

# IEC61000-4-6 TEST EQUIPMENT SEARCH

## This presentation summarizes the following items:

- **Review of IEC61000-4-6 standard for test (equipment) requirements. The 4<sup>th</sup> edition is in play (IE 2013).**
- **Review of available (online) literature and application notes regarding test methods and equipment requirements to conduct testing for the IEC61000-4-6 standard.**
- **High level discussion of the advantages/disadvantages of the three test methods specified in the IEC61000-4-6 standard. (CDN, EM Clamp, and BCI).**
- **Flow chart for selecting an appropriate test scenario for CDN, EM Clamp, or BCI test methods.**
- **Search for manufacturers of equipment and accessories designed to be used for IEC61000-4-6 testing.**
- **Summary of quotes received to date. (As of 8/8/2016).**
- **Examples of test configurations for conducting the three tests as specified in the IEC61000-4-6 standard.**

# EXECUTIVE SUMMARY

- Found five manufacturers involved with developing systems and components for IEC61000-4-6 testing.
- Request for quotes have been sent out.
- We have received some budgetary information. Waiting for more information and lead times.
- A used test system with accessories (without a computer) will cost approximately \$25,000.(See Appendix 1)
- A new generator without accessories and a computer will cost approximately \$28,000. (See appendix 3).
- A new stand alone 100 Watt RF Amplifier specified for IEC61000-4-6 testing (without accessories and signal generator/spectrum analyzer) will cost \$12,245.(See appendix 4).
- A system with accessories will cost approximately \$2,500 per month to rent. .(See appendix 2).

# THE BOTTOM LINE ADVANTAGE TO TESTING TO THE IEC61000-4-6 IN HOUSE

- NO NEED FOR AN ANECHOIC CHAMBER.
- ALL TESTS CAN BE PERFORMED IN HOUSE AGAINST GROUND PLANE (A GROUND PLANE IS IN TACT IN ESD LAB AT FRACKLIN DRIVE, PLEASANTON CALIFORNIA).
- TEST CONFIGURATIONS CAN BE ADAPTABLE (“PLUG AND PLAY”).
- THE OF COST DOING PREEMPTIVE (PRE-SCREEN) TESTS IN HOUSE “OUT WAY” THAT OF DOING SIMILIAR TESTS AT A TEST HOUSE.
- NO TRAVEL TIME TO AN OUTSIDE LAB FACILITY .
- NO OUTSIDE TEST LAB SET UP COST.

# WHAT DOES THE IEC61000-4-6(4<sup>th</sup> EDITION) IMPACT ?

- **IEC 61000-4-6:2013: EMC – Part 4-6: Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields**
- From the International Electrotechnical Commission webstore:
- “[IEC 61000-4-6:2013](#) relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 150 kHz up to 80 MHz. Equipment not having at least one conducting wire and/or cable (such as mains supply, signal line or earth connection) which can couple the equipment to the disturbing RF fields is excluded from the scope of this publication.”
- “The object of this standard is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by RF fields. The test method documented in IEC 61000-4-6:2013 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. This fourth edition cancels and replaces the third edition published in 2008 and constitutes a technical revision. It includes the following significant technical changes with respect to the previous edition:
- Use of the CDNs.
- Calibration of the clamps.
- Reorganization of Clause 7 on test setup and injection methods.
- Annex A which is now dedicated to EM and decoupling clamps.
- Annex G which now addresses the measurement uncertainty of the voltage test level; and informative Annexes H, I and J which are new.”

# IEC61000-4-6 TEST LEVELS

Frequency Range: 150 kHz to 80 MHz Test Levels		
Level	Voltage level (e.m.f.)	
	U <sub>o</sub> [dB(m V)]	U <sub>o</sub> [V]
1	120	1
2	130	3
3	140	10
X	Special	

"X" is an open test level.

No test is required for induced disturbances caused by electromagnetic fields coming from intentional RF transmitters in the frequency range of 9Khz to 150Khz.

# IEC61000-4-6 STANDARD REQUIREMENTS FOR TESTING CABLES

EN 61000-4-6 describes three methods of testing in order of preference:

- 1) CDN (Coupling-Decoupling Network)
- 2) EM-Clamp
- 3) Bulk Current Injection (BCI)

**Guidance Note** : *While it is recognized that BCI is considered the least repeatable of the test methods, it is also the most flexible in that the current injection clamp can be clamped to cables in difficult orientations and the use of a second clamp (the measurement clamp) allows real-time control of the current injected into the equipment under test.*

# BASIC EQUIPMENT REQUIRED TO CONDUCT TESTS PER THE IEC61000-4-6 STANDARD

1. A “ linear” signal source that can sweep from 10KHZ to 300MHZ.(OR HIGHER)
2. A modulation source that can AM modulate the signal source signal source.(See IEC61000-4-6 standard.)
3. A broad band RF power amplifier that can provide linear response across a frequency range of 100KHZ to 230MHZ. (OR HIGHER)
4. The RF amplifier should have sufficient power to test to the IEC6100-4-6 specified test levels given different coupling conditions.
5. Load matching and attenuators to reduce SWVR and test measurement uncertainty.
6. Additional signal power and spectrum measuring equipment.(A means to measure delivered power to EUT).
7. A large ground plane.

# CDN, EM CLAMP, BCI CLAMP TRANSDUCER EXAMPLES USED FOR IEC61000-4-6 TESTING

## CDN-Types

**CDN** = Coupling-/Decoupling-Network

Different types are specified in the standard

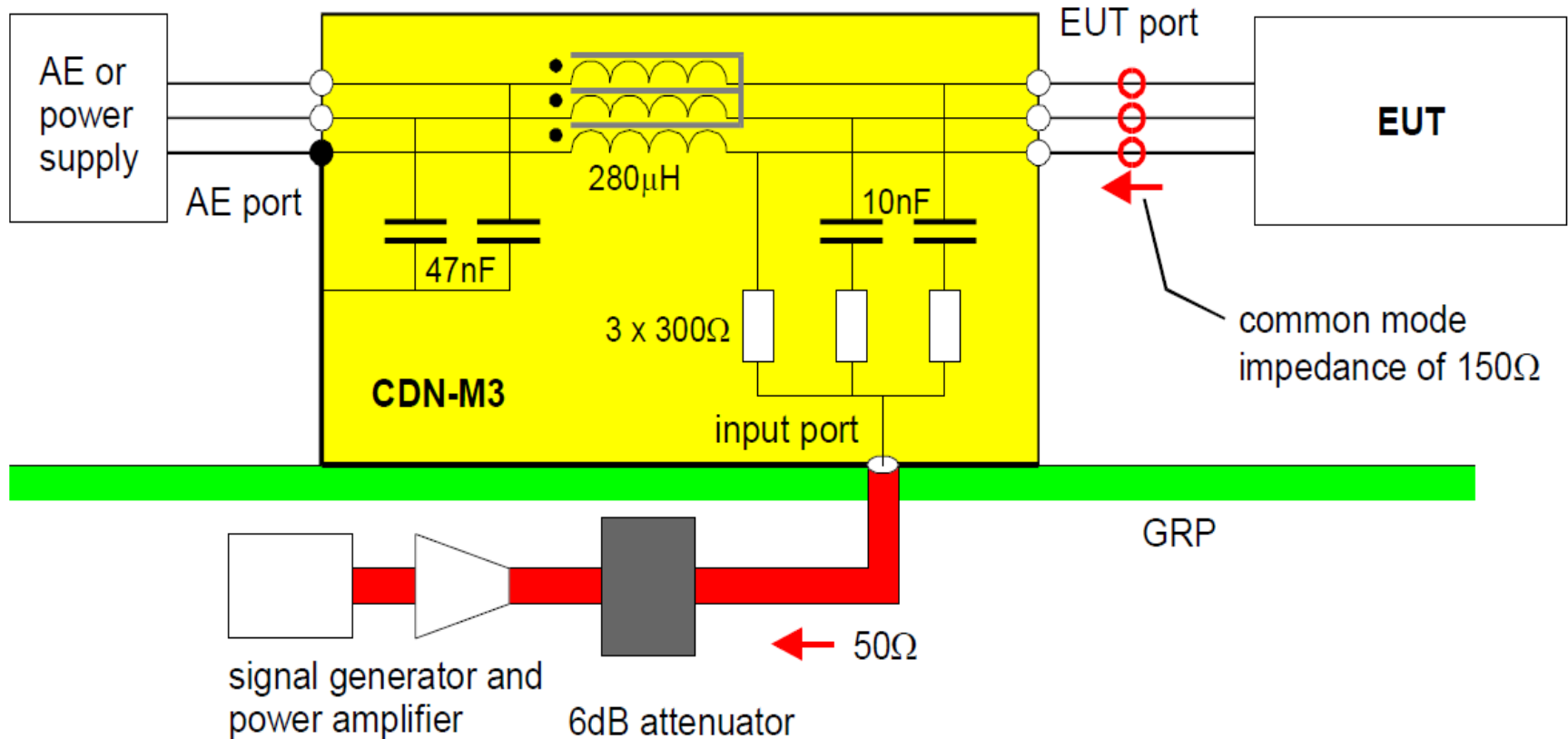
- **CDN-M1/2/3/4/5** (M = Mains)
- **CDN-S9/15/25/38** (S = Shielded)
- **CDN-T2/4** (T = Telecom, symmetrical)
- **CDN-AF2/3/4/8** (AF = General , asymmetrical)
  
- **EM clamp**
  
- **BCI-clamp** (Bulk Current Injection)





Place Holder

# CDN M3 DIGRAM: (Coupling-Decoupling Network) Test Configuration Concept



# ADVANTAGES/DISADVANTAGES OF THE CDN TEST METHOD

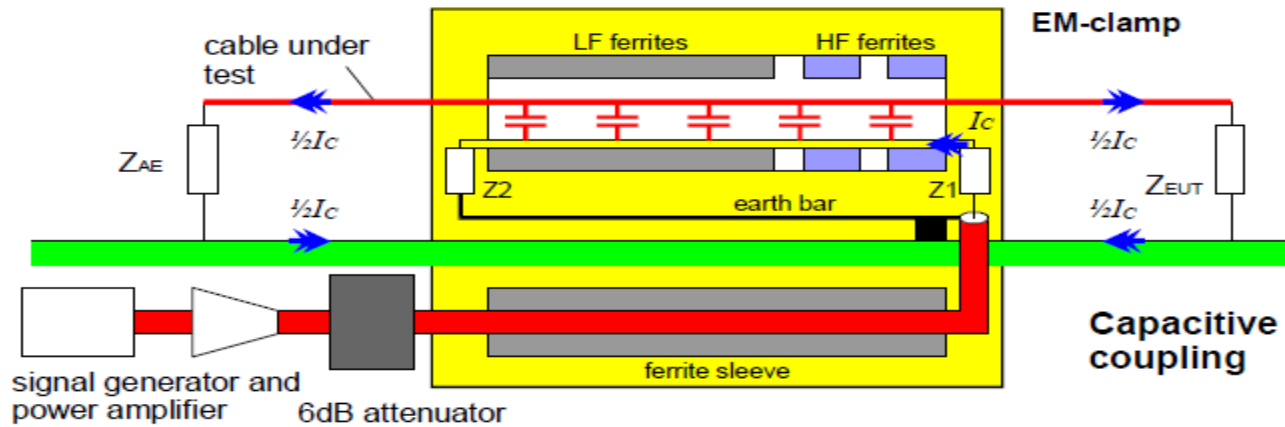
## Advantages of the CDN Test Method:

- Its prime advantages are near-perfect decoupling of the AE and low uncertainty of the applied stress.
- Minimal power is required and there is minimal radiation or environmental influence.
- Additionally it defines a  $150\Omega$  common-mode cable impedance, formed from the  $50\Omega$  generator impedance in series with  $100\Omega$  resulting from the injection resistors in parallel. This impedance damps cable resonance to increase the repeatability of the test and approximates to real-life, giving a very credible test.

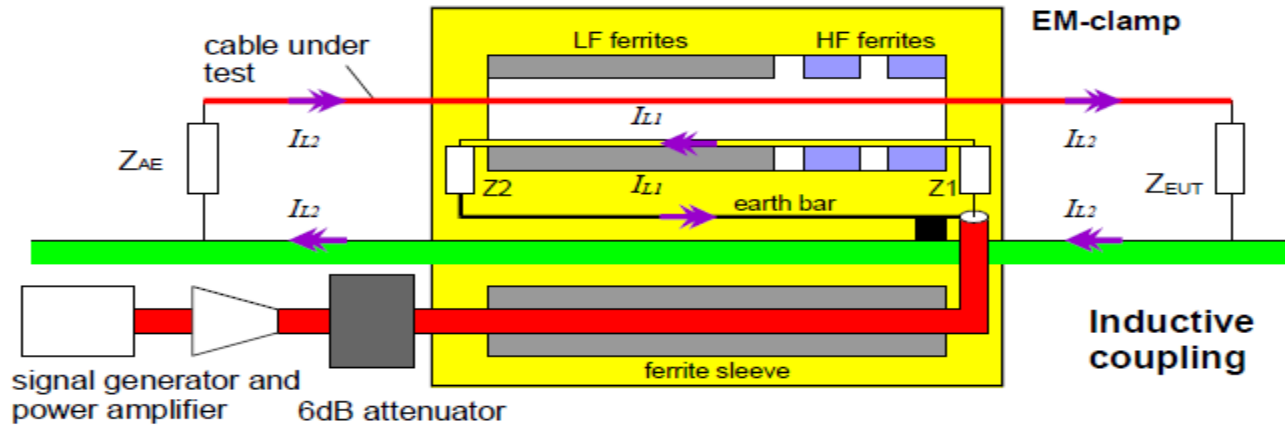
## Disadvantages of the CDN Test Method:

The disadvantage is that because the coupling is invasive, there are only certain classes of cable for which the method is suitable – for instance mains or DC power, or low-impedance unbalanced audio. A general test laboratory will have to keep a selection of CDN units for all the likely cable types expected, but this will never cover all possible types. On the other hand, a manufacturer may be prepared to hold CDNs for all the cable types used on his products. Even so, devising a CDN for wideband unscreened multi-way cables is not trivial and it is very easy for the device to degrade the wanted signals carried in the cable, which would make it unacceptable for the test.

# EM CLAMP TEST CONFIGURATION CONCEPT



If  $I_{L2} = \frac{1}{2}I_c$  then maximum directivity is obtained



# Advantages/Disadvantages of the EM CLAMP Test Method

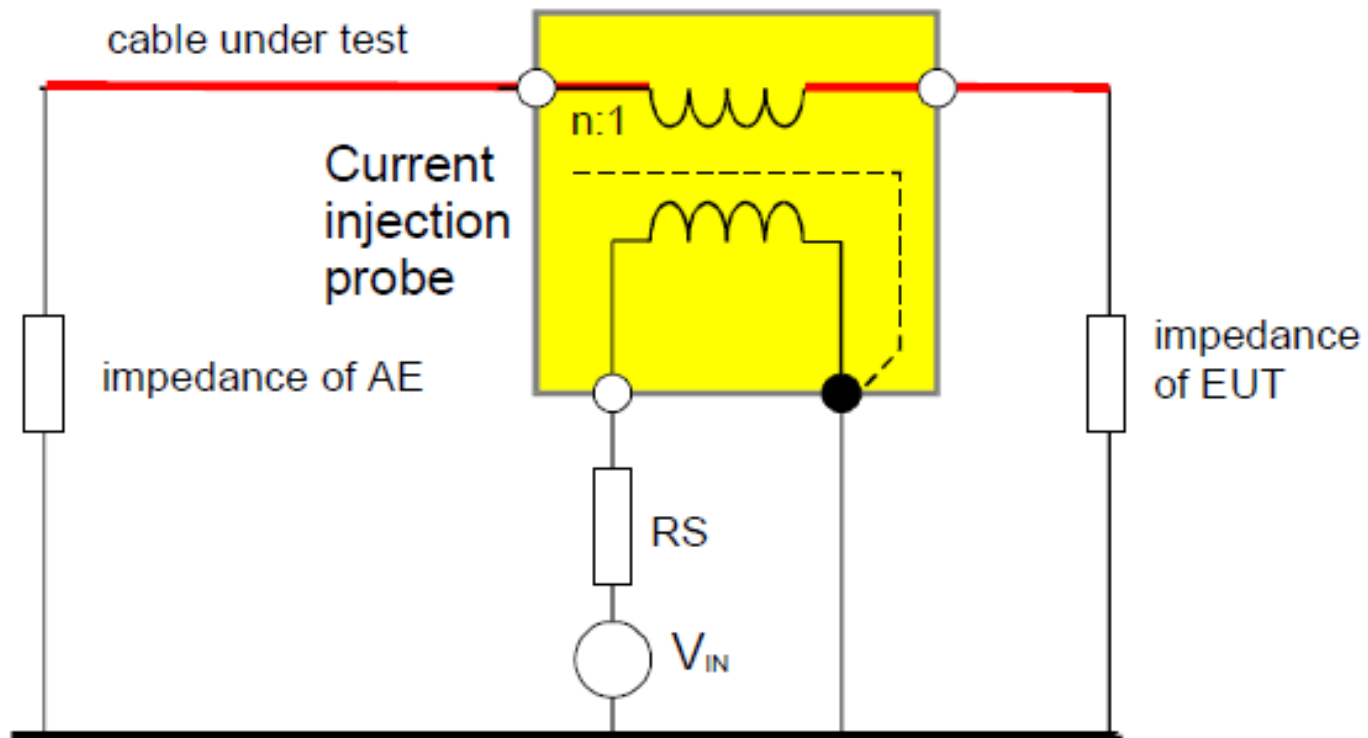
## Advantages of the EM Clamp Test Method:

- Its principal advantage is that it is entirely non-invasive. No connection need be made to the cable under test.
- Its second main advantage is that it allows adequate decoupling of the AE at high frequencies. The design is arranged so that the capacitive and inductive coupling paths reinforce one another at the EUT end, and cancel at the AE end. This gives the clamp about 10-15dB of directivity above 10MHz.
- Thirdly, it is reasonably power-efficient, although not as good as a CDN; for the same stress, about 6dB more power is needed.

## Disadvantages of the EM Clamp Test Method:

- Because it uses a series of ferrite sleeves to provide the inductive coupling, it is quite long, and to provide good capacitive coupling it has a relatively narrow inside diameter. This makes it bulky to use and restricts its application for short or large-diameter cables.
- Below 10MHz its directivity is negligible and therefore the AE low frequency common mode impedance is not decoupled.
- It does not provide an accurate source impedance of  $150\Omega$  across the frequency range.

# BCI (Bulk Current Injection) Test Configuration Concept



# Advantages/Disadvantages of the BCI Test Method

## **Advantages of the EM Clamp Test Method:**

The practical advantage of the current probe is that it is smaller than the EM-clamp and normally has a larger internal diameter, thus allowing its use on a much wider range of cable types.

- Its main advantage, and the reason it is widely used by many labs, is that it is both convenient and non-invasive. Because it is compact and can be made with quite a wide aperture, it can be used on virtually any cable, even short runs with limited access. This makes it the transducer of choice for in-situ tests.

## **Disadvantages of the EM Clamp Test Method:**

- Balancing this practical advantage are several technical failings. There is absolutely no decoupling of the AE, since the current induced on the cable must flow both into the EUT and the AE. Therefore the AE is being tested just as much as the EUT.
- The applied stress is very dependent on cable layout and AE impedance. The current flowing into the EUT is determined by the impedance of the cable, which acts as a transmission line at high frequencies and so may have standing waves due to mismatches, and by the impedance to the reference plane of the AE. So this offers the highest uncertainty and least repeatability of all the methods.
- The probe is lossy and has a high power requirement. The higher its internal turns ratio the more power is needed, but low turns ratios affect the coupling of the probe to the cable and are effectively forbidden by the standard.

PLACE HOLDER

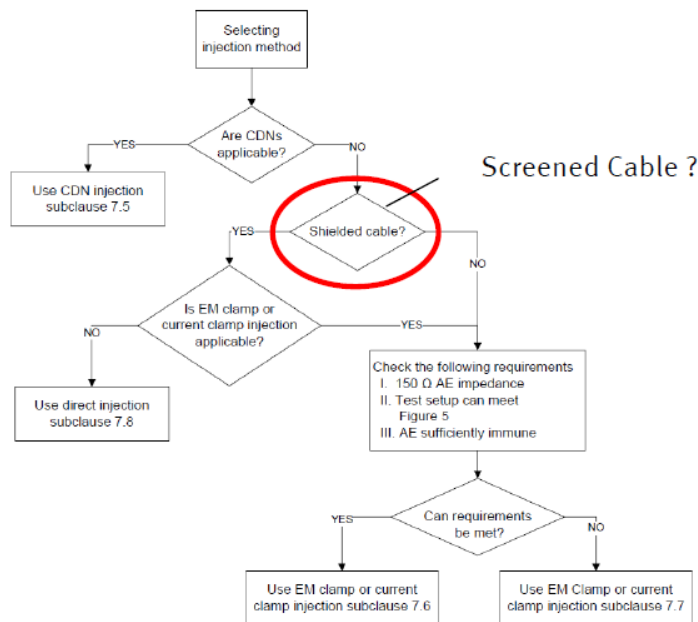


# SELECTING AN APPROPRIATE TEST METODOLOGY PER THE IEC61000-4-6 STANDARD

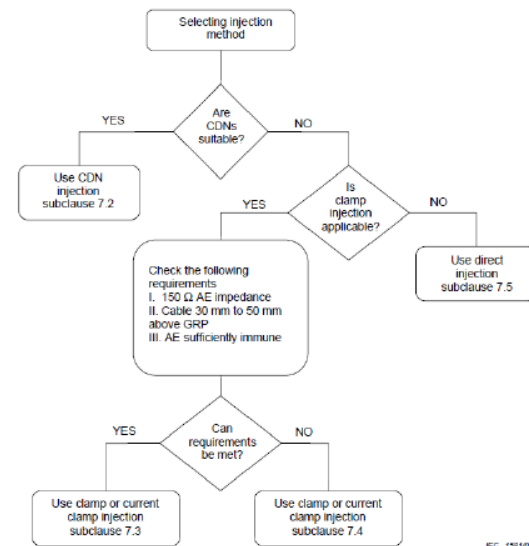
## Enhanced injection method flow chart

The flow chart for selecting appropriate injection method has been enhanced by a new decision. Now it is clear that injection method “direct injection” is only applicable to shielded cables.

### New in IEC61000-4-6 Ed.4



### IEC61000-4-6 Ed. 3

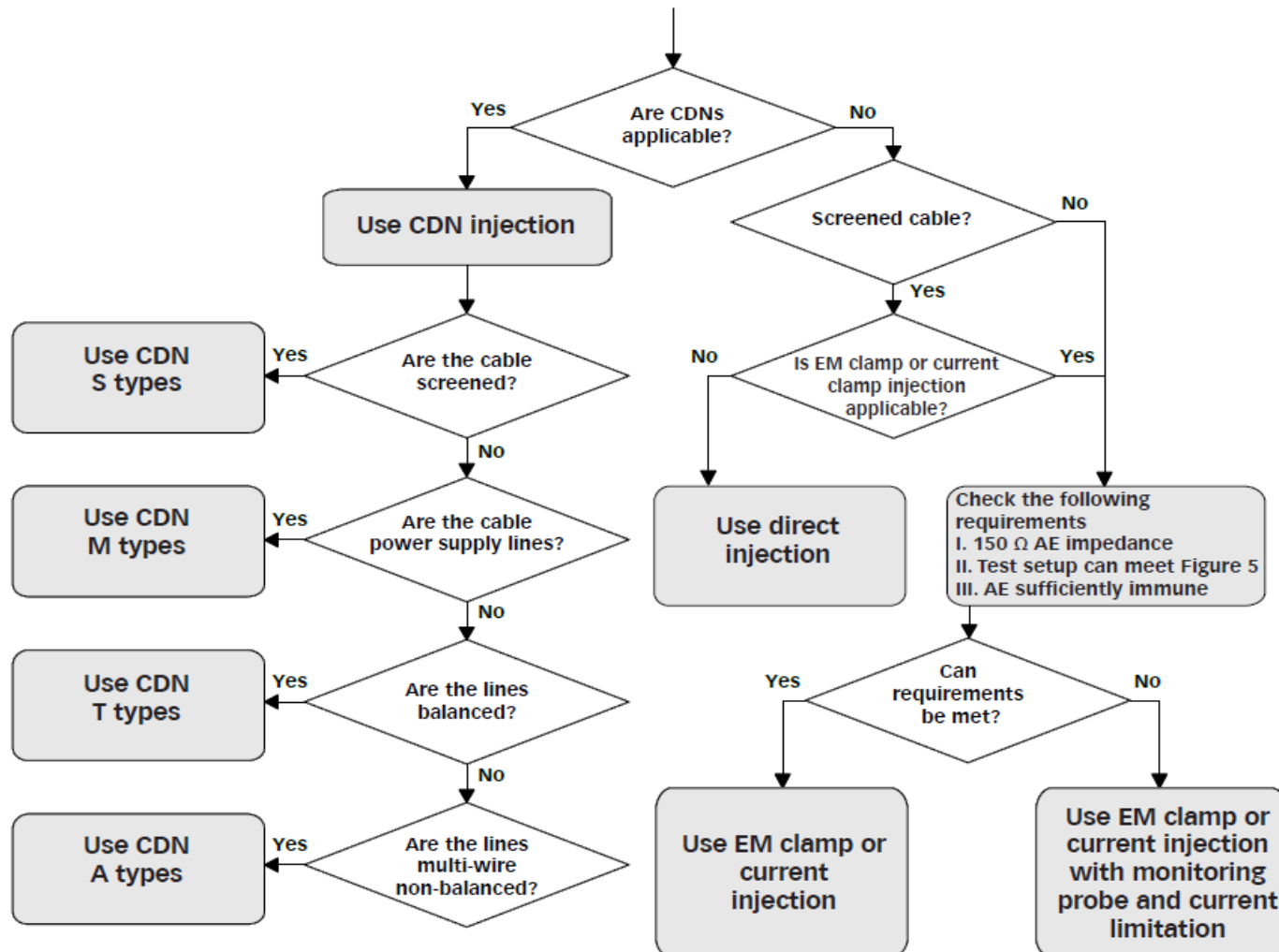


IEC 158103









<sup>11</sup> See Table 4

Figure 1 – Rules for selecting the injection method

# A MORE DETAILED APPROACH TO SELECTING INJECTION METHODS (CDN, EM CLAMP, OR BCI)



# CABLE EXAMPLES WITH CDN RECOMMENDATIONS.

Cable type	CDN type	Application	Product range
	<b>M type</b>	Used for unscreened AC or DC power supply applications.	M1 for one line, M2 for two lines, M2/3 switchable for two or three lines, M3 for three lines, M4 for lines and M5 for five lines "-10 types" for frequency range 10 kHz to 80 MHz, "-3L and -3LN types" for connections without PE "-750V, -760V, -1000V types" for higher EUT voltages
	<b>AF type</b>	Used for all unscreened, unbalanced lines, carrying low current.	Types with 4 mm banana sockets: AF2 for two lines, AF3 for three lines, AF4 for lines, AF5 for five lines, AF7 for 7 lines and AF8 for 8 lines Types with D-Sub connector: AF8 for 8 lines, AF12 for 12 lines and AF15 for 15 lines "-10 types" for frequency range 10 kHz to 80 MHz
	<b>CAN bus type</b>	Specially designed to test the unscreened CAN bus.	Types with D-Sub connector for unscreened four or five lines "-10 types" for frequency range 10 kHz to 80 MHz
	<b>S type</b>	Used for screened cables.	Types with D-Sub connector for screened lines with up to 25 lines: "-10 types" for frequency range 10 kHz to 80 MHz Type with DIN connector
	<b>S type coaxial</b>	Used for coaxial cables.	Types with coaxial connector: See also product range Impedance Stabilization Networks for ISN S501A, S502A, S751 and S752.
	<b>S type for USB and HDMI</b>	Specially designed to test the USB and HDMI	CDN USB/c, USB/p, CDN USB3.0, CDN HDMI
	<b>ST type</b>	Used for testing screened, balanced lines for telecommunication ports on ITE equipment.	CDN ST08A See also product range Impedance Stabilization Networks for ISN ST08.
	<b>T type</b>	Used for unscreened, balanced lines for telecommunication ports on ITE equipment.	CDN T2-10, T210A...T246AS, T4-10, T411A...T4AS CDN T8, T8-10 See also product range Impedance Stabilization Networks for ISN T2A, T4A, ISN T8 and ISN T8-CAT6.

# COMPARING KEY GENERATOR SPECIFICATIONS.(UNDER DEVELOPMENT)

MANUFACTURER	PART NUMBER	OUTPUT WATTAGE	RF OUTPUT VOLTAGE	AMPLIFIER GAIN	OUTPUT IMPEDANCE	RF AMPLIFIER FREQUENCY RANGE	SIGNAL GENERATOR FREQUENCY/POWER MEASUREMENT RANGE	AMPLITUDE MODULATION	61000-4-6 Ed. 4 TEST LEVELS	SERIAL INTERFACE
Teseq Schaffner	NSG 4070B-80	80 W	?	50dB	50 OHMs	100Khz to 300Mhz	9kHz TO 1Ghz	0 to 100%/1 to 50Khz	LEVEL 1 TO LEVEL 3	USB
Teseq Schaffner	NSG 4070B-75	75 W								
EMTEST/AMTEK	EMTE-CWS5001.4	80W	1 TO 30 V( emf)	48 dB	50 OHMs	100Khz to 300Mhz	9kHz TO 1Ghz	1Khz 80% per 61000-4-6/2hz 80% per 60601-1-2/400hz 80%	LEVEL 1 TO LEVEL 3	USB
AMPLIFIER RESEARCH	CI00250AM1	75 W	?	49 dB	50 OHMs	10Khz to 250Mhz	9Khz to 1.2Ghz	1Khz 80% per 61000-4-6/2hz 80% per 60601-1-2/400hz 80% ?	LEVEL 1 TO LEVEL 3	USB

# GENERATOR PRICES FROM QUOTES TO DATE (WAITING FOR ADDITIONAL QUOTES)

MANUFACTURER	GENERATOR PART NUMBER	CONDITION OF EQUIPMENT/SUPPLIER	BASE PRICE
Teseq Schaffner	NSG 4070B-80 (80 WATTS)	NEW FROM: TEST EQUIPMENT CONECTION (SEE NOTE 1)	\$27,700
Teseq Schaffner	NSG 4070B-75 (75 WATTS)	USED FROM: ADVANCED TEST EQUIPMENT RENTALS	\$21,140
EMTEST/AMTEK	EMTE-CWS5001.4 (75 WATTS)	USED FROM: ADVANCED TEST EQUIPMENT RENTALS(SEE NOTE 2)	\$18,750
EMTEST/AMTEK	EMTE-CWS5001.4	NEW FROM: EMTEST	?(WAITING FOR QUOTE)
AMPLIFIER RESEARCH	CI00250AM1 (75 WATTS)	NEW FROM: AMPLIFIER RESEARCH	\$48,000
AMPLIFIER RESEARCH	CI00400A (100 WATTS)	NEW FROM: AMPLIFIER RESEARCH	\$58,000
EMTEST/AMTEK	EMTE-CWS5001.4	RENTAL FROM: ADVANCED TEST EQUIPMENT RENTALS (SEE NOTE 3)	\$1920/MONTH

NOTE 1 : WAITNG FOR QUOTE ON ACCESSORIES. SAINT JUDES MEDICAL HAS AN ACCOUNT WITH "TEST EQUIPMENT CONNECTION".(I.E. 30 DAYS NET)

NOTE 2 : SEE APPENDIX 1 FOR FULL QUOTE WITH ACCESSORIES.

NOTE 3: SEE APPENDIX 2 FOR FULL QUOTE WITH ACCESSORIES.

NOTE 4: SEE APPENDIX 3 FOR QUOTE FOR A STANDALONE RF AMPLIFIER SPPECIFIED FOR IEC61000-4-6

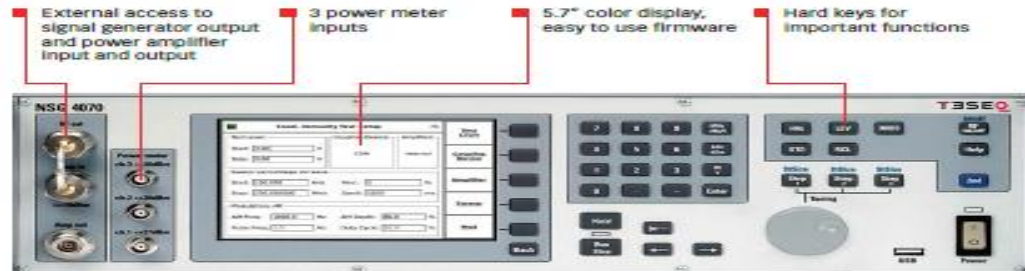
# NSG 4070B

## NSG 4070B TEST SYSTEM FOR CONDUCTED AND RADIATED IMMUNITY



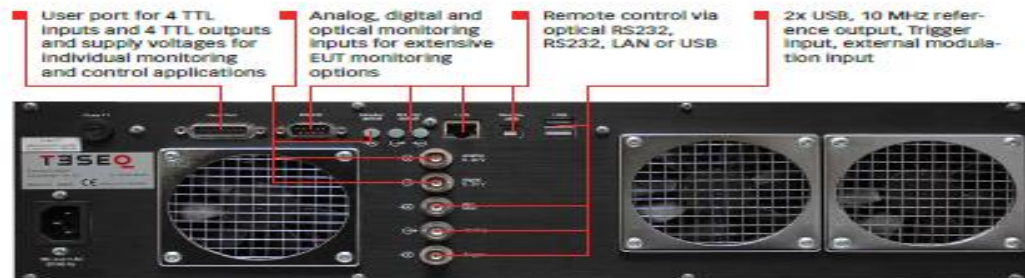
- Integrated signal generator  
9 kHz to 1 GHz
- 3 power meter inputs  
9 kHz to 1 GHz
- Integrated class A power amplifier  
module for different applications:  
35 W, 150 kHz to 230 MHz;  
40 W, 10 kHz to 400 MHz;  
45 W, 9 kHz to 1 GHz;  
80 W, 150 kHz to 230 MHz
- Multiple EUT monitoring options
- 5.7" TFT color display
- Internal, menu-based control  
software
- Basic remote control software and  
report generator included
- Optically decoupled remote control

The NSG 4070 is a multi-functional device for carrying out EMC immunity tests to accompany development and conformity testing in accordance to IEC/EN 61000-4-6, Namur and several automotive BCI standards. Anyone who spends a considerable amount of time on test level setting, connecting EUT monitoring or writing test reports can now carry out immunity testing in a much more efficient manner with the 3rd generation of NSG 4070. Its modular set-up using internal or external amplifiers enables a large variety of applications. The powerful and easy to use firmware makes the NSG 4070 independent from an external PC and control software, however it can also be remote controlled for system operation. A state-of-the-art data transfer of test and measurement data for documentation is provided by USB stick to be plugged into the front panel.



### Standards:

- IEC/EN 61000-4-3
- IEC/EN 61000-4-6
- IEC/EN 61000-4-20
- IEC/EN 61000-4-21
- IEC 62132
- ISO 11452-4
- MIL-STD-461 CS114
- Ford FMC127S
- GM GMW3097
- Nissan 2S400NDS
- Peugeot PSA B21 7110
- Renault 36-00-808
- And others



# AMPLIFIER RESEARCH MODEL C100250A

**Model C100250A,  
M1 through M12  
RF Conducted Immunity System  
75 Watts  
10 kHz–250 MHz**



Complete Testing Solutions to the following standards:

- EN/IEC 61000-4-6
- IEC 60601-1-2
- EN 50130-4
- EN 61000-6-1/2
- EN 55024
- CISPR 14-2

The Model C100250A is a fully self-contained state of the art system designed to test RF Conducted Immunity. The C100250A contains all the instruments needed to perform conducted immunity testing to the IEC

61000-4-6 specification. The system contains a signal generator, 3 channel power meter, 75W minimum AR amplifier 10kHz to 250MHz, and emcware® control software. Everything is contained in a single housing, which eliminates setup issues. This system will have the versatility needed for every test laboratory and equipment manufacturer. The RF amplifier and the signal generator can be used independently of the system. If special needs arise or standards were to change a larger amplifier can be connected to the system. The use of spectrum analyzers and monitoring equipment may also be controlled by the software.

# EMTEST/AMTEK MODEL CWS500N1.X

## CWS 500N1

CONTINUOUS WAVE SIMULATOR, 80W



### FOR TESTS ACCORDING TO ...

- > EN 300329
- > EN 300340
- > EN 300342-1
- > EN 300386 V1.3.2
- > EN 301489-1
- > EN 301489-17
- > EN 301489-24
- > EN 301489-7
- > EN 55024
- > EN 61000-4-6
- > EN 61000-6-1
- > EN 61000-6-2
- > IEC 60601-1-2
- > IEC 61000-4-6
- > IEC 61326
- > IEC 61850-3

### CWS 500N1 - THE SINGLE BOX SOLUTION FOR RF CONDUCTED IMMUNITY TESTING

The CWS 500N1 is the most compact single box test equipment for testing conducted rf immunity as per IEC 61000-4-6 and related standards with a frequency range of 100kHz to 300MHz. Apart from the 1kHz 80% AM signal the CWS 500N1 also generates a 2 Hz 80% AM signal to test medical appliances and a 1 Hz PM signal with 50% duty cycle required to test safety equipment like fire alarms. Equipped with a 1 GHz current monitor the CWS 500N1 can be used up to 1 GHz by means of an external amplifier.

EM TEST supplies a large range of CDNs, EM clamp and current injection clamps as well as the corresponding calibration accessories. Full compliant levelling can be run from the front panel of the CWS 500N1 storing the results in 5 memory spaces available in the CWS 500N1.

### HIGHLIGHTS

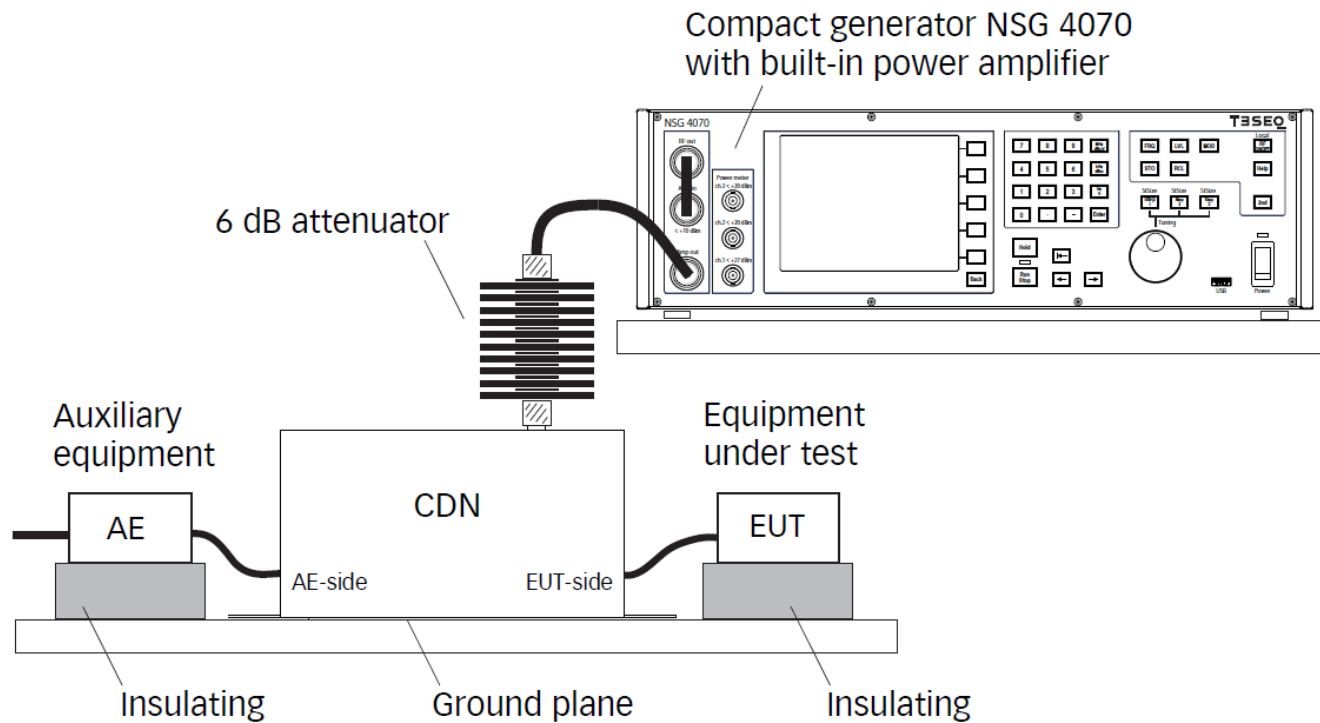
- > Signalgenerator 9kHz to 1GHz
- > Amplitude modulation: 1Hz to 3kHz (0% to 95%)
- > Pulse modulation: 1Hz - 1kHz (10% to 90%)
- > Built-in amplifier, 100kHz to 300MHz
- > Built-in current monitor, 9kHz to 1GHz

### APPLICATION AREAS

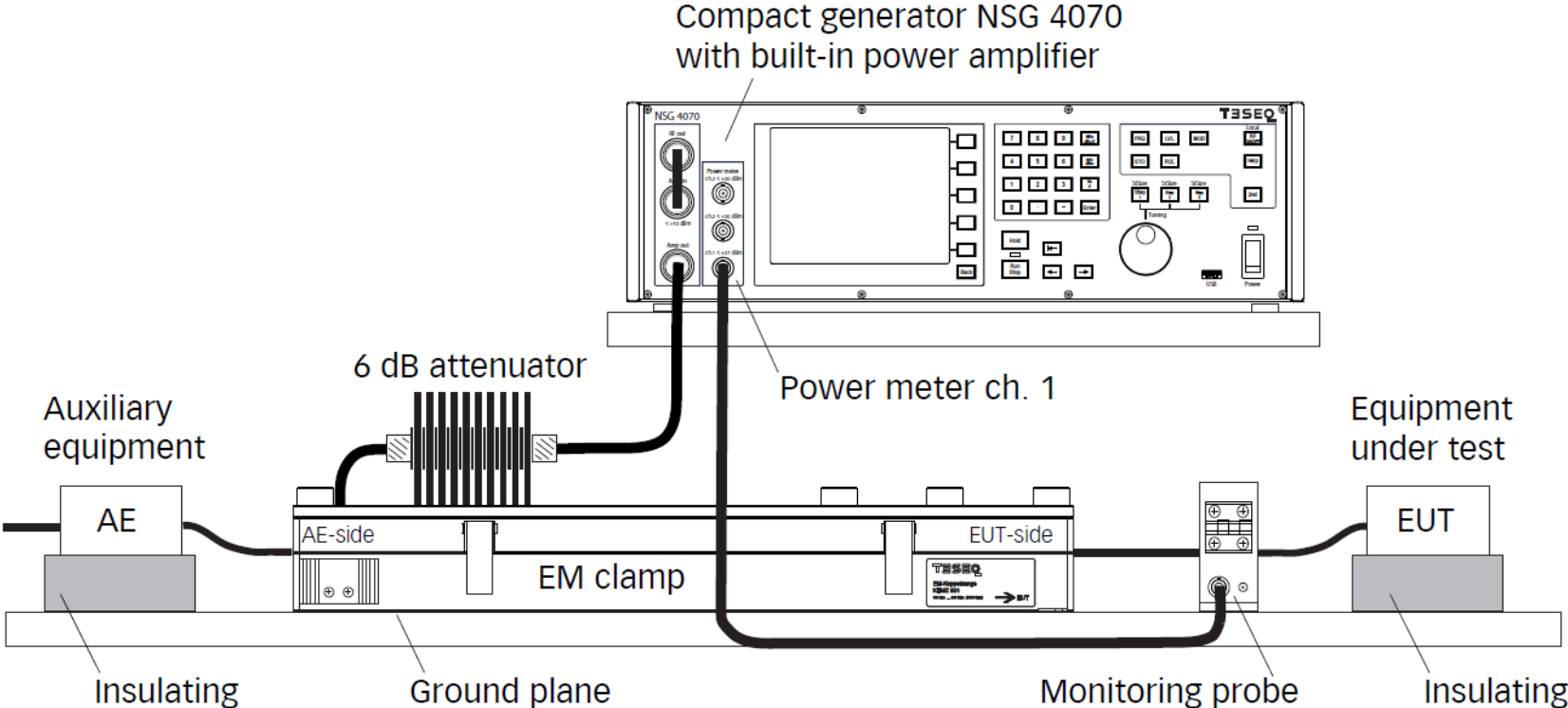
- |   |  |
|---|--|
|  INDUSTRY  |  TELECOM          |
|  MEDICAL   |  RESIDENTIAL      |
|  BROADCAST |  RENEWABLE ENERGY |



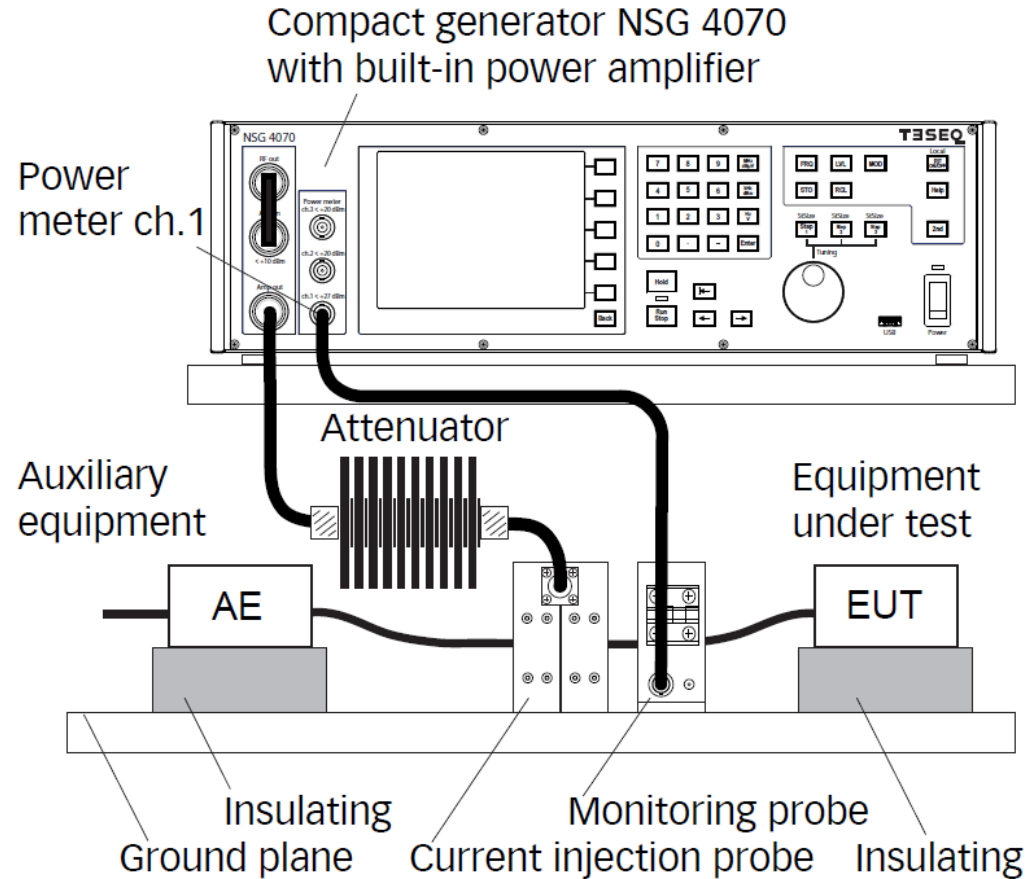
# DIAGRAM OF BASIC TEST SETUP WITH A CDN



# DIAGRAM OF BASIC TES SETUP WITH AN EM CLAMP WITH CURRENT MONITORING

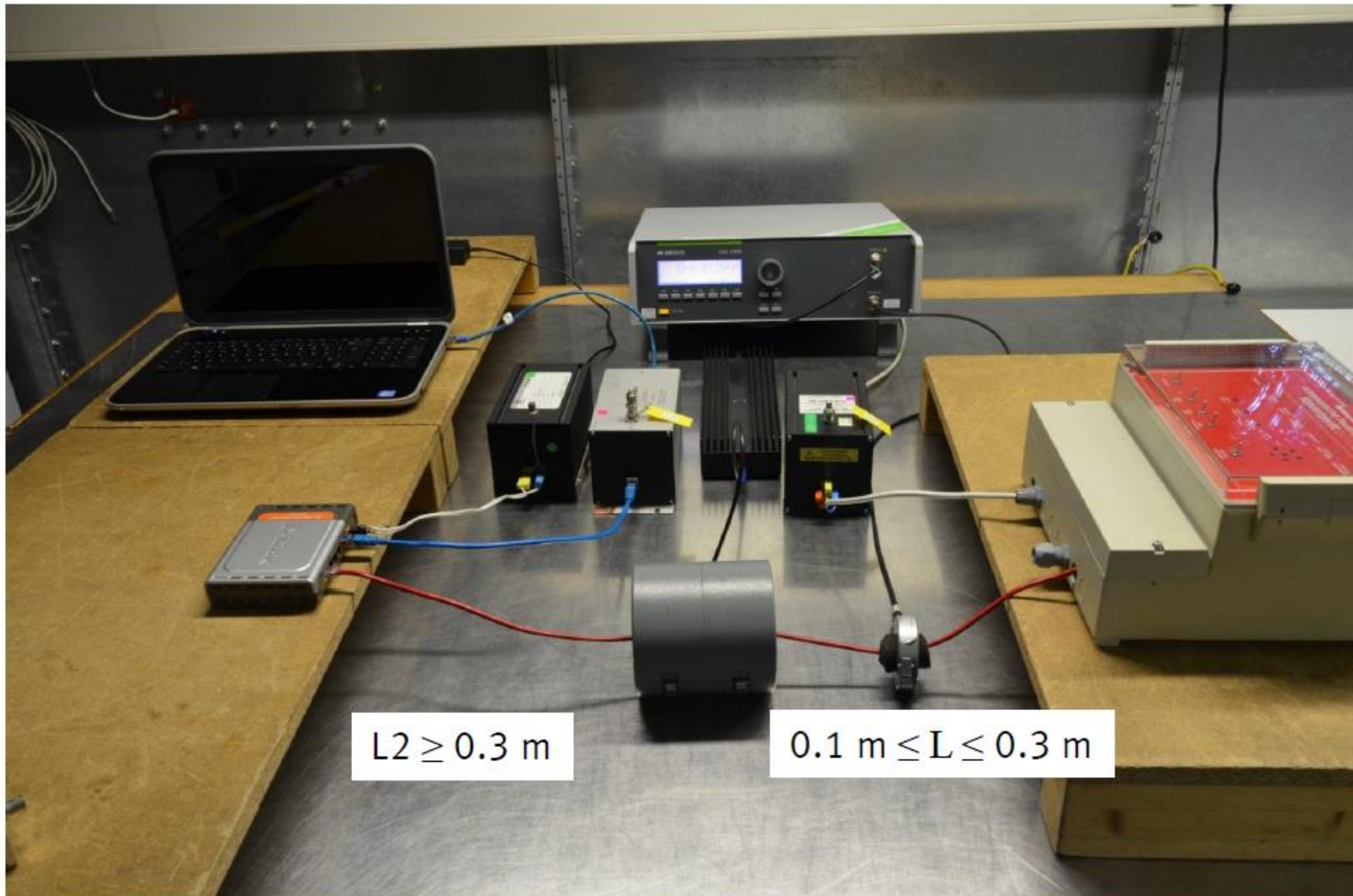


# DIAGRAM OF BASIC TEST SETUP WITH A BCI WITH CURRENT MONITORING



# EXAMPLE TEST CONFIGURATIONS

Test set-up with CDN and injection clamp as well as monitor probe



# Test set-up direct coupling via 100 Ohm



# APPENDIX 1 (QUOTE FOR PURCHASE OF EMTE-CWS5001.4 GENERATOR AND ACCESSORIES.)



**Advanced Test Equipment Rentals**  
 10401 Roselle St. San Diego, CA 92121  
 Phone: (800) 404-2832 FAX: (858) 558-6570  
<http://www.atecorp.com>  
 Rentals - Sales - Service

## Sales Quote

Quote Date: 08/05/2016  
 Quote No: QUO-89987-2  
 Quote Expires: 09/03/2016

### Ship To:

ATT: Nickols, Nick  
 Saint Jude Medical  
 6035 Stone Ridge Ave,  
 Pleasanton, CA 94597

### Customer Address:

Saint Jude Medical  
 6035 Stone Ridge Ave,  
 Pleasanton, CA 94597

### Summary

Total Amount: **\$24,350.00**  
 Shipping Method: **TBD**  
 Requested Delivery Date:  
 Payment Terms: **Credit Card**  
 Due By:

Freight Terms:  
 Sales Rep: **Berg, Alan**  
 Sales Rep Phone: **(800) 404-2832 x**  
 Sales Rep Email: **aberg@atecorp.com**

### Details

#	QTY	Product ID	Product	MFG	Model #	Unit	Price	Sub Total
1	1	EMTE-CWS500N1.4	EMTE-CWS500N1.4 Continuous Wave Simulator w/100kHz-300MHz 80W Amp Built In	EM Test	CWS500N1.4	Each	\$18,750.00	\$18,750.00
2	1	EMTE-CDN-M2/M3N	EMTE-CDN-M2/M3N Power Line CDN, 150kHz-300MHz, 0-240V, 0-16A, 1 Phase	EM Test	CDN-M2/M3N	Each	\$800.00	\$800.00
3	1	FISC-F-120-9A	FISC-F-120-9A 10k-230MHz Bulk Current Injection Probe, 100W max	Fischer Custom Communications	F-120-9A	Each	\$2,000.00	\$2,000.00
4	1	EMTE-ATT6/75	EMTE-ATT6/75 6dB Attenuator, 75W, 50 ohms, DC-300MHz	EM Test	ATT6/75	Each	\$800.00	\$800.00
5	1	FISC-FCC-BCICF-4	FISC-FCC-BCICF-4 10kHz-400MHz Calibration Test Fixture for F-120/F-130	Fischer Custom Communications	FCC-BCICF-4	Each	\$2,000.00	\$2,000.00

# APPENDIX 2 (QUOTE FOR RENT OF EMTE-CWS5001.4 GENERATOR AND ACCESSORIES.)



**Advanced Test Equipment Rentals**  
 10401 Roselle St. San Diego, CA 92121  
 Phone: (800) 404-2832 FAX: (858) 558-6570  
<http://www.atecorp.com>  
 Rentals - Sales - Service

Quote Date:  
 Quote No:  
 Rental Type:  
 Min # Periods:  
 Quote Expires:

## Rental Quote

08/05/2016  
 QUO-90000-0  
 Rental Monthly  
 1 Month  
 09/03/2016

### Ship To:

ATT: Nickols, Nick  
 Saint Jude Medical  
 6035 Stone Ridge Ave,  
 Pleasanton, CA 94597

### Customer Address:

Saint Jude Medical  
 6035 Stone Ridge Ave,  
 Pleasanton, CA 94597

### Summary

Total Amount: **\$2,520.00**  
 Shipping Method: **TBD**  
 Requested Delivery Date:  
 Payment Terms: **Credit Card**  
 Due By:

Freight Terms:  
 Sales Rep: **Berg, Alan**  
 Sales Rep Phone: **(800) 404-2832 x**  
 Sales Rep Email: **aberg@atecorp.com**

### Details

#	QTY	Product ID	Product	MFG	Model #	Unit	Price	Sub Total
1	1	EMTE-CWS500N1.4	EMTE-CWS500N1.4 Continuous Wave Simulator w/100kHz-300MHz 80W Amp Built In	EM Test	CWS500N1.4	Each	\$1,920.00	\$1,920.00
2	1	EMTE-CDN-M2/M3N	EMTE-CDN-M2/M3N Power Line CDN, 150kHz-300MHz, 0-240V, 0-16A, 1 Phase	EM Test	CDN-M2/M3N	Each	\$100.00	\$100.00
3	1	FISC-F-120-9A	FISC-F-120-9A 10k-230MHz Bulk Current Injection Probe, 100W max	Fischer Custom Communication s	F-120-9A	Each	\$200.00	\$200.00
4	1	EMTE-ATT6/75	EMTE-ATT6/75 6dB Attenuator, 75W, 50 ohms, DC-300MHz	EM Test	ATT6/75	Each	\$100.00	\$100.00
5	1	FISC-FCC-BCICF-4	FISC-FCC-BCICF-4 10kHz-400MHz Calibration Test Fixture for F-120/F-130	Fischer Custom Communication s	FCC-BCICF-4	Each	\$200.00	\$200.00

# APPENDIX 3 (QUOTE FOR NSG 4070B-80)

Nick Nickols  
SAINT JUDE MEDICAL  
6035 Stone Ridge Ave  
Pleasanton CA 94597  
United States

[NNichols04@sjm.com](mailto:NNichols04@sjm.com)

**Quotation Number: 498723 issued on 5 August 2016**

Thank you for your interest in Test Equipment Connection. All quotes are in U.S. dollars, and all equipment is subject to availability at time of order. Quoted equipment is NEW and is subject to original manufacturer's warranty terms. New equipment is non cancelable and non returnable. This Quote is valid for 30 Days.

---

<u>QTY</u>	<u>MFG/MODEL</u>	<u>UNIT PRICE</u>	<u>TOTAL</u>
1	Teseq Schaffner NSG 4070-75/Discontinued /NEW		Out Of Stock
1	Teseq Schaffner NSG 4070B-80/NEW	\$27,700.00	\$27,700.00
			=====
			TOTAL:
			\$27,700.00

RF Generator with built-in signal generator and power meter 9kHz to 1GHz. Internal amplifier 150kHz to 230MHz, 80W.

<https://goo.gl/pJg8bu>

Indicative pricing only.

Please describe your test application in detail so we may recommend all items needed.

Lead time is typically 6-8 weeks.



# APPENDIX 4 (QUOTE FOR CIS-100 RF AMPLIFIER)



19121 El Toro Rd., Silverado, CA 92676

Toll Free: (855) 364-2362  
Outside U.S. (949) 459-9600

Friday, August 05, 2016

Customer ID: 009176

**SAINT JUDE MEDICAL**  
NICK NICKOLS  
6035 STONE RIDGE AVE  
PLESANTON, CA 94597  
USA

RE: RFQ  
Quote # Q133344

Dear NICK,

Thank you for contacting Com-Power Corp. Here is the quote you requested for the following item(s):

Item	Description	Qty	Price	Subtotal	Delivery
1	CIS-25 Conducted Immunity test System with 25W power amplifier (Price listed is the base price, final price shall be determined based on the CDN selection)	1	\$9,545.00	\$9,545.00	1 - 2 Weeks
2	CIS-50 Conducted Immunity test System with 50W power amplifier (Price listed is the base price, final price shall be determined based on the CDN selection)	1	\$10,545.00	\$10,545.00	1 - 2 Weeks
3	CIS-100 Conducted Immunity test System with 100W power amplifier (Price listed is the base price, final price shall be determined based on the CDN selection)	1	\$12,245.00	\$12,245.00	1 - 2 Weeks

**Notes:**

**Terms**

Delivery time is based on best estimates and may be subject to change. Com-Power Corp is not liable for any delays.

All items quoted are new with **3 year warranty** unless otherwise specified.

All calibration is NIST traceable unless specified. Calibration services have a 90 day warranty.

FCA Silverado, CA (INCOTERMS 2010).

Payments are **Advance Terms** with approved credit. We also accept all major credit cards.

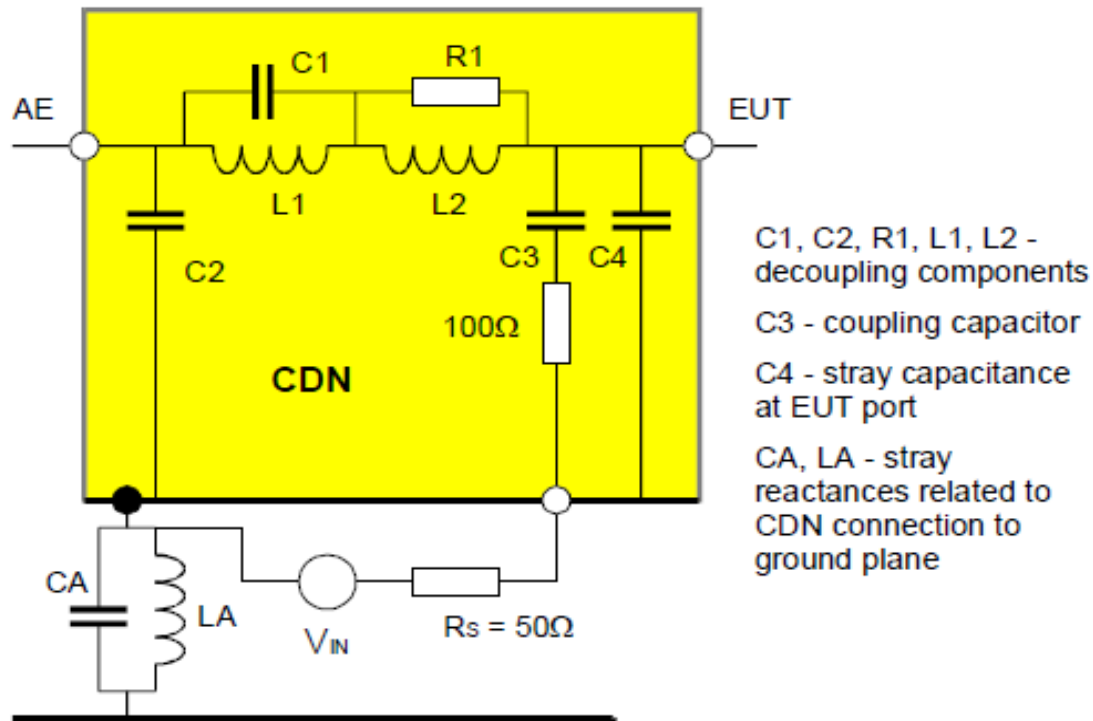
International orders require advance bank transfer and subject to \$30 USD processing fee.

This quote is valid and subject to your acceptance for 30 Days.

Please fax the order to (949) 635-0329 or email [sales@com-power.com](mailto:sales@com-power.com). If you have any questions, you may reach me at (949) 459-9600 ext. 106 or email me at [cardos@com-power.com](mailto:cardos@com-power.com)

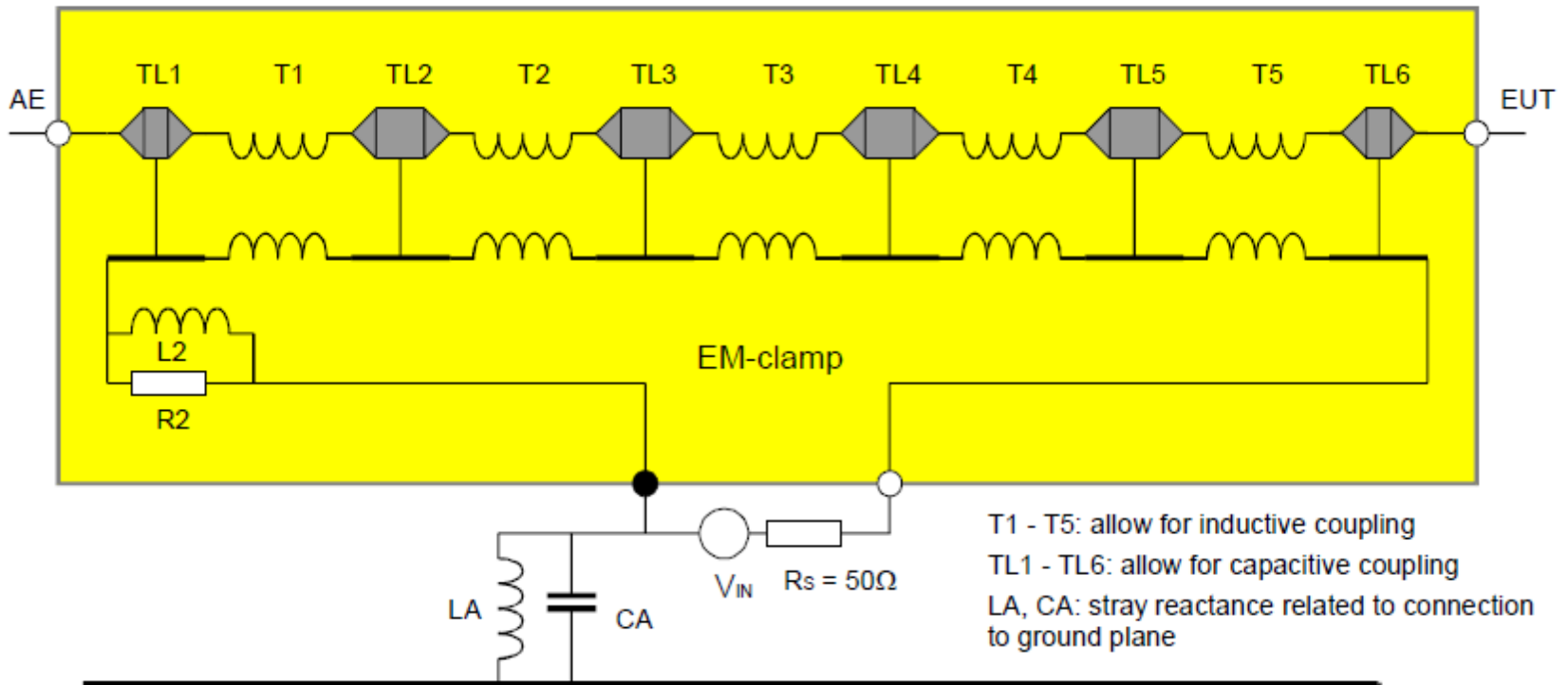
Sincerely,

# APPENDIX 5: CIRCUIT MODELS FOR CDN



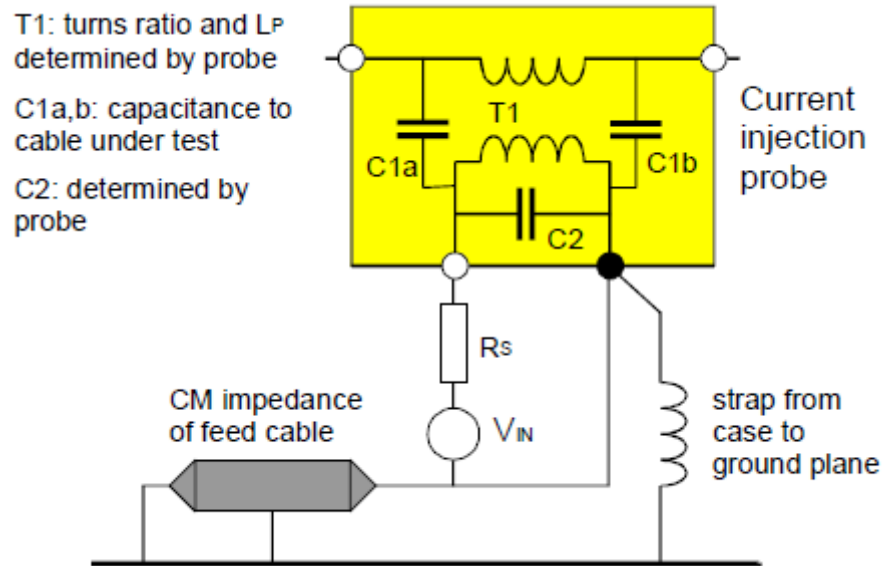
This model should represent all generic CDNs. Its values were adjusted to match the calibration characteristic of the M1 CDN used for the practical work. The circuit closely follows that given in the standard with the addition of expected stray components.

# APPENDIX 6: CIRCUIT MODELS FOR EM CLAMP



This model represents the Lüthi EM-101 clamp. This is the most widely used clamp in typical test laboratories

# APPENDIX 7: CIRCUIT MODELS FOR CURRENT CLAMP



This model represents generic injection probes. The turns ratio and primary inductance  $L_P$  were chosen to match the known specification of the probe used for the practical work, with stray components deduced from network analyser measurements of the probe.

# REFERENCES (Partial List)

- Practical Approach to IEC61000-4-6 Testing, Jan Sroka, 2004
- EMTEST Transient Immunity Presentation, November 11, 2015
- Uncertainties of Immunity Measurements, Tim Williams, 2002
- Pitfalls and Practice of IEC61000-4-6 Testing, Tim Williams, 2004
- CDN Selection Guide, TESEQ, MAY 2015
- IEC 61000-4-6 ed3.0 (2008-10): Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.