INSTRUCTION MANUAL

for

THREE-PHASE
LINE IMPEDANCE STABILIZATION NETWORK
(LISN)

Model:

LI-3P-216 V2.0 (16 Ampere)

Table of Contents

1679 Placentia Ave • Costa Mesa, CA 92627 • (949) 459-9600 • com-power.com

List of Figures

1679 Placentia Ave • Costa Mesa, CA 92627 • (949) 459-9600 • com-power.com

1.0 Introduction

This manual includes descriptions of front and rear panel ports, controls and indicators, product specifications, product dimensions, safety precautions, operational instructions and warranty information and guidelines and instructions for its proper usage.

2.0 Products Available from Com-Power


Antennas


Antenna Kits


Absorbing Clamps


Coupling/Decoupling Networks (CDN)


Comb Generators


Current Probes & Bulk Current Injection Probes


Emissions Test Systems

Conducted Immunity Test Systems


Impedance Stabilization Networks (ISN)

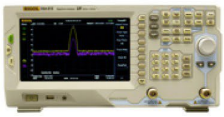

Line Impedance Stabilization Networks (LISN)


Antenna Masts


Near-Field Probe Sets


Preamplifiers


Power Amplifiers


Spectrum Analyzers


Surge Generators


Transient Limiters

Turntables


Antenna Tripods


Telecom Test Systems

www.com-power.com

3.0 Product Information

3.1 Incoming Inspection

WARNING – To avoid possibility of electrical shock, do not apply power to the LISN or any of its accessories if there is any evidence of shipping damage. If shipping damages to the product or any of the accessories are 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 contents in section 3.2 to ensure that you have received all applicable items.

3.2 What is in the Package

STANDARD ITEMS:

- ✓ **LI-3P-216 V2.0 Line Impedance Stabilization Network (LISN)**
- ✓ **CONN-KIT-3PLI25A**
- ✓ **RLI V2.0 Remote LISN Interface**
- ✓ **10-Meter Fiber Optic Cable**
  (Duplex Latching POF Connector at each end)
- ✓ **AC Power Adapter [6 Volts DC, 500 mA, unregulated]**
  (for powering the LISN fiber optic interface circuit)
- ✓ **AC Power Adapter [6 Volts DC, 500mA, unregulated**
  (for powering the RLI V2.0 Remote LISN Interface Box)
- ✓ **Calibration Certificate and Data**

OPTIONAL ACCESSORIES:

- ✓ **LI-3P-XXXX-ADA** *[Coaxial Adapter]* with **LI-3P-ADA_PP25A** *[Plug Pin]*
- ✓ **LI-3P-XXXX-ADA** *[Coaxial Adapter]* with **LI-3P-ADA_PS25A** *[Plug Socket]*

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.

The yellow triangle with a lightning bolt indicates an alert to the user that uninsulated ***dangerous voltages*** are present within the product enclosure and on output connectors. These voltages may be of sufficient magnitude to constitute a risk of electric shock to people.

The Ground symbol inside a circle indicates terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.

To indicate on the rating plate that the equipment is suitable for AC current.

To indicate on the rating plate that the equipment is suitable for direct current.

3.3.2 Product Warning/Caution Statements

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

WARNING: HIGH VOLTAGE!

CONNECT PROTECTIVE EARTH BEFORE APPLYING POWER!
VERIFY INPUT POWER CONFIGURATION PRIOR TO MAKING CONNECTION.

CAUTION:

TO PREVENT ELECTRIC SHOCK, DO NOT OPEN COVER. CONNECT PROTECTIVE EARTH BEFORE APPLYING POWER. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

TO AVOID OVERHEATING, OPERATE FANS DURING USAGE.

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 operations and use instructions.
- **WATER AND MOISTURE** - Do not use the instrument near water.
- **VENTILATION**- The instrument should be used/installed only in locations where the flow of air through the ventilation openings is not impeded.
- **MOUNTING** - The instrument can be used in Horizontal or vertical orientation if the ventilation holes are not obstructed and the protective grounding is not defeated.
- **HEAT** - The instrument should be situated away from heat Horizontal or vertical orientation if the ventilation holes are not obstructed and the protective grounding is not defeated
- **POWER SOURCES** – Connect the instrument only to the type of power source described in the operating instructions type of power source described in the operating instructions

- **GROUNDING** - Take precautions to ensure that the grounding of the instrument is not defeated. Grounding conductor with adequate cross-section must be connected between a grounding conductor connection for the measurement area and the grounding conductor connection (grounding bolt) on the back panel of the LISN and the LISN bottom plate, before applying any power to the LISN. At shutdown or before dismantling the LISN setup, ensure that the power to LISN is discontinued before the ground conductor connection is disconnected.

- ***CAUTION*** **-** *The specified minimum line to ground capacitance induces leakage currents more than the value permitted under EN 61010-1 standard – safety requirements for electrical equipment for measurement, control and laboratory use.*

  In addition, the basic insulation required for a category I protection device cannot be assured. Therefore, it is imperative to provide additional measures safeguarding against direct or indirect contact by users.

  The operator is responsible for ensuring that protection is maintained during work with the line impedance stabilization network (LISN).

  Before using the LISN, a secure ground connection must be made to the LISN grounding bolt and/or the bottom metal plate (The bottom surface of the LISN is left unpainted for effective ground connection). It must not be removed until after the LISN has been disconnected from the mains power supply, to avoid electric shock.

The safety notes in the accompanying operating instructions and on the outside of the device must be always followed.

- **POWER CORD PROTECTION** - Place power supply cords so that they are not likely to be walked on or pinched by items placed on them or against them.
- **CLEANING** - Clean the instrument outside surfaces of the device with soft, lint-free cloth. If necessary, a mild detergent may be used.
- **NON-USE PERIODS** - Unplug the power cords of the instrument when it is left unused for a long period of time.
- **OBJECT AND LIQUID ENTRY** - Take care that objects do not fall into 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

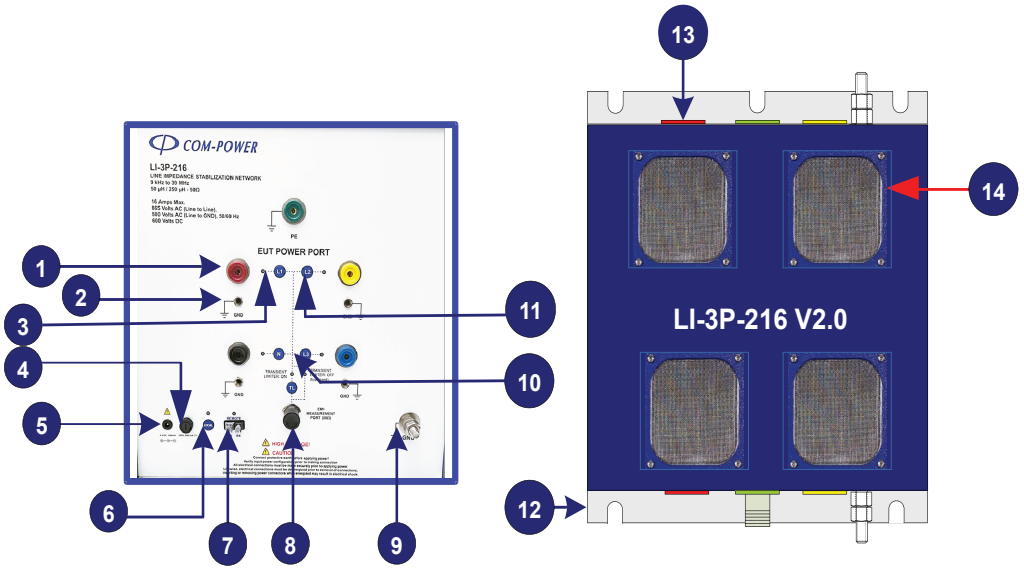


FIGURE 1 - Product Features – Front Panel and Top View

1 **EUT Power Ports**
Power ports to which the EUT power input wiring connects to LISN.

2 **Ground Connection Jack**
Reference ground connection points for coaxial adapters (sold separately).

3 **LED Indicators of Line Under Test**
L1, L2, L3 and N indicate which line is selected.
Only (1) LED is illuminated at any given time.

4 **Fuse Mounting Assembly**
Provides access to input power fuse for fiber optic interface circuit.
Fuse type: 250V, 500 mA (T).

5 **DC Power Port for Fiber Optic Interface Circuit**
This is the DC Power input port for the fiber optic interface circuit. The output cable of the included 6 VDC, 500 mA unregulated AC power adapter connects to this port.

6 **Push Button LOCAL with Green Led**
Press this button for Local Operation while LISN is in Remote Mode.

7 **Fiber Optic Port with REMOTE LED**
Fiber optic port for connection to RLI Remote LISN Interface. When the REMOTE LED is illuminated, the LISN is in remote mode.

8 **EMI Measurement Port**
Coaxial, Female N-type connector intended to be connected to the 50Ω RF input of the measuring instrument.

9 **Ground Stud**

Provides a ground connection point at the same electrical potential as the base plate.

10 **Push-Button (TL) with LED indicators for Transient Limiter**

The TL push-button is used to toggle ON/OFF the transient limiter circuit along the measurement path. When ON, the transient limiting circuit is ENABLED. When OFF, the transient limiting circuit is BYPASSED.

11 **Push-Buttons for L1, L2, L3 and N**

These buttons are used to select the line under test.

12 **LISN Base Plate**

The unpainted LISN base plate is intended to be bonded to the site reference ground plane. Please refer to section 5.1 for installation information and grounding precautions.

13 **EUT Power Input Ports**

Power ports for connection to EUT power sources.

14 **Air/Heat outlets (4 Nos.)**

Air/Heat outlets protected by steel mesh. Do not block any ventilation openings.

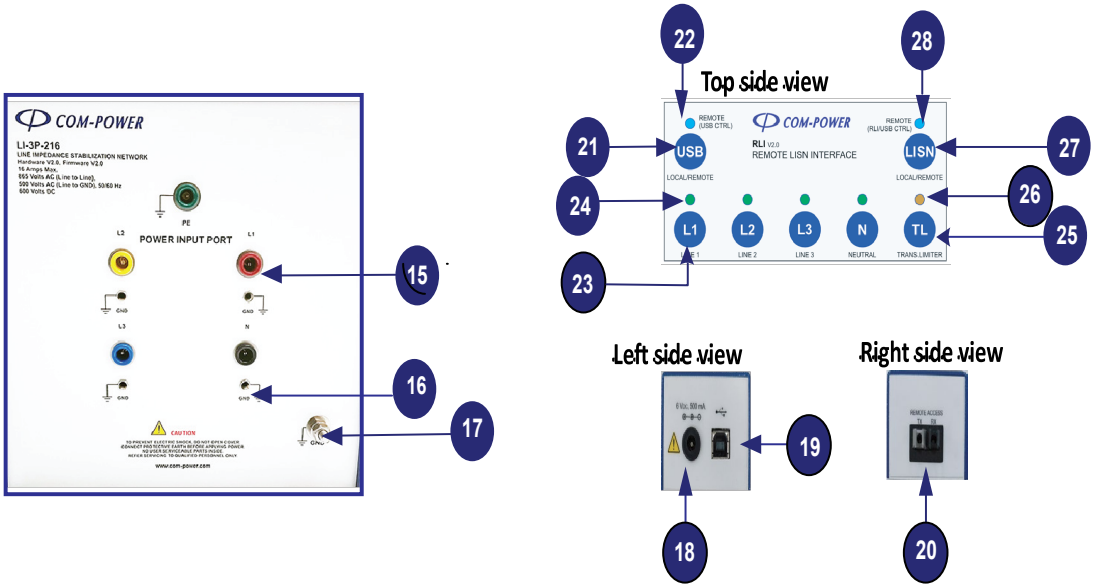


FIGURE 2 - *Product Features – Rear Panel & RLI V2.0*

15 **EUT Power Input Ports**

Power ports for connection to EUT power sources.

16 **Ground Connection Jack**

Reference ground connection points for coaxial adapters (sold separately).

17 **Ground Stud**

Provides a ground connection point at the same electrical potential as the base plate.

18 **DC Power Port**

This is the DC power input port for the RLI. The output cable of the included 6 VDC, 500 mA unregulated AC power adapter connects to this port.

19 **USB Port**

This USB port is for computer connection.

20 **Fiber Optic Port**

Fiber optic port for connection to LISN.

21 **USB Button**

Pressing the USB button allows a connected computer to control which line is selected.

22 **USB LED Indicator**

Indicates that the USB button is pressed and computer control is enabled.

23 **Line Under Test Selection Buttons (L1, L2, L3, N)**

These (4) buttons are used to select the Line Under Test.

24 **LED Indicators of Line Under Test (L1, L2, L3, N)**

These (4) LEDs correspond to the button immediately below each indicator. The illuminated LED indicates the current line under test.

25 **Transient Limiter Button (TL)**

The TL Push-button is used to toggle ON/OFF the transient limiter circuit along the measurement path. When the LED is ON, the transient limiting circuit is ENABLED. When OFF, the transient limiting circuit is BYPASSED.

26 **LED Indicator of Transient Limiter**

When illuminated, the transient limiter circuit is enabled.

27 **Local/Remote Button**

This button is used for remote control operations.

28 **REMOTE (RLI/USB CTRL) LED Indicator**

When the LED is illuminated, the LISN is in remote mode.

3.5 Product Specifications

GENERAL	
Product Description	**Line Impedance Stabilization Network** *[LISN]*
Application	**Power Line Conducted Emissions** *[Disturbance Voltages]* **Tests**
Standards	**CISPR 16-1-2** *[CE]*, **ANSI C63.4** *[FCC]*
LISN Type	**50Ω, 50/250 µH +5Ω Four-Conductor Network**
Frequency Range	**9 kHz to 30 MHz**
Insertion Loss - 9 kHz to 150 kHz	**<17 to <11 dB** *(decreasing linearly with the logarithm of frequency)*
Insertion Loss - 150 kHz to 30 MHz	**<11 dB**
Isolation - 9 kHz to 50 kHz	**>0 to >40 dB** *(increasing linearly with the logarithm of frequency)*
Isolation - 50 kHz to 30 MHz	**>40 dB**
INPUT POWER RATINGS FOR EQUIPMENT UNDER TEST (EUT)	
Current (maximum continuous, per line)	**16 Amperes**
AC Voltage (maximum)	**865 Volts**(rms) *[line to line]*, **500 Volts**(rms) *[line to ground]*
DC Voltage (maximum)	**600 Volts DC**
ELECTRICAL	
Remote Interface Power Inputs	**6 Volts DC** *[unregulated]*, **500 mA** *[LISN Front Panel and RLI V2.0 Remote LISN Interface]*
INPUT/OUTPUT CONNECTORS	
Power Input Port Plug (affixed to LISN chassis)	**25A Receptacle Pins** **CONN-RP25GR** *[Red]*, **CONN-RP25GY** *[Yellow]*, **CONN-RP25GBL** *[Blue]*, **CONN-RP25GB** *[Black]*, **CONN-RP25GG** *[Green]*
Power Input Socket (for power input cable)	**25A Plug Sockets** **CONN-PS25GR** *[Red]*, **CONN-PS25GY** *[Yellow]*, **CONN-PS25GBL** *[Blue]*, **CONN-PS25GB** *[Black]*, **CONN-PS25GG** *[Green]*
Power Output Port Socket (affixed to LISN chassis)	**25A Receptacle Sockets** **CONN-RS25GR** *[Red]*, **CONN-RS25GY** *[Yellow]*, **CONN-RS25GBL** *[Blue]*, **CONN-RS25GB** *[Black]*, **CONN-RS25GG** *[Green]*
Power Output Port Plug (for EUT power cable)	**25A Plug Pins** **CONN-PP25GR** *[Red]*, **CONN-PP25GY** *[Yellow]*, **CONN-PP25GBL** *[Blue]*, **CONN-PP25GB** *[Black]*, **CONN-PP25GG** *[Green]*
RF Measurement Port	**50Ω - N-Type** *[female]*
Fiber Optic Ports	**Avago Duplex Latching POF Jack** *[LISN and RLI V2.0 Remote LISN Interface]*
Remote Interface Power Input Ports	**5.5/2.1 mm Power Jack** *[LISN front panel and RLI V2.0 Remote LISN Interface]*
Optional Accessories	**LI-3P-XXXX-ADA** *[Coaxial Adapter]* with **LI-3P-ADA_PP25A** *[Plug Pin]* **LI-3P-XXXX-ADA** *[Coaxial Adapter]* with **LI-3P-ADA_PS25A** *[Plug Socket]*
ENVIRONMENTAL	
Operating Temperature	**40°F to 104°F** *(5°C to 40°C)*
Cooling	• **Louvered Side Panels** *(no forced air)* *(4)* **4" square air outlets located on the top cover** *(each opening protected by metallic mesh)*

3.6 Dimensions

DIMENSIONS & WEIGHT	
Figure 3 (a)- Dimension A	**22.77"***(57.86 cm)*
Figure 3(a)- Dimension B	**20.92"***(53.16 cm)*
Figure 3(a)- Dimension C	**18.88"***(47.96cm)*
Figure 3(a)- Dimension D	**14.25"** *(36.2 cm)*
Figure 3 (a)- Dimension E	**14.58"***(37.05 cm)*
Figure 3(b) - Dimension F	**0.97"***(2.47 cm)*
Figure 3 (b)- Dimension G	**2.84"** *(7.23cm)*
Figure 3(b) - Dimension H	**0.97"** *(2.47cm)*
Figure3(b) - Dimension I	**2.75"***(7.0 cm)*
Weight	**55.56 lbs.** *(25.20 kg)*
Weight with Shipment Box	**113.32 lbs.** *(51.40 kg)*
Shipment Box Size	**28.19" x 21.70" x 27.25"***(72 x 55 x 69 cm)*

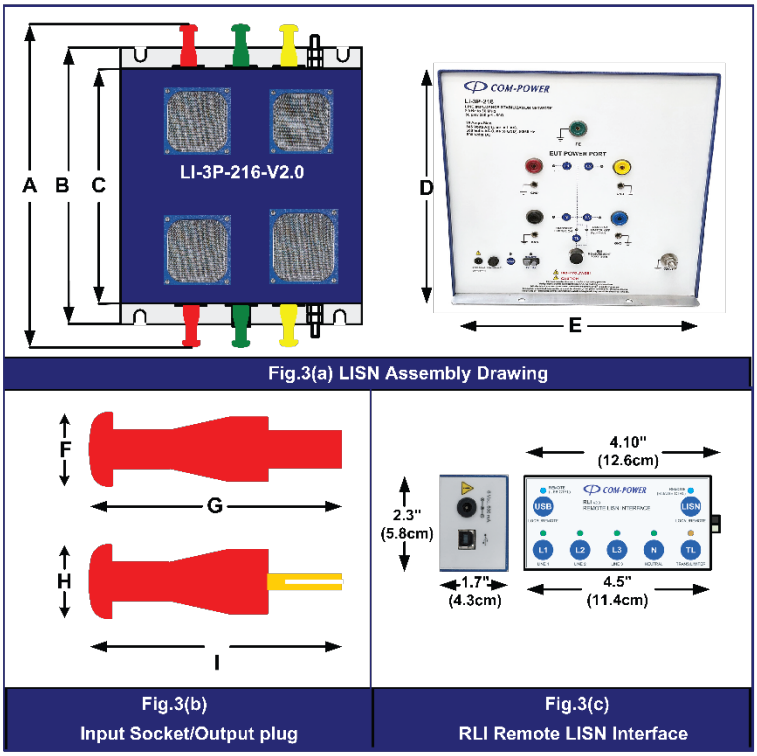


Fig.3(a) LISN Assembly Drawing

Fig.3(b)
Input Socket/Output plug

Fig.3(c)
RLI Remote LISN Interface

FIGURE 3 - *Product Dimensions*

3.7 Product Reference Data

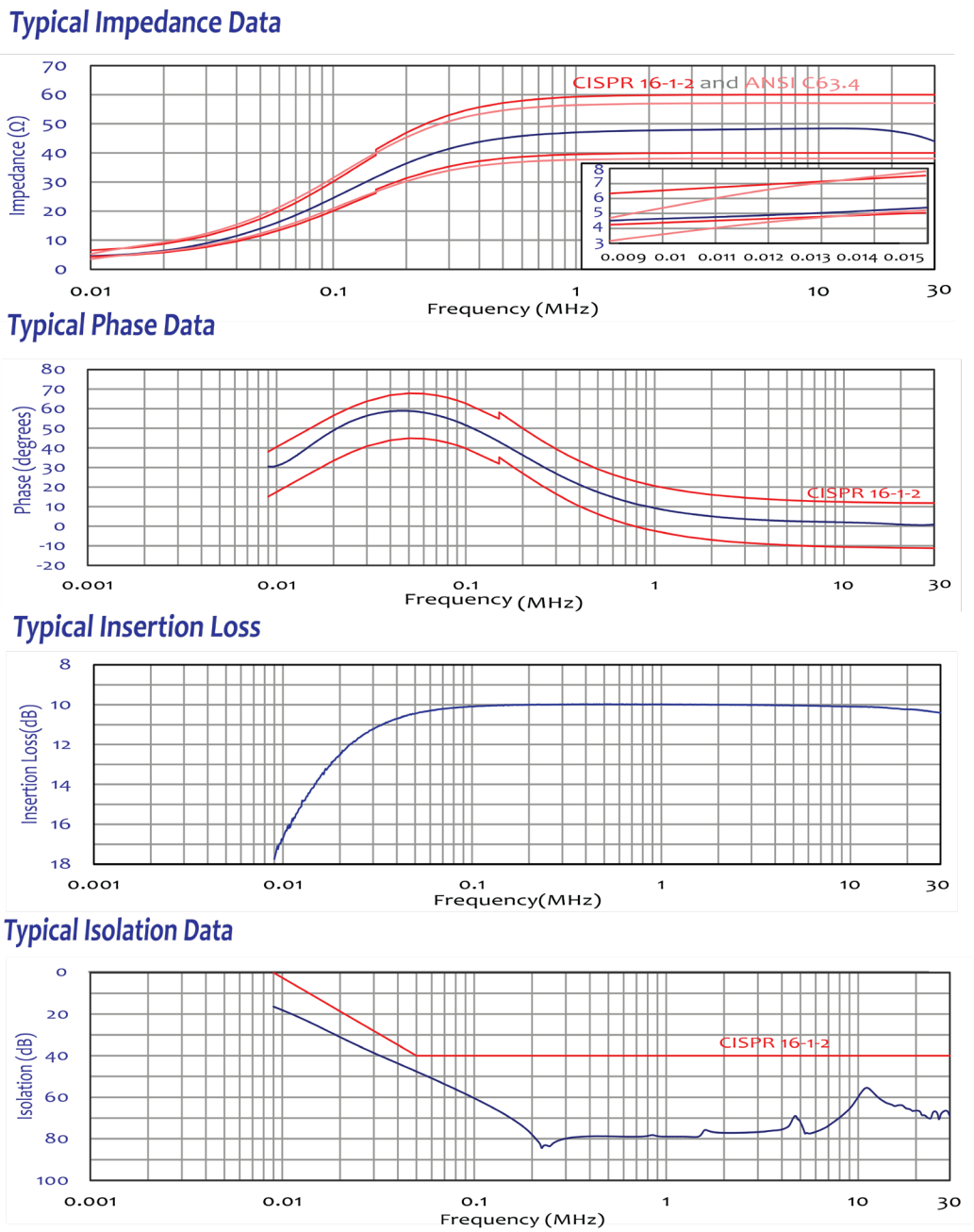


FIGURE 4 - *Product Reference Data*

4.0 LISN Installation

4.1 LISN Theory

The LI-3P-216 LISN is specifically designed to provide the necessary measurement platform for power line conducted emissions (disturbance measurements) compliance testing as required for FCC regulations, CISPR/EN/ETSI and other worldwide standards for commercial products. The LISN is fully compliant with the requirements of both CISPR 16-1-2 and ANSI C63.4.

Line Impedance Stabilization Networks provide standardized line impedance to the EUT during conducted emissions testing which is independent of the external power line impedance. The standardized impedance enables consistent readings for RF noise measurements on the power line.

In addition to providing a standardized impedance, the LISN also acts as a low pass filter for the power to equipment under test. The LISN provides some isolation between the power source or mains network to reduce the amplitude of unwanted ambient signals/noise while allowing the power to pass with minimal voltage drop. This filter is comprised of a single stage low pass LC filter. The inductor (L) used in all Com-Power LISNs are air core types to eliminate the possibility of saturation and to provide stability.

The LISN also provides a low impedance, capacitively coupled, minimal loss path for the RF noise from each EUT power conductor to the measurement port. The loss incurred along each of these paths is referred to as Insertion Loss. Insertion Loss factors are individually measured and provided for each line in the network. These factors must be considered to achieve the highest measurement accuracy. The insertion loss factors (in dB) are added to the measured values (in dBµV). A basic example schematic of the LISN is illustrated in Figure 5 below.

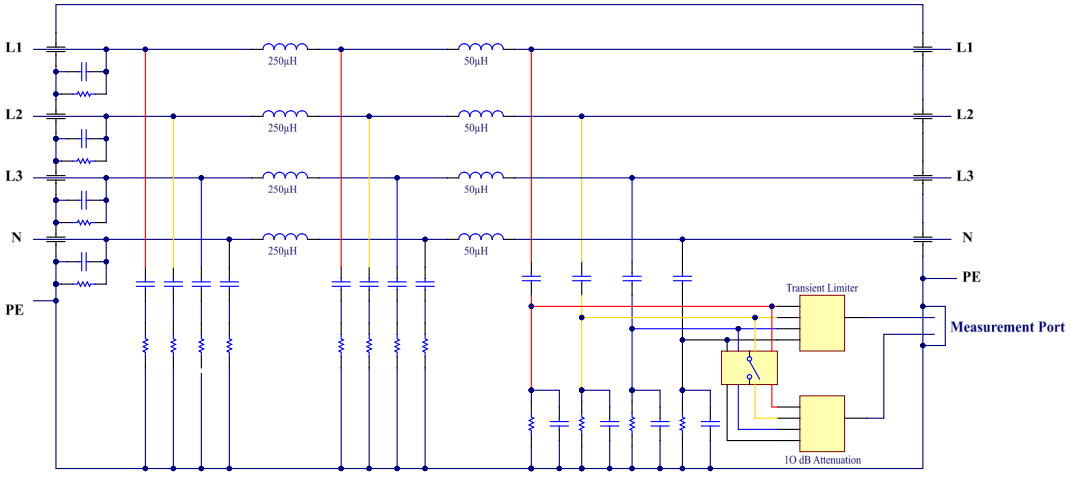


FIGURE 5 – *Schematic Diagram of LI-3P-216*

4.2 Safety Considerations

It is critical that the LISN be installed in a manner which ensures that each of following conditions is satisfied:

- The metal enclosure of the LISN must be connected to the reference ground plane of the site. The recommended connection method is via a direct, surface to surface connection between the LISN base plate and an exposed, conductive surface of the floor or wall of a shielded enclosure. The LISN base plate should be bolted to the surface using the mounting holes on the front and back of the LISN base plate.

  Where installation as described in the previous paragraph is not possible, the LISN may be connected to earth ground via the ground lug located on the rear panel of the LISN. Thick metallic braid or heavy gauge wiring is recommended, and the length shall be kept as short as possible.

  In cases where no ground plane is available, a Mains isolating transformer shall be used.

  Please refer to the safety instructions in section 3.3 for more information on the importance of grounding. The grounding instructions are to be always followed.

- The ventilation openings in the LISN enclosure must be unobstructed.
- No signal or operating voltages/currents shall exceed those specified in the product specifications listed in section 3.5.
- The LISN power input port must connect to an appropriate power source protected by a circuit breaker with a current rating which is greater than or equal to the rating of the LISN.

  Due to the high level of earth leakage current, the device cannot be connected to any power source protected by a Ground Fault Circuit Interrupter (GFCI), also called Ground Fault Interrupter (GFI) or Residual Current Device (RCD).

  Failure to comply with any of these points may damage the equipment and/or pose an electrical hazard.

4.3 Test Equipment Setup & Connections

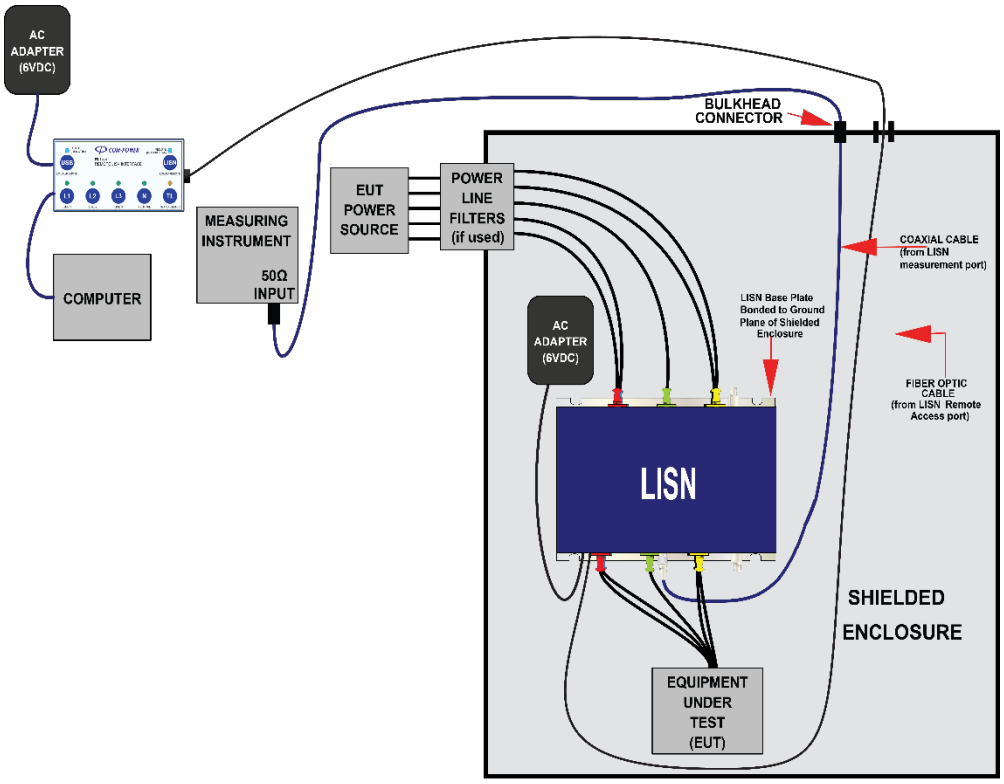


FIGURE 6 – *Typical Test Setup*

Depending on the electromagnetic environment, the use of a shielded enclosure, power line filters and/or isolation transformers may or may not be necessary. The LISN will act as a filter, providing some isolation between the Mains Port and EUT Port. However, this may not be sufficient for some installations, and additional power line filtration may prove to be necessary.

The Transient Limiter **(TL ON)** circuit includes 10 dB attenuation. When set for **(TL OFF),** the Transient Limiter is bypassed, but there is still a 10 dB attenuation pad in-circuit.

4.3.1 LISN Input Power Connections

Your LI-3P-216 LISN is provided with five (5) 25A plug sockets: red, yellow, blue, black, green (with female contacts), which are used to connect the LISN to the Power Source of EUT. The colors of these connectors match the respective colors of the input receptacles on the rear of the LISN. Figure 7 shows these connectors.

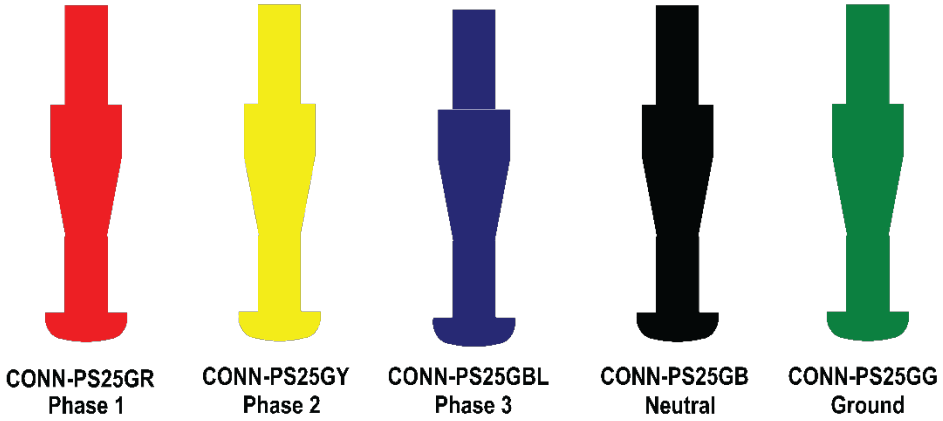


FIGURE 7 – *Power Input Port Plug Socket Connectors (25 Amp)*

4.3.2 LISN Output Power Connections

Your LI-3P-216 LISN is provided with five (5) 25A plug pins: red, yellow, blue, black, green (with male contacts), which are used to connect the LISN to the input power cable for the Equipment Under Test (EUT). The colors of these connectors match the respective colors of the output receptacles on the front of the LISN. Figure 8 shows these connectors.

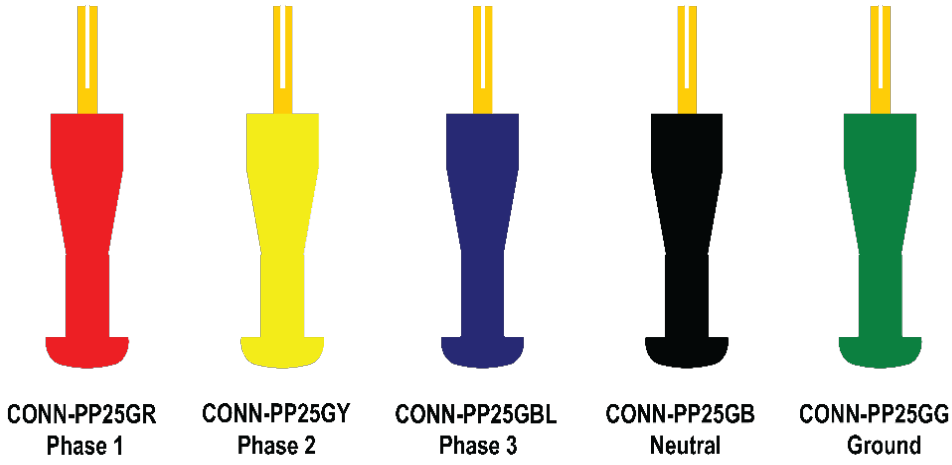


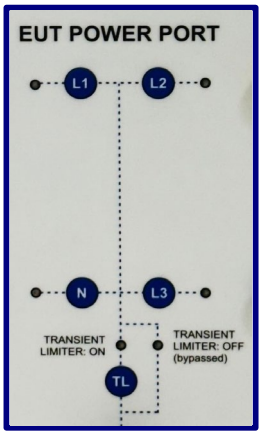
FIGURE 8 – *EUT Power Port Plug Pin Connectors (25 Amp)*

5.0 LISN Operation

Operation of the LI-3P-216 model includes local (front panel) and remote switching of the line under test.

5.1 Local (Front panel) Operation

To operate LISN locally, one of the supplied 6 VDC AC power adapters must be plugged into input port on the front panel. The push buttons on the LISN front panel are used to select Line L1, L2, L3 and N as the line under test and to enable/bypass the transient limiter.

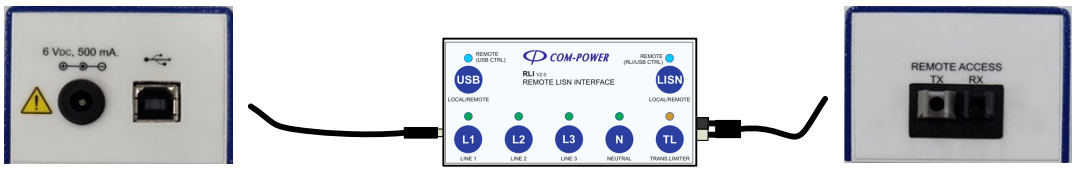


TEST LINE SELECTION **DC input, Local Operation, Fiber Optic**

NOTE: Operation of the LISN from the front panel is possible when the REMOTE LED is not illuminated, meaning there is no remote connection to the RLI Remote LISN Interface.

5.2 Remote Operation

To enable remote operation, the 6 VDC AC power adapters must be plugged in and connected to the appropriate input power ports on the left side of the RLI V2.0 Remote LISN Interface and on the front panel of the LISN.



Then, connect one end of the fiber optic cable to the fiber optic port on the RLI V2.0, and connect the other end into the fiber optic port on the front panel of the LISN.

Once the fiber optic cable is connected and both sides are powered, the link is established automatically. When linked, the REMOTE and L1 LEDs on the LISN front panel should become illuminated, as well as the L1 LED on the RLI V2.0.

Once linked, you are now able to select the Line using the L1, L2, L3 and N push-buttons on the top surface of the RLI V2.0. The active(illuminate) line under test indicator LEDs on both the RLI V2.0 and the LISN front panel should immediately change with respect to which push-button is pressed.

The LISN can also be controlled via computer. Simply connect RLI to the computer using a USB type B to type A cable. The command codes for the RLI are given in Figure 9.

No.	Commands	Description	Return Value	Condition For Return Value
1	@CT$	To begin communication between PC & RLI.	@Access Granted$	If RLI is in Remote Mode.
			@Access Denied$	If RLI is in Manual Mode.
2	@DT$	To end communication between PC & RLI.	@Disconnected$	If RLI is in Remote Mode.
			@Access Denied$	If RLI is in Manual Mode.
3	@CS$	Query the connection status between RLI & LI-3P.	@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@Access Denied$	If RLI is in Manual Mode.
			@Connected$	If RLI & LI-3P are Linked via Fiber Optic Communication.
4	@CH$	Query the Selected Channel on RLI.	@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@Access Denied$	If RLI is in Manual Mode.
			@L1$	If **L1** is Selected.
			@L2$	If **L2** is Selected.
			@L3$	If **L3** is Selected.
			@NE$	If **N** is Selected.
5	@L1$	Set the Channel Selection to L1 on RLI.	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@L1-Selected$	If RLI & LI-3P are Linked via Fiber Optic Communication.
6	@L2$	Set the Channel Selection to L2 on RLI.	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@L2-Selected$	If RLI & LI-3P are Linked via Fiber Optic Communication.
7	@L3$	Set the Channel Selection to L3 on RLI.	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@L3-Selected$	If RLI & LI-3P are Linked via Fiber Optic Communication.
8	@NE$	Set the Channel Selection to N on RLI.	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@NE-Selected$	If RLI & LI-3P are Linked via Fiber Optic Communication.
9	@TT$	Set Transient Limiter ON	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@TL-ON$	If RLI & LI-3P are Linked via Fiber Optic Communication.
10	@TB$	Set Transient Limiter OFF	@Access Denied$	If RLI is in Manual Mode.
			@Disconnected$	If RLI & LI-3P are Not Linked via Fiber Optic Communication.
			@TL-OFF$	If RLI & LI-3P are Linked via Fiber Optic Communication.

FIGURE 9 – *Commands for Controlling RLI/LISN*

6.0 LISN Measurements

Measurements of conducted emissions, sometimes referred to as disturbance voltages, using LI-3P-216 LISN are made individually on each current carrying conductor with reference to ground.

Measured values must be corrected to account for any losses incurred along the measurement path. These corrections usually include the insertion loss values for the LISN (with respect to the test line being measured), coaxial measurement cables, attenuation pads or transient limiters, connecting adapters, etc.

6.1 LISN Insertion Loss Factors

The Insertion Loss for an LISN is essentially the difference, in dB, between the signal amplitude on the EUT power conductor at the entry point of the EUT power port into the LISN, and the amplitude of the same signal at the measurement port of the LISN. The insertion loss factors for the LI-3P-216 LISN include the insertion loss of the internal transient limiter and/or 10 dB attenuator.

All Com-Power LISNs are individually calibrated, and the insertion loss values are provided. There are eight (8) total sets of Insertion Loss Factors for the LI-3P-216; two (2) for each line; One set is with the Transient Limiter ON (Enabled), and the other set is with the Transient Limiter OFF (bypassed).

Typical Insertion Loss factors for the LI-3P-216 LISN are shown in Figure 10 table.

Equipment:	**Three-Phase Line Impedance Stabilization Network (LISN)**
Model:	**LI-3P-216 V2.0**

Frequency	LISN Insertion Loss Factors (Transient Limiter ON/OFF)							
	LINE 1		LINE 2		LINE 3		NEUTRAL	
	TL OFF	TL ON	TL OFF	TL ON	TL OFF	TL ON	TL OFF	TL ON
(MHz)	*(dB)*	*(dB)*	*(dB)*	*(dB)*	*(dB)*	*(dB)*	*(dB)*	*(dB)*
0.009	16.25	17.39	16.26	17.35	16.33	17.44	16.30	17.37
0.01	15.58	16.54	15.59	16.52	15.65	16.60	15.61	16.55
0.011	14.95	15.78	14.95	15.75	15.02	15.83	14.99	15.78
0.012	14.45	15.17	14.46	15.16	14.51	15.22	14.49	15.17
0.013	14.01	14.64	14.02	14.64	14.07	14.69	14.05	14.65
0.014	13.63	14.19	13.63	14.19	13.68	14.24	13.66	14.19
0.015	13.29	13.80	13.30	13.80	13.35	13.85	13.32	13.81
0.016	12.99	13.45	13.00	13.45	13.04	13.50	13.02	13.46
0.017	12.71	13.11	12.71	13.12	12.75	13.16	12.73	13.12
0.018	12.49	12.87	12.49	12.87	12.53	12.91	12.52	12.87
0.02	12.10	12.41	12.10	12.41	12.13	12.45	12.12	12.42
0.025	11.45	11.66	11.45	11.67	11.47	11.69	11.46	11.67
0.03	11.03	11.18	11.02	11.18	11.04	11.19	11.03	11.18
0.035	10.77	10.88	10.77	10.88	10.78	10.90	10.78	10.89
0.04	10.59	10.68	10.59	10.68	10.60	10.69	10.60	10.68
0.045	10.46	10.53	10.46	10.53	10.47	10.54	10.48	10.53
0.05	10.38	10.43	10.38	10.43	10.38	10.44	10.39	10.43
0.1	10.07	10.09	10.09	10.08	10.07	10.08	10.10	10.09
0.3	9.98	9.99	10.01	9.98	9.98	9.98	10.02	9.99
0.5	9.98	9.98	10.01	9.98	9.97	9.98	10.02	9.99
1	9.98	9.99	10.01	9.99	9.98	9.99	10.03	9.99
3	10.00	10.01	10.03	10.01	9.99	10.01	10.05	10.02
5	10.01	10.03	10.04	10.03	10.00	10.03	10.07	10.05
10	10.02	10.09	10.07	10.09	10.02	10.09	10.11	10.12
30	10.10	10.52	10.24	10.53	10.18	10.62	10.38	10.68

Insertion Loss value to be added to receiver reading:

Meter Reading + Insertion Loss + cable loss = Corrected Reading

FIGURE 10 – *Typical Insertion Loss Factors for LI-3P-216 LISN*

6.1.1 Example Calculation

An LI-3P-216 LISN was used to measure the conducted emissions of an EUT. The measurement port of the LISN was connected to the RF input of the measuring instrument via a coaxial cable with Transient Limiter ON. A signal is observed on LINE 2, with the Transient Limiter ON. The frequency of the signal is 30 MHz, and the measured amplitude is 40 dBµV. What is the actual amplitude of this signal on the LINE 2 conductor of the EUT input power?

For the system shown above, there will be only two factors to consider: insertion loss of coaxial cable and LISN insertion loss factor at 30 MHz for Line 2 with TL ON.

We'll assume that the insertion loss of the coaxial cable at 30 MHz is 2 dB, and by referring to the typical insertion loss table shown in Figure 10, the LISN loss factor for LINE 2 with TL ON is 10.53 dB.

Measured amplitude at 30 MHz =	40.0 dBµV
LISN Insertion Loss Factor at 30 MHz for LINE 2 with TL ON =	10.53 dB
Insertion Loss of coaxial cable at 30 MHz =	2.0 dB
Measured Amplitude + LISN Insertion Loss + Cable Insertion Loss = Corrected Reading =	52.53 dBµV

6.1.2 LISN Insertion Loss Calibration

The test setup for normalization and LISN Insertion Loss measurements are illustrated in Figure 11. The insertion loss factor is the difference (in dB) between the normalization measurements and the LISN insertion loss measurements.

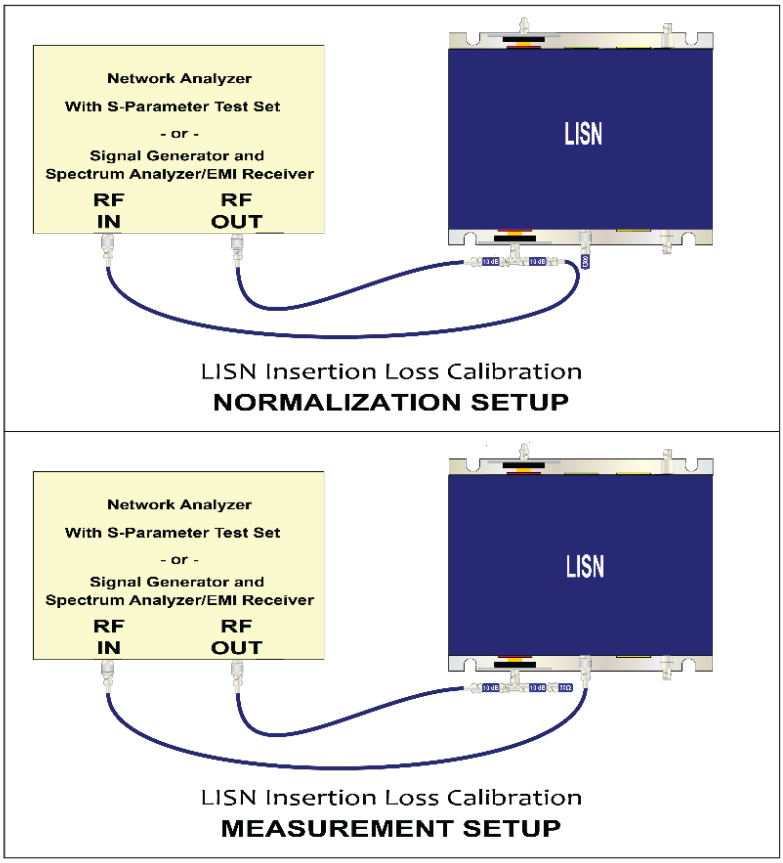


FIGURE 11 – ***Setup Diagrams for LISN Insertion Loss Calibration***

6.1.3 Non-LISN Insertion Loss Calibration

Insertion Loss values for coaxial cables and most measurement system components having a single coaxial input and output, such as attenuators, filters, dc blocks, etc., can be easily determined through a simple calibration process.

The test setup for normalization and insertion loss measurements is illustrated in Figure 12. The insertion loss factor is the difference (in dB) between the normalization measurements and the insertion loss measurements.

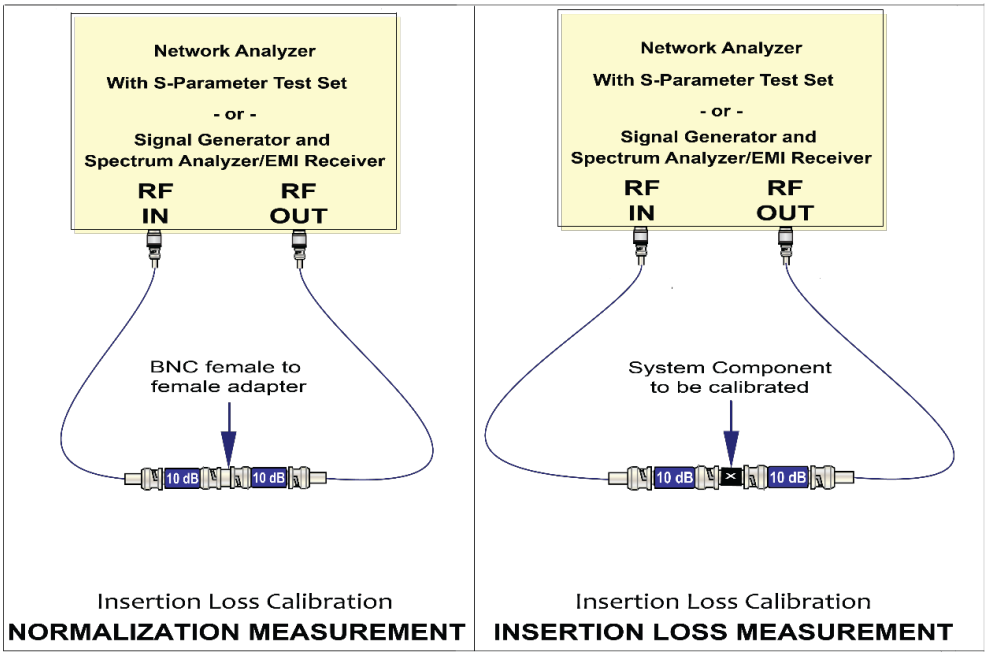


FIGURE 12 – *Setup Diagrams for Insertion Loss Calibration*

7.0 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 damage 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 knowledge 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 be avoided in the warranty.

If you feel that the product is not working as intended, or is malfunctioning, please contact Com-Power for assistance. In the case of repairs or complaints, please visit our website at www.com-power.com and fill out an RMA form (http://com power.com/repairservicereq.asp). 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.

8.0 Product 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. Use care to avoid liquids or other foreign objects entering the chassis.