



# **GUILDLINE**

**Operation Manual**

**For The**

**6623A-1000/2000/3000**

**High Current Range Extenders**

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**OM6623A-1\_2\_3000-D1-00  
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## 1. INTRODUCTION

### 1.1. SCOPE

This document describes the installation, operation, specifications, maintenance and verification of the Model 6623A-1000/2000/3000 High Current Range Extenders for the 6622A series of Automatic DCC Resistance Bridges. Precautions associated with very high current connections and measurements are provided for purposes of user safety and measurement system reliability. This manual describes mainly the 6623A-3000 High Current Range Extender as this model incorporates the full complement of features in all the models. Differences with respect to the 6623A-1000 and the 6623A-2000 models are stated where appropriate.

### 1.2. GENERAL DESCRIPTION

The Model 6623A-1000/2000/3000 High Current Range Extenders are designed to extend the test current and measurement range of the Guildline Instruments 6622A series of Automatic DCC Resistance Bridges. The three models are essentially the same except for the test current capability. The 6623A-1000 enables test currents up to 1000 A to be realized and is supplied with one CS1000 current source chassis. The models 6623A-2000 and 6623A-3000 models provide for test currents up to 2000 and 3000 A and are supplied with two and three CS1000 current source chassis's respectively. The lower current models can be upgraded by the addition of one or two CS1000 chassis's.

The extender is essentially a direct current transformer with primary windings which produce an output current that varies directly proportional to the input current. The windings provide transformation ratios of 20:1, 200:1, 2000:1 and 20,000:1 and allow for measurements to be performed above the 150 mA capability of the DCC Resistance Bridge up to a maximum of 3000 Amperes. Four current ranges are provided, 0.1 to 3 A, 3 to 15 A, 15 to 150 A and 150 to 1000, 2000 or 3000 A, with current ratios of 20:1, 200:1, 2000:1 and 20,000:1 respectively.

The 6623A-3000 requires a 6623A-3 current range extender which provides for the first range of 20:1 with a current extension to 3A and the cascading of the higher current ranges. The 6623A-3 is normally mounted close to the 6622A Bridge and the higher current ranges to 3000A are mounted in a separate cabinet with a single cable connection to the 6623A-3 current range extender. The 6623A-3000 Extender is pre-wired and configured in a 22U high rack cabinet designed to operate at a nominal power line voltage of 208 to 240 VAC.

The 6623A-3000 design allows measurements to be made that reduce thermal and current offset effects with the inclusion of a electronically switched current source and all the control circuits necessary for complete control through the 6622A series of bridges. All necessary interconnections of the 3000 A current source are integrated into one cabinet such that no hardware reconfiguration is required over the full range of operation other than the connection of the current terminals of the resistance to be measured to the correct range on the back panel. An Emergency Off switch is provided that can be placed in a convenient place close to the Range Extender to allow a for the immediate interruption of the test current if an emergency should arise.

## 1.3. OVERVIEW

The Model 6623A-3000 Current Range Extender is a precision, fixed ratio, direct current transformer based on the principle of the direct current comparator. Figure 1-1 illustrates the instrument circuits in block diagram form with the connections to the 6622A Bridge. A precision programmable current source is incorporated into the extender such that measurements can be fully automated through the 6622A current comparator resistance bridge using either front panel setup or fully automatic computer control. The 6623A-3 extender is connected to the 6622A Bridge using a seven conductor cable with circular connectors. The higher current cascade unit is connected to the 6623A-3 using a seven conductor cable with circular connectors also.

No adjustments of the 6623A-3000 range extender are required for proper operation, but the 6622A Bridge must be set up with a specific range extender profile. The bridge is generally configured at the factory for the range extender whenever a range extender is ordered at the same time. Where a range extender is ordered subsequently to that of ordering a bridge, the specifics of the profile including current and ratio correction coefficients are provided. A Summary of Coefficients for later reference as may be needed is provided with each range extender.

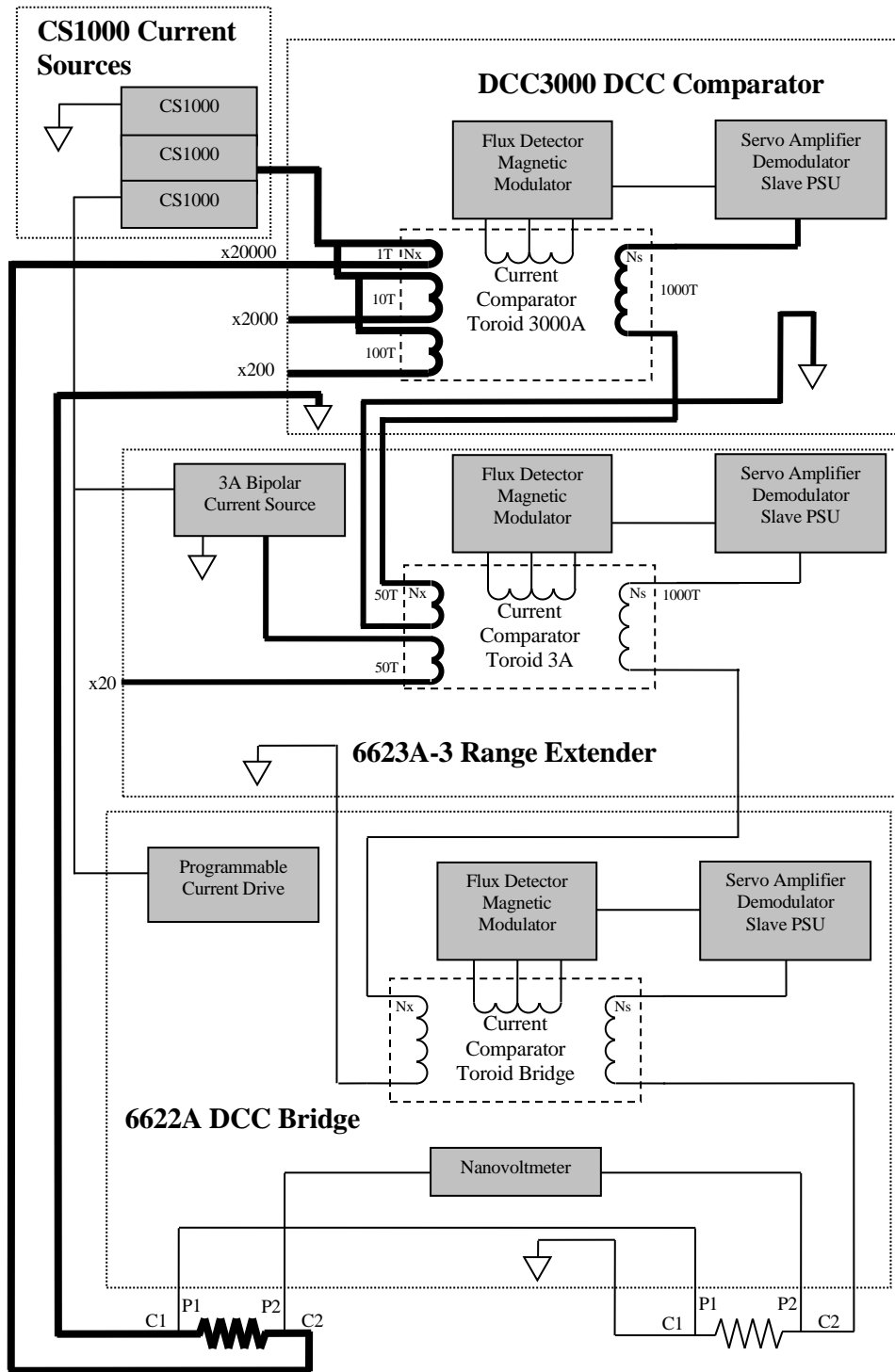
## 1.4. PRINCIPLE OF OPERATION

The Direct Current Comparator is a multiple winding toroidal transformer device shown in Figure 1-1 in which the primary and secondary windings carry direct currents and in which modulator and detector windings are used for the detection of DC flux in the core. When the primary and secondary ampere-turns are equal and opposite there is zero resultant DC flux in the core. This balance condition can be detected by the flux detector circuit. The DC output of the detector is proportional to ampere-turn imbalance. The presence of DC flux in the cores due to primary-secondary ampere-turns unbalance is indicated by the detector output both in magnitude and polarity.

Two current comparator toroidal transformers with associated servo and modulator circuits are utilized in the 6623A-3000. The lower range of 20:1 ratio with a 3 A current source is part of the first stage current comparator and is implemented in the 6623A-3 current range extender as a separate unit. The higher ranges are cascaded into a separate winding on the 6623A-3 to realize the other two ranges of 200:1, 2000:1 and 20,000:1 with the associated current sources.

The peak detector drives a servo circuit in each unit to provide correction current which maintains ampere-turn balance in the core at all times such that the ratio of input and output currents is exactly 20:1, 200:1, 2000:1 or 20,000:1 depending on which range of operation is selected. The 6622A Bridge provides a drive signal to the programmable current source as to allow test currents of from +/-150 mA to +/-3000 A to be realized. This current is directed to the primary windings of the toroidal transformer and the servo amplifier output drives a balancing current through the secondary winding which is directed back to the 6622A such that the bridge can also be balanced with the reduced current. The 6622A Bridge can then determine the resistance ratio of the test resistor with that of the reference resistor used in the measurement. Refer to the 6622A Operation Manual for a description of the bridge measurement technique.





**Figure 1-1 : Model 6623A-3000 Block Diagram**

## 2. INSTALLATION

### 2.1. PRELIMINARIES

Note that the 6623A-3000 will include a separate 6623A-3 Range Extender packaged separately with its own Operation Manual and is designed to be installed next to the 6622A Bridge as a bench mount or rack mount unit. The 3000A High Current section is always installed in a separate 22U rack cabinet fully configured for 220Volt, 50/60Hz operation with a power requirement of two 30A, 220Volt circuits. The 6623A-1000 and 6623A-2000 models are in the same 22U or smaller rack cabinet fully configured for 220Volt, 50/60Hz operation with a power requirement of one 30A, 220Volt circuit and may have the 6623A-3 unit installed in the same cabinet as space allows.

#### 2.1.1. Unpacking

- a. Remove the 6623A-3000 Current Range Extender and the other items from the shipping container to a suitable location.
- b. The following items are included with each new unit. Refer to the 6623A-3 Operators manual for the items included with the 6623A-3 unit.
  - i. Operation Manual (OM6623A-1\_2\_3000)
  - ii. Four Spare 200A Fuses, (GPN 099-32200)
  - iii. Two Spare Fuses 20A Slow Blow, (GPN 099-28521)
  - iv. Two Spare Fuses 2A Slow Blow, (GPN 099-22001)
  - v. One SCW Lead, 2m (GPN 20236.04.02)
  - vi. One 20A, 1.5m red connection cable (GPN 996-00105)
  - vii. One 20A, 1.5m black connection cable (GPN 996-00104)
  - viii. One 150A, 1.5m red connection cable (GPN 20239.03.02)
  - ix. One 150A, 1.5m black connection cable (GPN 20239.04.02)
  - x. Six 500A, 2m red connections cables (GPN 20241.03.02)
  - xi. Six 500A, 2m black connection cables (GPN 20241.04.02)
  - xii. One 7 conductor 2m connection cable (GPN# 20212.04.02)
  - xiii. One model 66236, Emergency Off switch (GPN# 31362-01-11)

Note that for the 6623A-1000 and the 6623A-2000 the number of 500 A connections cables are reduced to two and four of each colour respectively.

#### 2.1.2. Power Voltage Selection

The 6623A-3000 Current Range Extenders as shipped are equipped with 15 A circuit breakers such that fuses are not required to be installed in the power entry modules of the CS1000 Current Sources. Two 2A fuses are installed in the DCC3000 Comparator section. There is no line input selector as the units are pre-set for 220Volts operation. The 6623A-3000 is designed for universal use of AC power sources from nominal 208 Volts to 240 Volts in a frequency range of 50 Hz to 60 Hz. However, the 6623A-3 unit can be set for

100 to 240 Volt operation if desired and connected to a separate source as with the 6622A Bridge as described in the 6623A-3 Operators Manual. The 6623A-3 selection is noted on the back panel of the instrument to coincide with the requested voltage at the time of order.

Two 30 A, 220 Volt line cords with NEMA L6-30P molded plugs are supplied with the 6623A-3000 range extender. The 6623A-100 and 6623A-2000 are supplied with one line cord. Where the molded plugs, NEMA L6-30P, on the line cords do not match the local power outlet sockets, the plugs can be removed and replaced with one that does fit the local service. The plug should be re-wired as follows:

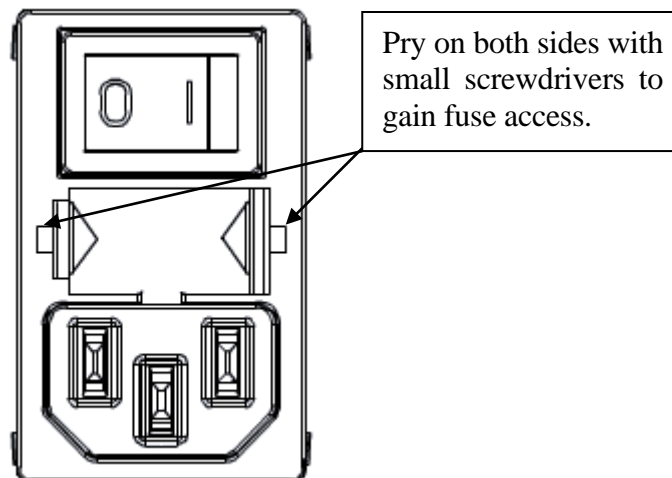
- Black wire - Line 1 input
- White wire - Neutral or Line 2 input
- Green wire - Ground (safety)

### 2.1.3. Fuse Replacement

Only fuses with specified current rating type should be used for replacement if necessary. See Table 2-1. See the 6623A-3 Operation Manual for the fuse ratings of the 3A unit for other voltage settings. Two fuses are required in the power entry of the DCC3000.

CS1000 1, 2 or 3 units 1000A Current Sources	DCC3000 DCC Comparator	6623A-3
15A, 250V, Circuit Breaker, no fuse	2A, 250V, (T)	1/2A, 250V, (T)

**Table 2-1 : Fuse Ratings**



Note: No external line voltage/frequency selection is required for power entry on the DCC3000.

**Figure 2-1 : Input Fuse Access DCC3000**

### 2.1.4. Setup and Power On

- a. Verify that the power switches are off inside the 6623A-3000 cabinet.
- b. Remove any excess packing material from around the front and back panels that are provided for shipping purposes only. Verify that the Line Voltage to be used matches the Line Voltage setting marked on the back panel of the 6623A-3000. If the Line Voltage to be used does not match, contact Guildline Instruments Limited for instructions before proceeding.
- c. Connect the 6623A-3 extender to the 6622A Bridge using the 7 conductor cable with the circular connectors. One end with the green shield leads exposed is to be connected to the circular connector on the back panel of the 6622A marked 'EXTENDER' and the other end to the circular connector to the back panel of the 6623A-3 Extender marked 'BRIDGE'.
- d. Install the correct fuse and ensure the correct voltage setting before power is applied to the 6623A-3 instrument as shown in the 6623A-3 Operation Manual.
- e. Install the Model 66236 Emergency Off Switch by connecting the cable to the top 7 pin circular connector on the last CS1000 Current Source inside the 6623A-3000 cabinet. Note that the Terminator Plug will need to be removed. One or the other must be installed to allow proper operation of the 6623A,
- f. Connect the input power cord from the 6623A-3 to the AC power outlet.
- g. Turn on the power switch to the 6622A Bridge.
- h. Turn on the power switch to the 6623A-3 Extender. You should see the red "POWER" indicator on the front panel light up.

**Note 1:** A termination plug, GPN 31061-01-09, must be connected to the 'Cascade' connector on the back panel of the 6623A-3 if the 6623A-3000 is disconnected before the extender can be used to make measurements.

**Note 2:** A termination plug, GPN 31061-01-09, must be connected to the last CS1000 unit in the 6623A-3000 if the Emergency Off Switch is removed.

**Note 3:** Do not cycle the power on the 6623A Range Extender with a shunt or load connected to one of the ranges on the back panel. Connect the load AFTER the 6623A is turned on. Disconnect the load BEFORE turning off the 6623A.

**Note 4:** It is essential that only one set of C1 and C2 current terminals be connected at any one time to a load (e.g. shunt). Only connect a load to one set of output current terminals.

**Note 5:** Do not connect or disconnect the load when the measurement is running.

**Note 6:** Make sure shunt current leads of sufficient size are connected to the correct C1 and C2 range terminals for a specific measurement current.

**Note 7:** Warm up time of 45 minutes is recommended to meet full specifications.

- i. The system should now be ready to use as a 3A current range extender. Refer the 6623A-3 Operation Manual for the incoming inspection procedure at this point.
- j. Once the 6623A-3 is known to be functional turn off the power to the 6623A-3 and the 6622A Bridge before proceeding with the 6623A-3000 installation.
- k. Connect the 6623A-3000 extender to the 6623A-3 Extender using the 7 conductor cable with the circular connectors. One end with the exposed green shield leads is to be connected to the circular connector on the back panel of the 6623A-3 marked 'Cascade' and the other end to the circular connector of the DCC3000 Comparator marked '6623A-3'.
- l. Connect the input power cords from the 6623A-3000 rack cabinet to the 208-240 VAC power outlets rated at 30A each.
- m. Turn on the power switches of the two 30A power bars at the back of the rack cabinet. Each power bar has two 15A sections with circuit breaker protection. You should see the green 'POWER' indicator on each 15A section of the power bars light up. Note that the 6623A-1000 will have only one power bar installed.
- n. Turn on the power switch to the 6622A Bridge. Then turn on the power switch to the 6623A-3 Extender. You should see the red 'POWER' indicator on the front panel light up.
- o. Turn on the power switch to the DCC-3000 Comparator first and then the three CS1000 Current Sources. You should see the red 'POWER' indicator on the front panels light up. The yellow fault indicators on the CS1000 modules will light 'ON' for about 6 seconds then remain off.
- p. There should not be any yellow 'Fault' indicators remaining on. There are a set of 6 yellow indicators visible within the front grill which indicate when a fault is experienced in any of the 6 internal 150 A slave current source modules. If some of these should remain on, the power can be re-cycled off and on a number of times to clear the fault.

**Note:** Always turn the CS1000 1000 A Current Sources on last after the bridge and range extenders are turned on. And, always turn the CS1000's off first before turning off the range extenders or the bridge. Never turn the CS1000 Current Sources off or on while a measurement is in progress.

### 2.2. INCOMING INSPECTION

If no errors are displayed during power up of the 6622A Bridge or 6623A-3000 Range Extender, (see section 2.1.4) then proceed to measure a 0.1 ohm resistor referenced to a 1 ohm standard. Note that the 6622A Bridge may require a firmware upgrade if it has not been shipped with the range extender. Refer to section 4.6.6.8.1 of the 6622A Operation Manual for information on setting up or checking the range extender profile. If the bridge was shipped with the range extender then the extender profile would have been created in the bridge before shipment.

Use the following measurement set up procedure to verify the functional performance of the range extender. Details of setting up a measurement profile for 'Low Ohms' operation using a range extender are provided in the 6622A Operation Manual in section 4.6.5.3. Where a scanner is to be used in the connections to the resistors, the current terminals of the resistor to be measured should not be connected through a scanner channel. Only the potential terminals of the resistor being measured should be connected through the scanner.

**Note 1: A proper extender profile must have been created in the non-volatile memory of the 6622A for the 6623A-3000 Range Extender before proceeding.**

**Note 2: Do not power on the 6623A-3000 with a shunt connected to one of the ranges on the back panel.**

Initially the measurement of the 0.1 ohm shunt with the 6622A Bridge is used as a ratio reference with a test current of 150 mA. Then, it is measured a second time with the 6623A-3 range extender at the same current level. The difference between the two measurements must be within specified limits to qualify the functionality of the first x20-3A range of the range extender. The exact values of the resistors are not required as only the measured ratio of the resistors is of concern to verify the functional performance of the range extender.

Also, a 0.001 ohm Shunt resistor is measured using both the x200-15A range and the x2000-150A range of the 6623A-3000 with a test current of 15 A, to qualify the integrity of these two ranges. Section 5 provides the procedure for a full verification of the 6623A-3000 range extender. Use The 20 A rated cables provided for connecting the current terminals of the range extender to the shunt.

The following is a step by step procedure for connecting the resistors and for setting up the bridge properly to make the measurements.

### Note:

To start the system, turn on the following equipment in specified order. Turn on Bridge or 66259 Controller. Turn on 3 A Range Extender. Turn on DCC 3000 (i.e. torroid at the bottom of range extender equipment rack). Turn on each of the three 1000 A Current Sources that are in the range extender equipment rack. Connect the load (e.g. shunt) to the correct output terminals. Only have one load connected to the output terminals at any one time. Start measurement as described below. Do not disconnect the load, or connect a load, while the measurement is running. Do not turn off the 1000 A Current Sources or DCC 3000 Range Extender while the measurement is running.

To stop the system, turn off the following equipment in specified order. Stop the measurement. Disconnect the load (e.g. shunt). Turn off each of the three 1000 A Current sources that are in the range extender equipment rack. Turn off the DCC 3000 (i.e. torroid at the bottom of the range extender equipment rack). Turn off the 3 A Range Extender. Turn off the Bridge or 66259 Controller.

- Step 1)** Connect a 1 ohm resistance standard to the Rs terminals and 0.1 ohm resistance standard to the Rx terminals of the 6622A Bridge.
- From the front panel of the model 6622A select 'Setup' from the main menu functions.
  - From the Setup menu, configure the measurement setup as follows:
  - Select 'Normal' mode function key.
  - Select 'Edit' function key.
  - Enter 1 on highlighted 'Resistance RS:' line on display by using the numeric key pad.
  - Select the down arrow key to highlight the next line on the display.
  - Leave standard resistor serial number under 'Serial No. RS:' line blank.
  - Select the down arrow key to highlight the next line on the display.
  - Enter 0.1 on highlighted 'Resistance RX:' line on display by using the numeric key pad.
  - Select the down arrow key to highlight the next line on the display.
  - Enter in 30 for the reversal rate for the measurement.
  - Select the down arrow key to highlight the next line on the display.
  - Enter 150 mA test current value for the test.
  - Select the down arrow key to highlight the next line on the display.
  - Enter the maximum Rs current value of 150 mA.
  - Verify that all entered data is correct, and then press 'OK'.

- Step 2)** Press the 'Previous' function key twice to come back to the main menu.
- Step 3)** Press the 'Measure' function key and then the 'Ratio' menu function to display Ohms. Press the 'Meas Off' sub-menu function key to start the measurement. The 6622A Bridge will begin by showing the nominal value of the resistor to be measured, and then continue to go through a number of rough measurement cycles until a full resolution measurement value is displayed. The measurement may be stopped at any time by pressing the 'Meas On' menu key.
- Step 4)** Record the ohms value displayed after about 15 minutes of measuring and stop the measurement.
- Step 5)** Disconnect the leads connected to the Rx C1 and C2 terminals of the 6622A and connect them to the C1 and C2 terminals of the x20-3A range on the back panel of the 6623A-3. See Figure 2-4 showing rear panel connections.
- Step 6)** On the front panel of the 6622A press the previous key to return to the main menu and perform the following set up;
- From the front panel of the model 6622A select 'Setup' from the main menu functions.
  - From the Setup menu, configure the measurement setup as follows:
  - Select 'Low Ohms' mode function key.
  - Press the right hand key until the selection '6623A-3000' is shown and select 'Edit' function key. Alternatively select '6623A-1000' or '6623A-2000' as appropriate. Note that the 6622A may have to be programmed for the 3000A Extender function as in described in the 6622A Operation Manual. Note that the maximum test currents for stages 2 to 4 must be 15A, 150A and 3000A or less, respectively and the minimum test currents must be 3A, 15A and 150A respectively.
  - Enter 1 on highlighted 'Resistance RS:' line on display by using the numeric key pad.
  - Select the down arrow key to highlight the next line on the display.
  - Leave standard resistor serial number under 'Serial No. RS:' line blank.
  - Select the down arrow key to highlight the next line on the display.
  - Enter 0.1 on highlighted 'Resistance RX:' line on display by using the numeric key pad.
  - Select the down arrow key to highlight the next line on the display.
  - Enter in 60 for the reversal rate for the measurement.
  - Select the down arrow key to highlight the next line on the display.
  - Enter 20 for the extender ratio range to be used.
  - Select the down arrow key to highlight the next line on the display.
  - Enter 0.150 A for the test current value



- Select the down arrow key to highlight the next line on the display screen 2-2.
- Enter the maximum Rs current value of 150 mA.
- Verify that all entered data is correct, and then press 'OK'.

**Step 7)** Press the 'Previous' function key twice to come back to the main menu.

**Step 8)** Press the 'Measure' function key and then the 'Meas Off' sub-menu function key to start the measurement. The 6622A Bridge will begin by showing the nominal ohm value of the resistor to be measured, and then continue to go through a number of rough measurement cycles until a full resolution measurement value is displayed. The measurement may be stopped at any time by pressing the 'Meas On' menu key.

**Step 9)** Record the ohms value displayed after about 15 minutes of measuring and then stop the measurement. Calculate the difference between the two measurement results. The difference should be less than  $\pm 0.00001$  ohms, ( $100 \mu\Omega/\Omega$ ), depending on the stability of the resistors used in the test.

**Step 10)** Disconnect the leads connected to the Rx C1 and C2 terminals of the 6623A-3 and connect them to the C1 and C2 terminals of the x200-15A range on the back panel of the DCC-3000. See Figure 2-5 showing rear panel C1 and C2 connections. Remove the 0.1 ohm resistance standard from the test leads and install a 0.001 ohm current shunt in its place.

**Step 11)** On the front panel of the 6622A press the previous key to return to the main menu and perform the following set up;

- From the front panel of the model 6622A select 'Setup' from the main menu functions.
- From the Setup menu, configure the measurement setup as follows:
- Select 'Low Ohms' mode function key.
- Press the right hand key until the selection '6623A-3000' is shown and select 'Edit' function key.
- Enter 1 on highlighted 'Resistance RS:' line on display by using the numeric key pad.
- Select the down arrow key to highlight the next line on the display.
- Leave standard resistor serial number under 'Serial No. RS:' line blank.
- Select the down arrow key to highlight the next line on the display.
- Enter 0.001 on highlighted 'Resistance RX:' line on display by using the numeric key pad.
- Select the down arrow key to highlight the next line on the display.
- Enter in 60 for the reversal rate for the measurement.
- Select the down arrow key to highlight the next line on the display.
- Enter 200 for the extender ratio range to be used.
- Select the down arrow key to highlight the next line on the display.
- Enter 15 A for the extender test current value.

- Select the down arrow key to highlight the next line on the display screen 2-2.
- Enter the maximum Rs current value of 150 mA.
- Verify that all entered data is correct, and then press 'OK'.

**Step 12)** Press the 'Previous' function key twice to come back to the main menu.

**Step 13)** Press the 'Measure' function key and then the 'Meas Off' sub-menu function key to start the measurement. The 6622A Bridge will begin by showing the nominal ohm value of the resistor to be measured, and then continue to go through a number of rough measurement cycles until a full resolution measurement value is displayed. The measurement may be stopped at any time by pressing the 'Meas On' menu key.

**Step 14)** Record the ohms value displayed after about 15 minutes of measuring and then stop the measurement.

**Step 15)** Disconnect the leads connected to the x200, 15A C1 and C2 terminals and connect them to the C1 and C2 terminals of the x2000, 150A range on the back panel of the DCC-3000. See Figure 2-5 showing rear panel C1 and C2 connections but connect the current leads to the x2000-150A range terminals.

**Step 16)** On the front panel of the 6622A press the previous key to return to the main menu and perform the following set up;

- From the front panel of the model 6622A select 'Setup' from the main menu functions.
- From the Setup menu, configure the measurement setup as follows:
- Select 'Low Ohms' mode function key.
- Press the right hand key until the selection '6623A-3000' is shown and select 'Edit' function key.
- Enter 1 on highlighted 'Resistance RS:' line on display by using the numeric key pad.
- Select the down arrow key to highlight the next line on the display.
- Leave standard resistor serial number under 'Serial No. RS:' line blank.
- Select the down arrow key to highlight the next line on the display.
- Enter 0.001 on highlighted 'Resistance RX:' line on display by using the numeric key pad.
- Select the down arrow key to highlight the next line on the display.
- Enter in 60 for the reversal rate for the measurement.
- Select the down arrow key to highlight the next line on the display.
- Enter 2000 for the extender ratio range to be used.
- Select the down arrow key to highlight the next line on the display.
- Enter 15 A for the extender test current value.
- Select the down arrow key to highlight the next line on the display screen 2-2.
- Enter the maximum Rs current value of 150 mA.
- Verify that all entered data is correct, and then press 'OK'.

- Step 17)** Press the 'Previous' function key twice to come back to the main menu.
- Step 18)** Press the 'Measure' function key and then the 'Meas Off' sub-menu function key to start the measurement. The 6622A Bridge will begin by showing the nominal ohm value of the resistor to be measured, and then continue to go through a number of rough measurement cycles until a full resolution measurement value is displayed. The measurement may be stopped at any time by pressing the 'Meas On' menu key.
- Step 19)** Record the ohms value displayed after about 15 minutes of measuring and then stop the measurement. Calculate the difference between this measurement result and that of step 14. The difference should be less than +/- 0.0001 milli-ohms, ( $100 \mu\Omega/\Omega$ ), depending on the stability of the resistors used in the test.

**Note: The test should execute with no measurement errors indicated and should indicate an ohms value approximating the actual values of the standards. This is not the 6623A-3000 full rated accuracy but serves a functional test for the purposes of determining the instrument has been received in proper working order. Refer to section 5 for a full verification procedure.**

**Note: It is recommended to keep the 6623A-3000 power off when the instrument is not in use for extended periods of time. Always turn the CS1000 modules off first then the DCC3000 Comparator.**

## 2.3. 6623A-3000 FRONT PANEL

There are no controls on the front panel of the 6623A-3000.

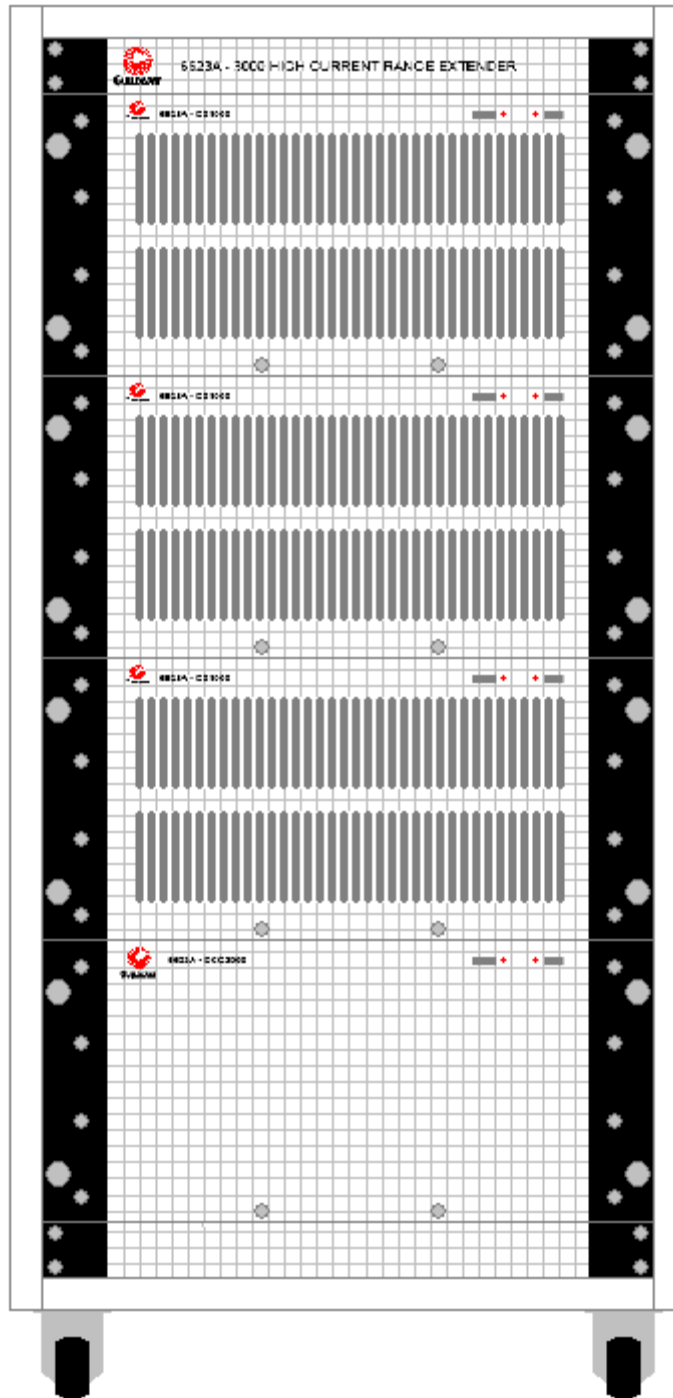


Figure 2-2 : 6623A-3000 Front View

### **2.3.1. Power**

The power-on indicators are lighted when the AC power is applied to the specific units and the power switch on the rear panel is 'ON'.

### **2.3.2. Fault**

The fault indicator on the DCC3000 is lighted when a fault condition in the servo amplifier of the current comparator module is detected.

The fault indicator on the CS1000 modules is lighted to indicate that a fault condition has been detected in the master 150A printed circuit board which controls the remaining six 150A internal current source boards.

There are a set of 6 yellow indicators visible within the front grill which indicate when a fault is experienced in any of the 6 slave internal 150 A current source modules. A fault will cause the particular current source to be disconnected and will allow the remaining units to continue to function.

Note that the 6623A-1000 and 6623A-2000 models will have only one or two CS1000 Current Source modules respectively.

## 2.4. 6623A-3000 REAR PANEL CONNECTORS AND CONTROLS

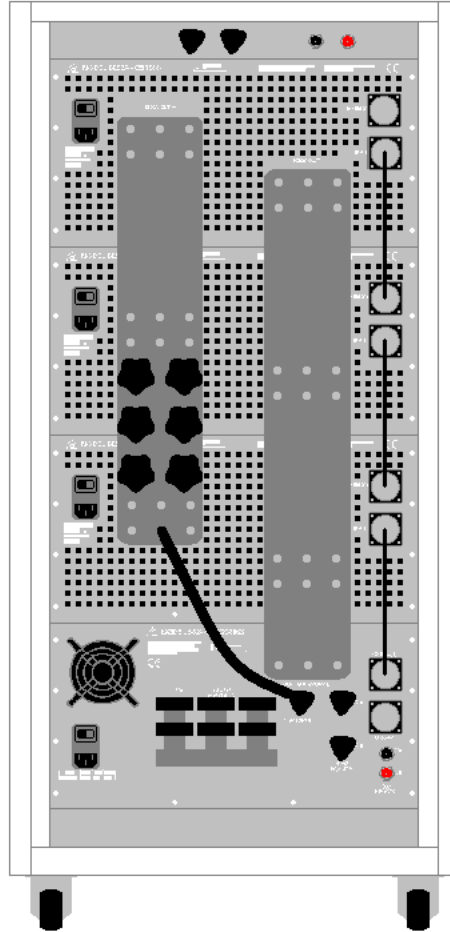


Figure 2-3 : 6623A-3000 Rear View

### 2.4.1. Line Input Connectors

The **Line Input Connectors** are a combination of a 3-prong AC standard male IEC connector, an ON/OFF switch. The DCC3000 Comparator section has a fused line input with access for fuse replacement. The CS1000's have a 15 A circuit breaker as part of the Line Input Connector. The line input connectors accommodate nominal voltages of 208 to 240V. Two 2 A time delay fuses are required for the DCC-3000 Comparator.

### 2.4.2. Resistor Under Test Input Terminals

The Test Resistor current output terminals consist of three sets of two binding posts. These binding posts are labeled as C1 and C2 for each current range of x200-15A, x2000-150A and x20000-3000A maximum. These terminals are to be connected to the C1 and C2 terminals of the resistor under Test whenever the current range extender is to be used. The potential terminals of the Test Resistor are always to be connected to the Rx P1 and P2 terminals of the 6622A Bridge.

**Note: It is essential that only one set of C1 and C2 current terminals be connected at any one time to a test resistor.**

The x200-15A terminal output is protected from over-current with a 20A fuse internal to the instrument. The x2000-150A terminal output is protected from over-current with a 200A fuse internal to the instrument. There are two sets of six knobs for connection to the 500A cables to the x20,000-3000A range to provide a 3000A connection capability. For the 6623A-1000 and the 6623A-2000 models two sets of two and four knobs are provided respectively.

### 2.4.3. 6623A-3 Connector

The '6623A-3' connector is a 7 pin circular connector which is used to connect the necessary signals to the model 6623A-3 Extender 'Cascade' connector.

### 2.4.4 Control Connector

The 'Control' connector is a 7 pin circular connector which is used to connect the necessary signals to the first 1000A current source 'INPUT' connector. The 'OUTPUT' connector of first CS1000 is connected to the 'INPUT' of the next unit and then to the third unit.

**Note that the 'OUTPUT' of the last or upper CS1000 module must have a termination plug, (GPN 31061-01-09) installed for proper operation or be replaced with the model 66236 Emergency Off Switch.**

**Note that if the Emergency Off Switch is triggered it may be reset by twisting the large red knob so that the switch is released from the Off position.**

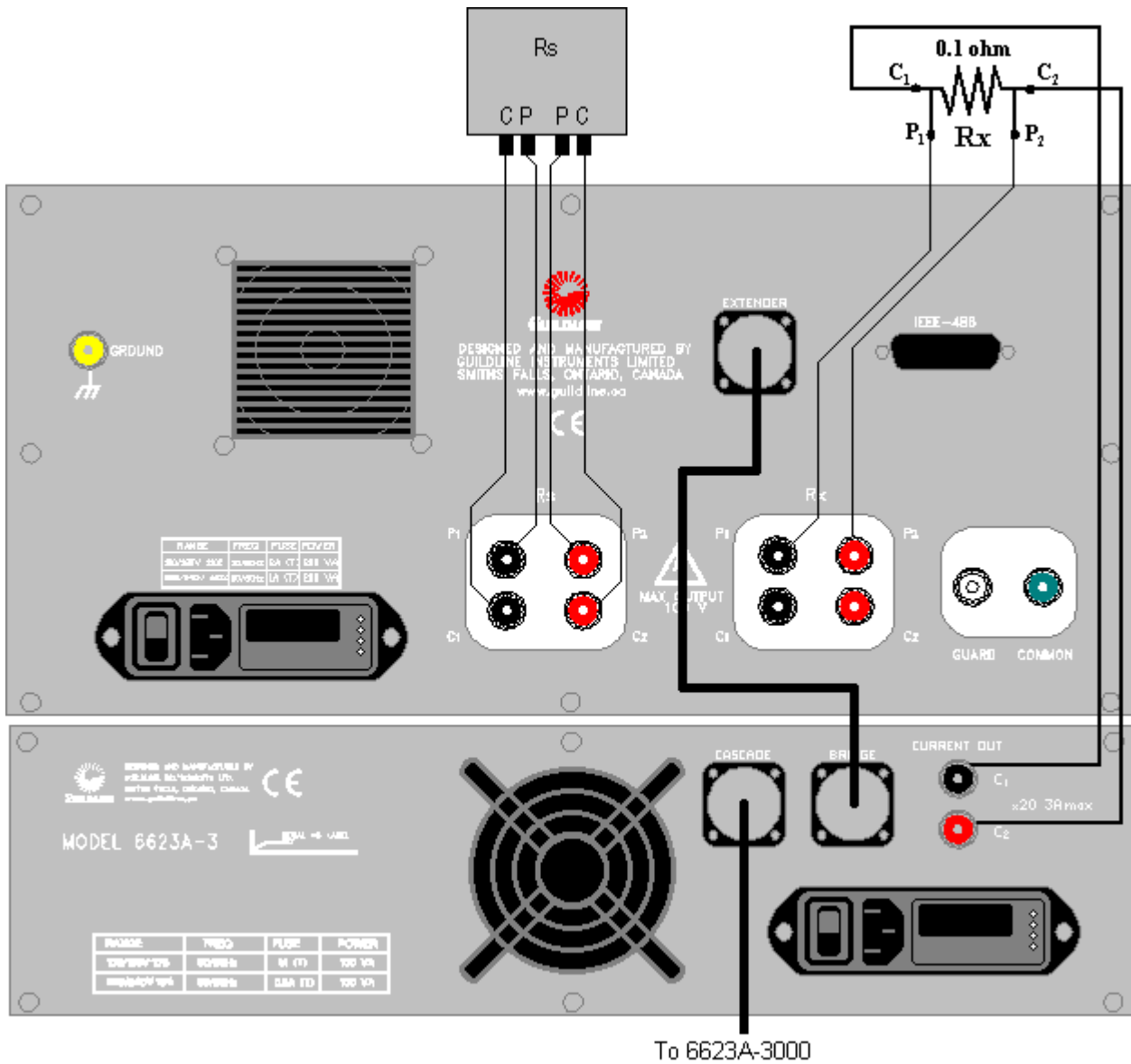


Figure 2-4 : Rear Panel Connections – 6623A-3, x20-3A Range



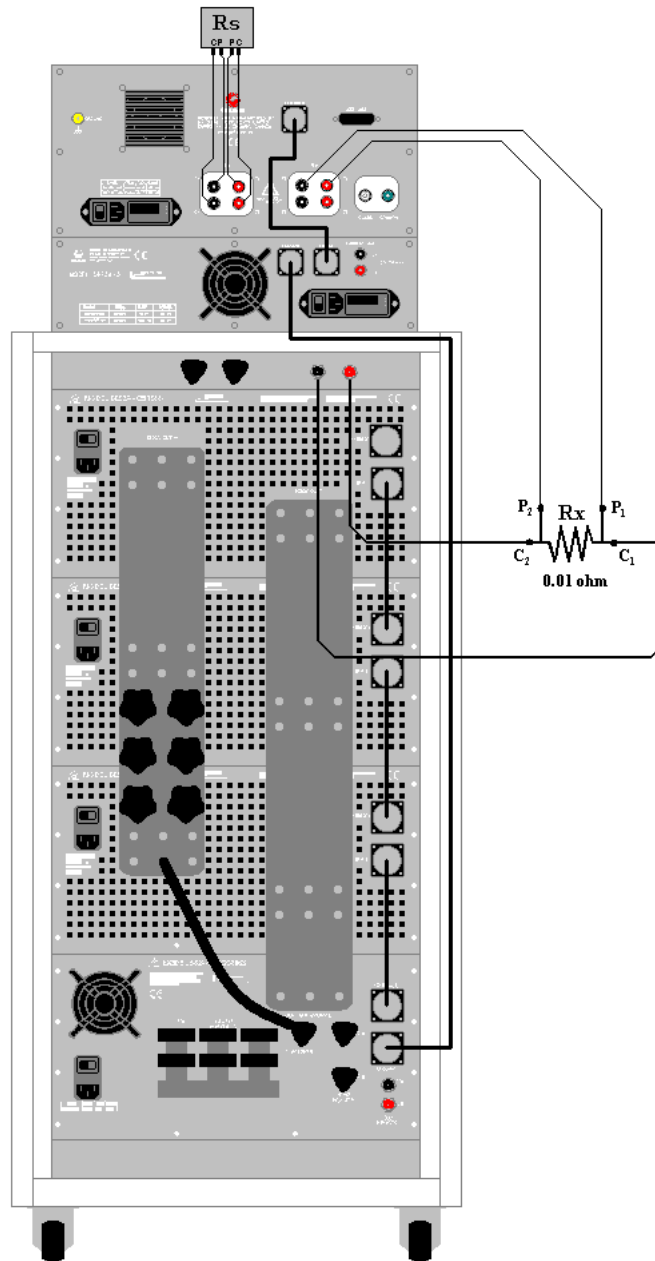
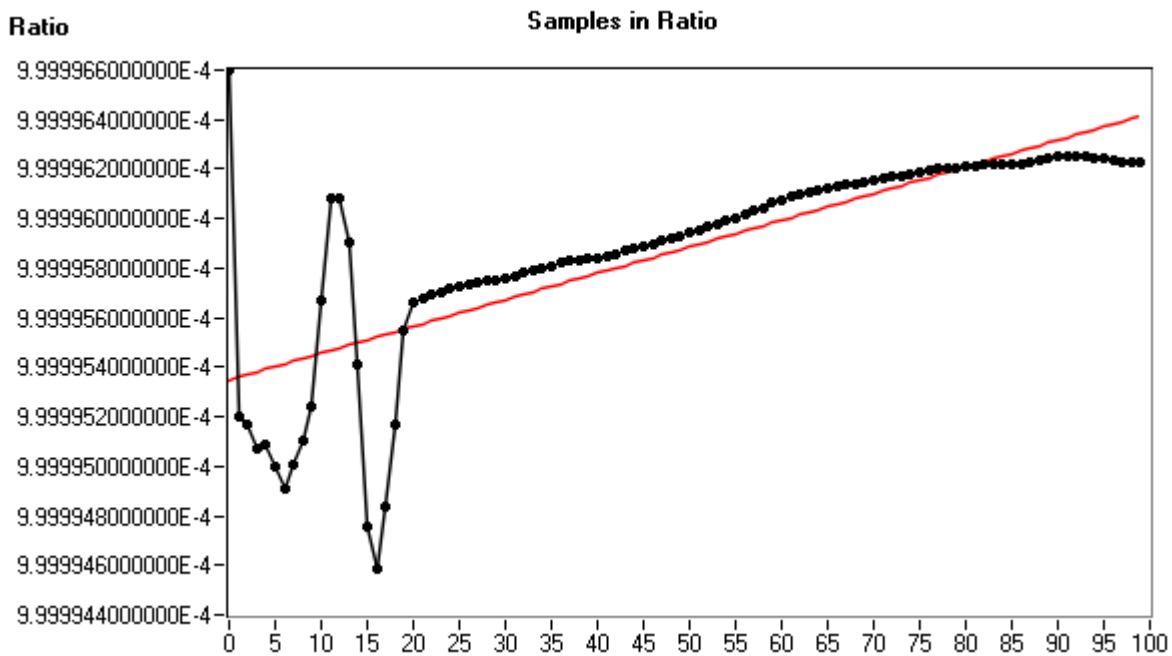


Figure 2-5 : Rear Panel Connections – 6623A-3000, x200-15A Range

## 3. QUICK MEASUREMENT GUIDE

### 3.1. MEASUREMENT OPERATION GUIDE

This section contains information regarding the measurement of resistors in the range of 0.1 $\mu$  ohm to 10 ohms. This guide is provided for manual control of the 6623A-3000 from the front panel of the 6622A Bridge. An operation guide for full automatic control of the 6623A-3000 high Current Range Extender and the 6622A Bridge through the terminal of the system computer is provided in the BridgeWorks Software User Manual. A typical example of a resistance measurement response versus test sample is illustrated in Figure 3-1.



**Figure 3-1 : Resistance Measurement Response Versus Test Sample**

**NOTE:** The last 35 samples of a total of 150 measurement samples should be used to determine the mean measurement value and standard deviation of the sample set, to allow for sufficient stabilization time to achieve the specified uncertainty for the model 6622A Bridge with the 6623A-3000 High Current Range Extender.

### 3.1.1. Low Ohm Mode Resistance Measurement for all 6622A Models with the 6623A-3000

The 6622A in its Low Ohm Mode enables measurement of resistors below 100 ohms. When used with a model 6623A-3000 High Current Range Extender, measurement of low ohm resistors can be made at a maximum test current up to 3000A. Note that for test currents up to 3A the 6623A-3 Extender is used without the need to power on the 6623A-3000 unit. Refer to the 6623A-3 Operation Manual for measurements in the range of 150mA to 3A.

#### **Cautions:**

1. **It is essential that only one set of C1 and C2 current terminals be connected at any one time and shunt current leads of sufficient size are connected to the correct C1 and C2 range terminals for a specific measurement current.**
2. **Do not cycle the power on the 6623A-3000 with a shunt or load connected to one of the ranges on the back panel.**
3. **Do not connect the current terminals of the test resistor through a scanner if test currents above 2 amperes will be selected.**
4. **Warm up time of 45 minutes is recommended to meet full specifications.**

The operator must be familiar with the various modes of operation of the 6622A Bridge before using the 6623A-3000 Range Extender. The 6622A Bridge Operation Manual and should be reviewed before proceeding.

The following is a basic step by step procedure for connecting the resistors and for setting up the bridge properly to make the measurements.

- Step 1)** Connect the bridge, the 6623A-3000 range extender, the reference standard and the test resistor as shown in the Figure 2-5 connection diagram. Use appropriate leads to carry the currents which are provided in the spare parts kit. See section 3.1.2 for test setup limits.
- Step 2)** Make sure the selection of working standard resistor is appropriate and the appropriate C1 and C2 extender terminals are connected to the shunt resistor for the current range selected for the test. For Measurement of low ohm resistors, usually a 1 $\Omega$  reference is chosen unless the resistor nominal value is higher than 0.01 ohms or high current requirements require the use of a 10 $\Omega$  or 100 $\Omega$  reference resistance. See Table 3-1.

- Step 3)** From the front panel of the model 6622A select 'Setup' from the main menu functions. Table 3-1 shows a summary of recommended test setups. From the Setup menu, configure the measurement setup as follows:
- Select 'Low (ohm)' mode function key.
  - Options at this level are 'Edit' (test setup information), 'ok' (to accept) or '6623A-3000A'. Make sure the '6623A-3000A' mode is selected with the specific range to be used. This can be done by pressing the softkey until the displayed value is changed to '6623A-3000A'. Alternatively select '6623A-1000' or '6623A-2000' as appropriate.
  - Select 'Edit' function key.
  - Enter standard resistor value on highlighted 'Resistance RS:' line on display by using the numeric key pad.
  - Select the down arrow key to highlight the next line on the display.
  - Enter standard resistor serial number under 'serial No. RS:' line.
  - Select the down arrow key to highlight the next line on the display.
  - Enter the nominal value of Rx.
  - Enter the reversal rate of 60 seconds for the measurement.
  - Select the down arrow key to highlight the next line on the display.
  - Set the extender ratio range to be used, 20, 200, 2000 or 20,000.
  - Note that for use of the x20 Ratio Range consult the 6623A-3 Operation Manual.
  - Select the down arrow key to highlight the next line.
  - For the model 6623A-3000A range extender, enter the test current, (for the resistor to be measured) in Amps up to 3000A depending on the current range selected and model being used.
  - Select the down arrow key to highlight the next line on the display.
  - Enter the maximum current value for the (reference) standard resistor in mA. The max current needs to be no less than the Rs current shown in Table 3-1 up to a maximum allowable value of 150 mA.
  - Verify that all entered data is correct, and then press 'OK'.
- Step 4)** Press the 'Previous' function key twice to come back to the main menu.
- Step 5)** Press the 'Measure' function key on the 6622A Bridge and then the 'Meas Off' sub-menu function key to start the measurement. The 6622A Bridge will begin by showing the nominal value of either the resistor or the ratio to be measured. At this time, the bridge is carrying out a measurement at the current set in the edit menu. Then bridge measurement may be stopped by pressing the 'Meas On' menu key.

### 3.1.2. Recommended Test Setup Limits and Precautions for 6623A-3000

See Table 3-1 for the recommended test setup limits for various resistor ranges. Note that the current in the standard resistor is controlled by the resistance of the resistor to be measured and the extender current such that the potentials across each resistance are equal and can be determined by the following formula:

**1. Standard Resistor Current = Test Resistor Current x (Rx / Rs)**

The current in the standard resistor generally should not exceed a power dissipation level of 10mW.

**2.  $R_s \geq \text{Ext. Ratio} \times R_x / 2$**

The standard resistor for the measurement must be no less than the calculated value in the formula above.

**3. Bridge Ratio = (Rx x Ext. Ratio) / Rs**

The bridge measurement ratio should not exceed a value of 2:1 and be no less than 0.02:1 to assure accuracy is within specifications.

### 3.1.3. Checks and Precautions

- Select the lowest ratio range of the extender that provides the current required for the test.
- Select current leads suitable to handle the maximum test current for a particular range, either the 20 A, 150 A or multiples of the 500 A high current leads. Undersized leads will cause the temperature of the cable and that of the shunt to increase significantly and increase the uncertainty of the measurements.
- Refer to the Table 3-1 to select the most suitable reference resistor value for the measurement.
- Verify that the bridge ratio will within limits as noted in 3.2.2.
- Verify that the reference resistor current will not exceed 10 mW dissipation limits.
- Ensure that all current lead connections are tight;

**CAUTION: Loose High Current Connections Can Create Very High Temperatures and Arcing.**

**It is recommended to keep the 6623A-3000 power off when the instrument is not in use for extended periods of time.**

### 3.1.4. Example Calculations

For example, if a 0.001 ohm shunt is to be measured at 100 A;

1. **The extender range x2000-150A** is required to satisfy the test current requirement.
2. The standard resistor must be at least;  $R_s = 2000 \times 0.001 / 2 = 1$  ohm or higher, so choose a standard resistor of 1 ohms.
3. The standard resistor test current will be;  
$$I_s = 100 \times 0.001 / 1 = 0.1 \text{ A}$$
4. The power dissipation level will be;  
$$W = 0.1 \times 0.1 \times 1 = 0.01 \text{ Watts.}$$
5. Since this is an acceptable dissipation level then the standard resistor of 1 ohm would be acceptable.
6. The **bridge ratio** then will be;  
$$\text{Ratio} = 0.001 \times 2000 / 1 = 2$$
7. The ratio is acceptable as it is between 2:1 and 0.02:1.
8. By looking up the Table 3-1, scan down the **Rx Resistor** column and locate the row that includes the 0.001 ohm value in the range and also has a **Ix-max** value greater than or equal to the 100 A. You will notice the row with an **Rs value of 1 ohm** also is within range for an **Ix-max value of 100 A** with an **Rs current** of 100 mA or less.

Rs (Ω)	Rx Resistor (Ω)	I <sub>x</sub> -max (A)	Rs Current (mA-max)	Extender Ratio/Range	Reversal Rate (sec)	Comment
1000	1 - 10	0.32	3.2	20:1 / 3A	60	Limit of 10 mW in Rs
100	0.32 - 1	1	10	20:1 / 3A	60	Limit of 10 mW in Rs
100	0.1 - 0.32	3	9.6	20:1 / 3A	60	Limit of x 20, 3A Range
10	0.32 - 1	0.32	32	20:1 / 3A	60	Limit of 10 mW in Rs
10	0.05 - 0.1	3	30	20:1 / 3A	60	Limit of x 20, 3A Range
1	0.05 - 0.1	1	100	20:1 / 3A	60	Limit of 10 mW in Rs
1	0.01 - 0.05	2	100	20:1 / 3A	60	Limit of 10 mW in Rs
1	0.005 - 0.01	3	30	20:1 / 3A	60	Limit of x 20, 3A Range
100	0.05 - 0.1	10	10	200:1 / 15A	60	Limit of 10 mW in Rs
10	0.05 - 0.1	3.2	32	200:1 / 15A	60	Limit of 10 mW in Rs
10	0.01 - 0.05	6.4	32	200:1 / 15A	60	Limit of 10 mW in Rs
10	0.005 - 0.01	15	15	200:1 / 15A	60	Limit of x 200/15A Range
1	0.005 - 0.01	10	100	200:1 / 15A	60	Limit of 10 mW in Rs
1	0.001 - 0.005	15	75	200:1 / 15A	60	Limit of x 200/15A Range
100	0.005 - 0.01	100	10	2000:1 / 150A	60	Limit of 10 mW in Rs
10	0.005 - 0.01	32	32	2000:1 / 150A	60	Limit of 10 mW in Rs
10	0.001 - 0.005	64	32	2000:1 / 150A	60	Limit of 10 mW in Rs
10	0.0005 - 0.001	150	15	2000:1 / 150A	90	Limit of x2000/150A Range
1	0.0005 - 0.001	100	100	2000:1 / 150A	90	Limit of 10 mW in Rs
1	0.0001 - 0.0005	150	75	2000:1 / 150A	90	Limit of x2000/150A Range
10	0.0005 - 0.001	320	32	20,000:1 / 3000A	90	Limit of 10 mW in Rs
10	0.0001 - 0.0005	640	32	20,000:1 / 3000A	90	Limit of 10 mW in Rs
10	0.00005 - 0.0001	3000	30	20,000:1 / 3000A	90	Limit of x 20k/3000A Range
1	0.00005 - 0.0001	1000	100	20,000:1 / 3000A	90	Limit of 10 mW in Rs
1	0.00001 - 0.00005	2000	100	20,000:1 / 3000A	90	Limit of 10 mW in Rs
1	0.00001 and lower	3000	30	20,000:1 / 3000A	90	Limit of x 20k/3000A Range

**Table 3-1 : 6623A-3000 Recommended Low Ohm Mode Test Setups**

- NOTES:**
1. The last 35 samples of a total of 150 measurement samples should be used to determine the mean measurement value and standard deviation of the sample set, to allow for sufficient stabilization time to achieve the specified uncertainty for the model 6622A Bridge with the 6623A-3000 High Current Range Extender.
  2. Refer to the 6622A Operation Manual for the complete resistance ratio and test current measurement specifications of the 6623A-3000 with the 6622A Bridge in Low Ohms mode of operation.
  3. It is recommended to keep the 6623A-3000 powered off when the instrument is not in use for extended periods of time.
  4. A warm up time of 45 minutes is recommended to meet full specifications.

### 3.2. BRIDGEWORKS DATA ACQUISITION SOFTWARE

The BridgeWorks, version 2.1c or higher, Data Acquisition Software is the control software for the 6622A Series Automatic DCC Resistance Bridges and the 6623A series of Current Range Extenders. Using the 6622A with the BridgeWorks Data Acquisition Software will increase the functionality and the productivity of the bridge. Adding optional 6664C Scanner(s) to work along with 6622A Series bridges and software control will create a fully automated Resistance Measurement System. Before using the 6622A with the computer, ensure that the operation of the software package is well understood. The computer controls the system through the IEEE-488 Interface (GPIB) of the 6622A, and optionally, the model 6664C.

Refer to the BridgeWorks Software User Manual for a description of the software functions and automatic operation of the system under software control.

**Warning:** It is strongly advised that you do not attempt to change any parameters manually while under software control. If manual intervention is viewed as necessary, it should only occur while the software is either closed or displaying an error message.

**Warning:** Do not connect the current terminals of the test resistor through the scanner if test currents above 2 amperes will be selected.



### 4. INSTRUMENT OPERATION

#### 4.1. FRONT PANEL OPERATING PROCEDURE

The 6622A Bridges and 6623A-3000 Current Range Extenders are manually operable from the front panel of the 6622A. The BridgeWorks Software User Manual contains the operating instructions for fully automatic software control of the 6622A Automatic DCC Resistance Bridge and the 6623A-3000 Current Range Extender via the computer system.

The Model 6622A Operation Manual contains the full detailed operating instructions for manual operation of the bridge including the range extender operation.

Section 3 provides basic instructions as a quick guide to making measurements with the 6623A-3000.

**Note: A proper extender profile must have been created in the non-volatile memory of the 6622A Automatic DCC Resistance Bridge for the 6623A-3000. Provision is made in the extender profile for calibration coefficients in regard to test current accuracy and extender ratio accuracy. See section 4.6.6.8.1 of the 6622A Operation Manual for details of checking, modifying and setting up a profile.**

## **5. VERIFICATION AND CALIBRATION**

### **5.1. RATIO ACCURACY VERIFICATION**

This procedure covers the ratio accuracy verification of the 6623A-3000A Current Range Extender. The following procedure can be automated by using a Bridgeworks Data Acquisition Software test sequence if the 6622A Bridge is connected through a 6664C scanner. Note that automatic range selection of the terminals on the 6623A-3000 is not available through Bridgeworks. The current leads must manually be changed over from one range to another as required.

**Do not connect the current terminals of the test resistor through the scanner if test currents above 2 amperes will be selected. Provision is made in the 6622A Bridge Extender Profile for extender test current and ratio calibration correction coefficients.**

#### **5.1.1. Purpose**

The purpose of this procedure is to assure that the 6623A-3000A Current Range Extender meets the manufacturer's specifications. It is recommended that these procedures be performed after any corrective maintenance activity, or if the operator perceives a problem with respect to ratio accuracy. The 6623A-3 is to be verified and calibrated as per the 6623A-3 Operation Manual.

It is recommended that all of these procedures be performed on an annual basis to verify performance of the 6623A-3000 for its recertification. The absolute value accuracy of the specified standard resistor and the shunt resistors to be used in this verification are not of prime importance since the verification is a ratiometric build up process based on an initial ratio measurement using the 6622A Bridge with the 6623A-3 range extender.

The following procedure is to be used to verify the calibration of the High Current Range Extender.

### **5.2. TEST EQUIPMENT REQUIRED**

Test equipment of equivalent performance may be substituted from the list provided.

<b>Description</b>	<b>Model</b>
DC Comparator Bridge	Guildline 6622A
DC Current Range Extender	Guildline 6623A-3
DC Resistance Standard	Guildline 9330/1Ω
DC Current Shunt Standard	Guildline 9230A-100-0.01Ω
DC Current Shunt Standard	Guildline 9230A-300-0.001Ω
DC Current Shunt Standard	Guildline 9230A-1000-0.0001Ω
DC Current Shunt Standard	Guildline 9230A-3000-0.00005Ω
Temperature Controlled Oil/Air Bath	Guildline 5010 or 5032

**Note:** The 6623A-3000 is calibrated at the factory using a temperature controlled oil bath controlled to within  $\pm 0.02$  °C. If the ambient conditions in the laboratory are sufficiently controlled to within  $\pm 0.5$ °C the verification procedure below may be used without an oil bath with precautions that the environment around the standards is kept as stable as possible and the additional uncertainties due to temperature variations is taken into account.

### 5.3. PROCEDURE

#### 5.3.1. PRELIMINARY MEASUREMENT OF THE 9230A-100-0.01Ω SHUNT

1. Place the 9330/1Ω Resistance Standard and the 9230A-100-0.01Ω Current Shunt Standard in the Bath and allow stabilizing in temperature at 25.0°C.
2. Connect the 9330/1 Standard to the 6622A Current Comparator Bridge Rs terminals and connect the 9230A-100-0.01Ω Current Shunt 'C' terminals to the Rx x20-3A terminals of the 6623A-3 and the P terminals to the 6622A Bridge Rx 'P' terminals. See Figure 2-4.
3. Measure and record the ohms value of the 9230A-100-0.01Ω Shunt Resistance using a current of 3A and reversal rate of 60 seconds. Ensure that adequate time is allowed for full stabilization of the measurement. Only the last 35 measurement samples of a full stabilization period of 150 samples is to be used to determine the measurement value and associated standard deviation of the sample set.
4. Note: The 6623A-3000 is not in operation with the 6622A Bridge at this step. See the 6622A Operation Manual for proper operation of the 6622A Automatic DCC Comparator Bridge and the 6623A-3 Operation Manual for the proper operation of the 6623A-3 Range Extender.

#### 5.3.2. VERIFICATION OF THE x200-15A RATIO OF THE 6623A-3000 RANGE EXTENDER

1. Remove the leads from the 6623A-3 Extender x20-3A range terminals and connect to the 6623A-3000 Current Range Extender C1 and C2 terminals of the x200-15A Range.
2. Ensure that 6623A-3000 Current Range Extender is connected to the 6623A-3 Extender with the 7 conductor cable provided with the 6623A-3000. (See Figure 2-5)
3. Set the 6622A Bridge, using the front panel menu or software control, for a measurement in 'Low Ohms' mode with the '6623A-3000A' selection, ratio of 200, a reversal rate of 60 seconds and a 'Test Current' of 3A as in 5.3.1. above.
4. Set the 6622A Comparator Bridge for 'MEAS ON'.
5. Measure and record the ohms value of the 9230A-100-0.01Ω Shunt. Ensure that adequate time is allowed for full stabilization of the measurement. Only the last 35 measurement samples of a full stabilization period of 150 samples is to be used to determine the measurement value and associated standard deviation of the sample set.
6. Compare the result with the result of 5.3.1. The ratio difference is to be less than  $\pm 0.99 \mu\Omega/\Omega$  when a 'B' or 'XR' 6622A Bridge is used and  $\pm 0.85 \mu\Omega/\Omega$  when a 'XP', 'XPR' or 'HV' bridge is used to make the measurements.
7. Note that if the difference exceeds the limit, repeat the measurement in 5.3.1. and use the average of the two measured values in the comparison as a means for compensating for any temperature variations over the measurement period.

- Note that the verification of the test current magnitude of the x200-15A range may be accomplished at this point by measurement of the voltage across the potential terminals of the shunt and calculating the test current value based on the measured resistance of the shunt over the range of test currents.

### **5.3.3. VERIFICATION OF THE x2000-150A RATIO OF THE 6623A-3000 RANGE**

- Replace the 9230A-100-0.01 $\Omega$  Shunt with the 9230A-300-0.001 $\Omega$  Shunt.
- Measure and record the ohms value of the 9230A-300-0.001 $\Omega$  Shunt on the 6623A-3000 Extender x200-15A range as in 5.3.2. but use a test current value of 15A. Ensure that adequate time is allowed for full stabilization of the measurement. Only the last 35 measurement samples of a full stabilization period of 150 samples is to be used to determine the measurement value and associated standard deviation of the sample set.
- Move the leads from the 6623A-3000 Extender x200-15A range terminals to the x2000-150A range terminals as shown in Figure 5-1.
- Measure and record the ohms value of the 9230A-300-0.001 $\Omega$  Shunt again but select the Extender Ratio value of x2000 in the 6622A menu and use a test current value of 15A.
- Compare the results of the two measurements. The difference is to be less than  $\pm 1.13 \mu\Omega/\Omega$  when a 'B' or 'XR' 6622A Bridge is used and  $\pm 0.99 \mu\Omega/\Omega$  when a 'XP', 'XPR' or 'HV' bridge is used to make the measurements.
- Note that if the difference exceeds the limit, repeat step 5.3.3.2 and use the average of the two measured values in the comparison as a means for compensating for any temperature variations over the measurement period.
- Note that the verification of the test current magnitudes of the x2000-150A range may be accomplished at this point by measurement of the voltage across the potential terminals of the shunt and calculating the test current value based on the measured resistance of the shunt over the range of test currents.

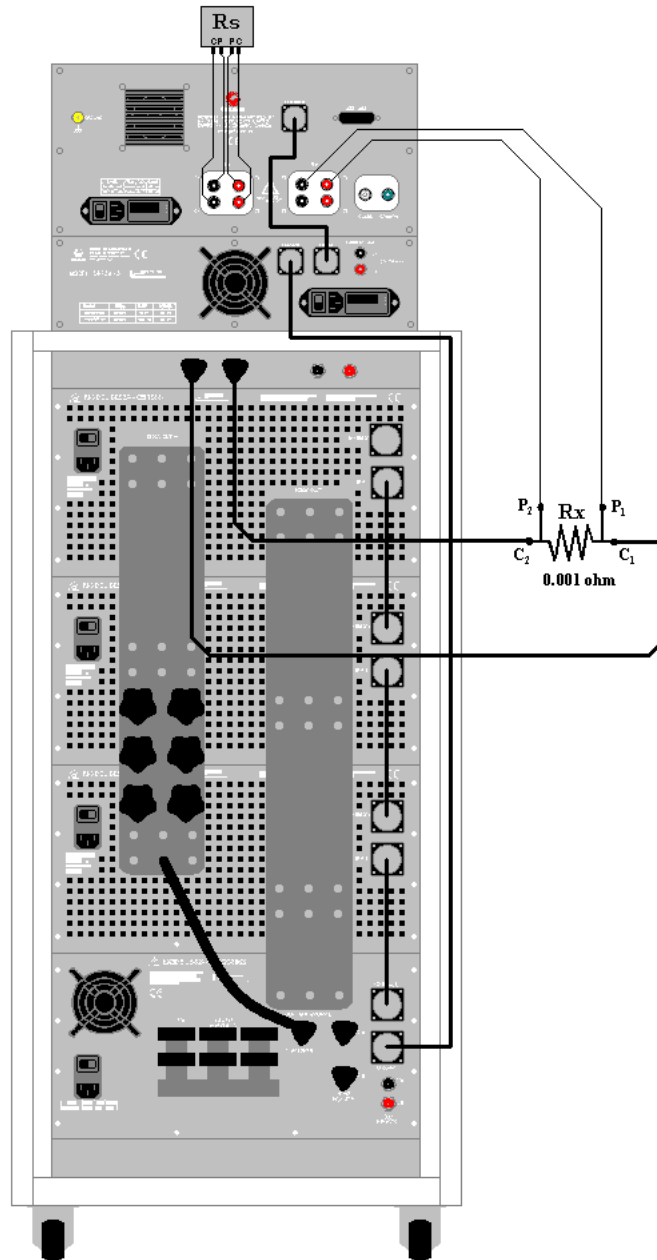


Figure 5-1 : Model 6623A-3000 setup, x2000-150A Range

### 5.3.4. VERIFICATION OF THE x20,000-3000A RATIO OF THE 6623A-3000 RANGE EXTENDER

1. Replace the 9230A-300-0.001Ω Shunt with the 9230A-1000-0.0001Ω Shunt.

2. Measure and record the ohms value of the 9230A-1000-0.0001 $\Omega$  Shunt on the 6623A-3000 Extender x2000-150A range as in 5.3.3. but use a test current value of 150A. Ensure that adequate time is allowed for full stabilization of the measurement. Only the last 35 measurement samples of a full stabilization period of 150 samples is to be used to determine the measurement value and associated standard deviation of the sample set.
3. Move the leads from the 6623A Extender x2000-150A range terminals to the x20,000-3000A range terminals as shown in Figure 5-2.
4. Measure the value of the 9230A-1000-0.0001 $\Omega$  Shunt as in 5.3.4.2, but select the Extender Ratio value of x20,000 in the 6622A menu and use a test current value of 150A. Record the result of the measurement.
5. Compare the results of the measurements. The difference is to be less than  $\pm 1.6$   $\mu\Omega/\Omega$  when a 'B' or 'XR' 6622A Bridge is used and  $\pm 1.4$   $\mu\Omega/\Omega$  when a 'XP', 'XPR' or 'HV' bridge is used to make the measurements.
6. Note that if the difference exceeds the limit, repeat step 5.3.4.2 and use the average of the two measured values in the comparison as a means for compensating for any temperature variations over the measurement period.
7. Note that the verification of the test current magnitudes of the x20,000-3000A range may be accomplished at this point by measurement of the voltage across the potential terminals of the shunt and calculating the test current value based on the measured resistance of the shunt over the range of test currents. Note that a calibrated current shunt that is suitable for use at the high end of the current range will be required such as the Guildline model 9230A-3000-00005 $\Omega$ .

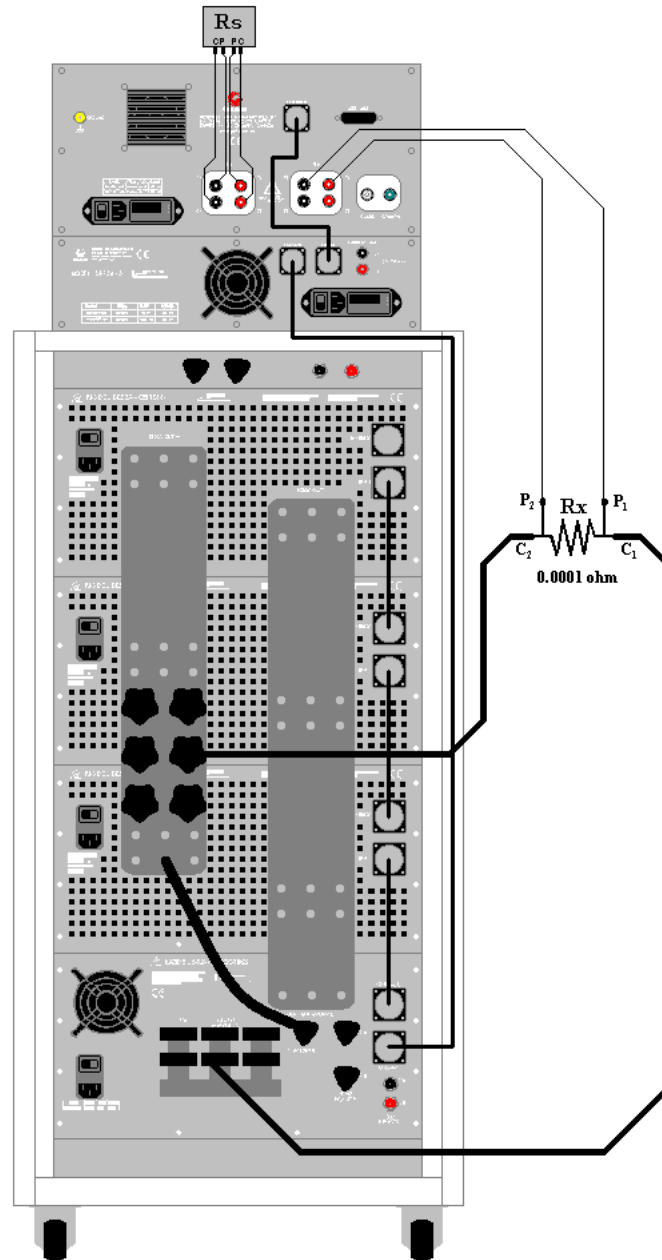


Figure 5-2 : Model 6623A-3000 setup, x20000-3000A Range

# 6. TROUBLESHOOTING AND MAINTENANCE

## 6.1. INTRODUCTION

This section covers troubleshooting, repair and verification of the 6623A Current Range Extender.

### 6.1.1. Error Messages

The 6622A Automatic DCC Resistance Bridge will display error messages either on the front panel display of the 6622A Resistance Bridge in manual mode or on the computer monitor when using the BridgeWorks Data Acquisition Software. The error messages may relate to faulty operation or setup of the 6623A-3000 Current Range Extender. The error messages and their corrective measures are summarized in Table 6-1. See also of the BridgeWorks Software User Manual. The 6622A will display the error messages until the next GPIB or keyboard event. The BridgeWorks Data Acquisition Software will display the error messages until acknowledged by the user.

### 6.1.2. Model 6622A Setup Warnings

The model 6622A Resistance Bridge provides limit checks for variables that can be setup during the configuration of a measurement including configuration of the Low Ohms mode using the 6623A-3000 Current Range Extender. Below is a listing of the warnings that may appear on its display in manual operation or on the computer monitor when the BridgeWorks Data Acquisition Software is used. Corrective measures can be made as appropriate before the measurement or other function is initiated. See also the BridgeWorks Software User Manual. The model 6622A will display the warning messages until the next GPIB or keyboard event. The BridgeWorks Data Acquisition Software will display the warning messages until acknowledged by the user.

- Reversal Rate too low or not set!! Minimum reversal rate is 4 seconds!!
- Rs value has not been set!!
- Extender Ratio not set
- Test Value not set
- Max Test Value has not been set
- Test Value Exceeds Max Test Value
- Test Value Exceeds Maximum Current Output!!
- Test Value is below minimum current output!!!
- Maximum Current Value exceeds Maximum Current output!!!
- Set internal Values. **“CAUTION: This menu allows full control of the model 6622A and 6623A. Great care should be taken when using these functions.”**
- Self test not completed.



Error Number	Error	Corrective Measures
0	nV Detector Communication Failure	<b>None</b> , fatal hardware error within the 6622A Bridge, (try power switch)
1	Invalid Test Setup	Resistors not wired to Rx and Rs terminals properly, improper test setup
2	Servo Railed	No current path on Rx or Rs terminals, improper connections or 6623A failure
3	Nano Zero, nVoltmeter not responding	Cycle power switch, else fatal hardware error, 6622A failure
4	Null out of Range	Autoranger having problems, so enter in approximate ratio
5	Max Test Exceeded	Exceeded max current on Rx or Rs resistor
6	EEROM Failure, Resetting all values to default	Corrupted or lost stored configuration data in 6622A. You will need to reset your GPIB address to 4 (refer to 6622A Operators Manual, sections 4.6.6.1 and 6.1.4) then run the "Coefficient" utility located in the "Utilities" menu of the BridgeWorks Data Acquisition Software.
7	Not implemented	
8	Nano Railed, Out of Nanovoltmeter range	Resistors not wired to Rx and Rs terminals properly, invalid Test setup
9	Failed Self Test	<b>None</b> , fatal 6622A power on error (try power switch)

**Table 6-1 : Model 6622A and 6623A-3000 Error Messages**

**Note:** The “Coefficient” utility described for error 6 is a dedicated program that can read in the stored ratio correction coefficients as well as load them into the 6622A Bridge. It can also store and load these values in a file as well as print them out. If error number 6 occurs, you should use this utility to verify that your 6622A has the proper coefficients loaded, by cross referencing them to the coefficient printout supplied with your system. If they are wrong, re-enter the correct values and update your 6622A bridge to reflect these coefficients. This will return the bridge's alignment to the "as shipped" settings.

### 6.1.3 Model 6623A and CS1000 'Fault' Indicators

The Fault indicator on the DCC3000 front panel will light up whenever an error condition is detected in the comparator circuit. The Fault indicator of the CS1000 current sources will light up when fault is detected with the master current source module. This may be due to improper connections to the range extender, improper measurement setup or and actual circuit failure. There are a set of 6 yellow indicators visible within the front grill of each CS1000 which will indicate when a fault is experienced in any of the slave 150 A current source modules. Note that when a fault is detected on a particular current source module only that module is disconnected from the current output bus. The remaining units will continue to operate but the total current output will be proportionally reduced.

### 6.1.4 Maintenance

Preventive maintenance is limited to checking the instrument operation, test current accuracy, cooling fan operation and making sure that the air filter screens are clean. The air filter screens can be removed and cleaned on a yearly basis or may be required.

The Service Manual available on request from Guildline Instruments Limited provides complete alignment and test information required if the 6623A-3000 fails to meet performance specifications in section 5.

### 6.1.5 Maintenance Guidelines and Schedule

The following section provides a guide to problem diagnosis and a schedule for maintenance. It is recommended that verification of the range extender be performed annually or whenever it is apparent that measurements may be out of specification. Under certain circumstances where verification fails then the range extender alignment should be checked and adjustments made as required. Specific verification procedures are provided in section 5 of this manual. Detailed alignment, repair and calibration procedures are found in the Service Manual.

Maintenance Item	Procedure	Interval
Measurement Error Messages	Follow guidelines in this section 6.1.1	As may be required
System Setup Warnings	Follow guidelines in this section 6.1.2	As may be required
Low Ohms Measurement Failures	Check cable/terminal connections, range extender fault indicator and perform range extender checks	As may be required
General Checks	Check cooling fans/screens and cable connections and fault indications	Every 3 months
Range Extender Accuracy	Perform Range Extender Verification	Annually
Range Extender Long Term Maintenance	Perform Range Extender Alignment Check and Calibration/Verification	Every 3 years

**Table 6-2 : Maintenance Schedule**

### 6.1.6 Connection Problems

Connection problems can be resolved by measuring the voltages on the potential terminals of the shunt resistance and that of the reference resistor and by observing the displayed test current on the bottom right of the bridge display.

Connect a suitably accurate DVM to the bridge front panel RxP1 and RxP2 terminals. When initiating the measurement, observe that the RxP2 terminal voltage is positive with respect to the RxP1 terminal and is of a value equal to the test current times the shunt resistance value and agrees with the displayed value.

Also measure the voltage across the RsP1 and RsP2 terminals, while the bridge displayed current is still positive, and observe that the RsP2 terminal is also positive with respect to the RsP1 terminal and is approximately equal to that of the voltage on the shunt resistance.

If the polarity of the displayed current on the bridge is not initially positive this indicates a problem within the range extender internal connections. Contact Guildline Instruments to resolve this particular problem.

If the polarity on bridge Rx P terminals is not initially positive when the measurement is initiated, this indicates most likely an error has been made in connecting the current terminals of the shunt to the range extender C terminals or the potential terminals of the shunt to the bridge front panel Rx P terminals. Check the connections.

Similarly if the polarity of the Rs P terminals is not initially positive as well, there is most likely an error in the connections of the reference resistor to the bridge Rs terminals.

### 6.1.7 Safety Features

The 6622A Bridge will automatically prevent the initiation of a measurement or stop a measurement in progress and shut down the current sources of the 6623A-3000 when an error is detected. **Always ensure that test current cables are tightly attached to the 6623A output terminals and the shunt resistor under test. Severe arcing and burning can occur if cable connections are not tight.**

## 7. APPENDICES

### 7.1. GENERAL SPECIFICATIONS

6623A-1000/2000/3000 Current Range Extender General Specifications		
Operating Temperature to Full Specification	+23 ± 4	°C
	+73 ± 7	°F
Operating Temperature Maximum Range <50% RH	+10 to +40	°C
	+50 to +104	°F
Storage Temperature Maximum Range	-20 to +60	°C
	-4 to +140	°F
Operating Humidity	20 to 70	% RH
Storage Humidity	15 to 80	% RH
Power Requirements (Maximum): 1000 A	2800	VA
Power Requirements (Maximum): 2000 A	4900	VA
Power Requirements (Maximum): 3000 A	7200	VA
Voltage Requirements (1)	220 - 240 ±10%	VAC
Line Frequency	50 ±5% or 60 ±5%	Hz
Weight: 1000 A	410/168	lbs/kg
Weight: 2000 A	500/227	lbs/kg
Weight: 3000 A	590/268	lbs/kg
Dimensions	D 826 , W 552 , H 1135	mm
	D 32.5 , W 21.8 , H 44.7	in

**Table 7-1 : General Specifications**

**NOTE: 1. The 6623A-3000 Current Range Extender is always configured for 208 to 240 VAC 50/60 Hz operation at the point of shipment. No voltage selection is required in this range.**

## 7.2. GENERAL SPECIFICATIONS (continued)

6623A-1000/2000/3000 Current Range Extenders General Specifications			
Resistance Range		0.1 $\mu$ to 10	$\Omega$
Transformation Ratios		200:1, 2000:1, 20,000:1	
Transformation Ratio Accuracies		$\pm 0.4, \pm 0.5, \pm 0.6$ <sup>1</sup>	ppm
Linearity		$\pm 0.02$ <sup>1</sup>	ppm of full scale ratio
Temperature Coefficient		$\pm 0.02$ <sup>1</sup>	ppm/ $^{\circ}$ C
Warm-up time to full rated accuracy		45	Minutes
Test Current Programmed through the 6622A Bridge and 6623A-3 Range Extender	15A Range	$\pm 3$ to $\pm 15$	A
	150A Range	$\pm 15$ to $\pm 150$	A
	1/2/3000A Range	$\pm 150$ to $\pm 1/2/3000$	A
	15A Compliance	+/-7.5	V
	150A Compliance	+/-1.5	V
	1/2/3000A Compliance	+/-1.5	V
	1/2/3000A Power Limits	1500/3000/4500	W
	15A Accuracy	$\pm 0.3 \pm 5$ <sup>1</sup>	% + mA
	150A Accuracy	$\pm 0.3 \pm 30$	% + mA
	1/2/3000A Accuracy	$\pm 0.35 \pm 150$	% + mA
15A Stability (10 Min.)	$\pm 0.03 \pm 2$	% + mA	
150A/3000A Stability (10 Min.)	$\pm 0.04 \pm 10$	% + mA	

Note 1: Accuracies and Coefficients expressed as a total uncertainty with a coverage factor of k = 2.

**Table 7-2 : General Specifications (continued)**

## 7.3. RESISTANCE MEASUREMENT SPECIFICATION

The ratio transformation accuracies specified in table 7-2 apply only to the range extender current division accuracy and does not apply to the overall resistance measurement accuracy as used with the 6622A Series of DCC Bridges.

Refer to the 6622A Operation Manual for the combined resistance measurement specification of the 6623A-3000 with the 6622A Series of DCC Bridges in Low Ohms mode of operation. Resistance measurement accuracy varies with the various 6622A models.