INSTRUCTION MANUAL

for

RF CURRENT PROBE

Model: **CLCE-400**

and

CALIBRATION FIXTURE

Model: **FCLCE-1000**

(optional)

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1. Introduction

This manual includes description of product features, typical electrical performance parameters, product specifications and instructions for use. Also included are important safety precautions, warranty and maintenance information.

The test procedures and guidance provided herein is for general guidance and is correct based on our understanding of the current, relevant standards at the time that this manual was written. However, the information may become dated or may be inappropriate for some applications.

The user is cautioned to refer and adhere to the appropriate standards, rules, procedures, practices, and/or relevant interpretations thereof for your application in order to ensure proper application of the test.

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2. Products Available from Com-Power


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Comb Generators


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Emissions Test Systems


Conducted Immunity Test Systems


Impedance Stabilization Networks (ISNs)


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Power Amplifiers


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Surge Generators


Transient Limiters

Turntables


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3. Product Information

3.1 Incoming Inspection

If shipping damage to the product or any of the accessories is suspected, or if the package contents are not complete, contact Com-Power or your Com-Power distributor.

Please check the contents of the shipment against the package inventory in section 3.2 to ensure that you have received all applicable items.

3.2 Package Inventory

STANDARD ITEMS:

- ✓ **CLCE-400** RF Current Probe
- ✓ Calibration Certificate and Associated Data

OTIONAL ITEMS:

- ✓ **FCLCE-1000** Calibration Fixture

3.3 Product Safety Information

3.3.1 Product Hazard Symbols Definitions

The hazard symbols appearing on the product exterior are defined below.

The yellow triangle with an exclamation mark indicates the presence of important operating and/or maintenance (servicing) instructions in the literature accompanying the product.

3.3.2 Product Warning/Caution Statements

The following warnings/caution statements must be adhered to in order to ensure safe operation of the product.

CAUTION:
Hazardous Voltages present during operation. Do not handle probe while test is in progress.

3.3.3 General Safety Instructions

The following safety instructions have been included in compliance with safety standard regulations. Please read them carefully.

- **READ AND RETAIN INSTRUCTIONS** - Read all safety and operating instructions before operating the instrument. Retain all instructions for future reference.
- **HEED WARNINGS** - Adhere to all warnings on the instrument and operating instructions.
- **FOLLOW INSTRUCTIONS** - Follow all operating and use instructions.
- **WATER AND MOISTURE** - Do not use the instrument near water.
- **HEAT** - The instrument should be situated away from heat sources such as heat registers or other instruments which produce heat.
- **CLEANING** – Clean the instrument outside surfaces of the device with a soft, lint-free cloth. If necessary, a mild detergent may be used.
- **NON-USE PERIODS** - Unplug the power cords of the instrument when it will be left unused for a long period of time.
- **OBJECT AND LIQUID ENTRY** - Take care that objects do not fall into the instruments and that liquids are not spilled into the enclosure through openings.
- **DEFECTS AND ABNORMAL STRESS** - Whenever it is likely that the normal operation has been impaired, make the equipment inoperable and secure it against further operation.
- **SITTING OR CLIMBING** - Do not sit or climb upon the instrument or use it as a step or ladder.
- **ENVIRONMENTAL CONDITIONS** - This equipment is designed for indoor use. Ambient temperature range during operation should be between 5° C to 40° C.
- **STORAGE AND PACKAGING** - The device should only be stored at a temperature between –25 and +70 °C. During extended periods of storage, protect the device from dust accumulation. The original packaging should be used if the device is transported or shipped again. If the original packaging is no longer available, the device should be packed carefully to prevent mechanical damage.

3.4 Product Features

3.4.1 CLCE-400 RF Current Probe Features

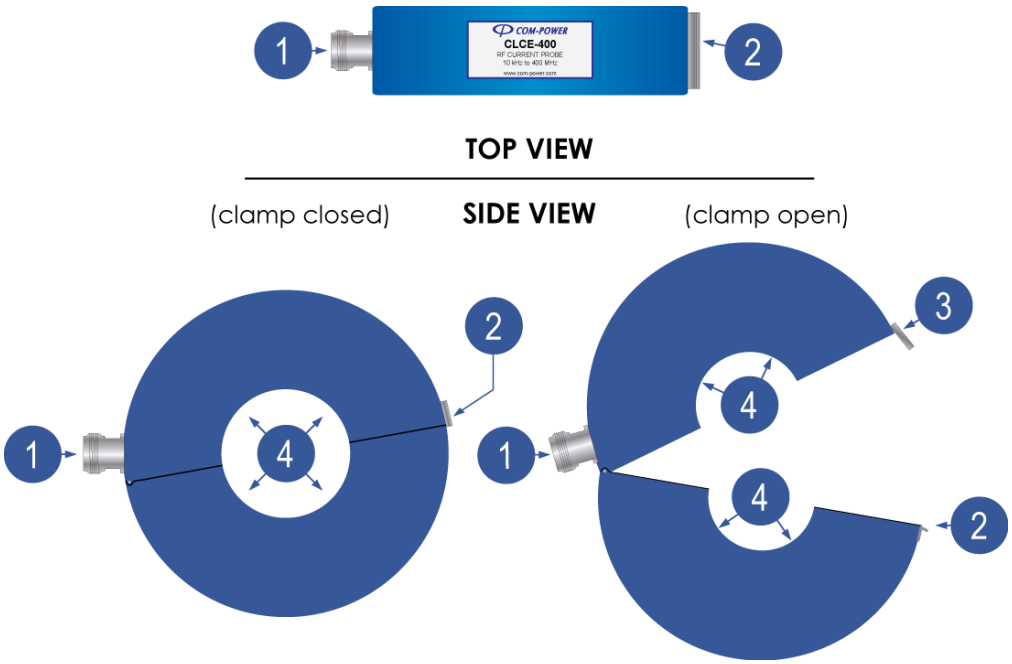

Figure 1 – CLCE-400 RF Current Probe Features

1. **Input/Output Port**
   This is the probe's output port. It is fitted with an N-type (female) coaxial connector.
2. **Spring-loaded Clasp**
   The clasp, when secured over the opposing bracket, locks the clamp into its closed position
3. **Clasp Bracket**
   The bracket anchors the clasp in order to lock the clamp into its closed position.
4. **Clamp Window**
   This clamp window is the aperture in the center of the clamp through which the wire(s), cable(s) or cable bundle(s) to be tested is/are passed through.

3.4.2 FCLCE-1000 Calibration Fixture Features

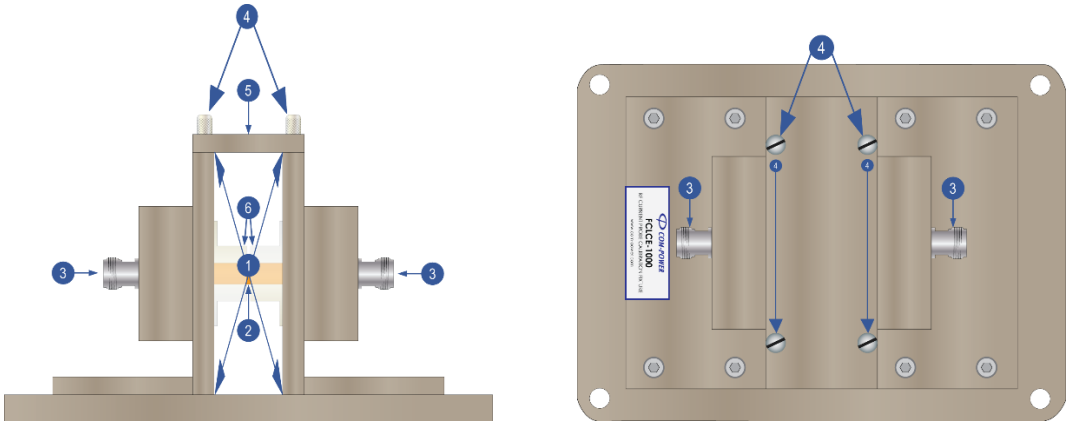

Figure 2 – FCLCE-1000 Calibration Fixture Features

1. **Fixture Opening**
   The CLCE-400 is installed within this opening so that the center conductor rod of the fixture passes through the approximate center of the probe aperture.
2. **Center Conductor Rod**
   This is the fixture's center conductor.
3. **Calibration Fixture Coaxial Ports**
   These are female N-type coaxial connectors providing input/output connections to the fixture.
4. **Thumb Screws for Removable Top Plate**
   These (4) screws secure the fixture's removable top plate to the assembly.
5. **Removable Top Plate of Fixture**
   In order to install/remove the clamp into/from the calibration fixture, the top plate must be removed by removing the four (4) thumb screws. The top cover and thumb screws must be replaced prior to the performance of tests.
6. **Teflon Spacers**
   These spacers center the clamp within the fixture; thereby aligning the center conductor through the center of the probe window.

3.5 Product Specifications

3.5.1 CLCE-400 RF Current Probe Specifications

Table 1 – CLCE-400 RF Current Probe Specifications

Product	**RF Current Probe**
Model	**CLCE-400**
Frequency Range	**10 kHz to 400 MHz**
Transfer Impedance	**0.06 to 9 ohms** *(-25 to 19 dBΩ)*
Standard(s)	**MIL-STD 461, RTCA-DO-160, CISPR 22, CISPR 32, etc.**
Impedance	**50Ω** *(nominal)*
Coaxial RF Connector	**N-type** *(female)*
Dimensions (H)x(W)x(D)	**2.83" x 0.75" x 3.7"** *(72 x 19 x 94 mm)*
Probe Window Diameter	**1.22"** *(31 mm)*
Weight	**0.35 lbs.** *(0.1625 kg)*
Operating Temperature	**40° F to 104° F** *(5° C to 40° C)*

All values are typical, unless specified.
All specifications are subject to change without notice.

3.5.2 FCLCE-1000 Calibration Fixture Specifications

Table 2 – FCLCE-1000 Calibration Fixture Specifications

Product	**Calibration Fixture**	
Model	**FCLCE-1000**	
Frequency Range	**10 kHz to 1000 MHz**	
Standard(s)	**MIL-STD 461, RTCA-DO-160, CISPR 22, CISPR 32, etc.**	
Impedance	**50Ω** *(nominal)*	
VSWR	**0.01-20 MHz**	**≤ 1.01 : 1**
	20-100 MHz	**≤ 1.05 : 1**
(empty fixture – no probe installed)	**100-200 MHz**	**≤ 1.15 : 1**
	200-400 MHz	**≤ 1.3 : 1**
Coaxial RF Connectors	**(2) N-type** *(female)*	
Dimensions (H)x(W)x(L)	**5" x 4.61" x 9.1"** *(128 x 117 x 230 mm)*	
Weight (empty fixture)	**3.5 lbs.** *(1.59 kg)*	
Max. Probe Diameter	**3.54"** *(90 mm)*	
Min. Probe Aperture Diameter	**1.18"** *(30 mm)*	
Max. Probe Width	**0.87"** *(22 mm)*	
Operating Temperature	**40°F to 104°F** *(5°C to 40°C)*	

All values are typical, unless specified.
All specifications are subject to change without notice.

3.6 Product Dimensional Diagrams

3.6.1 Dimensions of CLCE-400 RF Current Probe

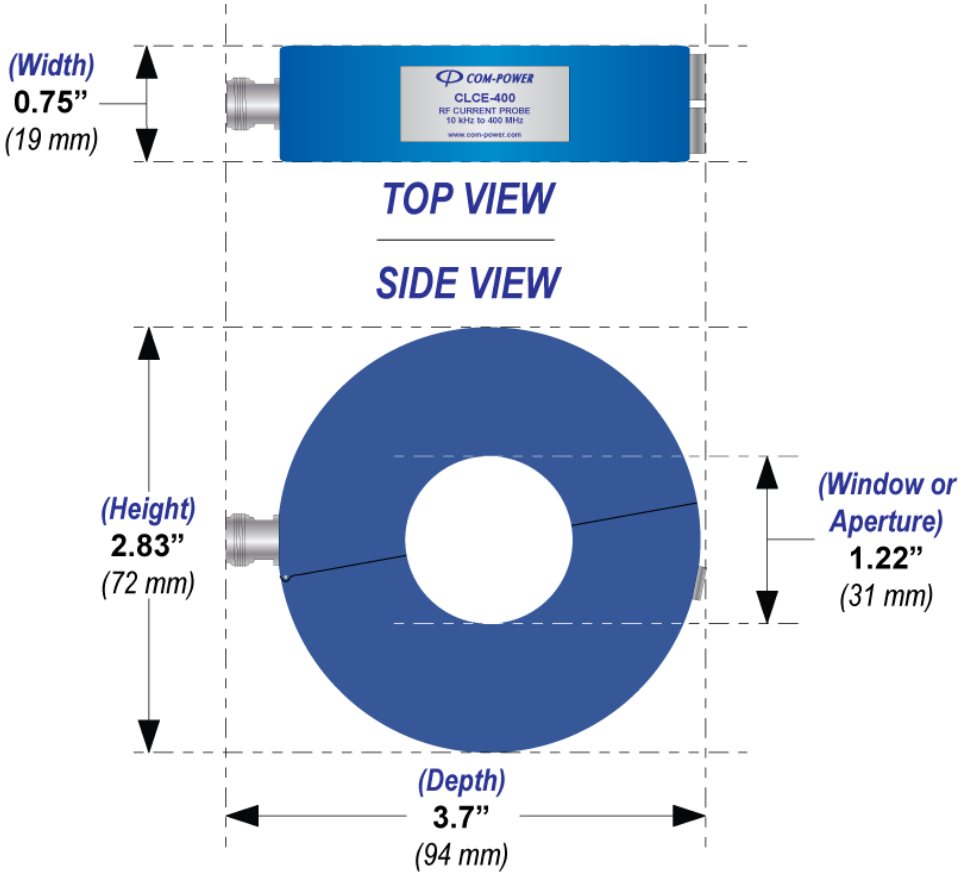

Figure 3 – CLCE-400 RF Current Probe Dimensions

3.6.2 Dimensions of FCLCE-1000 Calibration Fixture

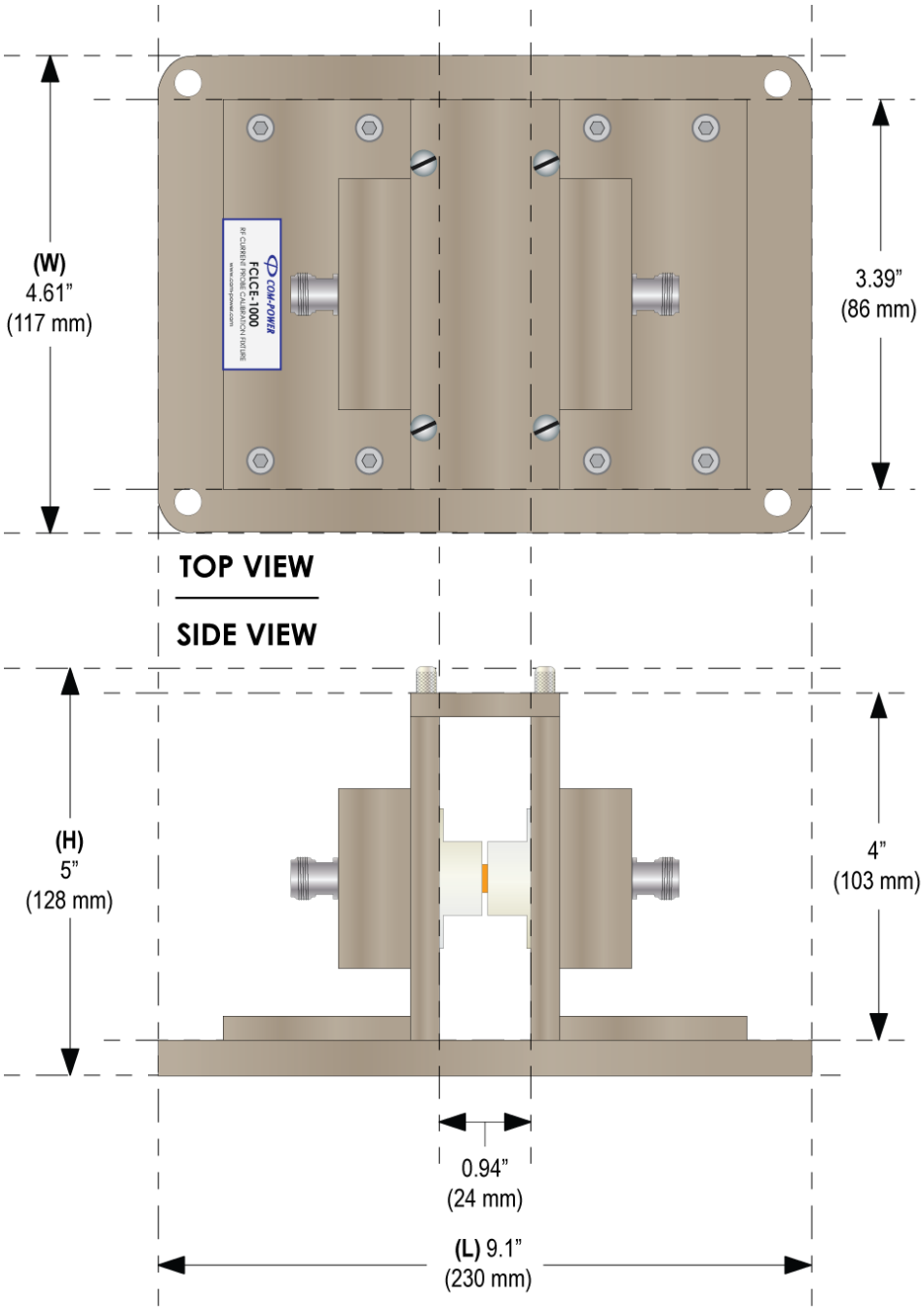

Figure 4 – FCLCE-1000 Calibration Fixture Dimensions

3.7 Typical Performance Data

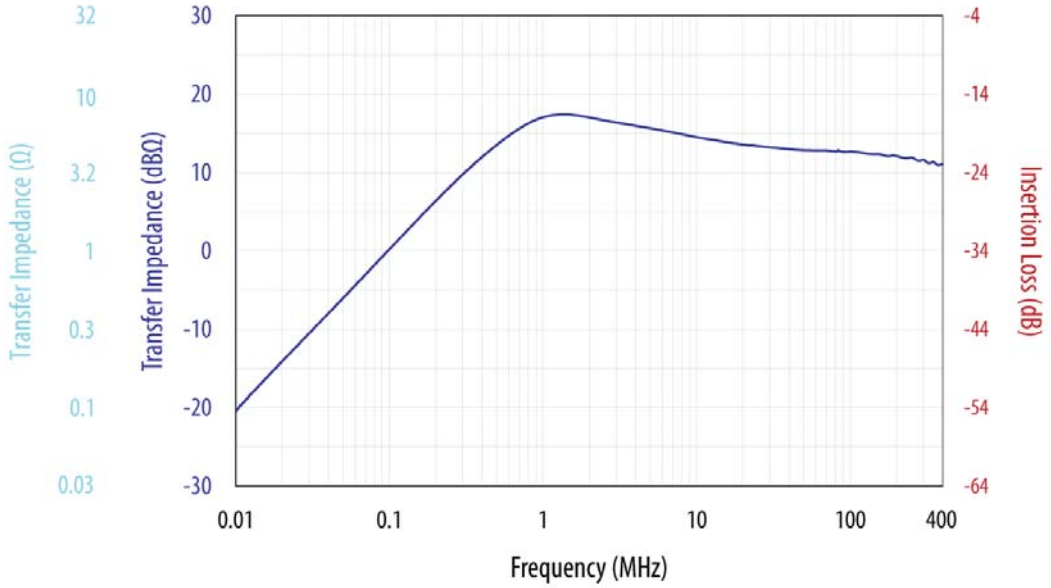

Figure 5 – Typical Insertion Loss/Transfer Impedance Factors for CLCE-400 Probe

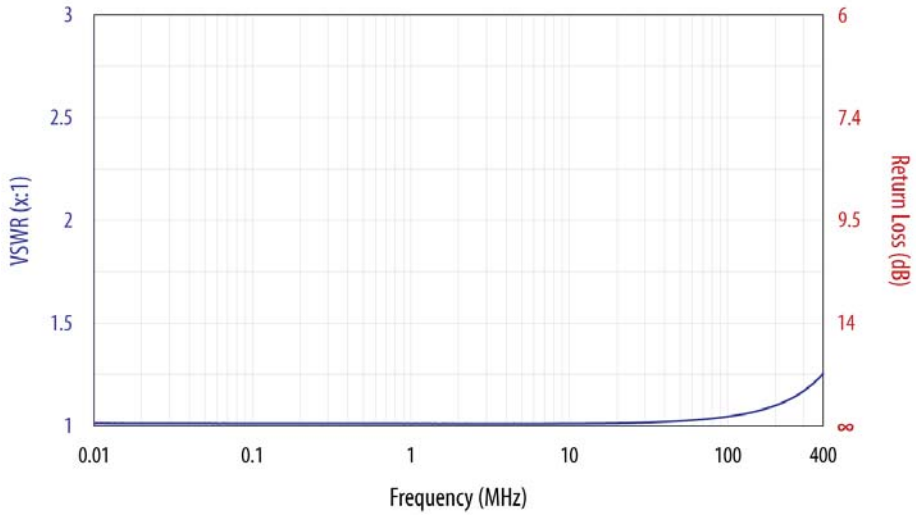

Figure 6 – Typical VSWR/Return Loss for FCLCE-1000 Calibration Fixture

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4. Calibration

Calibration fixtures provide a means by which current probes can be calibrated to determine the insertion loss and transfer impedance factors for the probe. Fixtures are also used when establishing or calibrating, drive levels for conducted susceptibility tests. These applications are discussed in more detail in the following sections.

The FCLCE-1000 Fixture is specifically designed for use with the CLCE-400.

The intent of the fixture is to maintain the coaxial structure of the transmission line, while allowing the probe to be installed around the center conductor of the coaxial line.

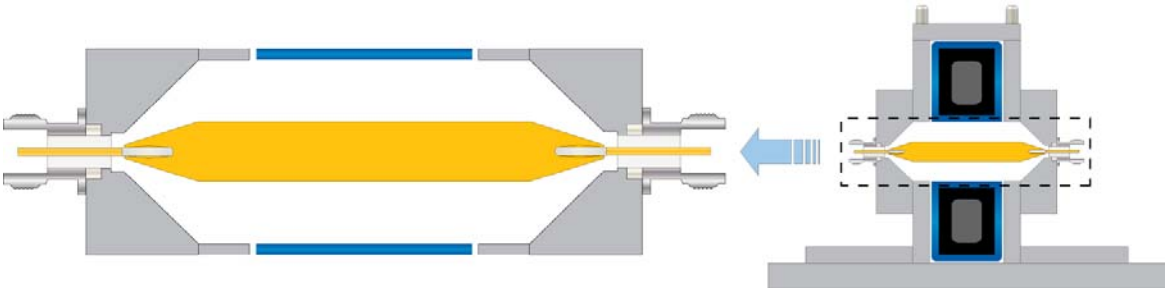

Figure 7 – Cross-Sectional Diagram of Calibration Fixture with Probe Installed

4.1 Installation of CLCE-400 Probe into FCLCE-1000 Fixture

Illustrated in Figure 8 is the procedure to be followed for installing the CLCE-400 Current Probe into the FCLCE-1000 Calibration Fixture.

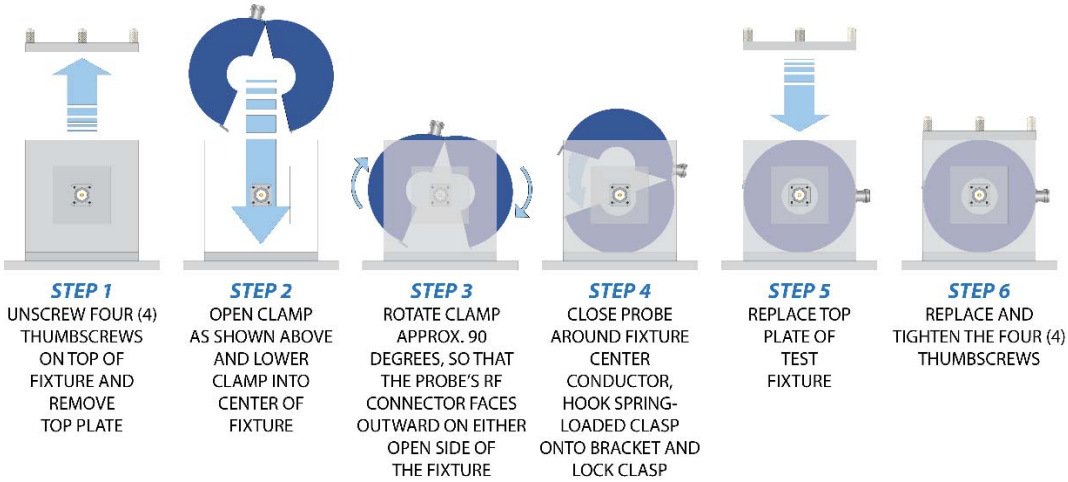

Figure 8 – Installation of CLCE-400 Probe into FCLCE-1000 Fixture

4.2 Insertion Loss/Transfer Impedance Calibration

4.2.1 Insertion Loss

The insertion loss of a current probe, at any given frequency, quantifies the difference between the voltage quantity present on the center conductor of the test fixture into which the probe is installed and the voltage quantity present at the output connector of the probe.

To determine the insertion loss of the probe, a known voltage is applied into one side of the calibration fixture, with the opposite side terminated into 50 ohms; while measuring the voltage present at the output of the probe. The difference between the applied voltage and the measured voltage, at any given frequency, is the insertion loss of the probe.

Shown in Figure 9 is the equivalent schematic circuit for the calibration. The physical test setup showing the equipment and connections is illustrated in Figure 10.

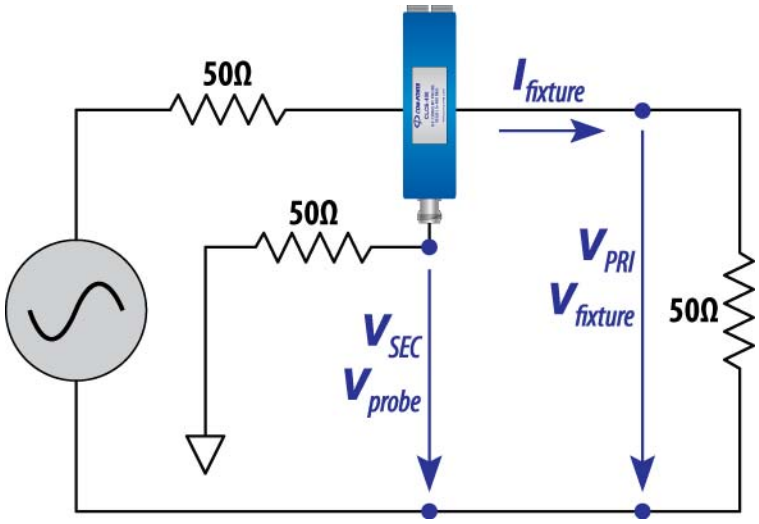

Figure 9 – Equivalent Schematic of the Insertion Loss Calibration Circuits

As measured in either of the circuits shown in Figure 9, the following equation defines the insertion loss of the probe, at any given frequency:

$$\underset{(\text{in } dB)}{\text{Insertion Loss } (L_{ins})} = \underset{(\text{in } dB)}{V_{PRI}} - \underset{(\text{in } dB)}{V_{SEC}} = 20\log\left(\frac{V_{PRI}\,(\text{in Volts})}{V_{SEC}\,(\text{in Volts})}\right)$$

NOTE: Typical Insertion Loss Values for the CLCE-400 are represented in Figure 5 (Section 3.7).

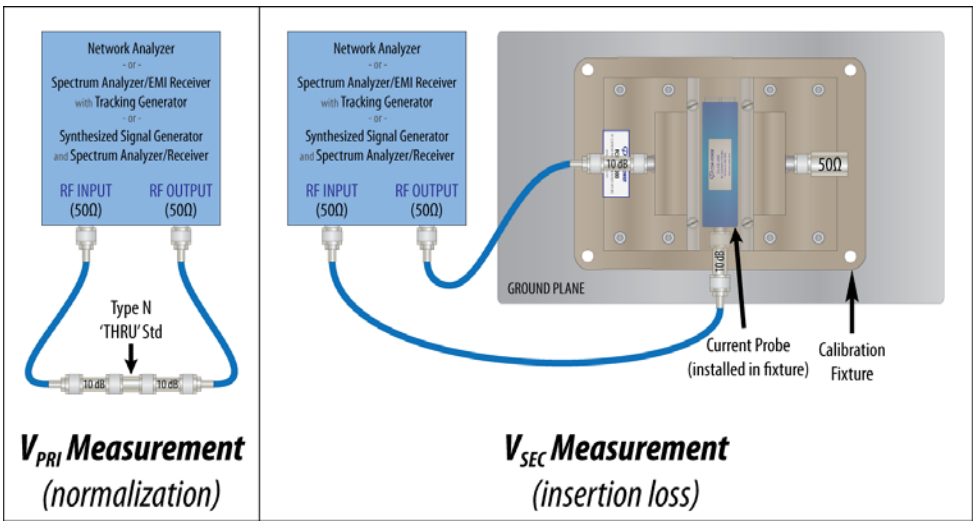

Figure 10 – Test Setup for Insertion Loss Measurement

4.2.2 Transfer Impedance Factors

When the probe is used to measure current, the transfer impedance factors convert the *[measured]* voltage quantity present at the probe's output port into a current quantity corresponding to the actual current through the conductor(s) passing through the probe aperture.

The transfer impedance factors include the insertion loss of the probe, and also perform the function of converting the measured voltage quantity into a current quantity. Based on the assumption that the probe is connected to a measuring instrument having a nominal input impedance of 50 ohms, this conversion is simple Ohm's Law:

$$\text{Current}_{(\text{in } \textit{Amps})} = \left(\frac{\text{Voltage}_{(\text{in } \textit{Volts})}}{50\Omega}\right) \quad \text{- or -} \quad \text{Current}_{(\text{in } \textit{dB}\mu\textit{A})} = \text{Voltage}_{(\text{in } \textit{dB}\mu\textit{V})} - 20\text{*log}(50\Omega)$$

$$\text{Current}_{(\text{in } \textit{dB}\mu\textit{A})} = \text{Voltage}_{(\text{in } \textit{dB}\mu\textit{V})} - 34$$

The transfer impedance factors are determined by combining the conversion described above with the insertion loss calibration data (L_{ins}), as shown below:

$$\text{Transfer Impedance Factor } (Z_T)_{(\text{in } \textit{dB}\Omega)} = \left(V_{SEC}{}_{(\text{in } \textit{dB})} - V_{PRI}{}_{(\text{in } \textit{dB})}\right) + 34 = 20\text{*log}\left(\frac{V_{SEC}{}_{(\text{in } \textit{Volts})}}{V_{PRI}{}_{(\text{in } \textit{Volts})}}\right) + 34$$

- or -

$$\text{Transfer Impedance Factor } (Z_T)_{(\text{in } \textit{dB}\Omega)} = -\left(L_{ins}{}_{(\text{in } \textit{dB})}\right) + 34$$

The transfer impedance factors can be applied in practice, as follows:

$$\text{Current}_{(\text{in } \textit{dB}\mu\textit{A})} = \text{Voltage}_{(\text{in } \textit{dB}\mu\textit{V})} - \text{Transfer Impedance Factor } (Z_T)_{(\text{in } \textit{dB}\Omega)}$$

5. Warranty

Com-Power warrants to its Customers that the products it manufactures will be free from defects in materials and workmanship for a period of three (3) years. This warranty shall not apply to:

- Transport damages during shipment from your plant.
- Damages due to poor packaging.
- Products operated outside their specifications.
- Products Improperly maintained or modified.
- Consumable items such as fuses, power cords, cables, etc.
- Normal wear
- Calibration
- Products shipped outside the United States without the prior knowlege of Com-Power.

In addition, Com-Power shall not be obliged to provide service under this warranty to repair damage resulting from attempts to install, repair, service or modify the instrument by personnel other than Com-Power service representatives.

Under no circumstances does Com-Power recognize or assume liability for any loss, damage or expense arising, either directly or indirectly, from the use or handling of this product, or any inability to use this product separately or in combination with any other equipment.

When requesting warranty services, it is recommended that the original packaging material be used for shipping. Damage due to improper packaging will void warranty.

In the case of repair or complaint, Please visit our website www.com-power.com and fill out the service request form (http://com-power.com/repairservicereq.asp). Our technical assistance personnel will contact you with an RMA number. The RMA number should be displayed in a prominent location on the packaging and on the product, along with a description of the problem, and your contact information.

6. Maintenance

This product contains no user serviceable parts. If the unit does not operate or needs calibration, please contact Com-Power Corporation. Any modifications or repairs performed on the unit by someone other than an authorized factory trained technician will void warranty.

The exterior surface may be cleaned with mild detergent and then be wiped with a dry, clean, lint-free cloth. The coaxial connectors can be cleaned using isopropyl alcohol and a cotton swab. Use care to avoid liquids or other foreign objects entering the chassis.

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