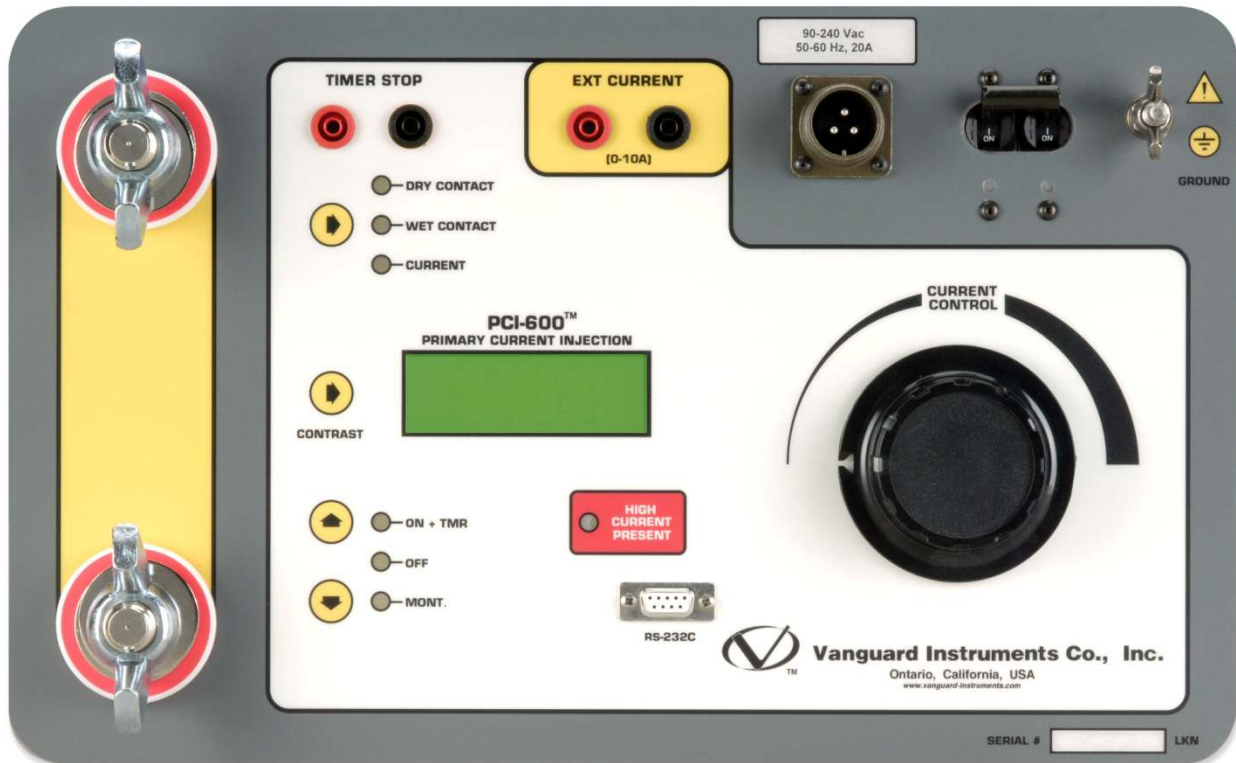


# PCI-600 PRIMARY CURRENT INJECTION DEVICE

## USER'S MANUAL



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## **SAFETY SUMMARY**

### **FOLLOW EXACT OPERATING PROCEDURES**

Any deviation from the procedures described in this User's Manual may create one or more safety hazards, may damage the PCI-600, or cause errors in the test results. Vanguard Instruments Company, Inc. assumes no liability for unsafe or improper use of the PCI-600.

All safety precautions provided in this manual must be observed during all phases of testing including test preparation, test lead connection, actual testing, and test lead disconnection.

### **SAFETY WARNINGS AND CAUTIONS**

Only trained operators shall use this device. **All circuits under test shall be off-line and fully isolated.**

### **DO NOT MODIFY TEST EQUIPMENT**

To avoid the risk of introducing additional or unknown hazards, do not install substitute parts or perform any unauthorized modification to any PCI-600 test unit. To ensure that all designed safety features are maintained, it is highly recommended that repairs be performed only by Vanguard Instruments Company factory personnel or by an authorized repair service provider. Unauthorized modifications can cause safety hazards and will void the manufacturer's warranty.

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## CONVENTIONS USED IN THIS DOCUMENT

This document uses the following conventions:

- A key, switch, input, or knob on the PCI-600 is indicated as **[KEY]**, **[SWITCH]**, **[INPUT]**, **[KNOB]**.
- Menu options are referenced as *(MENU OPTION)*.
- PCI-600 LCD screen output is shown as:

```
1. OPTION 1
2. OPTION 2
3. OPTION 3
4. OPTION 4
```

- Warning messages are indicated as:



- Important notes are indicated as:



## 1.0 INTRODUCTION

### 1.1 General Description and Features

The PCI-600 is a programmable AC high-current source designed specifically for utility-substation applications. This device is well suited for primary injection testing of protective relays. This versatile device can also be used for testing thermal, magnetic, and solid-state motor-protection relays and molded-case circuit-breakers, as well as any application that requires a high-current source.

#### **Built-in Timer**

The PCI-600's built-in timer can test the time-delay characteristics of protection relays and molded-case circuit-breakers. Once the test is initiated, the current source and the timer are automatically turned on at the next zero-crossing point of the AC. The timer stops when the PCI-600 input detects a change in the dry contact or voltage input, or detects the removal of the test current. The test results are then displayed in milli-seconds and fractions of a cycle(s) on the unit's back-lit LCD screen (20 characters by 4 lines).

#### **Current Source**

Test currents, ranging from 10 to 600 amperes, can be set by using the rotary dial knob on the control panel. The test current is then measured, and the results are displayed on the LCD screen. When the PCI-600 is used as a current source, the current-on time (duration of current flow) is displayed on the LCD screen.

#### **External Current Input**

The PCI-600 also has an external-current input (0 – 10 A). Both the internal current source amplitude and the external current source measurement readings can be viewed at the same time.

## 1.2 PCI-600 Technical Specifications

**Table 1. PCI-600 Technical Specifications**

<b>TYPE</b>	100 - 600 Amp current source
<b>PHYSICAL SPECIFICATIONS</b>	Dimensions: 17"W x 12.5"H x 10.5"D (42.6 cm x 32.0 cm x 27.0 cm); Weight: 46 lbs (21 kg)
<b>INPUT POWER</b>	100 – 120 Vac or 200 – 240 Vac (factory pre-set), 50/60 Hz
<b>INTERNAL METER RANGE</b>	100 mA – 1000 A; Accuracy: 1% of reading ±20 mA
<b>MEASUREMENT METHOD</b>	Isolated CT
<b>EXTERNAL METER RANGE</b>	10 mA – 10 A; Accuracy: 1% of reading, ±2mA
<b>MEASUREMENT METHOD</b>	Isolated CT
<b>TIMER READING RANGE</b>	1ms – 2 hours; Accuracy: 0.1% of reading ±1ms
<b>TIMER STOP INPUTS</b>	Voltage input (24V – 300V, DC or peak AC), dry contact input, or removal of primary current
<b>DISPLAY</b>	Back-lit LCD Screen (20 characters by 4 lines); viewable in bright sunlight and low-light levels
<b>COMPUTER INTERFACE</b>	RS-232C port for factory calibration and diagnostics
<b>SAFETY</b>	Designed to meet IEC61010 (1995), UL61010A-1, CSA-C22.2 standards
<b>ENVIRONMENT</b>	Operating: -10°C to 50° C (15°F to +122° F); Storage: -30° C to 70° C (-22°F to +158° F)
<b>CABLES</b>	10-foot #1/0 AWG test leads, power cord, ground cable
<b>OPTIONS</b>	Transportation case
<b>WARRANTY</b>	One year on parts and labor



**NOTE**

The above specifications are valid at nominal operating voltage and at a temperature of 25°C (77°F). Specifications may change without prior notice.

### 1.3 Controls and Indicators

The PCI-600's controls and indicators are shown in Figure 1. A leader line with an index number points to each control and indicator, which is cross-referenced to a functional description in Table 2. The table describes the function of each item on the control panel. The purpose of the controls and indicators may seem obvious, but users should become familiar with them before using the PCI-600. Accidental misuse of the controls will usually cause no serious harm. Users should also be familiar with the safety summary found on the front page of this User's Manual.

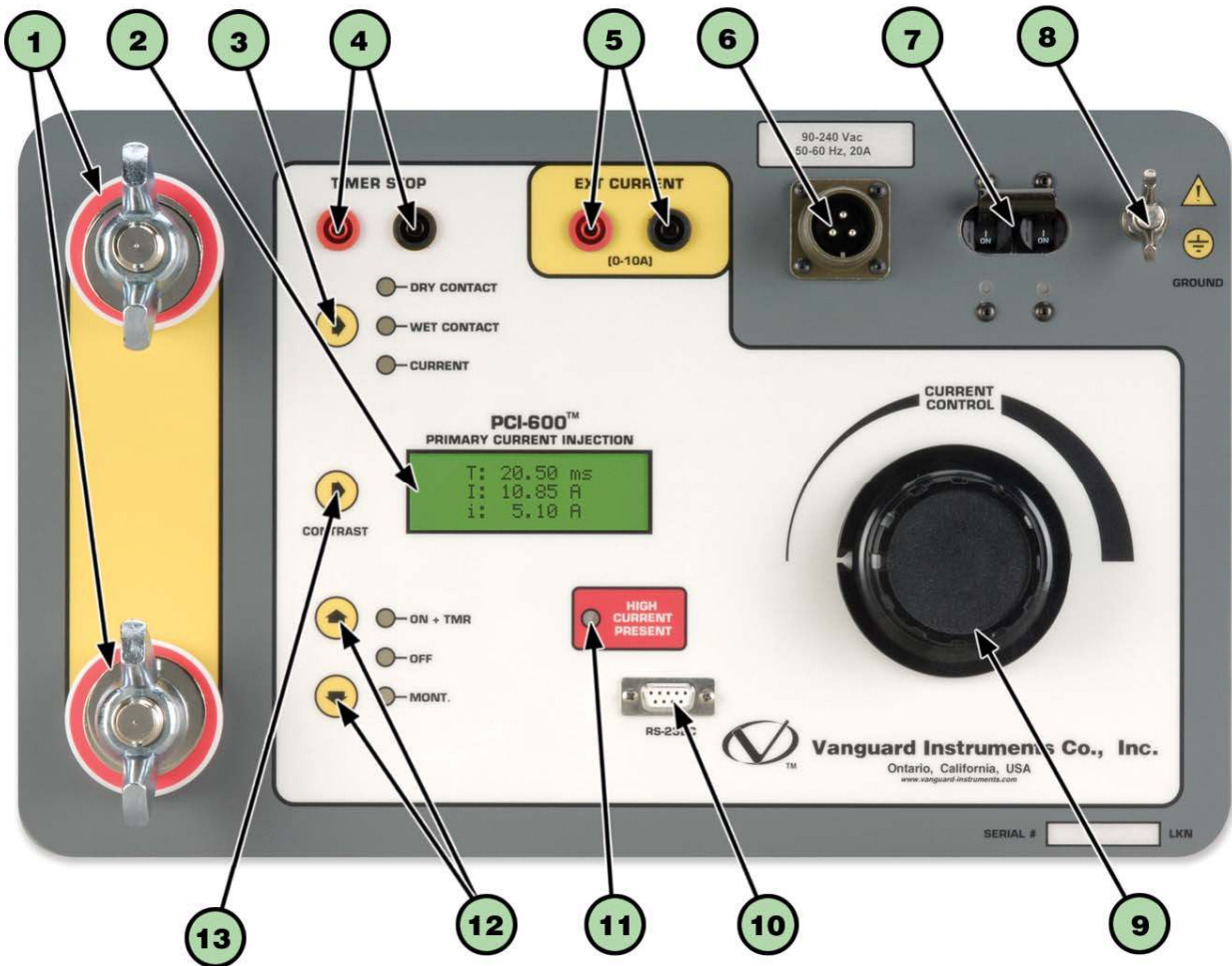


Figure 1. PCI-600 Controls and Indicators

Table 2. Functional Descriptions of PCI-600 Controls and Indicators

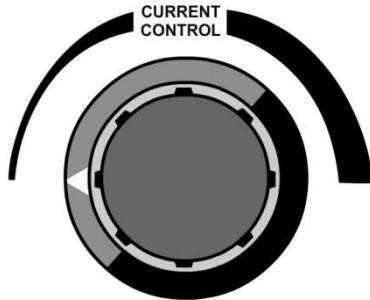
Item Number	Panel Markings	Functional Description
1		Current lead connectors
2		Back-lit LCD screen (20 characters by 4 lines), viewable in bright sunlight and low-light levels.
3	DRY CONTACT WET CONTACT CURRENT	Timer and current source stop input selection with LED indicator. Stop input mode is selected by using the arrow keys.
4	TIMER STOP	Timer "STOP" input connectors
5	EXT CURRENT	External current input connectors
6		Input power connector
7		Circuit Breaker/Power Switch
8	GROUND	PCI-600 ground stud. Connect ground stud to substation ground using provided cable.
9	CURRENT CONTROL	Current control knob
10	RS-232C	RS-232C port for factory calibration, diagnostics, and firmware updates
11	HIGH CURRENT PRESENT	High current presence indicator LED
12		The up and down arrows are used to control the current source output and timer. Three modes are available: <b>ON+TMR</b> : Turns on current source and timer <b>OFF</b> : Turns off current source and timer <b>MONT</b> : Turns on current source momentarily
13	CONTRAST	LCD screen contrast control



## 2.0 OPERATING PROCEDURES

### 2.1 Functional Description

#### 2.1.1. AC Current Source

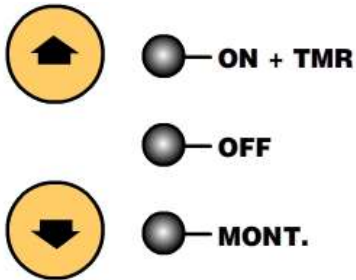


AC test currents from 10A to 600A are set by turning the **[CURRENT CONTROL]** knob on the front panel. The test current is measured and displayed on the LCD screen. The PCI-600 output current ratings are shown in Table 3 below.

**Table 3. Current Output vs. Time**

Output @ 120 Vac	Output @ 240 Vac	Time
5.6 Vac @ 100 A	9.5 Vac @ 100 A	1 hour
5.3 Vac @ 200 A	9.4 Vac @ 200 A	5 minutes
4.9 Vac @ 300 A	9.0 Vac @ 300 A	2 minutes
4.6 Vac @ 400 A	8.2 Vac @ 400 A	1 minute
4.2 Vac @ 500 A	7.5 Vac @ 500 A	30 seconds
3.9 Vac @ 600 A	7.0 Vac @ 600 A	20 seconds

#### 2.1.2. Current Output Control



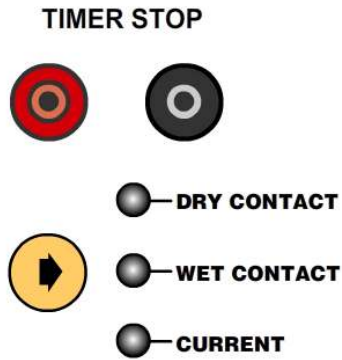
The PCI-600 current source output is controlled by the **[↑]** and **[↓]** keys. Three control modes are available:

**ON + TMR** This mode turns on the PCI-600's current source and timer. This initiates a test and is stopped by using the "Timer Stop" inputs. The test results will be displayed on the LCD. The test can be terminated by pressing the **[↓]** key. The PCI-600's built-in time/cycle counter is used to time events in milliseconds and cycles. The elapsed time is displayed on the LCD along with the test current after a test is completed.

**OFF** In this mode both the current source output and timer are off.

**MONT.** This mode turns on the current source momentarily. To turn on the current source, press and hold the **[↓]** key. The PCI-600 current output can now be set by turning the **[CURRENT CONTROL]** knob. Release the **[↓]** key to turn off the current source.

### 2.1.3. Timer Stop Input and Control



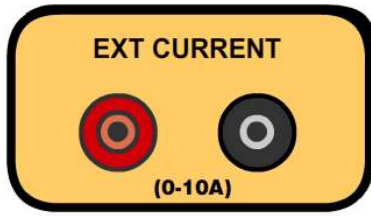
After a test is started, the PCI-600 timer can be stopped and the current source turned off using one of three options listed below. Press the **[→]** key next to the option LED indicators to select the mode.

**DRY CONTACT** In "DRY CONTACT" mode, the PCI-600 will output a DC voltage to the "TIMER STOP" terminals to sense the state of dry contacts. A change in this dry contact state will stop the timer and turn off the current source. This mode requires an external input to the PCI-600. External timer stop input signals are sensed through the "TIMER STOP" connectors.

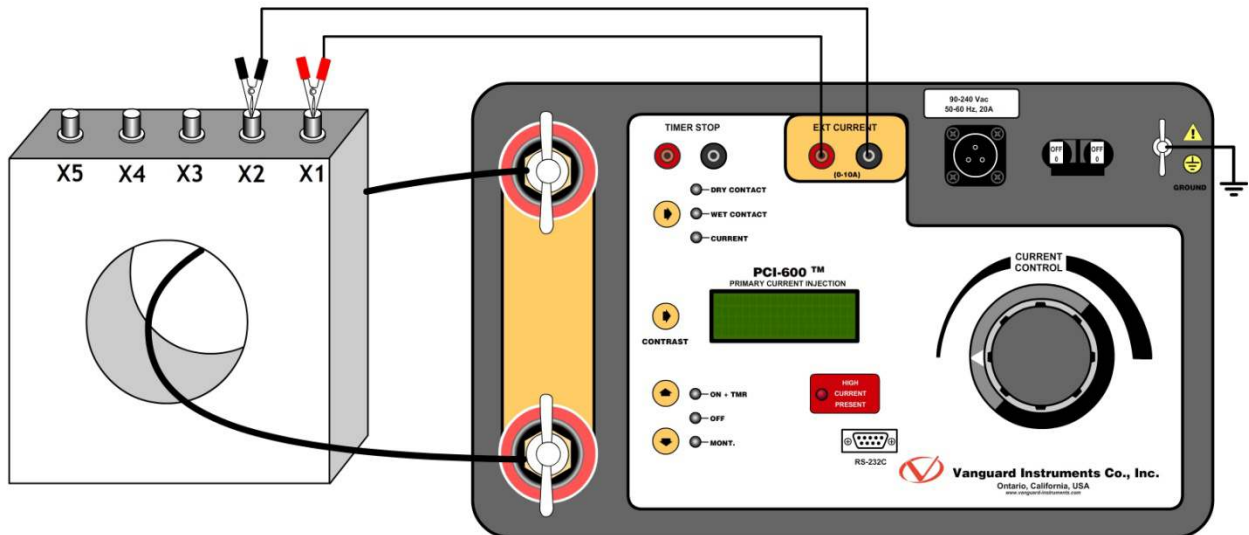
**WET CONTACT** In "WET CONTACT" mode, the PCI-600 will sense an AC or DC voltage applied to the "TIMER STOP" connectors. The "OFF" state is any voltage from 0 to 10 V ac/dc. The "ON" state is any voltage from 24 to 300 V ac/dc. A change in the "Voltage" state will stop the timer and turn off the current source. This mode requires an external input to the PCI-600. External timer stop input signals are sensed through the "TIMER STOP" connectors.

**CURRENT** In "CURRENT" mode, an interruption of the PCI-600 current source output (CB contact opened) will stop the timer and turn off the current source.

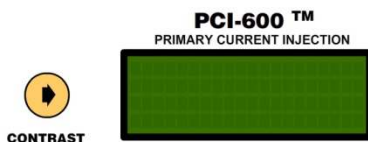
### 2.1.4. External Current Input



The PCI-600's "EXT CURRENT" input is a 10 ampere AC current meter. This built-in ampere meter allows the user to monitor an AC current. This current input is isolated. A typical application for this feature is to measure a Current Transformer (CT) current ratio. The user can set the PCI-600 to output a current through the CT primary input. The CT secondary output is measured with the PCI-600 "EXT CURRENT" input. Both the PCI-600 output current and the CT secondary current are displayed on the LCD allowing the user to easily calculate the CT current ratio. The External Current's polarity with respect to the PCI-600 drive current is indicated on the LCD by a "+" sign (in phase) or a "-" sign (out of phase). Proper phasing is indicated when the same colored PCI connectors are connected to corresponding terminals on the CT as shown below:



### 2.1.5. LCD Contrast Control



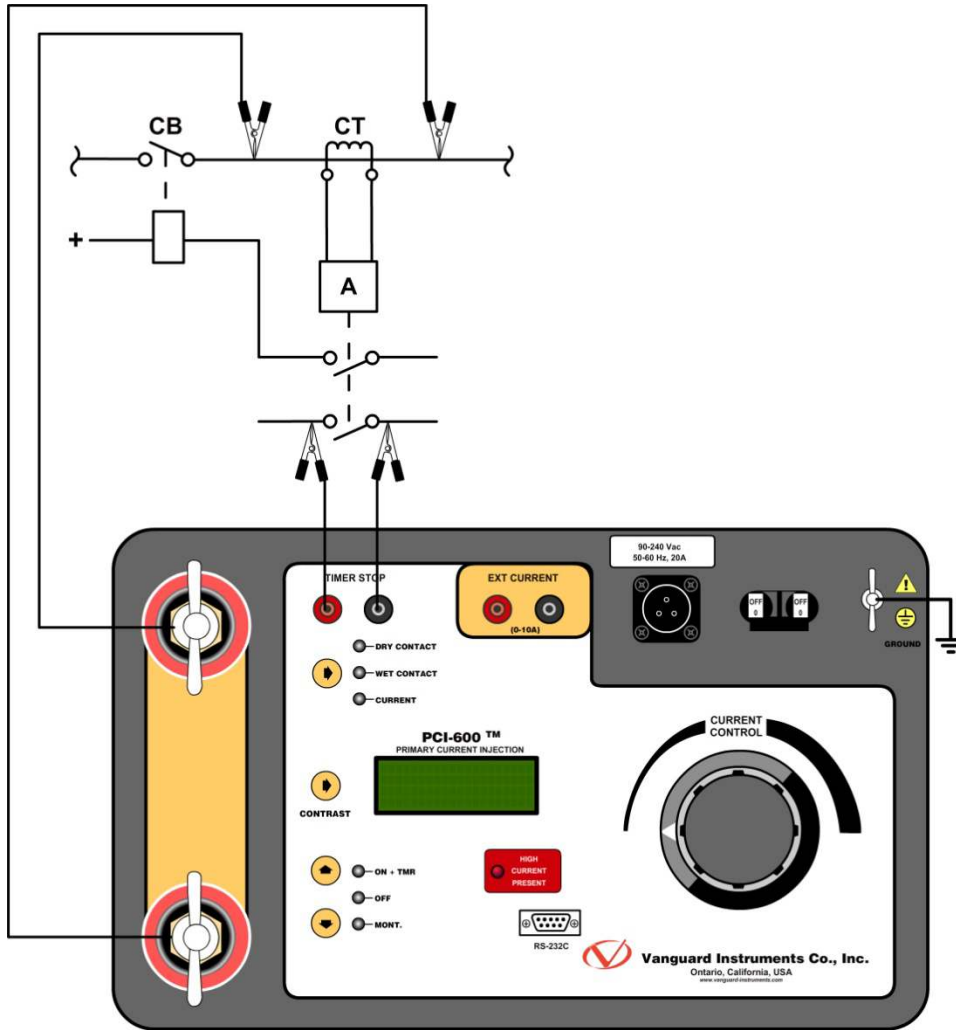
To change the contrast level on the PCI-600's LCD screen, press and hold the contrast [→] key next to the LCD screen. Release the contrast [→] key when the desired contrast level has been reached.

## 2.2 Performing Tests

### 2.2.1. Testing the Open Time Delay of a Protection Relay

Follow the steps below to test the Open Time Delay of a protection relay:

- a. Make cable connections per the illustration below:

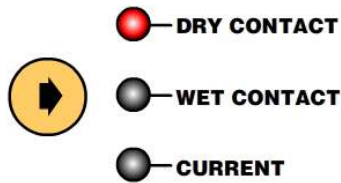


- b. Turn the [**CURRENT CONTROL**] knob counter-clockwise to the zero position.
- c. Turn on the power switch. After the initial informational screens, the following screen will be displayed:

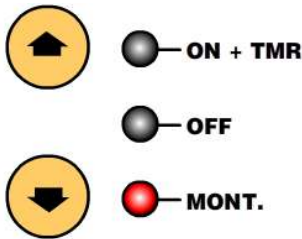
```

0mS    0.0CY
Ext I: +0.000 A
Drv I:  0.00 A
    
```

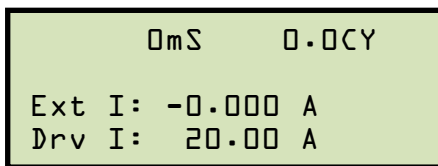
- d. From the "Timer Stop" section on the control panel, press the **[→]** key until "DRY CONTACT" is selected as shown below:



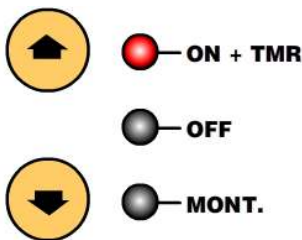
- e. Press and hold the **[↓]** key to momentarily turn on the current source:



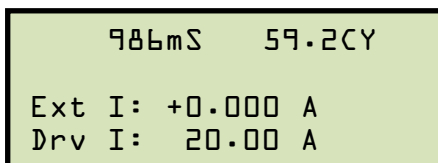
- f. Turn the **[CONTROL KNOB]** clockwise to set the desired current. The screen will be updated as shown below:



- g. Release the **[↓]** key.  
 h. Press the **[↑]** key to select "ON + TMR" mode and start the test:



- i. The PCI-600 will inject the preset current into the bus and turn on the timer. The LCD will be updated as shown below:

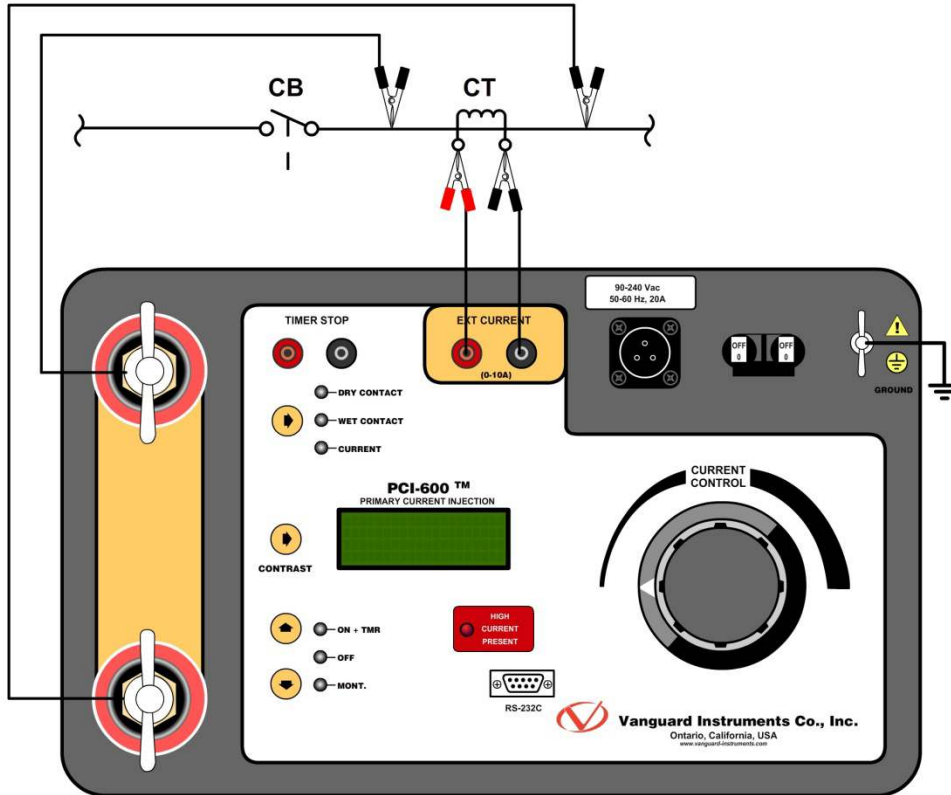


- j. The timer will stop and the current source will turn off when the PCI-600 "TIMER STOP" input detects a change in the relay dry contact, or if the operator presses the **[↓]** key to select the "OFF" mode.

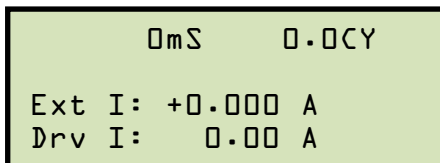
### 2.2.2. Measuring Current Transformer Primary and Secondary Currents

Follow the steps below to measure current transformer primary and secondary currents:

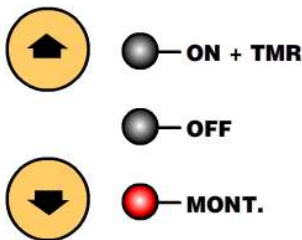
- a. Make cable connections per the illustration below:



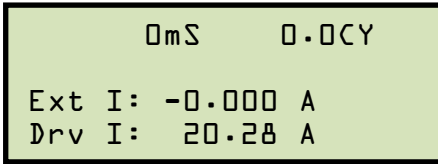
- b. Turn the **[CURRENT CONTROL]** knob counter-clockwise to the zero position.
- c. Turn on the power switch. The following screen will be displayed:



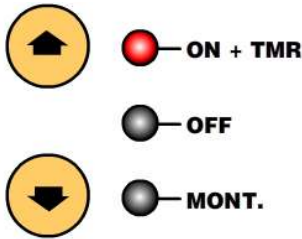
- d. Press and hold the **[↓]** key to momentarily turn on the current source:



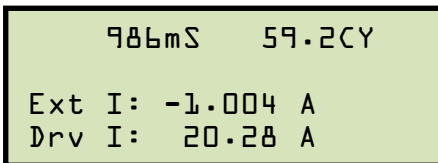
- e. Turn the **[CURRENT CONTROL]** knob clockwise to set the desired current. The screen will be updated as shown below:




- f. Release the **[↓]** key when the desired current is displayed on the screen.
- g. Press the **[↑]** key to select "ON + TMR" mode and start the test:



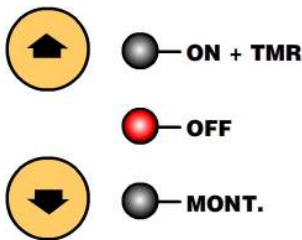
- h. The CT primary and secondary currents will be displayed as well as the polarity as shown below:



 The External current polarity is shown either as in-phase (“+” sign) or out of phase (“-” sign) with respect to the PCI-600's drive current.

**NOTE**

- i. Turn off the current source by pressing the **[↓]** key.





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