

GUILDLINE

Operation Manual

For The

6624CT-3000

High Current DC Transformer

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**OM6624CT-3000-A-00
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1. INTRODUCTION

1.1. SCOPE

This document describes the installation, operation, specifications, maintenance and verification of the 6624CT-3000 High Current DC Transformer. Precautions associated with high current connections and measurements are provided for purposes of user safety and reliability.

1.2. GENERAL DESCRIPTION

The Model 6624CT-3000 High Current DC Transformer is designed to measure Direct Currents up to a magnitude of 3000 amperes. The 6624CT-3000 is designed to be used with any current source; however the 6624CT-3000 has additional built-in protection and safety features when used with Guildline equipment. Specifically these protection and safety features are activated when the 6624CT-3000 is used in conjunction with Guildline CS1000 Current Sources and the 66259 Extender Control Unit; or when used with a Guildline 6622A DCC Bridge and the 6623A High Current Range Extender. The direct current transformer is designed with an open window to pass through a cable, set of cables, or buss bar that carry the current to be measured. The 6624CT-3000 High Current DC Transformer produces an output current that varies directly with the input current in three ranges. By the connection of a reference shunt burden on one of the output terminals the primary current can be deduced from the measured voltage on the reference shunt.

Switch selectable secondary windings provide transformation ratios of 100:1, 500:1, and 1,000:1; and allow for measurements to be performed up to a maximum of 3000 amperes. The full scale output range of 3 A is provided at a pair of binding post terminals on the front panel of the control chassis. Three primary current ranges are provided, 300 A, 1500 A and 3000 A. A second pair of binding post terminals is provided which provides an additional 20:1 reduction in the secondary current such that a full scale output of 0.15 A is available for each primary range. A reference shunt of 1 ohm or less is recommended for use as a burden.

The 6624CT-3000 High Current DC Transformer includes a 6623A-3S DC Current Transformer Controller which provides for the modulation and demodulation of the DC flux in the Current Transformer Unit. The 6623A-3S is normally mounted close to the current transformer through a 1.5m 12 conductor cable. The 6623A-3S also provides connections between CS1000 Current Source Units and a Model 66259 Extender Control Unit or a 6622A DCC Bridge. The Model 66259 in combination with the CS1000 Current Source Units provides for primary DC currents from 3 to 3000 A. The 6624CT-3000 High Current DC Transformer is pre-wired and configured for operation at nominal power line voltages of 100, 120, 220 or 240 VAC.

All necessary interconnections for the control of the Guildline 6623A current source, the 6623A-3S DC Current Transformer Controller and the 6624CT-3000 High Current DC Transformer are provided such that no hardware reconfiguration is required over the full range of operation other than the connection of the output current terminal to an appropriate reference burden.

1.3. OVERVIEW

The Model 6624CT-3000 High Current DC Transformer 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. Connections to the Guildline CS1000 Current Source Units and the Model 66259 Extender Control Unit are shown when it is desired to use these as the current source. The precision programmable electronically switched 6623A current source is controlled using the Model 66259 Extender Control Unit. The 6623A-3S DC Current Transformer Controller is connected to the Current Transformer Unit with a twelve conductor cable with circular connectors. The 6623A-3S also has two other connections for the Model 66259 Extender Control Unit and the CS1000 current sources.

No adjustments of the 6624CT-3000 High Current DC Transformer are required for proper operation, but the correct range must be manually selected on the Current Transformer Unit for one of three specific full scale current ranges. Three full scale ranges are provided; 3000 A, 1500 A and 300 A with transformation ratios of 1000:1, 500:1 and 100:1 respectively.

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 window carries the direct current input. Modulator and detector windings are used for the detection of DC flux in the core. Switch selectable secondary windings of 100, 500 and 1000 turns provide the means to balance the ampere-turns in the transformer 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 core due to primary-secondary ampere-turns unbalance is indicated by the detector in both magnitude and polarity.

The peak detector drives a servo circuit to provide correction current which maintains ampere-turn balance in the core such that the ratio of input and output currents is exactly 100:1, 500:1 or 1000:1 depending on which range of operation is selected. The Model 66259 Extender Control Unit provides a drive signal to the CS1000 programmable current sources as to allow test currents from +/- 3 A to +/- 3000 A to be realized. This current is normally directed to the primary window of the toroidal transformer. Refer to the 66259 Operation Manual for a description of the current source control and safety features.

Note that the 6624CT-3000 can be operated with a non-Guildline current source. In this configuration no connections are required to the 66259 Extender Control Unit or to the CS1000 Programmable Current Sources.

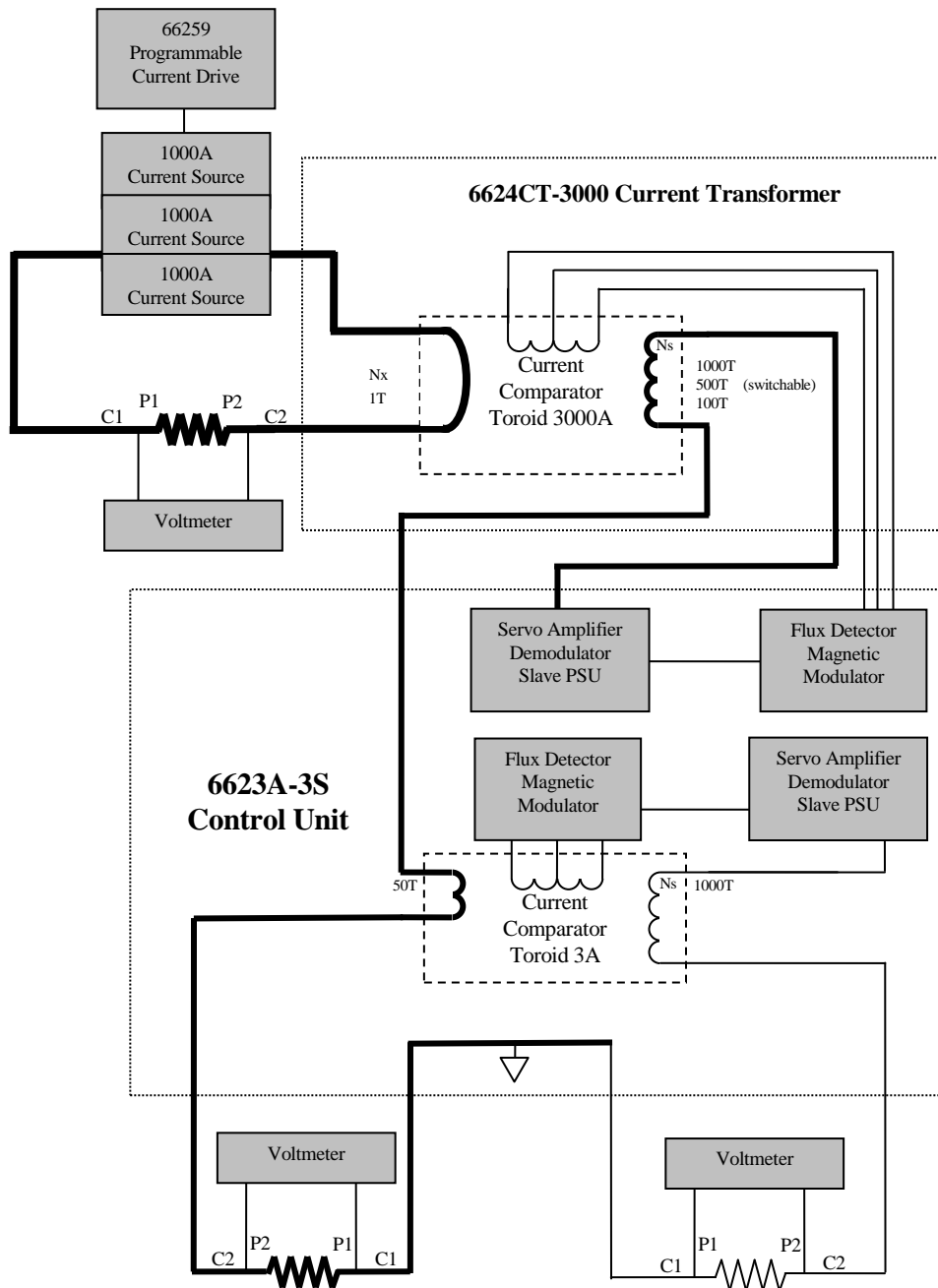


Figure 1-1 : Model 6624CT-3000 Block Diagram

2. INSTALLATION

2.1. PRELIMINARIES

Note that the Model 6624CT-3000 High Current DC Transformer includes a separate 6623A-3S DC Current Transformer Control Unit. The 6624CT-3000 High Current DC Transformer is connected to the 6623A-3S DC Current Transformer Control Unit with a 1.5 m cable. The 6623A-3S is normally shipped set for 240 Volt, 50/60 Hz operation. If necessary the 6623A-3S can be set for 100, 120 or 220 Volt, 50/60 Hz operation. The Model CS1000 Current Source Units and the Model 66259 Extender Control Unit are options for providing a suitable current source for use with the 6624CT-3000 system.

2.1.1. Unpacking

- a. Remove the 6624CT-3000 High Current DC Transformer and the other items from the shipping container to a suitable location.
- b. The following items are included along with the current transformer and control units.
 - i. Operation Manual (OM6624CT-3000)
 - ii. Two Spare Fuses 1 A, (T) (GPN 099-21000)
 - iii. Two Spare Fuses 2 A, (T) (GPN 099-22000)
 - iv. Three SCW Leads, 2 m (GPN 20236.04.02)
 - v. One 12 conductor 1.5 m connection cable (GPN# 31482-01-21)
 - vi. AC Line Cord (GPN# 250-04030)
 - vii. Two Shorting Links (GPN# 225-02090)
 - viii. Termination Connector (GPN# 31061-02-09)
 - ix. Extender Cable 2.0 m (GPN# 20212.04.02)

2.1.2. Power Voltage Selection

The 6623A-3S DC Current Transformer Controller Unit is 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 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
2 A, 250 V, (T)	2 A, 250 V, (T)	1 A, 250 V, (T)	1 A, 250 V, (T)

Table 2-1 : Fuse Ratings

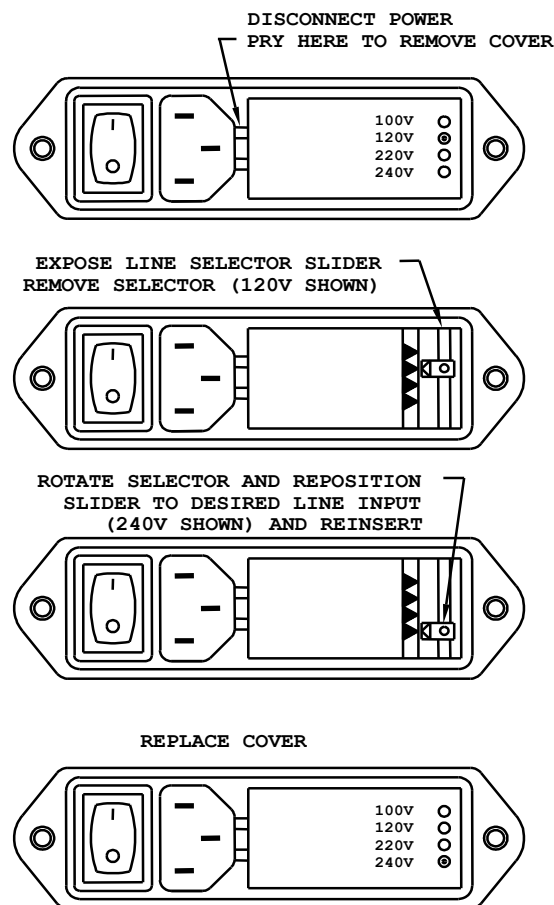


Figure 2-1 : Line Voltage Selector

2.1.4. Setup and Power On

- a. Refer to Figure 2-4 for a typical system setup for current and shunt measurements.
- b. Verify that the power switch is off on the 6623A-3S DC Current Transformer Controller.
- c. Remove any excess packing material from around the front and back panels that is 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-3S DC Current Transformer Controller. If the Line Voltage to be used does not match, see section 2.1.3. to set the line voltage selector to the proper line voltage and select the correct fuse.
- d. Connect the 6623A-3S Control Unit to the 6624CT-3000 High Current DC Transformer Unit using the 12 conductor cable provided. One end is to be connected to the circular connector on the back panel of the 6623A-3S marked 'DCCT-3000' and the other end to the circular connector on the back panel of the 6624CT-3000 marked 'CONTROL'.
- e. Set the Range Switch on the front panel of the 6624CT-3000 unit to '1000:1, 3000A FS' range.
- f. If it is to be utilized, connect the Model 66259 Extender Control Unit to the circular connector on the back panel of the 6623A-3S marked 'CONTROL'. The 66259 Extender Control Unit should have the cable attached to the connector marked 'EXTENDER'. Ensure that a termination plug is connected to the connector marked 'BRIDGE' on the 66259 unit. Note that when the Model 66259 is not used, a termination plug (GPN# 31061-02-09) must be connected to the 'CONTROL' connector on the 6623A-3S.
- g. If it is to be utilized, connect one end of a 7 conductor cable, (GPN# 20212.04.02) with circular connectors to the circular connector on the back panel of the 6623A-3S marked 'CS1000' and the other end to the first CS1000 Current Source Unit connector marked 'INPUT'. Ensure that a termination plug, (GPN# 31061-02-09) is connected to the 'OUTPUT' connector on the last CS1000 unit connected to the system. Also ensure each CS1000 unit is interconnected from 'OUTPUT' to 'INPUT' with short 7 conductor cables.

Note: Where more than three CS1000 Current Source Units are connected only the first three units can be turned on for use in the 6624CT-3000 system. Otherwise a serious over-current condition may result that may damage the 6623A-3S Control Unit.

When a non-Guildline current source is being used make sure that the supplied current is less than or equal to 3000 A. Otherwise a serious over-current condition may result that may damage the 6623A-3S Control Unit.

- h. Connect a suitable reference burden or shunt resistance to one of the 6623A-3S terminals marked '3 A BURDEN' or '150 mA BURDEN'. A shorting link must be installed across the terminals that are not being used. Normally a 1 ohm or less DC reference shunt is used that has a known calibrated resistance at the full scale current of 3 A and 0.15 A.
- i. Connect the input power cord from the 6623A-3S to the AC power outlet.
- j. Turn on the power switch to the 6623A-3S Control Unit. You should see the red 'POWER' indicator on the front panel light up and that the meter indicator moves to the right or left side initially then returns to the centre line within the graduation lines of the meter. A small offset is a satisfactory indication that a balance condition exists on the 6624CT-3000 Transformer Unit.
- k. If it is to be utilized, connect the line cord of the 66259 Extender Control Unit to an AC power outlet and turn on the unit. Note that the 66259 Operation Manual should be referenced for proper operation and control of the CS1000 Current Sources. The 66259 Extender Control Unit must be properly configured for the number of CS1000 units employed.
- l. If it is to be utilized, connect the 'OUT+' buss of the CS1000 units through the window of the 6624CT-3000 going from left to right looking from the front panel with suitable heavy current cables. Continue to connect the other end of the cables across a shunt that is to be measured or to the 'OUT-' buss of the CS1000 units such that a complete circuit is provided. Where the CS1000 units are not used a separate current source must be setup to supply a test current through the window of the 6624CT-3000 High Current DC Transformer Unit.
- m. If it is to be utilized, turn on the power switch to the CS1000 Current Source Units. 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.
- n. There should not be any yellow 'Fault' indicators remaining on the connected CS1000 Current Sources. There is a set of 7 yellow indicators visible within the front grill which indicate when a fault is experienced in any of the 7 internal 150 A 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.
- o. Up to three CS1000 Current Source Units may be utilized. If more than three units are available power on only the first three units and leave the others turned off. Where the CS1000 units are not used a separate current source is required.
- p. The system should now be ready to use as a current source and current measurement system. The potential on the reference burden will be a direct ratio of the high current being sourced from the current source depending on the range selection of the 6624CT-3000 High Current DC Transformer. When set for a range of '1000:1,

3000 A FS' the output current on the 3 A reference burden will be a maximum of 3 A when a 3000 A current is selected.

Note: Always turn the Current Sources on LAST after the 6623A-3S Control Unit and the 66259 Extender Control Unit are turned on. And, always turn the Current Source off FIRST before turning off the 6623A-3S or the 66259. Never turn the Current Source off or on while a measurement is in progress.

2.2. INCOMING INSPECTION

If a 66259 Extender Control Unit is being used, a specific current program profile must be entered into the 66259 Extender Control Unit before measurements can be set up and initiated. Where the 66259 Extender Control Unit and the 6624CT-3000 High Current DC Transformer are shipped at the same time from the factory, a proper profile for three CS1000 Current Source Units is already entered and a Summary of Coefficients is supplied with the system. Otherwise a profile will need to be configured as specified in the 66259 Operation Manual.

If no faults are displayed during power up then proceed to measure a selected test current. A 1 ohm or less Reference Shunt, such as a Guildline 9230A-10-1 Ω must be installed on the 6623A-3S front panel terminals marked '3 A BURDEN' and a shorting link on the 6623A-3S terminals marked '150 mA BURDEN'. Note that for proper setup and operation of the 66259 refer to the 66259 Operation Manual. Refer to Figure 2-4 for interconnection details. Using the measurement set up procedure below:

Step 1) Check the connection of components of the system in the following order:

- The 6624CT-3000 Transformer Unit is connected to the 6623A-3S with the 12 conductor cable.
- The 6624CT-3000 is set to the '1000:1, 3000 A' range.
- If it is to be utilized, the 66259 Extender Control Unit is connected to the 6623A-3S 'CONTROL' connector and a termination plug is installed at the 'BRIDGE' connector.
- If it is to be utilized, the CS1000 Current Source(s) input is connected to the 6623A-3S 'CS1000' connector. Where the CS1000 is not used, a separate current source is required.
- A 1 ohm shunt is connected to the 6623A-3S front panel terminals marked '3 A BURDEN'.
- A high accuracy Digital Volt Meter is connected to the potential terminals of the 1 ohm reference shunt, set for a measurement on the 1 Volt range and any thermal EMF offset removed.
- A shorting link is installed at the 6623A-3S terminals marked '150 mA BURDEN'.

- Step 2)** Turn on the components of the system in the following order:
- The 6623A-3S Control Unit.
 - The DVM.
 - The 66259 Extender Control Unit if implemented.
 - The CS1000 Current Sources, if implemented, up to three units only; or the separate current source.
- Step 3)** Zero the DVM reading then set a nominal positive test current of 100 A.
- Step 4)** Observe and record the voltage on the potential terminals of the reference shunt as displayed on the DVM after the test current has stabilized for a few minutes. Observe that the balance meter on the front panel returns to and remains near the centre line within the graduation lines of the meter. A small offset is a satisfactory indication that a balance condition exists on the 6624CT-3000 Transformer Unit. Note that an averaging function on the DVM will be required to smooth out small variations in the current source output.
- Step 5)** Set a negative nominal test current of 100 A.
- Step 6)** Observe and record the voltage on the potential terminals as displayed on the DVM after the test current has stabilized for a few minutes.
- Step 7)** Divide the absolute value of the mean of the two voltages, and divide the result by the known calibrated resistance value of the reference shunt.
- Step 8)** Multiply the result by the range factor of 1000 and check that the result is within 0.1 % of the 100 A test current requested.

Note: The test should execute with no measurement errors indicated. This is not the 6624CT-3000 full rated accuracy but serves as a functional test for the purposes of determining the instrument has been received in proper working order.

Note: It is recommended to keep the CS1000 modules powered off when the instrument is not in use for extended periods of time. Always turn the CS1000 modules off first then the remaining components.

2.3. 6624CT-3000 FRONT VIEW

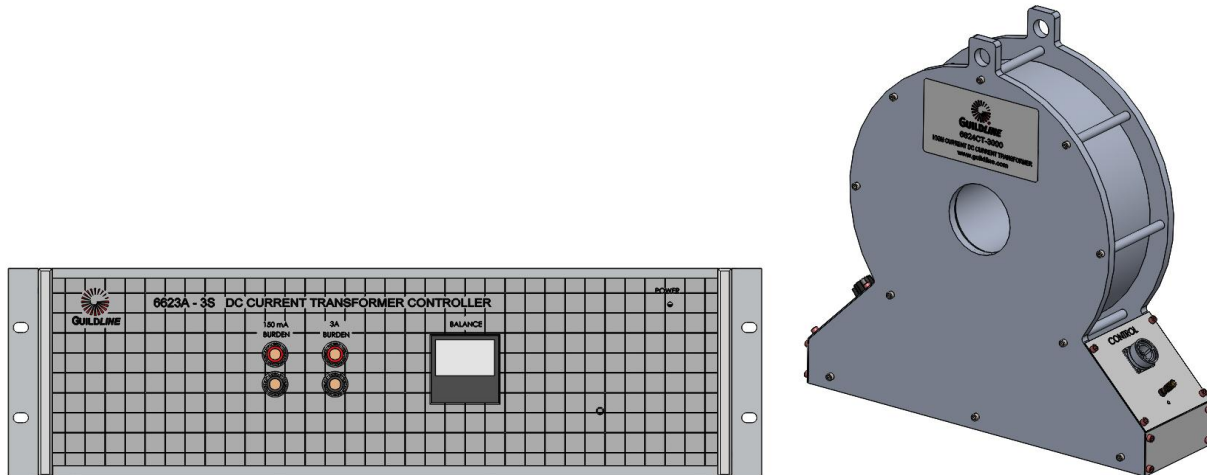


Figure 2-2 : 6624CT-3000 Front View

2.3.1. Power

The **Power** indicator is lighted when the AC power is applied to the units and the power switches on the rear panels are 'ON'. The power indicator on the 6623A-3S may dim if a large comparator imbalance condition exists. In this case the current source and the 6623A-3S should be turned off.

2.3.2. Balance

The **Balance** indicator or meter on the 6623A-3S DC Current Transformer Controller will be pegged to the left or the right when a fault condition in the servo amplifier of the current comparator module is detected indicating a comparator imbalance condition may exist or there is an open circuit at one of the output terminals.

A small offset is a satisfactory indication that a balance condition exists on the DCCT-3000 Transformer Unit.

Note: Do not operate the system if the meter remains pegged off-scale as this may damage the controller electronics. Turn off the current source and the 6623A-3S and correct any connection problems or range selection errors.

2.3.3. 3 A Burden

The **3 A Burden** binding post terminals are provided for connection of a suitable reference shunt. If a shunt is not used a shorting link must be installed for proper operation. The full scale output is 3 A.

2.3.4. 150 mA Burden

The **150 mA Burden** binding post terminals are provided for connection of a suitable reference shunt. If a shunt is not used a shorting link must be installed for proper operation. The full scale output is 150 mA.

2.3.5. Range Switch

The **Range Switch** located on the 6624CT-3000 High Current DC Transformer allows for selection of 1000:1, 500:1 and 100:1 current transformation ratios with full scale values of 3000, 1500 and 300 A respectively.

2.4. 6624CT-3000 REAR VIEW

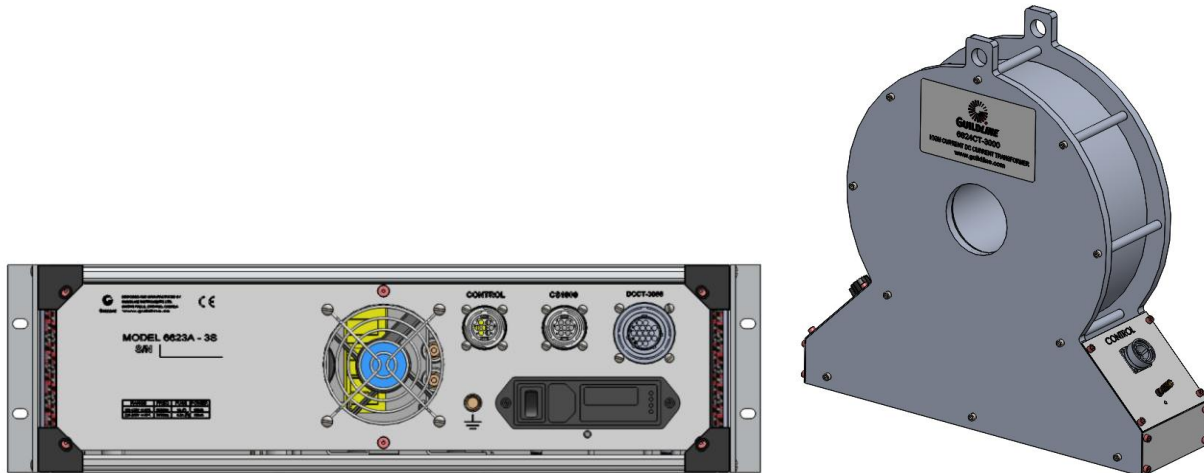


Figure 2-3 : 6624CT-3000 Rear View

2.4.1. Line Input Connectors

The **Line Input Connectors** are a combination of a 3-prong AC standard male IEC connector, and an ON/OFF switch. The 6623A-3S Controller 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 240 V.

2.4.2. Control Connector

The **Control Connector** of the 6623A-3S is a 7 pin circular connector which is used to connect the Model 66259 Control Unit. The 66259 provides program signals for the CS1000 Current Sources and the 6623A-3S tracking of the current comparator.

2.4.3. DCCT-3000 Connector

The **DCCT-3000 Connector** is a 16 pin circular connector which is used to connect the necessary signals to the Model 6624CT-3000 Current Transformer 'CONTROL' connector. Only 12 of the pin connections are utilized.

2.4.4. CS1000 Connector

The **CS1000 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 31061-02-09) installed for proper operation.

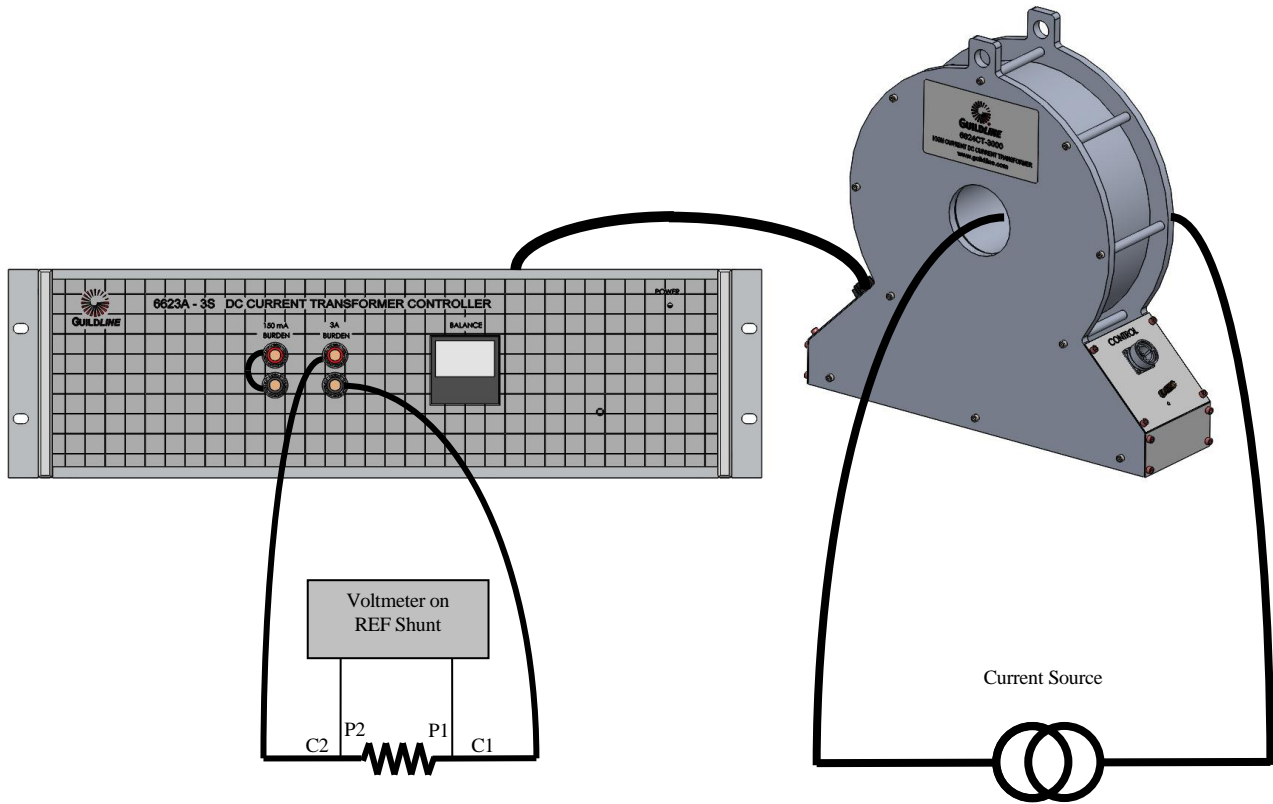


Figure 2-4 : 6624CT-3000 Connections

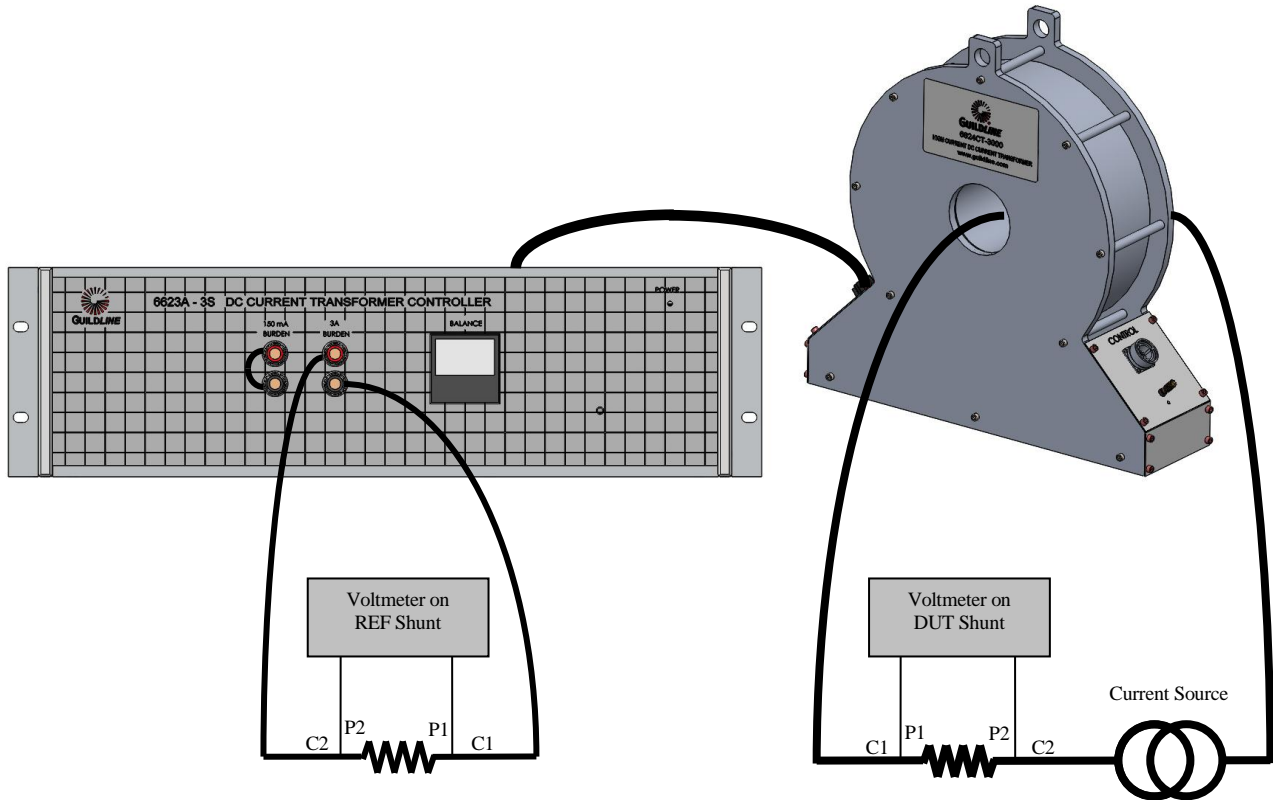


Figure 2-5 : 6624CT-3000 with Primary Current Shunt Connections

3. QUICK MEASUREMENT GUIDE

3.1. MEASUREMENT OPERATION GUIDE

The Model 6624CT-3000 High Current DC Transformer can be used to measure and monitor high DC currents up to 3000 A in three ranges. As well, the 6624CT-3000 can be used to determine the ratio of a high current shunt with that of a low current shunt such that the DC resistance of the high current shunt can be determined from the known resistance of a low current reference unit.

The following section contains information regarding the measurement ranges and calculations required to determine high current values and high current shunt resistances. A suitable calibrated long scale precision Digital Volt Meter is required to make full use of the capabilities of the 6624CT-3000.

NOTE: Sufficient stabilization time must be observed in order to achieve the specified uncertainty for the Model 6624CT-3000 High Current DC Transformer.

3.1.1. Current Measurement all Ranges

The Model 6624CT-3000 can be used to measure test currents and to compare the resistances of high current shunts. It is only required that a reference shunt of known resistance be connected on one of the **Burden** output terminals. The **3 A Burden** terminals are limited to a shunt resistance of 1 ohm or less while the **150 mA Burden** terminals are limited to a maximum of 10 ohms although less is preferable.

Notes: It is essential that a shorting link is used on the burden output terminals of the 6623A-3S that are not used.

The operator must be familiar with the various modes of operation of the 66259 Extender Control Unit before using the CS1000 Current Sources as a source of test current. The 66259 Operation Manual and should be reviewed before proceeding.

If a non-Guildline current source is being used the operator should be familiar with its operation.

The following is a basic step by step procedure for connecting the resistors and for setting up the 6624CT-3000 properly to make the measurements.

Step 1) Connect the 6624CT-3000, the 6623A-3S, the reference standard and the UUT resistor as shown in the Figure 2-4 connection diagram. Use appropriate cables to carry the currents.

Step 2) If the CS1000's are to be used to provide a test current make the connections as shown in Figure 2-5. Otherwise setup a separate current source directly through the primary window of the 6624CT-3000 Transformer Unit.

- Step 3)** Make sure the selection of working standard resistor is appropriate and the current range selected for the test is within the range of test currents to be measured. Usually a 1 Ω reference is chosen for the 3 A Burden and a 10 Ω reference is chosen for the 150 mA Burden. See Table 3-1.
- Step 4)** Turn on the power for each component of the system in the following order:
- The 6623A-3S Control Unit.
 - The DVM.
 - The 66259 Extender Control Unit if utilized.
 - The CS1000 Current Sources up to three units only; or the separate current source.

Note: Always turn the Current Source on LAST after the 6623A-3S Control Unit and the 66259 Extender Control Unit are turned on. And, always turn the Current Source off FIRST before turning off the 6623A-3S or the 66259. Never turn the Current Source off or on while a measurement is in progress.

- Step 5)** Select initially a test current of one tenth the desired current.
- Step 6)** Check that the null meter indicator on the 6623A-3S moves to the right or left side initially then returns to the centre line within the graduation lines of the meter. A small offset is a satisfactory indication that a balance condition exists on the 6624CT-3000 Transformer Unit.
- Step 7)** Increase the test current to the desired magnitude and observe that the meter indicator moves to the right or left side initially then returns to the centre line within the graduation lines of the meter.
- Step 8)** Change the polarity of the current source if possible and use the DVM to measure the average potentials on the reference shunt so as to determine the magnitude of the test current positive and negative values. The primary test current can then be determined by the following formula:

$$\text{Primary Test Current} = \text{Range Ratio} \times (\text{Vref} / \text{Rref})$$

Where:

Range Ratio is the Range selected on the 6624CT-3000 Transformer Unit.

Vref is the average magnitude of the absolute positive and negative potentials on the reference shunt.

Rref is the calibrated resistance value of the reference shunt.

Note that where the reference shunt is used on the 150 mA Burden terminals, the Range Ratio is twenty times the selection on the 6624CT-3000 Transformer Unit.

3.1.2. Calculation of the Unknown Shunt Resistance

The resistance of the unknown shunt resistor on the primary side of the 6624CT-3000 can be calculated from the measurements made in steps 7 and 8 above and with additional measurements of the potentials on the unknown shunt potential terminals. Calculate the resistance of the unknown shunt from the following formula:

$$\text{Shunt Resistance} = \text{Primary Test Current} / V_{\text{shunt}}$$

Where:

Primary Test Current is the magnitude of the test current source as calculated in step 8 of 3.1.1.

V_{shunt} is the average magnitude of the absolute positive and negative potentials on the unknown shunt.

3.1.3. Recommended Test Setup Limits and Precautions for the 6624CT-3000

See Table 3-1 for the recommended test setup limits for various current ranges. Note that the current on the 150 mA Burden terminals is 1/20 of that on the 3 A Burden terminals such that the ratio is 20 times of that stated on the 6624CT-3000 range switch.

3.1.4. Checks and Precautions

- Start with a test current of 1/10 of the value to be measured and increase the current slowly to the desired value.
- Verify that the meter on the 6623A-3S does not stay off scale when the test current is applied but returns close to the centre point in a few seconds.
- Turn off the test current if the power indicator lamp on the 6623A-3S dims or the meter remains off scale.
- Ensure that a suitable burden is connected to one of the burden terminals and a shorting plug is connected to the other burden terminals.
- Ensure that a termination plug is connected to the 'Control' connector on the 6623A-3S if the Model 66259 Extender Control Unit is not used.
- Ensure that all current lead connections are tight.

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

Primary Test Current (A)	6624CT Range (A)	3 A Output Ratio	150 mA Output Ratio	3 A Output (A)	150 mA Output (mA)
3000	3000	1000:1	20,000:1	3	150
2000	3000	1000:1	20,000:1	2	100
1000	3000	1000:1	20,000:1	1	50
1500	1500	500:1	10,000:1	3	150
1000	1500	500:1	10,000:1	2	100
500	1500	500:1	10,000:1	1	50
300	1500	500:1	10,000:1	0.6	30
300	300	100:1	2,000:1	3	150
200	300	100:1	2,000:1	2	100
100	300	100:1	2,000:1	1	50
50	300	100:1	2,000:1	0.5	25

Table 3-1 : 6624CT-3000 Test Setups

4. VERIFICATION AND CALIBRATION

4.1. RATIO ACCURACY VERIFICATION

This procedure covers the ratio accuracy verification of the 6624CT-3000 High Current DC Transformer.

4.1.1. Purpose

The purpose of this procedure is to assure that the 6624CT-3000 High Current DC Transformer 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 6624CT-3000 for its recertification. The absolute value accuracy of the high current shunt and the burden resistors to be used in this verification are of prime importance since the verification is based on the known ratio of these shunt resistors.

4.2. TEST EQUIPMENT REQUIRED

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

Description	Model
DC Resistance Standard	Guildline 9230A-10-1Ω
DC Current Shunt Standard	Guildline 9230A-300-0.001Ω
100 A DC Current Source	Guildline CS1000
Current Source Controller	Guildline 66259
Temperature Controlled Oil/Air Bath	Guildline 5600, 5010 or 5032
High Accuracy 8.5 Digit DC Voltmeter	Agilent 3458A
DCC Bridge	Guildline 6622A
High Current Range Extender	Guildline 6623A-150

Note: The 6624CT-3000 High Current DC Transformer is calibrated at the factory using a temperature controlled oil bath controlled to within ± 0.02 °C with the ratio of the DC Current Shunt Standard to that of the DC Resistance Standard known to within 2 parts in 10^6 .

If the ratio of the DC Current Shunt Standard to that of the DC Resistance Standard is not known in the test environment to within 2 parts in 10^6 additional uncertainties must be factored into the calibration process.

4.3. PROCEDURE

4.3.1. Preliminary Connections to the 6624CT-3000

1. Place the 9230A-10-1 Ω Resistance Standard and the 9230A-300-0.001 Ω Current Shunt Standard in the Bath and allow stabilizing in temperature at 25.0 $^{\circ}\text{C}$.
2. Measure, as may be required, the ratio of the DC Current Shunt Standard to that of the DC Resistance Standard using a 6622A DCC Bridge and 6623A High Current Range Extender using a test current of 100 A.
3. Connect the 6624CT-3000 Transformer to the 6623A-3S Controller as shown in Figure 2-4.
4. Connect the Current Source output terminal through the window of the 6624CT-3000 and connect to the 9230A-300-0.001 Ω Current Shunt C2 terminal then connect the shunt C1 terminal to the Current Source return terminal. See Figure 2-5.
5. Connect the 9230A-10-1 Ω Resistance Standard current terminals to the 3 A Burden terminals of the 6623A-3S DC Current Transformer Controller, ensure that a shorting link is attached to the 150 mA Burden terminals, and ensure that a Termination Plug is connected to the 'Control' circular connector on the 6623A-3S if the 66259 Extender Control Unit is not used.
6. Turn on the 6623A-3S DC Current Transformer Controller, then turn on the Current Source but do not yet apply any test current.
7. Observe that the meter indicator on the 6623A-3S initially moves to the right or left then returns to the centre line within the graduation lines of the meter. A small offset is satisfactory indication that a balance condition exists.

4.3.2. Measurement of the Potentials on the Resistors

1. Set the 6624CT-3000 range switch to the 1000:1 position and apply a test current of 100 A through the window of the 6624CT-3000 and the 9230A-300-0.001 Ω Current Shunt.
2. Ensure that the 6623A-3S meter indicator remains within the graduation lines of the meter after any initial transient.
3. Using the DC Voltmeter measure and record the potentials across both the 9230A-300-0.001 Ω Current Shunt and 9230A-10-1 Ω Resistance Standard potential terminals. Ensure that the DC Voltmeter is properly setup for a 100 mV measurement and sufficient time is allowed for the measurements to settle.
4. Turn off the current source and reverse the current output cable connections.
5. Repeat steps 1 to 4 for the reversed test current.
6. Record the results.

4.3.3. Calculation of the Range Ratios

1. Calculate the mean of the absolute values of the two potentials on the 9230A-300-0.001Ω Shunt for a test current of 100 A.
2. Calculate the mean of the absolute values of the two potentials on the 9230A-10-1Ω Resistance Standard.
3. Calculate the ratio of the test currents using the following formula:

$$\text{Ratio} = (V_p/V_s) \times (R_s/R_p)$$

Where: **V_p** is the mean of the absolute values of the positive and negative test current potentials on the 0.001 ohm shunt.

V_s is the mean of the absolute values of the positive and negative test current potentials on the 1 ohm resistance standard.

(R_s/R_p) is the ratio of the 1 ohm resistance standard to that of the 0.001 ohm current shunt.

4. Repeat the steps of 4.3.2. and 4.3.3. above for the 500:1 and 100:1 ranges of the 6624CT-3000.
5. Record the results and verify that the ratios as calculated are within 10 parts in 10⁶ of the nominal ratios.
6. In order to verify the accuracy of the 0.150 A Burden output the 9230A-10-1Ω shunt is to be connected to these terminals and a shorting link moved to the 3 A Burden terminals.
7. Repeat the procedures of 4.3.1., 4.3.2. and 4.3.3. above. The calculated ratios should be within 10 parts in 10⁶ of nominal values of 20,000:1, 10,000:1 and 2,000:1 respectively.

5. TROUBLESHOOTING AND MAINTENANCE

5.1. INTRODUCTION

This section covers troubleshooting, and maintenance of the 6624CT-3000 High Current DC Transformer.

5.1.1. Model 6623A-3S Controller Fault Indications

The meter indicator on the 6623A-3S Controller front panel will remain off scale whenever a large imbalance condition is detected in the comparator circuit. This may be due to improper connections to the range extender, improper measurement setup or an actual circuit failure. Under extreme unbalance conditions the RED 'Power' indicator may dim. In this case it is important to turn off the test current and turn off the 6623A-3S to avoid damage to the electronic circuits.

Check that a shorting link is installed on the unused Burden terminals and a termination plug is installed on the 'Control' connector on the 6623A-3S if the Model 66259 Extender Control Unit is not used.

5.1.2. Maintenance

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

6. APPENDICES

6.1. GENERAL SPECIFICATIONS

6624CT-3000 High Current DC Transformer General Specifications		
Operating Temperature to Full Specification	+23 ± 3	°C
	+73.4 ± 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):	200	VA
Voltage Requirements (1)	100, 120, 220, or 240 ± 10%	VAC
Line Frequency	50 ± 5% or 60 ± 5%	Hz
Control Unit Weight	28/12.7	lbs/kg
Control Unit Dimensions (Rack Model)	D 500 , W 480 , H 132	mm
	D 19.7 , W 18.9 , H 5.2	in
Control Unit Dimensions (Bench Model)	D 500 , W 442 , H 147	mm
	D 19.7 , W 17.4 , H 5.8	in
Transformer Unit Weight	55/25	lbs/kg
Transformer Unit Dimensions	D 161 , W 575 , H 565.2	mm
	D 6.33 , W 22.63 , H 22.25	in

Table 6-1 : General Specifications

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

6.2. GENERAL SPECIFICATIONS (continued)

6624CT-3000 High Current DC Transformer General Specifications (3 Year)			
Transformation Ratios, 3 A Output		1000:1, 500:1, 100:1	
Transformation Ratios, 0.15 A Output		20,000:1, 10,000:1, 2,000:1	
Transformation Ratio Accuracies		± 10	ppm
Linearity		± 0.1	ppm of full scale
Temperature Coefficient		± 0.1	ppm / °C
Warm-up time to full rated accuracy		5	Minutes
Test Current Ranges	1000:1 Range	± 3000	A
	500:1 Range	± 1500	A
	100:1 Range	± 300	A
	20,000:1 Range	± 3000	A
	10,000:1 Range	± 1500	A
	2,000:1 Range	± 300	A

Table 6-2 : General Specifications (continued)