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COUPLING DECOUPLING  
NETWORK  
MODEL CDN-AF2

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## 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 2 years. This warranty shall not apply to:

- a) transport damages during shipment from your plant.
- b) damages due to poor packaging.
- c) product operated outside their specification.
- d) improperly maintained or modified.
- e) consumable items, fuses, power cords, cables, etc.
- f) normal wear
- g) calibration
- h) product is 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 representative.

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 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 a complaint, a label should be attached to the housing of the instrument which describes briefly the faults observed. If at the same time the name and telephone number (dialing code and telephone or direct number or department designation) is stated for possible queries, this helps towards speeding up the processing of warranty claims. In order to obtain service under this warranty, Customers must contact the Com-Power factory.

## Safety Precautions

This instrument has left the factory in a safe condition. Proper safety precautions must be observed in order to avoid injury to test personnel. Prior to the connection of RF power, the CDN must be securely fastened to the ground plane. Proper grounding ensures the low impedance required for accurate immunity measurements. Proper grounding must be verified after installation. The resistance between the CDN grounding base plate and the ground plane should indicate a value of 10 milli-ohms or less.

Power conductors to the mains should not be connected until all the connections to the EUT, CDN, auxiliary equipment and test equipment are completed.

Test personnel should not touch any exposed test leads or terminals during the test. After each test disconnect power conductors from the mains and turn off power to the amplifier.

### About this this manual

This manual provides instructions on how to operate and maintain Model CDN-AF2 coupling decoupling network.

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### If you need assistance:

Telephone: (714) 528-8800

Fax: (714) 528-1992

Email: [Sales@Com-Power.com](mailto:Sales@Com-Power.com)

## Operating Environment

The instrument has been designed for indoor use only. It should not be used in damp or wet environment. The permissible ambient temperature range during operation is +10°C (+50°F) to +40°C (+104°F). Please read the safety section.

## Maintenance

There are no user serviceable parts inside these units. If the unit does not operate or needs calibration, please return it to the factory. Do not open instrument cover. 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. Do not let any cleaning agent seep into the chassis.

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# General Information

# 1

This section includes the following

- Introduction
  - General Description
  - Specifications
  - Standard Accessories Supplied
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## 1.0 Introduction

This section contains general description and performance information on the Com-Power model CDN-AF2 Coupling Decoupling Network (CDN). More detailed explanation on how to use CDN is given in sections 2 and 3 of this manual.

## 1.1 General Description

The Com-Power CDN-AF2 Coupling / Decoupling networks (CDN) is intended for testing products according to EN61000-4-6 standard for immunity to conducted disturbance induced by radio frequency fields from 150 kHz - 80 MHz. The CDN-AF2 couples common mode CW and modulated signals on to a unshielded 2 conductor cable.

## 1.2 Specifications

Please see table 1-2 on page on next page.

## 1.3 Standard Accessories Supplied;

1. Coupling Decoupling Network
2. User's Guide
3. Calibration data- Impedance, attenuation, coupling factor
4. Certificate of calibration

Options if ordered: Jig with shorting bars, Two 150 $\Omega$  - 50 $\Omega$ , One 50  $\Omega$  adapter, one Ground plane  
(Complete kit Part# CK-CDNAF2RCA)

## Table 1-1 Specifications

Frequency Range:	150 kHz - 80 MHz
Cable type:	Unshielded 2 conductor cable
Coupling:	Each Conductor
Voltage:	160 VAC
Current:	2 Amps
Common mode impedance:	
150 kHz - 26 MHz:	150 Ohms $\pm$ 20%
26 MHz - 80 MHz:	150 Ohms + 60% and - 45.5%
Maximum RF voltage input:	40 V max
Voltage attenuation (RF/EUT):	9 dB to 12 dB
Insertion loss EUT/AE:	
30 dB min from 150 kHz to 2 MHz	
50 dB min from 2 MHz to 80 MHz	
Coupling factor:	0. dB, + 1 dB / - 2 dB
Decoupling attenuation (RF/AE):	50 dB min, 150 kHz - 80 MHz
I/O connections:	Professional Audio Socket
RF (Disturbance coupling) connector:	BNC (f) 50 Ohm
Dimensions ( L x W X H):	12" x 6" x 6" inches
Weight :	4 lb.



Figure 1-1 Model CDN-AF2

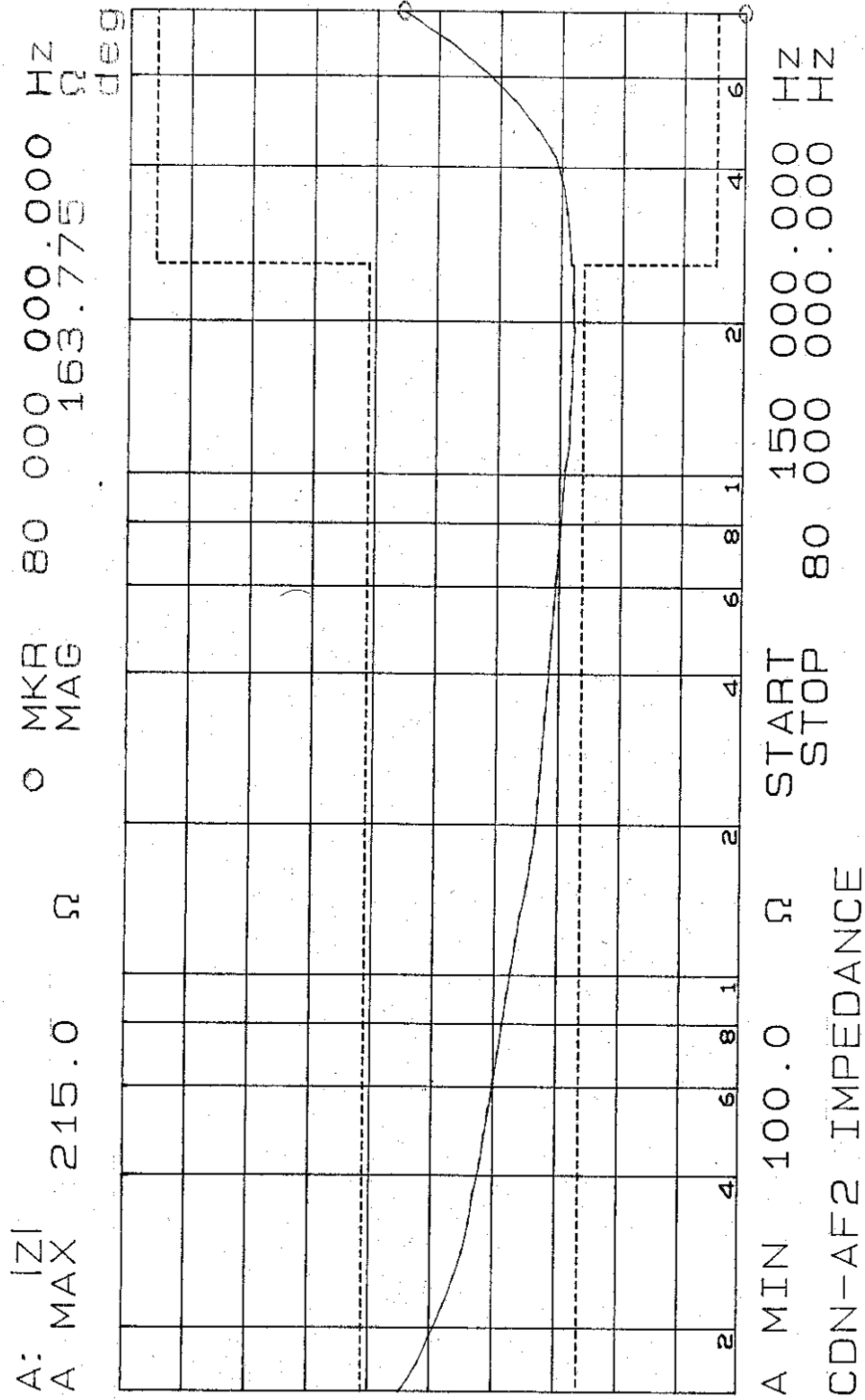


Figure 1-2 CDN Model CDN-AF2 typical common mode impedance



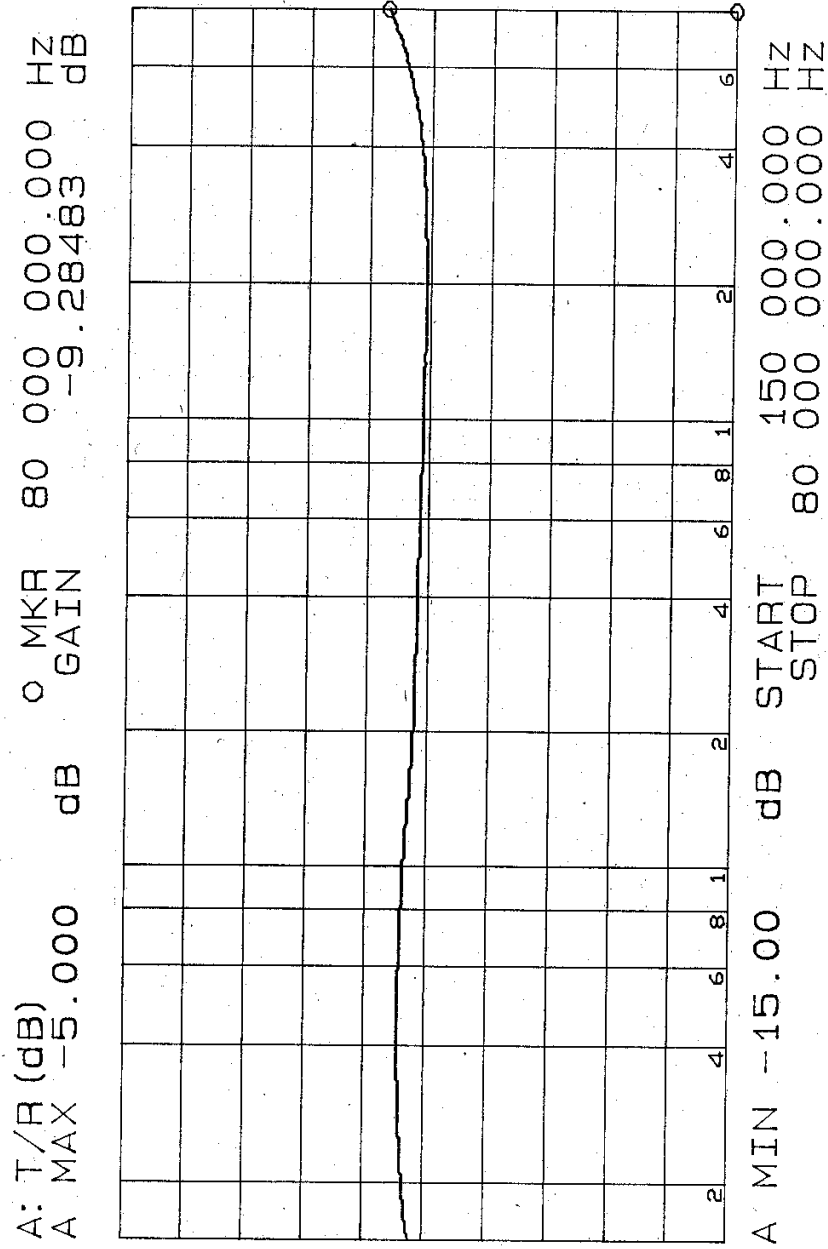


Figure 1-3 CDN Model CDN-AF2 typical attenuation factor graph

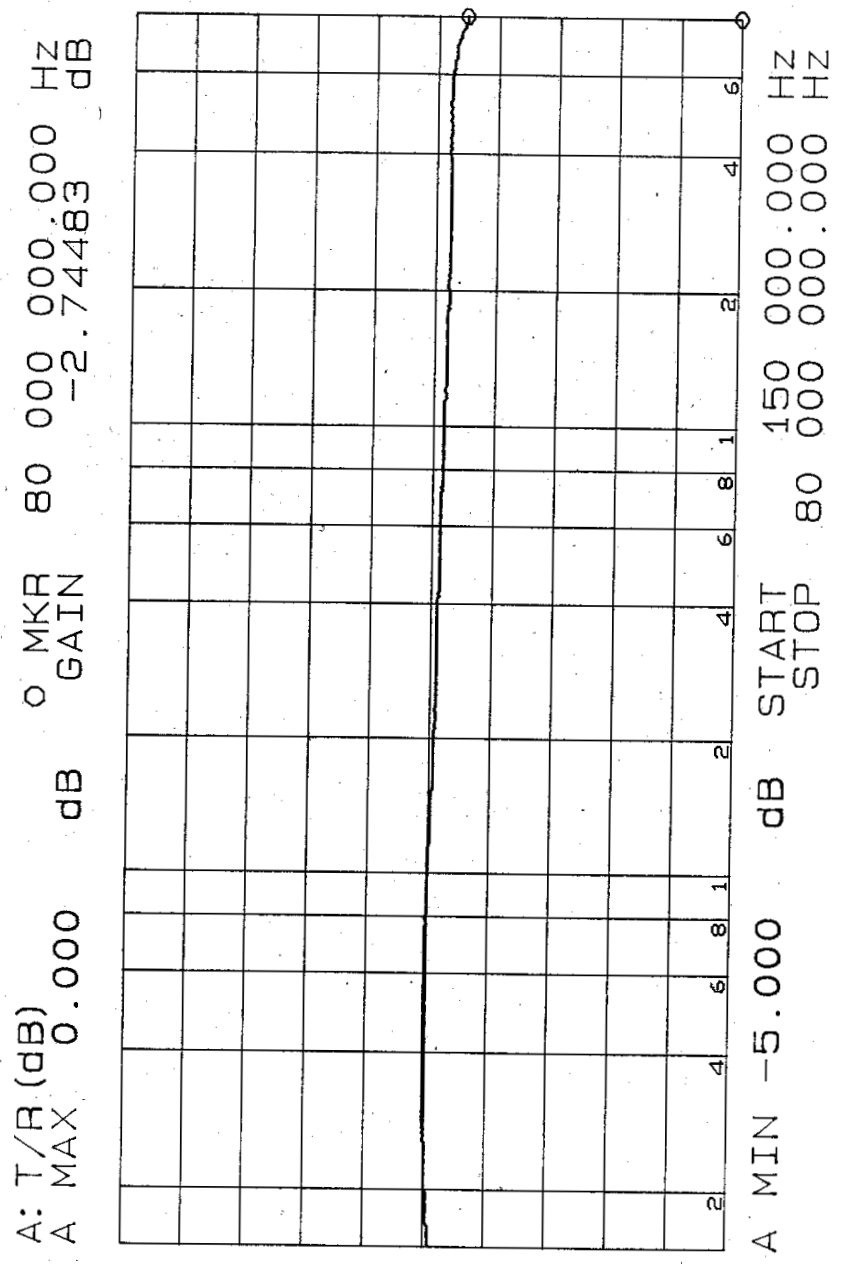


Figure 1-4 CDN Model CDN-AF2 typical Coupling factor graph

# CDN Requirements

# 2

This section includes the following

- Overview
- CDN requirements
- Calibration

## 2.0 Overview

Com-Power CDN-AF2 allows coupling of RF CW and modulated voltages into equipment through the shield of four conductor signal cables. This CDN was built to meet the requirements of IEC-1000-4-6. This CDN-AF2 can be used to verify that electronic equipment are not susceptible to sources electromagnetic disturbance which may couple to shield of signal cables.

## 2.1 CDN requirements

The CDN-AF2 coupling and decoupling network:

- Allows Coupling of the disturbing signals to the equipment under test.
- Provides stable impedance to the equipment under test independent of the auxiliary equipment common mode impedance.
- Prevents interference to the auxiliary equipment by decoupling the disturbing signals.
- Does not interrupted signals to the EUT

The Com-Power CDN-AF2 meet the following parameters specified by IEC-1000-4-6 specifications.

Parameter	Frequency band	
	0,15 MHz – 26 MHz	26 MHz – 80 MHz
$ Z_{co} $	$150 \Omega \pm 20 \Omega$	$150 \Omega^{+60}_{-45}$

The IEC-1000-4-6 recommends putting coupling decoupling net-

Table 2-1 Coupling Decoupling Device Parameters

Generally the stop frequency range for IEC-1000-4-6 requirement is 80 MHz. Some product specific standards may require extending the stop frequency to 230 MHz when the dimensions of device under test may be less than  $\lambda/4$ . The Com-Power CDNs can be used to meet this extended frequency requirement.

## 2.2 Important CDN parameters

The most important characteristic when selecting CDN is to insure that it meets the Common mode terminal impedance specified in the IEC-1000-4-6. It would be also beneficial to select CDN with low attenuation and coupling factors. Please see section 1 for typical measured values for these parameters for Com-Power CDN-AF2

Common mode impedance parameters at the EUT port of the CDN are given in table 2-1. This ensures that any circuit level abnormal operation was caused by the injected RF signal on the EUT and not the auxillary equipment (AE). The requirement must be met with CDN auxillary input terminals open or short circuited to ground.

### 2.2.2 Voltage attenuation

Attenuation is the amount of power that is lost between the signal input terminal of the CDN and the EUT port. The IEC-1000-4-6 specification does not specify the attenuation factor, however it beneficial to keep it low as possible. The attenuation factor for the Com-Power CDN is approximately 10 dB for the frequency range of 150 kHz - 80 MHz. The attenuation is useful factor for predicting the amount of input power required to generate required immunity voltage.

### 2.2.3 Coupling factor

The CDN coupling factor is defined as the open circuit voltage obtained at the EUT (common mode) port divided by the open circuit voltage obtained at the input connector. The coupling factor value is not defined by IEC-1000-6 specification, but should kept minimum. The Com-Power CDN coupling factor is almost 0 dB for the entire frequency of 150 kHz - 80 MHz.

## 3.0 Measuring these factors on site

Typically, the common mode terminal impedance, attenuation and coupling factors are measured at the factory and supplied with each

unit. However if you wish to check the attenuation and coupling factor on site you could purchase optional calibration kit which includes the shorting bars, set of 150 $\Omega$  - 50 $\Omega$  adapters and 50 $\Omega$  adapter. You will also need calibration the shorting bars for making level measurements described in section 4.0 (part# CK-CDNAF2RCA). The common mode impedance measurement is made using appropriate network analyzer.

## 4.0 Establishing a drive table

Before you begin you will need to test your setup to establish the correct immunity levels. The setup is similar to the attenuation measurement setup except connect the power amplifier to the CDN input (please see figure 2-5). The IEC-1000-4-6 call out testing to three different open circuit test levels. The table below shows unmodulated disturbing signal levels expressed in r.m.s.

Frequency range 150 kHz – 80 MHz		
Level	Voltage level (e.m.f.)	
	$U_0$ [dB( $\mu$ V)]	$U_0$ [V]
1	120	1
2	130	3
3	140	10
X <sup>1)</sup>	special	

<sup>1)</sup> X is an open level.

Table 2-2 Test Levels specified by IEC-1000-4-6

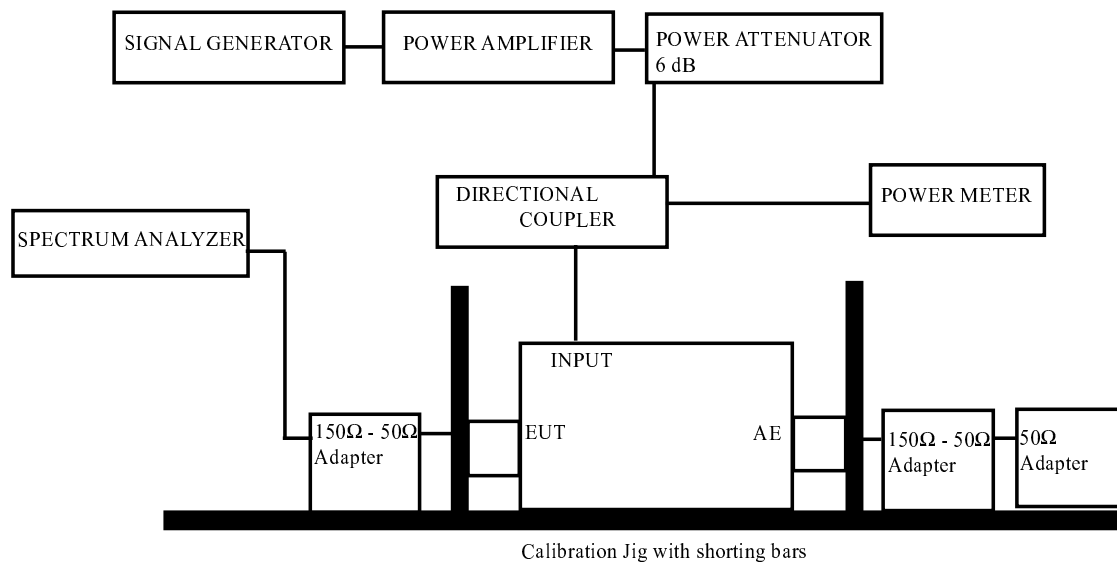


Figure 2-5 Level measurement setup using CDN

## 4.1 Setting Levels

After you make all the connection shown in figure 2-5, you are now ready for level measurements . The open circuit voltage levels given in table 2-2 must be recalculated to to account for the 50  $\Omega$  impedance adapter and the spectrum analyzer in the test setup. They are given below:

Level 1	0.167 RMS	150 kHz - 80 MHz
Level 2	0.5 RMS	150 kHz - 80 MHz
Level 3	1.67 RMS	150 kHz - 80 MHz

The above voltage levels were calculated by deviding the open circuit voltage specified in table 2-1 by a factor of 6. The factor of 6 established due to the following. When the 150  $\Omega$  impedance adapter is connected CDN EUT port, the voltage level at the output terminal of the 150  $\Omega$  adapter it will be to half the injected voltage level at the CDN input. When adapter output is connected to a 50 $\Omega$  spectrum analyzer, the voltage measured will be one third of the that value.

Next, turn on the power amplifier and signal generator and take the measurements from 150 kHz - 80 MHz for each level with CW unmodulated. The rate of the sweep shall not exceed  $1.5 \times 10^3$  decades/seconds. If the frequency is swept incrementally, the step size shall not exceed 1% start and thereafter 1% of preceding frequency value. Create a chart and record the frequency and input power needed at each frequency to achieve each of the three levels for the entire range. (This process can be automated with appropriate software, contact Com-Power for details.)

The next step is to activate the 1 kHz sine wave modulator on your signal generator set it to 80% modulation depth and repeat measurements described in the previous paragraph.

## 4.2 Expected amplifier power requirement

The power requirement to generate the maximum level is not expected to be more than 10 Watts. This takes into account attenuation factor 9 -12 dB of the CDN for entire frequency range and the loss of amplifier forward power due to 3:1 VSWR created by the CDN and the passive impedance adapter.

# Theory of Operations

# 3

This section includes the following

- Overview
- Typical Test Setup

## 3.0 Overview

This describes the typical test setup for making measurements using the CDN. Please read safety precautions in this manual before proceeding.

## 3.1 Typical test setup

The IEC-1000-4-6 requires that an appropriate coupling decoupling networks (CDN) with defined common mode impedance must be connected the various cables connected to the EUT. The AF series CDN are only appropriate for cables with multiple unshielded conductors. Other types CDN may be necessary to couple and decouple different types of cables that may connected to the EUT. Such as coax, shielded cables, balanced pairs and powerline. Please call Com-Power for assistance. Please see connection diagram below for typical conducted immunity test setup using the AF series CDNs.

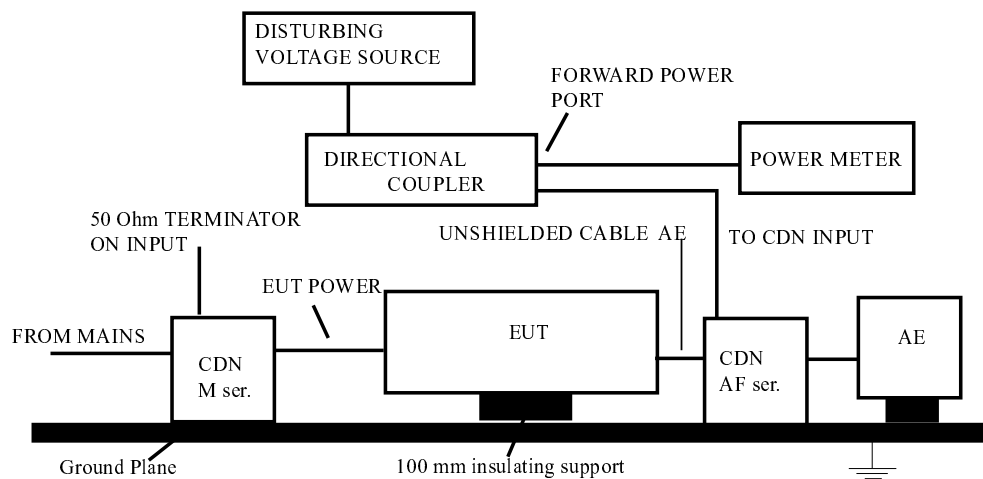


Figure 3-1 Conducted Immunity test setup using S series CDNs