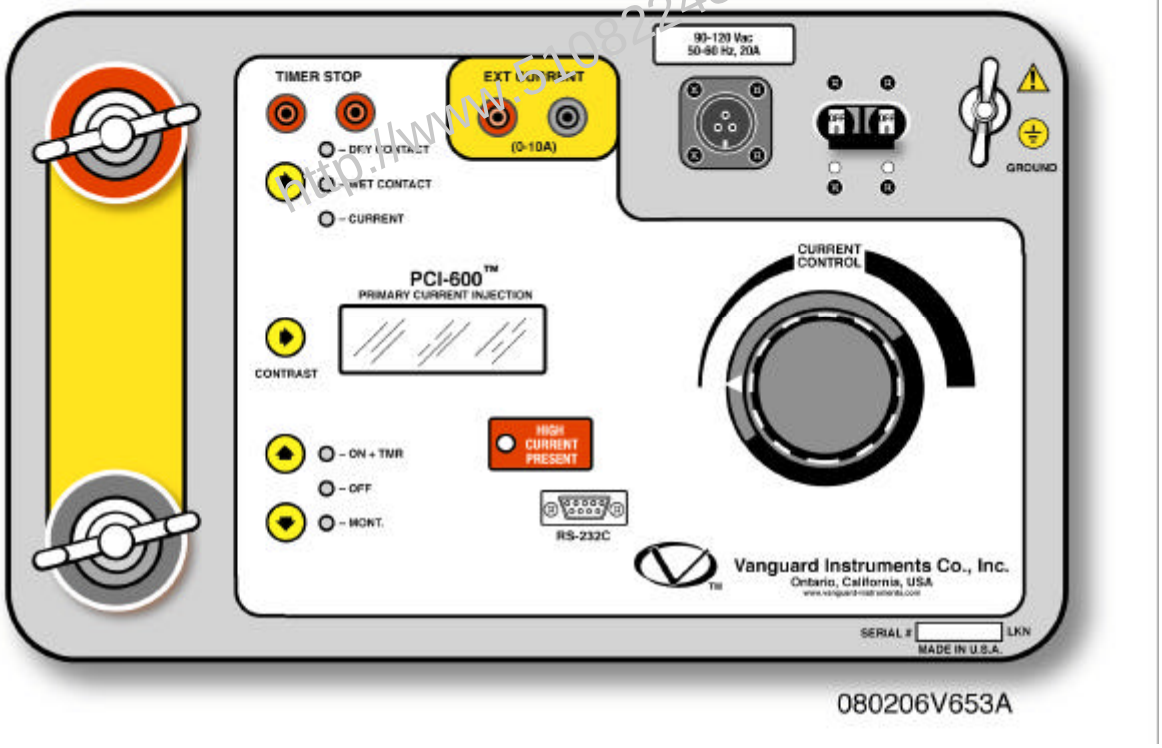
OPERATING INSTRUCTIONS
For the
PCI-600
Portable Primary Current Injection Device



080206V653A

Vanguard Instruments Company
1520 South Hellman Ave.
Ontario, California 91761

TEL: (909) 923-9390
FAX: (909) 923-9391

March 2008
Rev 1

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

Due to 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 recommended that repairs be performed only by Vanguard Instruments Company's factory personnel or by an authorized repair service center. Unauthorized modifications can cause serious safety hazards and will nullify the manufacturer's warranty.

Follow Exact Operating Procedures

Any deviation from the procedures described in the operator's manual may create one or more safety hazards, 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.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

The Vanguard Instruments Co. Model PCI-600 is a portable, high-current source designed specifically for utility-substation applications. This alternating current (AC) test device is used primarily for injection testing of protective relays. The same device can also be used for testing thermal, magnetic and solid-state motor-protection relays, and molded case circuit breakers. The PCI-600 is versatile and can be used in many other applications that may require a high-current source. The PCI-600 has the following features:

One variable AC current source (0-600A).
One internal current meter (range from 1 to 999 A).
One built-in digital timer displays tested timing results in both milliseconds and cycles.
An external current meter (input range from 0 to 10A) is also available to the user.
Test results display on a 4-line by 20-character, back lighted LCD.

The front panel control arrangement is designed to allow a user to intuitively operate the PCI-600 with a minimum of training.

1.1 Furnished Test Accessories

The PCI-600 is supplied with two 10-foot #1/0 AWG current cables with heavy-duty alligator clamps, two 6-foot voltage-sensing cables with alligator clips, ground cable, and power cord.

2.0 PCI-600 Descriptions

2.1 PCI-600 Specifications

PCI-600 specifications and leading particulars are listed in Table 1.0

Table 1.0 PCI-600 Specifications

MODEL	PCI-600
TYPE	Special-Purpose Test Equipment, 10-600 amp current source
SIZE (inches)	16.8 W by 12.6 H by 10.6 D (42.6 cm by 32.0 cm x 30.5 cm)
WEIGHT	46 pounds (21 Kg)
INPUT POWER	90-130 Vac or 200-240 Vac, 50/60 Hz (factory preset).
INTERNAL CURRENT METER	100 mA to 1000 A, Accuracy: 1% of reading, ?20 mA
EXTERNAL CURRENT METER	10 mA to 10 A, Accuracy: 1% of reading, ?20 mA
MEASURING METHOD	Isolated CT
TIMER READING RANGE	1 ms to 2 hours, Accuracy: 0.1% of reading ?1 ms
TIMER STOP INPUT	Voltage Input (24-300 V, dc or peak AC) Or Dry contact input Or Interruption of primary current
DISPLAY	LCD, backlighted, 4-line by 20-character
COMPUTER INTERFAC	RS-23C, 19200 Baud (Factory Calibration and Diagnostic)
SAFETY	Designed to meet IEC61010 (1995), UL 61010A-1, CSA-22.2
ENVIROMENT	Operating: -10?C to 50?C (15?F to +122?F) Storage: -30?C to 70?C (-22?F to +158?F)

PCI-600 SPECIFICATIONS ARE SUBJECT TO UPGRADES AND MAY BE CHANGED WITHOUT PRIOR NOTICE.

2.2 PCI-600 Control and Display

The PCI-600 controls and displays are shown in the control-panel illustration in Figure 1.0. Pointing leader lines reference each item with an index number. Each index number is cross-referenced to a functional description in Table 2.0, which describes the function and purpose of each item on the control panel. Although the purpose of these controls and the display may seem obvious and intuitive, users should become familiar with them before attempting to use the PCI-600. First-time users should also review and become familiar with the Safety Summary on the front page.

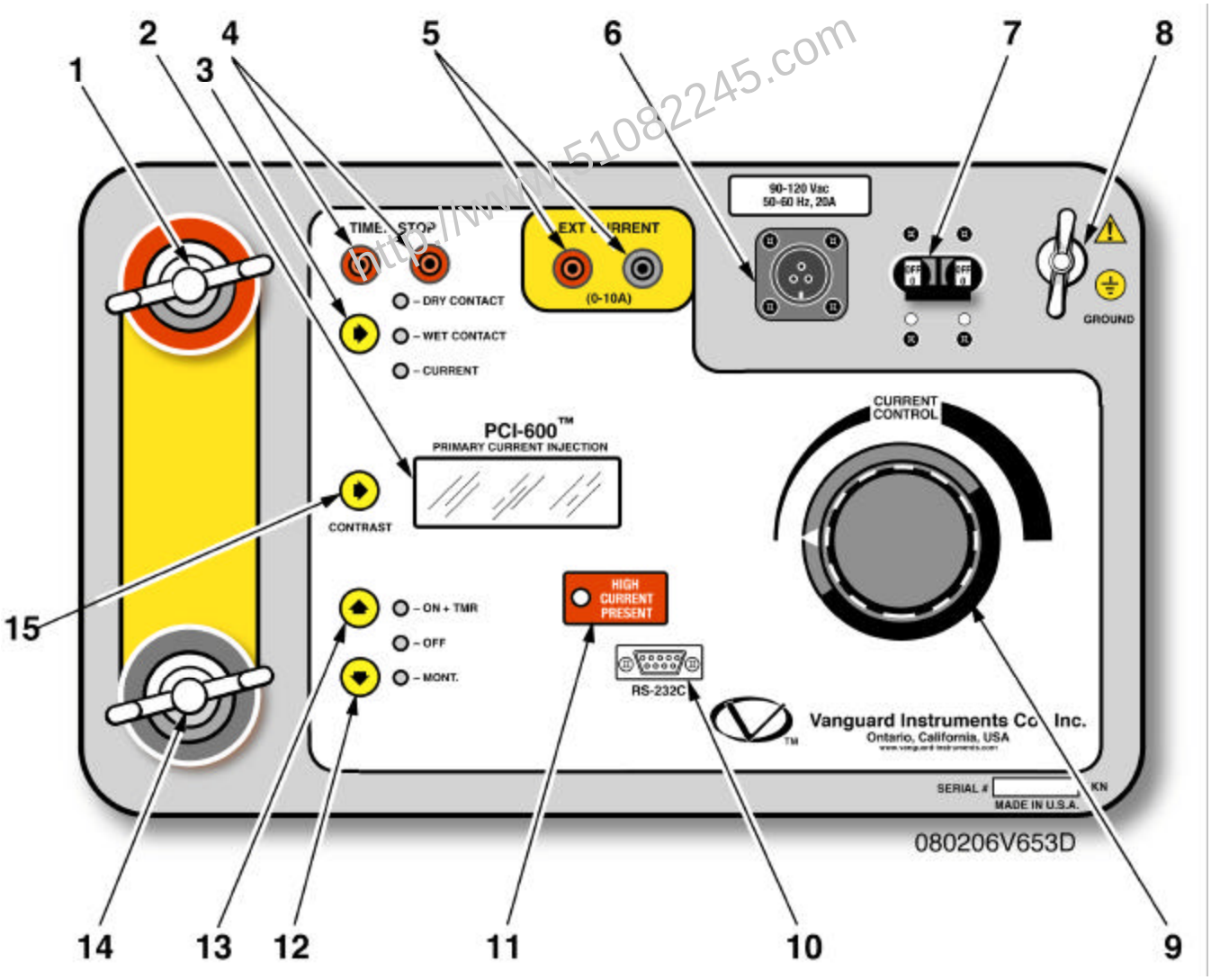


Figure 1.0 PCI-600 Front Panel Controls and Display

Table 2.0 Functional Description of PCI-600 Controls and Display

Figure 1 Index #	Adjacent Panel Marking	Functional Description
1 & 14	(Wing Nut)	Current lead connectors
2	No marking	LCD; 4-line by 20-character; back-lighted; displays menus of selections, operator entries, and test-measurement results.
3	**DRY CONTACT** **WET CONTACT** **CURRENT**	Timer and current source stop input selection with LED indicator. Stop input mode is selected by using Arrow Key.
4	**TIMER STOP**	Timer "STOP" input connectors
5	**EXTERNAL CURRENT**	External current input connectors.
6	**90-120 Vac** **50- 60 Hz, 20A** or **200-240 Vac** **50- 60 Hz, 10A**	Input power connector.
7	No Marking	Circuit Breaker
8	**GROUND** (Wing Nut)	PCI-600 ground stud. Connect ground stud to substation ground using provided cable.
9	**CURRENT CONTROL**	Current Control knob.
10	**RS-232C**	RS-232C interface port; 9-pin connector; female DB type. The data rate is set to 19,200 baud, 1 start bit, 8 data bits, and no parity bit; PIN — SIGNAL 2 — Rx 3 — Tx 5 — Signal Gnd This serial port is for factory calibration and firmware updates.
11	**HIGH CURRENT PRESENT**	High Current indicator LED
12 & 13	Up and Down Arrows **ON + TMR** **OFF** **MONT**	The up and down arrows allow the user to control the current source output and timer. Three modes are available: **ON+TIMR (Turn on current source and timer)** **OFF (Turn off timer and current source)** **MONT (Turn on current source momentarily)**
15	**CONTRAST**	LCD contrast control.

3.0 Functional Description

3.1 PCI-600 AC Current Source

AC tests current, from 10A to 600A, are set by the “Current Control” knob on the front panel. The test current is measured and displayed on the LCD. The PCI-600 output current ratings are shown in table 3.0 below.

Table 3.0 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

3.2 PCI-600 Current Output Control

The PCI-600 current source output is controlled by the “UP” and “DOWN” arrows shown in Figure 2.0. Three control modes are available: “ON+TMR”, “OFF” and MONT”.

The “OFF” mode indicates that both the current source output and timer are off.

The “MONT” mode turns on the current source momentarily. To turn on the current source, press and hold the “DOWN” arrow key. The “MONT” indicator indicates the PCI-600 current source is on and the output current is displayed on the LCD. The PCI-600 current output can now be set by turning the “CURRENT CONTROL” knob. Release the “DOWN” arrow key to turn off the current source.

The “ON+TMR” mode turns on the PCI-600 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 “DOWN” arrow key. In this case, no test results will be displayed on the LCD.

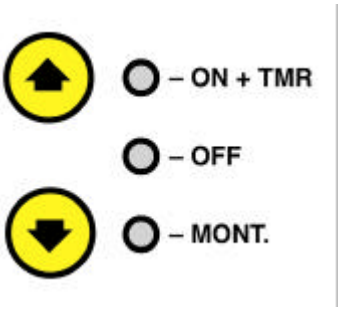


Figure 2.0 PCI-600 Current Source and Timer Control

3.3 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: Dry contact input, Wet contact input, or when the PCI-600 current output is interrupted. The user will use the “ARROW” key to select one of these 3 modes.

DRY CONTACT Mode: When this mode is selected, 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.

WET CONTACT Mode: When this mode is selected, the PCI-600 will sense an AC or DC voltage applied to the “TIMER STOP” connectors. The “OFF” state is a voltage from 0 to 10 V ac/dc. The “ON” state is a voltage from 24 to 300 V ac/dc.
A change in the “Voltage” state will stop the timer and turn of the current source.

CURRENT Mode: When this mode is selected, an interruption of the PCI-600 current source output (CB contact opened) will stop the timer and turn off the current source.

Both the “DRY CONTACT” and “WET CONTACT” modes require an external input to the PCI-600. External timer stop input signals are sensed through the “TIMER STOP” connectors.

Figure 3.0 Timer Stop Input and Control

3.4 PCI-600 Timer

A built-in time/cycle counter allows the user 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.
The timer is turned on when the “ON+TMR” mode is selected (see section 3.2)
.

3.5 External Current Input

The PCI-600 “EXT CURRENT” 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 CT (Current Transformer) 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. For example: Red Current connector to H1 / Red External Current connector to X1 and Black Current connector to H2 / Black External Current connector to other “X” terminals.

Figure 4.0 External Current Input

3.5 LCD Contrast Control

To change the PCI-600 LCD contrast, press and hold the “Arrow” key shown in Figure 5.0. The contrast will increase in darkness until it reaches its darkest setting at which point it will return to its lightest setting and begin the cycle again. When the “Arrow” key is released, the LCD contrast setting will be stored.

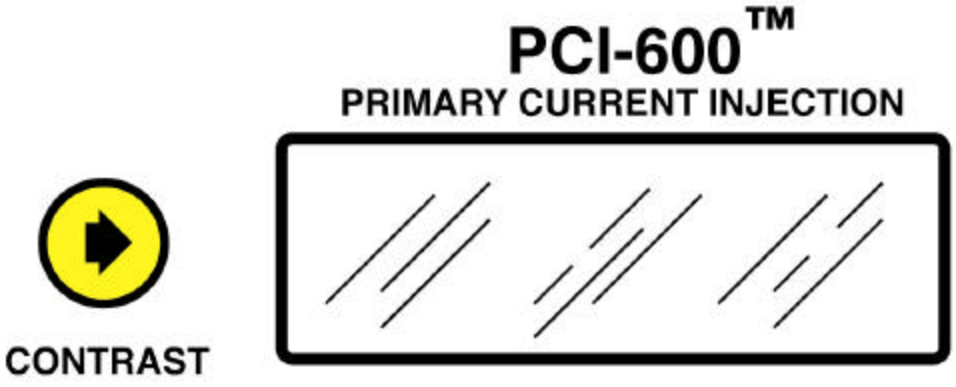


Figure 5.0 PCI-600 Contrast Control

4.0 Typical PCI-600 Applications

4.1 Test the Time Delay of a Protection Relay

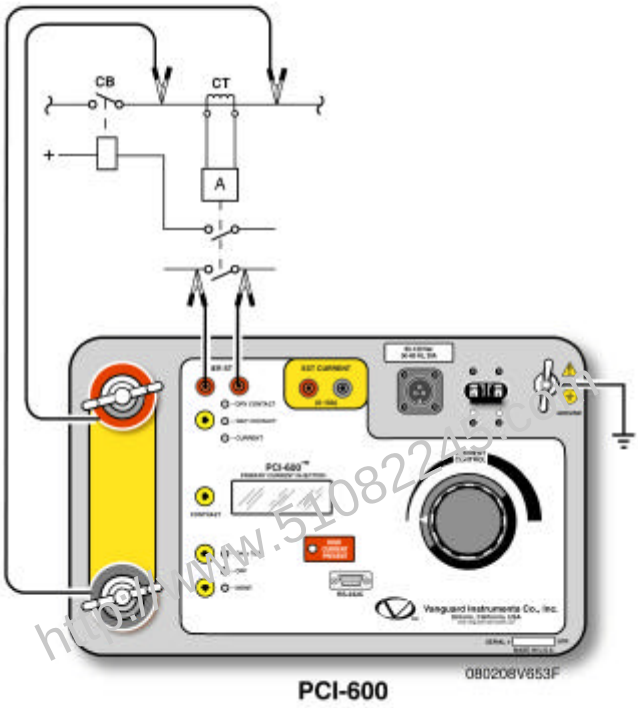


Figure 6.0 Typical PCI-600 Timing Application

Figure 6.0 illustrates a typical connection of the PCI-600 to a protection relay to test its “Open Time Delay”. The PCI-600 injects a test current through a bus. The test current is sensed by the CT of the protection relay. One of the relay dry contacts is used to stop the PCI-600 timer. Use the following steps to run this test.

- ? Connect the Safety Ground to the PCI-600
- ? Connect the Current cables from the PCI-600 to the bus.
- ? Connect the Timer Stop cables.
- ? Turn the Current control Knob to Zero.
- ? Turn on the power switch.
- ? Select the Timer Stop Input to “Dry Contact”.
- ? Hold the “?” key to momentarily turn on the current source.
- ? Turn the “Current Control” Knob to set the desired current
- ? Release the “?” key
- ? Press the “?” key to (select ON+TIMER) to start the test

The PCI-600 will inject the preset current into the bus and turn on the timer. The timer will stop and the current source turn off when the PCI-600 “TIMER STOP” detects a change in the relay dry contact.

Typical PCI-600 time delay test results are shown in Figure 7.0.

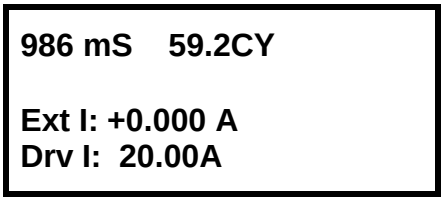


Figure 7.0 Typical PCI-600 Timing Test Result

Notes

In the above test, the timer and current source will stop with the change in the Timer Stop input or when operator press the “DOWN ARROW” key to select the “OFF” mode.

4.2 Measure Current Transformer Primary and Secondary Currents

Figure 8.0 illustrates a typical connection of the PCI-600 to a current transformer. In this connection, the PCI-600 injects a test current through the CT primary. The CT secondary current is sensed by the PCI-600 “EXT CURRENT” input.

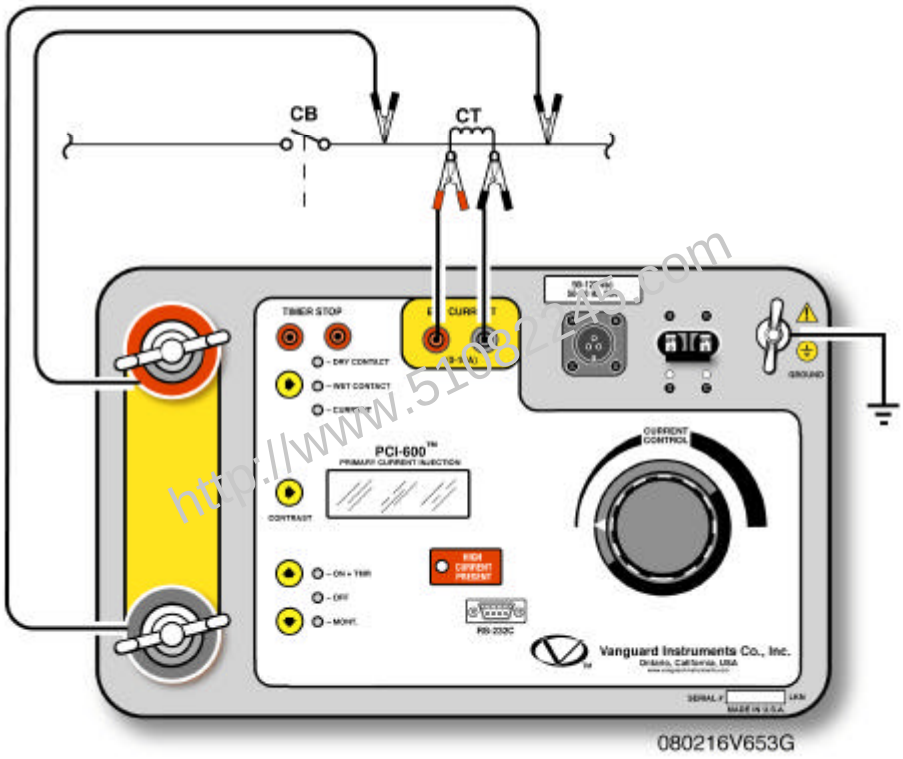


Figure 8.0 Typical Current Transformer Current Ratio Test

Use the following steps to run this test.

- Connect the Safety Ground to the PCI-600
- Connect the Current cables from the PCI-600 to the bus. (CT primary)
- Connect the CT secondary winding to the PCI-600 “EXT CURRENT” input.
- Turn the Current control Knob to Zero.
- Turn on the power switch.
- Hold the “?” key to momentarily turn on the current source.
- Turn the “Current Control” Knob to set the desired current
- Release the “?” key
- Press the “?” key (select ON+TIMER) to start the test
- Observe and record the CT primary, CT secondary current, and polarity.
- Turn off the current source using the “DOWN ARROW” key.

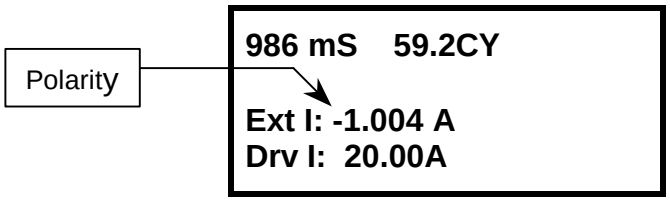


Figure 9.0 Typical PCI-600 CT Current Ratio Test Display

Notes

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

Vanguard Instruments
Company, Inc.

www.vanguard-instruments.com