



**TECHNICAL MANUAL**

**FOR**

**MODEL 7223CT-2S**

**COMPENSATED AC CURRENT TRANSFORMER**

[www.guildline.com](http://www.guildline.com)

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**TM7223CT-2S-C-00**  
**24 April, 2019**



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## 1. INTRODUCTION

### 1.1. SCOPE

This manual contains specifications, operating instructions and theory of operation for the Guildline Instruments Model 7223CT-2S Compensated Current Transformer. It is written for personnel who are familiar with analogue electronic circuits and techniques for calibrating and measuring high voltage and current power transmission systems.

### 1.2. SERVICE

The phone number in the USA and Canada to obtain Product Support, Calibration Service or Replacement Parts is (800) 310-8104.

To Contact Guildline Instruments, the following information is provided.

USA and Canada Telephone: (613) 283-3000

USA and Canada Fax: 1-613-283-6082

Outside US and Canada Telephone: + [0] [1] 613 283-3000

Outside US and Canada Fax: + [0] [1] 613 283-6082

You can also contact Guildline Instruments Limited via Email or Website.

Email is: [sales@guildline.com](mailto:sales@guildline.com)

Website is: [www.guildline.com](http://www.guildline.com)

### 1.3. UNPACKING INSPECTION

Guildline uses custom designed packing material so that your equipment will reach you in good condition. If the equipment has been subject to excessive handling in transit, there will probably be visible external damage to the shipping container.

In the event of damage, the shipping container and cushioning material should be kept for the carrier's inspection.

Carefully unpack the equipment and check for external damage to the standard. If the shipping container and packing material are undamaged, they should be retained for use in return shipments. If damage is found notify the carrier and Guildline immediately.

## **1.4. WARRANTY**

Guildline Instruments warrants its products to be free of defects in manufacture and normal operation for a period of two (2) years from the date of purchase, except as otherwise specified. This warranty applies only in the country of original purchase and only to the original purchaser, who is also the end user. Equipment, which is defective or fails within the warranty period, will be repaired or replaced at our factory without charge at the discretion of Guildline Instruments.

In addition, standards and systems manufactured by Guildline Instruments are warranted to be free of defects in overall system operation for a period of two (2) years from the date of receipt by the original purchaser.

Third party system components purchased by Guildline carry the warranty of the original equipment manufacturer and will be accepted for claim by Guildline Instruments at our factory only after warranty authorization by the original manufacturer.

### **1.4.1. Limitation of Warranty**

Warranty coverage does not apply to equipment which has failed due to misuse, neglect, accident or abnormal conditions of operation or if modifications or repairs have been made without prior written authorization of Guildline instruments.

### **1.4.2. Non-Warranty Service**

If a Guildline Instrument fails, or is not capable of meeting published specifications, it should be thoroughly inspected for visible damage. Operational tests should be carried out if appropriate to determine if there is internal damage. Contact Guildline Instruments before returning for repair. The Customer or purchaser must complete all final claims with the carrier.

Regular charges will apply to non-warranty service. External service charges and expenses will be billed at cost plus handling.



### 1.4.3. To Obtain Warranty or Calibration and Repair Service

**Call for a Return Material Authorization (RMA) number. RMA's are required for all Warranty Returns and/or Calibration and Repair Service Requests.** Telephone, Fax and email addresses to contact Guildline are provided previously.

Guildline Instruments will pay for all warranty costs including shipping from Guildline to the original shipment point. However, if the instrument is purchased within one country and shipped to another, Guildline will only pay for shipping to the original ship to country or customer point. The customer is responsible for paying for the shipping costs to return an item to Guildline.

#### **USA Warranty Return Address.**

USA Customers should use the following address to return instruments for warranty service or calibration support.

Guildline Instruments Limited  
C/O AN Deringer  
835 Commerce Park Drive  
Ogdensburg, NY 13669

Mark on the outside of the box:

RMA # \_\_\_\_\_

Model # \_\_\_\_\_

Serial # \_\_\_\_\_

The Statement: "Canadian manufactured goods being returned for repair."

#### **For all other countries, including Canada please ship to:**

Guildline Instruments Limited  
21 Gilroy Street, PO Box 99  
Smiths Falls, ON K7A 4S9

Mark on the outside of the box:

RMA # \_\_\_\_\_

Model # \_\_\_\_\_

Serial # \_\_\_\_\_

The Statement: "Canadian manufactured goods being returned for repair."

## 1.5. Safety Information

**These Standards can be used with Equipment capable of voltages up to 300 Vac rms. The operator should be aware of the environment in which these standards are used.**

**WARNING: Use caution when working with voltages above 30 V ac rms, 42 V ac peak, or 42 V dc. These voltages pose a shock hazard.**

The 7223CT-2S Compensated Current Transformer is designed to work within specifications at voltages up to 300 Vac rms, and currents up to 2000 Aac rms. Applying more than the recommended voltage or power will damage the unit and voids the warranty.

Do not use the 7223CT-2S in wet environments.

Never use the 7223CT-2S with the cover removed or the case open.

Inspect the 7223CT-2S for damage such as cracked connectors prior to use. If unit has a burned smell or smoke is visible during use, discontinue use immediately.

If test equipment used with the 7223CT-2S overloads or trips, this could be a sign that the 7223CT-2S requires repair.

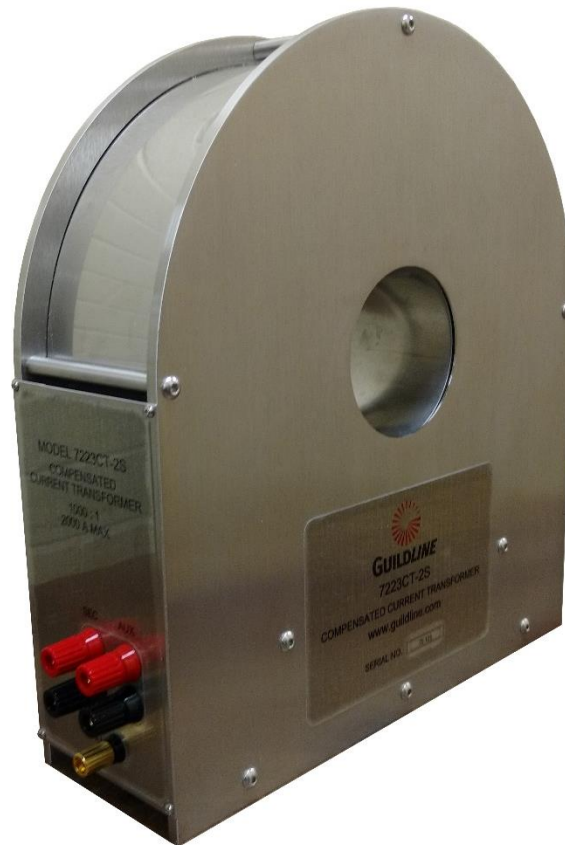
Inspect all test leads used with the 7223CT-2S for damaged insulation or exposed metal. Check all test leads for continuity.

Ensure all test leads are correctly connected prior to applying current or voltage.

Do not use the 7223CT-2S around explosive gas, vapor or dust.

## 2. GENERAL DESCRIPTION

The Model 7223CT-2S Compensated Current Transformer is a 1000:1 ratio toroidal transformer. The current transformer is constructed as a toroid containing a high permeability magnetic core, secondary winding, and an auxiliary (compensation) winding, of 1000 turns each. The primary winding consists of an 82.6 mm (3.25 in.) diameter window through which a bus bar with a suitable isolation bushing can be inserted. The current transformer is designed for a maximum of 2000 Aac rms primary current.



**Figure 2-1: 7223CT-2S Picture**



## 3. SPECIFICATIONS

7223CT-2S AC Current Transformer Specifications (3 Year)		
Uncertainty / Accuracy 50/60 Hz (Burden 0.5 Ω)	In-phase	± 5 ppm
	Quadrature	± 5 ppm
Linearity	< ± 1 ppm full scale	
Temperature Coefficient	± 0.01 ppm / °C	
Test Current Range	7223CT-2S	± 2000 A
Transformation Ratio	7223CT-2S	1000 : 1
Primary Winding	82.6 mm (3.25 in.) Window	
Secondary Winding	1000 Turns	
Auxiliary Winding	1000 Turns	
Secondary and Compensation Winding Breakdown Voltage	300 Vac rms	

**Table 3-1 : 7223CT-2S Specifications**

General Specifications			
Temperature	Operating	15 °C to 30 °C	59 °F to 86 °F
	Storage	-20 °C to +60 °C	-4 °F to 140 °F
Humidity	Operating	20 % to 70 % RH	
	Storage	15 % to 80 % RH	
Weight	30 kg	66 lbs.	
Dimensions (H x D x W)	350 x 107 x 315 mm	13.8 x 4.2 x 12.4 in.	

**Table 3-2 : 7223CT-2S General Specifications**





### 4. OPERATING NOTES

Take care not to damage the terminals or case when connecting or disconnecting the 7223CT-2S, or when placing a buss bar or cables through the CT opening. The exterior case is part of the electrostatic shielding and must remain intact to ensure correct operation.

Do not make or break electrical connections to the CT while voltage or current is applied as this will cause a transient pulse which may magnetize the core. Current should be applied at a reasonable rate of change of less than 1 A/s.

If the system sensitivity drops, the current transformer core may be magnetized. To demagnetize the core, increase the primary current slowly until the core saturates (i.e. the output voltage does not change with the input current) and then slowly reduce the current to zero. A reasonable rate of current change for this operation is 1 A/s.



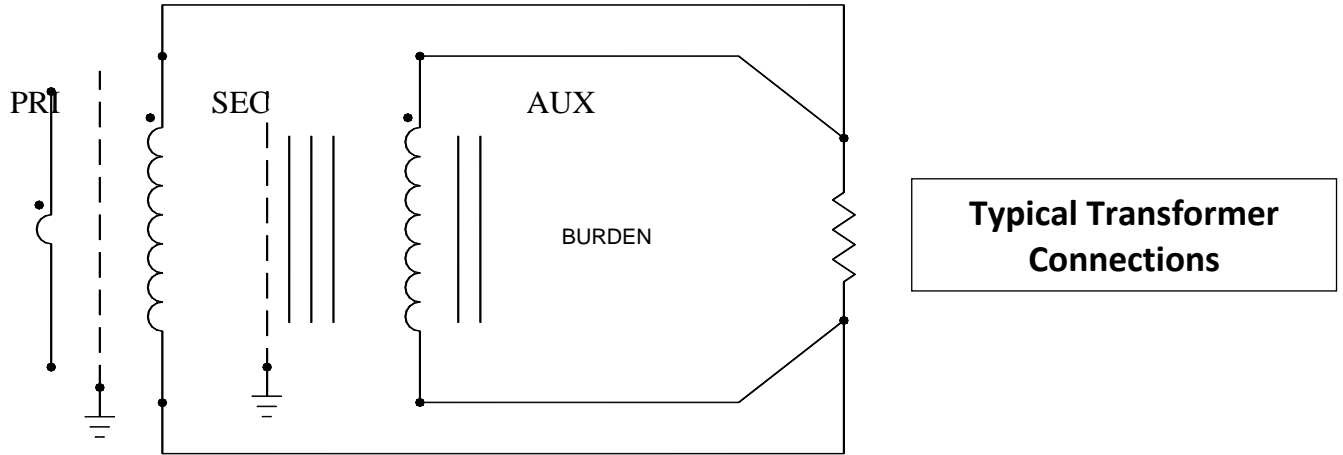
### 5. THEORY OF OPERATION

The Model 7223CT-2S Compensated Current Transformer is a fixed ratio compensated current transformer. It consists of a toroidal high permeability magnetic core on which are wound a 1000 turn auxiliary (compensation) winding and a 1000 turn secondary winding. The auxiliary winding is shielded by Mu-metal inside a copper enclosure. The construction is such that the auxiliary winding links only the magnetic core, whereas the primary (i.e. conductor through the center hole of the CT) and secondary windings link both the magnetic shield and magnetic core. The purpose of compensation is to enable the current transformer to supply, by means of shield excitation, its burden which consists of its own internal impedance plus the impedance of the leads between it and the load. This condition will exist if the voltage across the load is zero. One way in which this voltage can be made equal to zero is to join these points together with a low impedance link. In order that current flowing through this link will not bypass the transformer however, it is made to include the compensation winding of the transformer. This winding has the same number of turns as the secondary, hence the net ampere-turns imposed on the core is unchanged. It is located inside the magnetic shield so that it is not affected by shield excitation, has low resistance by design, and has no voltage induced in it because at balance the flux in the core is zero. For practical purposes, the voltage across the load can be neglected. The current which actually flows through the compensation winding is determined by how well the primary and secondary windings of the transformer act with the magnetic shield as a current transformer. To support the burden, the shield must be excited. The sum of the ampere-turns of the primary, secondary and auxiliary windings is equal to zero. Therefore, it is apparent that the ampere-turn difference between the primary and secondary windings, which excites the magnetic shield, must be equal and opposite to the ampere-turns of the auxiliary winding. It is therefore important that the burden which is outside the compensation circuit be kept as low as possible.



## 6. DRAWINGS

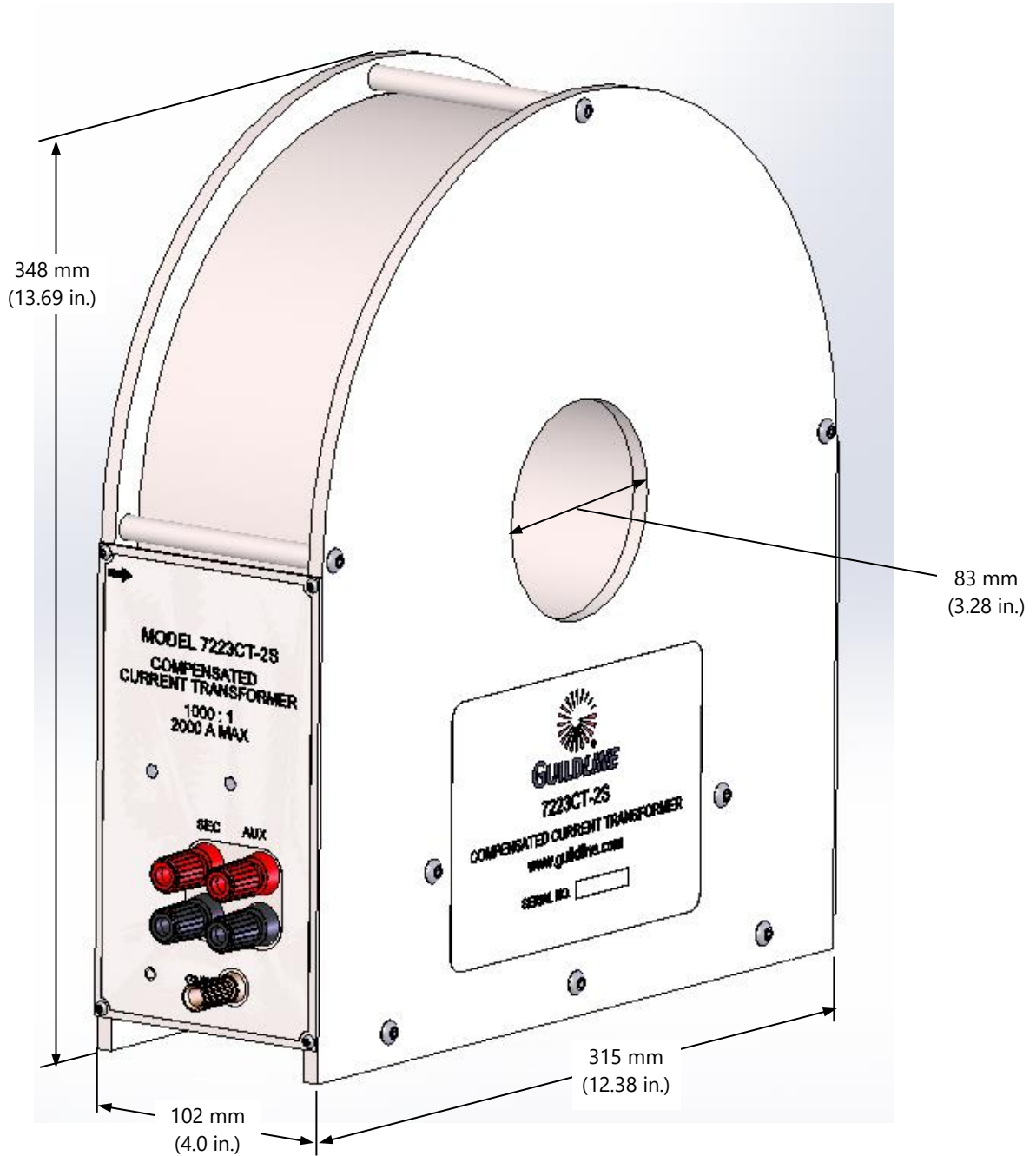
### 6.1. TYPICAL TRANSFORMER CONNECTIONS



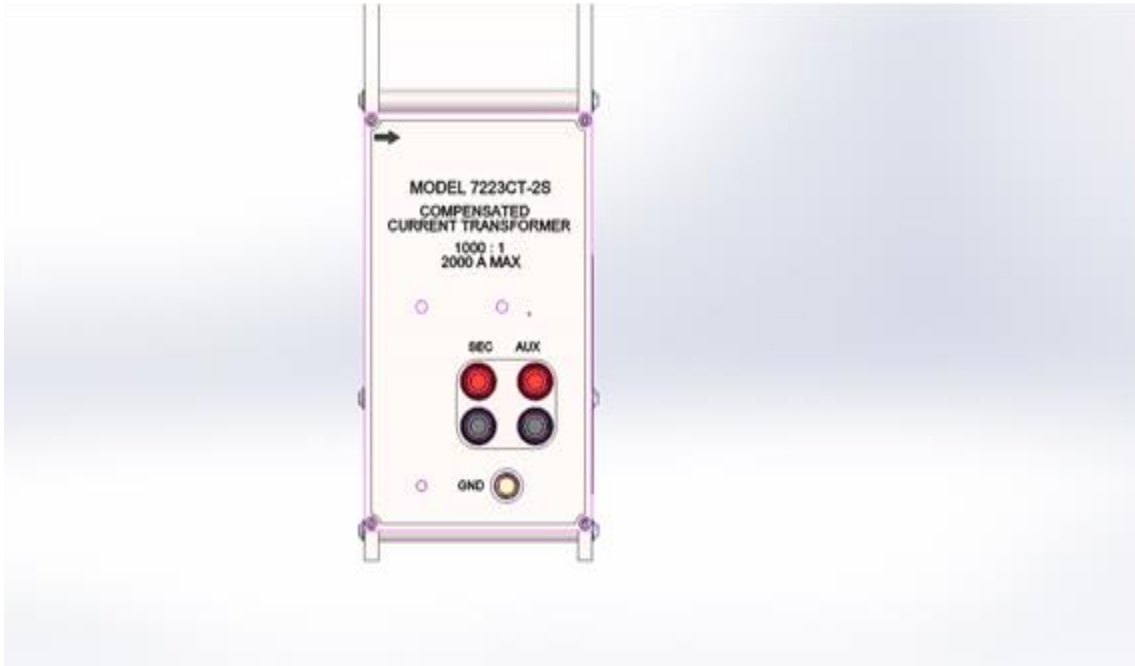
**Typical Transformer Connections**

**Figure 6-1: Typical Transformer Connections**

## 6.2. DIMENSIONED MECHANICAL DRAWING



**Figure 6-2: Dimensioned Mechanical Drawing**



**Figure 6-3: Connection Panel**

**SEC** SEC terminals provide for connections to the 1000 turn secondary winding.

**AUX** AUX terminals provide for connections to the 1000 turn auxiliary winding.

**GND** GND terminal provides for a ground connection to the case of the CT and the internal shields.





# 7. INSTALLATION

## 7.1. Unpacking

1. Remove the 7223CT High Current ACC Transformer from the shipping container to a suitable location.
2. The following item is included along with the current transformer:  
Operation Manual (OM7223CT).

## 7.2. Preliminaries

1. Place the CT on a stable table top so that cables to the unit will not cause it to topple.
2. Make sure that the current to be supplied will be less than or equal to 2000 Aac rms. Otherwise a serious over-current condition may result that may damage the 7223CT.

## 7.3. Measurement Setup

1. The connection to the current source (i.e. via cables or a buss bar containing suitable isolation) should be placed at the center of the 7223CT 82.6 mm (3.28 in.) diameter window.
2. Connect a suitable reference burden or shunt resistance to the 7223CT-2S secondary winding terminals marked 'SEC'. Normally a 1 ohm or less AC reference shunt is used that has a known calibrated resistance.
3. Connect the auxiliary winding terminals marked 'AUX' to the reference burden or shunt resistance at the same points as the secondary connections as shown in Figure 2.
4. Connect the case ground terminal marked 'GND' to a suitable earth ground near the source of current.
5. Connect a Digital Volt Meter (DVM) or Digital MultiMeter (DMM) to the voltage terminals of the AC reference shunt and set to the appropriate Volt Range (i.e. volt range defined by value of the source current divided by 1000).
6. The 7223CT-2S should now be ready to use for measuring AC current. The potential on the reference burden will be a direct ratio of the high current being sourced from the current source. With the 7223CT fixed 1000:1 ratio the output current on the 1  $\Omega$  reference burden will be a maximum of 2 A when a 2000 A current is used.

7. Ensure that the current to be applied is increased slowly from zero current to the maximum current of 2000 A or less.
8. To provide current ratios less than 1000:1 the primary current cable can be passed through the CT primary window opening more than once. If the primary current cable is passed twice through the CT primary window twice the current ratio will be 500:1 etc. Note that in this case the maximum current that can be applied must be reduced to  $2000/n$  A where  $n$  is the number of times the primary current cable is passed through the CT window. The overall CT current ratio is given by  $1000/n : 1$ .

**Note:** Always turn the Current Source on LAST after all cable or buss bar connections are in place and checked for tightness. And, always turn the Current Source off FIRST before touching or changing any cable and/or buss bar connections. Never turn the Current Source off or on while a measurement is in progress.

#### 7.4. CALIBRATION AND VERIFICATION

The 7223CT can only be calibrated using a Current Comparator Transformer Test Set of known traceable accuracy. Verification of the 7223CT may be accomplished by a side by side comparison with another CT of known accuracy.

#### 7.5. TROUBLESHOOTING AND MAINTENANCE

Preventive maintenance is limited to checking the instrument operation. The 7223CT should be periodically re-calibrated using a Current Comparator Transformer Test Set of known traceable accuracy.