

GUILDLINE

INSTRUMENTS

Operation Manual

For The

6623A-3

High Current Range Extender

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**OM6623A-3-C1-00
01 September 2021**

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1. INTRODUCTION

1.1. SCOPE

This document describes the installation, operation, specifications, maintenance and verification of the 6623A-3 High Current Range Extender for the 6622A series of Automatic DCC Resistance Bridges.

1.2. GENERAL DESCRIPTION

The model 6623A-3 High Current Range Extender is designed to extend the test current and measurement range of the Guildline Instruments 6622A series of Automatic DCC Resistance Bridges.

The extender is essentially a direct current transformer with a primary winding which produces an output current that varies directly proportional to the input current. The winding provides a transformation ratio of 20:1 and allows for measurements to be performed above the 150 mA capability of the DCC Resistance Bridge up to a maximum of 3 Amperes.

The 6623A-3 design allows measurements to be made that reduces thermal and current offset effects with the inclusion of a electronically switched current source and includes all the control circuits necessary for complete control through the 6622A series of bridges.

Provision is also made for connection to higher current cascaded extenders, above 600 Amperes, which provide for complete control through the 6622A series of bridges as well. High current extension can be accommodated up to 3,000 Amperes using the DCC3000 Current Comparator. No ancillary components such as external current sources or current reversal relays are needed for full utilization of the 6623A series of current range extenders.

All necessary interconnections of the current sources are integrated into the chassis 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 of the 6623A-3 or the higher current cascaded models above 600 Amperes.

The 6623A-3 and the cascaded units are fully programmable via the 6622A series of bridges with the system or via software if automation is desired. The programming is accomplished via the Bridge's Low Ohms menu. Programming includes selection of the current ratio, (current output), automated reversal rates, and actual required test current output(s).

1.3. OVERVIEW

The Model 6623A-3 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 extender is connected to the 6622A Bridge using a seven conductor shielded cable with circular connectors.

No adjustments of the 6623A-3 High Current Range Extender are required for proper operation, but the 6622A Bridge must be set up with a specific range extender profile. The 6622A Bridge is generally configured at the factory for a specific 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.

The 6623A-3 High Current Range Extender is also provided with all the necessary connections required to control and interconnect a cascaded Range Extender above 600 Amperes up to a limit of 3,000 Amperes. The interconnections are provided through a second seven conductor shielded cable from the 6623A-3 to the higher current unit.

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 imbalance is indicated by the detector output both in magnitude and polarity.

The peak detector drives a servo circuit 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 to 1. The same circuit also maintains ampere-turn balance when a cascaded higher current extender is connected through a second primary winding.

The 6622A Bridge provides a drive signal to the programmable current source as to allow test currents of 100mA to 3000mA to be realized. This current is directed to the primary winding 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. Refer to the specific 6623A manual for the high current extender models above 600 Amperes for operation details.

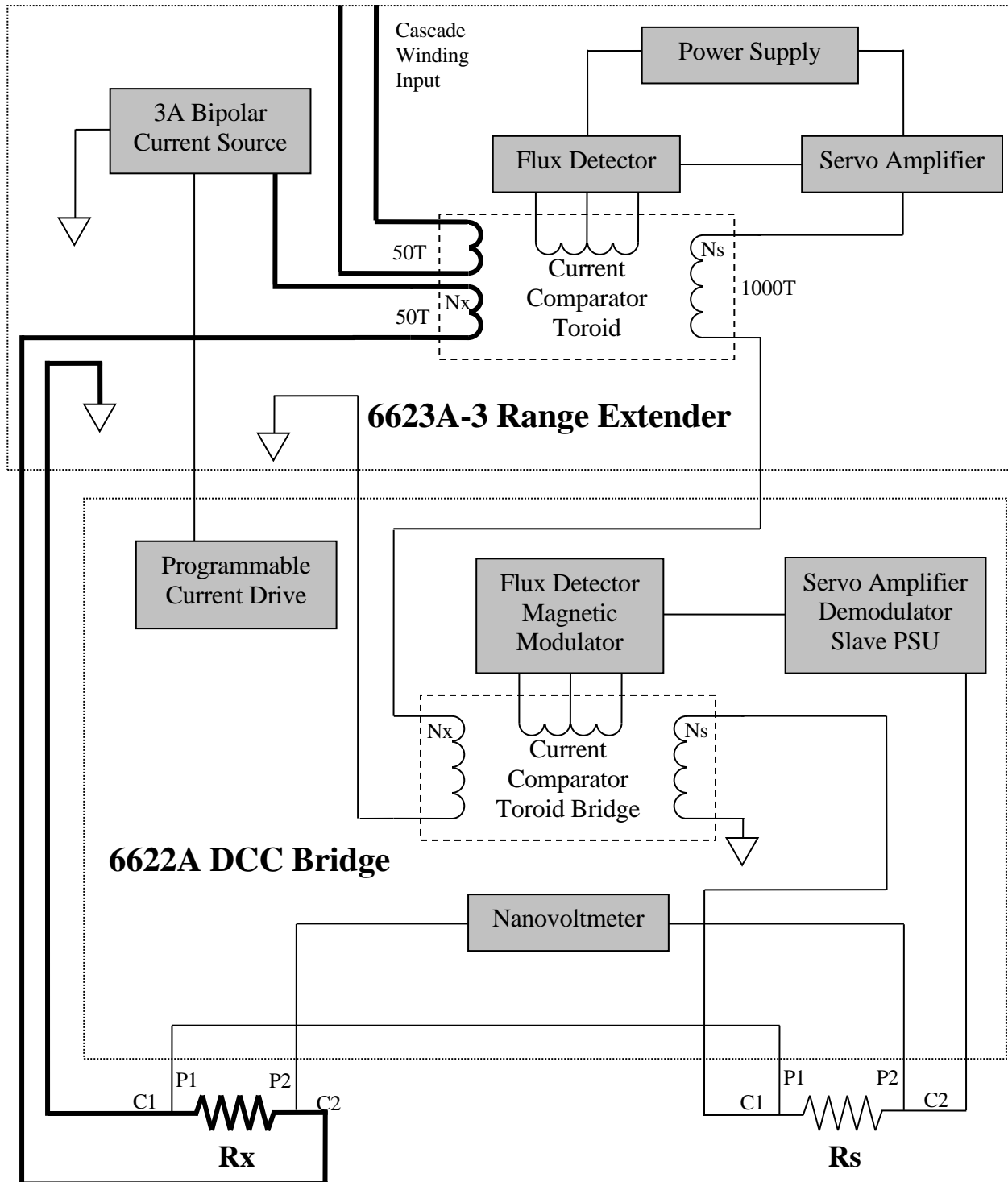


Figure 1-1 : Model 6623A-3 with 6622A Block Diagram

2. INSTALLATION

2.1. PRELIMINARIES

2.1.1. Unpacking

- a. Remove the 6623A-3 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
 - i. Operation Manual (OM6623A-3)
 - ii. Two Spare Fuses 1A, (T) (GPN# 099-21000)
 - iii. Two Spare Fuses 1/2A, (T) (GPN# 099-20120)
 - iv. Two SCW Lead, 2m (GPN# 20236.04.02)
 - v. One 20A, 1.5m red connection cable (GPN# 996-00105)
 - vi. One 20A, 1.5m black connection cable (GPN# 996-00104)
 - vii. 7 conductor, 2m bridge connection cable (GPN# 20212.04.02)
 - viii. AC Line Cord (GPN# 250-04030)
 - ix. Socket screw key, 5/64 (GPN# 950-61905)
 - x. Termination Plug (GPN 31061-01-09), must be installed on back panel of the unit.

2.1.2. Power Voltage Selection

The 6623A-3 Current Range Extenders are shipped with the line input voltage set to 240 V. The line input selector must be set to the correct line voltage and the correct fuse must be installed before power is applied to the instrument. The 6623A-3 has a voltage selection which must be set correctly. The settings available are 100 V, 120 V, 220 V, and 240 V. Figure 2-1 details the line input voltage selector settings and fuse requirements.

Where the molded plug on the line cord supplied with the instrument does not match the local power outlet socket, the plug can be removed and replaced with one that does fit the local service. The plug should be re-wired as follows:

Brown wire	-	Line input
Blue wire	-	Neutral input
Green/Yellow	-	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.

FUSES (TIME DELAY TYPE)			
100 V	120 V	220 V	240 V
1A, 250V, (T)	1A, 250V, (T)	1/2A, 250V, (T)	1/2A, 250V, (T)

Table 2-1 : Fuse Ratings

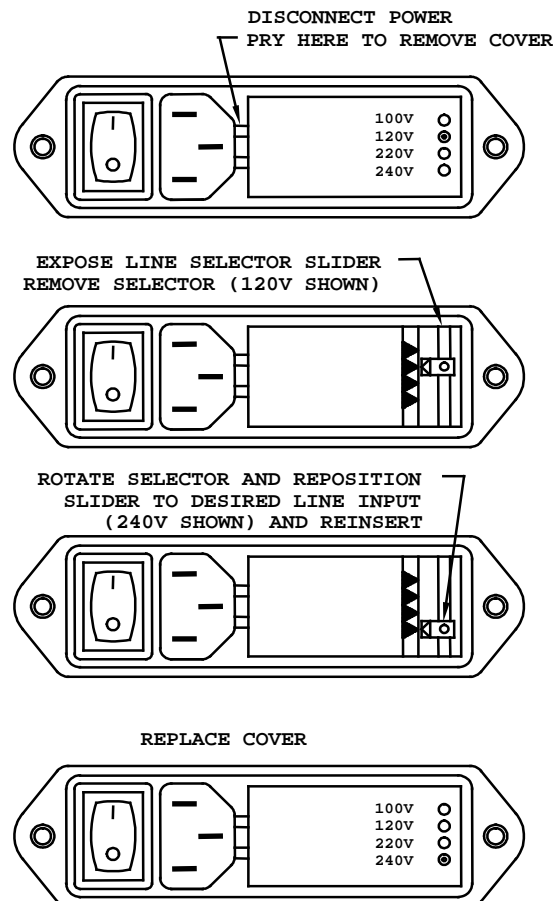


Figure 2-1 : Line Voltage Selector

2.1.4. Setup and Power On

- a. Verify that the power switch is off and that the termination plug from the spare parts kit, GPN 31061-01-09, is connected to the 'Cascade' connector on the back panel.
- b. Remove any excess packing materials from around the front and back panels that are provided for shipping purposes only.
- c. Connect the extender to the 6622A Bridge using the 7 conductor cable with the circular connectors. One end marked 'BRIDGE' is to be connected to the circular connector on the back panel of the 6622A Bridge marked 'EXTENDER' and the other end to the circular connector of the 6623A-3 marked 'BRIDGE'.
- d. Set the line input selector to the correct line voltage and install the correct fuse before power is applied to the instrument as shown in Section 2.1.2.
- e. Connect the input power cord from the 6623A-3 to the AC power outlet.
- f. Turn on the power switch to the 6622A Bridge.

Note: Do not power on the 6623A-3 with a shunt connected to one of the ranges on the back panel.

- g. Turn on the power switch on the 6623A-3 High Current Range Extender. You should see the red 'POWER' indicator on the front panel light up.
- h. The system should now be ready to use. Refer to section 2.2 to complete a functional test of the 6623A-3 High Current Range Extender.
- i. Note that the operator must be familiar with the various modes of operation of the 6622A Bridge before using the 6623A-3 High Current Range Extender. The 6622A Operation Manual should be reviewed before proceeding.

Note 1: Do not connect the current terminals of the test resistor through a scanner if test currents above 2 amperes will be selected.

2.2. INCOMING INSPECTION

If no errors are displayed during power up of the 6622A Bridge and Range Extender, (see section 2.1.4g) 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 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 should be connected to the resistor being measured.

Note 1: A proper extender profile must have been created in the non-volatile memory of the 6622A Bridge for the 6623A-3 High Current Range Extender before proceeding.

Note 2: Do not power on the 6623A-3 with a shunt connected to the back panel. Powering on the Range Extender with a load can cause a fault to occur. Refer to section 2.3.2 for Fault Indications.

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 High Current Range Extender at the same current level. The difference between the two measurements must be within specified limits to qualify the functionality of the x20-3A range of the 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.

- 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 60 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 ohm 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 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-3A' 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 0.1 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.
- Select the down arrow key to highlight the next line.
- 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 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 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 ohm 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 +/- 0.00001 ohm.

Step 10) The leads may now be disconnected.

Note: The test should execute with no measurement errors indicated and should indicate an ohm value of approximately 0.1000 ohm depending on the actual values of the standards. This is not the 6623A-3 full rated accuracy but serves a functional test for the purposes of determining the instrument has been received in proper working order.

2.3. 6623A-3 FRONT PANEL

There are no controls on the front panel of the 6623A-3.

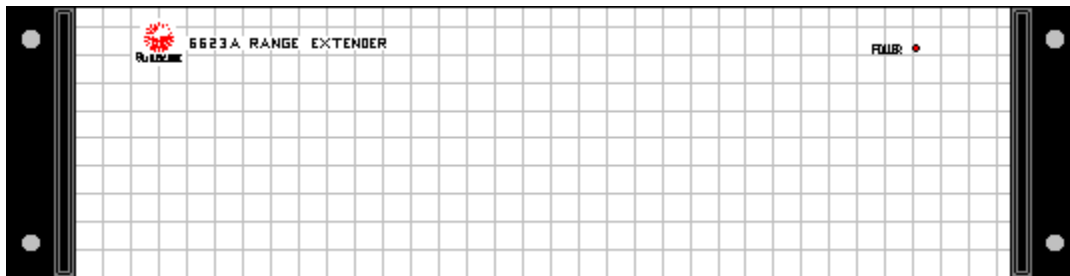


Figure 2-2 : 6623A-3 Front View

2.3.1. Power

The power-on indicator is lighted when the AC power is applied to the unit and the power switch on the rear panel is 'ON'.

2.4. 6623A-3 REAR PANEL CONNECTORS AND CONTROLS

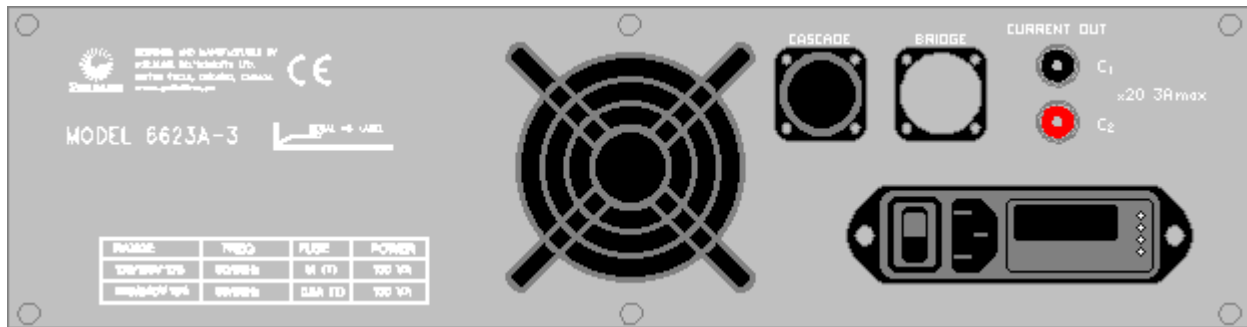


Figure 2-3 : 6623A-3 Rear View

2.4.1. Line Input Connector

The **Line Input Connector** is a combination of a 3-prong AC standard male connector, an ON/OFF switch and a fused input line voltage selector. The input line's voltage selector consists of a four-position selector and a fuse holder. The selector allows switching between the four possible voltages: 100V, 120V, 220V and 240V. A 1 Amp time delay fuse is provided for the 100/120 V operation and a 1/2 Amp time delay fuse is provided for the 220/240 V operation. The voltage selector and the fuse are set for the 240V operation unless it is requested otherwise.

2.4.2. Resistor Under Test Input Terminals

The Test Resistor's current input terminals consist of 2 binding posts. These binding posts are labeled as C1 and C2. These terminals are to be connected to the C1 and C2 terminals of the Resistor under Test whenever the Range Extender is to be used. The potential terminals of the Test Resistor are always to be connected directly to the Rx P1 and P2 terminals of the 6622A Bridge or through a channel of a 6664C scanner.

Do not power on the 6623A-3 with a shunt connected to the terminals on the back panel.

2.4.3. Bridge Connector

The Bridge connector is a 7 pin circular connector which is used to connect the necessary signals to the model 6622A Bridge.

2.4.4. Cascade Connector

The cascade connector is a circular connector which is used to connect the necessary signals to cascaded higher current range extenders such as the DCC3000 along with associated CS1000 current sources. Whenever the 6623A-3 is used separately, a termination plug, GPN 31061-01-09, must be installed to allow proper operation of the internal current source. Otherwise the termination plug must be installed on the last CS1000 current source 'OUTPUT' connector of the system.

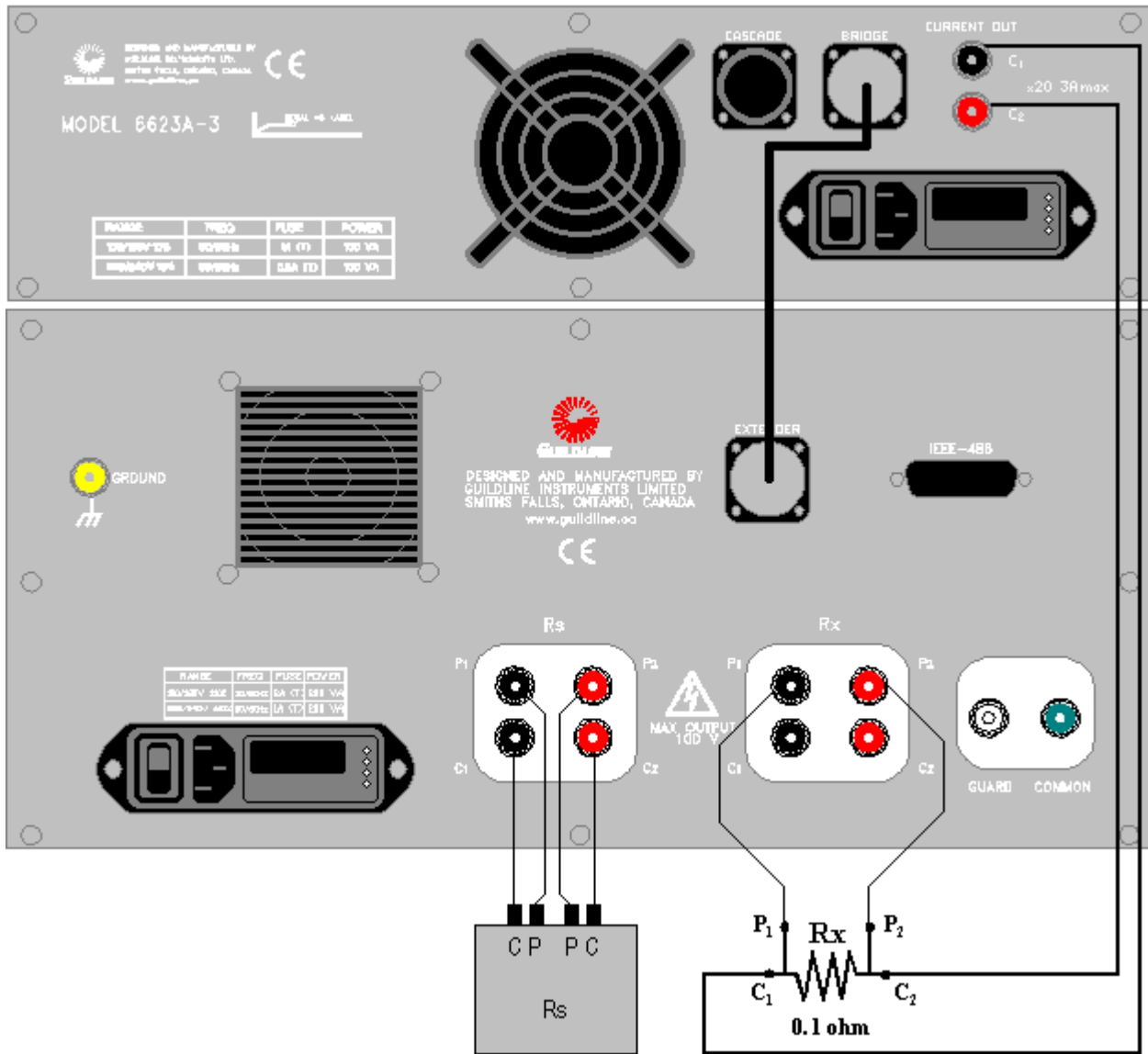


Figure 2-4 : Rear Panel Connections – Low Ohm Mode with 6623A-3

3. QUICK MEASUREMENT GUIDE

3.1. MEASUREMENT OPERATION GUIDE

This section contains information regarding the measurement of resistors in the range of 1m ohm to 10 ohm. This guide is provided for manual front panel control of the 6622A bridge. An operation guide for full automatic control of the 6622A Bridge, through the terminal of the system computer, is provided in the BridgeWorks, version 2.1b or higher, Software User Manual.

A typical example of a resistance measurement response versus test sample is illustrated in Figure 3-1.

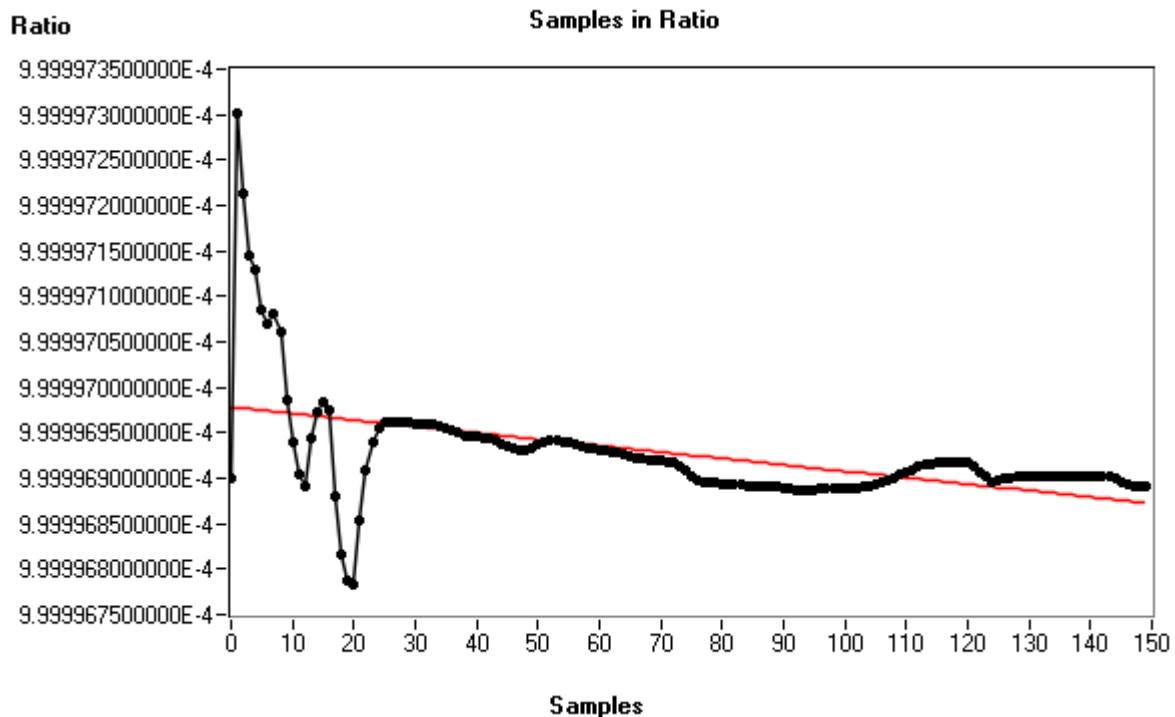


Figure 3-1 : Resistance Measurement Response Versus Test Sample

NOTE: 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-3 Range Extender.

3.1.1. Low Ohm Mode Resistance Measurement for all 6622A Models with 6623A-3

The 6622A in its Low Ohm Mode enables measurement of resistors below 100 ohm. When used with a model 6623A-3 Current Range Extender, measurement of low ohm resistors can be made at a maximum test current up to 3A.

Cautions:

1. **Do not cycle the power on the 6623A-3 with a shunt or load connected to the back panel. Connect the load AFTER the 6623A-3 is turned on. Disconnect the load BEFORE turning off the 6623A-3.**
2. **Do not connect or disconnect the load when the measurement is running.**
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 30 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-3 High Current Range Extender. The 6622A Bridge Operation Manual 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, reference standard, and the 6623A-3 range extender. Turn on the bridge first, then turn on the 6623A-3 range extender, then connect the load (e.g. shunt or UUT). The connections should be as shown in the Figure 2-4 connection diagram. Use appropriate leads to carry the 3A current 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. For Measurement of low ohm UUT, usually a 1 Ω reference is chosen unless the UUT resistor is higher than 0.1 ohm.

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-3A'. Make sure the '6623A-3A' mode is selected. This can be done by pressing the softkey until the displayed value is changed to '6623A-3A'.
- 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.
- The standard resistor serial number may be entered 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.
- Select the down arrow key to highlight the next line.
- For the model 6623A-3 range extender, enter the test current (for the resistor to be measured) in Amps up to 3A.
- Select the down arrow key to highlight the next line.
- 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. The bridge measurement may be stopped by pressing the 'Meas On' menu key.

3.1.2. Recommended Test Setup Limits for 6623A-3

See Table 3-1 for the recommended test setups. The current in the standard resistor is limited to a maximum of 150mA. 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 (R_x / R_s)

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

2. $R_s \geq 10 \times R_x$

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

3. Bridge Ratio = $(R_x \times 20) / R_s$

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 current leads suitable to handle the maximum test current.
- Refer to the Table 3-1 to select the most suitable reference resistor value for the measurement.
- Verify that the bridge ratio will be within limits as noted in 3.1.2.
- Verify that the reference resistor current will not exceed 10 mW dissipation limits.
- Ensure that all current lead connections are tight
- On startup first turn on the bridge or 66259 stand-alone controller, then turn on the range extender, then connect the load (i.e. shunt or resistance standard), then start the measurement
- On shutdown first stop the measurement, turn off the range extender, disconnect the load (i.e. shunt or resistance standard), then turn off the bridge or 66259 controller
- Do NOT connect or disconnect the load (e.g. shunt or resistance standard) when the measurement is running

3.1.4. Example Calculations

For example, if a 0.1 ohm shunt is to be measured at 3 A;

1. **The extender range x20-3A** can satisfy the test current requirement.
2. The standard resistor must be at least; **$R_s = 20 \times 0.1 / 2 = 1 \text{ ohm}$** or higher, so choose a standard resistor initially of at least 1 ohm.
3. The standard resistor test current will be;
 $I_s = 3 \times 0.1 / 1 = 0.3 \text{ A}$
4. The power dissipation level will be;
 $W_s = 0.3 \times 0.3 \times 1 = 0.03 \text{ Watts.}$
5. Since this dissipation level is greater than 10 mW and that the maximum **I_s** current is 0.15 A, then a higher standard resistor of 10 ohms should be used.
6. The **bridge ratio** then will be;
 $\text{Ratio} = 0.1 \times 20 / 10 = 0.2$
7. The standard resistor test current will then be;
 $I_s = 3 \times 0.1 / 10 = 0.03 \text{ A}$
7. The bridge ratio is also acceptable as it is between 2:1 and 0.02:1.
8. Using Table 3-1, scan down the **R_x Resistor** column and locate the row that includes the 0.1 ohm value in the range and also has a **I_x -max** value equal to the 3 A. You will notice the row with an **R_s value of 10 ohms** also is within range for an **I_x -max value of 3 A** with an **R_s current** of 30 mA or less.

Rs (Ω)	Rx Resistor (Ω)	I _{x-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 Current Source
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 Current Source
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 Current Source
1	0.001 - 0.005	3	3	20:1 / 3A	60	Limit of Current Source

Table 3-1 : 6623A-3 Recommended Low Ohm Mode Test Setup

NOTE: 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-3 High Current Range Extender.

NOTE: 2. Refer to the 6622A Operation Manual for the complete resistance ratio and test current measurement specifications of the 6623A-3 with the 6622A Bridge in Low Ohms mode of operation.

3.2. BRIDGEWORKS DATA ACQUISITION SOFTWARE

The BridgeWorks, version 2.1b 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 model 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 Scanner.

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-3 High 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-3 Range Extender via the computer with one or more model 6664C Scanners.

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

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

Note: A proper extender profile must have been created in the non-volatile memory of the 6622A Automatic DCC Resistance Bridge for the 6623A-3. 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 or creating an extender profile as may be required.

5. VERIFICATION AND CALIBRATION

5.1. RATIO ACCURACY VERIFICATION

This procedure covers the ratio accuracy verification of the 6623A-3A 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.

Do not connect the current terminals of a 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 factors.

5.1.1. Purpose

The purpose of this procedure is to assure that the 6623A-3A 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.

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

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

5.2. TEST EQUIPMENT REQUIRED

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

Description	Model
DC Comparator Bridge	Guildline 6622A
DC Resistance Standard	Guildline 9330/1Ω
DC Current Shunt Standards	Guildline 9230A-30-0.1Ω
Temperature Controlled Oil or Air Bath	Guildline 5010, 5031 or 5032
PC with BridgeWorks Software, optional	

Note: The 6623A-3 is calibrated at the factory using a temperature controlled oil bath controlled to within ± 0.02 °C. If the ambient conditions in the laboratory are sufficiently controlled to less ± 0.5 °C the verification procedure below may be used without an oil or air 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/30A/0.1 SHUNT

1. Place the 9330/1 Ω Resistance Standard and the 9230A-30-0.1 Ω Current Shunt Standard in the Bath and allow stabilizing in temperature at 25.0°C or other suitable temperature.
2. Connect the 9330/1 Ω Standard to the 6622A Current Comparator Bridge front panel Rs terminals and connect the 9230A-30-0.1 Ω Current Shunt to the Rx terminals of the 6622A.
3. Measure and record the ohms value of the 9230A-30-0.1 Ω Shunt Resistance using a current of 150 mA 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-3 is not in operation with the 6622A Bridge at this time. See the 6622A Operation Manual for proper operation of the 6622A Automatic DCC Comparator Bridge.

5.3.2. VERIFICATION OF THE x20 RATIO OF THE 6623A RANGE EXTENDER

1. Remove the leads from the 6622A Comparator Bridge RxC1 and RxC2 terminals and connect to the 6623A-3 Current Range Extender C1 and C2 terminals. Refer to Figure 2-4.
2. Ensure that 6623A-3 Current Range Extender is connected to the 6622A Comparator Bridge with the 7 conductor cable provided with the 6623A-3. **Do not power on the 6623A with a shunt connected.**
3. Set the 6622A Bridge, using the front panel menu or software control, for a measurement in 'Low Ohms' mode with the '6623A-3A' selection, a reversal rate of 60 seconds, a 'Ratio' of 20 and a 'Test Current' of 150 mA 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-30-0.1 Ω Shunt again. 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 5.3.2. The difference in the measurement values is to be less than $\pm 0.92 \text{ u}\Omega/\Omega$ when a 'B' or 'XR' 6622A Bridge is used and $\pm 0.72 \text{ u}\Omega/\Omega$ 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.

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-3 High Current Range Extender. The error messages and their corrective measures are summarized in Table 6-1. See also the BridgeWorks Software User Manual for additional information on error messages when using the software. 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-3 High 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's 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-3. Great care should be taken when using these functions.”**
- Self test not completed.

Error Number	Error	Corrective Measures
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0	nV Detector Communication Failure	None , 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-3 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 6.1.3) 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	None , fatal 6622A power on error (try power switch)

Table 6-1 : Model 6622A and 6623A-3 Error Messages

Note: The '**Coefficient**' utility described for error 6 is a dedicated program that can read in the stored calibration data as well as load them into the 6622A DCC 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. Fault Indication

The power-on indicator on the front panel of the 6623A-3 is normally lighted when the AC power is applied to the unit. If the indicator should significantly dim during a measurement, this is an indication that there is a possible faulty connection. The measurement should be stopped as soon as possible and the cause of the fault should be investigated. Check that a termination plug, GPN 31061-01-09, is installed on the cascade connector of the back panel to allow proper operation of the internal current source.

6.1.4. Maintenance

Preventive maintenance is limited to checking at least on an annual basis and preferably more often; the instrument operation, test current accuracy and making sure that the air screen is clean and that the cooling fan is operating. The air screen can be removed and cleaned on a yearly basis as may be required. The Service Manual available on request from Guildline Instruments Limited provides complete alignment and test information required if the 6623A-3 fails to meet performance specifications in section 5. The cooling fan operation can be checked by verifying that there is air flow out of the air screen at the back panel.

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 Rs P2 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 RxP 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 RxP terminals. Check the connections.

Similarly if the polarity of the RsP 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 source of the 6623A-3 when an error is detected.

7. APPENDICES

7.1. GENERAL SPECIFICATIONS

6623A-3 Current Range Extender General Specifications		
Operating Temperature to Full Specification	+23 ± 3	°C
	+73 ± 5.4	°F
Operating Temperature Maximum Range <50% RH	+18 to +28	°C
	+64.4 to +82.4	°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):	100	VA
Voltage Requirements (1)	100, 120, 220 or 240 ±10%	VAC
Line Frequency (1)	50 ±5% or 60 ±5%	Hz
Weight (Nominal Bench Unit)	28/12.7	lbs/kg
Weight (Nominal Rack Unit)	23/10.5	lbs/kg
Dimensions (Bench Unit):	D 516 , W 440 , H 145	mm
	D 20.3 , W 17.3 , H 5.7	in
Dimensions (Rack Unit):	D 516 , W 526 , H 132	mm
	D 20.3 , W 20.7 , H 5.2	in

Table 7-1 : General Specifications

NOTE: 1. The 6623A-3 Current Range Extender is always configured for 240 VAC 50/60 Hz operation at the point of shipment.

2. The voltage setting at the power entry on the back of the instrument must be set for the correct line voltage and the correct fuse must be installed by the customer.

7.2. GENERAL SPECIFICATIONS (continued)

6623A-3 Current Range Extender General Specifications (3 Years)			
Resistance Range		0.1m to 10	Ω
Transformation Ratio		20:1	
Transformation Ratio Accuracy		0.2 ¹	ppm
Linearity		± 0.01 ¹	ppm of full scale ratio
Temperature Coefficient		± 0.01 ¹	ppm/ $^{\circ}\text{C}$
Warm-up time to full rated accuracy		30	minutes
Test Current Programmed through the 6622A Bridge	Range	± 100 to ± 3000	mA
	Compliance	+/-5	V
	Accuracy	± 0.1 ± 0.4 ¹	% + mA
	Stability (10 minutes)	± 0.01 ± 0.1	% + 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-3 with the 6622A Series of DCC Bridges in Low Ohms mode of operation. Resistance measurement accuracy varies with the various 6622A models.