulse waveform configuration.
	
	    bits 15-14 reserved -- must be 0
	    bit 13 pulse polarity: 0 = negative, 1 = positive
	    bit 12 speaker control: 0 = off, 1 = on
	    bits 11-9 reserved -- must be 0
	    bit 7-6 pulse mode: 0 = normal, 1 = x10, 2 = x100
	    bits 5-2 reserved -- must be 0
	    bits 1-0 waveform to use: 0, 1, or 2

waveform**N**	Sets/requests the Nth pulse waveform values (up to 16 values) where N = 1, 2, 3. Must finish with '0'. >wave1 255,229,177,107,59,32,16,8,0,0,0,0,0,0,0,0 >wave1=220,255,188,92,28,12,6,2 >
echo	Sets the echo mode. echo=0 means command prompts are returned echo=1 sets 'macro mode' where only Set commands are accepted and the instrument sends no responses.
quit	Releases remote control and returns function to front panel controls. Writes settings to non-volatile memory.