



User Manual **PCX-7401**

Pulsed Current Source



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Safety

- Do not open the cover of PCX-7401. There are no user-serviceable parts inside. Opening the cover exposes you to shock and voids the factory warranty.
- Do not install, handle, or remove the output cables or laser diode while the PCX-7401 is operating. Allow at least 10 minutes after power-down before handling the output cable or laser diode.
- Do not use this device in a manner not specified by the manufacturer.
- Allow sufficient space around this device for air circulation. Cooling air enters the front of the chassis and exits the back of the chassis.
- Do not use where liquids are present or in corrosive environments. Clean this instrument by wiping with a dry or damp cloth.

WARNING

Risk of lethal electric shock. Do not open the cabinet of this device. Do not touch the output or laser diode while it is operating. This device produces LETHAL levels of electric current, both inside its cabinet and at its output.

DO NOT OPERATE THIS DEVICE UNLESS ANOTHER PERSON, CAPABLE OF RENDERING FIRST AID OR RESUSCITATION IS PRESENT.

SAFE AND PROPER OPERATION OF THIS DEVICE IS THE RESPONSIBILITY OF THE USER.

Berkeley Nucleonics Corporation (BNC) provides information on its products and associated hazards, but it assumes no responsibility for the after-sale operation and safety practices.

Quick Start Guide

❖ Safety

Follow the safety guidelines on previous page. DO NOT PROCEED WITHOUT UNDERSTANDING AND OBSERVING THESE GUIDELINES.

❖ Requirements

Make sure the PCX-7401 is:

- connected with the proper cables and termination impedance
- powered up
- Has all faults cleared
- Has the rear enable and keyswitch enabled. The proper icons will be green when enabled.

❖ Controlling the PCX-7401 from the front panel

1. Disable the PCX-7401

- The **Enable** button on the front panel glows green if the PCX-7401 is enabled. Press the button to disable. The green light goes out.

2. Set the output current.

- Press the **Output** button on the touch screen.
- Press the encoder knob to set the resolution.
- Turn the encoder knob to set the output current from 0.000 A to 3.000 A.
- Press the **Done** button.

3. Set the bias current.

- Press the **Bias** button on the touch screen.
- Press the encoder knob to set the resolution.
- Turn the encoder knob to set the bias current from 0 .000 A to 0.550 A.
- Press the **Done** button.

4. Set the trigger to internal, external, or single shot, as needed.

- Press the **Trigger** button on the touch screen.
- Press the **Internal** or **External** or **Single Shot** button to select the trigger.

5. Set the internal pulse trigger frequency

- Press the **Frequency** icon on the touch screen.
- Press the encoder knob to set the resolution.
- Turn the encoder knob to set the frequency.
- Press the **Done** icon.

6. Set the duty cycle

- Press the **Duty Cycle** icon on the touch screen.
- Press the encoder knob to set the resolution.
- Turn the encoder knob to set the duty cycle.
- Press the **Done** icon.

7. Enable the PCX-7401

- Press the **Enable** button on the front panel. The button lights green.

❖ Controlling the PCX-7401 from a computer

1. Disable the PCX-7401

- Send the command "OUTPUT:DISABLE".

2. Set the trigger to internal, external, or single shot, as needed.

- Send the command "TRIG:INTERNAL", "TRIG:EXTERNAL", or "TRIG:SINGLESHOT".

3. Set the internal pulse trigger frequency

- Send the command "TRIG:INT:FREQ n", where n = [5 to 1000000].
- Units are hertz.

4. Set the pulse duty cycle

- Send the command "TRIG:INT:MAIN:DUTYCYCLE n", where n = [1.00 to 99.00].
- Units are percent.

5. Set the output current

- Send the command "MAIN:CURRENT:SETPOINT n", where n = [0 to 3000].
- Units are milliamperes.

6. Set the bias current.

- Send the command "BIAS:CURRENT:SETPOINT n", where n = [0 to 550].
- Units are milliamperes.

7. Enable the PCX-7401

- Send the command "OUTPUT:ENABLE".

Introduction

❖ Description

The PCX-7401 is a precision pulsed current source for driving laser diodes, bars, and arrays. It delivers current pulses variable from 0.000 A to 3.000 A, with a bias current from 0.000 A to 0.550 A. An internal trigger provides pulse repetition frequencies from 5 Hz to 1.000 MHz and duty cycles of 1.00 % to 99.00 %.

The internal Single-shot pulse is adjustable in pulse widths ranging from 200 ns to 1.000000000 second. The single shot is easily enabled using the **Enable** button on the front panel.

The system can be fully adjusted by using the color touch screen or by using a computer interface. System adjustments include the main output current amplitude, bias current amplitude, main pulse width, trigger source, trigger frequency, duty cycle, and single shot pulse width.

The bias feature allows the PCX-7401 to deliver the current pulse in two steps. The first step—the bias DC—is turned on before the intended trigger time, and is adjusted to supply enough current to set the laser diode just below the trigger point of the laser diode. This minimizes the laser diode's response time to the main pulse.

The second step—the main pulse—adds to the current from the bias pulse and triggers the diode at the intended time. The main pulse amplitude is variable from 0.000 A to 3.000 A. Its duty cycle is variable from 1.00 % to 99.00 %.

The total current output pulse is always the sum of the bias current and the main pulse current. Consider both the bias output current and the main output current when setting the total output current.

The PCX-7401 can be triggered internally or externally, and readily synchronized with other devices via a Sync output signal on the rear panel. The input termination impedance for the external trigger is selectable for either 50 Ω or 10000 Ω . The Sync signal amplitude varies between 0 and +5.0V. The rising edge corresponds to the rising edge of the main output current pulse. The delay between the sync output signal and the main output current pulse is ~100 ns, measured from rising edge to rising edge.

The PCX-7401 has the ability to store four unique user settings, which include all system configurations for operation of the PCX-7401.

❖ Panel Layout

All features of the front touch screen and the rear panel are labeled. Their functions are covered in the next sections.



❖ Front Panel Features

Local Button Mode

Pressing the **LOCAL** button returns the PCX-7401 to front panel control from computer control. The Local button is lit when the computer is in control.

Enable Button Mode

The **ENABLE** button selects whether the PCX-7401 output current is enabled or disabled. The Enable button is lit when the unit is enabled.

Touch Screen

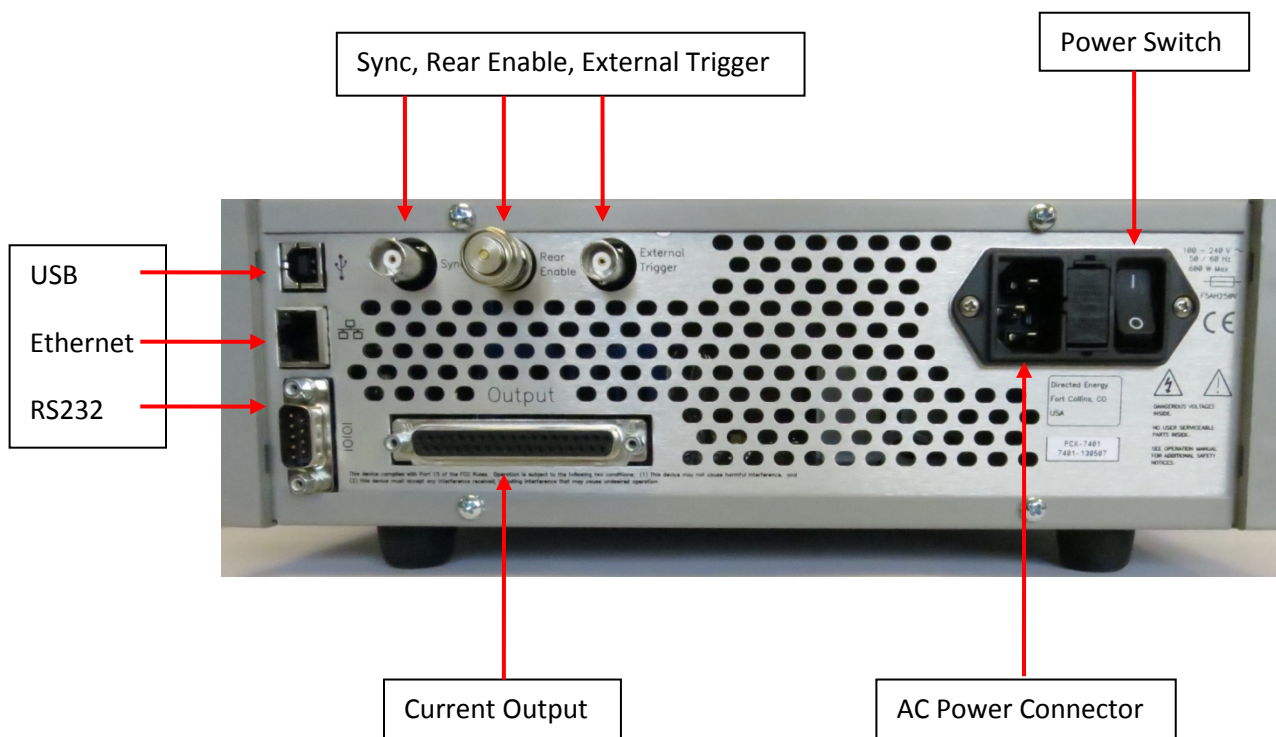
The touch screen provides a graphical user interface and touch control to adjust all functions of the PCX-7401.

Encoder Knob

Turn the encoder knob to change a value for functions of the PCX-7401. Push it to cycle through the resolutions (increments of value change).

Keyswitch

The Keyswitch ON allows the PCX-7401 output current to be enabled. OFF disables the PCX-7401.



❖ Rear Panel Features

Current Output

A socket that accepts the factory-supplied output cable, and is the connection for the system generated current pulses. **DO NOT TOUCH** any part of this cable while the PCX-7401 is powered up. Please review the Safety section.

Note: Absence of a properly installed output cable disables the output and creates an output enable fault.

Sync Output

Synchronization pulses for external devices are available at this BNC connector. The sync pulse corresponds to the leading edge of the output current pulse.

Rear Enable

This connector accepts either an external dry-contact closure or the factory-supplied shorting BNC plug. Closed contacts or use of the shorting plug enables the output. Open contacts or removal of the shorting plug disables the output and creates a rear enable fault.

USB Connector

Use this connector to communicate with an external computer with a USB cable.

Ethernet Connector

Use this connector to communicate with an external computer through an Ethernet network.

RS232 Connector

Use this connector to communicate with an external computer via a RS232 cable.

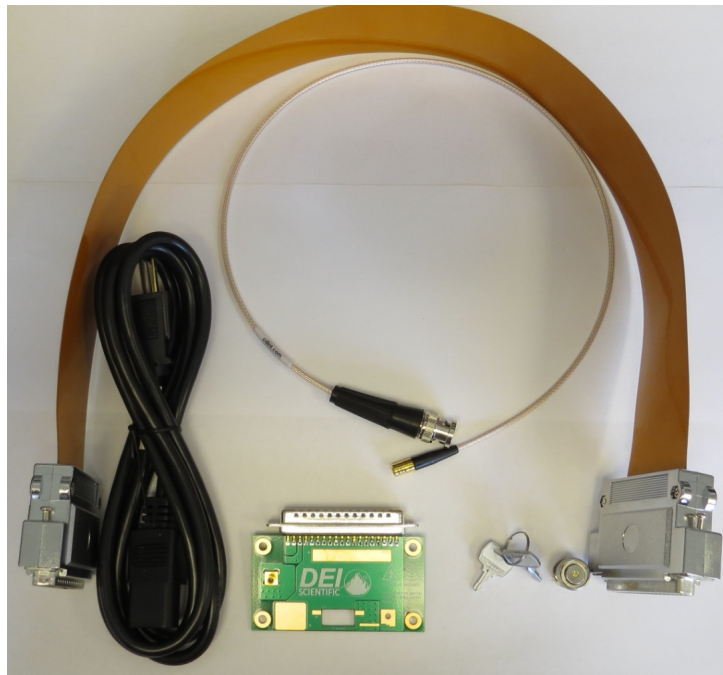
Power Cord Connector

The power cord connector accepts a standard grounding equipment power cord, connector type NEMA C-14.

On-Off Power Switch

This switches powers the PCX-7401 on and off.

❖ Accessories Included

**AC Power Cord**

Factory-supplied standard computer-style power cord, with a NEMA C14 and a NEMA 5-15R connectors.

Current/Voltage Monitor Cable

This factory-supplied cable (PCA-9550) connects the laser output PCBA to a monitoring instrument, such as an oscilloscope.

Shorting BNC Plug

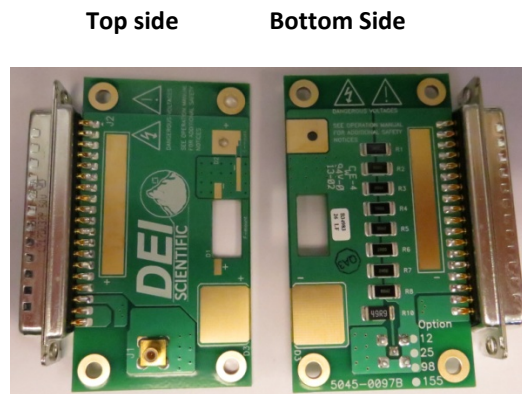
The factory supplied shorting BNC plug (PCA-9410) attaches to the Rear Enable BNC connector on the rear panel. It takes the place of closed contacts and enables the output.

Keyswitch Keys

The keys access the front panel on-off keyswitch. The output is enabled when the keyswitch is in the ON position.

Laser Output PCBA

This factory-supplied PCB assembly provides a connection to the laser. Use this assembly to monitor the system's output current and voltage. On the laser output PCBA below, the current monitor (J1) has a ratio of 125 mV/A, with a 50 Ω termination.



Output Strip Line Cable

This factory-supplied cable that provides output current pulses to external devices. A DB37 male connector fits the socket on the rear panel of the PCX-7401; a DB37 female connector is on the user end.

Output Cable Connector Pinouts

The male DB-37 connector interfaces with the instrument and has the following pinout:

- Pins 1 through 16: positive (+) output
- Pins 20 through 35: negative (–) output
- Pins 17, 36, 37: no connection
- Pins 18 and 19: connected together to satisfy interlock requirement

The female DB-37 connector interfaces with the customer's laser diode PC board and has the following pinout:

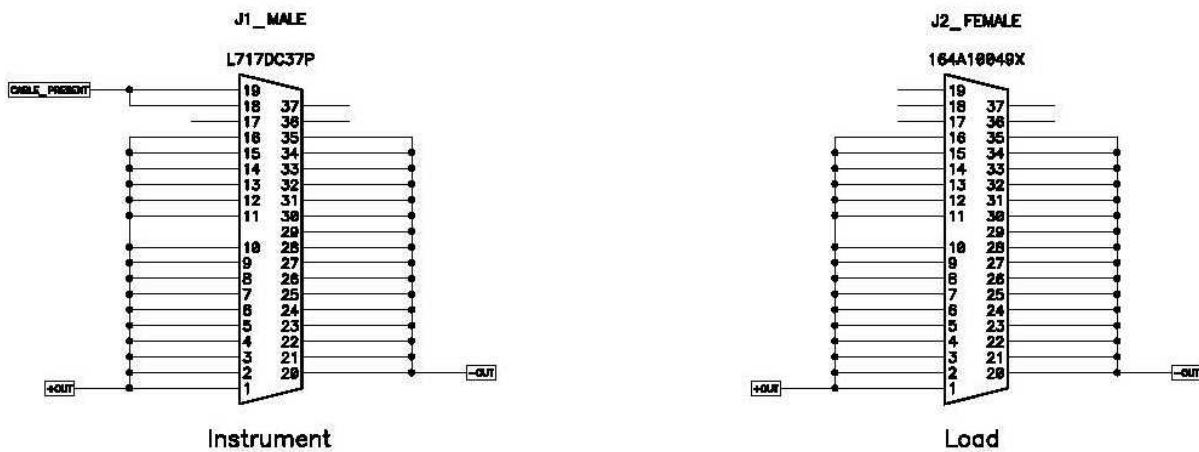
- Pins 1 through 16: positive (+) connection (to laser diode anode)
- Pins 20 through 35: negative (–) connection (to laser diode cathode)
- Pins 17, 18, 19, 36, 37: no connection

Interlock

The BNC instrument requires that **pins 18 and 19** of the **male DB-37** be connected together to satisfy an interlock that determines whether the output cable is present. If this connection is not detected the instrument will not be enabled.

Output Cable Diagram

The diagram below depicts the male and female connectors and their pinouts.



Operation

❖ Setup

NOTE: Any change to a command adjustment requires <200ms (typically) to complete.

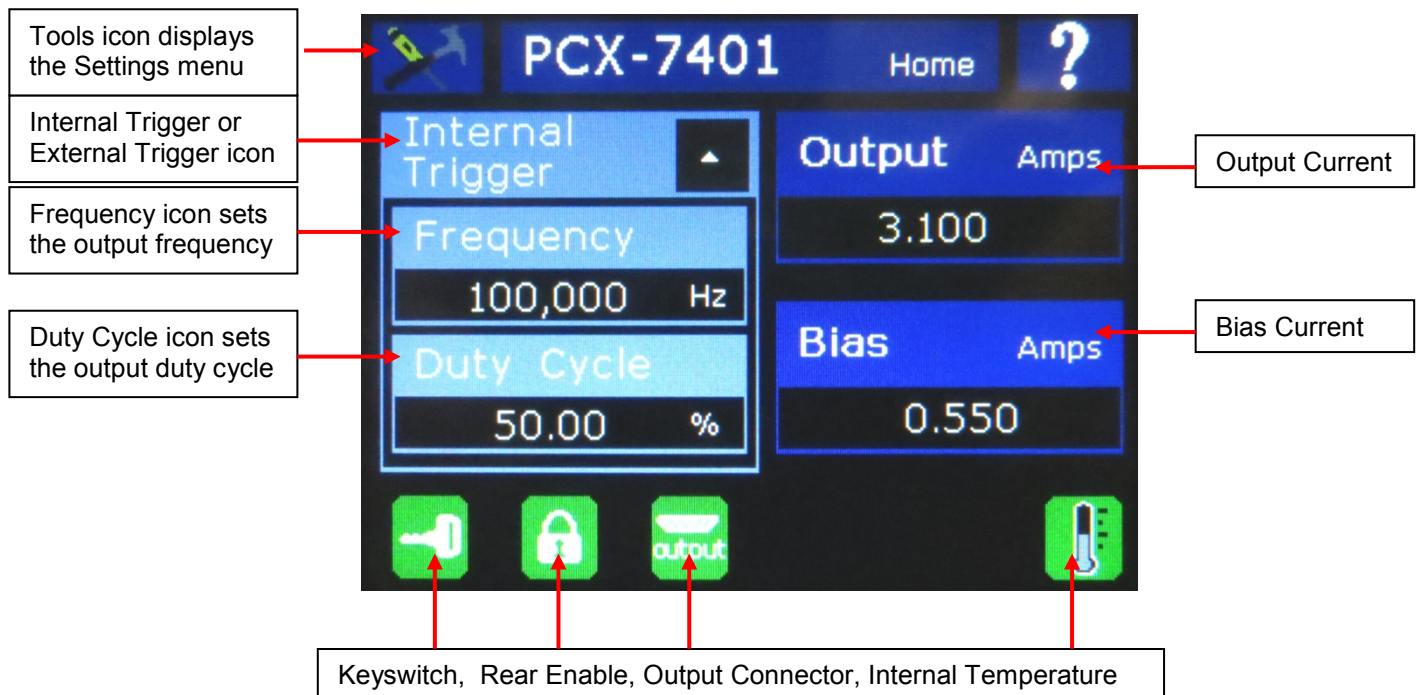
1. Make sure the PCX-7401 has been OFF for at least ten minutes.
2. Make sure the diode connection is in the correct polarity. If necessary review the output cable for polarity specifications.
3. Make the other connections as necessary: External Trigger, External Bias, Sync, Rear Enable, or the connection to the computer.
4. Connect the power cable.

Power Up

Turn on the power switch. The instrument powers up in about 3 seconds.

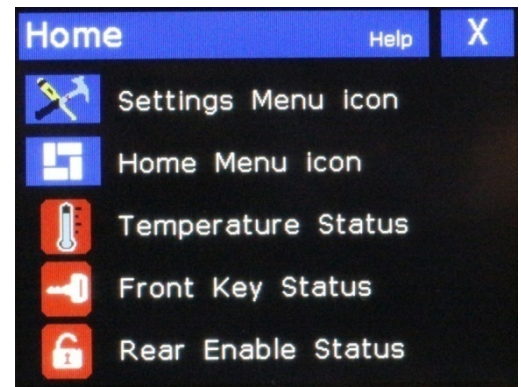
The instrument plays a tune and displays BNC information.

After a few seconds, the PCX-7401 displays the **Home** screen.



❖ Home Help Screen

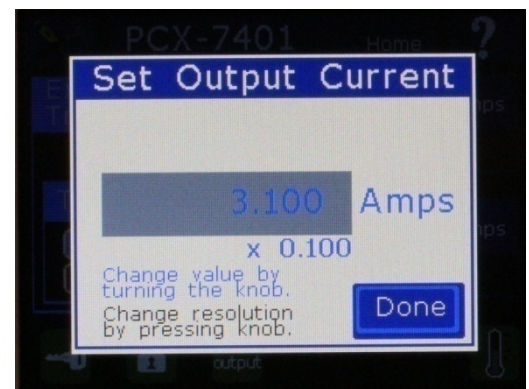
1. On the Home screen, press the “?”, question mark icon.
2. The **Help** screen appears. This screen describes the icons used in the PCX-7401.



❖ Set the Output Current

MAIN:CURRENT:SETPOINT?
MAIN:CURRENT:SETPOINT n (in mA)

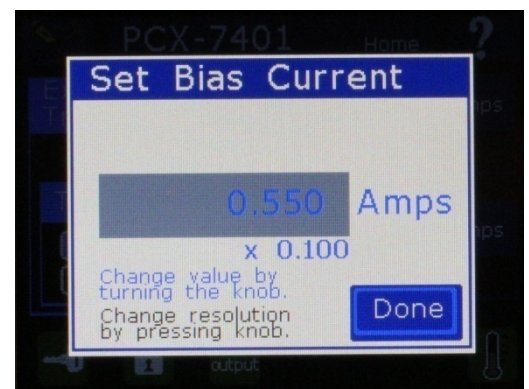
1. On the Home screen, press the **Output** button. The **Set Output Current** screen appears.
2. Press the encoder knob to select a resolution: x0.001, x0.010, x0.100, or x1.000.
3. Turn the encoder knob to change the output current: 0.000 A to 3.000 A.
4. Press the **Done** button.



❖ Set the Bias Current

BIAS:CURRENT:SETPOINT?
BIAS:CURRENT:SETPOINT n (in mA)

1. On the Home screen, press the **Bias** button. The **Set Bias Current** screen appears.
2. Press the encoder knob to select a resolution: x0.001, x0.010, x0.100, or x1.000.
3. Turn the encoder knob to change the output current: 0.000 A to 0.550 A.
4. Press the **Done** button.



❖ Set the Trigger Source

TRIG:INTERNAL
TRIG:EXTERNAL

Note: The PCX-7401 will default to Internal Trigger mode during initial power up.

1. From the Home screen, press the **Trigger** icon. The **Select Trigger** screen appears.
2. Press the icon for the desired trigger mode.
 - a. For **Internal Trigger** the **Home** screen appears. Set the frequency.
 - b. For **External Trigger** the **Set Termination** screen appears. Set the Termination if necessary.

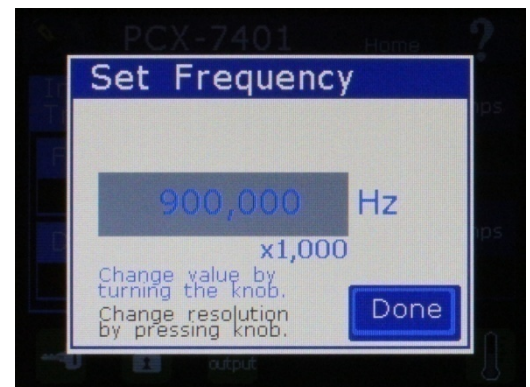


❖ Set the Frequency

TRIG:INT:FREQ?
TRIG:INT:FREQ n

1. From the Home screen, press the **Set Frequency** icon. The **Set Frequency** screen appears.
2. Press the encoder knob to change the resolution:

<u>Frequency</u>	<u>Resolution</u>
5 Hz to 995 Hz	5 Hz
1.0 kHz to 49.9 kHz	100 Hz
50 kHz to 1.000 MHz	1000 Hz

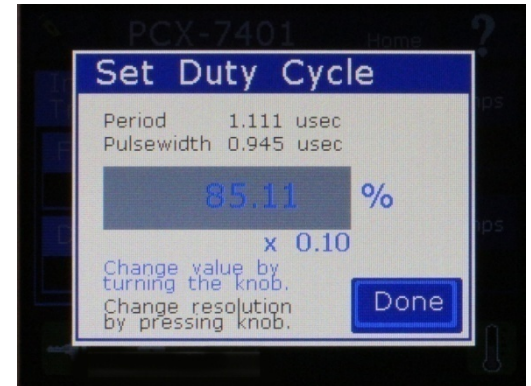


3. Turn the encoder knob to change the frequency to a value from 5 Hz to 1000000 Hz.
4. Press the **Done** icon. The **Home** screen reappears.

❖ Set the Duty Cycle

DUTYCYCLE?
DUTYCYCLE n

1. On the **Home** screen, press the **Duty Cycle** icon. The **Set Duty Cycle** screen appears.
2. Press the encoder knob to select a resolution: x0.01, x0.10, x1.00, or x10.00.
3. Turn the encoder knob to change the duty cycle: 1.00 % to 99.00 %.
4. Press the **Done** icon.



❖ Set the Single Shot

SINGLE:SHOT?
SINGLE:SHOT n

1. On the Home screen, press the **Internal Trigger** icon. The **Select Trigger** screen appears.
2. Press the **Single Shot** box.
3. The **Home** screen appears in single shot control.
4. To change the single shot pulse width, press the **Pulsewidth** icon.



5. The **Set Pulsewidth** screen appears.
6. Press the encoder knob to select a resolution (incremental mode):
200ns to 5,000ns is 100ns
6μs to 1,000ms is 1μs
7. Turn the encoder knob to change the single shot from 200 ns to 1.0000000s.
8. Press the **Done** icon.
9. To perform a single shot pulse, press the **Enable** button. This will produce a pulse for the programmed pulse width.
NOTE: In single-shot mode, the bias is a fixed pulsewidth before and after the main pulse.



10. To change back to internal or external trigger control, press the **Single Shot Trigger** box.
11. The **Select Trigger** screen appears. Press the **Internal or External Trigger** box.
12. The home screen appears in internal or external trigger control.



❖ Settings Menu

1. On the Home screen, press the **Tools** icon.
2. The **Settings** screen appears.

This screen allows the user to view the system settings and change settings as necessary.



❖ View Information About the PCX-7401

*IDN?

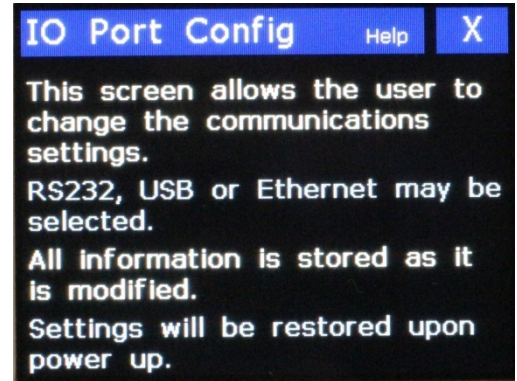
1. On the **Home** screen, press the **Tools** icon. The **Settings** screen appears.
2. Press the **About** icon. The **About** screen appears.
3. View the model number, serial number, calibration date, and firmware revision level.
4. Press the **Home** icon to return to the **Settings** screen.
5. Press the **Home** icon to return to the **Home** screen.



❖ View the Communication Settings

1. On the **Home** screen, press the **Tools** icon. The **Settings** screen appears.
2. Press the **COM Settings** icon. The **PCX-7401 COM** screen appears.
3. To view the communication help screen, press the ? (question mark) icon.
4. Press the **X** to return to the **PCX-7401 COM** screen.
5. Press the icon for the desired communication port.

- a. If **RS232** is selected, change the baud rate to appropriate setting.
The screen reports the number of data bits, stop bits, and the parity.



- b. If **USB** is selected, change the baud rate to appropriate setting.
The screen reports the number of data bits, stop bit, and the parity.



- c. If **Ethernet** is selected, choose **DHCP** or **STATIC** for IP address.

- For **DHCP**, press **DHCP** then press the **Update Hardware** icon.
To reset the **DHCP** address press the **Settings** icon and press the **Default DHCP Settings**, then press **Save and Exit** icon, and then press **Update Hardware** icon.



- For Static, press **STATIC**, then press the **Settings** icon to make the desired entries for IP, Gateway, and Netmask fields.

Ethernet Configuration

MAC	00:20:4A:D3:FF:F0
IP	000.000.000.000
Gateway	000.000.000.000
Netmask	255.255.255.255

- Press the **IP** box to set the IP address, the **IP Address Config** screen appears. Press each field setting and use the encoder knob to change settings. Press the **Save and Exit** icon,

IP Address Config

Previous Setting: 000.000.000.000

000 . 000 . 000 . 000

To update a value, touch it and then use the knob. (Press knob to add 50)

- Press the **Gateway** box to set the Gateway, the **Gateway Configuration** screen appears. Press each field setting and use the encoder knob to change settings. Press the **Save and Exit** icon,

Gateway Configuration

Previous Setting: 000.000.000.000

000 . 000 . 000 . 000

To update a value, touch it and then use the knob. (Press knob to add 50)

- Press the **Netmask** box to set the Netmask, the **Netmask Configuration** screen appears. Press each field setting and use the encoder knob to change settings. Press the **Save and Exit** icon,

Netmask Configuration

Previous Setting: 255.255.255.255

255 . 255 . 255 . 255

To update a value, touch it and then use the knob. (Press knob to add 50)

- Once all static settings are completed then press the **Save and Exit** icon. Then press the **Update Hardware** icon.

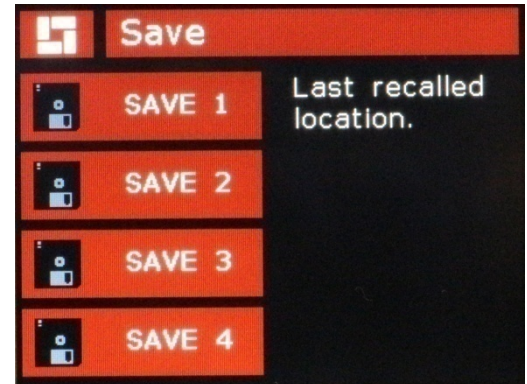
6. Press the home icon to return to the **Home** screen.

❖ Save Settings

*SAVE n

1. On the Home screen, press the **Tools** icon. The **Settings** screen appears.
2. Press the **Save Settings** icon. The **Save** screen appears.
3. Press the icon for one of the four locations to which you want to save the settings.

NOTE: Saving to a location overwrites any data at that location.

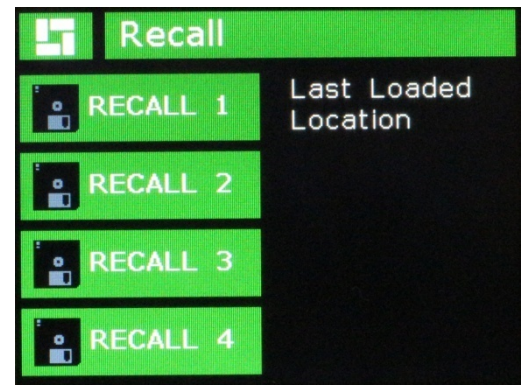


4. The save takes ~10 seconds. Press the **Home** icon to return to the **Home** screen.

❖ Recall Settings

*RECALL n

1. On the **Home** screen, press the **Tools** icon. The **Settings** screen appears.
2. Press the **Recall Settings** icon. The **Recall** screen appears.
3. Press the icon for one of the four locations from which you want to recall the settings.
4. The recall takes ~10 seconds. Press the **Home** icon to return to the **Home** screen.



❖ Power Down

OUTPUT:DISABLE

1. Disable the unit by pressing the **Enable** button.
2. Turn the **Keyswitch OFF**.
3. Turn the power **OFF** by using the power switch on the rear of the instrument.

Command Set

The Command Set consists of all the commands and queries that the PCX-7401 supports via remote computer control. Commands and queries must be in all capital letters. Commands and queries that require data, denoted as *n*, must have a space between the command and the data.

The PCX-7401 expects “\n” to be the end line character of commands and queries. The responses to the user’s computer are also terminated with “\n”. For every command sent to the PCX-7401, a response will be sent back to the user from the PCX-7401. The user’s software must wait for a response before sending another command to avoid an overflow of the PCX-7401 receive buffer.

NOTE: Any change to a command adjustment typically needs <200 ms to complete.

In the examples, the command or query is in black; the response is in blue italics.

*LIST?

Lists all commands and queries supported by the PCX-7401. Example:

```
*LIST?
*IDN?
*SAVE n :: n=[1 ... 5]
*RECALL n :: n=[1 ... 5]
*LIST?
OUTPUT?
OUTPUT:ENABLE
OUTPUT:DISABLE
TRIG?
TRIG:INTERNAL
TRIG:EXTERNAL
TRIG:EXT:TERM?
TRIG:EXT:TERM
TRIG:INT:FREQ?
TRIG:INT:FREQ n :: n=[5 ... 1,000,000] Hz
TRIG:INT:MAIN:DUTYCYCLE?
TRIG:INT:MAIN:DUTYCYCLE nn.nn :: n=[1.00 ... 99.00] %
TRIG:SINGLESHOT
TRIG:SS:PULSEWIDTH n
MAIN:CURRENT:SETPOINT?
MAIN:CURRENT:SETPOINT nnnn
BIAS:CURRENT:SETPOINT?
BIAS:CURRENT:SETPOINT nnnn :: n=[0 ... 0.550] mAmps
STATUS:KEYSWITCH?
STATUS:REAR:ENABLE?
STATUS:OUTPUT:CABLE?
```

TEMP:HEATSINK?
FAULT?
FAULT:CLEAR:ALL

***IDN?**

Abbreviation for identity; returns the manufacturer's name, unit model number, serial number, firmware revision, and manufacture date. Example:

**IDN?*
BNC, PCX-7401, 2012-121131, FW.002, 11.27.2012

***SAVE n**

Saves the current configuration to non-volatile memory. The value of n must be between 1 and 5. Example:

**SAVE 3*
Saved Memory Location 3

***RECALL n**

Recalls saved configurations. The value of n must be between 1 and 5. Example:

**RECALL 2*
Recall Memory Location 2

OUTPUT?

Returns the state of the output (Enabled or Disabled). Example:

OUTPUT?
Disabled

OUTPUT:ENABLE

Enables the output. Performs the same function as pressing the front-panel ENABLE icon. Example:

OUTPUT:ENABLE
OUTPUT:ENABLE

OUTPUT:DISABLE

Disables the output. Performs the same function as pressing the front-panel ENABLE icon. Example:

OUTPUT:DISABLE
OUTPUT:DISABLE

TRIG?

Returns the trigger type (Internal, External, or Single Shot). Example:

TRIG?
INTERNAL

TRIG:INTERNAL, TRIG:EXTERNAL, or TRIG:SINGLESHOT

Sets the trigger type. The trigger types are Internal, External, or Single Shot. Example:

TRIG:INTERNAL	response is <i>TRIG:INTERNAL</i>
TRIG:EXTERNAL	response is <i>TRIG:EXTERNAL</i>
TRIG:SINGLESHOT	response is <i>TRIG:SINGLESHOT</i>

TRIG:EXT:TERM?

Returns the external trigger termination value. Example:

TRIG:EXT:TERM?
50 Ohms

TRIG:EXT:TERM n

Sets the external trigger termination of 50 ohms or 10k ohms, use n value of 50 or 10. Example:

TRIG:EXT:TERM 10
TRIG:EXT:TERM 10k

TRIG:INT:FREQ?

Returns the trigger frequency in hertz. Example:

TRIG:INT:FREQ?
1000000 Hz

TRIG:INT:FREQ n

Sets the trigger frequency in hertz. The value of n must be between 5 and 1000000.

Example:

TRIG:INT:FREQ 24000
TRIG:INT:FREQ 24000

<u>Frequency</u>	<u>Resolution</u>
5 Hz to 995 Hz	5 Hz
1.0 kHz to 49.9 kHz	100 Hz
50 kHz to 1.000 MHz	1000 Hz

TRIG:INT:MAIN:DUTYCYCLE?

Returns the duty cycle of the pulse in percent. Example:

TRIG:INT:MAIN:DUTYCYCLE?
28.10 %

TRIG:INT:MAIN:DUTYCYCLE nn.nn

Sets the duty cycle of the pulse in percent. The value of n.nn must have two decimal places and be from 1.00 to 99.00. Example:

TRIG:INT:MAIN:DUTYCYCLE 28.10

TRIG:INT:MAIN:DUTYCYCLE 28.10

TRIG:SS:PULSEWIDTH?

Returns the Single Shot pulse width in nanoseconds. Example:

If the pulse width is 1100 ns then the response will be:

TRIG:SS:PULSEWIDTH?

1.100 μ s

If the pulse width is 500001100 ns then the response will be:

TRIG:SS:PULSEWIDTH?

500.001100 ms

TRIG:SS:PULSEWIDTH n

Sets the Single Shot pulse width always in nanoseconds. The value of n must be from 200 ns to 1,000,000,000 ns in 100 ns increments. Example:

TRIG:SS:PULSEWIDTH 180000000

TRIG:SS:PULSEWIDTH 180000000

Note: To enable a single shot, send an OUTPUT:ENABLE command. The computer must have a delay of 2000 ms before sending any other command to the system.

MAIN:CURRENT:SETPOINT?

Returns the Main Output Current in amperes. Example:

MAIN:CURRENT:SETPOINT?

1.100 Amps

MAIN:CURRENT:SETPOINT n

Sets the Main Output Current in mA. The value of n must be from 0 mA to 3100 mA. Example:

MAIN:CURRENT:SETPOINT 1100

MAIN:CURRENT:SETPOINT 1100

BIAS:CURRENT:SETPOINT?

Returns the Bias Output Current in amperes. Example:

BIAS:CURRENT:SETPOINT?

0.110 Amps

BIAS:CURRENT:SETPOINT n

Sets the Bias Output Current in mA. The value of n must be from 0 mA to 550 mA. Example:

BIAS:CURRENT:SETPOINT 110

BIAS:CURRENT:SETPOINT 110

STATUS:KEYSWITCH?

Returns the state of the keyswitch, (Enabled, Disabled). Example:

STATUS:KEYSWITCH?

Enabled

STATUS:REAR:ENABLE?

Returns the state of the rear enable connector, (Enabled, Disabled). Example:

STATUS:REAR:ENABLE?

Enabled

STATUS:OUTPUT:CABLE?

Returns the state of the current output cable connector, (Connected, Not Connected). Example:

STATUS:OUTPUT:CABLE?

Connected

TEMP:HEATSINK?

Returns the temperature of the internal heat-sink, value in degrees centigrade. The typical temperature is 45°C. Example:

TEMP:HEATSINK?

50 C

Warranty and Service

❖ Warranty

Berkeley Nucleonics Corporation (BNC) warrants equipment it manufactures to be free from defects in materials and factory workmanship under conditions of normal use, and agrees to repair or replace any standard product that fails to perform as specified within ninety days (90) after date of shipment to the original owner. OEM, modified, and custom products are warranted, as stated above, for ninety (90) days from date of shipment to original owner. This Warranty shall not apply to any product that has been:

- I. Repaired, worked on, or altered by persons unauthorized by BNC in such a manner as to injure, in BNC's sole judgment, the performance, stability, or reliability of the product;
- II. Subjected the product to misuse, neglect, or accident; or
- III. Connected, installed, adjusted, or used otherwise than in accordance with instructions furnished by BNC.

BNC reserves the right to make any changes in the design or construction of its products at any time, without incurring any obligation to make any change whatever in units previously delivered.

BNC's sole obligation, and buyer's sole remedies, under this agreement shall be limited to a refund of the purchase price, or at BNC's sole discretion, to the repair or replacement of products in kind that prove, to BNC's satisfaction, to be defective, when returned to the BNC factory, transportation prepaid by the buyer, within the warranty period. BNC shall in no way be liable for damages consequential or incidental to defects in its products, for failure of delivery in whole or in part, for injuries resulting from its use, or for any other cause.

Returns must be preauthorized and accompanied by a BNC return authorization number.

The foregoing states the entire warranty extended by BNC, and is given and accepted in lieu of 1) any and all other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for any particular purpose and 2) any obligation, liability, right, claim or remedy in contract or tort.

❖ **Factory Service and Support**

For more information about your instrument or for an operation problem, please contact the factory:

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2955 Kerner Blvd., San Rafael
CA 94901
(800) 234-7858
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