CARLO GAVAZZI SPACE SpA

ORIGINALE ARCHIVIO

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Preparato da: *Prepared by:*	Alia S. (DT/EE)		21-10-09
Approvato da: *Approved by:*	Grossi R. (DT/EE) Alia S. (DT/EE) Francini E. (PA/QA) Cinquepalmi C. (PA/CC)		21-10-09 21-10-09 21/10/09 21.10.09
Applicazione autorizzata da: *Application authorized by:*	Olivier M. (PM)		21.10.09

Customer / Higher Level Contractor

Accettato da: *Accepted by:*	ASI		
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REGISTRAZIONE DELLE MODIFICHE / *CHANGE RECORD*

EDIZIONE *ISSUE*	DATA *DATE*	AUTORIZZAZIONE *CHANGE AUTHORITY*	OGGETTO DELLA MODIFICA E SEZIONI AFFETTE *REASON FOR CHANGE AND AFFECTED SECTIONS*
1	21/10/2009	-	First Issue

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1. SCOPE

This document provides the test report results of the EMC test performed on:

Model: PFM
Part number: 10-AMS02PDS-000.00
Serial number: FM 01

The radiated (conduction and emission) and the ESD tests have been performed at the CEMLAB facilities.
The conducted tests have been performed at the CGS facilities.

The document represents the following contract deliverables:
- DEL 101

2. DOCUMENTS

2.1 APPLICABLE DOCUMENTS

AD	Doc. Number	Issue / Date	Rev	Title / Applicability	Remarks
1	*AMS-RQ-CGS-002*	*1 / April 2007*	*N.A.*	*PDS Specification*	
2	*PDS-PL-CGS-003*	*1 / 11-05-2009*	*N.A.*	*AMS02 PDS DESIGN DEVELOPMENT AND QUALIFICATION PLAN*	
3	*SSP 57003*	*June 17, 2003*	*B*	*Attached Payload Interface Requirements Document. International Space Station Program*	

2.2 REFERENCE DOCUMENTS

RD	Doc. Number	Issue / Date	Rev	Title / Applicability	Remarks
1	*10-AMS02PDS-000.00*	*28/07/2008*	*/*	*AMS02 Power Distribution System Assembly*	
2	*10-AMS02PDS-000.01*	*28/07/2008*	*/*	*AMS02 Power Distribution System Assembly Parts List*	
3	*10-AMS02PDS-000.02*	*08/06/2009*	*A*	*AMS02 Power Distribution System ICD*	

3. ACRONYMS

APM Attached Payload Model
C.I. Configuration Item. Also called Part Number (P/N)
CGS Carlo Gavazzi Space
CE Conducted Emissions
CS Conducted Susceptibility
FM Flight Model
NA Not Applicable
P/N Part Number. Also called Configuration Item C.I.
PA Product Assurance
PDS Power Distribution System

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PFM	Proto Flight Model
PVS	Procedure Variation Sheet
RE	Radiated Emissions
RS	Radiated Susceptibility
QA	Quality Assurance
S/N	Serial Number
TE	Test Equipment
UUT	Unit Under Test

4. PARTICIPANTS REQUIRED

4.1 GENERAL

All test will be performed under QA surveillance in accordance with and following detailed procedure of applicable PA Plan.

4.2 RESPONSIBILITY

The technical responsibility for testing and test results is up to the Engineering Department.

QA is responsible for ensuring that all the agreed procedures are carefully observed, that test equipment and instrumentation used during testing are calibrated and within validity date, that the test data sheets are recorded in the Test Report and signed by the operators and QA witnesses, that all non conforming condition and test results are properly documented and notified to the Prime Contractor and that all requirements of applicable PA Plan, Specification and Statement of Work pertaining to the acceptance tests are fully satisfied.

4.3 QA WITNESS OF TEST AND SIGN-OFF

QA inspector, or its delegate, shall witness the tests described in this procedure in accordance to the requirement specified in the applicable PA Plans.

4.4 NON CONFORMANCE AND FAILURES

Any malfunction/defect which occurred during the test will be processed along the Non Conformance Procedure described in the applicable PA Plans.

4.5 CALIBRATION REQUIREMENTS

All instruments used for testing shall be calibrated.

Evidence of certification shall be provided by a label attached to the instruments itself, showing the calibration date, the expiring date and the signature of the operator.

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5. TEST ARTICLE

The test article consists of AMS02-PDS PFM Unit (see Para. 1 for Part Number and Serial Number)

Before starting the test, model, P/N and S/N of the test article to be tested shall be recorded on the step-by-step procedure sheets under the table cell "UNIT UNDER TEST".

6. TEST CONFIGURATION

The following general requirements shall be taken into consideration:

- During EMC tests the UUT shall be placed on and grounded to a copper test table.
- Power cable from LISN to UUT during conducted tests shall be 2 meter long.
- All cables shall be placed 5 cm above the ground plane using insulated stand-off's.
- Power and signal cables shall be taken 2 cm far one to each other.
- Power cables shall be routed 10 cm from the edge of the copper test table.
- UUT shall be operated by UUT TE and as prescribed in the User Manual
- UUT TE shall be used for providing, where applicable, on/off-line requirements verification.
- To avoid high frequency ground loops, test receiver for test above 30MHz shall be placed outside the test chamber. All accessory equipment shall be checked to ensure that they will not affect measurement integrity.
- During emission tests the indicated levels shall be never exceeded when the equipment power supply and operations are set to the conditions yielding the maximum emissions.
- During susceptibility tests the equipment operation and test set-up shall be such that the susceptibility is maximized.
  If susceptibility is noted, the level of the disturbance shall be decreased until full performances of the UUT are reached.
  Investigation shall be performed to verify which is the most interfering signal (in terms of modulation, repetition rate, sweep rate, etc...) for the UUT.
  The threshold level and each pertinent data shall be recorded.

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6.1 TEST SETUP

This paragraph contains the test set up to be used during the EMC tests.

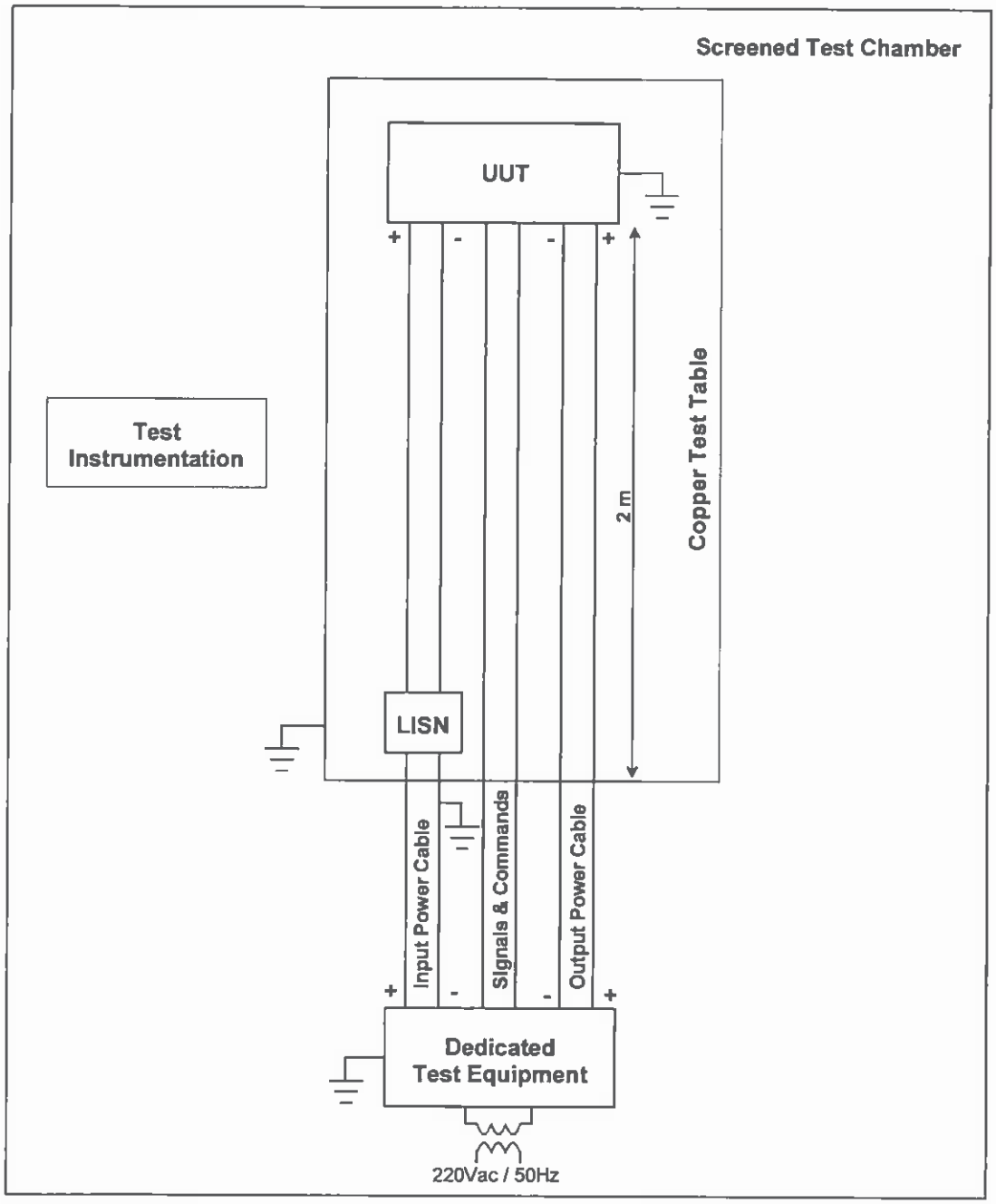

Figure 6-1: General EMC Test Set-up

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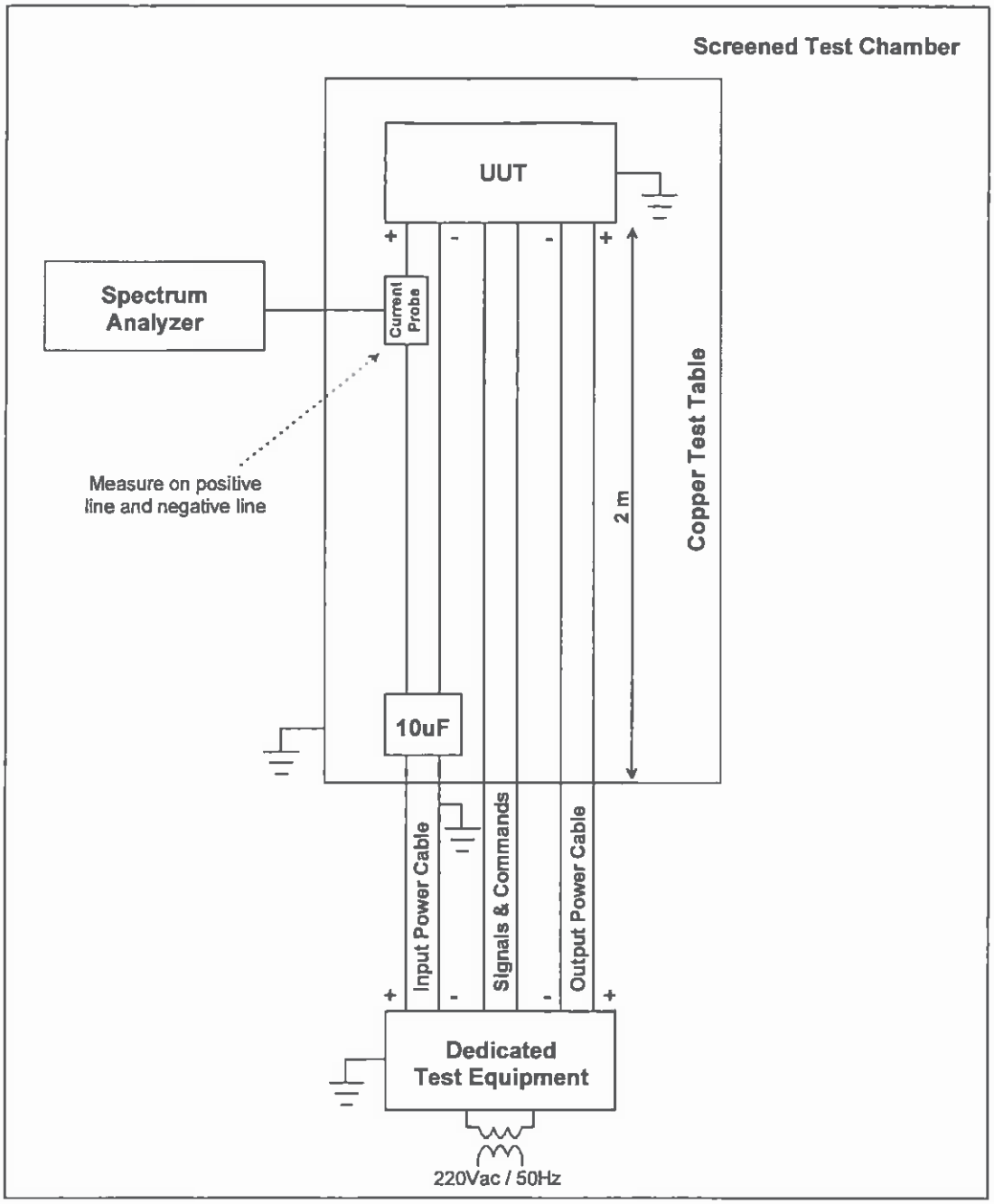

Figure 6-2: Conducted Emission Frequency Domain Test Set-up

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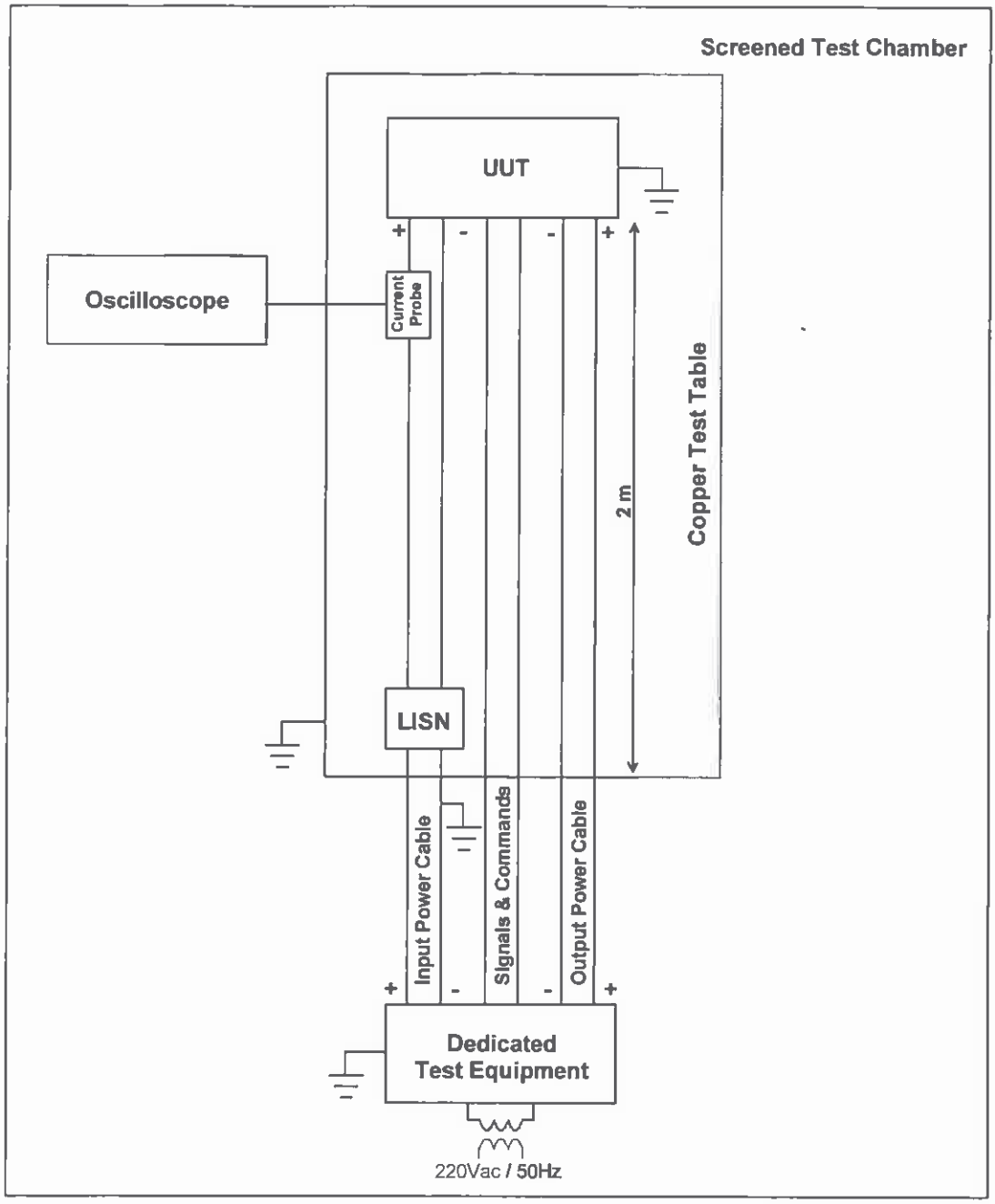

Figure 6-3: Conducted Emission Current Time Domain (Inrush Current) Test Set-up

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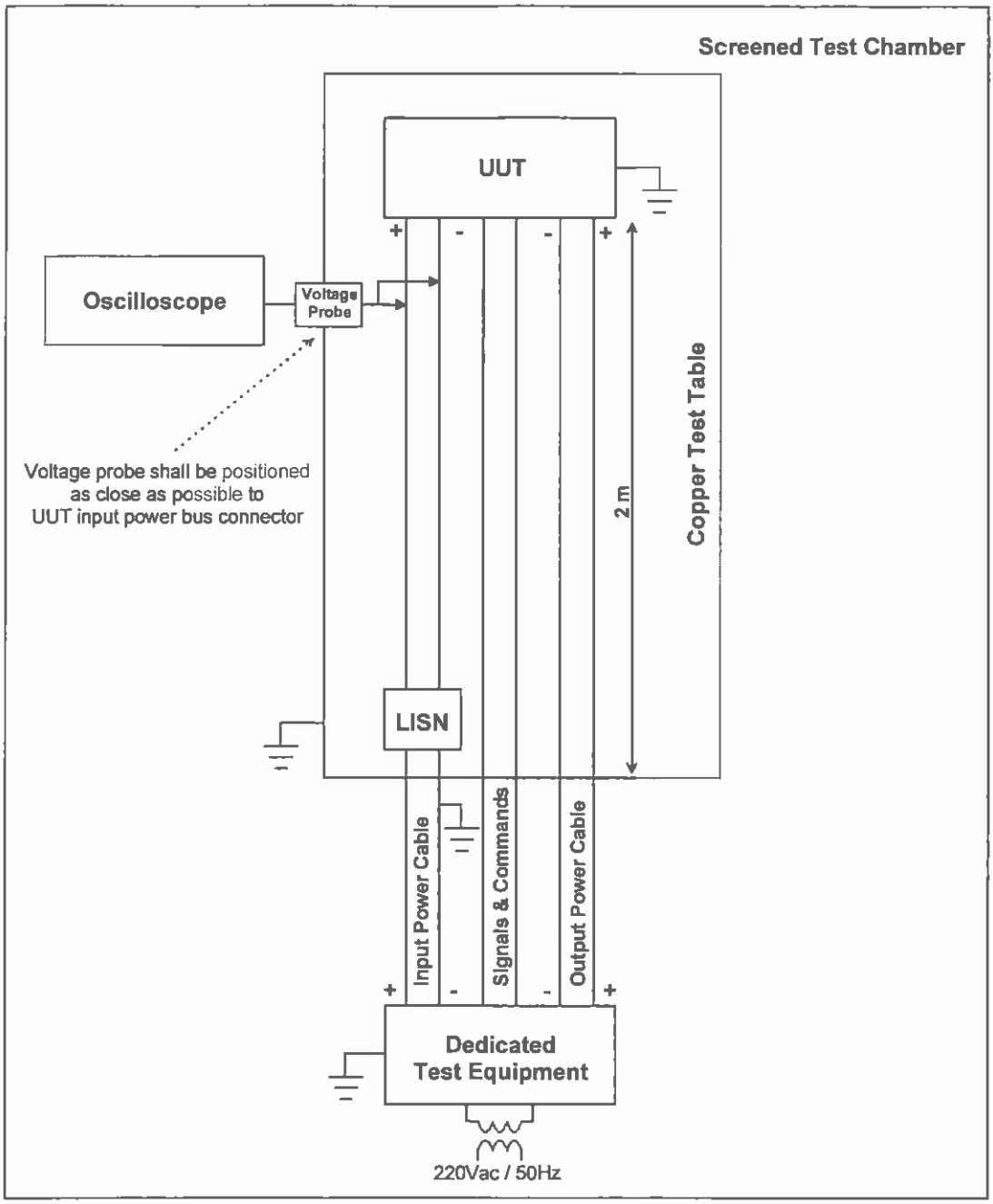

Figure 6-4: Conducted Emission Load Broad Band Voltage Emission / Load Transient Test Set-up

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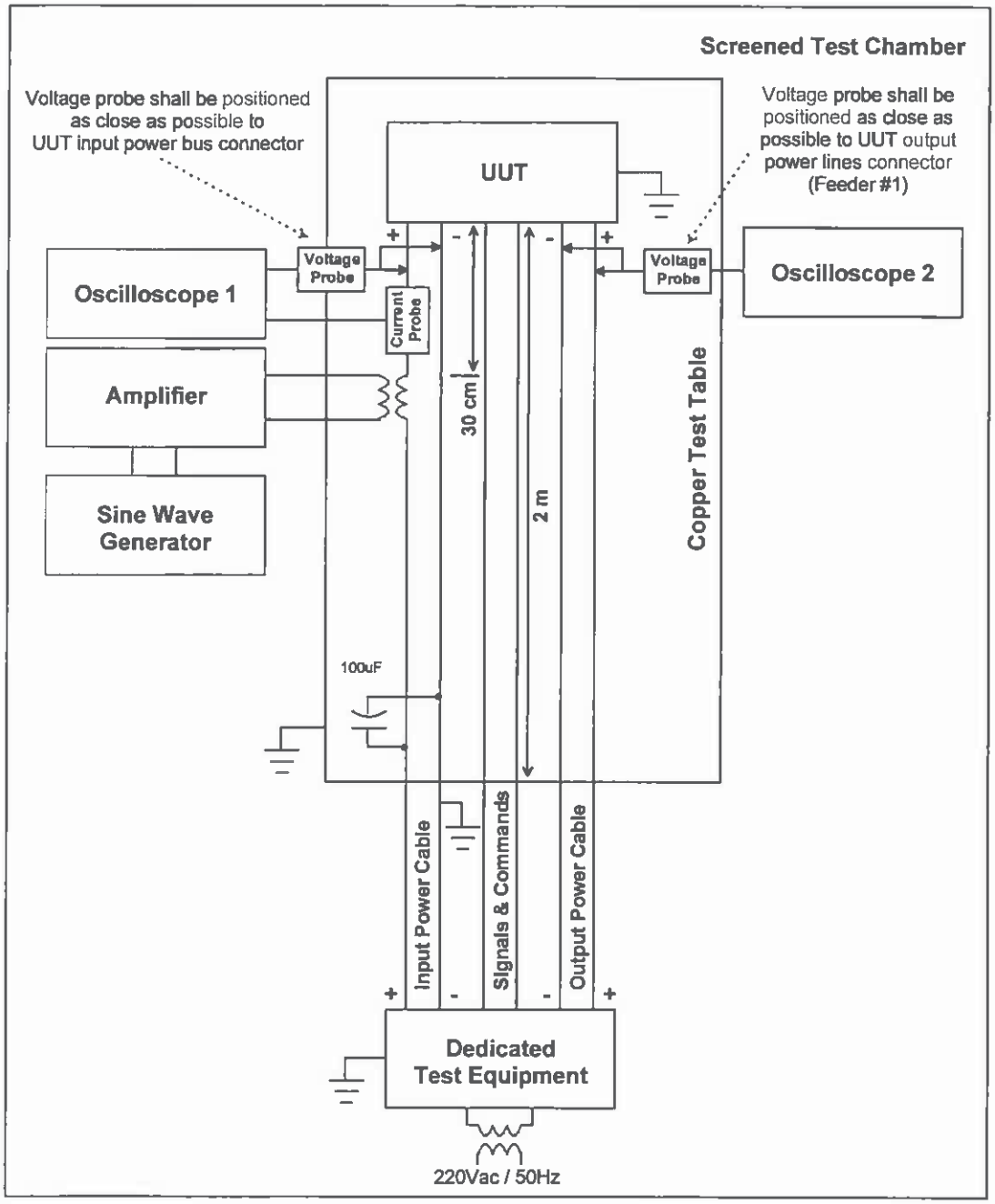

Figure 6-5: Input Sine Wave Injection (30Hz ÷ 50kHz) Test Set-up (Transformer Coupling)

The 100 microfarad capacitor may be required as a shunt to dc power source impedance if difficulty is encountered in obtaining the required test voltage.

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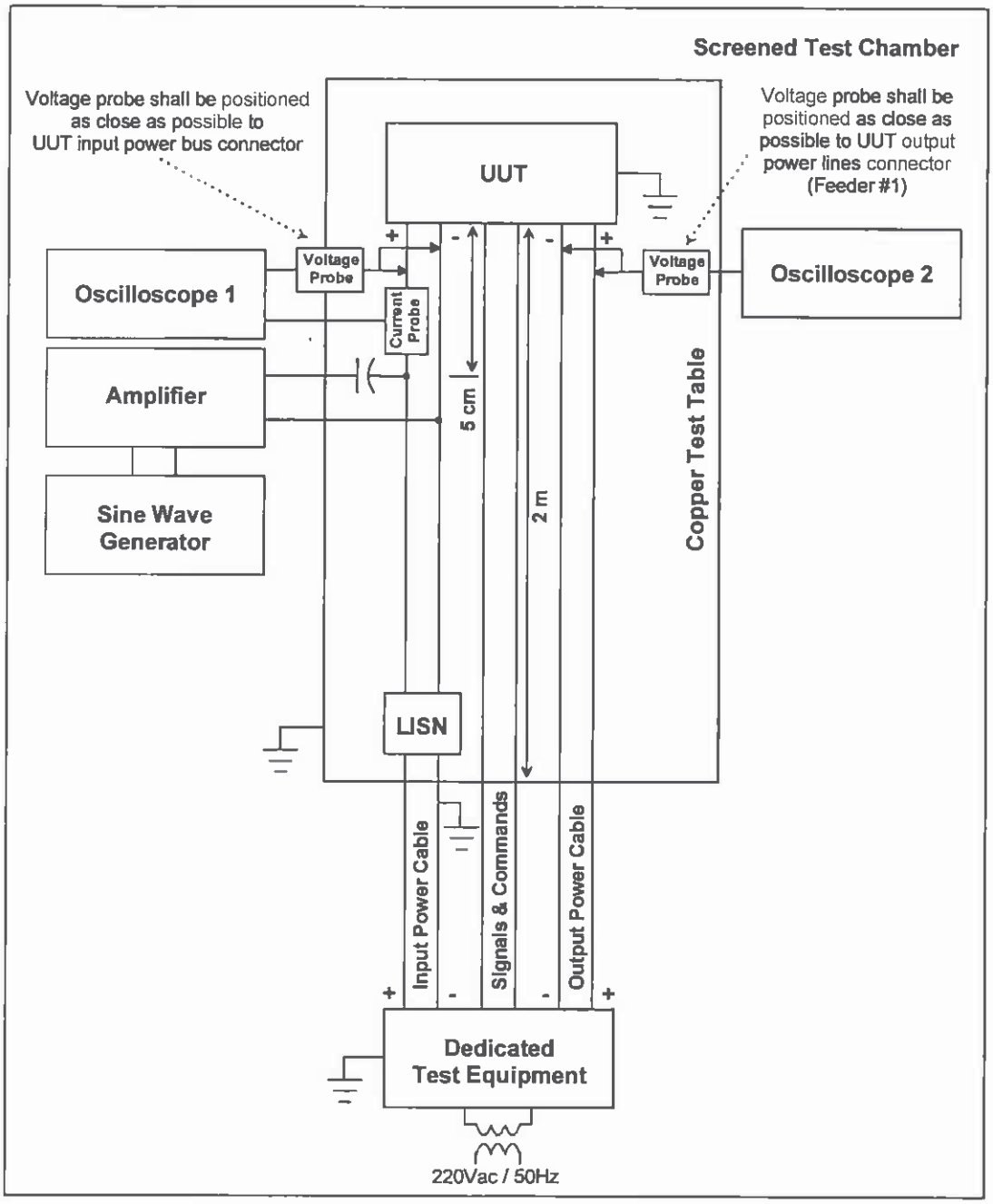

Figure 6-6: Input Sine Wave Injection (50kHz ÷ 50MHz) Test Set-up (Capacitor Coupling)

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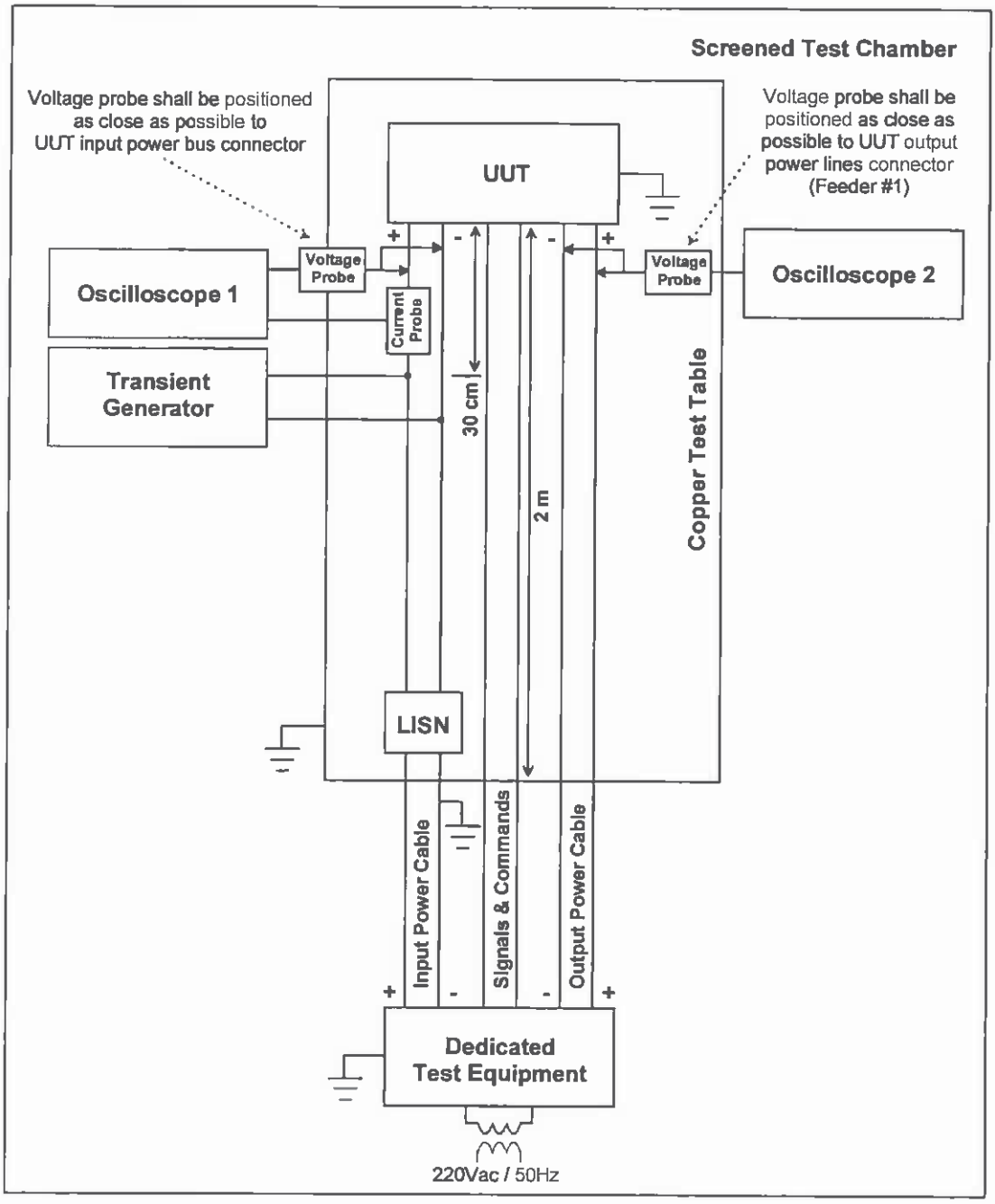

Figure 6-7: Transient Voltage Spikes Conducted Susceptibility Test Set-up

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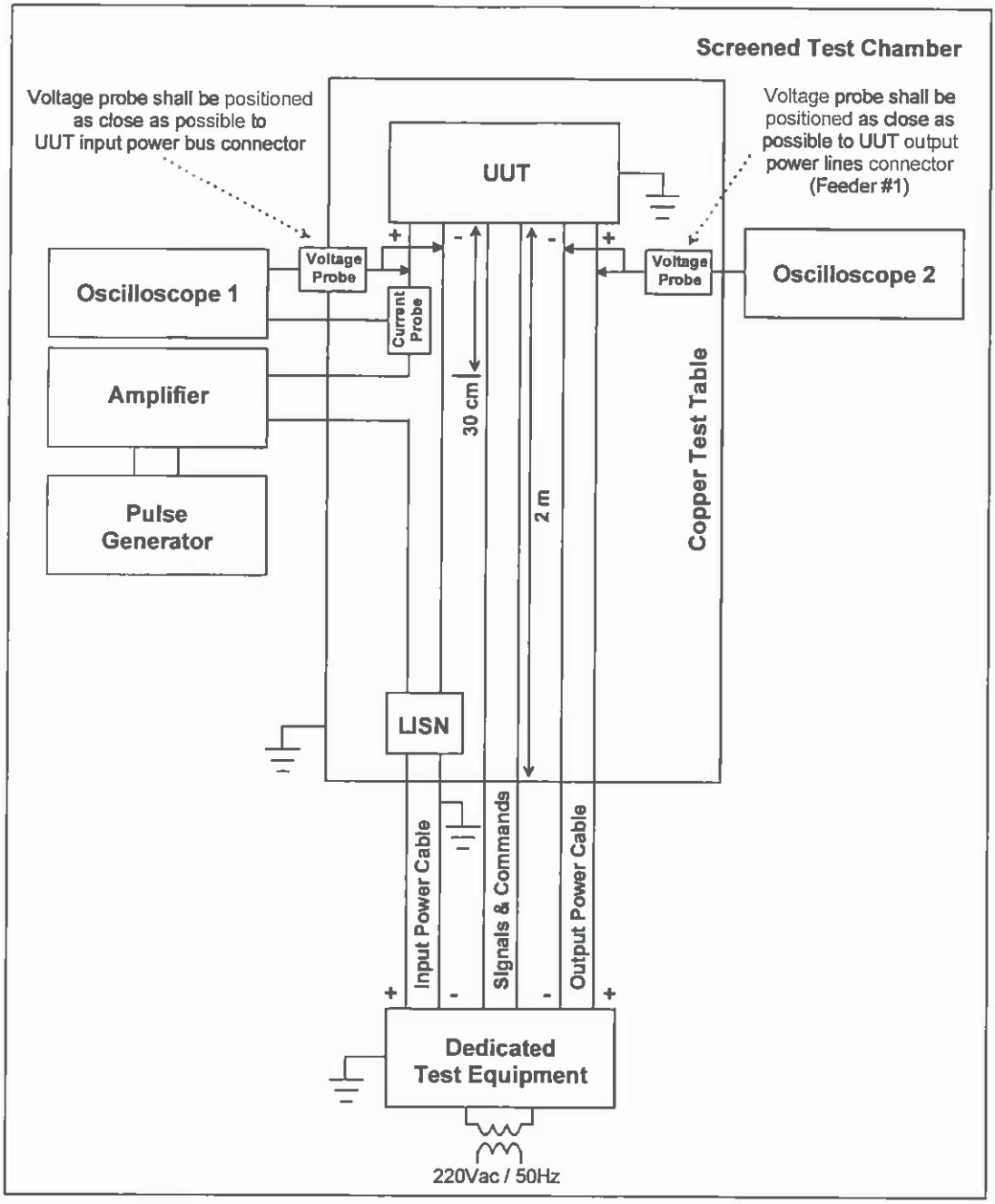

Figure 6-8: Normal & Abnormal Voltage Transients and Large Signal Stability Test Set-up

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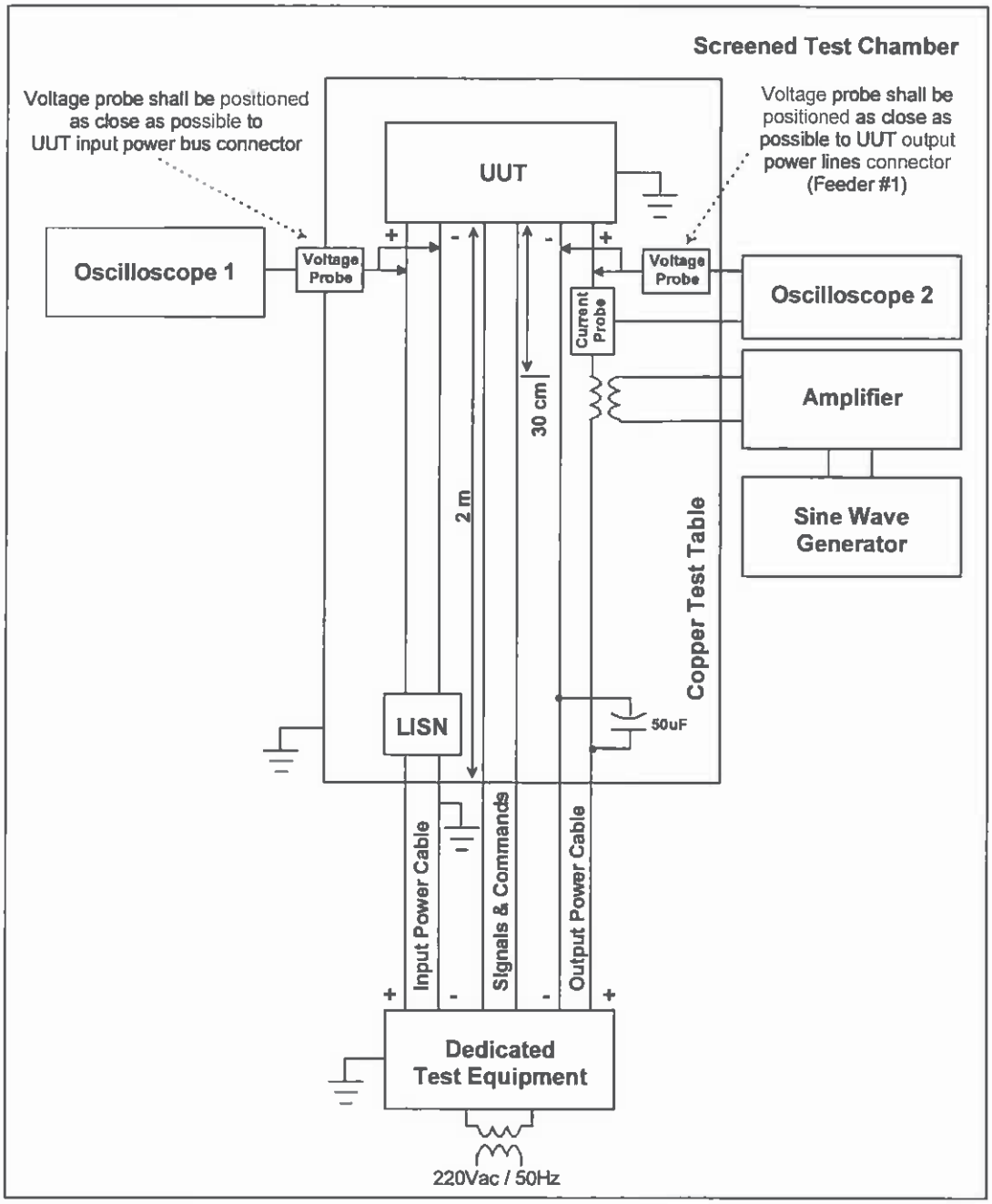

Figure 6-9: Output Sine Wave Injection (30Hz ÷ 50kHz) Test Set-up (Transformer Coupling)

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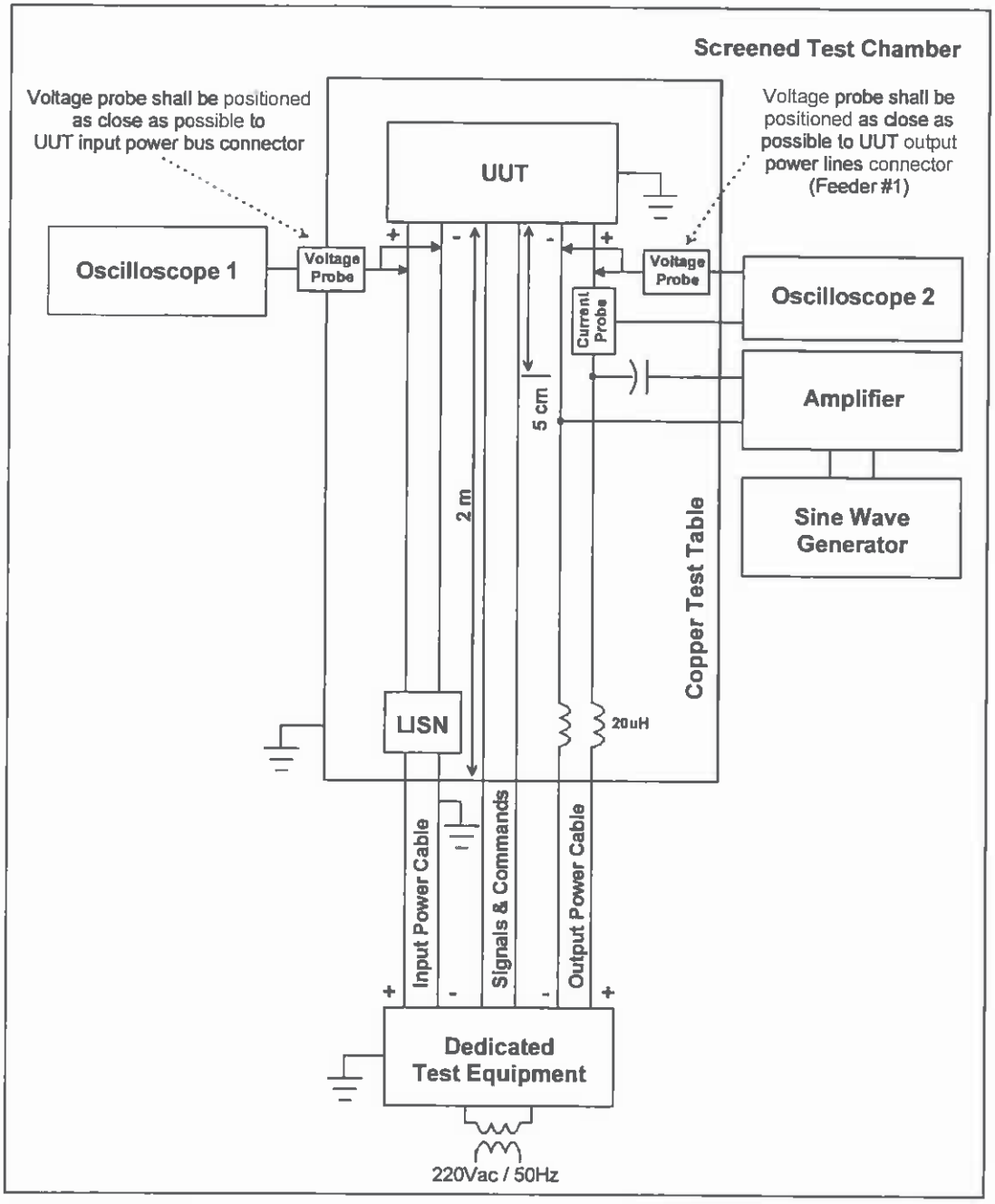

Figure 6-10: Output Sine Wave Injection (50kHz ÷ 50MHz) Test Set-up (Capacitor Coupling)

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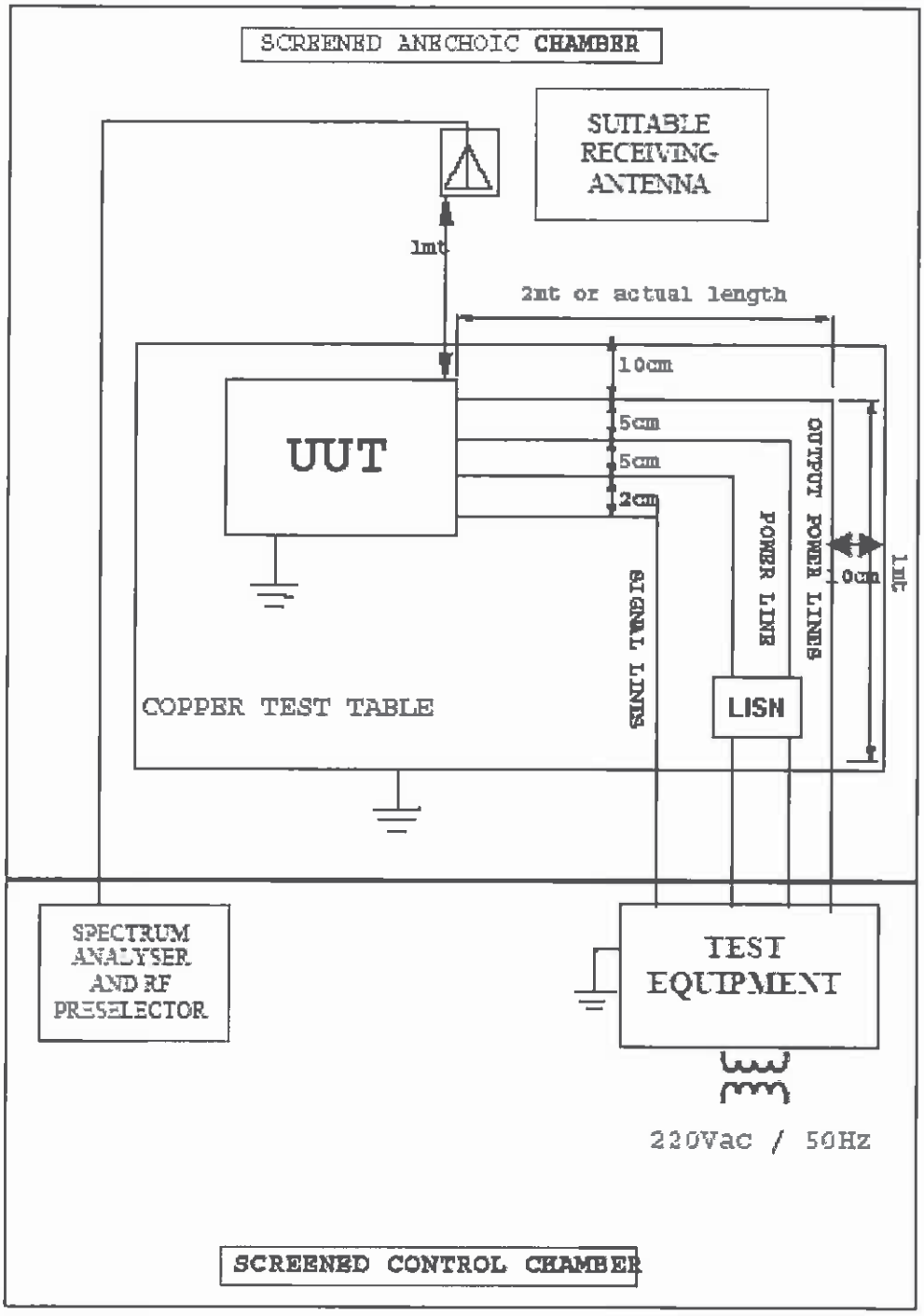

Figure 6-11: Radiated emissions setup

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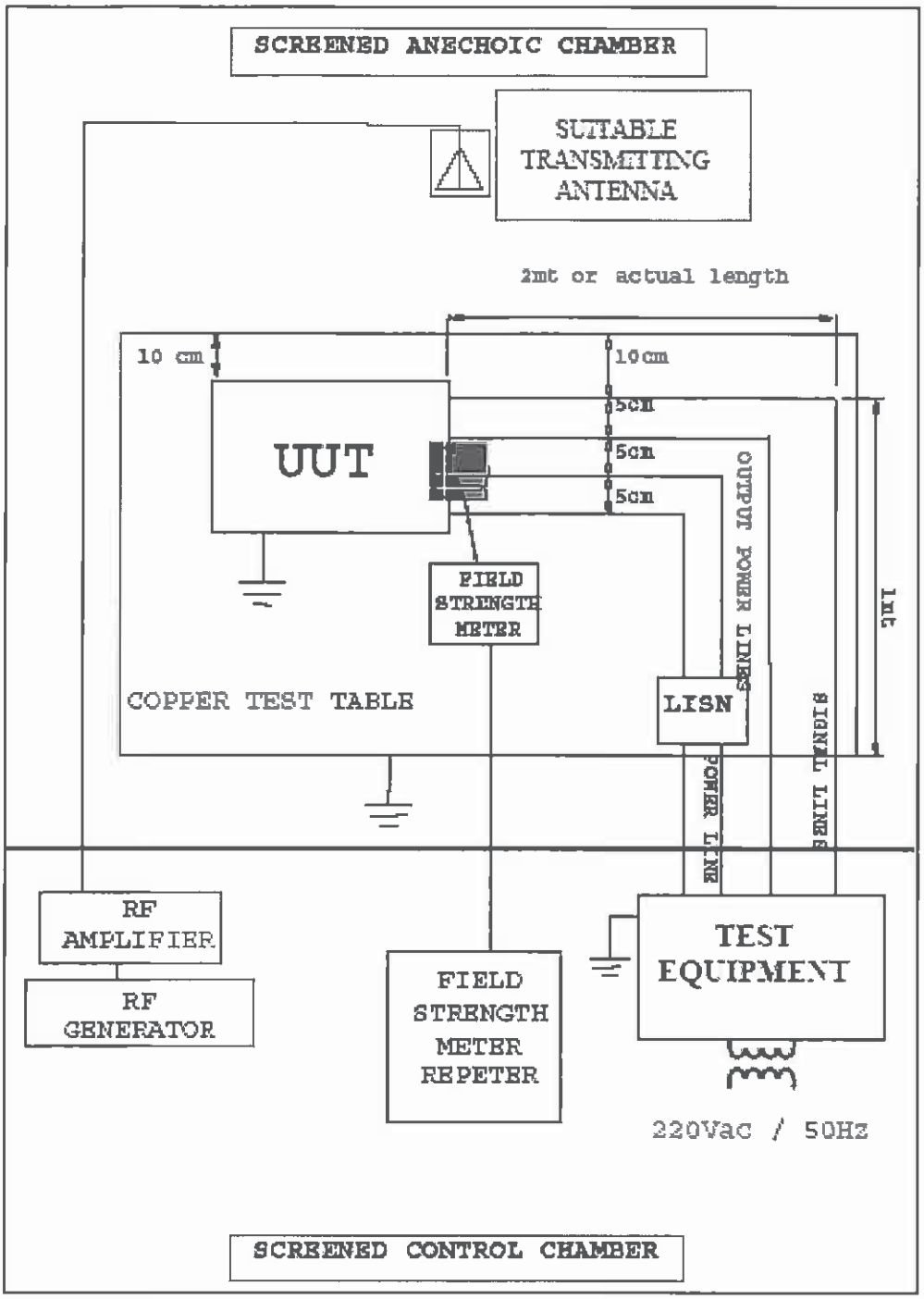

Figure 6-12: Radiated susceptibility setup

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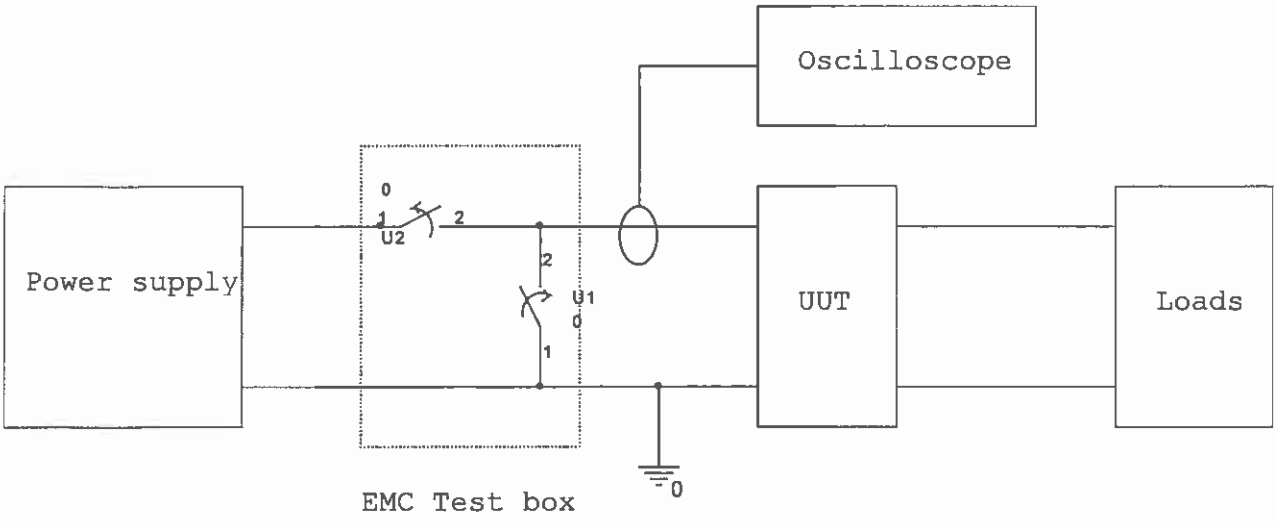

Figure 6-13: Reverse current

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6.2 GROUNDING

6.2.1 GROUNDING OF THE UNIT UNDER TEST

During all the EMC tests the unit under test shall be bonded to a copper table. The thickness of the table shall be 5 mm and the area shall be 2 square meters with the smaller side of 1 meter.
The table shall be bonded to the shielded chamber. The DC resistance between table and shielded chamber shall be less than 10mΩ.
Only the provision included in the design of the unit under test shall be used to bond the unit under test to the ground plane. The bonding strap used to connect the unit under test to the copper test table shall have its length lower than five times its width. The bonding strap shall consist of copper and shall have a minimum thickness of 0.5mm.

6.2.2 GROUNDING OF THE TEST INSTRUMENTATION

The grounding of test instrumentation shall be in accordance with the following rules to avoid the generation of false data which may be introduced by ground loops:

- The interference measuring equipment shall be physically grounded with only one connection
- The interference instruments shall be connected to the AC power source through an isolation transformer
- The rod antenna metal base plate shall be bonded to the ground plane with strap of such length that the rod antenna can be positioned correctly. The width of the strap shall be the same of the metal base plate.

6.3 AMBIENT NOISE

During emission tests the ambient noise level, measured before starting the tests with the unit under test in "OFF" condition and all simulators and monitors (dedicated test equipment) in "ON" condition, shall be at least 6dB below the allowable specified limits.

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6.4 REQUIREMENTS CROSS REFERENCE

Cross reference among requirements and procedure steps is provided in Table 6-1.

AMS-RQ-CGS-002 Requirement	SSP 57003 Requirement	Procedure Section
4.1.4.2 Peak surge current	3.2.2.2.4 Surge Current	10.2.4 – 10.3.4
4.1.4.3 Ripple voltage and noise	3.2.2.1.2.1 Ripple voltage and noise	10.2.2 – 10.3.2
4.1.4.4 Transient voltages	3.2.2.1.3.1 Normal Transient Voltages	10.4.4 – 10.5.4
4.1.4.5 Abnormal voltage conditions	3.2.2.1.3.2 Fault Clearing Protection	10.4.5 – 10.5.5
4.1.4.7 PDS power input impedance	3.2.2.2.7 Interface C attached payload complex load impedances	10.4.2 – 10.5.2
4.1.4.8 Large signal stability	3.2.2.2.8 Large Signal Stability	10.4.6 – 10.5.6
5.5.2.3.1 Conducted emissions	3.2.2.4.4 Electromagnetic Interference	10.2.1 – 10.3.1
5.5.2.3.2 Conducted susceptibility– ripple voltage	3.2.2.1.2.2 Ripple voltage spectrum	10.4.1 – 10.5.1
	3.2.2.2.5 Reverse Current	10.6
5.5.2.4 Electrostatic discharge	3.2.2.4.5 Electrostatic Discharge	10.7

Table 6-1: Requirements Cross Reference

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6.5 PDS TEST EQUIPMENT

The complete list of instruments used during tests shall be recorded in Table 6-5. The list shall be filled up during tests and reported in Test Report.
The following figure shows the main parts constituting the PDS Test Equipment.

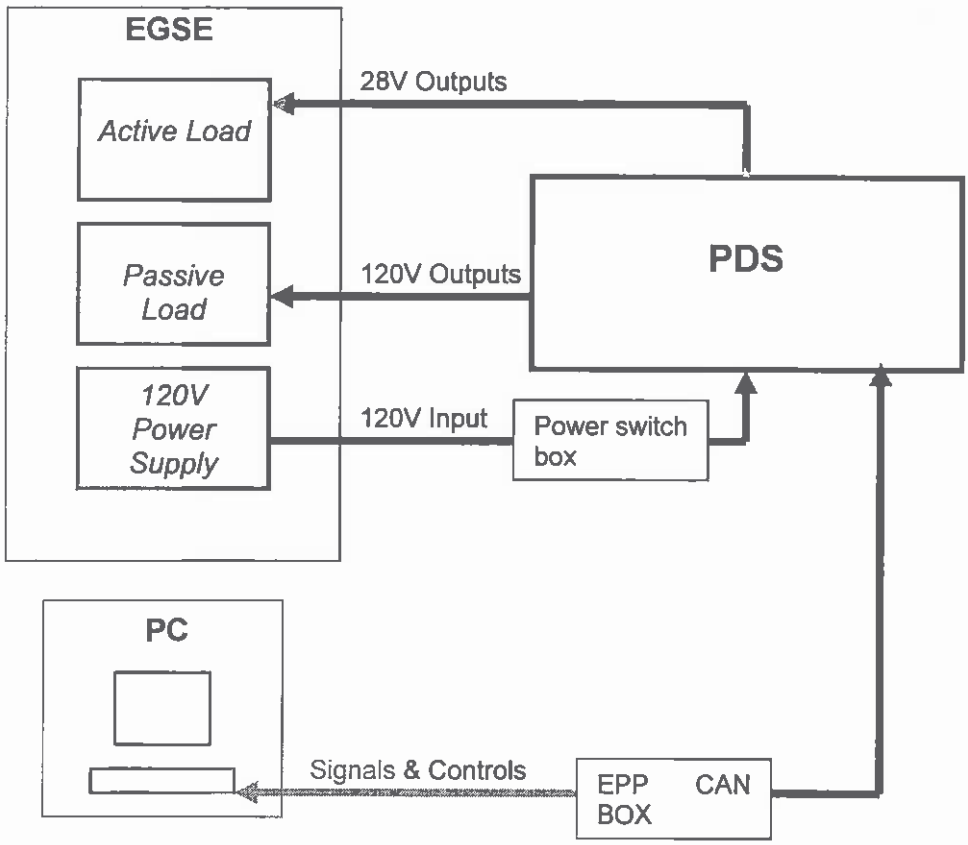

Figure 6-14: PDS Test Equipment

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6.6 SPECTRUM ANALYZER

A spectrum analyzer shall be used for the measurements of both conducted and radiated emission in frequency domain. The spectrum analyzer shall be set in peak detection mode and shall present an accuracy better than +/-2 dB for levels and 2% for frequency. A R.F. pre-selector shall be used, together with the spectrum analyzer, to increase the analyzer's tolerance to broad band overload.

To perform the tests the following resolution bandwidth shall be used:

Frequency range	Narrowband Resolution BW
30 Hz ÷ 1 kHz	10 Hz
1 KHz ÷ 10 kHz	100 Hz
10 kHz ÷ 1 MHz	1 kHz
1 MHz ÷ 50 MHz	10 kHz

Table 6-2: Conducted Emission Resolution Bandwidth

For each frequency range the video BW shall be three times the specified Resolution BW. The following criteria shall be taken into account to determine if emissions are to be considered broadband or narrowband:

- In peak analysis mode, switch the bandwidth from W1 to W2 (assuming that W2/W1 = 10). If there is a change in the spectrum analyzer indications which is:
  - lower than 10 dB → the signal shall be considered narrowband
  - greater than 10 dB → the signal shall be considered broadband

- Alternatively:
  - Set the spectrum analyzer sweep time to a calibrated value
  - Record the number of measured spectrum lines ("A" measurement)
  - Increase the sweep time by a factor of two
  - Record the number of measured spectrum lines ("B" measurement)
  - If the ratio (A/B) is about two the signal shall be considered broadband, otherwise the signal shall be considered narrowband.

The broadband signals are to be related to 1 MHz bandwidth using the relation:

- dBuV/m/MHz = dBuV/m + 10 Log(W2/1 MHz) for incoherent signals
- dBuV/m/MHz = dBuV/m + 20 Log(W2/1 MHz) for coherent signals

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6.7 10 μF CAPACITOR AND LISN

During EMC tests a 10μF capacitor or a LISN (Line Impedance Stabilization Network) shall be connected on the power line according to the following table:

TEST	10μF	LISN
EC-01: Load NB Current Emission		X
EC-02: RIPPLE VOLTAGE AND NOISE		X
EC-03: Load Transient		X
EC-04: PEAK and SURGE Current		X
SC-01: Sine Wave Injection On Input DC Power Supply	30Hz to 50kHz	50kHz to 50MHz
SC-02: Input Impedance		X
SC-03: Voltage Spike Transients Injection On DC Power Lines		X
SC-04: Normal Voltage Transient Injection On DC Power Lines		X
SC-05: Abnormal Voltage Transient		X

Table 6-3: LISN or 10uF Capacitor use during EMC Tests

The 10μF capacitor insertion loss, measured into a 50Ω circuit (as required by MIL STD 220A), is shown in Figure 6-15.

The LISN circuit's schematic adopted for EMC tests is shown in Figure 6-16; the LISN impedance is shown in Figure 6-17.

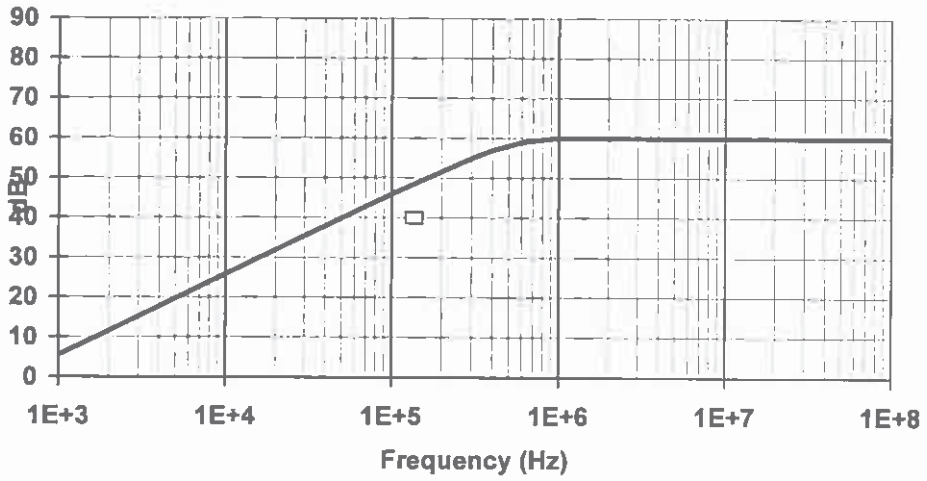

Figure 6-15: 10μF Capacitor Insertion Loss

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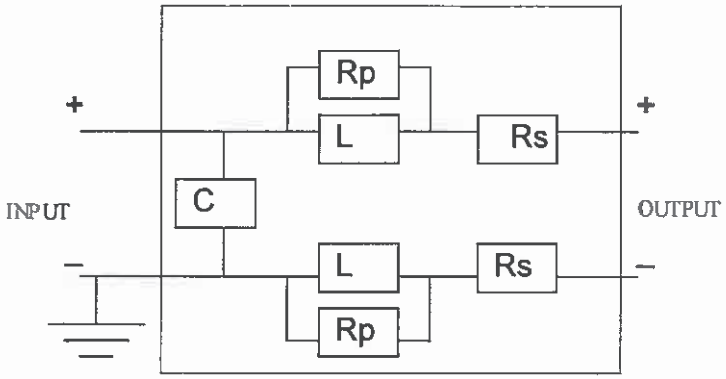

Electrical Component	Value for 120 Vdc
Rp	25Ω
Rs	0.05Ω
L	10μH
C	5000μF

Figure 6-16: LISN Electrical Schematic

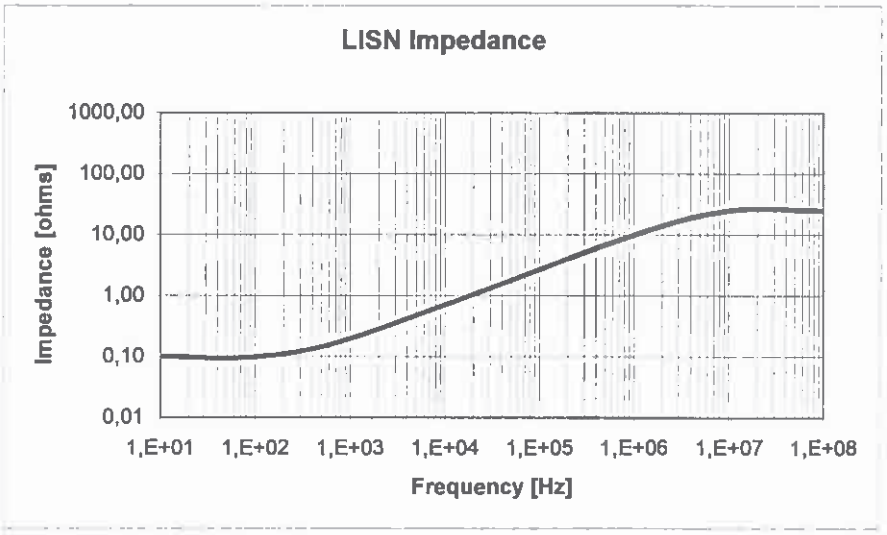

Figure 6-17: LISN Impedance

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6.8 CURRENT PROBE

Conducted interference current shall be measured by means of special developed clamp-on current transformers. The current probe transfer impedance, which is defined as the ratio of secondary voltage across a 50Ω load to the primary current, shall be furnished by the current probe manufacturer.
The current probe correction factors shall be added to the Spectrum Analyzer measurement (read in dBuV) to obtain the real emission in dBuA.

6.9 TEST HARNESS

During conducted emission and susceptibility tests the power cable shown in Figure 6-18 shall be inserted between the TE Power Distribution Unit (PDU) and the UUT Power Input Connector.

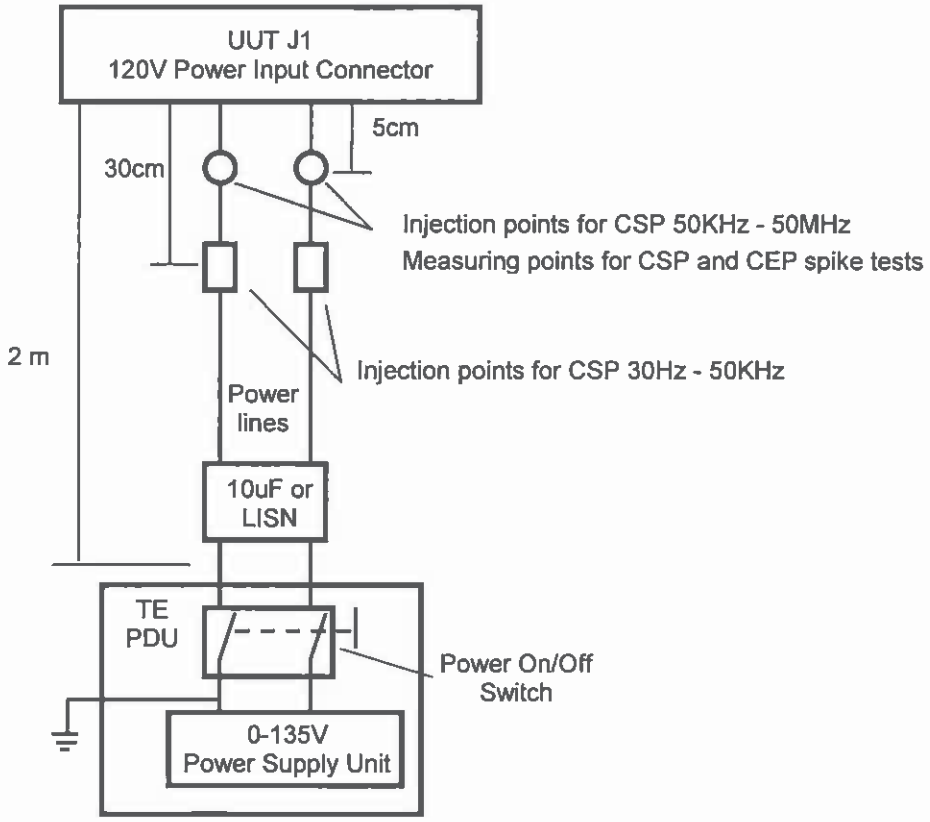

Figure 6-18: Power Cable For Conducted Emission and Susceptibility Tests

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6.10 TEST ANTENNAS

During RE and CE test, the antennas of following table will be used.

FREQUENCY RANGE	TEST	ANTENNA CHARACTERISTICS
14kHz–30MHz	RE02	Electrically short high impedance electric field probe, vertically polarized. Traditionally the 41 inch rod with active or passive matching to 50 ohms.
14kHz–30MHz	RS03	The parallel plate (and numerous modifications), long wire, and E–field generator are available and listed in order of preference. The E–field generator should be reserved for the case in which the EUT is too large for other methods.
30MHz–200MHz	RE02 RS03	Dipole–like antennas. Typical antenna used in this band has been the MIL–STD–461 biconical. Care should be taken in the antenna selection to ascertain that the balun does an adequate job of matching the low frequency high antenna impedance of 50 ohms.
200MHz–1GHz	RE02 RS03	The traditional logconical and the logperiodic are available. The double ridge horn should be avoided, since the gain increases drastically with frequency.
1GHz–10GHz	RE03	RE02 Broadband (ridged) or standard gain horns. Logconicals are also available
10GHz–	RE02 RS03	20–dB standard gain horns.

Table 6-4: Recommended test antenna characteristics

6.11 MEASUREMT ANTENNAS POSITION

6.11.1 LOCATION

When performing radiated emission and susceptibility tests, no points of the antennas shall be less than 30 cm from the floor and ceiling and 1 meter from the walls of the shielded enclosure or obstruction.

6.11.2 LINEARLY POLARIZED ANTENNAS

For radiated emission measurements above 30 MHZ, linearly polarized antennas shall be positioned to measure the vertical and horizontal components of the emission.
For radiated susceptibility measurements above 30 MHz, linearly polarized test antennas shall be positioned so as to generate vertical and horizontal field.

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6.12 TEST INSTRUMENT LIST

N.	EQUIPMENT	MANUFACTURER	P/N	S/N	ACCURACY (*)	NEXT CAL. DATE	REMARKS
1	Dual Display Multimeter	Fluke	45	7788030		24/05/2010	
2	Oscilloscope	Tektronix	TDS 224	B020220		24/05/2010	
3	Micrometer	HP	34420A	US36001975		24/05/2010	
4	Current Probe	LEM	PR430	P05190026431		24/05/2010	
5	Current Probe	LEM	PR30	PO1-08-66804		24/05/2010	
6	Pulse / Function Generator	Hewlewtt Packard	8116A	2901G09158		24/05/2010	
7	Network Analyzer	Solartron	SI 1260	134122		NA	
8	Power Operational Amplifier	Kepco	BOP50-8M	E125004		NA	
9	Voltage Supplier	EA-Elektro	EA-PS 7150-04A	2004161439		NA	
10	Spectrum Analyzer	Hewlewtt Packard	8568B	2517A0176		24/05/2010	
11	Spectrum Analyzer	Hewlewtt Packard	85662A	2534A10389		N.A.	
12	Magnetic Probe Clamp	Electromet	PCL-30	1260		24/05/2010	
13	Transient Generator	Solar Electronic	8282-1	933034		NA	
14	Audio Amplifier	Solar Electronic	6552-1A	027513		NA	
15	RF Amplifier	Amplifier Research	25A250A	310032		NA	
16	Audio Isolation Transformer	Solar Electronic	6220-1A	000		NA	
17	For radiated, conducted emission and ESD test performed at CEM LAB facility refer to Annex B for instrument list						

Table 6-5: Instruments List

(*) Where not specified the accuracy is as stated on the instrument manufacturer data sheet

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7. TEST CONDITIONS

- The UUT shall be tested in its defined configuration: it shall be properly closed, all electrical loads shall be present and the UUT interface function(s) shall be simulated.

- Unless otherwise specified, all measurements shall be performed at the following ambient conditions:

Temperature:	25°C +/- 3°C
Relative humidity:	between 30% and 60% RH
Pressure:	Ambient
Cleanliness:	100000 class

- All tests included in this document, unless otherwise specified, shall be performed in a proper test chamber in order to minimize measurement noise contribution that can false the verification of the requirements related to the running test procedure. General disposition shall be applied to maximize personnel safety from potential hazards

- Connectors savers shall be used on PFM as applicable to protect the UUT interface connectors.

- Skilled personnel shall be employed.

- All used instruments shall meet the necessary accuracy and shall not degrade the UUT performances.

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8. TEST PROCEDURE VARIATION SHEET

In case that for any reason the test procedure has to be changed, the change shall be described in a Procedure Variation Sheet (PVS) as shown in the next page.

The PVS shall contain:

- Reference to the test procedure to be changed
- Reference to the relevant test, procedure page and paragraph
- Description of the change, possibly in the form was....is.....
- Reason for change
- Test Engineer, QA, Test conductor signatures and dates
- Customer signature and date (when required).

Each PVS shall be identified by a reference number provided in sequential order.

All the generated PVS shall be collected in a dedicated section of the Test Report.

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PROCEDURE VARIATION SHEET ref. N°:

Test Procedure Ref.:	Page Revised:	Paragraph Revised:

Description of Change:

Reason for Change:

CONCURRENCE

Test Cond.	QA	System Eng.		Customer
Date	Date	Date		Date

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9. TEST DATA SHEETS

The step-by-step procedure sheets are provided in the following pages.

9.1 DATA SHEETS FILLING UP

The following fields of the data sheets:

- UUT Data (including Model, Item, C.I., S/N)
- Measured value

shall be filled up during the tests execution and shall be part of the Test Report together with photographs, sketches, etc. eventually useful to document the tests execution/results.

Remarks field shall be used as a minimum to provide, where appropriate, reference to NCRs and PVS.

Test Report reference data shall be added in the relevant field.

Each data sheet (including the attachments) shall be certified by QA stamp and signature together with the Test Conductor signature and date.

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10. PDS EMC PRECOMPLIANCE TEST PROCEDURE

10.1 BONDING

10.1.1 B.01: UNIT BONDING STRUCTURE VERIFICATION

B-01.1	Objective: verify that the DC resistance between any mechanical part of PDS (including connectors body) and bonding stud is lower than 2.5 mΩ per bonding junction: between wall 1 and bonding stud between wall 2 and bonding stud between wall 3 and bonding stud between wall 4 and bonding stud between wall 5 and bonding stud between wall 6 and bonding stud	 <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ	N.A.	Already performed during FFT (PDS-RP-CGS-072)
B-01.2	Between the walls of PDS box and bonding stud: 1 and 3 1 and 4 1 and 5 1 and 6 2 and 3 2 and 4 2 and 5 2 and 6 3 and 5 3 and 6 4 and 5	 <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ <2.5mΩ	N.A	

DATE: 7-10-09	TEST CONDUCTOR	QA	CUSTOMER

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	4 and 6	<2.5mΩ		

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

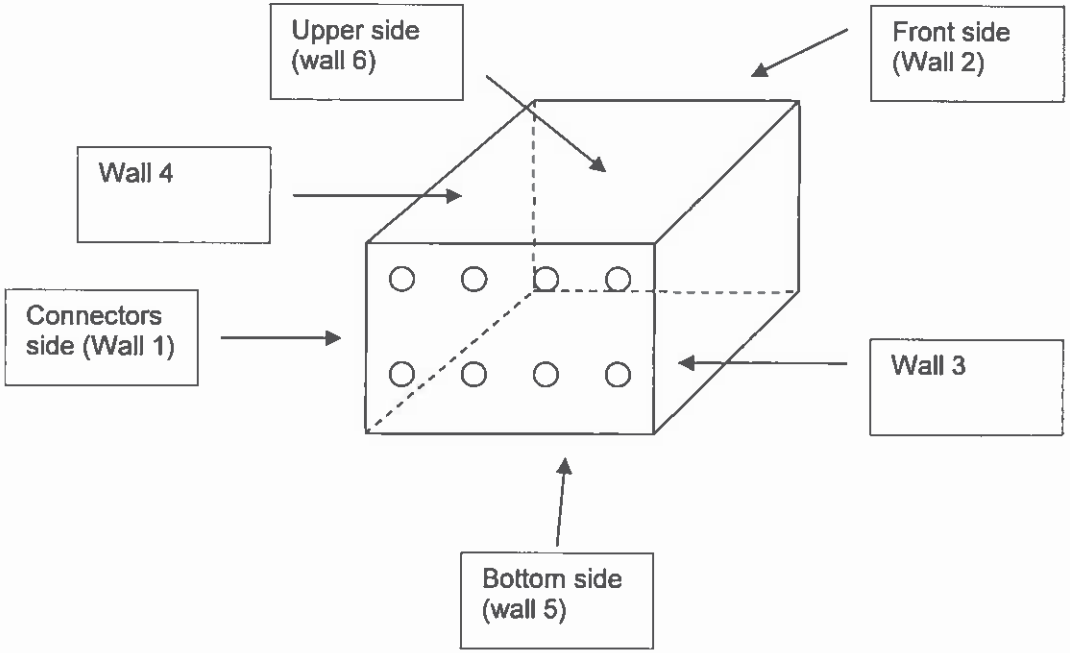

Figure 10-1: Test Site Bonding Verification Set-up

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

10.1.2 B.02: TEST SITE BONDING VERIFICATION

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
B-02.1	Objective of this test is to verify the bonding resistance between equipment chassis and EMC test table. The test is performed at closed box. See Figure 10-2			
B-02.2	Connect the UUT to the EMC table via EMC table grounding strip	OK	OK	
B-02.3	Use micro-ohmmeter to perform the measurement	OK	OK	
B-02.4	Connect the instrument between UUT bonding stud and the other couple to the EMC table	OK	OK	
B-02.5	Take note of the measurement	≤ 10 mΩ	1,40mOhm	See Annex_A Fig.1
B-02.6	Connect the instrument between the EMC table bonding stud screw-point and the chamber ground point	OK	OK	
B-02.7	Take note of the measurement	≤ 10 mΩ	1,67mOhm	See Annex_A Fig.2

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

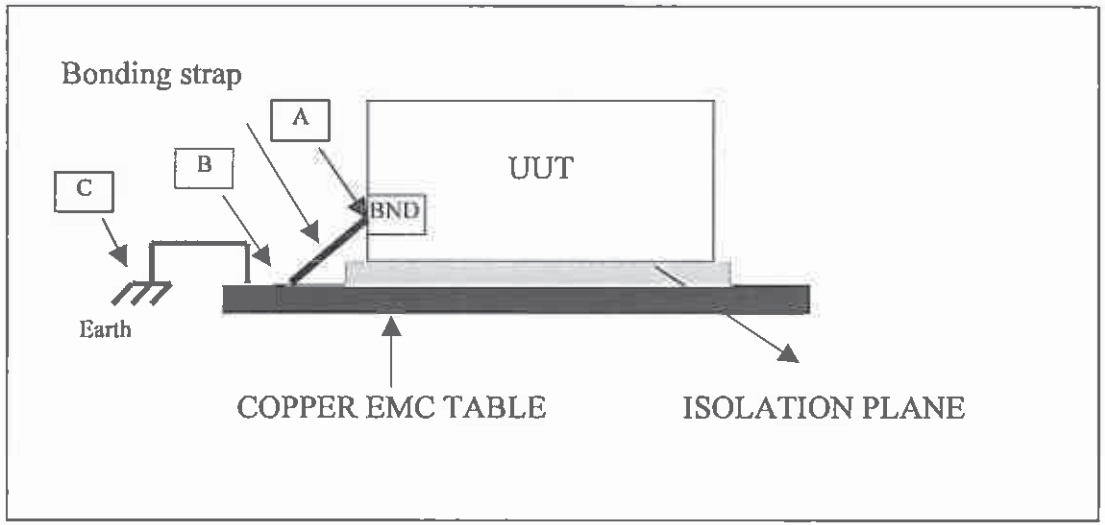

Figure 10-2: Test Site Bonding Verification Set-up

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.2 CONDUCTED EMISSIONS ON A SECTION

10.2.1 EC-01: LOAD NB CURRENT EMISSION

EC-01.1	**OBJECTIVE** To verify the current ripple appearing on the input power lines in the frequency domain. The test is performed at closed box.			
EC-01.2	**TEST SET-UP** Test set-up is shown in Figure 6-2			
EC-01.3	**TEST FEATURE** - measurement type: differential and common mode - frequency range: 30 Hz ÷ 50 MHz - emission type: narrowband - measurement line: UUT Input Power Lines The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive) - J100 (AI_120V_RTN (negative))			
EC-01.4	**EMISSION LIMITS** **30 hertz (Hz) to 15 kilohertz (kHz):** 30 Hz–200 Hz: 110 dB above 1 microampere 200 Hz–15 kHz: Decreasing log linearly with increasing frequency from 110 to 74 dB above 1 microampere For equipment drawing more than one amp, the limits, in decibels (dB) shall be raised by 20 x log I, where I equals the total dc current used by the			

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	equipment under test. **15 kHz to 50 megahertz (MHz):** 15 KHz–500 KHz: Decreasing log linearly with increasing frequency from 74 to 45 dB above 1 microampere 500 kHz–50 MHz: 45 dB above 1 microampere For equipment drawing more than one amp, the limits shall be raised by 20 x log I, where I equals the total dc current used by the equipment under test.			
EC-01.5	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
EC-01.6	Switch ON test equipment	OK	OK	
EC-01.7	Take ambient noise measurement on the operational input power bus lines. Take measurements on: **HOT** input power bus line **RETURN** input power bus line Both **HOT and RETURN** (common mode) input power bus lines	OK	OK	Annex plots in the end of document See Annex B (Attach. C)
EC-01.8	Verify that the emissions measurement are at least 6dB below the limits otherwise check for UUT TE emission	OK	OK	
EC-01.9	Connect main power supply cable J100 (AI_120V (positive) and AI_120V_RTN (negative)) to the "power switch box"	J100 connected	J100	
EC-01.10	Set Power supply to 120V	120,00V±1,00V	120V	V1
EC-01.11	Set output current limitation to 27,5A	27,5A±0,05V	27,5A	
EC-01.12	Enable power supply output	enabled	N.A.	Not used for this test
EC-01.13	Verify that green led of **"power switch box"** is lighted	Green led lighted	N.A.	Not used for this test
EC-01.14	Switch ON the **"power switch "**of **"power switch box"**	Switch ON	N.A.	Not used for this test

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-01.15	Verify that red led of **"power switch box"** is lighted	Red led lighted	N.A.	Not used for this test
EC-01.16	Load the PDS unit at the nominal load configuration (See Table 11.1)	OK	OK	
EC-01.17	Measure the UUT current consumption	17,8A ± 0.2A	18,0A	
EC-01.18	Perform measurement on **HOT** input power bus line	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.19	Perform measurement on **RETURN** input power bus line	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.20	Perform measurement on both **HOT and RETURN** (common mode) input power bus lines	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.21	Switch OFF the **"power switch "**of **"power switch box"**	OK	OK	
EC-01.22	OFF-LINE REQUIREMENT VERIFICATION Verify that the measurements are inside the limits	OK	OK	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

BOARD	OUT NAME	DEF STATUS	CONNECTOR	Current [A]	Nominal Current config [A]
ESEM3B 1				@120V	@120V
out1	ECAL	ON	J103	1,2	
out2	Ram Rad., Set#1	ON	J104	3,2	
out3	TRD+TRD Gas	ON	J103	1,2	
out4	Tracker Rad. -Wake	OFF	J103	1,2	
out5	Ram Rad., Set#2	OFF	J103	2,4	
out6	(E,R)HV+E-Crates	ON	J103	1,2	
out7	RICH+LTOF	OFF	J103	1,2	
out8	Wake Rad.+CAB	OFF	J104	1,2	
out9	Cryocoolers	OFF	J104	1,2	
out10	Tracker Rad.-Ram	OFF	J104	1,2	
out11	CAB LHPs	OFF	J104	1,2	
out12	CCEB	OFF	J102	3,8	3,8
ESEM3B 2				@120V	@120V
out1	ECAL	ON	J203	1,2	
out2	Ram Rad., Set#1	ON	J204	3,2	
out3	TRD+TRD Gas	ON	J203	1,2	
out4	Tracker Rad. -Wake	OFF	J203	1,2	
out5	Ram Rad., Set#2	OFF	J203	2,4	
out6	(E,R)HV+E-Crates	ON	J203	1,2	
out7	RICH+LTOF	OFF	J203	1,2	
out8	Wake Rad.+CAB	OFF	J204	1,2	

DATE: 7-15/09/09	TEST CONDUCTOR	QA	CUSTOMER

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
out9	Cryocoolers	OFF	J204		1,2		
out10	Tracker Rad.-Ram	OFF	J204		1,2		
out11	CAB LHPs	OFF	J204		1,2		
out12	CCEB	OFF	J202		3,8	3,8	
PB2+ESEM3A - 1					**@28V**	**@28V**	
28V.1.1	TPD3	OFF	J113		2,9	2,9	
28V.1.2	TPD7	OFF	J113		2,9	2,9	
28V.1.3	JPD_N	ON	J113		1,8	1,8	
28V.1.4	SPD1_N	OFF	J113		1,5	1,5	
28V.1.5	UGPD_N	OFF	J111		1,2	1,2	
28V.1.6	SPD0_R	OFF	J210		-	-	
28V.1.7	TPD1	OFF	J210		2,9	2,9	
28V.1.8	TTPD_R	OFF	J210		-	-	
PB2+ESEM3A - 2					**@28V**	**@28V**	
28V.2.1	ER1_N	OFF	J113		3.4	3.4	
28V.2.2	TPD2	OFF	J112		2,9	2,9	
28V.2.3	TPD6	OFF	J112		2,9	2,9	
28V.2.4	SPD3_N	OFF	J112		1,5	1,5	
28V.2.5	MPD_N	OFF	J112		1,8	1,8	
28V.2.6	UPD1	OFF	J112		1,6	1,6	
28V.2.7	SPD2_N	OFF	J111		1,5	1,5	
28V.2.8	CAB_R	OFF	J210		0,7	0,7	
PB2+ESEM3A - 3					**@28V**	**@28V**	
28V.3.1	TPD0	OFF	J111		2,9	2,9	
28V.3.2	TPD4	OFF	J111		2,9	2,9	
28V.3.3	ER0_N	OFF	J111		3.4	3.4	
28V.3.4	MPD_R	OFF	J212		-	-	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
28V.3.5	SPD3_R	OFF	J212		-	-	
28V.3.6	UGPD_R	OFF	J211		-	-	
28V.3.7	SPD2_R	OFF	J211		-	-	
28V.3.8	CAB_N	OFF	J110		2,6	2,6	
PB2+ESEM3A - 4					**@28V**	**@28V**	
28V.4.1	JPD_R	ON	J213		-	-	
28V.4.2	ER1_R	OFF	J213		-	-	
28V.4.3	SPD1_R	OFF	J213		-	-	
28V.4.4	ER0_R	OFF	J211		-	-	
28V.4.5	UPD0	OFF	J110		1,6	1,6	
28V.4.6	SPD0_N	OFF	J110		1,5	1,5	
28V.4.7	TPD5	OFF	J110		2,9	2,9	
28V.4.8	TTPD_N	OFF	J110		4,8	4,8	

Table 10-1: Nominal Load Table

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.2.2 EC-02: RIPPLE VOLTAGE AND NOISE

EC-02.1	OBJECTIVE To verify the voltage ripple generated by the UUT on the input power bus line is lower than limits. The test is performed at closed box			
EC-02.2	TEST SET-UP Test set-up is shown in Figure 6-4			
EC-02.3	**TEST FEATURE** - measurement type: differential mode - oscilloscope time base: 10mS, 1mS, 100uS, 10uS, 1uS, 100nS - oscilloscope trigger mode: normal - trigger level: close to the limit - bandwidth: 50 MHz - measurement line: UUT Input Power Lines (Worst Load Case) - applicable limit: 0.3Vpp * sqr (current A) The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
EC-02.4	TEST RUN Verify that UUT and Operational Bus are switched off	OK	OK	
EC-02.5	Connect main power supply cable J100 (AI_120V (positive) and AI_120V_RTN (negative))to the "power switch box"	J100 connected	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-02.6	Place the voltage probes in differential mode on positive and negative power leads of the input power bus lines	OK	OK	
EC-02.7	Switch ON test equipment	OK	OK	Main bus OFF
EC-02.8	Take and record the ambient noise measurement	OK	OK	Annex picture in the end of the document See Annex A Fig. 3, Fig.4
EC-02.9	Verify that the emission is at least 6dB below the limit	OK	OK	
EC-02.10	Set power supply at 113Vdc	113,00V±1,00V	113V	Worst case (maximum emissions)
EC-02.11	Set output current limitation to 27,5A	27,5A±0,05V	27,5A	
EC-02.12	Enable power supply output	enabled	OK	
EC-02.13	Verify that green led of "power switch box" is lighted	Green led ligthed	OK	
EC-02.14	Switch ON the "power switch "of "power switch box"	Switch ON	OK	
EC-02.15	Verify that red led of "power switch box" is lighted	Red led lighted	OK	
EC-02.16	Set PDS unit in nominal configuration described in Table 11.1	OK	OK	
EC-02.17	Measure the UUT current consumption	18,7A ± 0.2A	18,7A	
EC-02.18	Set the time base of the oscilloscope to 10mS	OK	OK	
EC-02.19	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.23V	Annex plot in the end of document See Annex A Fig. 5
EC-02.20	Set the time base of the oscilloscope to 1mS	OK	OK	
EC-02.21	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.2V	Annex plot in the end of document See Annex A Fig. 6
EC-02.22	Set the time base of the oscilloscope to 100uS	OK	OK	
EC-02.23	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.2V	Annex plot in the end of document See Annex A Fig. 7
EC-02.24	Set the time base of the oscilloscope to 10uS	OK	OK	
EC-02.25	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.21V	Annex plot in the end of document See Annex A Fig. 8

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-02.26	Set the time base of the oscilloscope to 1uS	OK	OK	
EC-02.27	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.2V	Annex plot in the end of document See Annex A Fig. 9
EC-02.28	Set the time base of the oscilloscope to ~~10uS~~ 100ns	OK	OK	See PVS_01
EC-02.29	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.13V	Annex plot in the end of document See Annex A Fig. 10
EC-02.30	Switch Off the "power switch "of "power switch box"			
EC-02.31	Switch off main bus			

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.2.3 EC-03: LOAD TRANSIENT

EC-03.1	**OBJECTIVE** To verify that no pulse is exceeding the limit during the global ON/OFF operation and representative outlets ON/OFF operations. The voltage transients are measured during the ON/OFF operations as defined in the following steps. The test is performed at closed box			
EC-03.2	**TEST SET-UP** Test set-up is shown in Figure 6-4 Important note: the power switch box must be connected between LISN and PDS unit			ESEM 3-B loads connected. External heaters not connected
EC-03.3	**TEST FEATURE** - measurement type: differential mode - bandwidth: 50 MHz - measurement line: UUT Input Power Lines - **applicable limit: see** Figure 10-3: Transients Emission Limit The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
EC-03.4	**TEST RUN**			
EC-03.5	Verify that TE is on (with Operational Bus off)	OK	OK	
EC-03.6	Set main bus to 120V	120V±1V	120V	
EC-03.7	Switch ON the "power switch "of "power switch box"	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-03.8	Set the unit in nominal configuration	OK	OK	17,8A input current absorption
EC-03.9	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.10	From remote switch off PB2-2			
EC-03.11	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 11
EC-03.12	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.13	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.14	From remote switch ON PB2-2	OK	OK	
EC-03.15	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 12
EC-03.16	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.17	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.18	From remote, ESEM 3-B window, switch off outlet 12	OK	OK	ESEM 3-B on transient measure
EC-03.19	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 13
EC-03.20	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.21	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.22	From remote, ESEM 3-B window, switch on outlet 12	OK	OK	ESEM 3-B off transient measure
EC-03.23	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 14
EC-03.24	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.25	Switch off the "power switch "of "power switch box"	OK	OK	Global switch off command test
EC-03.26	Switch off main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

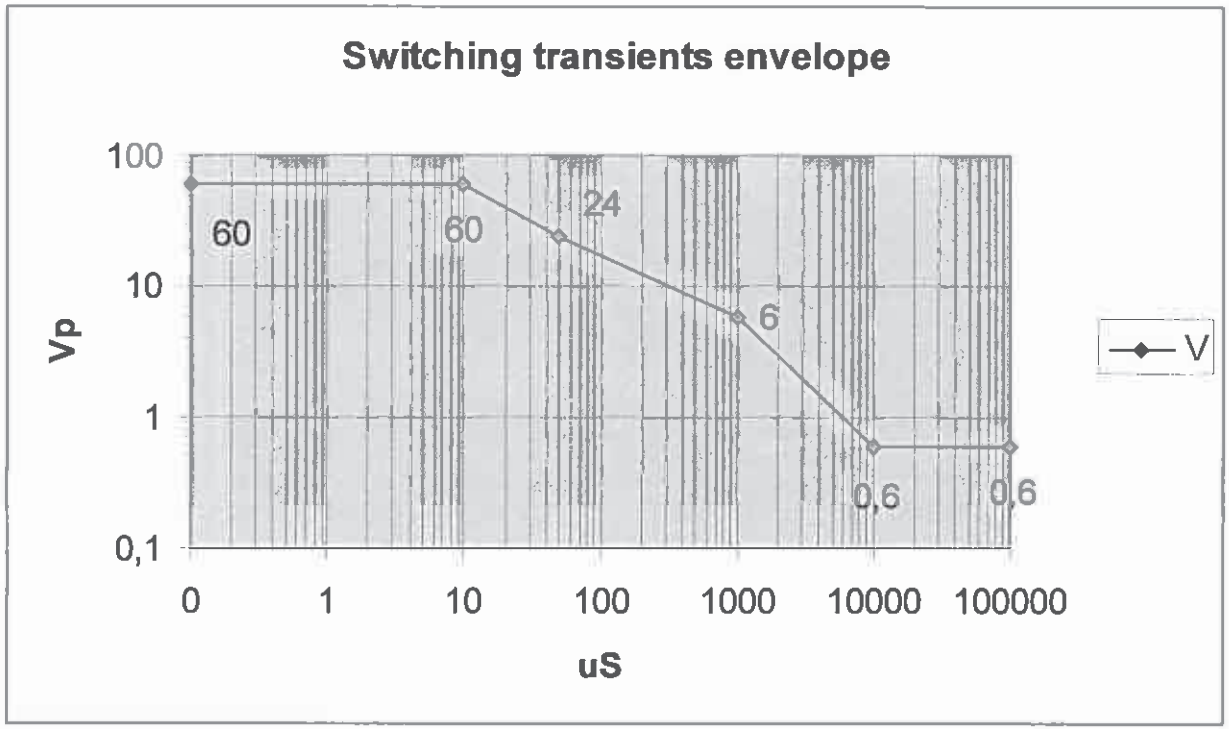

Figure 10-3: Transients Emission Limit

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.2.4 EC-04: PEAK AND SURGE CURRENT

EC-04.1	<u>OBJECTIVE</u> To verify that the inrush and surge current appearing on the input power lines in the time domain does not exceed the limits. The test is performed at closed box			
EC-04.2	<u>TEST SET-UP</u> Test set up is shown in Figure 6-3			ESEM 3-B loads connected External heaters not connected
EC-04.3	Set all the loads in nominal value			

EC-04.4	<u>**TEST FEATURE**</u>
	- measurement type: differential mode
	- bandwidth: 50 MHz
	- measurement line: UUT Input Power Lines
	- **applicable limits:**
	  ○ **Ipk** = 27.3 A for Vbus=126V and 28.5 A for Vbus=113V
	  ○ **dI/dt** = 163.5 A/ms A/ms for Vbus=126V and 157.5 A/ms for Vbus=113V
	The test shall be performed on the following UUT Input Power Bus Lines:
	<u>Operational BUS</u>
	- J100 (AI_120V (positive))
	- J100 (AI_120V_RTN (negative))			

EC-04.5	<u>**TEST RUN**</u> Verify that UUT and Operational Bus are switched off	OK	OK	
EC-04.6	Verify that TE is on (with Operational Bus off)	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-04.7	Connect main and return power bus lines to power supply through the LISN	OK	OK	
EC-04.8	Place the current probe on the positive power lead of the input power bus line	OK	OK	
EC-04.9	Set out JPD_N to 1.8A current absorption	1.8A±0.2A	1.8A	
EC-04.10	Set out JPD_R to 0A current absorption	0±0.2A	0	
EC-04.11	Set power supply at 113Vdc	113Vdc ± 1Vdc	113V	
EC-04.12	Set the oscilloscope in single mode acquisition	OK	OK	
EC-04.13	Switch ON the "power switch "of "power switch box"	Switch ON	Switch ON	
EC-04.14	Record the current transient	OK	OK	Annex measure in the end of document See Annex A Fig. 15
EC-04.15	Switch OFF the "power switch "of "power switch box"	OK	OK	
EC-04.16	Verify the measurements at 113Vdc:			
EC-04.17	- Ipk	< 28.5A	15,7A	
EC-04.18	- dI/dt	< 157.5 A/ms	5A/mS	
EC-04.19	Set power supply at 126Vdc	126Vdc ± 1Vdc	126V	
EC-04.20	Set the oscilloscope in single mode acquisition	OK	OK	
EC-04.21	Switch ON the "power switch "of "power switch box"	OK	OK	
EC-04.22	Record the current transient	OK	OK	Annex measure in the end of document See Annex A Fig. 16
EC-04.23	Switch OFF the "power switch "of "power switch box"	OK	OK	
EC-04.24	Verify the measurements at 126Vdc:			
EC-04.25	- Ipk	< 27.3A	19,4A	
EC-04.26	- dI/dt	< 163.5 A/ms	7A/ms	
EC-04.27	Switch-off the Operational Bus by operating on the power supply on/off switch	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.3 CONDUCTED EMISSIONS ON B SECTION

10.3.1 EC-01: LOAD NB CURRENT EMISSION

EC-01.23	**OBJECTIVE** To verify the current ripple appearing on the input power lines in the frequency domain. The test is performed at closed box.			
EC-01.24	**TEST SET-UP** Test set-up is shown in Figure 6-2			
EC-01.25	**TEST FEATURE** - measurement type: differential and common mode - frequency range: 30 Hz ÷ 50 MHz - emission type: narrowband - measurement line: UUT Input Power Lines The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J200 (BI_120V (positive) - J200 (BI_120V_RTN (negative))			
EC-01.26	**EMISSION LIMITS** **30 hertz (Hz) to 15 kilohertz (kHz):** 30 Hz–200 Hz: 110 dB above 1 microampere 200 Hz–15 kHz: Decreasing log linearly with increasing frequency from 110 to 74 dB above 1 microampere For equipment drawing more than one amp, the limits, in decibels (dB) shall be raised by 20 x log I, where I equals the total dc current used by the			

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	equipment under test. **15 kHz to 50 megahertz (MHz):** 15 KHz–500 KHz: Decreasing log linearly with increasing frequency from 74 to 45 dB above 1 microampere 500 kHz–50 MHz: 45 dB above 1 microampere For equipment drawing more than one amp, the limits shall be raised by 20 x log I, where I equals the total dc current used by the equipment under test.			
EC-01.27	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
EC-01.28	Switch ON test equipment		OK	
EC-01.29	Take ambient noise measurement on the operational input power bus lines. Take measurements on: **HOT** input power bus line **RETURN** input power bus line Both **HOT and RETURN** (common mode) input power bus lines	OK	OK	Annex plots in the end of document See Annex B (Attach. C)
EC-01.30	Verify that the emissions measurement are at least 6dB below the limits otherwise check for UUT TE emission	OK	OK	
EC-01.31	Connect main power supply cable J100 (BI_120V (positive) and BI_120V_RTN (negative)) to the "power switch box"	J100 connected	J100	
EC-01.32	Set Power supply to 120V	120,00V±1,00V	120V	V1
EC-01.33	Set output current limitation to 27,5A	27,5A±0,05V	27,5A	
EC-01.34	Enable power supply output	enabled	N.A.	Not used for this test
EC-01.35	Verify that green led of **"power switch box"** is lighted	Green led lighted	N.A.	Not used for this test
EC-01.36	Switch ON the **"power switch "**of **"power switch box"**	Switch ON	N.A.	Not used for this test

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-01.37	Verify that red led of **"power switch box"** is lighted	Red led lighted	N.A.	Not used for this test
EC-01.38	Load the PDS unit at the nominal load configuration (See Table 11.1)	OK	OK	
EC-01.39	Measure the UUT current consumption	17,8A ± 0.2A	18,0A	
EC-01.40	Perform measurement on **HOT** input power bus line	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.41	Perform measurement on **RETURN** input power bus line	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.42	Perform measurement on both **HOT and RETURN** (common mode) input power bus lines	OK	OK	Annex plot in the end of document See Annex B (Attach. C)
EC-01.43	Switch OFF the **"power switch "**of **"power switch box"**	OK	OK	
EC-01.44	**OFF-LINE REQUIREMENT VERIFICATION** Verify that the measurements are inside the limits	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.3.2 EC-02: RIPPLE VOLTAGE AND NOISE

EC-02.32	**OBJECTIVE** To verify the voltage ripple generated by the UUT on the input power bus line is lower than limits. The test is performed at closed box			
EC-02.33	**TEST SET-UP** Test set-up is shown in Figure 6-4			
EC-02.34	**TEST FEATURE** - measurement type: differential mode - oscilloscope time base: 10mS, 1mS, 100uS, 10uS, 1uS, 100nS - oscilloscope trigger mode: normal - trigger level: close to the limit - bandwidth: 50 MHz - measurement line: UUT Input Power Lines (Worst Load Case) - applicable limit: 0.3Vpp * sqr(current A) The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J200 (BI_120V (positive)) - J200 (BI_120V_RTN (negative))			
EC-02.35	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
EC-02.36	Connect main power supply cable J200 (BI_120V (positive) and BI_120V_RTN (negative))to the "power switch box"	J200 connected	J200	
EC-02.37	Place the voltage probes in differential mode on positive and negative power	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	leads of the input power bus lines			
EC-02.38	Switch ON test equipment	OK	OK	Main bus OFF
EC-02.39	Take and record the ambient noise measurement	OK	OK	Annex picture in the end of the document See Annex A Fig. 19, Fig.20
EC-02.40	Verify that the emission is at least 6dB below the limit	OK	OK	
EC-02.41	Set power supply at 113Vdc	113,00V±1,00V	113,00V	Worst case (maximum emissions)
EC-02.42	Set output current limitation to 27,5A	27,5A±0,05V	27,5A	
EC-02.43	Enable power supply output	enabled	enabled	
EC-02.44	Verify that green led of "power switch box" is lighted	Green led lighted	Green led lighted	
EC-02.45	Switch ON the "power switch "of "power switch box"	Switch ON	Switch ON	
EC-02.46	Verify that red led of "power switch box" is lighted	Red led lighted	Red led lighted	
EC-02.47	Set PDS unit in nominal configuration described in Table 11.1	OK	OK	
EC-02.48	Measure the UUT current consumption	18.7A ± 0.2A	18.7A	
EC-02.49	Set the time base of the oscilloscope to 10mS	OK	OK	
EC-02.50	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.4V	Annex plot in the end of document See Annex A Fig. 21
EC-02.51	Set the time base of the oscilloscope to 1mS	OK	OK	
EC-02.52	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.4V	Annex plot in the end of document See Annex A Fig. 22
EC-02.53	Set the time base of the oscilloscope to 100uS	OK	OK	
EC-02.54	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.44V	Annex plot in the end of document See Annex A Fig. 23
EC-02.55	Set the time base of the oscilloscope to 10uS	OK	OK	
EC-02.56	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.36	Annex plot in the end of document See Annex A Fig. 24
EC-02.57	Set the time base of the oscilloscope to 1uS	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-02.58	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.4V	Annex plot in the end of document See Annex A Fig. 25
EC-02.59	Set the time base of the oscilloscope to 10uS	OK	OK	
EC-02.60	Verify that noise is lower than 0.3Vpp * sqr (current without 120V lines)	0.3*sqr(15)= 1.16Vpp	OK 0.27V	Annex plot in the end of document See Annex A Fig. 26
EC-02.61	Switch Off the "power switch "of "power switch box"			
EC-02.62	Switch off main bus			

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.3.3 EC-03: LOAD TRANSIENT

EC-03.27	**OBJECTIVE** To verify that no pulse is exceeding the limit during the global ON/OFF operation and representative outlets ON/OFF operations. The voltage transients are measured during the ON/OFF operations as defined in the following steps. The test is performed at closed box			
EC-03.28	TEST SET-UP Test set-up is shown in Figure 6-4 Important note: the power switch box must be connected between LISN and PDS unit			ESEM 3-B loads connected. External heaters not connected
EC-03.29	**TEST FEATURE** - measurement type: differential mode - bandwidth: 50 MHz - measurement line: UUT Input Power Lines - **applicable limit: see** Figure 10-3: Transients Emission Limit The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
EC-03.30	**TEST RUN**			
EC-03.31	Verify that TE is on (with Operational Bus off)	OK	OK	
EC-03.32	Set main bus to 120V	120V±1V	120V	
EC-03.33	Switch ON the "power switch "of "power switch box"	OK	OK	
EC-03.34	Set the unit in nominal configuration	OK	OK	17,8A input current absorption

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-03.35	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.36	From remote switch off PB2-2			
EC-03.37	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 27
EC-03.38	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.39	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.40	From remote switch ON PB2-2	OK	OK	
EC-03.41	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 28
EC-03.42	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.43	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.44	From remote, ESEM 3-B window, switch off outlet 12	OK	OK	ESEM 3-B on transient measure
EC-03.45	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 29
EC-03.46	Verify that the voltage transition is within the limit shown in Figure 10-3	OK	OK	
EC-03.47	Set the oscilloscope in single mode acquisition	OK	OK	
EC-03.48	From remote, ESEM 3-B window, switch on outlet 12	OK	OK	ESEM 3-B off transient measure
EC-03.49	Record the voltage transient	OK	OK	Annex plot in the end of document See Annex A Fig. 30
EC-03.50	Verify that the voltage transition is within the limit shown in fig. Figure 10-3	OK	OK	
EC-03.51	Switch off the "power switch "of "power switch box"	OK	OK	Global switch off command test
EC-03.52	Switch off main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.3.4 EC-04: PEAK AND SURGE CURRENT

EC-04.28	**OBJECTIVE** To verify that the inrush and surge current appearing on the input power lines in the time domain does not exceed the limits. The test is performed at closed box			
EC-04.29	**TEST SET-UP** Test set up is shown in Figure 6-3			ESEM 3-B loads connected External heaters not connected
EC-04.30	Set all the loads in nominal value			

EC-04.31	**TEST FEATURE**
	- measurement type: differential mode
	- bandwidth: 50 MHz
	- measurement line: UUT Input Power Lines
	- **applicable limits:**
	  o **Ipk** = 27.3 A for Vbus=126V and 28.5 A for Vbus=113V
	  o **dI/dt** = 163.5 A/ms A/ms for Vbus=126V and 157.5 A/ms for Vbus=113V
	The test shall be performed on the following UUT Input Power Bus Lines:
	Operational BUS
	- J200 (BI_120V (positive))
	- J200 (BI_120V_RTN (negative))			

EC-04.32	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
EC-04.33	Verify that TE is on (with Operational Bus off)	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
EC-04.34	Connect main and return power bus lines to power supply through the LISN	OK	OK	
EC-04.35	Place the current probe on the positive power lead of the input power bus line	OK	OK	
EC-04.36	Set out JPD_N to 1.8A current absorption	1.8A±0.2A	1.8A	
EC-04.37	Set out JPD_R to 0A current absorption	0±0.2A	0A	
EC-04.38	Set power supply at 113Vdc	113Vdc ± 1Vdc	113Vdc	
EC-04.39	Set the oscilloscope in single mode acquisition	OK	OK	
EC-04.40	Switch ON the **"power switch "**of **"power switch box"**	Switch ON	Switch ON	
EC-04.41	Record the current transient	OK	OK	Annex measure in the end of document See Annex A Fig. 31, Fig.32
EC-04.42	Switch OFF the **"power switch "**of **"power switch box"**	OK	OK	
EC-04.43	Verify the measurements at 113Vdc:			
EC-04.44	- Ipk	< 28.5A	16A	
EC-04.45	- dI/dt	< 157.5 A/ms	5A/ms	
EC-04.46	Set power supply at 126Vdc	126Vdc ± 1Vdc	126Vdc	
EC-04.47	Set the oscilloscope in single mode acquisition	OK	OK	
EC-04.48	Switch ON the **"power switch "**of **"power switch box"**	OK	OK	
EC-04.49	Record the current transient	OK	OK	Annex measure in the end of document See Annex A Fig. 33, Fig.34
EC-04.50	Switch OFF the **"power switch "**of **"power switch box"**	OK	OK	
EC-04.51	Verify the measurements at 126Vdc:			
EC-04.52	- Ipk	< 27.3A	19.6A	
EC-04.53	- dI/dt	< 163.5 A/ms	7A/ms	
EC-04.54	Switch-off the Operational Bus by operating on the power supply on/off switch	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4 SECTION "A" CONDUCTED SUSCEPTIBILITY

10.4.1 SC-01: SINE WAVE INJECTION ON INPUT DC POWER SUPPLY

SC-01.1	**OBJECTIVE** To verify the UUT immunity from sine wave differential mode noise injected on input power bus lines. The test is performed at closed box			
SC-01.2	**TEST SET-UPS** Test set-ups are shown in: -Figure 6-5 for frequency range 30Hz ÷50kHz Figure 6-6 for frequency range 50kHz ÷50MHz			Heaters not connected Set loads in nominal configuration

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

SC-01.3	**TEST FEATURE**
	Signal Characteristics:
	- frequency range: see Figure 10-4
	- voltage amplitude: see Figure 10-4
	- injection method:
	  - series/transformer for 30Hz ÷50kHz range
	  - parallel/capacitor (Xc lower than 5Ω over freq. range) for 50kHz ÷50MHz
	- sweep mode: sweep
	
	The test shall be performed on the following UUT Input Power Bus Lines:
	Operational BUS
	- J100 connector hot (+) power bus line
	- J100 connector return (-) power bus line			

SC-01.4	**SUSCEPTIBILITY CRITERIA** The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification From 30Hz up to 50KHz the requirement is also met when the audio power source adjusted to dissipate 50 Watts in a 0.5 ohm load, cannot develop the required voltage at the EUT power input terminals, and the EUT is not susceptible to the output of the signal source. From 50KHz up to 50MHz the requirement is also met under the following condition: A 1 Watt source of 50 ohms impedance cannot develop the required voltage at the EUT power input terminals, and the EUT is not susceptible to the output of the signal source.			
SC-01.5	**TEST RUN with transformer coupling (30Hz÷50kHz)** Verify that UUT and Operational Bus are switched off	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-01.6	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-01.7	Connect the UUT as shown in Figure 6-5	OK	OK	
SC-01.8	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-01.9	Set power supply at 120Vdc	120V±1V	120V	
SC-01.10	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-01.11	By remote command the unit in nominal configuration	OK	OK	
SC-01.12	Take note of current absorption from main bus	16,00A<Iin<20,00A	17,8A	
SC-01.13	Verify by remote that the status of all the boards of the section is OK	OK	OK	
SC-01.14	Start with frequency injection sweep	OK	OK	
SC-01.15	During the test verify the following UUT parameters:		OK	
SC-01.16	using CAN BUS 30 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 30 Digital status check
SC-01.17	using CAN BUS 31 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 31 Digital status check
SC-01.18	monitor with the oscilloscope the input current and voltage and the representative secondary output voltage of the following 28V outlets: ER1_N		OK	Annex pictures in the end of document See Annex A Fig.35 to Fig,54
SC-01.19	Monitor with oscilloscope the following 120V outlet: CCEB 120V		OK	Annex pictures in the end of document See Annex A Fig.35 to Fig,54
SC-01.20	By remote, using CAN BUS 30 switch OFF ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 30 Digital command check
SC-01.21	By remote, using CAN BUS 31 switch ON ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 31 Digital command check
SC-01.22	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-01.23	Switch off power supply	OK	OK	
SC-01.24	**TEST RUN with capacitor coupling (50kHz÷50MHz)**	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	Verify that UUT and Operational Bus are switched off			
SC-01.25	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-01.26	Connect the UUT as shown in Figure 6-6	OK	OK	
SC-01.27	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-01.28	Set power supply at 120Vdc	OK	OK	
SC-01.29	Switch ON the **"power switch "of "power switch box"**	120Vdc ± 1Vdc	120V	
SC-01.30	By remote command the unit in nominal configuration			
SC-01.31	Take note of current absorption from main bus	16,00A<Iin<20,00A	17,7A	
SC-01.32	Verify by remote that the status of all the boards of the section is	OK	OK	
SC-01.33	Start with frequency injection sweep	OK	OK	
SC-01.34	During the test verify the following UUT parameters:			
SC-01.35	using CAN BUS 30 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 30 Digital status check
SC-01.36	using CAN BUS 31 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 31 Digital status check
SC-01.37	Monitor with the oscilloscope the input current and voltage and the representative secondary output voltage of the following 28V outlets: TPD3		OK	Annex pictures in the end of document See Annex A Fig.54 to Fig,72
SC-01.38	Monitor with oscilloscope the following 120V outlet: CCEB 120V		OK	Annex pictures in the end of document See Annex A Fig.54 to Fig,72
SC-01.39	By remote, using CAN BUS 30 switch OFF ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 30 Digital command check
SC-01.40	By remote, using CAN BUS 31 switch ON ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 31 Digital command check
SC-01.41	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-01.42	Switch off power supply	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

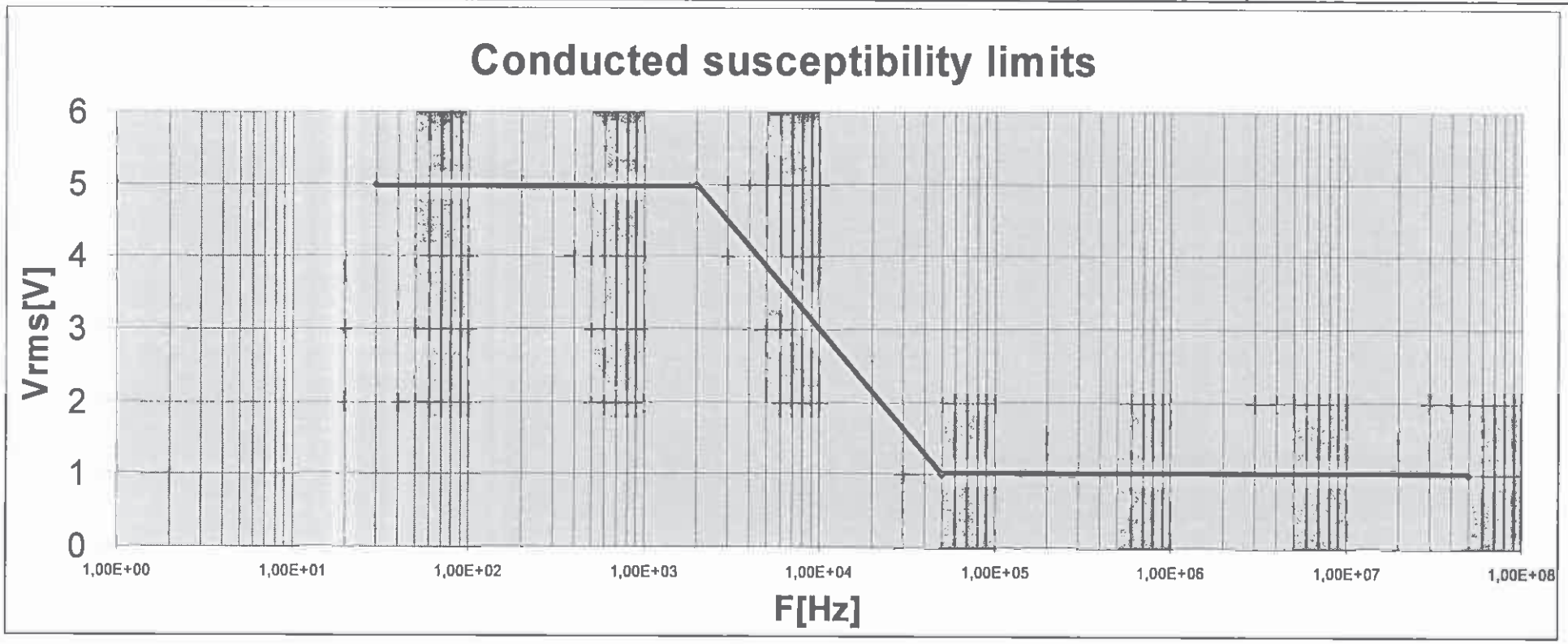

Figure 10-4: Sine Wave Injection Mask

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4.2 SC-02: INPUT IMPEDANCE

SC-02.1	**OBJECTIVE** To measure the UUT input impedance on 120V Operational feeder. The test is performed at closed box			
SC-02.2	**TEST SET-UP** Test set-up is shown in Figure 6-5 for all the frequency range (50Hz ÷ 100kHz)			
SC-02.3	**TEST FEATURE** The test shall be performed with the same set-up and procedure as per paragraph 10.4.1 , but with the following differences: - the amplitude of the input signal is reduced to have a small signal result. - the frequency range is reduced to 50Hz ÷ 100kHz The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
SC-02.4	**IMPEDANCE LIMIT** The load impedance presented by AMS02-PDS unit shall be measured and shall not exceed the limits defined in Figure 10-5 and Figure 10-6.			
SC-02.5	**TEST RUN with transformer coupling (50Hz ÷100kHz)** Verify that UUT and main Bus are switched off	OK	OK	
SC-02.6	Verify that TE is on (with main Bus off)	OK	OK	
SC-02.7	Connect the UUT as shown in Figure 6-5	OK	OK	
SC-02.8	Connect main and return power bus lines to power supply	OK	OK	
SC-02.9	Set power supply to 113Vdc	113V±1V	113V	
SC-02.10	Switch ON the "power switch "of "power switch box"	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-02.11	By remote set the unit in nominal configuration	OK	OK	Use CAN BUS 30
SC-02.12	Take note of input current from main bus	16,00A<Iin<20,00A	18,6A	
SC-02.13	Start with frequency injection sweep	OK	OK	
SC-02.14	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.15	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.73 and Fig,74
SC-02.16	Set power supply to 120Vdc	120V±1V	120V	Unit still ON in nominal configuration
SC-02.17	Take note of input current from main bus	16,00A<Iin<20,00A	17,6A	
SC-02.18	Start with frequency injection sweep	OK	OK	
SC-02.19	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.20	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.75 and Fig,76
SC-02.21	Set power supply to 120Vdc	126V±1V	126V	Unit still ON in nominal configuration
SC-02.22	Take note of input current from main bus	16,00A<Iin<20,00A	16,9A	
SC-02.23	Start with frequency injection sweep	OK	OK	
SC-02.24	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.25	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.77 and Fig,78
SC-02.26	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-02.27	Switch off main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

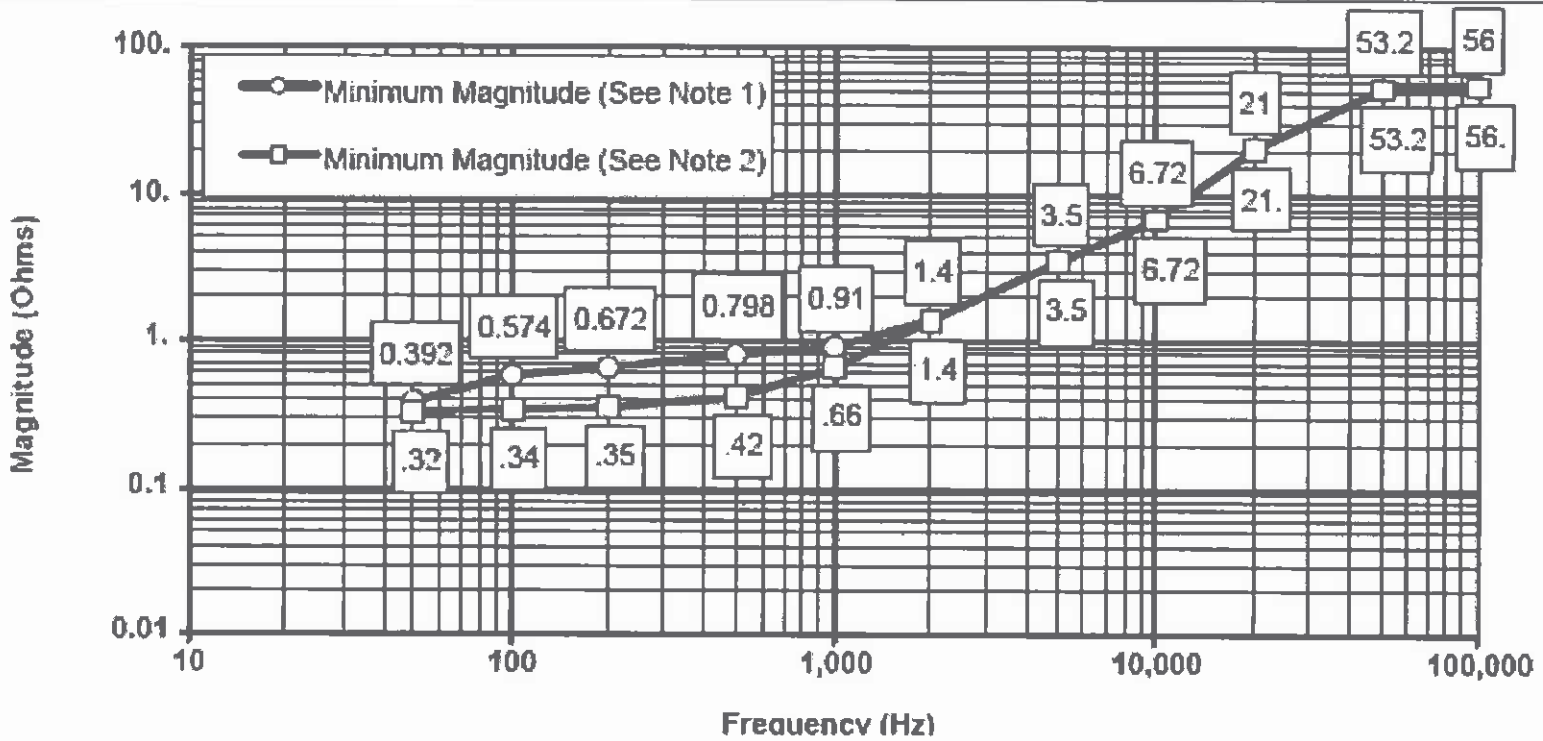

Figure 10-5: Load Impedance Magnitude Limits
(Note 1 and Note 2 are in next picture)

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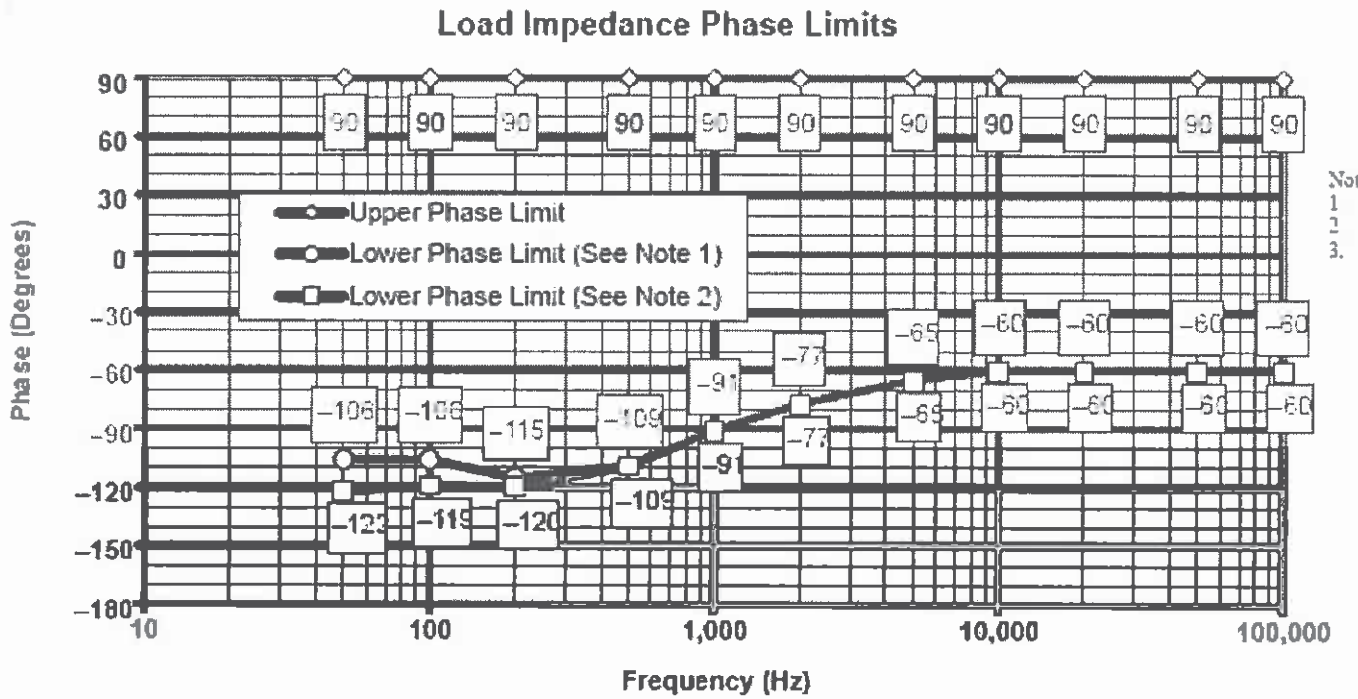
STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS



Notes:
1. Limit when steady state EPCE loading is less than 800 watts (see note 3).
2. Limit when steady state EPCE loading is at least 800 watts (see note 3).
3. 800 watts if from two DDCUs operating in parallel, or 400 watts from a single DDCU.

Figure 10-6: Load Impedance Phase Limits

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4.3 SC-03: VOLTAGE SPIKE TRANSIENTS INJECTION ON DC POWER LINES

SC-03.1	**OBJECTIVE** To verify the UUT immunity from differential mode voltage spike transients injected on input power bus lines. The test is performed at closed box			
SC-03.2	**TEST SET-UP** Test set-up is shown in Figure 6-7: - the current probe shall be positioned as close as possible to UUT input power bus connector (J100) - the voltage probe shall be connected directly on UUT input power bus connector (J100)			

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.3	**TEST FEATURE** Signal Characteristics: - transient shape: see Figure 10-7 - voltage amplitude: ± 120V over power bus voltage (120V) Note: The voltage amplitude generated by the transient generator shall be calibrated on a 5Ω resistance. Then the voltage transient shape shall be applied to the UUT with the same transient generator settings, regardless the actual voltage amplitude applied to the UUT if it is less than 120V. If the actual voltage amplitude applied to the UUT rises over 120V, it shall be limited to 120V by changing the transient generator settings. - duration: 10us and 0.15us - max pulse repetition rate: 10Hz - the spike will be applied for a period not less than 2 minutes in duration - injection method: parallel The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
SC-03.4	**SUSCEPTIBILITY CRITERIA** The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification			
SC-03.5	**TEST RUN: 120V + 120V for 0.15us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.6	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.7	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig.79
SC-03.8	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.9	Connect main and return power bus lines to power supply through the LISN	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.10	Set power supply at 120Vdc	OK	OK	
SC-03.11	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.12	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.13	Take note of input current	16,00A<Iin<20,00A	17,6 A	
SC-03.14	Apply the voltage transient shape	OK	OK	
SC-03.15	During the test verify the following UUT parameters:	OK	OK	
SC-03.16	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.17	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.18	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.80
SC-03.19	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.20	Verify that command is correctly executed	OK	OK	
SC-03.21	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.22	Verify that command is correctly executed	OK	OK	
SC-03.23	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.24	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.25	Switch OFF main bus	OK	OK	
SC-03.26	**TEST RUN: 120V + 120V for 10us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.27	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.28	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig.81
SC-03.29	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.30	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.31	Set power supply at 120Vdc	OK	OK	
SC-03.32	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.33	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.34	Take note of input current	16,00A<Iin<20,00A	17,6 A	
SC-03.35	Apply the voltage transient shape	OK	OK	
SC-03.36	During the test verify the following UUT parameters:	OK	OK	
SC-03.37	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.38	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.39	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.82
SC-03.40	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.41	Verify that command is correctly executed	OK	OK	
SC-03.42	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.43	Verify that command is correctly executed	OK	OK	
SC-03.44	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.45	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.46	Switch OFF main bus	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.47	**TEST RUN: 120V - 120V for 0.15us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.48	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.49	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig.83
SC-03.50	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.51	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.52	Set power supply at 120Vdc	OK	OK	
SC-03.53	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.54	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.55	Take note of input current	16,00A<Iin<20,00A	17,8 A	
SC-03.56	Apply the voltage transient shape	OK	OK	
SC-03.57	During the test verify the following UUT parameters:	OK	OK	
SC-03.58	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.59	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.60	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.84
SC-03.61	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.62	Verify that command is correctly executed	OK	OK	
SC-03.63	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.64	Verify that command is correctly executed	OK	OK	
SC-03.65	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
				two minutes
SC-03.66	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.67	Switch OFF main bus	OK	OK	
SC-03.68	**TEST RUN: 120V - 120V for 10us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.69	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.70	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-03.71	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.72	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.73	Set power supply at 120Vdc	OK	OK	
SC-03.74	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.75	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.76	Take note of input current	16,00A<Iin<20,00A	17,8 A	
SC-03.77	Apply the voltage transient shape	OK	OK	
SC-03.78	During the test verify the following UUT parameters:	OK	OK	
SC-03.79	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.80	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.81	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.86
SC-03.82	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.83	Verify that command is correctly executed	OK	OK	
SC-03.84	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
				during spike transients
SC-03.85	Verify that command is correctly executed	OK	OK	
SC-03.86	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.87	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.88	Switch OFF main bus	OK	OK	
SC-03.89	Switch OFF main bus	OK	OK	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

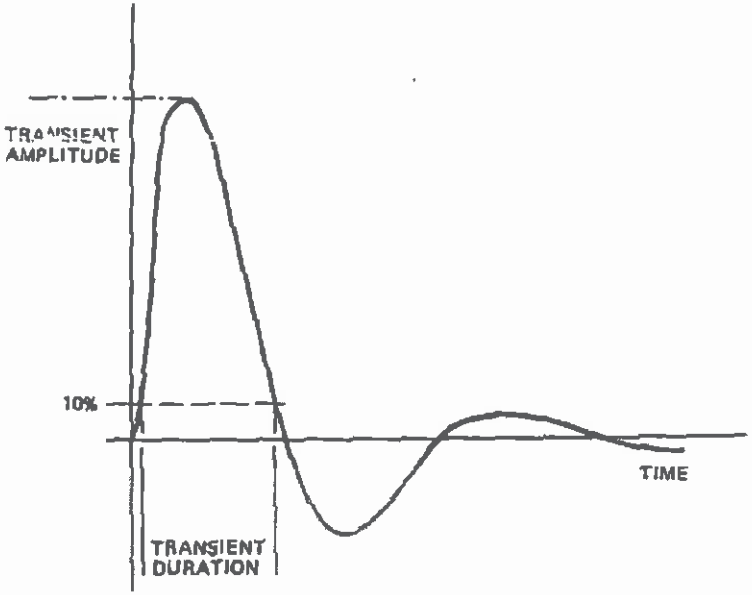

Figure 10-7: Transient Injection Mask

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4.4 SC-04: NORMAL VOLTAGE TRANSIENT INJECTION ON DC POWER LINES

SC-04.1	OBJECTIVE To verify the UUT immunity from normal input bus transients The test is performed at closed box			
SC-04.2	**TEST SET-UP** Test set-up is shown in Figure 6-8 - the current probe shall be positioned as close as possible to UUT input power bus connector (J100) - the voltage probe shall be connected directly on UUT input power bus connector (J100)			
SC-04.3	**TEST FEATURE** *Signal Characteristics:* - transient shape: see Figure 10-8 - voltage amplitude: see Figure 10-8 - injection method: series The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			
SC-04.4	SUSCEPTIBILITY CRITERIA The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification			
SC-04.5	TEST RUN (Positive Shape) Verify that UUT and Operational Bus are switched off	OK	OK	
SC-04.6	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-04.7	Connect the UUT as shown in Figure 6-8	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-04.8	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-04.9	Set power supply at 126Vdc	126Vdc ± 1Vdc	126V	
SC-04.10	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-04.11	By remote set the unit in nominal configuration	OK	OK	
SC-04.12	Take note of input current	16,00A<Iin<20,00A	16,9 A	
SC-04.13	Apply the positive voltage shape to the UUT	OK	OK	
SC-04.14	During voltage shape applying, acquire with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.87
SC-04.15	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.16	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.17	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SC-04.18	Verify that command is correctly executed	OK	OK	
SC-04.19	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-04.20	Verify that command is correctly executed	OK	OK	
SC-04.21	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-04.22	Switch OFF main bus	OK	OK	
SC-04.23	Prepare the instrumentation for negative voltage shape	OK	OK	
SC-04.24	Switch ON main bus	OK	OK	
SC-04.25	Set main bus to 112.5V	112.5V ± 1V	112,5V	
SC-04.26	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-04.27	By remote set the unit in nominal configuration	OK	OK	
SC-04.28	Take note of input current	16,00A<Iin<20,00A	18,7 A	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-04.29	Apply the negative voltage shape to the UUT	OK	OK	
SC-04.30	During voltage shape applying, acquire with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.88
SC-04.31	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.32	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.33	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SC-04.34	Verify that command is correctly executed	OK	OK	
SC-04.35	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-04.36	Verify that command is correctly executed	OK	OK	
SC-04.37	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-04.38	Switch OFF main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

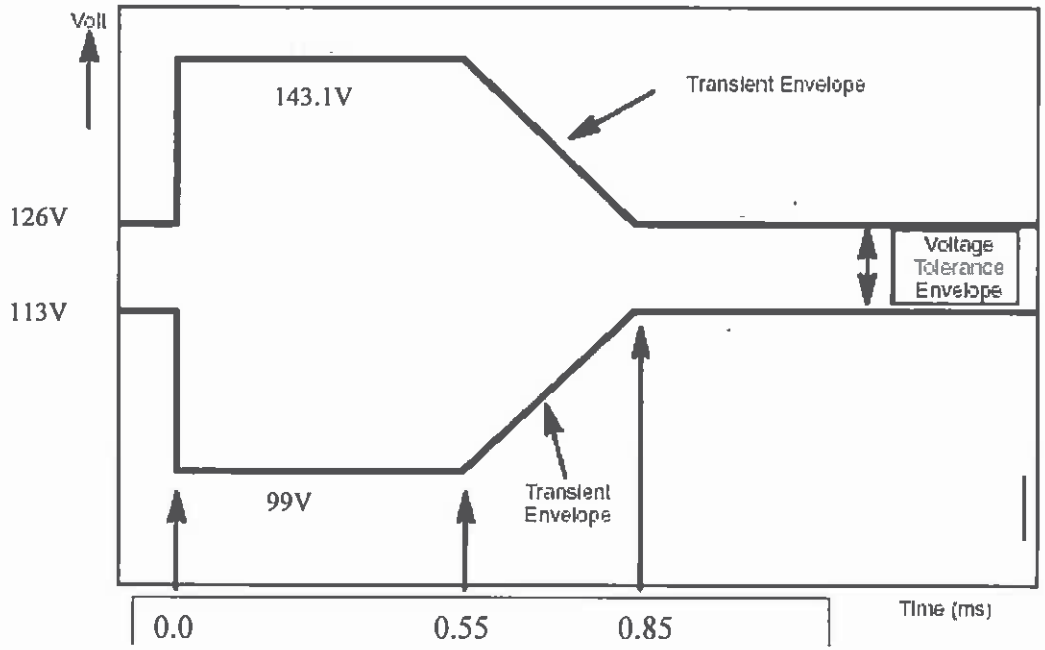

Figure 10-8: Normal Transient Mask

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4.5 SC-05: ABNORMAL VOLTAGE TRANSIENT

SC-05.1	OBJECTIVE To verify the UUT immunity from input bus abnormal voltage transient The test is performed at closed box			
SC-05.2	**TEST SET-UP** Test set up is shown in Figure 6-8 - the current probe shall be positioned as close as possible to UUT input power bus connector - the voltage probe shall be connected directly on UUT input power bus connector			
SC-05.3	**TEST FEATURE** *Signal Characteristics:* - transient shape and voltage: see Figure 10-9 - injection method: series **Note:** since the transient generator available at the test facility is not able to generate the complete transient shape shown in Fig.10-10, *the test shall be performed splitting the transient in different parts, which will be annexed in the end of the document. The final envelope given by the different parts shall ensure to cover the limit mask.* The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 connector, positive power bus line AI_120V - J100 connector, negative power bus line AI_120V_RTN			The required shape can not be reproduced with one laboratory instrument. This shape is in fact the result of the protection intervention at the RPCM (space station power distribution device) that is not available. For this reason the shape is divided in two shape: **Shape 1:** positive peak 240V 12usec **Shape 2:** negative peak 0V 60msec Test has been performed with NASA devices on the EM with successful result.

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-05.4	**SUSCEPTIBILITY CRITERIA** No permanent degradation and no failure propagation across the UUT interfaces shall result. The downward shape causes the UUT switching-off because of the input under voltage protection intervention: in this case at the following switching-on the UUT must not show any performance degradation. The same will happen for the positive peak, when voltage protection set to 150V ± 2V switches off the unit . After switch ON the UUT must not show any performance degradation.			See Annex A Fig.89 for calibration spike
SC-05.5	**TEST RUN (Downward Shape – first part of the transient shape)** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-05.6	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-05.7	Connect the UUT as shown in Figure 6-8	OK	OK	
SC-05.8	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-05.9	By remote set the unit in nominal configuration	OK	OK	
SC-05.10	Take note of input current	16,00A<Iin<20,00A	17,1 A	Main bus set to 126V
SC-05.11	Apply the positive voltage spikes described in Figure 10-9	OK	OK	Every spike must be applied with unit ON. Every spike generated on input bus will be monitored and annexed In the end of the document. See Annex A Fig.90
SC-05.12	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SC-05.13	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SC-05.14	Using CAN BUS 31 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.15	Verify that command is correctly executed	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-05.16	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.17	Verify that command is correctly executed	OK	OK	
SC-05.18	Set the main bus to 113V and take note of input current	OK	18,6 A	
SC-05.19	Apply the negative voltage spikes described in Figure 10-9	OK	OK	Every spike must be applied with unit ON. Every spike generated on input bus will be monitored and annexed In the end of the document. See Annex A Fig.91 As expected the unit switched OFF and restart in the default configuration. Communication is guaranteed after switch ON and nominal config has been restored.
SC-05.20	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SC-05.21	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SC-05.22	Using CAN BUS 31 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.23	Verify that command is correctly executed	OK	OK	
SC-05.24	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.25	Verify that command is correctly executed			
SC-05.26	Switch off the unit			

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UUT DATA :	Model	PFM	Item	AMS02 Power Distribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

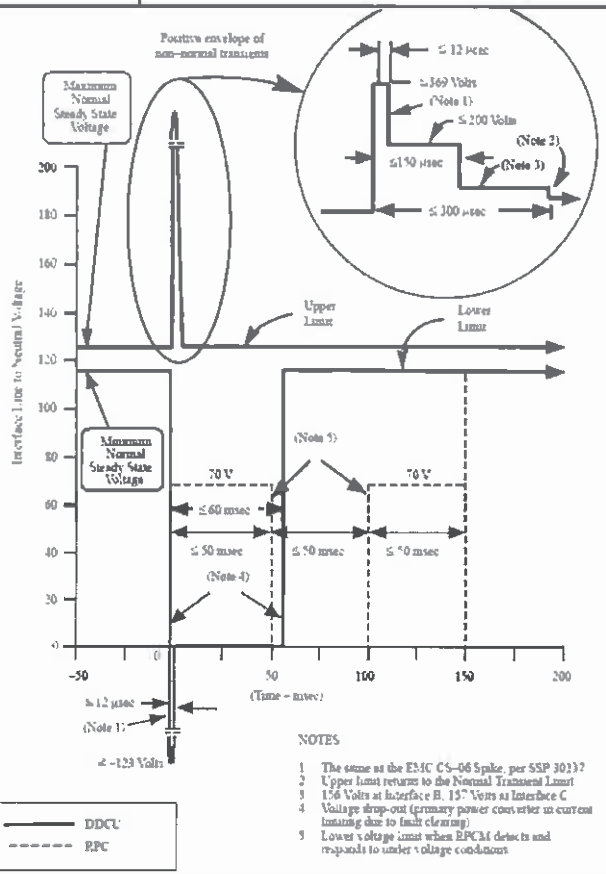

Figure 10-9: Abnormal Voltage Transient Mask

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.4.6 LARGE SIGNAL STABILITY

LSS-0.1	OBJECTIVE To verify the UUT capability of maintaining stability with the APM interface by damping a transient response to 10% of the maximum response amplitude within 1 ms, and remaining below 10% thereafter under the following conditions: - The rise time / fall time (between 10% and 90% of the amplitude) of the input voltage pulse is less than 10 us - The voltage pulse is varied from 100 us to 150 us in duration The test shall be performed at closed box			
LSS-0.2	**TEST SET-UP** Test set-up is shown in Figure 6-8; the voltage probe shall be connected directly on UUT input power bus connector			
LSS-0.3	**TEST FEATURE** *Signal Characteristics:* - Transient shape: see Figure 10-10 - Voltage amplitude: see Figure 10-10 - injection method: series The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
LSS-0.4	**SUSCEPTIBILITY CRITERIA** The integrated external payload shall maintain stability with the APM interface by damping a transient response to 10% of the maximum response amplitude within 1 ms, and remaining below 10% thereafter under the following conditions: - The rise time / fall time (between 10% and 90% of the amplitude) of the input voltage pulse is less than 10 us - The voltage pulse is to be varied from 100 us to 150 us in duration The above requirements are clarified by Figure 10-10 No permanent degradation and no failure propagation across the UUT interfaces shall result			
LSS-0.5	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
LSS-0.6	Verify that TE is on (with Operational Bus off)	OK	OK	
LSS-0.7	Connect the UUT as shown in Figure 6-8	OK	OK	
LSS-0.8	Connect the oscilloscope to 28V outlets: TPD3 And to CCEB (120v outlet)	OK	OK	
LSS-0.9	Connect main and return power bus lines to power supply through the LISN	OK	OK	
LSS-0.10	Set power supply at 120Vdc	OK	OK	
LSS-0.11	Switch ON the "power switch "of "power switch box"	OK	OK	
LSS-0.12	Set the unit in nominal configuration	OK	OK	
LSS-0.13	Take note of input current	16,00A<Iin<20,00A	17,6 A	
LSS-0.14	Apply the voltage pulse with 100uS duration	OK	OK	
LSS-0.15	Verify with oscilloscope that the transient response diminish to 10% of the maximum amplitude within 1mS and remains below 10% thereafter (see Figure 10-10)	OK	OK	Annex picture in the end of the document See Annex A Fig.92

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
LSS-0.16	Acquire with oscilloscope the signals: TPD3 ESEM 3-B out 1 (120v outlet)	OK	OK	Annex picture in the end of the document See Annex A Fig.92
LSS-0.17	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
LSS-0.18	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
LSS-0.19	Apply the voltage pulse with 150uS duration	OK	OK	
LSS-0.20	Verify with oscilloscope that the transient response diminish to 10% of the maximum amplitude within 1mS and remains below 10% thereafter (see Figure 10-10)	OK	OK	Annex picture in the end of the document See Annex A Fig.93
LSS-0.21	Acquire with oscilloscope the signals: TPD3 ESEM 3-B out 1 (120v outlet)	OK	OK	Annex picture in the end of the document See Annex A Fig.93
LSS-0.22	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
LSS-0.23	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
LSS-0.24	Switch Off the "power switch "of "power switch box"	OK	OK	
LSS-0.25	Switch Off main bus	OK	OK	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

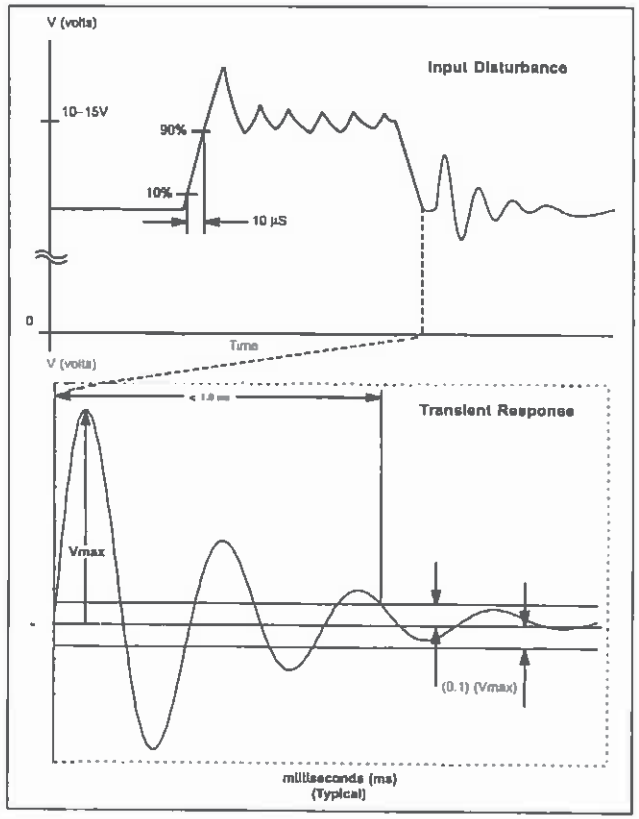

Figure 10-10: Pulse applied to the power input of the integrated external payload load

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5 SECTION "B" CONDUCTED SUSCEPTIBILITY

10.5.1 SC-01: SINE WAVE INJECTION ON INPUT DC POWER SUPPLY

SC-01.1	**OBJECTIVE** To verify the UUT immunity from sine wave differential mode noise injected on input power bus lines. The test is performed at closed box			
SC-01.2	**TEST SET-UPS** Test set-ups are shown in: -Figure 6-5 for frequency range 30Hz ÷50kHz Figure 6-6 for frequency range 50kHz ÷50MHz			Heaters not connected Set loads in nominal configuration

SC-01.3	TEST FEATURE
	Signal Characteristics:
	- frequency range: see Figure 10-4
	- voltage amplitude: see Figure 10-4
	- injection method:
	  - series/transformer for 30Hz ÷50kHz range
	  - parallel/capacitor (Xc lower than 5Ω over freq. range) for 50kHz ÷50MHz
	- sweep mode: sweep
	
	The test shall be performed on the following UUT Input Power Bus Lines:
	Operational BUS
	- J200 connector hot (+) power bus line
	- J200 connector return (-) power bus line			

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-01.4	**SUSCEPTIBILITY CRITERIA** The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification From 30Hz up to 50KHz the requirement is also met when the audio power source adjusted to dissipate 50 Watts in a 0.5 ohm load, cannot develop the required voltage at the EUT power input terminals, and the EUT is not susceptible to the output of the signal source. From 50KHz up to 50MHz the requirement is also met under the following condition: A 1 Watt source of 50 ohms impedance cannot develop the required voltage at the EUT power input terminals, and the EUT is not susceptible to the output of the signal source.			
SC-01.5	**TEST RUN with transformer coupling (30Hz÷50kHz)** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-01.6	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-01.7	Connect the UUT as shown in Figure 6-5	OK	OK	
SC-01.8	Set power supply at 120Vdc	120V±1V	120V	
SC-01.9	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-01.10	By remote command the unit in nominal configuration	OK	OK	
SC-01.11	Take note of current absorption from main bus	16,00A<Iin<20,00A	17,7 A	
SC-01.12	Verify by remote that the status of all the boards of the section is OK	OK	OK	
SC-01.13	Start with frequency injection sweep	OK	OK	
SC-01.14	During the test verify the following UUT parameters:	OK	OK	
SC-01.15	using CAN BUS 30 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 30 Digital status check

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-01.16	using CAN BUS 31 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 31 Digital status check
SC-01.17	monitor with the oscilloscope the input current and voltage and the representative secondary output voltage of the following 28V outlets: ER1_N		OK	Annex pictures in the end of document See Annex A Fig. 94 to Fig.113
SC-01.18	Monitor with oscilloscope the following 120V outlet: CCEB 120V		OK	See Annex A Fig. 94 to Fig.113
SC-01.19	By remote, using CAN BUS 30 switch OFF ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 30 Digital command check
SC-01.20	By remote, using CAN BUS 31 switch ON ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 31 Digital command check
SC-01.21	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-01.22	Switch off power supply			
SC-01.23	**TEST RUN with capacitor coupling (50kHz÷50MHz)** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-01.24	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-01.25	Connect the UUT as shown in Figure 6-6	OK	OK	
SC-01.26	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-01.27	Set power supply at 120Vdc	OK	OK	
SC-01.28	Switch ON the **"power switch "of "power switch box"**	120Vdc ± 1Vdc	120V	
SC-01.29	By remote command the unit in nominal configuration	OK	OK	
SC-01.30	Take note of current absorption from main bus	16,00A<Iin<20,00A	17,7 A	
SC-01.31	Verify by remote that the status of all the boards of the section is	OK	OK	
SC-01.32	Start with frequency injection sweep	OK	OK	
SC-01.33	During the test verify the following UUT parameters:	OK	OK	
SC-01.34	using CAN BUS 30 monitor the OK/NOK flags of all the Boards: all the flags shall be in the OK status	OK	OK	CAN BUS 30 Digital status check
SC-01.35	using CAN BUS 31 monitor the OK/NOK flags of all the Boards: all the flags	OK	OK	CAN BUS 31 Digital status check

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	shall be in the OK status			
SC-01.36	Monitor with the oscilloscope the input current and voltage and the representative secondary output voltage of the following 28V outlets: ER1_N		OK	Annex pictures in the end of document See Annex A Fig. 114 to Fig.130
SC-01.37	Monitor with oscilloscope the following 120V outlet: CCEB 120V		OK	See Annex A Fig. 114 to Fig.130
SC-01.38	By remote, using CAN BUS 30 switch OFF ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 30 Digital command check
SC-01.39	By remote, using CAN BUS 31 switch ON ESEM 3-A-1 outlet 1	OK	OK	CAN BUS 31 Digital command check
SC-01.40	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-01.41	Switch off power supply	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5.2 SC-02: INPUT IMPEDANCE

SC-02.1	**OBJECTIVE** To measure the UUT input impedance on 120V Operational feeder. The test is performed at closed box			
SC-02.2	**TEST SET-UP** Test set-up is shown in Figure 6-5 for all the frequency range (50Hz ÷ 100kHz)			
SC-02.3	**TEST FEATURE** The test shall be performed with the same set-up and procedure as per paragraph 10.4.1 , but with the following differences: - the amplitude of the input signal is reduced to have a small signal result. - the frequency range is reduced to 50Hz ÷ 100kHz The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J200 (BI_120V (positive)) - J200 (AI_120V_RTN (negative))			
SC-02.4	**IMPEDANCE LIMIT** The load impedance presented by AMS02-PDS unit shall be measured and shall not exceed the limits defined in figure 11-5 and 11-6.			
SC-02.5	**TEST RUN with transformer coupling (50Hz ÷100kHz)** Verify that UUT and main Bus are switched off	OK	OK	
SC-02.6	Verify that TE is on (with main Bus off)	OK	OK	
SC-02.7	Connect the UUT as shown in Figure 6-5	OK	OK	
SC-02.8	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-02.9	Set power supply to 113Vdc	113V±1V	113V	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-02.10	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-02.11	By remote set the unit in nominal configuration	OK	OK	Use CAN BUS 30
SC-02.12	Take note of input current from main bus	16,00A<Iin<20,00A	18,8A	
SC-02.13	Start with frequency injection sweep	OK	OK	
SC-02.14	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.15	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.131 and Fig,132
SC-02.16	Set power supply to 120Vdc	120V±1V	120V	Unit still ON in nominal configuration
SC-02.17	Take note of input current from main bus	16,00A<Iin<20,00A	17,6A	
SC-02.18	Start with frequency injection sweep	OK	OK	
SC-02.19	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.20	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.133 and Fig,134
SC-02.21	Set power supply to 120Vdc	126V±1V	126V	Unit still ON in nominal configuration
SC-02.22	Take note of input current from main bus	16,00A<Iin<20,00A	16,9A	
SC-02.23	Start with frequency injection sweep	OK	OK	
SC-02.24	During the test measure the following UUT parameters: - Input voltage (AC coupling) - Input current (AC coupling)	OK	OK	
SC-02.25	Plot input impedance (Voltage/Current) both in magnitude and phase and verify that is in compliance with limits.	OK	OK	Annex picture in the end of document See Annex A Fig.135 and Fig,136
SC-02.26	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-02.27	Switch off main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5.3 SC-03: VOLTAGE SPIKE TRANSIENTS INJECTION ON DC POWER LINES

SC-03.1	**OBJECTIVE** To verify the UUT immunity from differential mode voltage spike transients injected on input power bus lines. The test is performed at closed box			
SC-03.2	**TEST SET-UP** Test set-up is shown in Figure 6-7: - the current probe shall be positioned as close as possible to UUT input power bus connector (J200) - the voltage probe shall be connected directly on UUT input power bus connector (J200)			

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.3	**TEST FEATURE** Signal Characteristics: - transient shape: see Figure 10-7 - voltage amplitude: ± 120V over power bus voltage (120V) Note: The voltage amplitude generated by the transient generator shall be calibrated on a 5Ω resistance. Then the voltage transient shape shall be applied to the UUT with the same transient generator settings, regardless the actual voltage amplitude applied to the UUT if it is less than 120V. If the actual voltage amplitude applied to the UUT rises over 120V, it shall be limited to 120V by changing the transient generator settings. - duration: 10us and 0.15us - max pulse repetition rate: 10Hz - the spike will be applied for a period not less than 2 minutes in duration - injection method: parallel The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J200 (BI_120V (positive)) - J200 (AI_120V_RTN (negative))			
SC-03.4	SUSCEPTIBILITY CRITERIA The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification			
SC-03.5	**TEST RUN: 120V + 120V for 0.15us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.6	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.7	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig,137
SC-03.8	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.9	Connect main and return power bus lines to power supply through the LISN	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.10	Set power supply at 120Vdc	OK	OK	
SC-03.11	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.12	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.13	Take note of input current	16,00A<Iin<20,00A	17,9 A	
SC-03.14	Apply the voltage transient shape	OK	OK	
SC-03.15	During the test verify the following UUT parameters:	OK	OK	
SC-03.16	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.17	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.18	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig,138
SC-03.19	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.20	Verify that command is correctly executed	OK	OK	
SC-03.21	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.22	Verify that command is correctly executed	OK	OK	
SC-03.23	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.24	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.25	Switch OFF main bus	OK	OK	
SC-03.26	**TEST RUN: 120V + 120V for 10us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.27		OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.28	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.29	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig,139
SC-03.30	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.31	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.32	Set power supply at 120Vdc	OK	OK	
SC-03.33	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.34	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.35	Take note of input current	16,00A<Iin<20,00A	17,9 A	
SC-03.36	Apply the voltage transient shape	OK	OK	
SC-03.37	During the test verify the following UUT parameters:	OK	OK	
SC-03.38	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.39	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.40	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig,140
SC-03.41	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.42	Verify that command is correctly executed	OK	OK	
SC-03.43	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.44	Verify that command is correctly executed	OK	OK	
SC-03.45	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.46	Switch OFF the "power switch "of "power switch box"	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.47	Switch OFF main bus	OK	OK	
SC-03.48	**TEST RUN: 120V - 120V for 0.15us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.49	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.50	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig,141
SC-03.51	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.52	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.53	Set power supply at 120Vdc	OK	OK	
SC-03.54	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.55	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.56	Take note of input current	16,00A<Iin<20,00A	17,9 A	
SC-03.57	Apply the voltage transient shape	OK	OK	
SC-03.58	During the test verify the following UUT parameters:	OK	OK	
SC-03.59	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.60	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.61	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig,142
SC-03.62	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.63	Verify that command is correctly executed	OK	OK	
SC-03.64	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.65	Verify that command is correctly executed	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.66	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.67	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.68	Switch OFF main bus	OK	OK	
SC-03.69	**TEST RUN: 120V - 120V for 10us** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-03.70	Calibrate the spike generator on 5Ω resistance	OK	OK	Annex plot in the end of the document
SC-03.71	Verify that TE is on (with Operational Bus off)	OK	OK	See Annex A Fig,143
SC-03.72	Connect the UUT as shown in Figure 6-7	OK	OK	
SC-03.73	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-03.74	Set power supply at 120Vdc	OK	OK	
SC-03.75	Switch ON the "power switch "of "power switch box"	120Vdc ± 1Vdc	120V	
SC-03.76	By remote set the unit in nominal configuration	OK	OK	USE CAN BUS 30
SC-03.77	Take note of input current	16,00A<Iin<20,00A	17,9 A	
SC-03.78	Apply the voltage transient shape	OK	OK	
SC-03.79	During the test verify the following UUT parameters:	OK	OK	
SC-03.80	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.81	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-03.82	Monitor with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig,144
SC-03.83	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check during spike transients
SC-03.84	Verify that command is correctly executed	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-03.85	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check during spike transients
SC-03.86	Verify that command is correctly executed	OK	OK	
SC-03.87	Stop voltage spikes injection	OK	OK	Voltage spike injection duration at least two minutes
SC-03.88	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-03.89	Switch OFF main bus	OK	OK	
SC-03.90	Switch OFF main bus	OK	OK	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5.4 SC-04: NORMAL VOLTAGE TRANSIENT INJECTION ON DC POWER LINES

SC-04.39	**OBJECTIVE** To verify the UUT immunity from normal input bus transients The test is performed at closed box			
SC-04.40	**TEST SET-UP** Test set-up is shown in Figure 6-8 - the current probe shall be positioned as close as possible to UUT input power bus connector (J200) - the voltage probe shall be connected directly on UUT input power bus connector (J200)			
SC-04.41	**TEST FEATURE** *Signal Characteristics:* - transient shape: see Figure 10-8 - voltage amplitude: see Figure 10-8 - injection method: series The test shall be performed on the following UUT Input Power Bus Lines: Operational_BUS - J200 (BI_120V (positive)) - J200 (AI_120V_RTN (negative))			
SC-04.42	**SUSCEPTIBILITY CRITERIA** The equipment shall not exhibit any malfunction, degradation of performance or deviation from specified parameters beyond tolerances given by the corresponding specification			
SC-04.43	**TEST RUN (Positive Shape)** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-04.44	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-04.45	Connect the UUT as shown in Figure 6-8	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-04.46	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-04.47	Set power supply at 126Vdc	126Vdc ± 1Vdc	126V	
SC-04.48	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-04.49	By remote set the unit in nominal configuration	OK	OK	
SC-04.50	Take note of input current	16,00A<Iin<20,00A	16,9 A	
SC-04.51	Apply the positive voltage shape to the UUT	OK	OK	
SC-04.52	During voltage shape applying, acquire with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig,145
SC-04.53	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.54	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.55	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SC-04.56	Verify that command is correctly executed	OK	OK	
SC-04.57	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-04.58	Verify that command is correctly executed	OK	OK	
SC-04.59	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-04.60	Switch OFF main bus	OK	OK	
SC-04.61	Prepare the instrumentation for negative voltage shape	OK	OK	
SC-04.62	Switch ON main bus	OK	OK	
SC-04.63	Set main bus to 112.5V	112.5V ± 1V	112,5V	
SC-04.64	Switch ON the "power switch "of "power switch box"	OK	OK	
SC-04.65	By remote set the unit in nominal configuration	OK	OK	
SC-04.66	Take note of input current	16,00A<Iin<20,00A	18,7 A	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-04.67	Apply the negative voltage shape to the UUT	OK	OK	
SC-04.68	During voltage shape applying, acquire with the oscilloscope the following signals: Input bus TPD3 CCEB (120V outlet)	OK	OK	Annex picture in the end of document See Annex A Fig.146
SC-04.69	With CAN BUS 30 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.70	With CAN BUS 31 Monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	
SC-04.71	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SC-04.72	Verify that command is correctly executed	OK	OK	
SC-04.73	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-04.74	Verify that command is correctly executed	OK	OK	
SC-04.75	Switch OFF the "power switch "of "power switch box"	OK	OK	
SC-04.76	Switch OFF main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5.5 SC-05: ABNORMAL VOLTAGE TRANSIENT

SC-05.27	<u>OBJECTIVE</u> To verify the UUT immunity from input bus abnormal voltage transient The test is performed at closed box			
SC-05.28	<u>TEST SET-UP</u> Test set up is shown in Figure 6-8 - the current probe shall be positioned as close as possible to UUT input power bus connector - the voltage probe shall be connected directly on UUT input power bus connector			
SC-05.29	<u>TEST FEATURE</u> *Signal Characteristics:* - transient shape: see Figure 10-8 - voltage amplitude: see Figure 10-8 - injection method: series ***Note:*** *since the transient generator available at the test facility is not able to generate the complete transient shape shown in figure 10-10, the test shall be performed splitting the transient in different parts, which will be annexed in the end of the document. The final envelope given by the different parts shall ensure to cover the limit mask.* The test shall be performed on the following UUT Input Power Bus Lines: <u>Operational BUS</u> - J200 connector, positive power bus line AI_120V - J200 connector, negative power bus line AI_120V_RTN			The required shape can not be reproduced with one laboratory instrument. This shape is in fact the result of the protection intervention at the RPCM (space station power distribution device) that is not available. For this reason the shape is divided in two shape: **Shape 1:** positive peak 240V 12usec **Shape 2:** negative peak 0V 60msec Test has been performed with NASA devices on the EM with successful result.

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-05.30	**SUSCEPTIBILITY CRITERIA** No permanent degradation and no failure propagation across the UUT interfaces shall result. The downward shape causes the UUT switching-off because of the input under voltage protection intervention: in this case at the following switching-on the UUT must not show any performance degradation. The same will happen for the positive peak, when voltage protection set to 150V ± 2V switches off the unit . After switch ON the UUT must not show any performance degradation.			See Annex A Fig.147 for calibration spike
SC-05.31	**TEST RUN (Downward Shape – first part of the transient shape)** Verify that UUT and Operational Bus are switched off	OK	OK	
SC-05.32	Verify that TE is on (with Operational Bus off)	OK	OK	
SC-05.33	Connect the UUT as shown in Figure 6-8	OK	OK	
SC-05.34	Connect main and return power bus lines to power supply through the LISN	OK	OK	
SC-05.35	By remote set the unit in nominal configuration	OK	OK	
SC-05.36	Take note of input current	16,00A<Iin<20,00A	16,9 A	Main bus set to 126V
SC-05.37	Apply the positive voltage spikes described in Figure 10-9	OK	OK	Every spike must be applied with unit ON. Every spike generated on input bus will be monitored and annexed In the end of the document. See Annex A Fig.148
SC-05.38	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SC-05.39	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SC-05.40	Using CAN BUS 31 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.41	Verify that command is correctly executed	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SC-05.42	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.43	Verify that command is correctly executed	OK	OK	
SC-05.44	Set the main bus to 113V and take note of input current		18,8 A	
SC-05.45	Apply the negative voltage spikes described in Figure 10-9	OK	OK	Every spike must be applied with unit ON. Every spike generated on input bus will be monitored and annexed In the end of the document. See Annex A Fig.149 As expected the unit switched OFF and restart in the default configuration. Communication is guaranteed after switch ON and nominal config has been restored.
SC-05.46	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SC-05.47	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SC-05.48	Using CAN BUS 31 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.49	Verify that command is correctly executed	OK	OK	
SC-05.50	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SC-05.51	Switch Off the "power switch "of "power switch box"	OK	OK	
SC-05.52	Switch off main bus	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.5.6 LARGE SIGNAL STABILITY

LSS-0.26	**OBJECTIVE** To verify the UUT capability of maintaining stability with the APM interface by damping a transient response to 10% of the maximum response amplitude within 1 ms, and remaining below 10% thereafter under the following conditions: - The rise time / fall time (between 10% and 90% of the amplitude) of the input voltage pulse is less than 10 us - The voltage pulse is varied from 100 us to 150 us in duration The test shall be performed at closed box			
LSS-0.27	**TEST SET-UP** Test set-up is shown in Figure 6-8; the voltage probe shall be connected directly on UUT input power bus connector			
LSS-0.28	**TEST FEATURE** *Signal Characteristics:* - Transient shape: see Figure 10-10 - Voltage amplitude: see Figure 10-10 - injection method: series The test shall be performed on the following UUT Input Power Bus Lines: Operational BUS - J200 (BI_120V (positive)) - J200 (AI_120V_RTN (negative))			

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
LSS-0.29	**SUSCEPTIBILITY CRITERIA** The integrated external payload shall maintain stability with the APM interface by damping a transient response to 10% of the maximum response amplitude within 1 ms, and remaining below 10% thereafter under the following conditions: - The rise time / fall time (between 10% and 90% of the amplitude) of the input voltage pulse is less than 10 us - The voltage pulse is to be varied from 100 us to 150 us in duration The above requirements are clarified by Figure 10-10 No permanent degradation and no failure propagation across the UUT interfaces shall result			
LSS-0.30	**TEST RUN** Verify that UUT and Operational Bus are switched off	OK	OK	
LSS-0.31	Verify that TE is on (with Operational Bus off)	OK	OK	
LSS-0.32	Connect the UUT as shown in Figure 6-8	OK	OK	
LSS-0.33	Connect the oscilloscope to 28V outlets: TPD3		OK	
LSS-0.34	Connect main and return power bus lines to power supply through the LISN	OK	OK	
LSS-0.35	Set power supply at 120Vdc	OK	OK	
LSS-0.36	Switch ON the "power switch "of "power switch box"	OK	OK	
LSS-0.37	Set the unit in nominal configuration	OK	OK	
LSS-0.38	Take note of input current	16,00A<Iin<20,00A	17,6 A	
LSS-0.39	Apply the voltage pulse with 100uS duration	OK	OK	
LSS-0.40	Verify with oscilloscope that the transient response diminish to 10% of the maximum amplitude within 1mS and remains below 10% thereafter (see Figure 10-10)	OK	OK	Annex picture in the end of the document See Annex A Fig.150
LSS-0.41	Acquire with oscilloscope the signals: TPD3 ESEM 3-B out 1 (120v outlet)	OK	OK	Annex picture in the end of the document See Annex A Fig.150

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
LSS-0.42	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
LSS-0.43	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
LSS-0.44	Apply the voltage pulse with 150uS duration	OK	OK	
LSS-0.45	Verify with oscilloscope that the transient response diminish to 10% of the maximum amplitude within 1mS and remains below 10% thereafter (see Figure 10-10)	OK	OK	Annex picture in the end of the document See Annex A Fig.151
LSS-0.46	Acquire with oscilloscope the signals: TPD3 ESEM 3-B out 1 (120v outlet)	OK	OK	Annex picture in the end of the document See Annex A Fig.151
LSS-0.47	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
LSS-0.48	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
LSS-0.49	Switch Off the "power switch "of "power switch box"	OK	OK	
LSS-0.50	Switch Off main bus	OK	OK	

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10.6 REVERSE CURRENT

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RC-1.	**OBJECTIVE** The unit shall limit reverse current transients that can occur when a hard fault occurs across the power source within the transient envelope defined for 25 Amps curves shown in pictures in the end of this section (Fig. 10.5)			
RC-2.	**TEST SET-UP** Connect the unit as described in picture Figure 6-13			
RC-3.	**TEST FEATURE** 1) Test shall be performed with UUT in nominal configuration 2) Section A and section B will be tested			
RC-4.	Operational BUS - J100 (AI_120V (positive)) - J100 (AI_120V_RTN (negative))			Section A verification
RC-5.	Set power supply at 120Vdc	120Vdc ± 1Vdc	120V	
RC-6.	Switch ON the "power switch "of "power switch box"	OK	OK	
RC-7.	By remote set the unit in nominal configuration	OK	OK	
RC-8.	Take note of input current	16,00A<Iin<20,00A	17.7 A	
RC-9.	Using EMC box test close U1 switch and simultaneously open U2 switch	OK	OK	
RC-10.	Take note of input reverse current	OK	OK	Annex picture in the end of the document
RC-11.	Verify that reverse current is under the limits described in the three pictures in the end of this section (use 25A limits)	OK	OK	See Annex A Fig. 152, Fig. 153
RC-12.	Switch off power switch box and power supply	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RC-13.	Operational BUS - J200 (BI_120V (positive)) - J200 (BI_120V_RTN (negative))			Section B verification
RC-14.	Set power supply at 120Vdc	120Vdc ± 1Vdc	120V	
RC-15.	Switch ON the "power switch "of "power switch box"	OK	OK	
RC-16.	By remote set the unit in nominal configuration	OK	OK	
RC-17.	Take note of input current	16,00A<Iin<20,00A	17.7 A	
RC-18.	Using EMC box test close U1 switch and simultaneously open U2 switch	OK	OK	
RC-19.	Take note of input reverse current	OK	OK	Annex picture in the end of the document
RC-20.	Verify that reverse current is under the limits described in the three pictures in the end of this section (use 25A limits)	OK	OK	See Annex A Fig. 154, Fig. 155
RC-21.	Switch off power switch box and power supply	OK	OK	

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

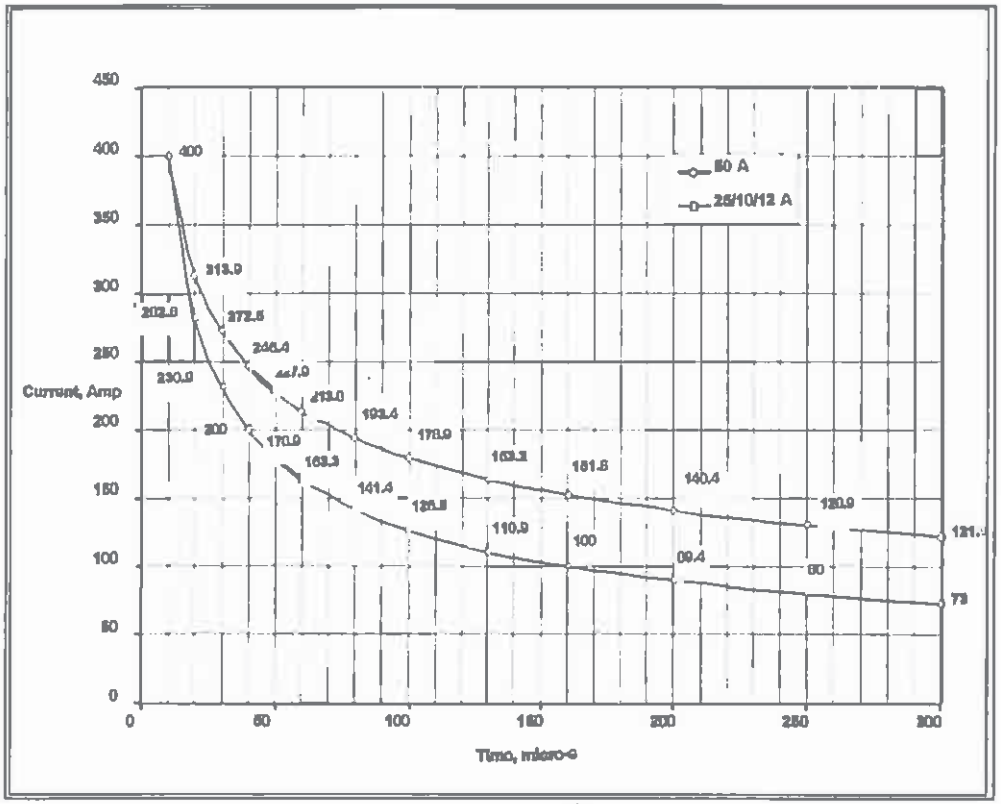

Figure 10-12: current limits 10uS-300uS

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

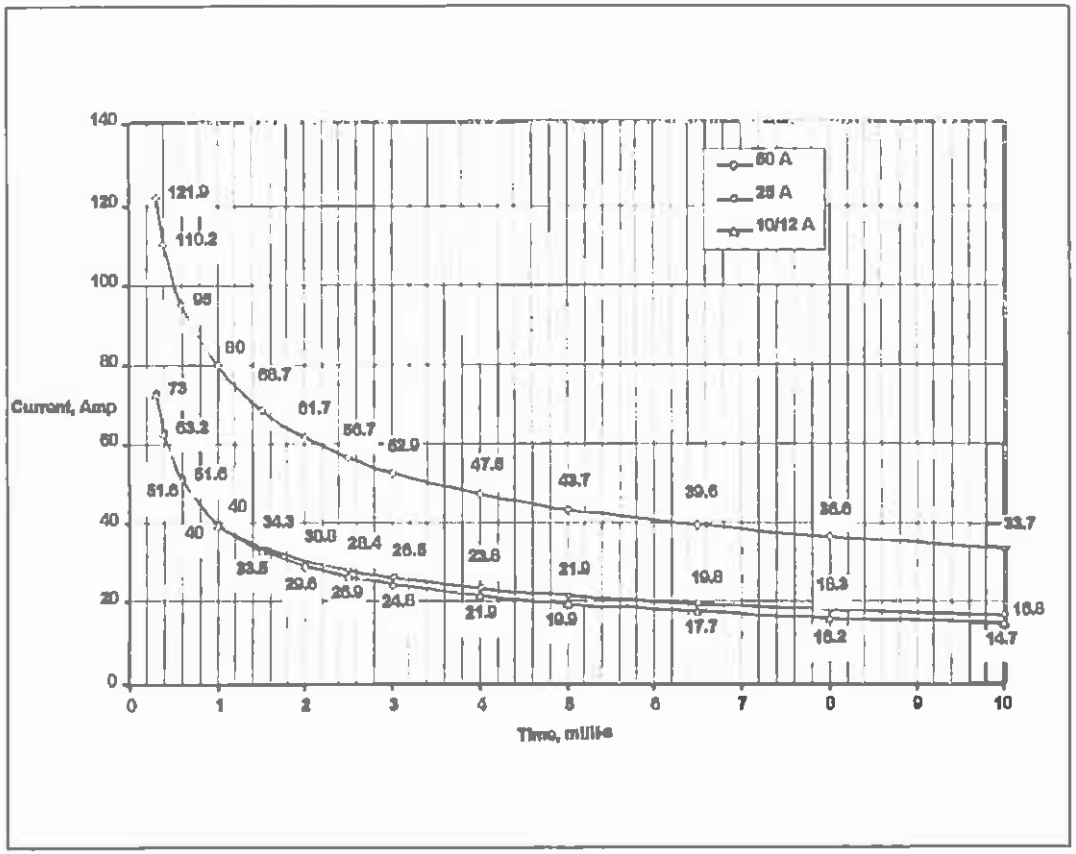

Figure 10-13: Reverse current limits 300uS-10mS

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

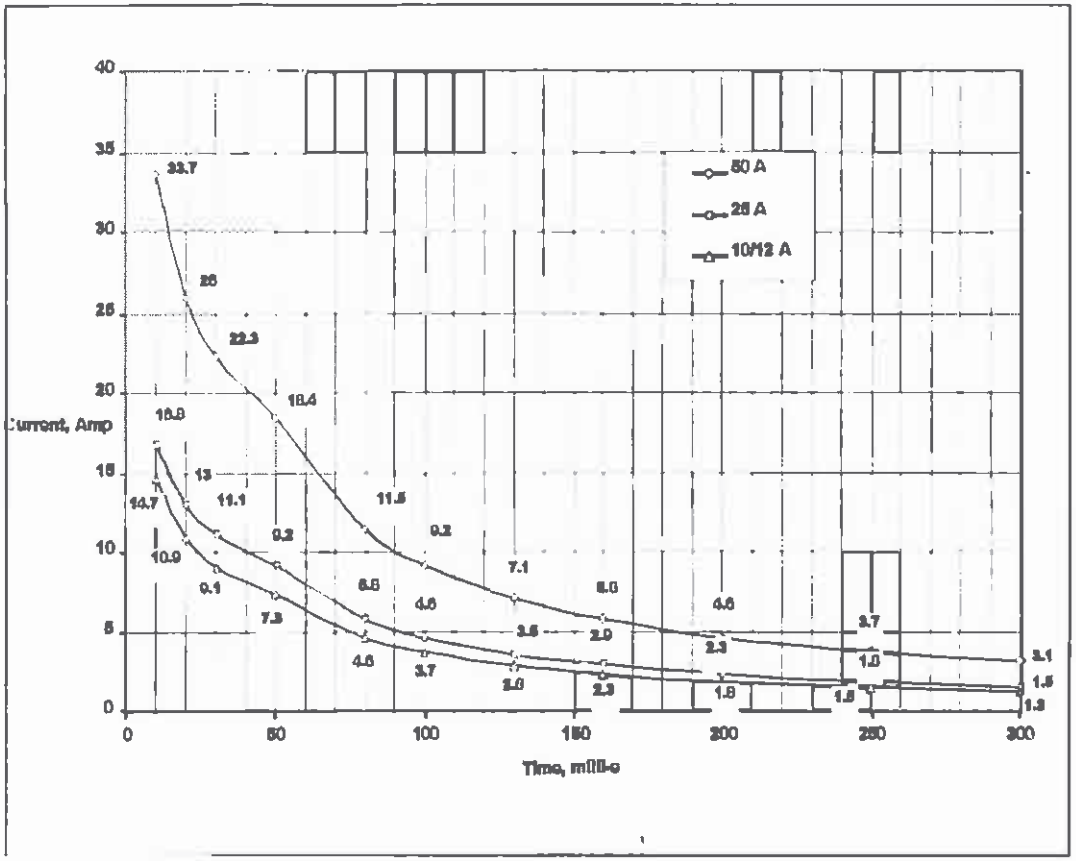

Figure 10-14: Reverse current limits 10mS-300mS

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.7 SR-A: ARC DISCHARGE SUSCEPTIBILITY

SR-A.1	**OBJECTIVE** To verify the immunity of the UUT to due to a repetitive electrostatic arc discharge. The test shall be performed at closed box on the four corners of the unit.			
SR-A.2	**TEST SET-UP** Disconnect the unit from all the cables and loads, except from bonding connection			
SR-A.3	**TEST FEATURE** 3) Test shall be performed with ESD source 4) For conducted test the discharge probe shall be positioned in contact with each UUT wall / chassis corner *ESD Source Characteristics:* - Amplitude: 4kV - Repetition rate: between 3Hz and 10Hz - Duration: > 5min			
SR-A.4	**SUSCEPTIBILITY CRITERIA** No permanent degradation and no failure propagation across the UUT interfaces shall result after ESD test			
SR-A.5	**TEST RUN** Verify that UUT is disconnected from all the cables, except from bonding	OK	OK	
SR-A.6	Apply electrostatic discharge	OK	OK	See Annex B Para. 5
SR-A.7	Connect the cables	OK	OK	HEATERS NOT CONNECTED

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SR-A.8	**SECTION A CHECK**			
SR-A.9	Connect the supply lines AI_120V and AI_120V_RTN (J100) to power switch box	OK	OK	A section supplied
SR-A.10	Set main bus to 120V	OK	OK	
SR-A.11	Switch ON the "power switch "of "power switch box"	OK	OK	
SR-A.12	Using CAN BUS 30 set the unit in nominal condition	OK	OK	
SR-A.13	Take note of the input current	16,00A<Iin<20,00A	18,0A	
SR-A.14	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SR-A.15	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SR-A.16	Verify with multimeter the presence of 28V on following outlets : TPD3 ER1_N TPD0 TTPD_N	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 26,85V (OK) 26,66V (OK) 27,13V 27,32V	Measured at load level, voltage drop is present due to cable length
SR-A.17	By remote, with CAN BUS 30, verify the analog telemetries of the output voltage of: PB2 SN1 PB2 SN3 PB2 SN4 PB2 SN7	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 27,90V 28,20V 28,00V 27,99V	CAN BUS 30 Analog telemetries check
SR-A.18	By remote, with CAN BUS 31, verify the analog telemetries of the output voltage of: PB2 SN1 PB2 SN3 PB2 SN4 PB2 SN7	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 27,90V 27,76V 27,99V 28,00V	CAN BUS 31 Analog telemetries check

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SR-A.19	Using CAN BUS 31 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SR-A.20	Verify that command is correctly executed	OK	OK	
SR-A.21	Using CAN BUS 31 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 31 digital command check
SR-A.22	Verify that command is correctly executed	OK	OK	
SR-A.23	Switch off power switch box	OK	OK	
SR-A.24	Switch off main bus	OK	OK	
SR-A.25	**SECTION B CHECK**			
SR-A.26	Connect the supply lines BI_120V and BI_120V_RTN (J200) to power switch box	OK	OK	B section supplied
SR-A.27	Set main bus to 120V	OK	OK	
SR-A.28	Switch ON the "power switch "of "power switch box"	OK	OK	
SR-A.29	Using CAN BUS 31 set the unit in nominal condition	OK	OK	
SR-A.30	Take note of the input current	16,00A<Iin<20,00A	18,0A	
SR-A.31	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 30 check
SR-A.32	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
SR-A.33	Verify with multimeter the presence of 28V on following outlets : TPD3 ER1_N TPD0 TTPD_N	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 26,88V (OK) 26,67V (OK) 27,14V 27,32V	Measured at load level, voltage drop is present due to cable length
SR-A.34	By remote, with CAN BUS 30, verify the analog telemetries of the output voltage of: PB2 SN2 PB2 SN5 PB2 SN6 PB2 SN8	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 27,99V 27,45V 28,26V 27,90V	CAN BUS 30 Analog telemetries check

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
SR-A.35	By remote, with CAN BUS 31, verify the analog telemetries of the output voltage of: PB2 SN2 PB2 SN5 PB2 SN6 PB2 SN8	 27V<V<29V 27V<V<29V 27V<V<29V 27V<V<29V	 27,97V 27,74V 28,19V 28,12V	CAN BUS 31 Analog telemetries check
SR-A.36	Using CAN BUS 30 switch ON by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SR-A.37	Verify that command is correctly executed	OK	OK	
SR-A.38	Using CAN BUS 30 switch OFF by remote, in ESEM 3-A-1 window, the outlet 6	OK	OK	CAN BUS 30 digital command check
SR-A.39	Verify that command is correctly executed	OK	OK	
SR-A.40	Switch off power switch box	OK	OK	
SR-A.41	Switch off main bus	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.8 RE02, SECTION "A" RADIATED EMISSIONS

RE02-1	**OBJECTIVE** To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits The test is performed at closed box			
RE02-2	**TEST SETUP** Test set up is shown in Figure 6-11			
RE02-3	**TEST FEATURE** Narrow-band electric fields generated by the subsystem equipment and measured at 1m distance shall not exceed the limits shown in Table 10-2 : Field emissions limits. Operational bus - J100 connector, positive line (AI_120V) - J100 connector, return (AI_120V_RTN)			
RE02-4	**TEST RUN** Verify UUT is switched off	OK	OK	
RE02-5	Verify TE is switched on	OK	OK	
RE02-6	Verify the antennas are placed 1 meter far from UUT	OK	OK	
RE02-7	Verify the ambient noise both with and without TE on	OK	OK	
RE02-8	Verify the emission are 6dB below the limit otherwise check the TE emission	OK	14KHz-30MHz NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RE02-9	Connect the UUT as shown in Figure 6-11	OK	OK	Also with ambient noise, caused by test equipment, too high the unit measurement is performed.
RE02-10	Connect hot and return power bus line (J100) to power supply through the LISN	OK	OK	
RE02-11	Set the power supply output to 120V	120V ± 0.1V	120V	
RE02-12	Switch ON the "power switch "of "power switch box"	OK	OK	
RE02-13	From remote set the unit in nominal configuration	OK	OK	
RE02-14	Take note of the input current	16,00A<Iin<20,00A	18,0 A	
RE02-15	Perform the measurement	OK	OK	
RE02-16	Verify that the emissions are below the limit given in Table 10-2 : Field emissions limits	OK	14KHz-30MHz NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)
RE02-17	Switch Off the "power switch "of "power switch box"	OK	OK	
RE02-18	Switch off the main bus	OK	OK	

NOTE: The emissions are most probably originated by the use of not shielded cables; The test will be repeated using a temporary shielding performed by wrapping cable bundles with aluminium foil.

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

Frequency	Emissions
14 kHz–10 MHz	56 dBµV/m
10 MHz–259 MHz	Increasing log linearly with increasing frequency from 56 to 86 dBµV/m (16dB per decade)
259 MHz–10 GHz	Increasing log linearly with increasing frequency from 46 to 72 dBµV/m (16dB per decade)
13.5–15.5 GHz	72 dBµV/m

Table 10-2 : Field emissions limits

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UUT DATA :	Model	PFM	Item	AMS02 Power Distrribution System	C.I.	PDS 18	S/N	FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.8.1 RE02, SECTION "A" RADIATED EMISSIONS CABLES SHIELDED

RE02-19	<u>OBJECTIVE</u> To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits The test is performed at closed box with the cables shielded. Since the most probable path of emission are the cables, the goal of this test, with shielded cables, is to verify the emission of the electronics boards and box itself. One by one the cables will be shielded and grounded to the copper table using aluminium paper.			See PVS 02
RE02-20	<u>TEST SETUP</u> Test set up is shown in Figure 6-11			
RE02-21	<u>TEST FEATURE</u> Narrow-band electric fields generated by the subsystem equipment and measured at 1m distance shall not exceed the limits shown in Table 10-2 : Field emissions limits. <u>Operational bus</u> - J200 connector, positive line (BI_120V) - J200 connector, return (BI_120V_RTN)			
RE02-22	<u>TEST RUN</u> Verify UUT is switched off	OK	OK	
RE02-23	Verify TE is switched on	OK	OK	
RE02-24	Verify the antennas are placed 1 meter far from UUT	OK	OK	
RE02-25	Verify the ambient noise both with and without TE on	OK	OK	
RE02-26	Verify the emission are 6dB below the limit otherwise check the TE emission	OK	14KHz-30MHz	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
			NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)
RE02-27	Connect the UUT as shown in Figure 6-11	OK	OK	
RE02-28	Connect hot and return power bus line (J200) to power supply through the LISN	OK	OK	
RE02-29	Set the power supply output to 120V	120V ± 0.1V	120V	
RE02-30	Switch ON the "power switch "of "power switch box"	OK	OK	
RE02-31	From remote set the unit in nominal configuration	OK	OK	
RE02-32	Take note of the input current	16,00A<Iin<20,00A	18,0 A	
RE02-33	Perform the measurement	OK	OK	
RE02-34	Verify that the emissions are below the limit given in Table 10-2 : Field emissions limits	OK	14KHz-30MHz NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)
RE02-35	Switch Off the "power switch "of "power switch box"	OK	OK	
RE02-36	Switch off the main bus	OK	OK	

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

10.9 RE02, SECTION "B" RADIATED EMISSIONS

RE02-37	**OBJECTIVE** ~~To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits~~ ~~The test is performed at closed box~~ To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits The test is performed at closed box with the cables shielded. Since the most probable path of emission are the cables, the goal of this test, with shielded cables, is to verify the emission of the electronics boards and box itself. One by one the cables will be shielded and grounded to the copper table using aluminium paper.			See PVS 03
RE02-38	**TEST SETUP** Test set up is shown in Figure 6-11			
RE02-39	**TEST FEATURE** Narrow-band electric fields generated by the subsystem equipment and measured at 1m distance shall not exceed the limits shown in Table 10-2 : Field emissions limits. Operational bus - J200 connector, positive line (BI_120V) - J200 connector, return (BI_120V_RTN)			
RE02-40	TEST RUN Verify UUT is switched off	OK	OK	

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UUT DATA : Model PFM Item AMS02 Power Distrribution System C.I. PDS 18 S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RE02-41	Verify TE is switched on	OK	OK	
RE02-42	Verify the antennas are placed 1 meter far from UUT	OK	OK	
RE02-43	Verify the ambient noise both with and without TE on	OK	OK	
RE02-44	Verify the emission are 6dB below the limit otherwise check the TE emission	OK	14KHz-30MHz NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)
RE02-45	Connect the UUT as shown in Figure 6-11	OK	OK	
RE02-46	Connect hot and return power bus line (J200) to power supply through the LISN	OK	OK	
RE02-47	Set the power supply output to 120V	120V ± 0.1V	120V	
RE02-48	Switch ON the "power switch "of "power switch box"	OK	OK	
RE02-49	From remote set the unit in nominal configuration	OK	OK	
RE02-50	Take note of the input current	16,00A<Iin<20,00A	18,0 A	
RE02-51	Perform the measurement	OK	OK	
RE02-52	Verify that the emissions are below the limit given in Table 10-2 : Field emissions limits	OK	14KHz-30MHz NOK 30MHz-15GHz OK	Annex B (Attach.B) Ref. NCR-PDS-CGS-C-142 Annex B (Attach.B)
RE02-53	Switch Off the "power switch "of "power switch box"	OK	OK	
RE02-54	Switch off the main bus	OK	OK	

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UUT DATA :	Model	PFM	Item	AMS02 Power Distribution System	C.I.	PDS 18	S/N	FM01

10.10 RS03 SECTION "A" RADIATED SUSCEPTIBILITY

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RS-E_R-0.1	**OBJECTIVE** To verify the immunity of the UUT to radiated electromagnetic susceptibility due to electrical field. The test is performed at closed box	The test is performed at closed box with the cables shielded. Since the most probable path of interference during irradiation are the cables, the goal of this test, with shielded cables, is to verify the immunity of the electronics boards and box itself. One by one the cables will be shielded and grounded to the copper table using aluminium paper.		
RS-E_R-0.2	**TEST SET-UP** Test set up is shown in Figure 6-12			Antenna is placed at 1m from the relative side that must be illuminated.
RS-E_R-0.3	**TEST FEATURE** For the unit irradiation see *Table 10-3: RS 03 Emission limits* Operational bus J100 connector, positive line (AI_120V) J100 connector, return (AI_120V_RTN)			
RS-E_R-0.4	**SUSCEPTIBILITY CRITERIA** The subsystem equipment shall not exhibit any malfunction, degradation of performance or deviation beyond the tolerance indicated in its individual specification.			
RS-E_R-0.5	**TEST RUN** Verify UUT is switched off	OK	OK	
RS-E_R-0.6	Connect the UUT as shown in Figure 6-12	OK	OK	
RS-E_R-0.7	Connect hot and return power bus line to power supply through the LISN	OK	OK	
RS-E_R-0.8	Verify UUT TE is switched on	OK	OK	
RS-E_R-0.9	Connect the oscilloscope to following outputs: TPD3	OK	TPD3 (PB2_1)	These voltages will be monitored during radiated field emission

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	ER1_N TPD0 TTPD_N ~~AH_TRD~~ CCEB (120V outlet)		ER1_N (PB2_2) TPD0 (PB2_3) CCEB (120V out)	With 4 channel oscilloscope the PB2-4 can not be monitored. SEE PVS 04
RS-E_R-0.10	Set main bus to 120V	120V ± 1V	120V	
RS-E_R-0.11	Switch ON the "power switch "of "power switch box"	OK	OK	
RS-E_R-0.12	Set the unit in nominal configuration	OK	OK	
RS-E_R-0.13	Take note of the input current from main bus	OK	18.0 A	Vin_meas = 118,4V (J300 box)
RS-E_R-0.14	Start with radiated ~~emission~~ susceptibility	OK	OK	SEE PVS 05
RS-E_R-0.15	During ~~emission~~ susceptibility verify the following parameters:	OK	OK	SEE PVS 05
RS-E_R-0.16	The voltage of: TPD3 ER1_N TPD0 TTPD_N ~~AH_TRD~~ CCEB (120V outlet)		200MHz-1GHz oriz 200MHz-1GHz vert 14KHz-10MHz 1GHz-2GHz oriz 1GHz-2GHz vert 2GHz-4GHz oriz 2GHz-4GHz vert 2,2GHz oriz 2,2GHz vert 4GHz-8GHz oriz 4GHz-8GHz vert 8GHz-10GHz vert 8,5GHz vert 8,5GHz oriz 8GHz-10GHz oriz 13,7GHz-15,2GHz oriz 13,7GHz-15,2GHz vert	Add acquired pictures in the end of the document See Annex A Fig. 156 to Fig. 187 SEE PVS 04
RS-E_R-0.17	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power	OK	OK	CAN BUS 30 check

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	Boards. All the flags shall be in the OK status			
RS-E_R-0.18	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
RS-E_R-0.19	Read from remote the telemetries indicated in "Read input" software window: Vbus Ibus	120V±9.5V 16,00A<Iin<20,00A	122,5V 17,7A	Telemetries check
RS-E_R-0.20	Switch Off the "power switch "of "power switch box"	OK	OK	Perform this action when the emissions have been completed
RS-E_R-0.21	Switch off main bus	OK	OK	

Frequency/Range	Radiated Electric Field Level
14 kHz–10 MHz	5 V/m
200 MHz–8 GHz	60 V/m
8 GHz–10 GHz	20 V/m
2.2 GHz	161 V/m
8.5 GHz	79 V/m
13.7 GHz–15.2 GHz	250 V/m

Table 10-3: RS 03 Emission limits

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10.11 RS03 SECTION "B" RADIATED SUSCEPTIBILITY

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
RS-E_R-0.22	**OBJECTIVE** To verify the immunity of the UUT to radiated electromagnetic susceptibility due to electrical field. The test is performed at closed box	The test is performed at closed box with the cables shielded. Since the most probable path of interference during irradiation are the cables, the goal of this test, with shielded cables, is to verify the immunity of the electronics boards and box itself. One by one the cables will be shielded and grounded to the copper table using aluminium paper.		
RS-E_R-0.23	**TEST SET-UP** Test set up is shown in Figure 6-12			Antenna is placed to 1m from the relative side that must be illuminated.
RS-E_R-0.24	**TEST FEATURE** For the unit irradiation see *Table 10-3: RS 03 Emission limits* Operational bus J200 connector, positive line (BI_120V) J200 connector, return (BI_120V_RTN)			
RS-E_R-0.25	**SUSCEPTIBILITY CRITERIA** The subsystem equipment shall not exhibit any malfunction, degradation of performance or deviation beyond the tolerance indicated in its individual specification.			
RS-E_R-0.26	TEST RUN Verify UUT is switched off	OK	OK	
RS-E_R-0.27	Connect the UUT as shown in Figure 6-12	OK	OK	
RS-E_R-0.28	Connect hot and return power bus line to power supply through the LISN	OK	OK	
RS-E_R-0.29	Verify UUT TE is switched on	OK	OK	
RS-E_R-0.30	Connect the oscilloscope to following outputs: TPD3	OK	TPD3 (PB2_1)	These voltages will be monitored during radiated field emission

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	ER1_N TPD0 TTPD_N ~~BH_TRD~~ CCEB (120V outlet)		ER1_N (PB2_2) TPD0 (PB2_3) CCEB (120V out)	With 4 channel oscilloscope the PB2-4 can not be monitored. **SEE PVS 04**
RS-E_R-0.31	Set main bus to 120V	120V ± 1V	120V	
RS-E_R-0.32	Switch ON the "power switch "of "power switch box"	OK	OK	
RS-E_R-0.33	Set the unit in nominal configuration	OK	OK	
RS-E_R-0.34	Take note of the input current from main bus	OK	18.0 A	Vin_meas = 118,4V (J300 box)
RS-E_R-0.35	Start with emission susceptibility emission	OK	OK	
RS-E_R-0.36	During emissions verify the following parameters:	OK	OK	
RS-E_R-0.37	The voltage of: TPD3 ER1_N TPD0 TTPD_N ~~BH_TRD~~ CCEB (120V outlet)		200MHz-1GHz oriz 200MHz-1GHz vert 14KHz-10MHz 1GHz-2GHz oriz 1GHz-2GHz vert 2GHz-4GHz oriz 2GHz-4GHz vert 2,2GHz oriz 2,2GHz vert 4GHz-8GHz oriz 4GHz-8GHz vert 8GHz-10GHz vert 8,5GHz vert 8,5GHz oriz 8GHz-10GHz oriz 13,7GHz-15,2GHz oriz 13,7GHz-15,2GHz vert	Add acquired pictures in the end of the document See Annex A Fig. 188 to Fig. 219 **SEE PVS 04**
RS-E_R-0.38	From remote, with CAN BUS 30 monitor the OK/NOK flags of all the Power	OK	OK	CAN BUS 30 check

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STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
	Boards. All the flags shall be in the OK status			
RS-E_R-0.39	From remote, with CAN BUS 31 monitor the OK/NOK flags of all the Power Boards. All the flags shall be in the OK status	OK	OK	CAN BUS 31 check
RS-E_R-0.40	Read from remote the telemetries indicated in "Read input" software window: Vbus Ibus	120V±9.5V 16,00A<Iin<20,00A	123,6V 17,16A	Telemetries check
RS-E_R-0.41	Switch Off the "power switch "of "power switch box"	OK	OK	Perform this action when the emissions have been completed
RS-E_R-0.42	Switch off main bus	OK	OK	

DATE: 7-15/09/09	TEST CONDUCTOR	QA	CUSTOMER

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UUT DATA :	Model PFM	Item AMS02 Power Distrribution System	C.I. PDS 18	S/N FM01

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS

11.CONCLUSIONS

The unit

AMS02-PDS
Model: PFM
Part number: 10-AMS02PDS-000.00
Serial number: FM01

tested according to the EMC test procedure PDS-PR-CGS-016_Is2, is compliant with the requirement of the specification AMS-RQ-CGS-002 Is1 with the following exception:

Radiated emission out of limits in the low range of frequency spectrum (from about 70kHz up to about 25MHz) for both side A and side B of unit: see NCR-PDS-CGS-C-142.

Additional note: during radiated susceptibility first verification, <u>without cable shielded</u>, a low susceptibility (few reading) of some temp tlm has been observed in the range 200MHz-300MHz. With cable shielding the anomaly is not observed anymore. Test without shield is not representative.

DATE: 7-15/09/09	TEST CONDUCTOR GFzoio	QA	CUSTOMER

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12. PVS COLLECTION

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PROCEDURE VARIATION SHEET ref. N°: 01

Test Procedure Ref.: **PDS-PR-CGS-016 Is.2**	Page Revised: 49	Paragraph Revised: 10.2.2

Description of Change:

WAS

Set the time base of the oscilloscope to 10uS

IS

Set the time base of the oscilloscope to 100ns

Reason for Change:

Typing error

CONCURRENCE

Test Cond.	QA	System Eng.		Customer
Date 31-7/2-8 2009	Date 31-07/02-2009	Date 31-7/2-8 2009		Date

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PROCEDURE VARIATION SHEET ref. N°: 02

Test Procedure Ref.: **PDS-PR-CGS-016 Is.2**	Page Revised: 128	Paragraph Revised: 10.8

Description of Change: Additional radiated emission test

WAS

Missing test

IS

Added paragraph "10.8.1 RE02, SECTION "A" RADIATED EMISSIONS cables shielded"

Reason for Change:

Due to some out of spec founded in the results of the Radiated emission test in the previouse paragraph 10.8, an additional test sequence is performed shielding the cables with aluminium foil.

CONCURRENCE

Test Cond	QA	System Eng.		Customer
Date 7-15/09/09	Date 7-15/09/09	Date 7-15/09/09		Date

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PROCEDURE VARIATION SHEET ref. N°: 03

Test Procedure Ref.: **PDS-PR-CGS-016 Is.2**	Page Revised: 130	Paragraph Revised: 10.9

Description of Change: Shielding added on the cables

Step RE02-37

WAS

To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits
The test is performed at closed box

IS

To verify that UUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits
The test is performed at closed box with the cables shielded.
Since the most probable path of emission are the cables, the goal of this test, with shielded cables, is to verify the emission of the electronics boards and box itself.
One by one the cables will be shielded and grounded to the copper table using aluminium paper.

Reason for Change:

Test on side B of the unit is performed directly with cables shielded as already implemented for the Side A test.

CONCURRENCE

Test Cond	QA	System Eng.		Customer
Date 7-15/09/09	Date 7-15/09/09	Date 7-15/09/09		Date

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PROCEDURE VARIATION SHEET ref. N°: 04

Test Procedure Ref.: **PDS-PR-CGS-016 Is.2**	Page Revised: 131, 136	Paragraph Revised: 10.10 and 10.11

Description of Change: 120V output line monitor

Step RS-E_R-0.9, RS-E_R-0.6

WAS
TPD3
ER1_N
TPD0
TTPD_N
AH_TRD (120V outlet)

IS
TPD3
ER1_N
TPD0
TTPD_N
~~AH_TRD~~ CCEB (120V outlet)

Step RS-E_R-0.30, RS-E_R-0.37

WAS
TPD3
ER1_N
TPD0
TTPD_N
BH_TRD (120V outlet)

IS
TPD3
ER1_N
TPD0
TTPD_N
~~BH_TRD~~ CCEB (120V outlet)

Reason for Change:

Typing error

CONCURRENCE

Test Cond.	QA	System Eng.		Customer
Date 7-15/07/09	Date 7-15/09/09	Date 7-15/07/09		Date

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PROCEDURE VARIATION SHEET ref. N°: 05

Test Procedure Ref.: **PDS-PR-CGS-016 Is.2**	Page Revised: 131	Paragraph Revised: 10.10

Description of Change: Shielding added on the cables

Step RS-E_R-0.14, RS-E_R-0.15

WAS

Start with radiated emission

IS

Start with radiated ~~emission~~ susceptibility

Step RS-E_R-0.15

WAS

During emission verify the following parameters:
IS

During ~~emission~~ susceptibility verify the following parameters:

Reason for Change:

Typing error

CONCURRENCE

Test Cond	QA	System Eng.		Customer
Date 7-15/09/09	Date 7-15/09/09	Date 7-15/09/09		Date

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13.ANNEX A - PICTURES COLLECTION

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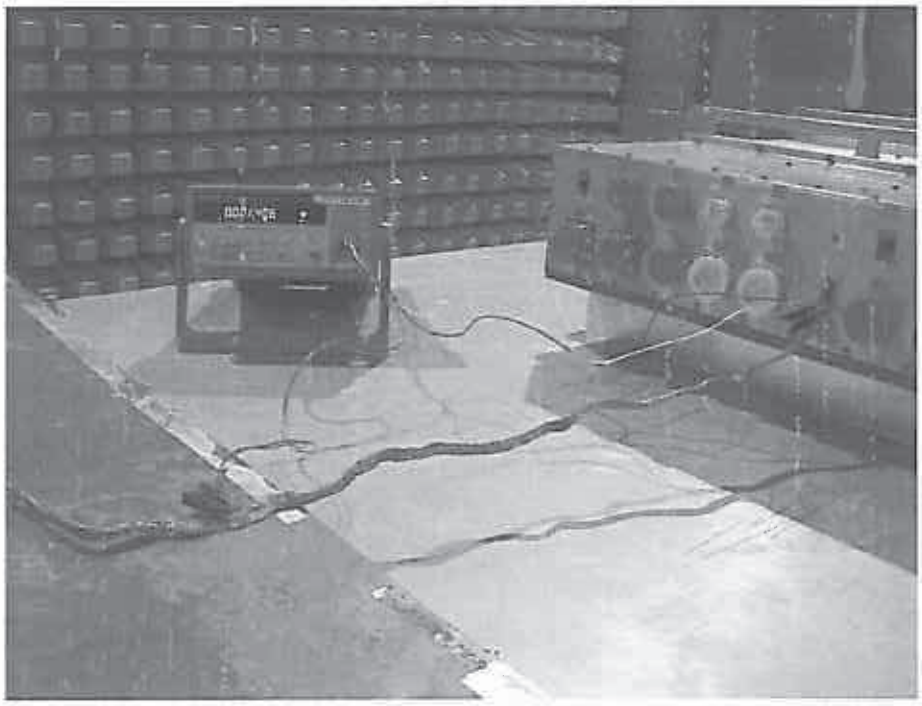


Figure 1 : UNIT bonding strap measurement

Step B-02.4

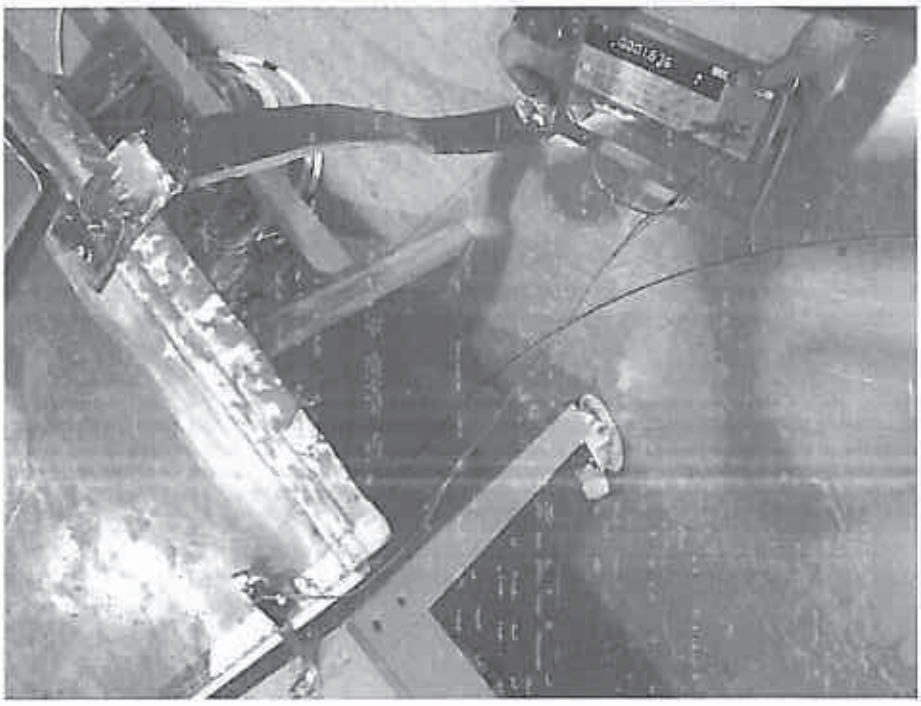
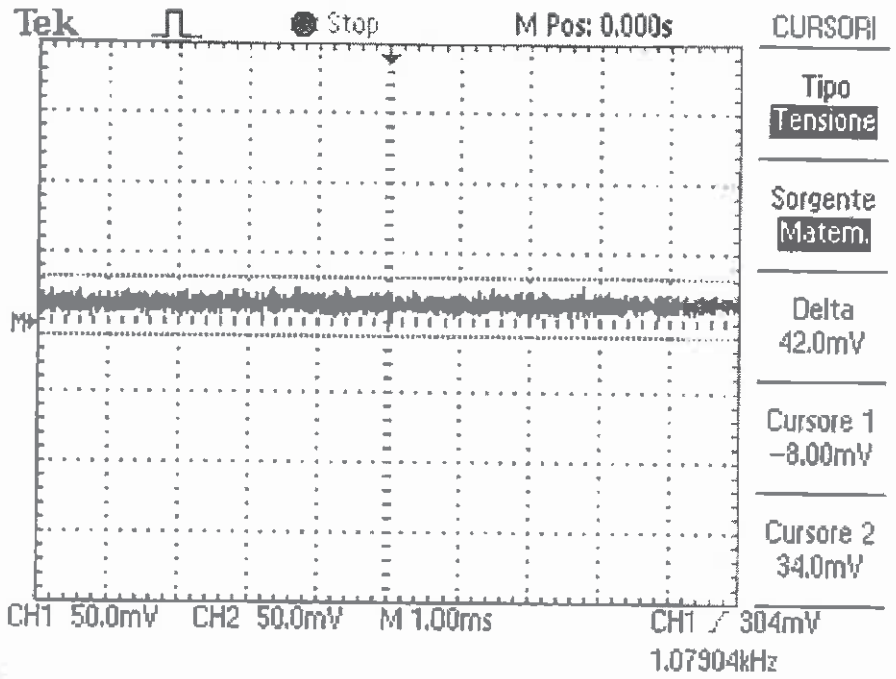


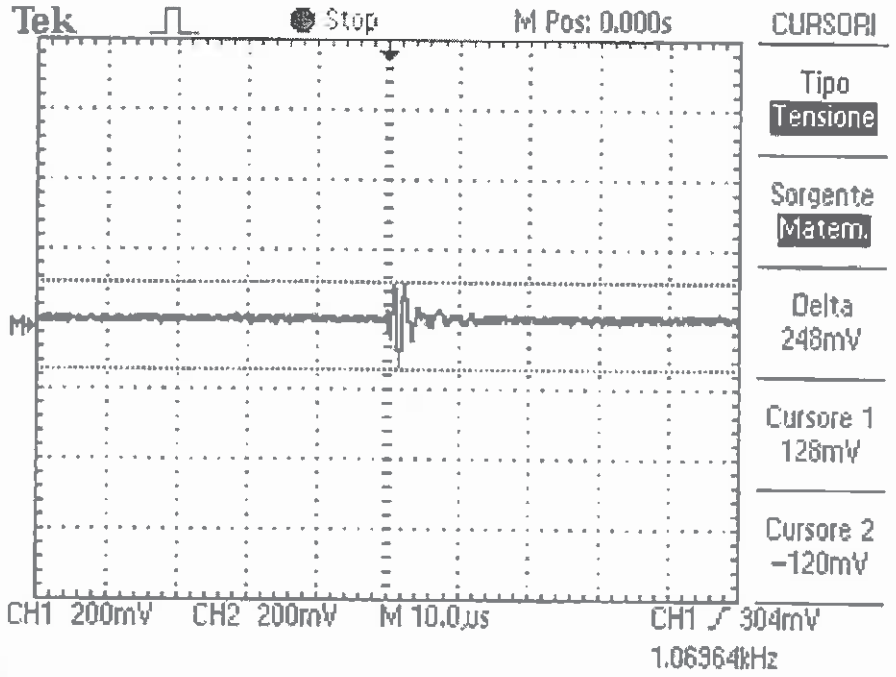
Figure 2 :: Test Site bonding strap measurement

Step B-02.7



Step EC-02.8

Figure 3: Side A background noise



Step EC-02.8

Figure 4: Side A background noise

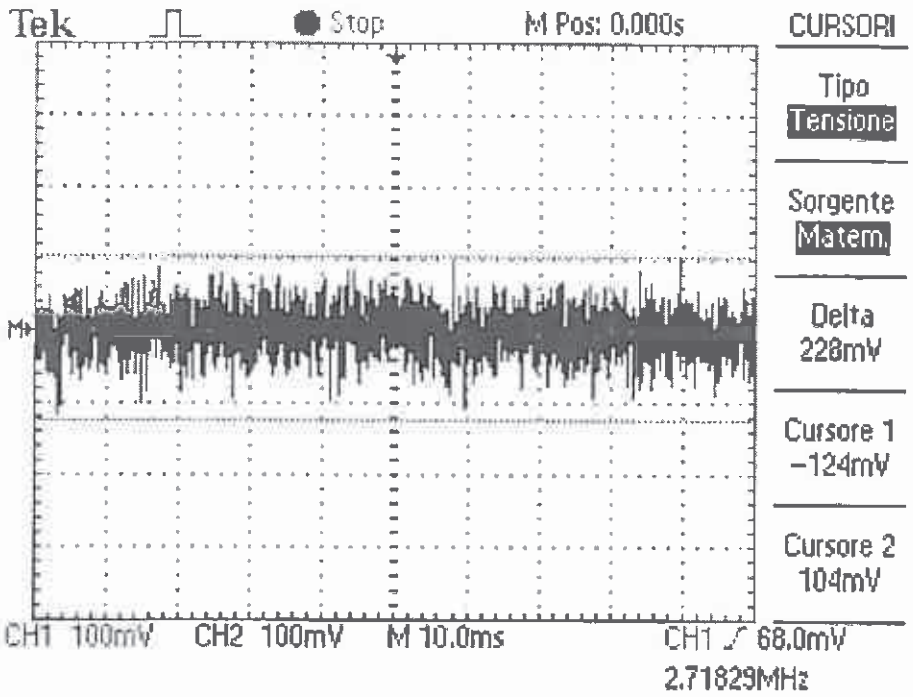


Figure 5: Side A ripple voltage and noise

Step EC-02.19

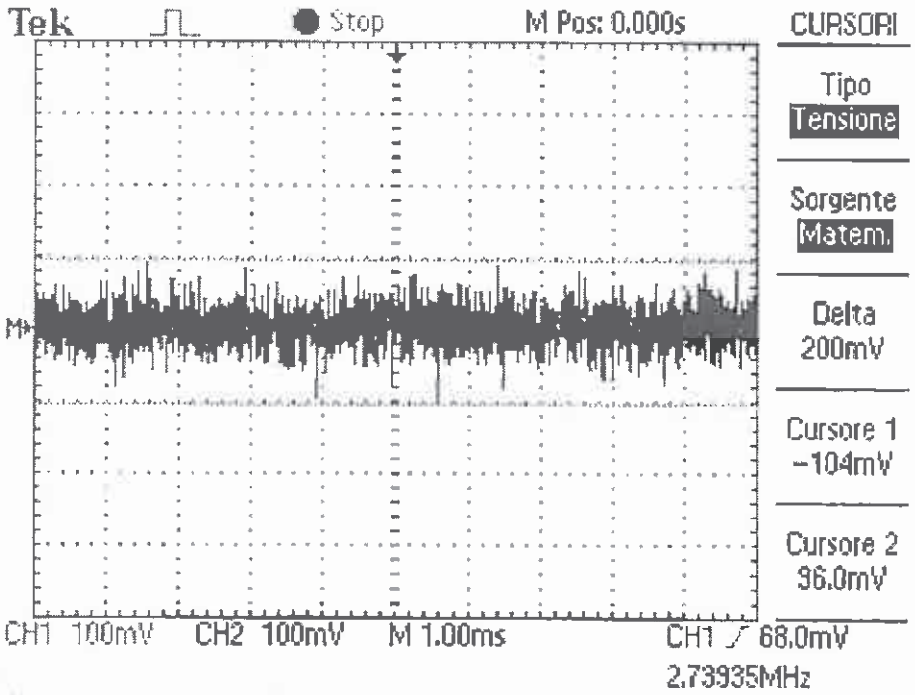


Figure 6: Side A ripple voltage and noise

Step EC-02.21

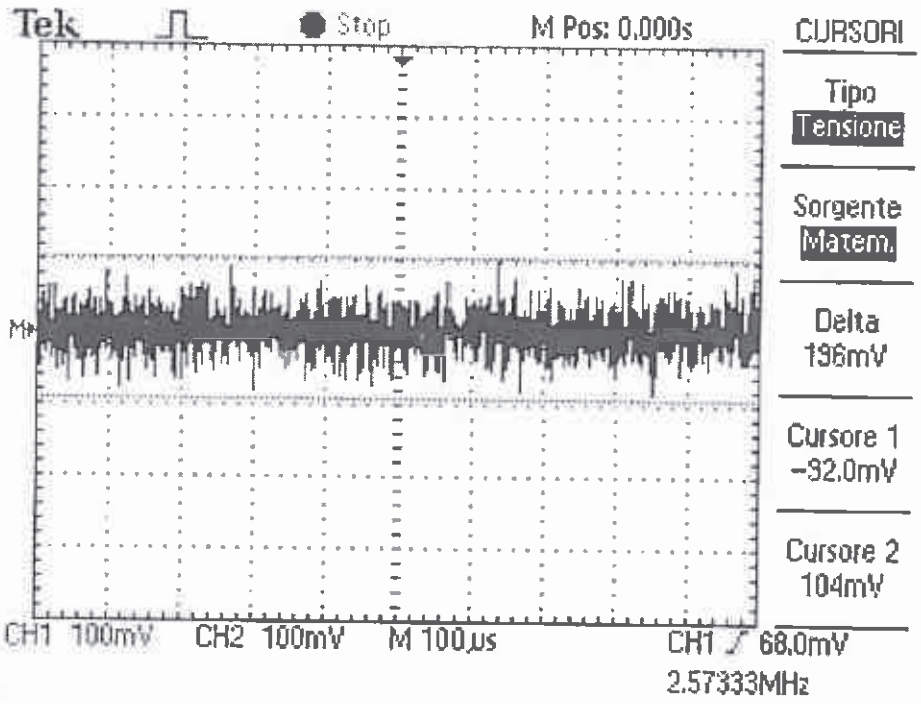


Figure 7: Side A ripple voltage and noise

Step EC-02.23

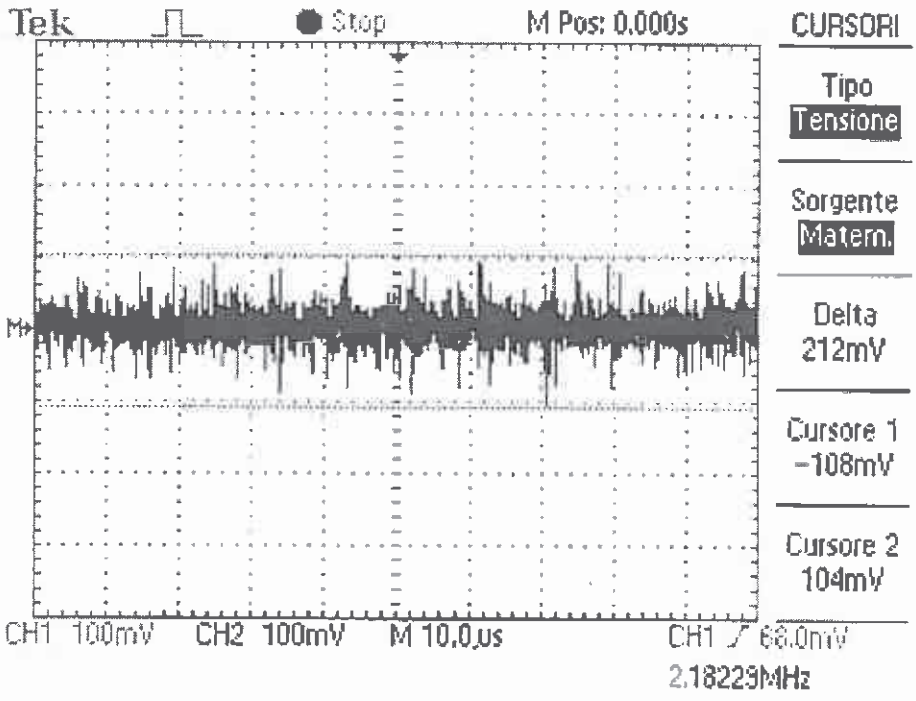


Figure 8: Side A ripple voltage and noise

Step EC-02.25

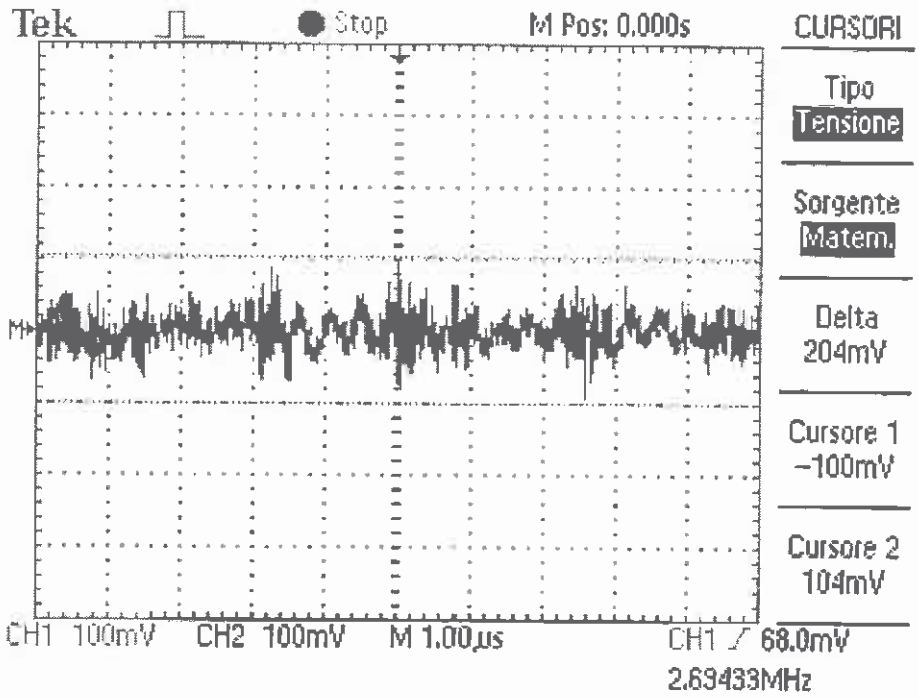


Figure 9: Side A ripple voltage and noise

Step EC-02.27

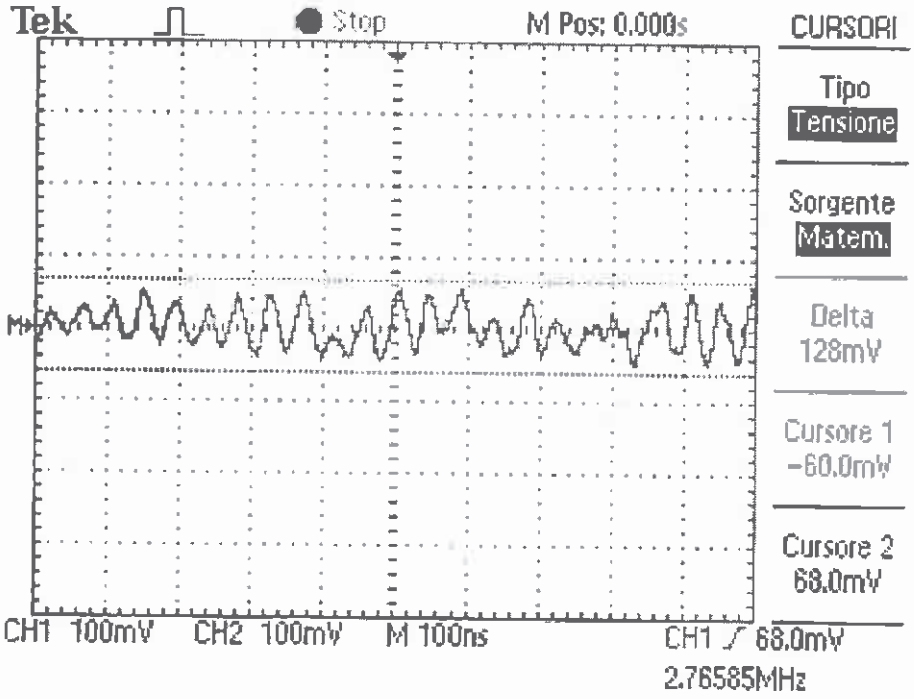
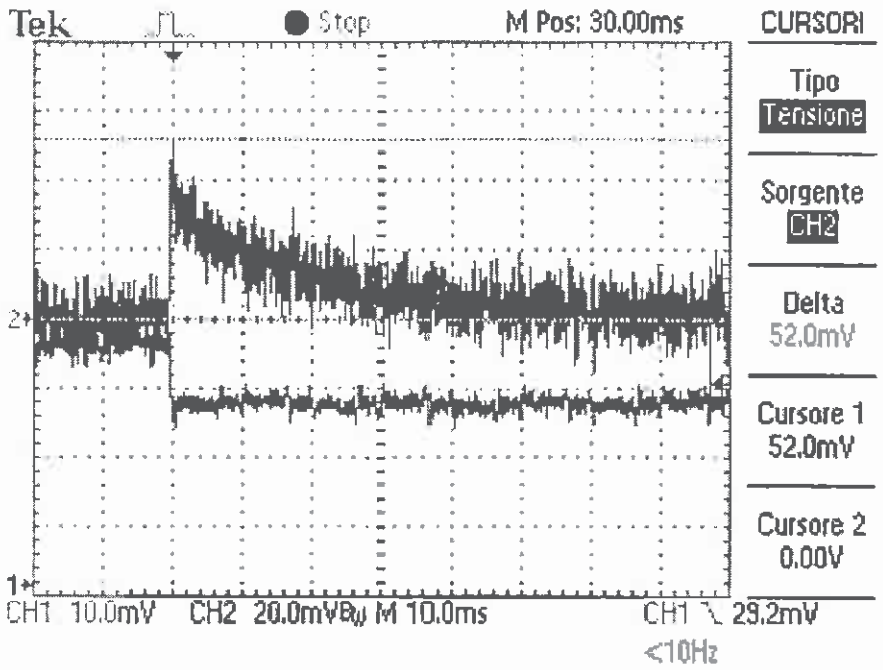


Figure 10: Side A ripple voltage and noise

Step EC-02.29

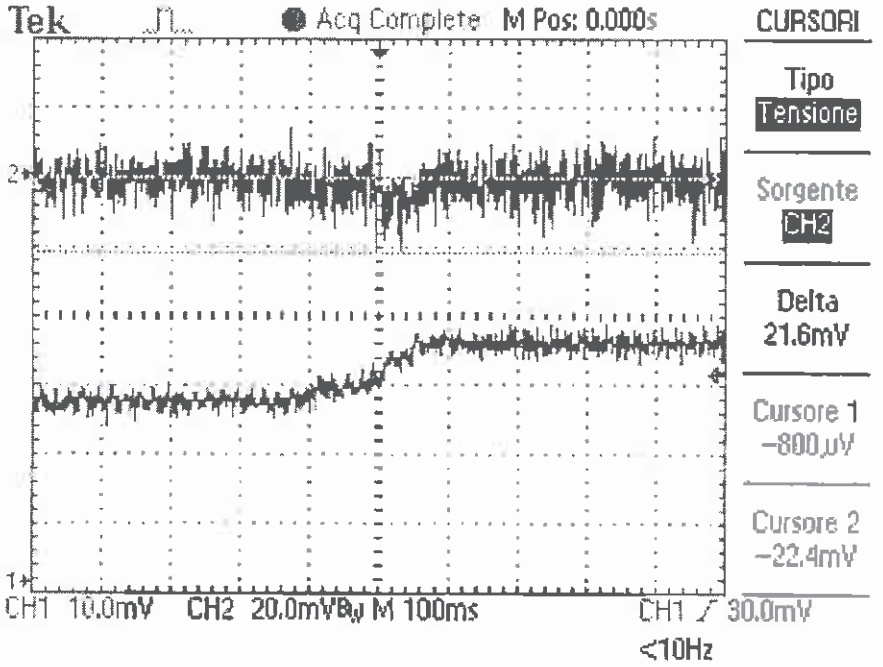


Step EC-03.11

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 11: Side A Load transient during PB2-2 switching OFF



Step EC-03.15

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 12: Side A Load transient during PB2-2 switching ON

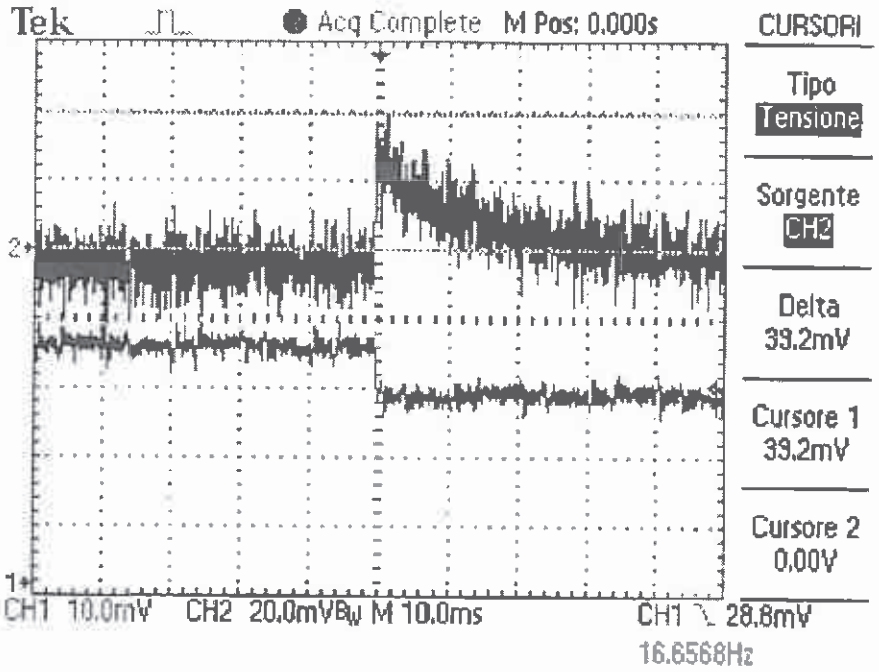


Figure 13: Side A Load transient during E3-B Out12 switching OFF

Step EC-03.19

Ch.2 = Vout x 10

Ch.4 = I 5A/div

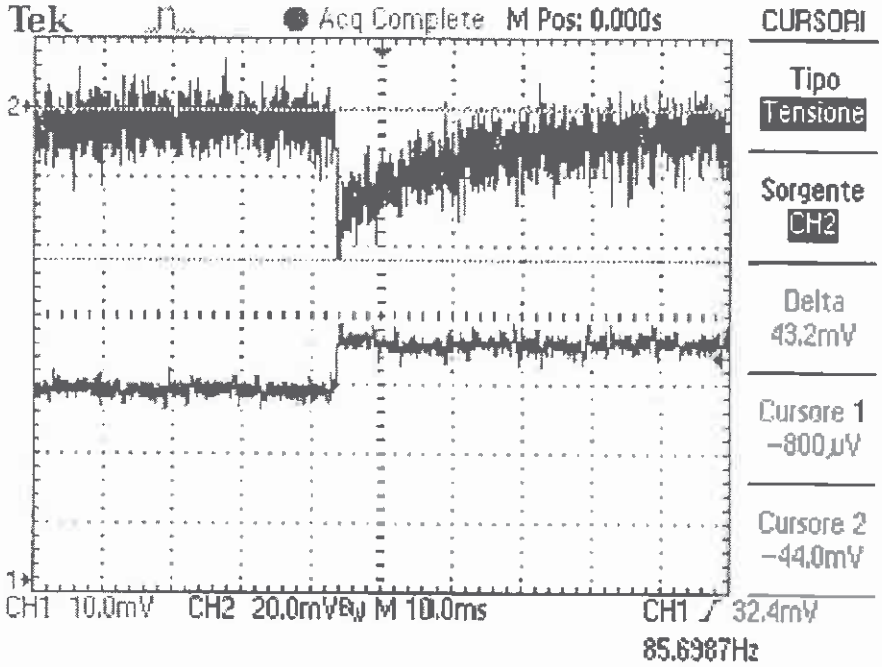
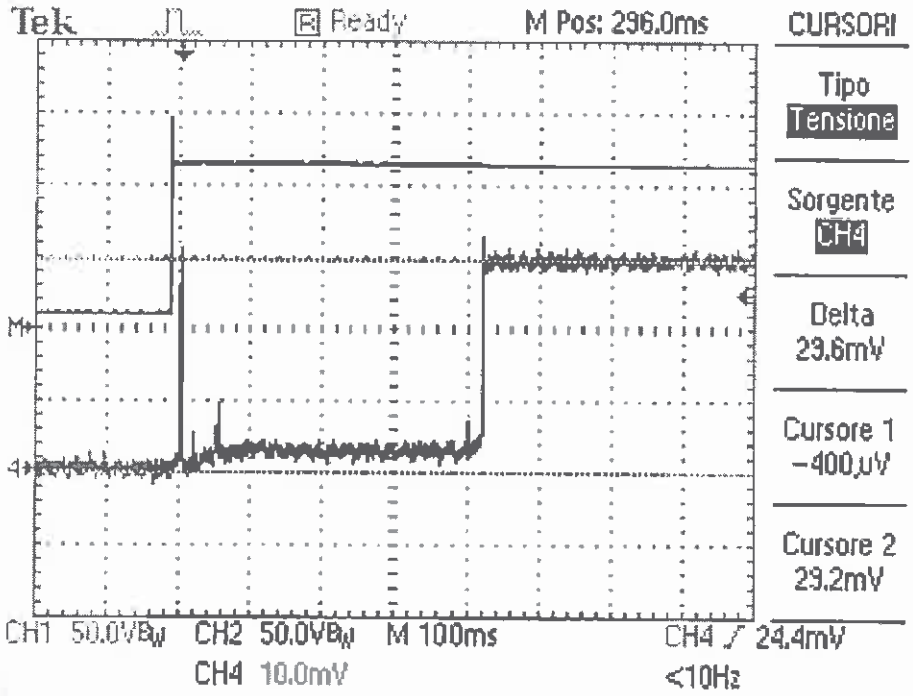


Figure 14: Side A Load transient during E3-B Out12 switching ON

Step EC-03.23

Ch.2 = Vout x 10

Ch.4 = I 5A/div

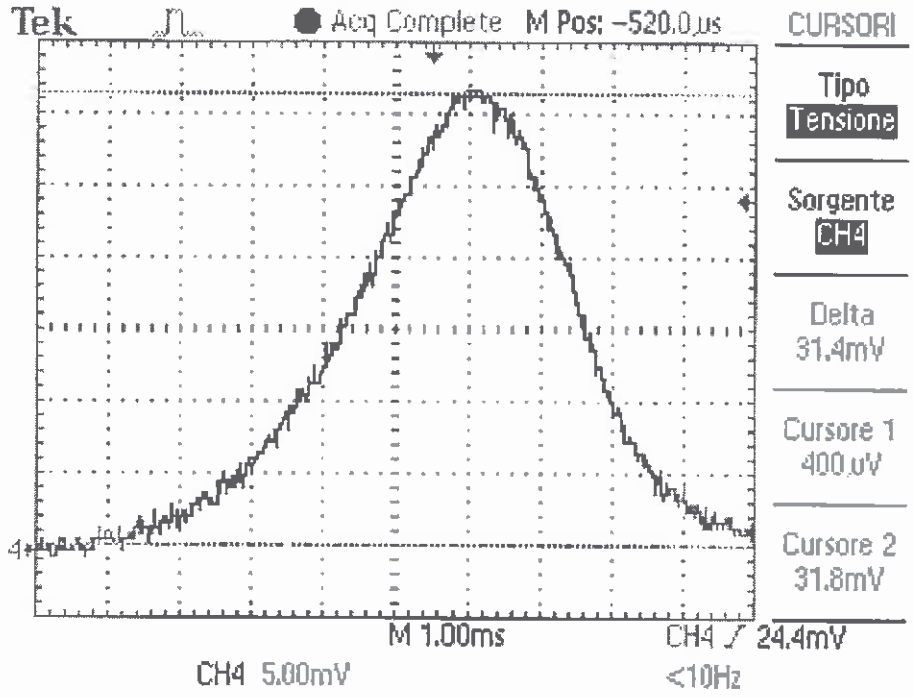


Step EC-04.14

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

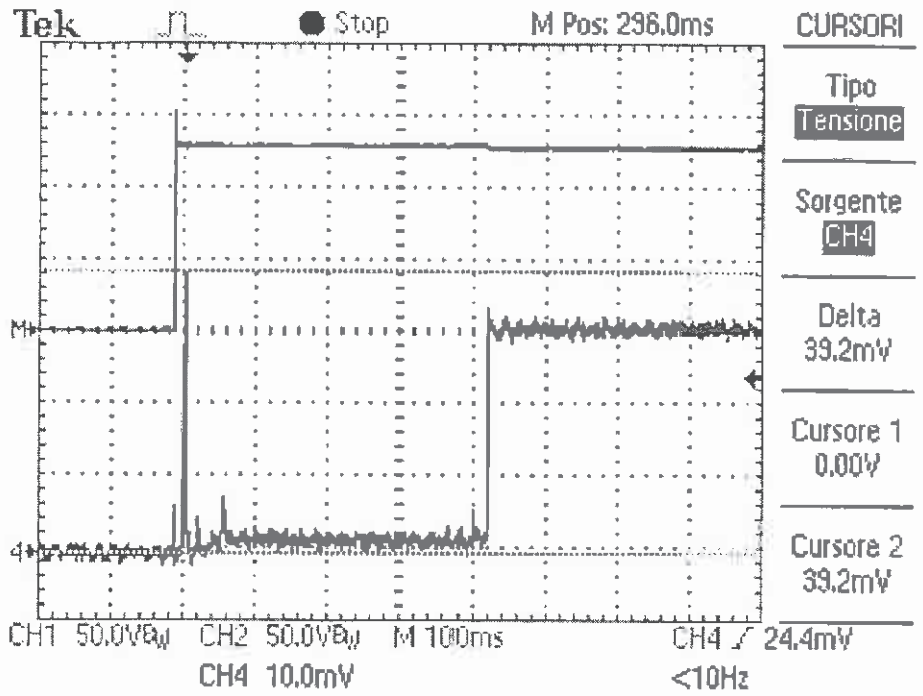
Figure 15: Side A peak and surge current at 113V



Step EC-04.14

Ch.4 = Iinput 5A/div

Figure 16: Side A peak and surge current at 113V

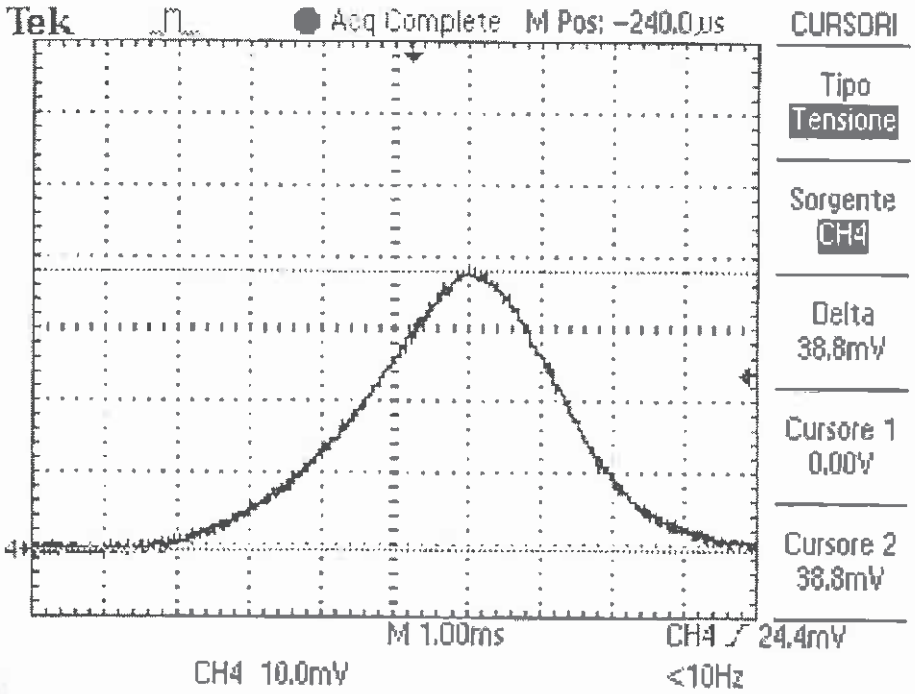


Step EC-04.14

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

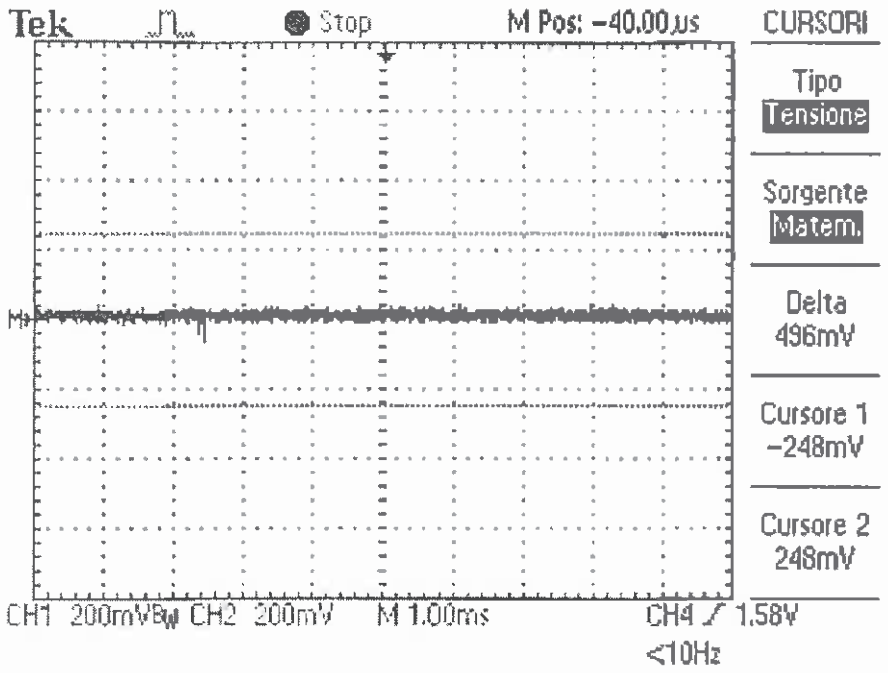
Figure 17: Side A peak and surge current at 126V



Step EC-04.14

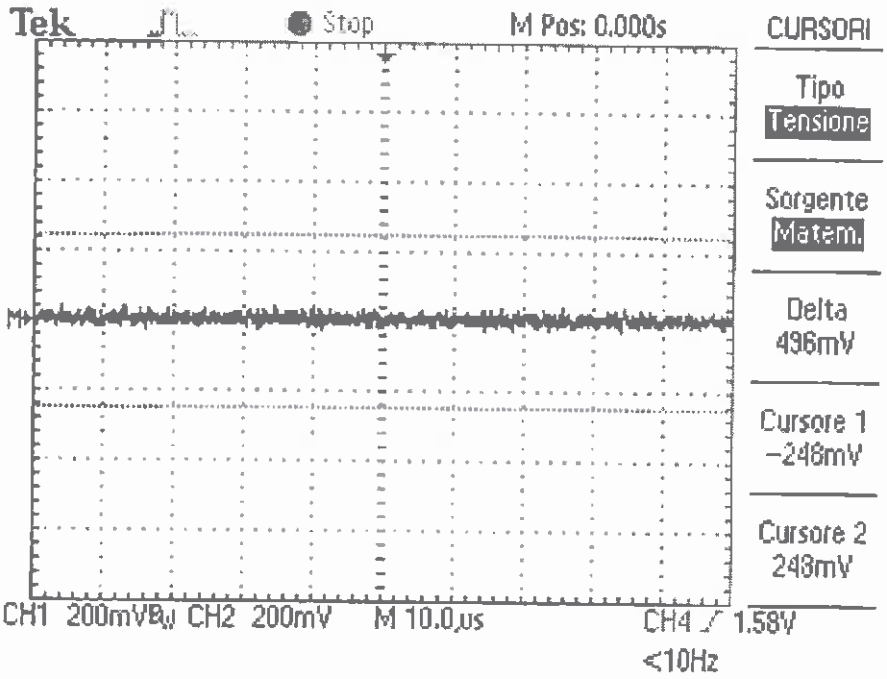
Ch.4 = Iinput 5A/div

Figure 18: Side A peak and surge current at 126V



Step EC-02.39

Figure 19: Side B background noise



Step EC-02.39

Figure 20: Side B background noise

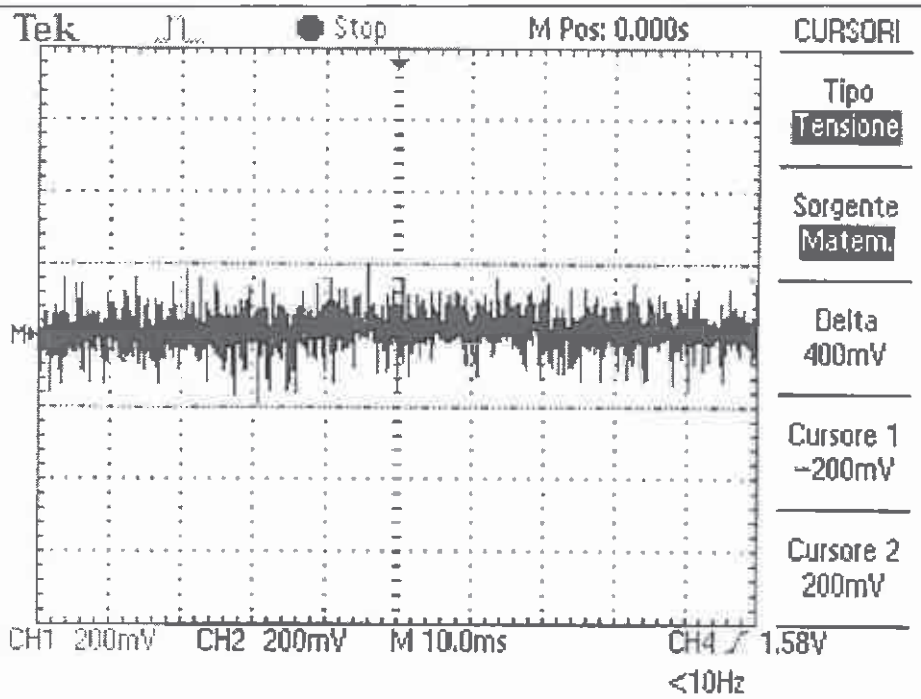


Figure 21: Side B ripple voltage and noise

Step EC-02.50

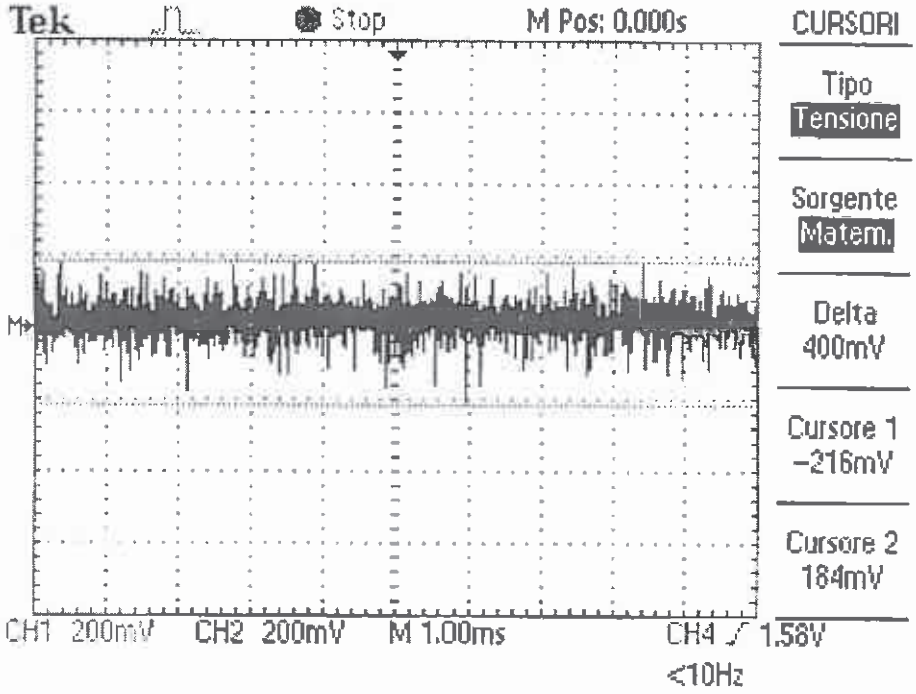


Figure 22: Side B ripple voltage and noise

Step EC-02.52

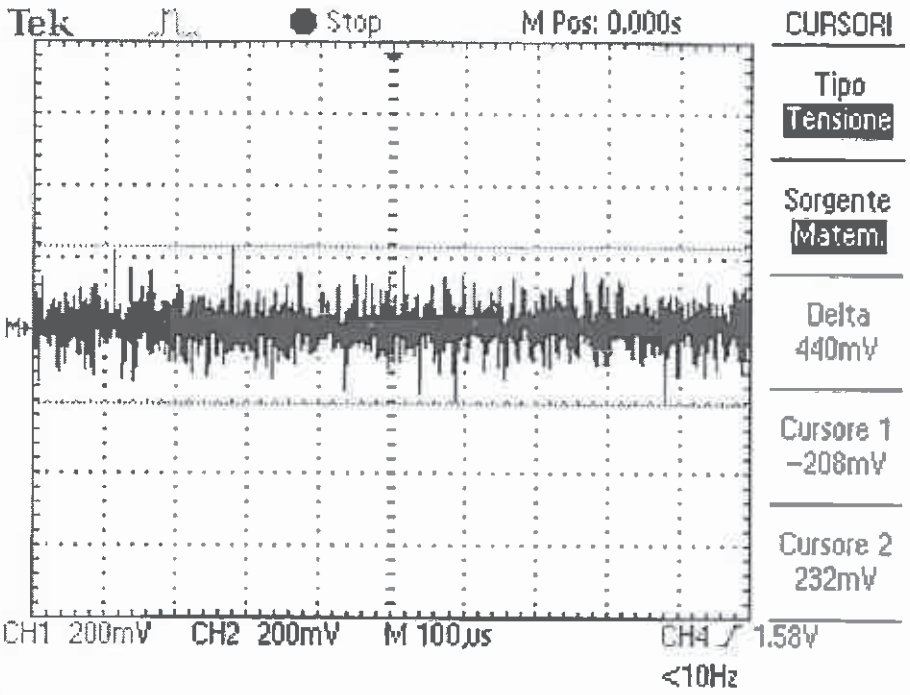


Figure 23: Side B ripple voltage and noise

Step EC-02.54

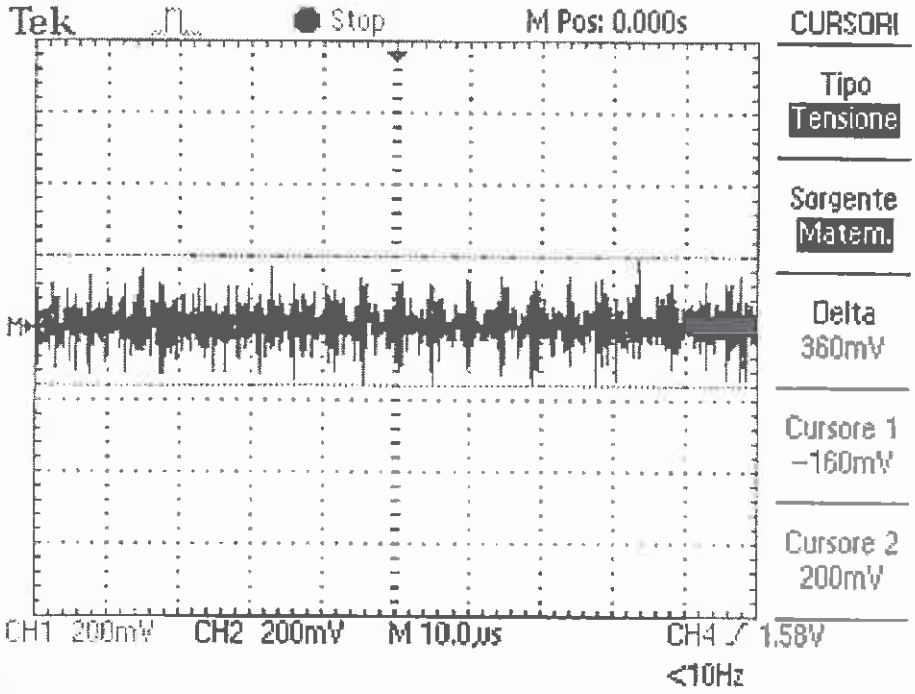


Figure 24: Side B ripple voltage and noise

Step EC-02.56

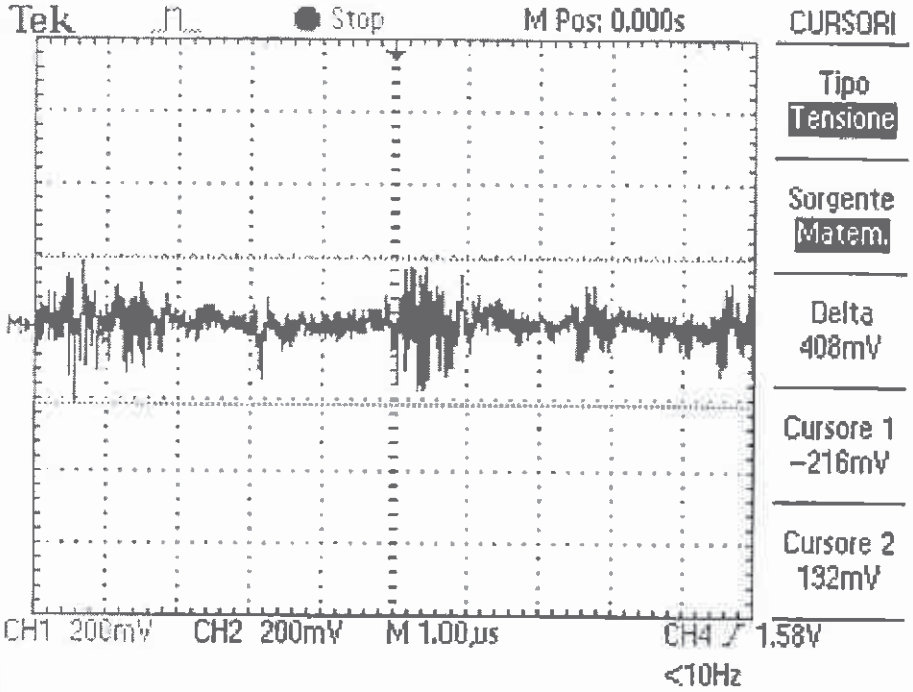


Figure 25: Side B ripple voltage and noise

Step EC-02.58

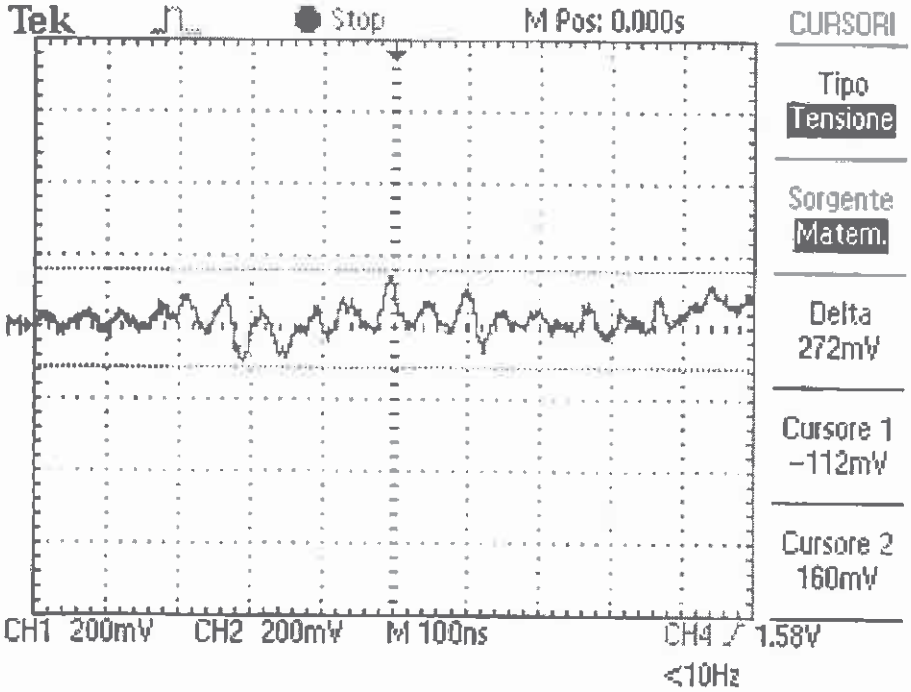
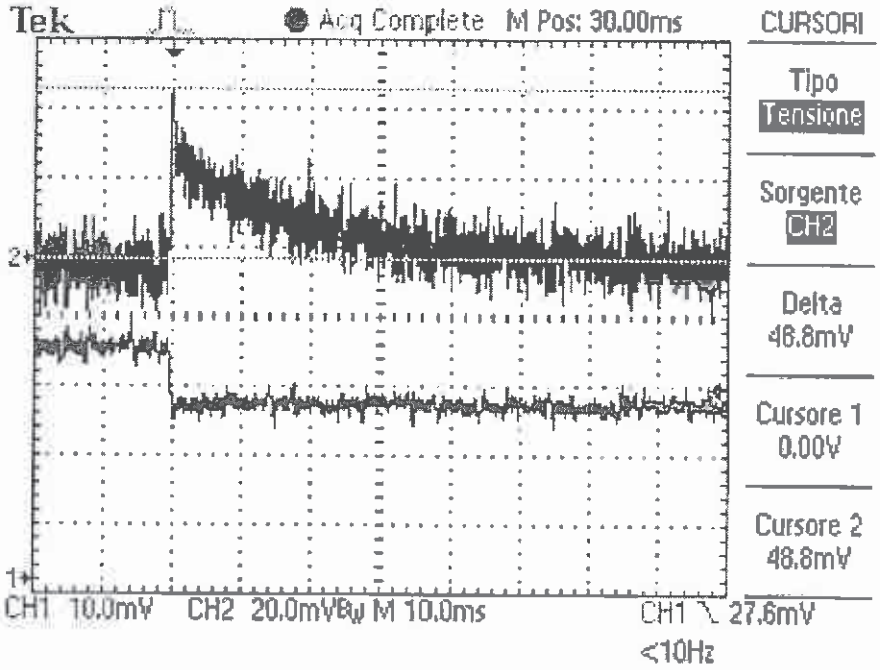


Figure 26: Side B ripple voltage and noise

Step EC-02.60

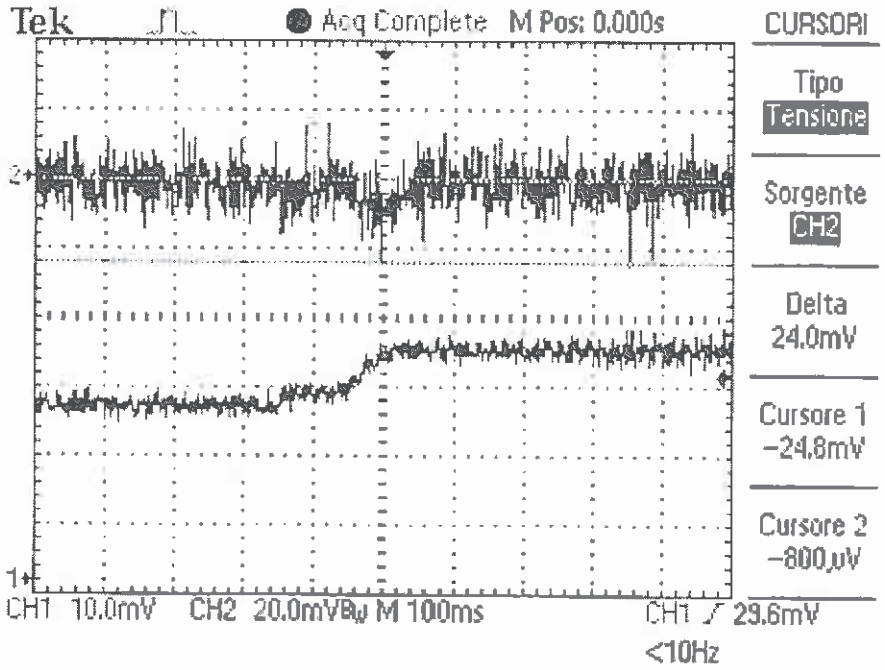


Step EC-03.37

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 27: Side B Load transient during PB2-2 switching OFF

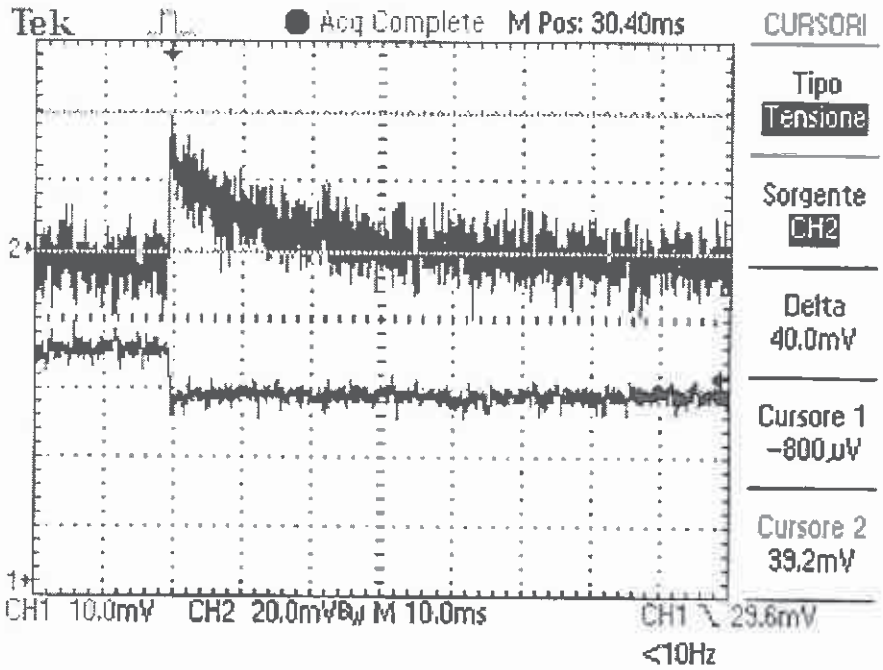


Step EC-03.41

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 28: Side B Load transient during PB2-2 switching ON

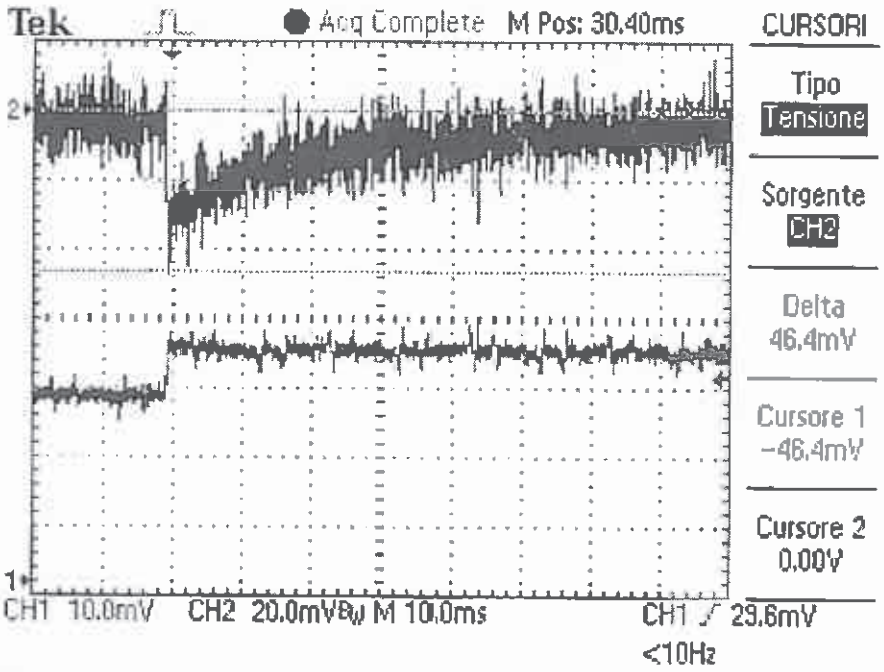


Step EC-03.45

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 29: Side B Load transient during E3-B Out12 switching OFF

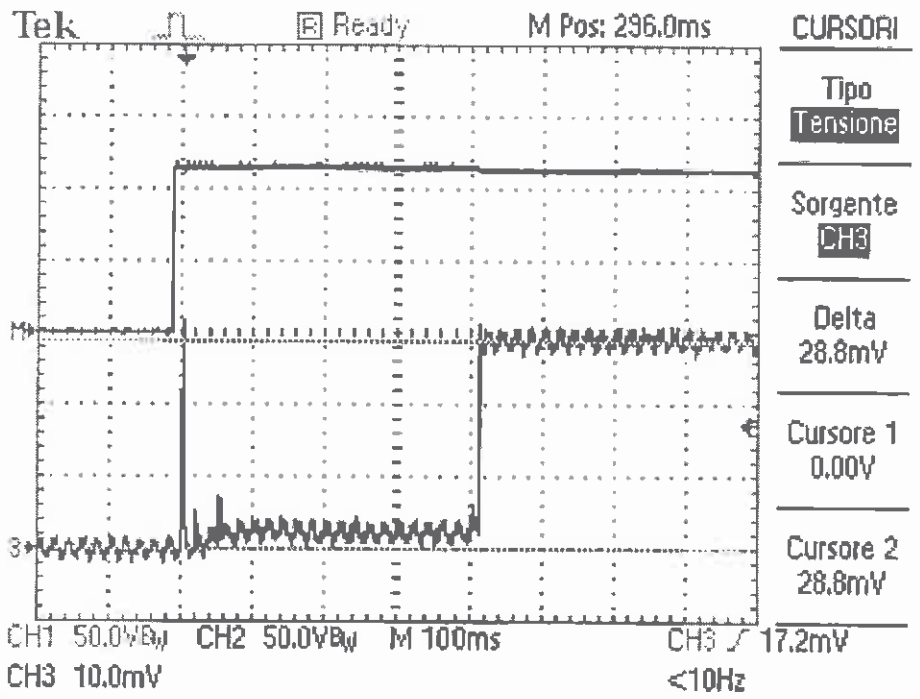


Step EC-03.49

Ch.2 = Vout x 10

Ch.4 = I 5A/div

Figure 30: Side B Load transient during E3-B Out12 switching ON

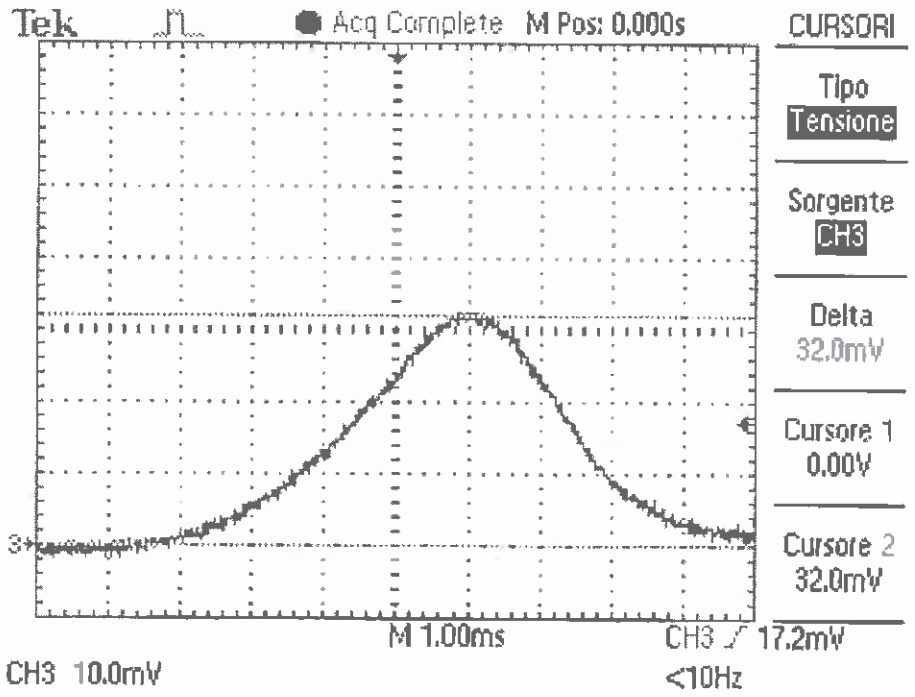


Step EC-04.41

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

Figure 31: Side B peak and surge current at 113V

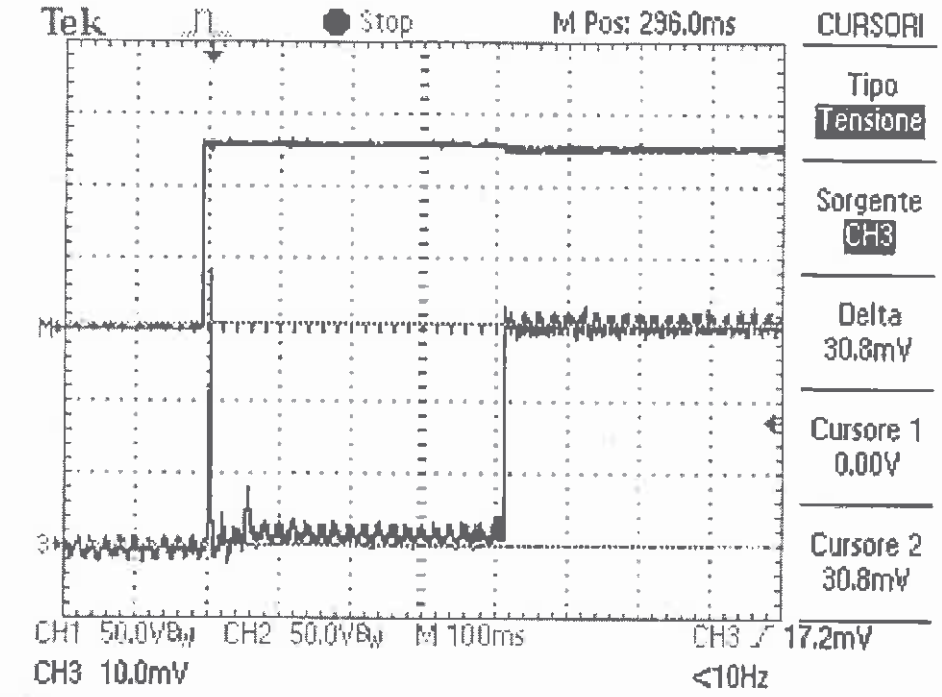


Step EC-04.41

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

Figure 32: Side B peak and surge current at 113V

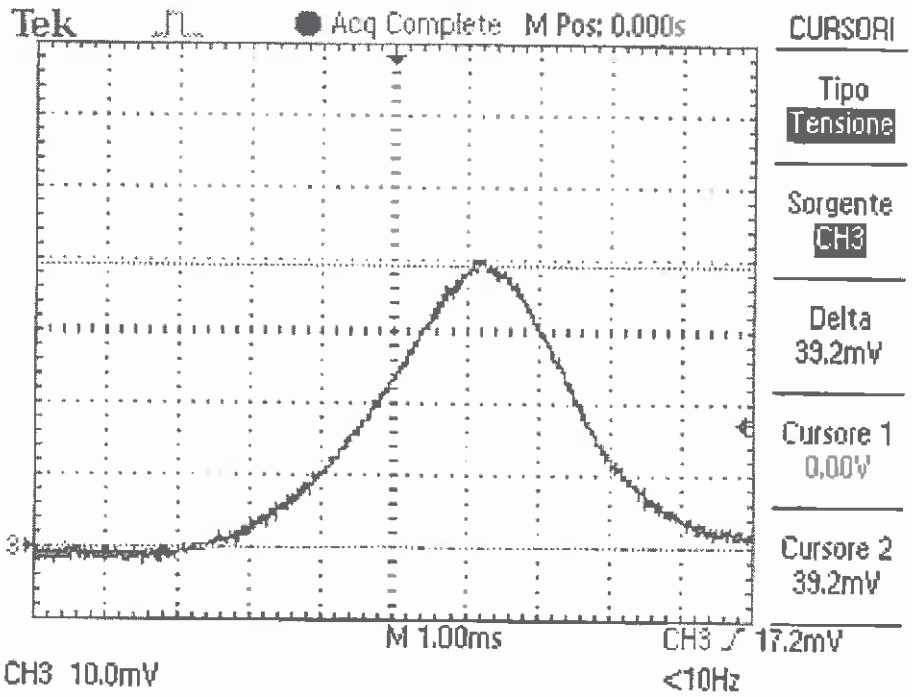


Step EC-04.49

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

Figure 33: Side B peak and surge current at 126V

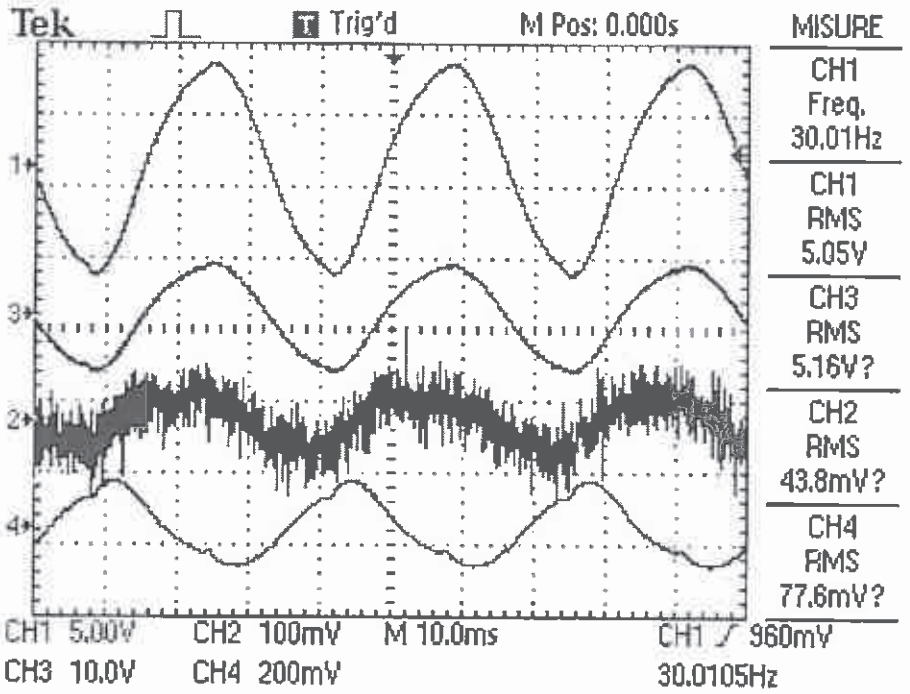


Step EC-04.49

Ch. M = Vinput bus

Ch.4 = Iinput 5A/div

Figure 34: Side B peak and surge current at 126V



Step
SC-01.18
SC-01.19

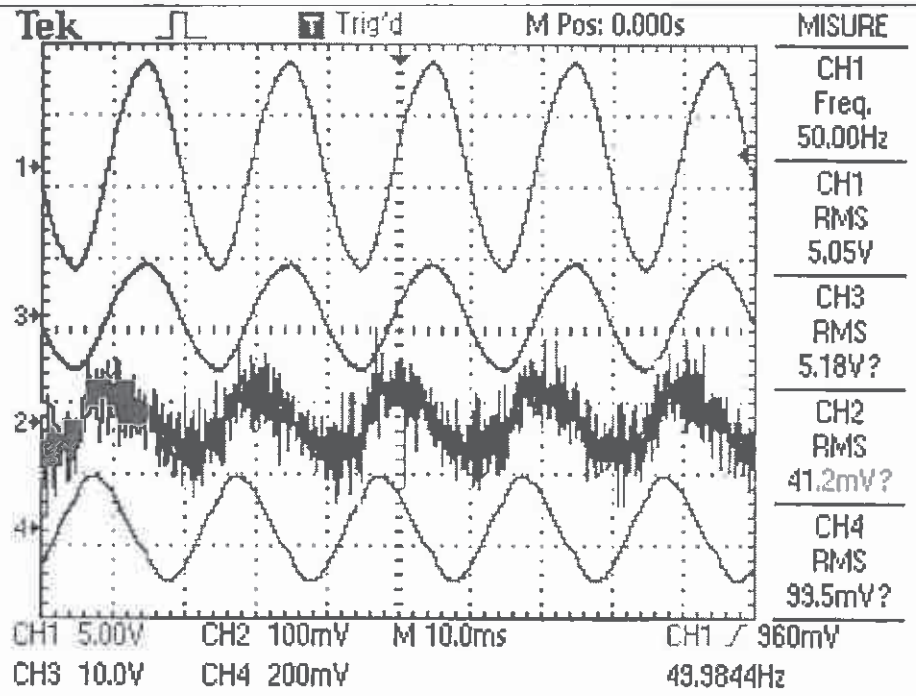
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 35: Side A Sine Wave Injection 30Hz



Step
SC-01.18
SC-01.19

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 36: Side A Sine Wave Injection 50Hz

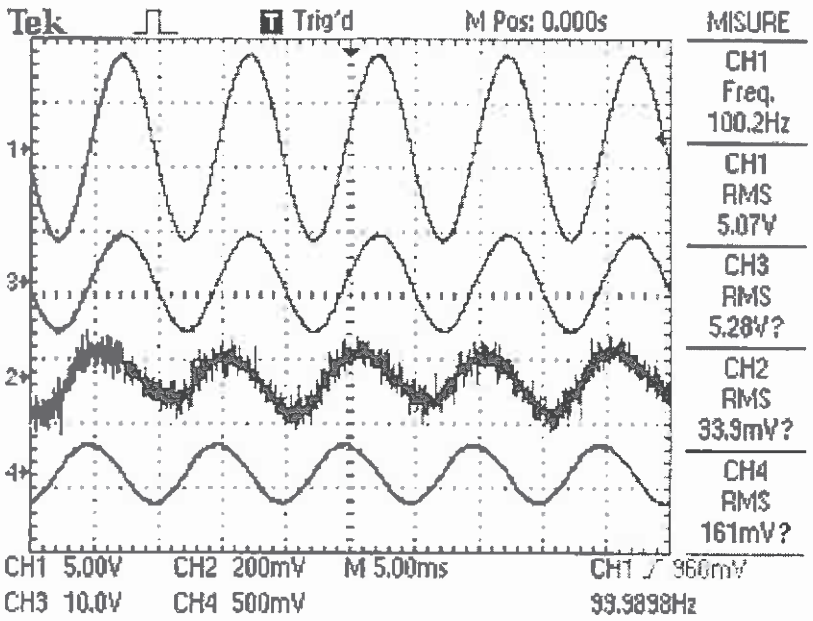


Figure 37: Side A Sine Wave Injection 100Hz

Step SC-01.18 SC-01.19

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

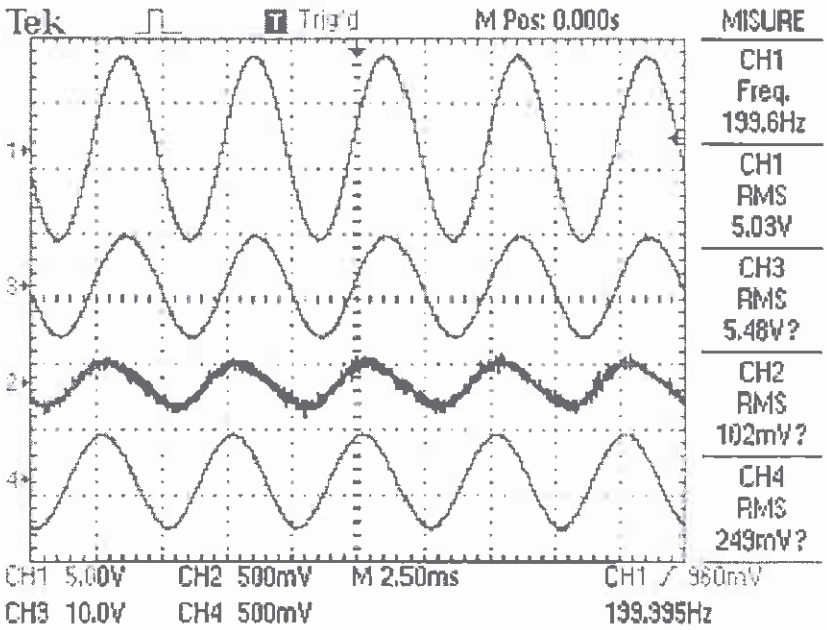


Figure 38: Side A Sine Wave Injection 200Hz

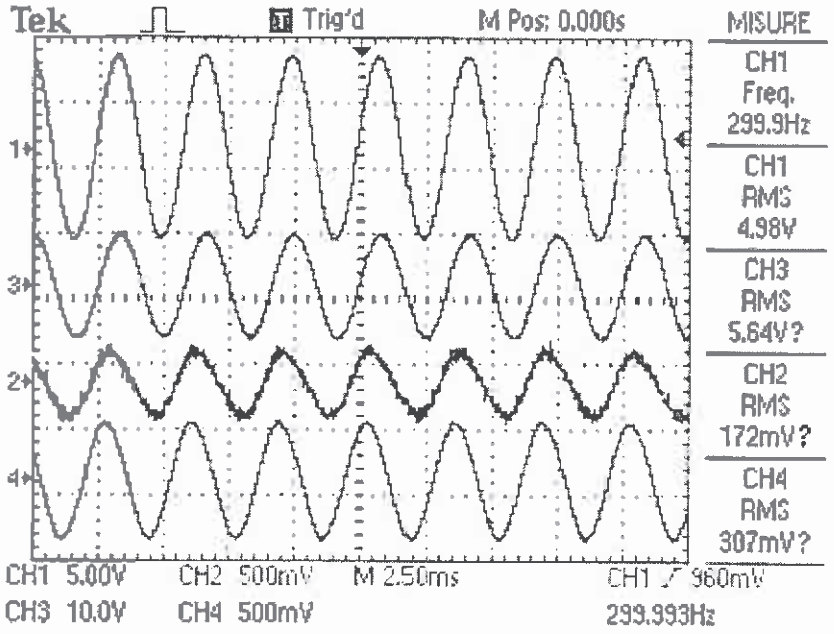
Step SC-01.18 SC-01.19

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Step
SC-01.18
SC-01.19

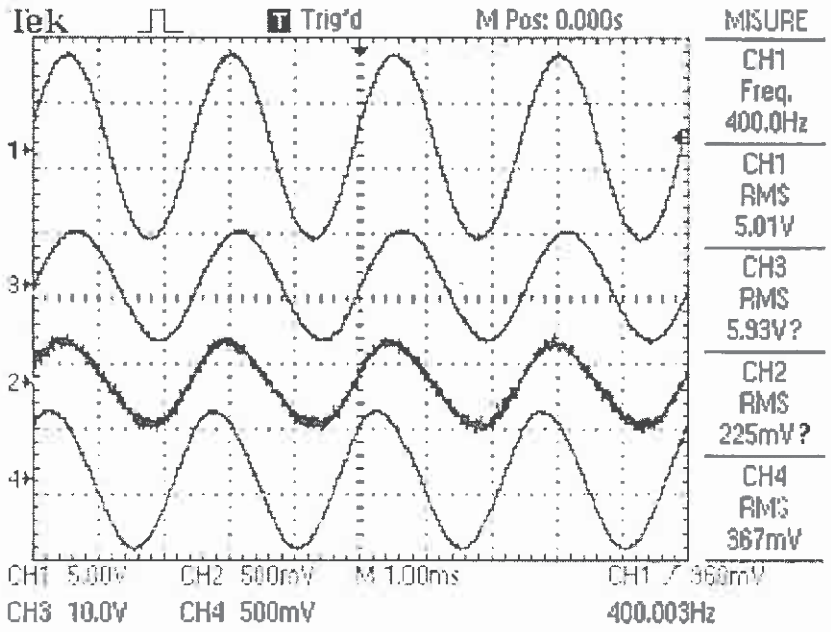
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 39: Side A Sine Wave Injection 300Hz



Step
SC-01.18
SC-01.19

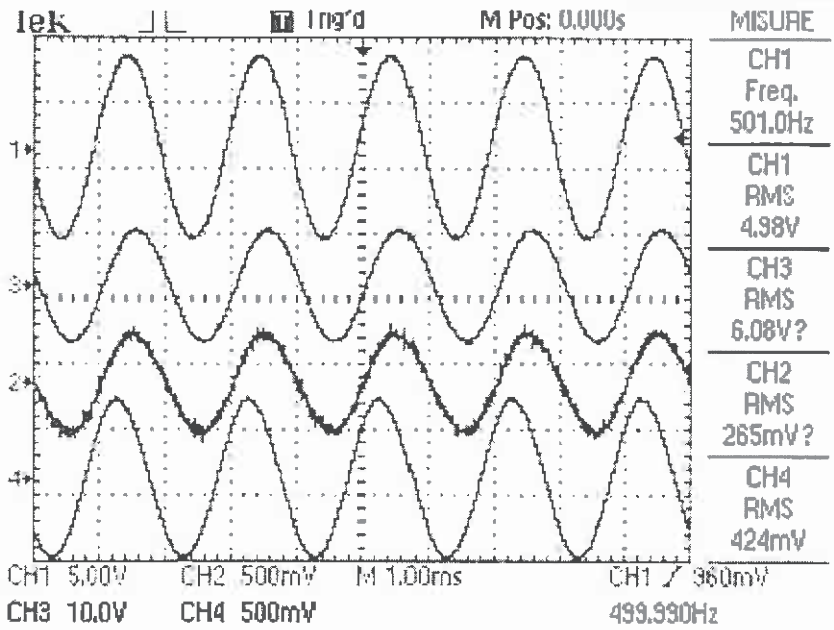
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 40: Side A Sine Wave Injection 400Hz



Step
SC-01.18
SC-01.19

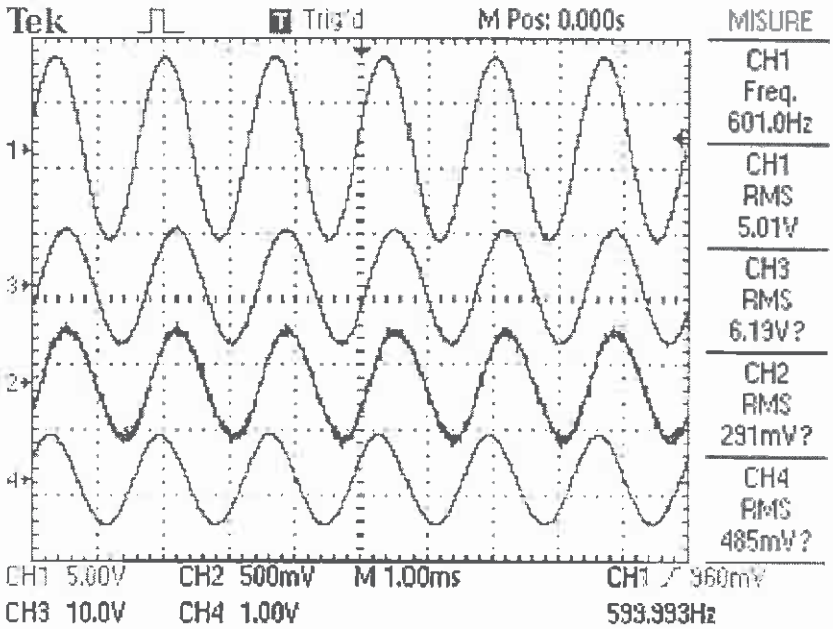
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 41: Side A Sine Wave Injection 500Hz



Step
SC-01.18
SC-01.19

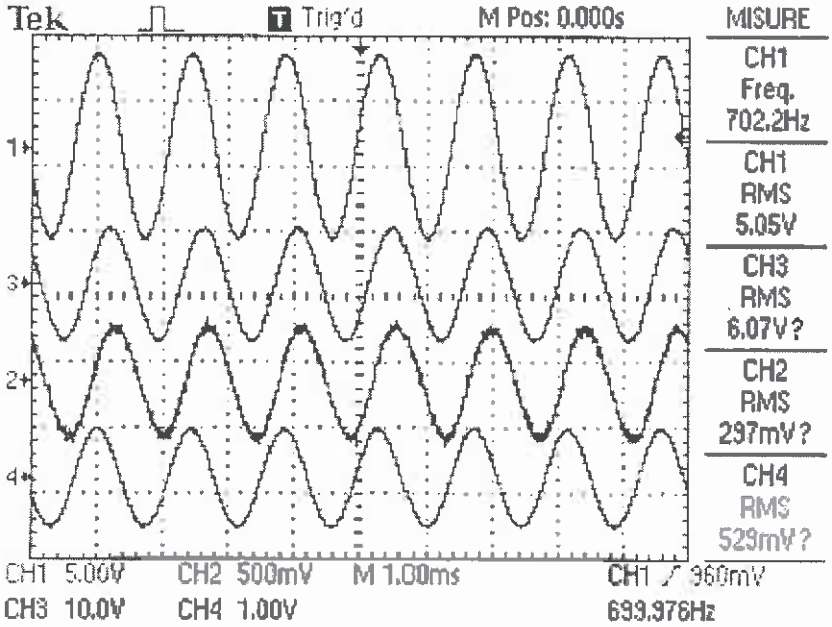
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 42: Side A Sine Wave Injection 600Hz



Step
SC-01.18
SC-01.19

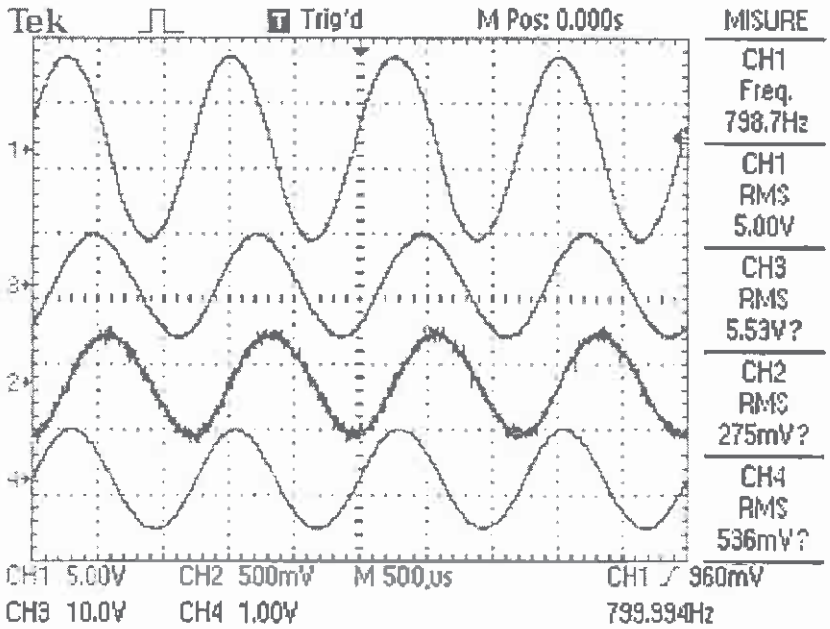
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 43: Side A Sine Wave Injection 700Hz



Step
SC-01.18
SC-01.19

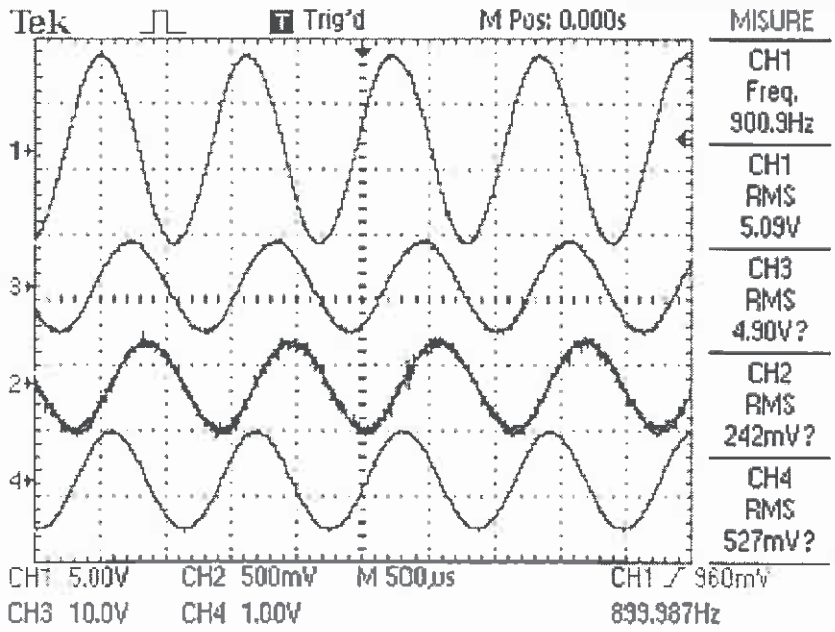
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 44: Side A Sine Wave Injection 800Hz



Step
SC-01.18
SC-01.19

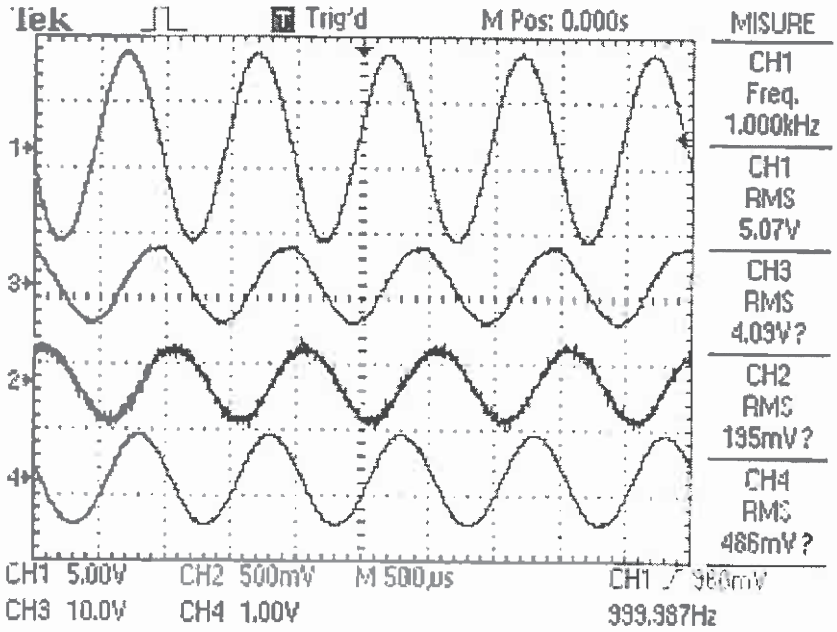
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 45: Side A Sine Wave Injection 900Hz



Step
SC-01.18
SC-01.19

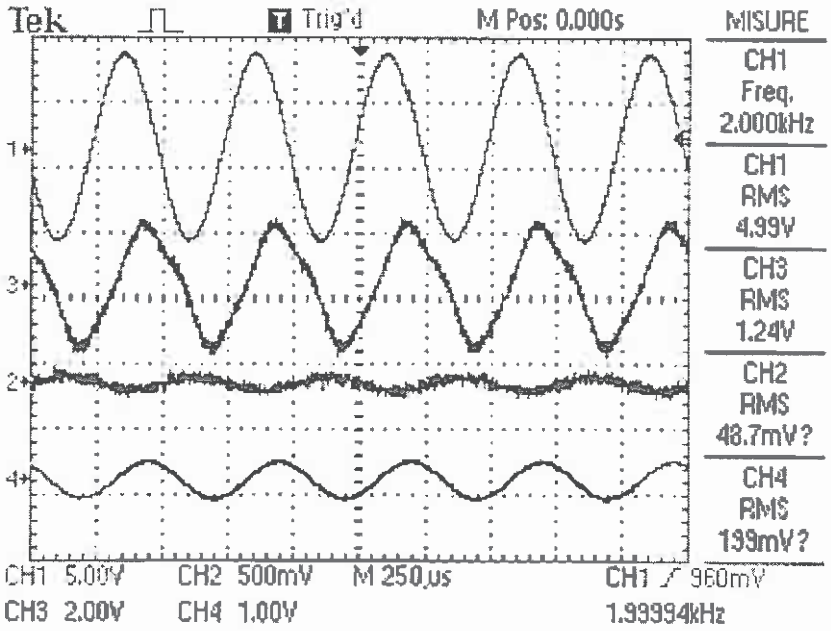
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 46: Side A Sine Wave Injection 1KHz



Step
SC-01.18
SC-01.19

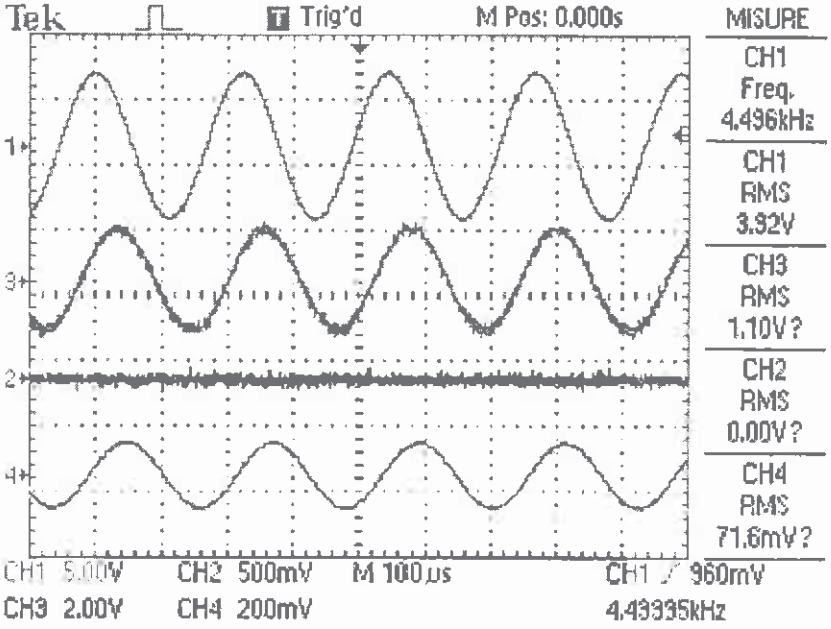
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 47: Side A Sine Wave Injection 2KHz



Step
SC-01.18
SC-01.19

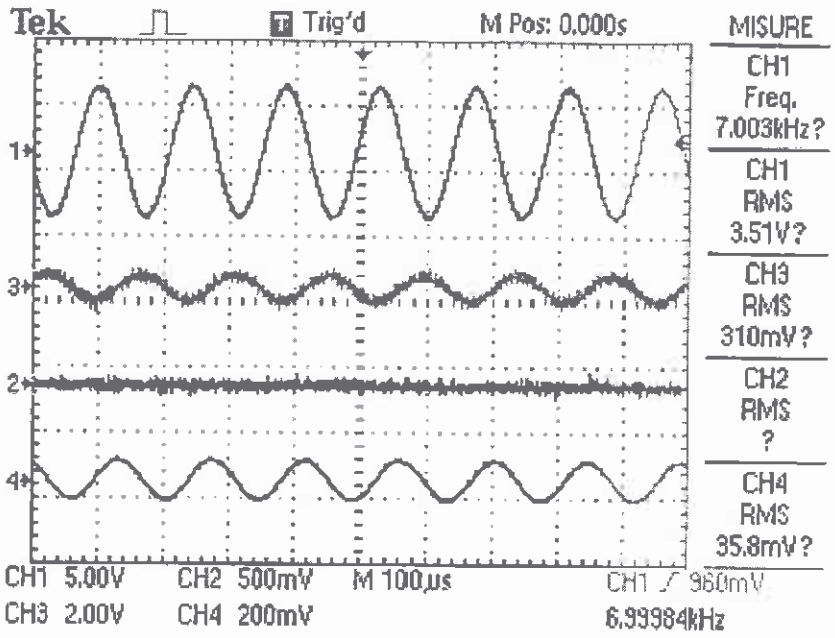
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 48: Side A Sine Wave Injection 5KHz



Step
SC-01.18
SC-01.19

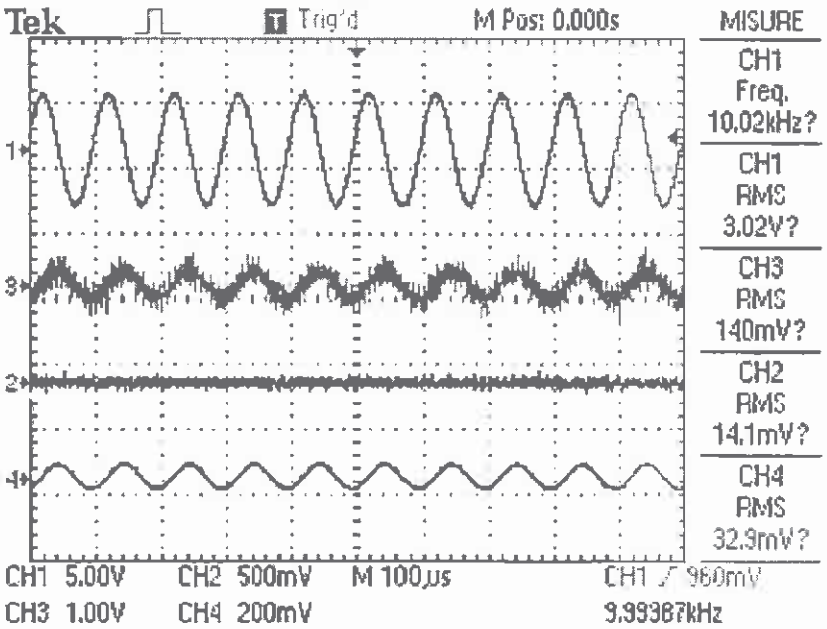
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 49: Side A Sine Wave Injection 7KHz



Step
SC-01.18
SC-01.19

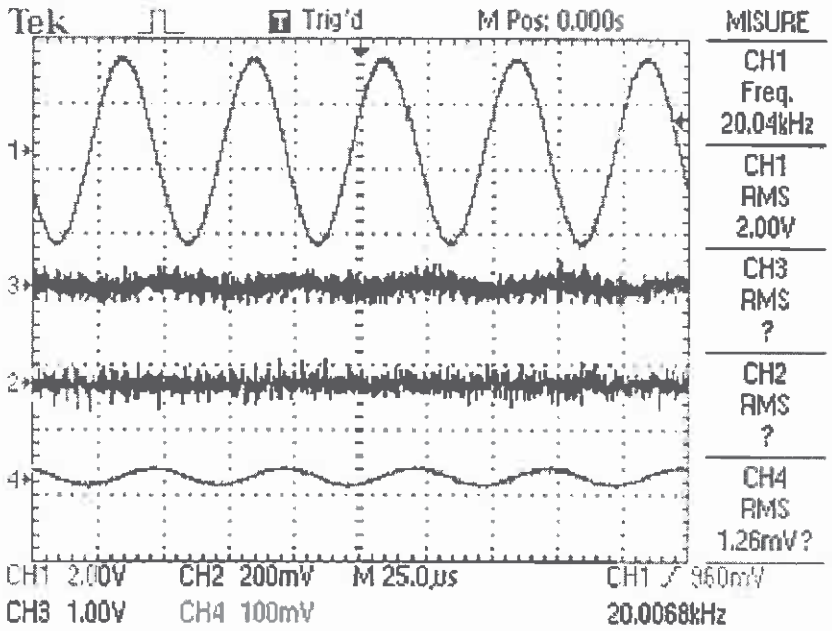
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 50: Side A Sine Wave Injection 10KHz



Step
SC-01.18
SC-01.19

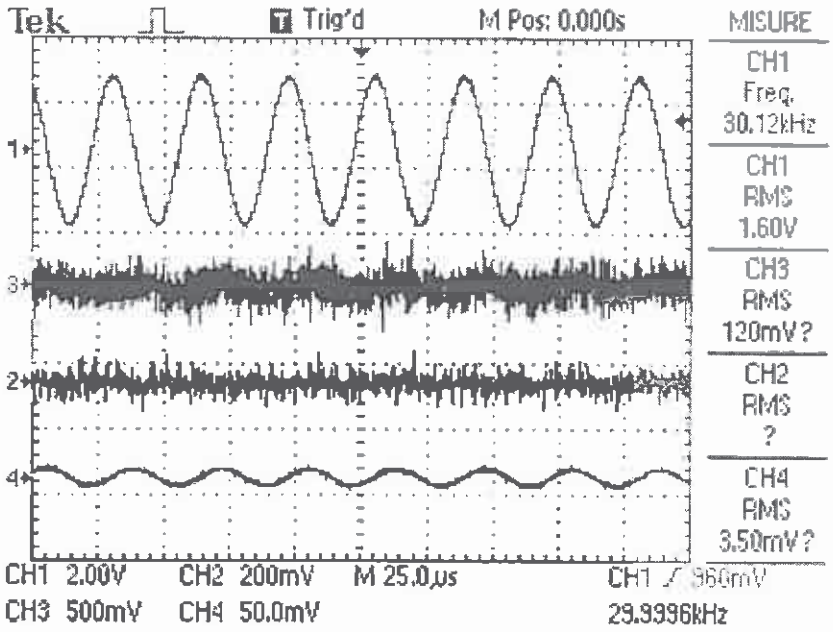
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 51: Side A Sine Wave Injection 20KHz



Step
SC-01.18
SC-01.19

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 52: Side A Sine Wave Injection 30KHz

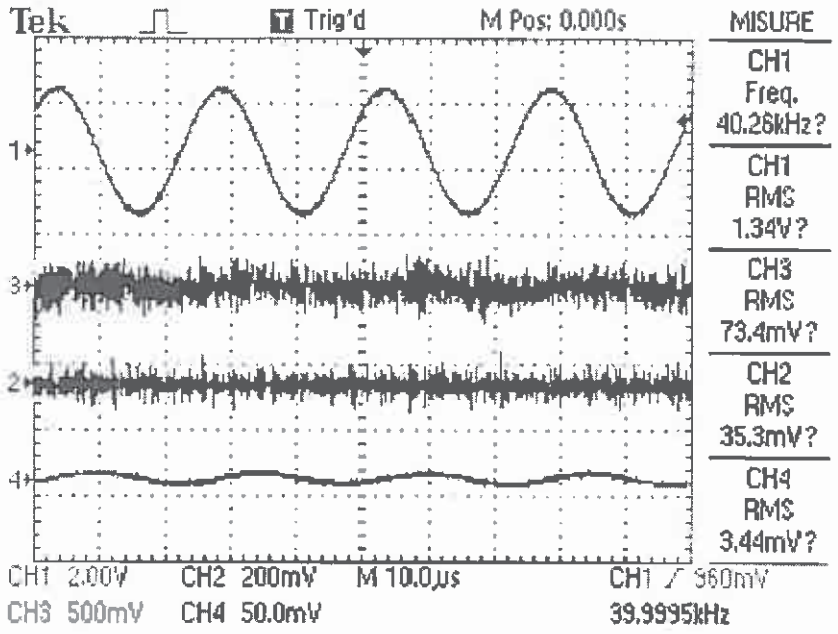


Figure 53: Side A Sine Wave Injection 40KHz

Step
SC-01.18
SC-01.19

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

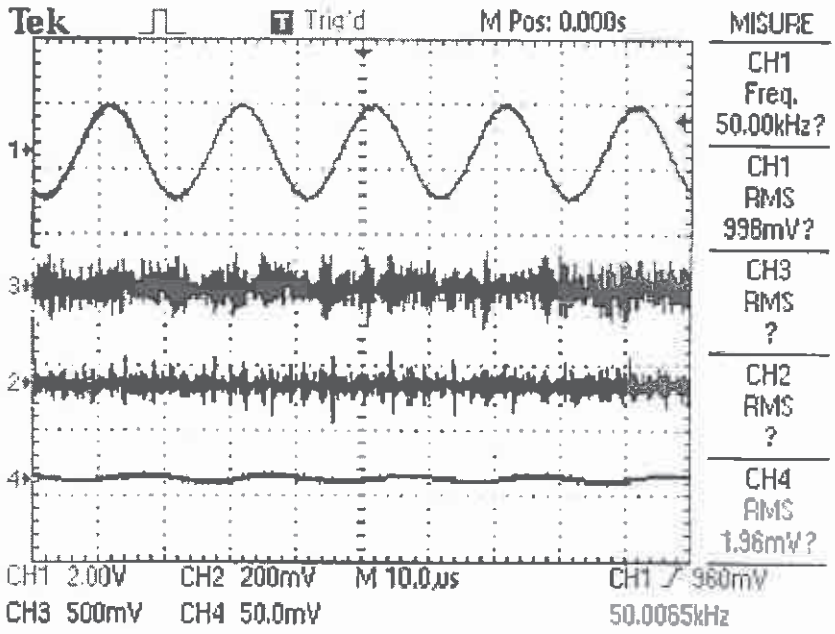


Figure 54: Side A Sine Wave Injection 50KHz

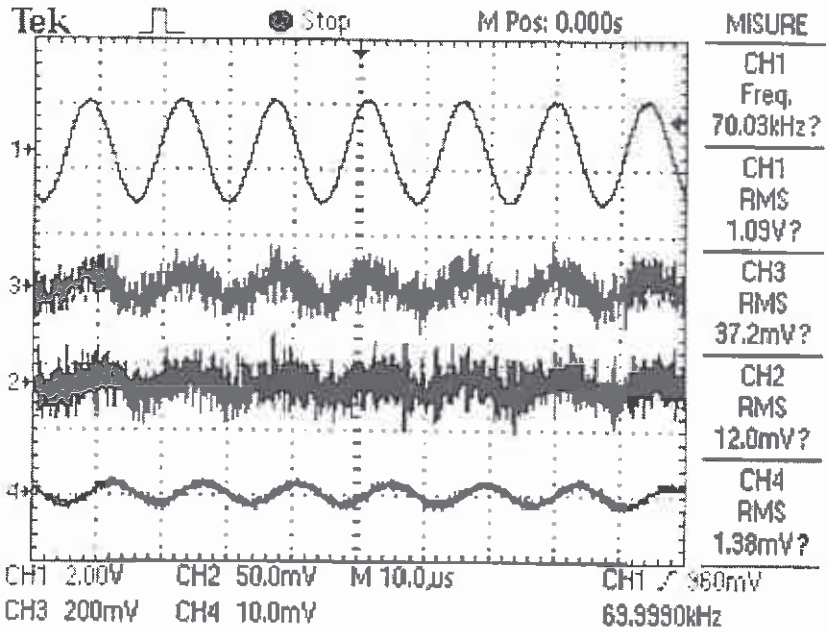
Step
SC-01.18
SC-01.19

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV



Step SC-01.37 SC-01.38

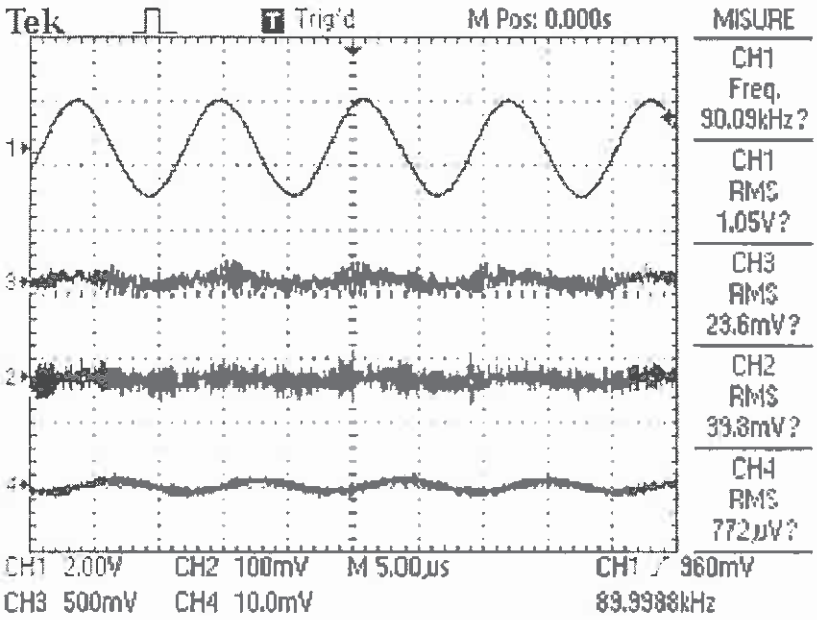
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 55: Side A Sine Wave Injection 70KHz



Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 56: Side A Sine Wave Injection 90KHz

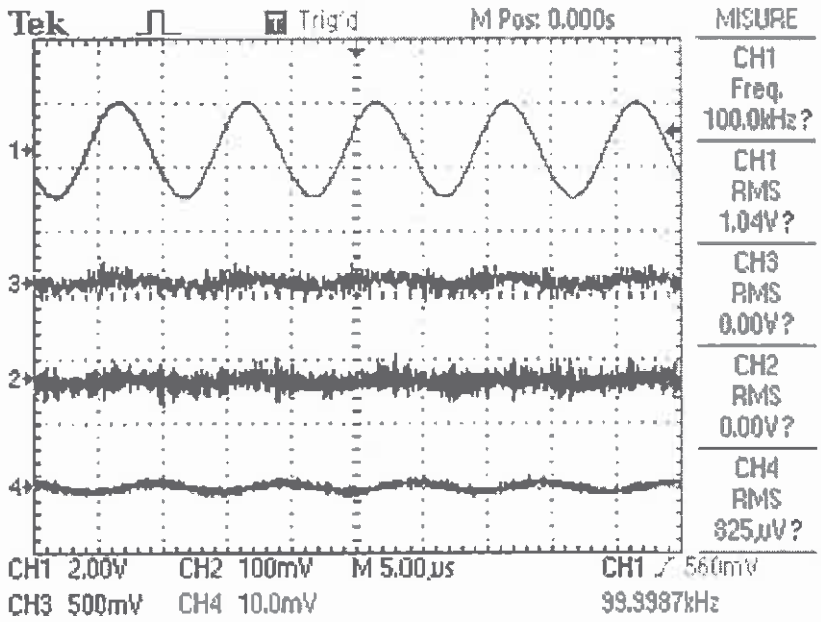


Figure 57: Side A Sine Wave Injection 100KHz

Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

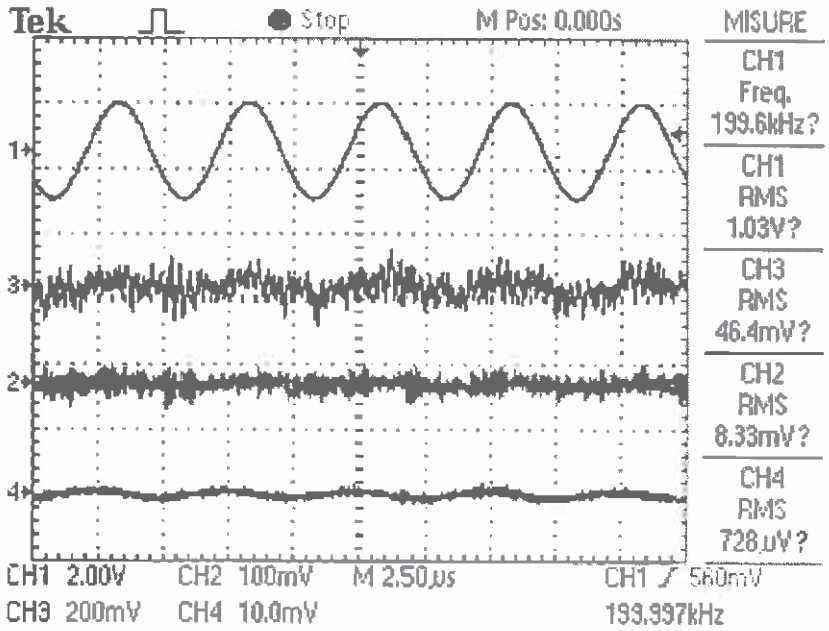


Figure 58: Side A Sine Wave Injection 200KHz

Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

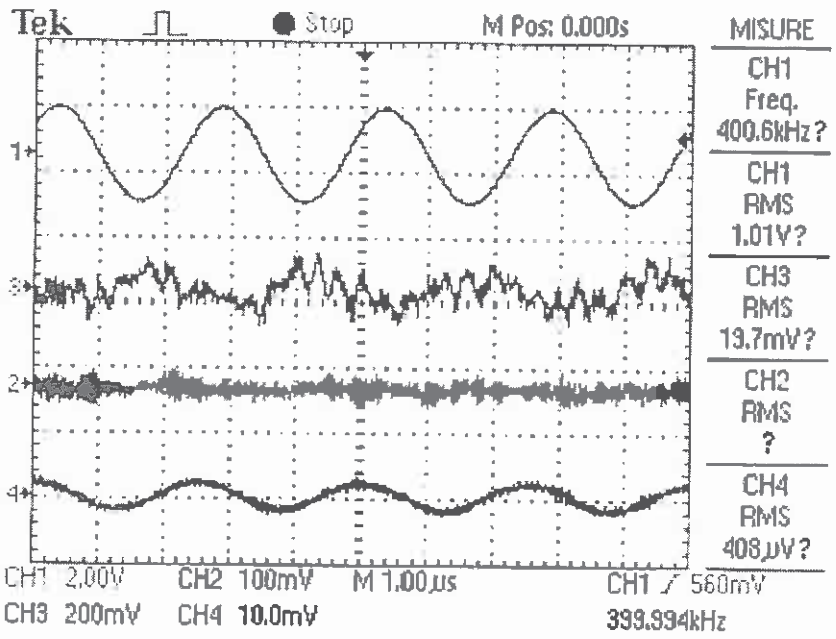


Figure 59: Side A Sine Wave Injection 400KHz

Step
SC-01.37
SC-01.38

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

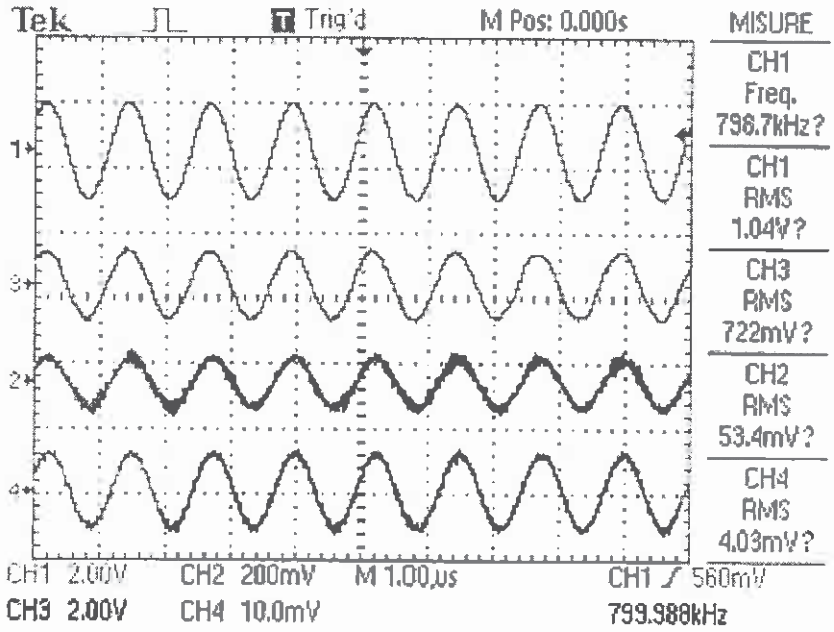


Figure 60: Side A Sine Wave Injection 800KHz

Step
SC-01.37
SC-01.38

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

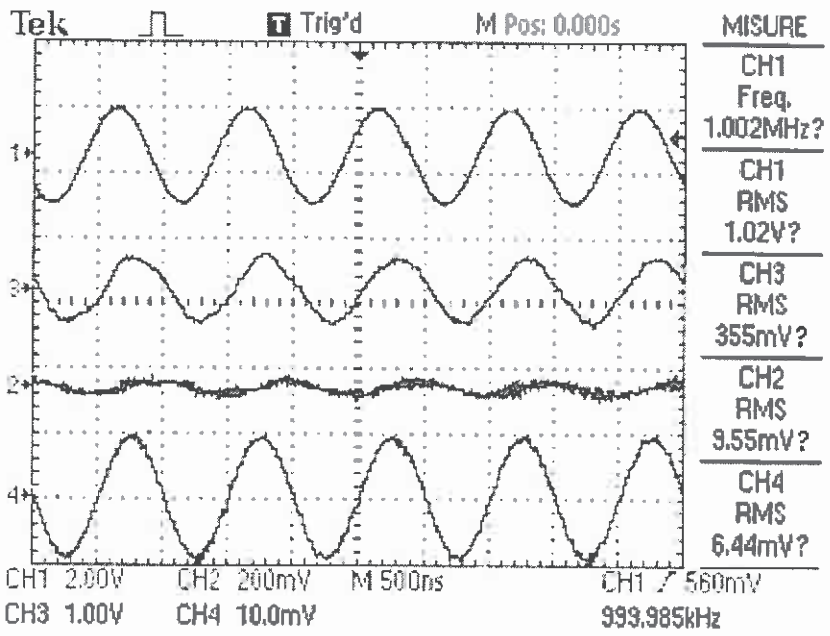


Figure 61: Side A Sine Wave Injection 1MHz

Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

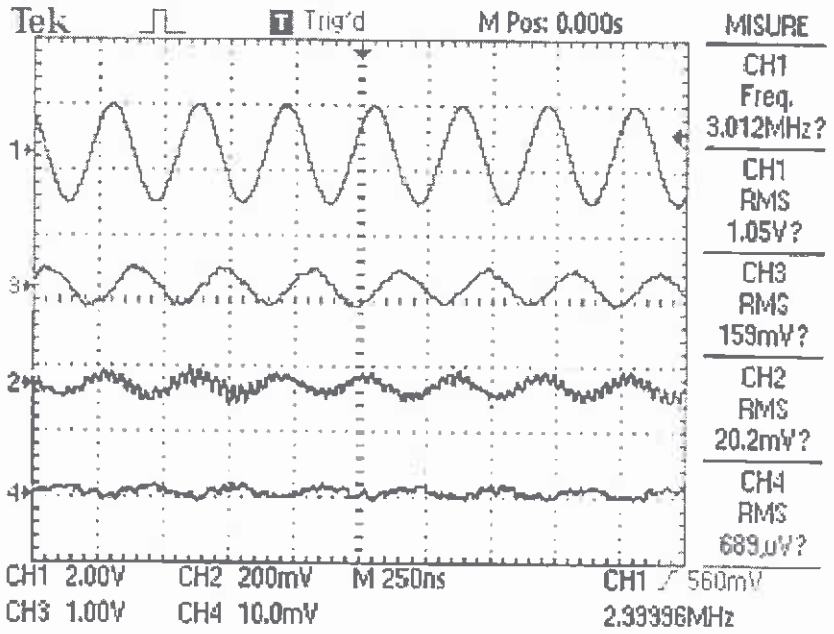


Figure 62: Side A Sine Wave Injection 3MHz

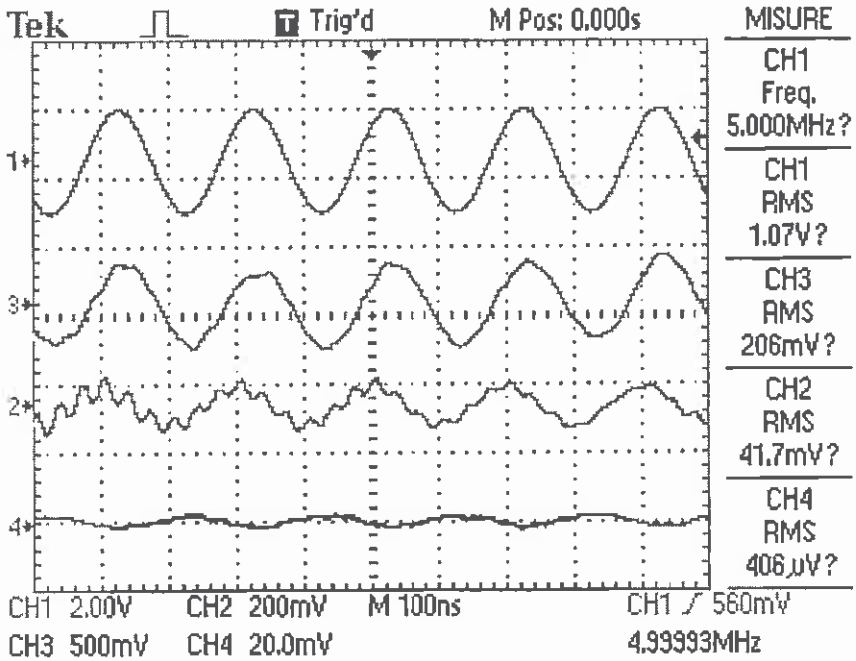
Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Step
SC-01.37
SC-01.38

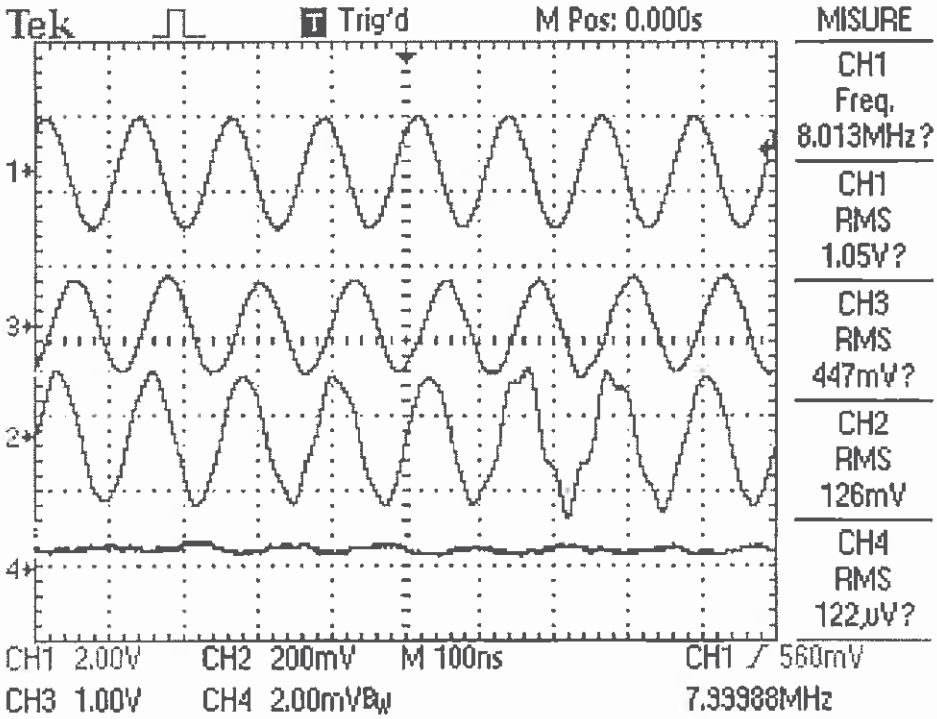
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 63: Side A Sine Wave Injection 5MHz



Step
SC-01.37
SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 64: Side A Sine Wave Injection 8MHz

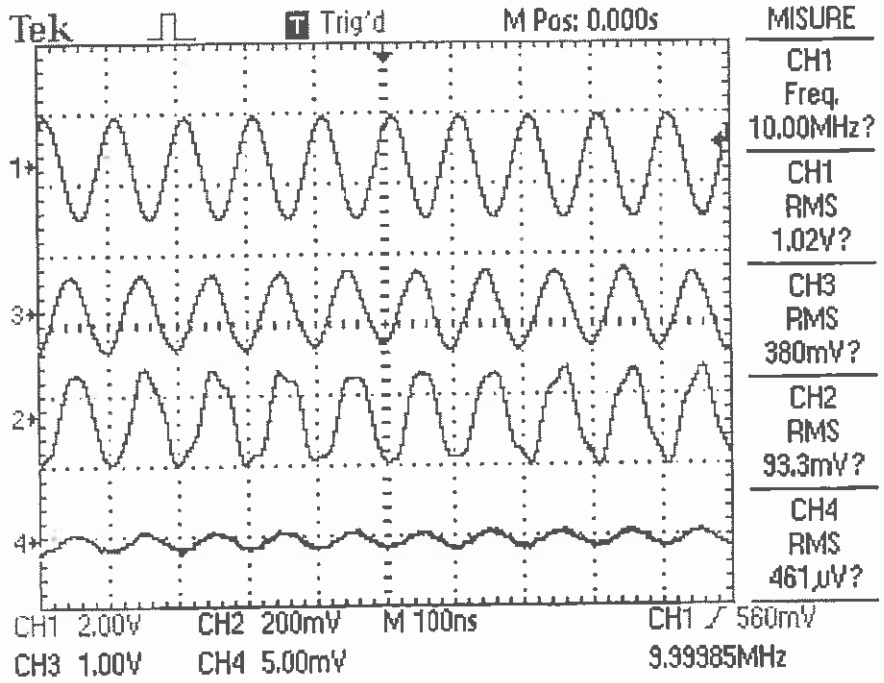


Figure 65: Side A Sine Wave Injection 10MHz

Step
SC-01.37
SC-01.38

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

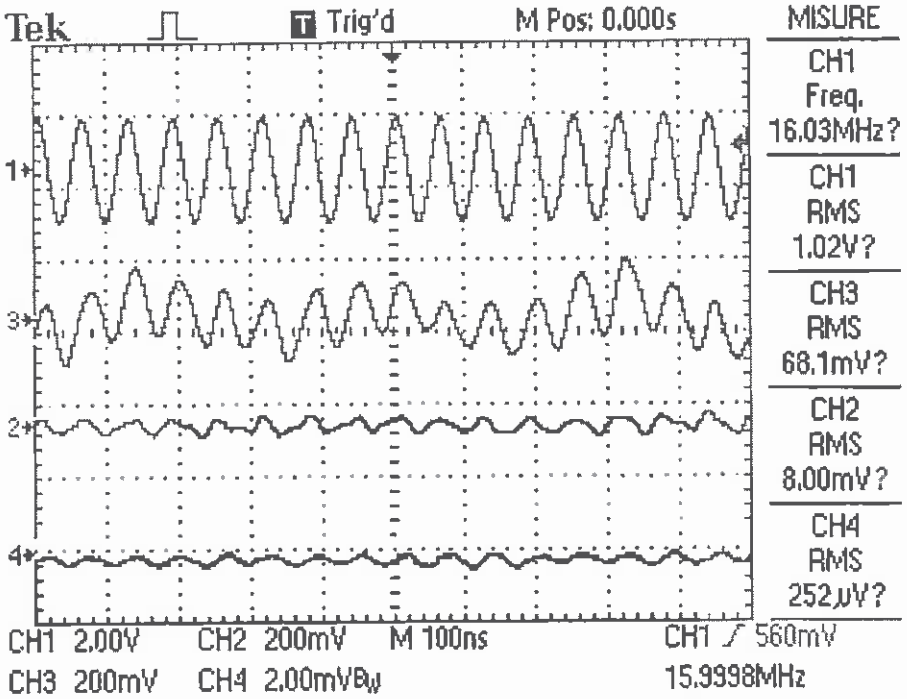


Figure 66: Side A Sine Wave Injection 16MHz

Step
SC-01.37
SC-01.38

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

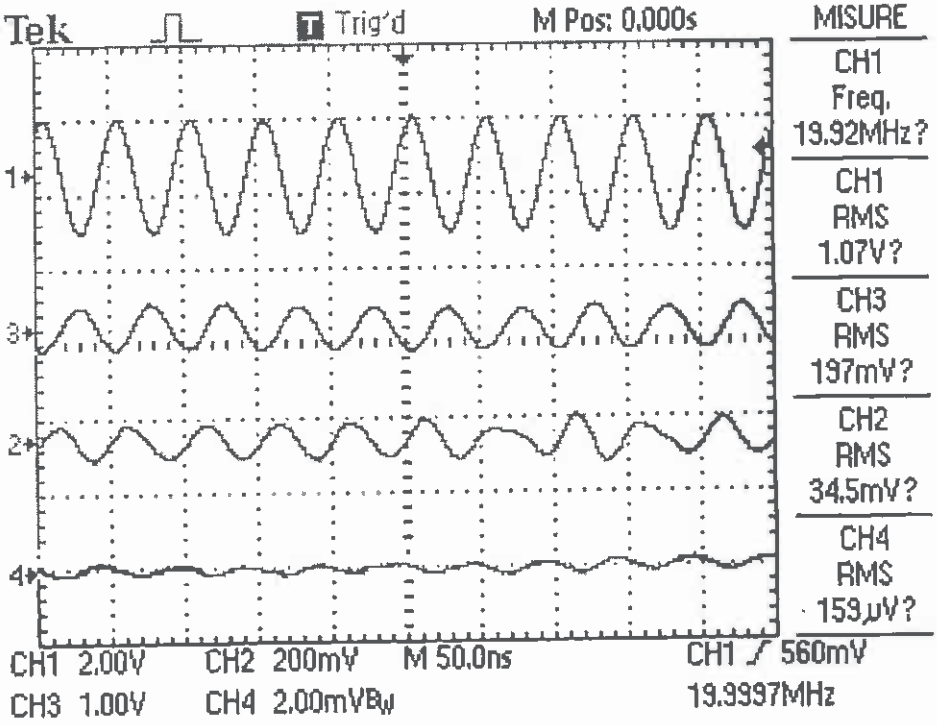


Figure 67: Side A Sine Wave Injection 20MHz

Step
SC-01.37
SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

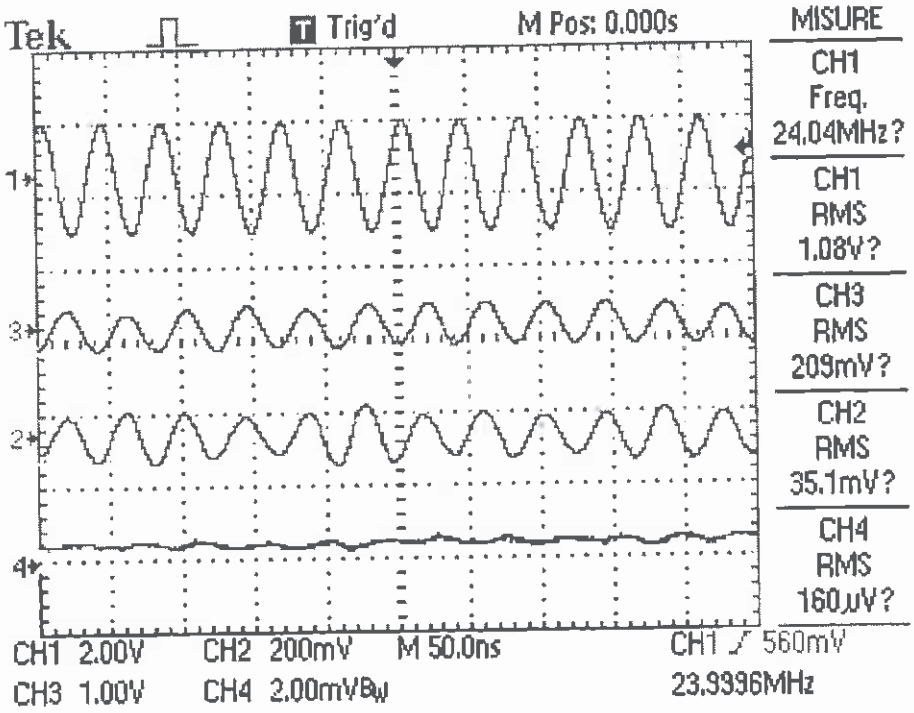


Figure 68: Side A Sine Wave Injection 24MHz

Step
SC-01.37
SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

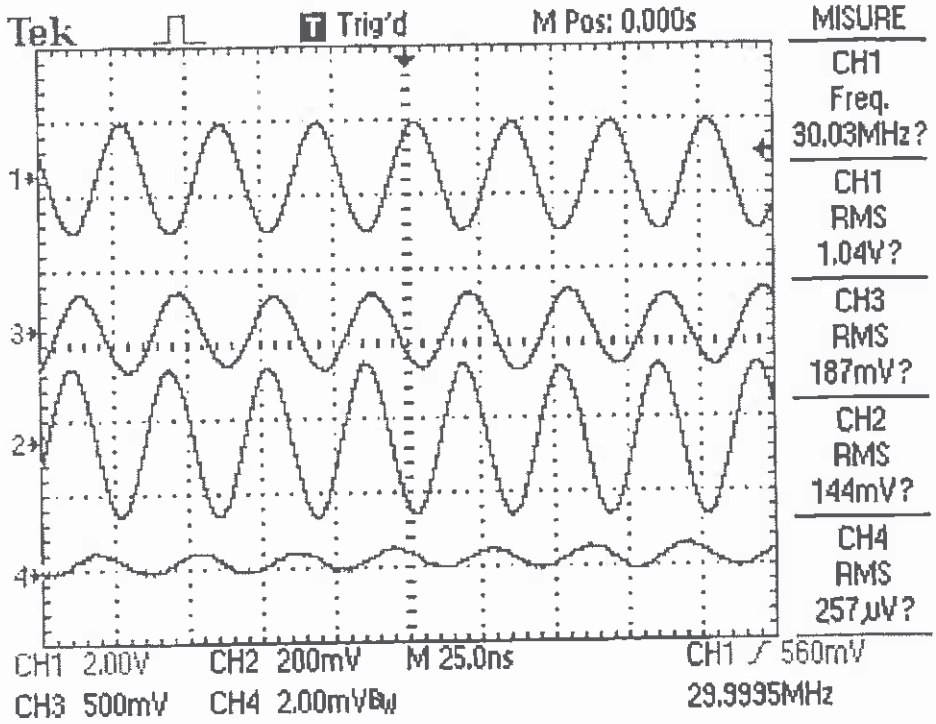


Figure 69: Side A Sine Wave Injection 30MHz

Step
SC-01.37
SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

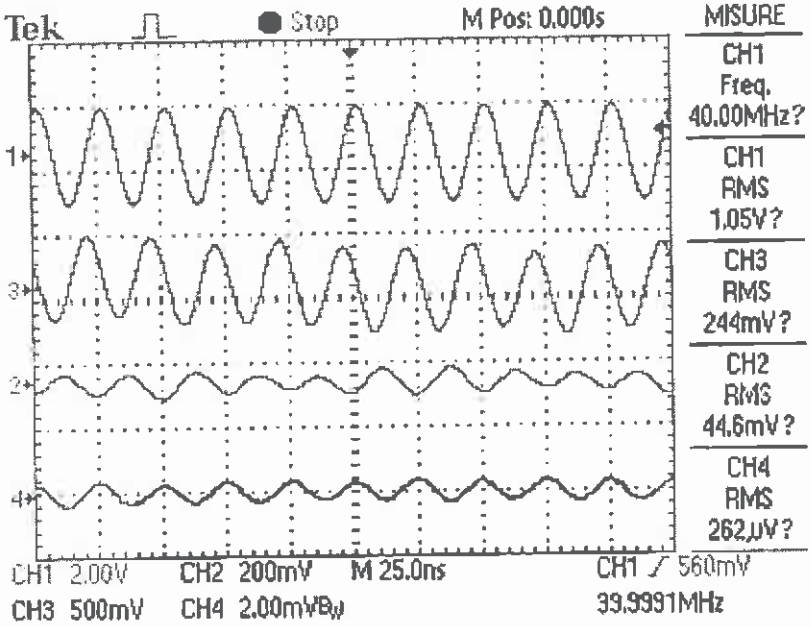


Figure 70: Side A Sine Wave Injection 40MHz

Step
SC-01.37
SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

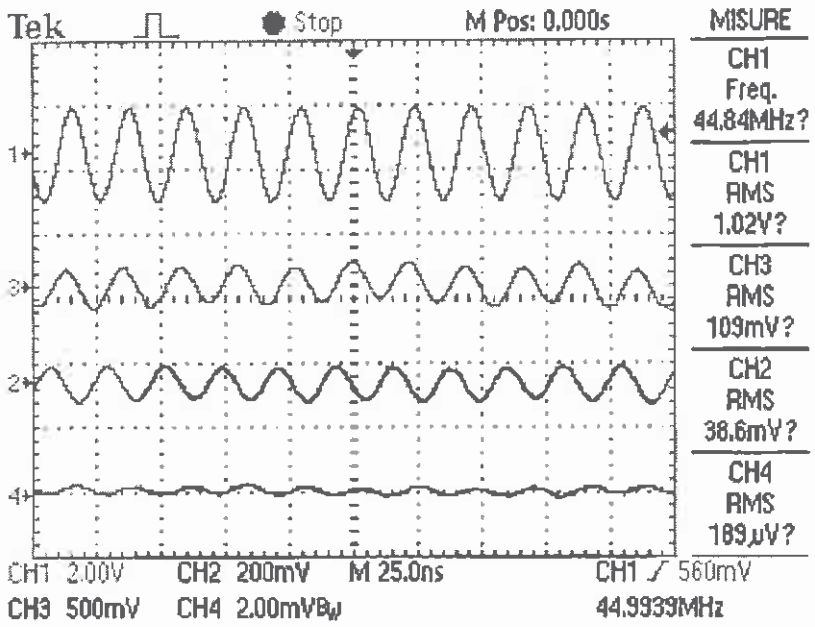


Figure 71: Side A Sine Wave Injection 45MHz

Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

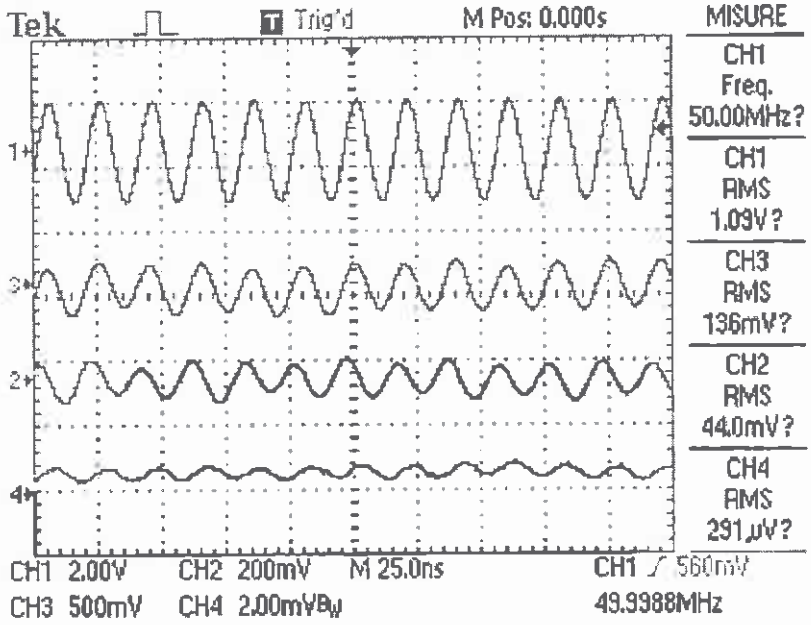


Figure 72: Side A Sine Wave Injection 50MHz

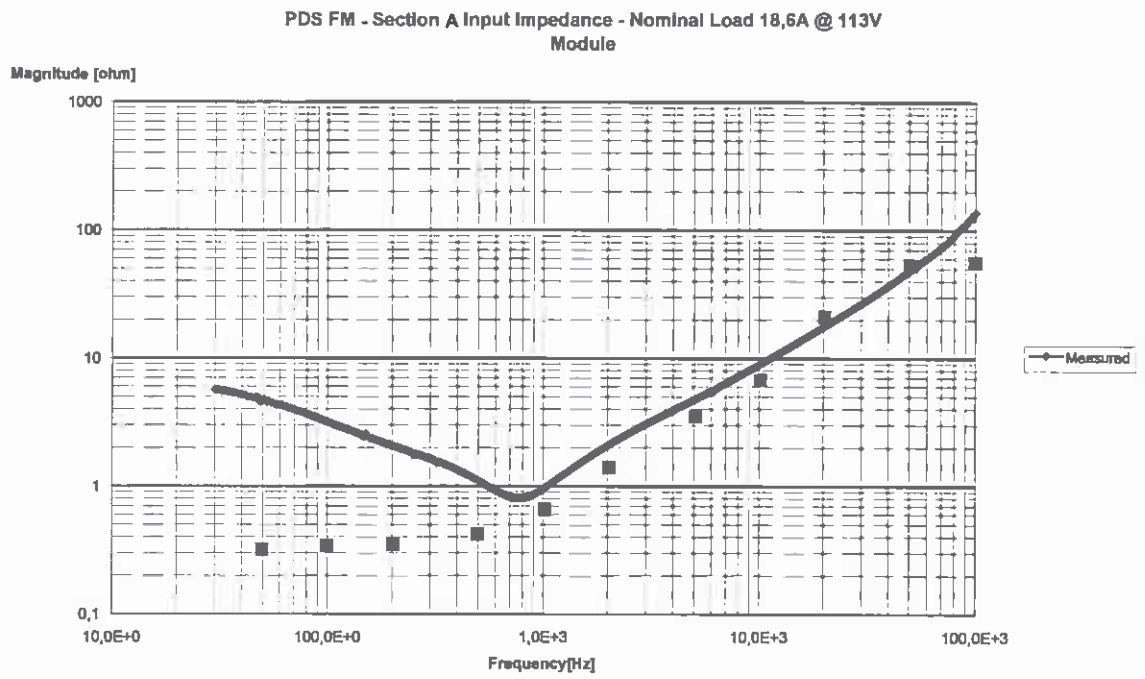
Step SC-01.37 SC-01.38

Ch1= Vinput

Ch3= Vout_120V

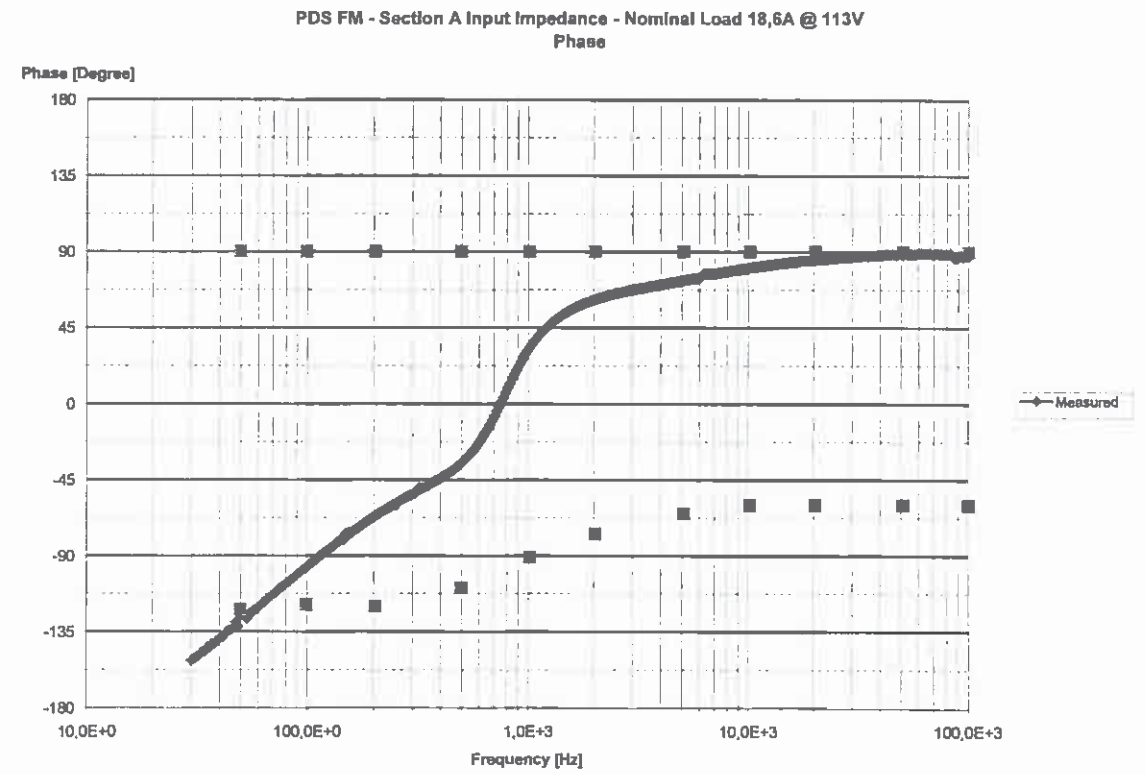
Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



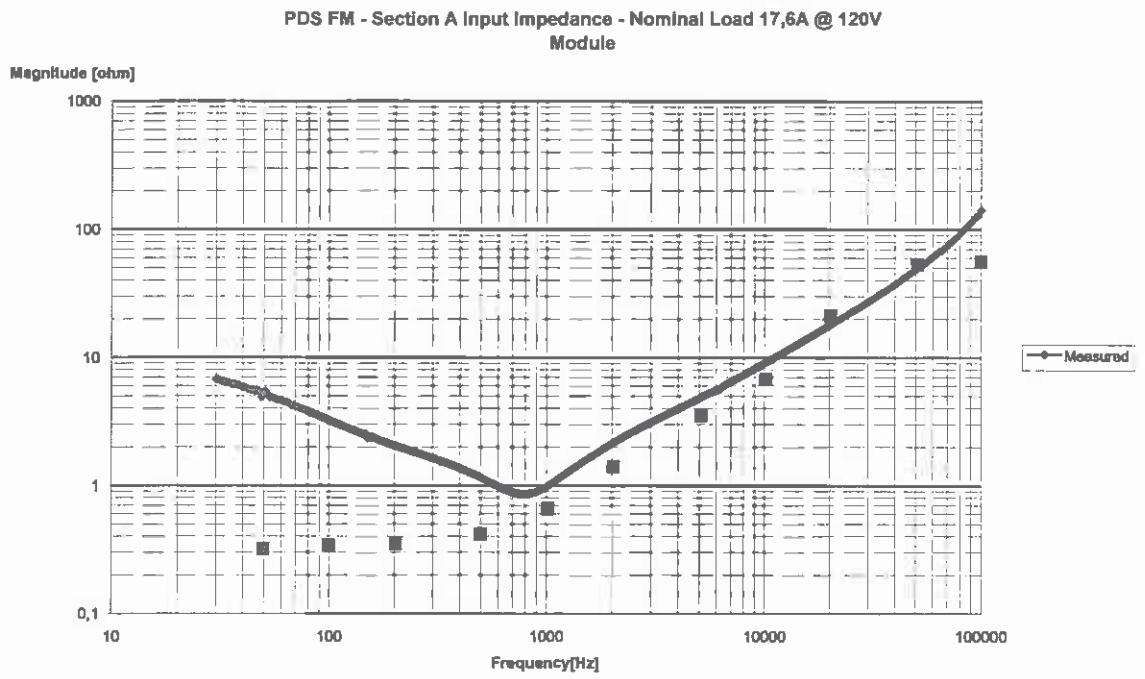
Step SC-02.15

Figure 73: Side A Input impedance module – nominal load @113V



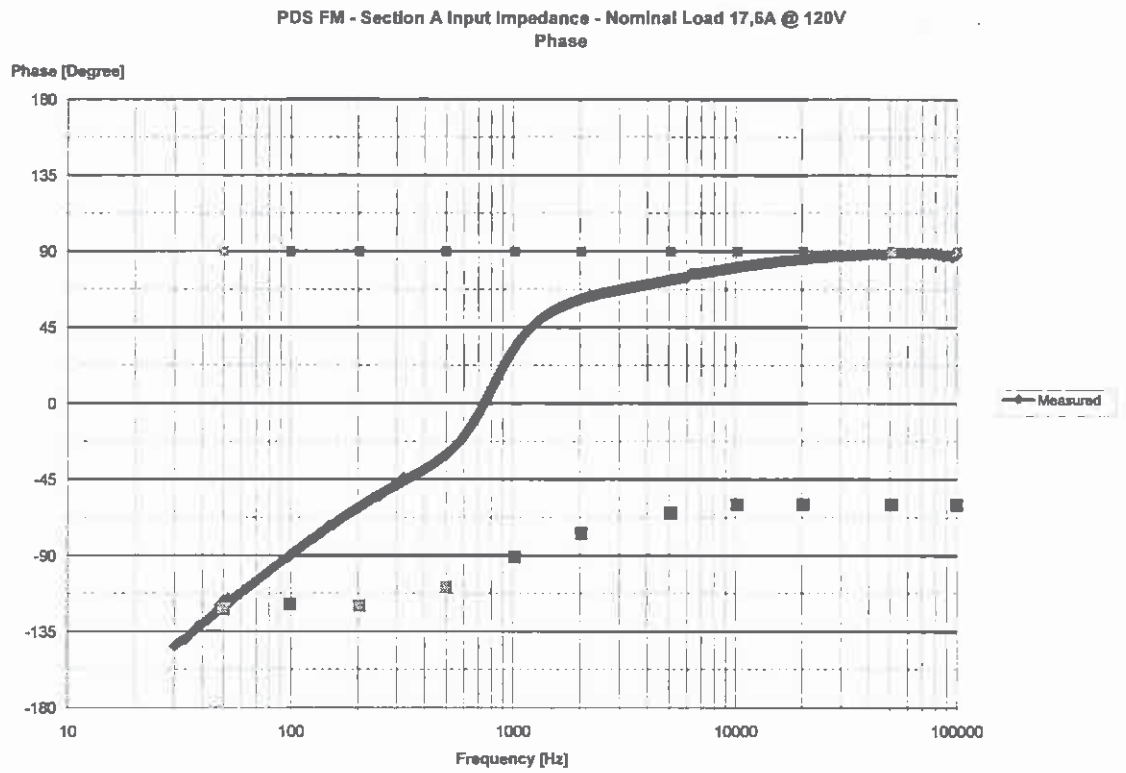
Step SC-02.15

Figure 74: Side A Input impedance phase – nominal load @113V



Step SC-02.20

Figure 75: Side A Input impedance module – nominal load @120V



Step SC-02.20

Figure 76: Side A Input impedance phase – nominal load @120V

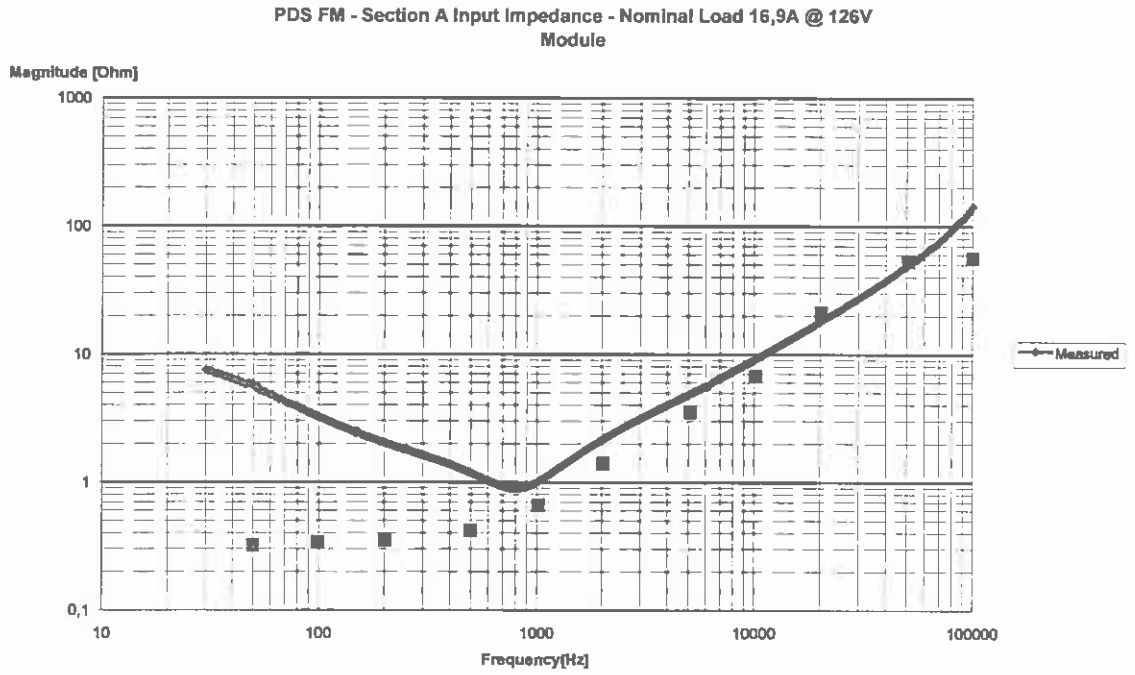


Figure 77: Side A Input impedance module – nominal load @126V

Step SC-02.25

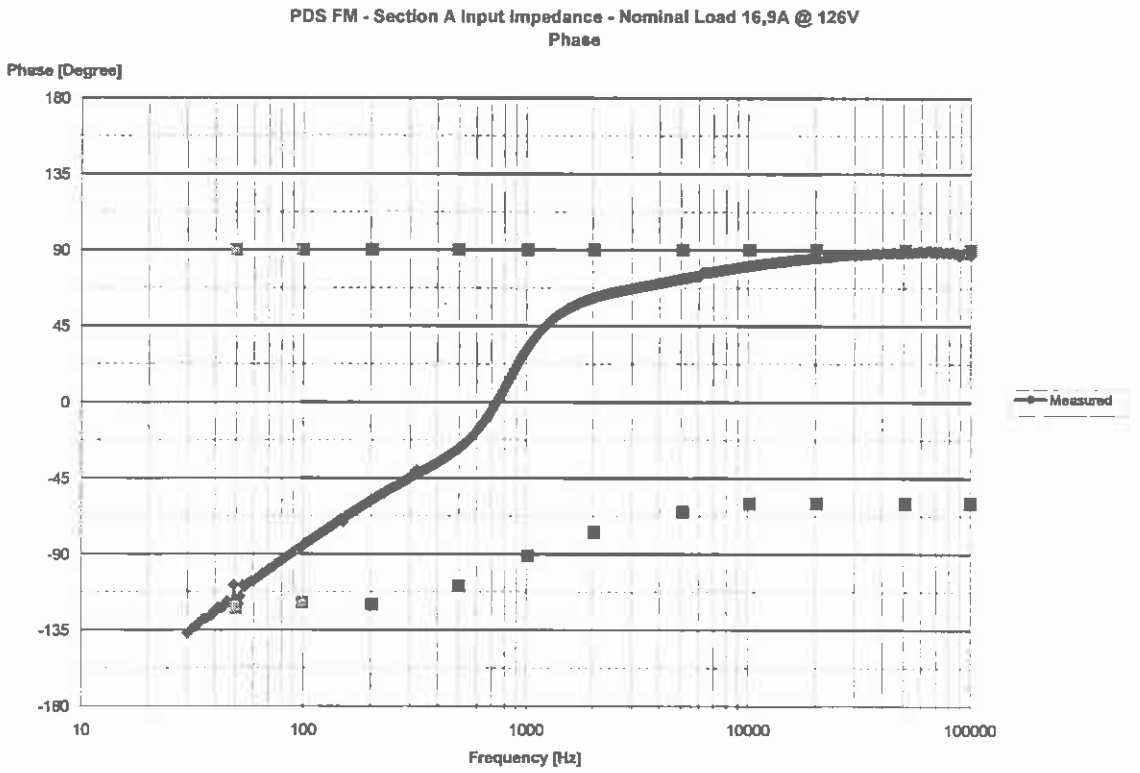


Figure 78: Side A Input impedance phase – nominal load @126V

Step SC-02.25

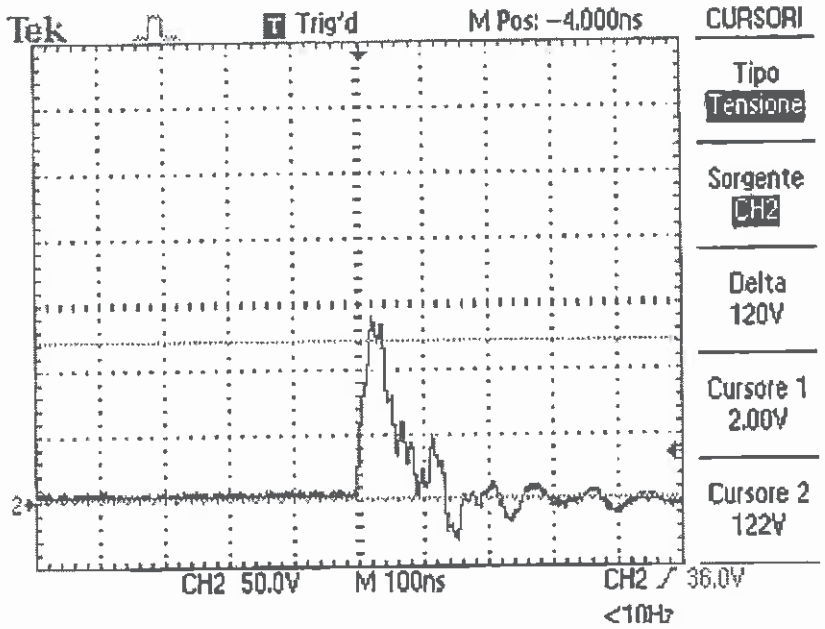


Figure 79: Side A Voltage Spike Transient calibration +120V for 0.15usec

Step SC-03.6

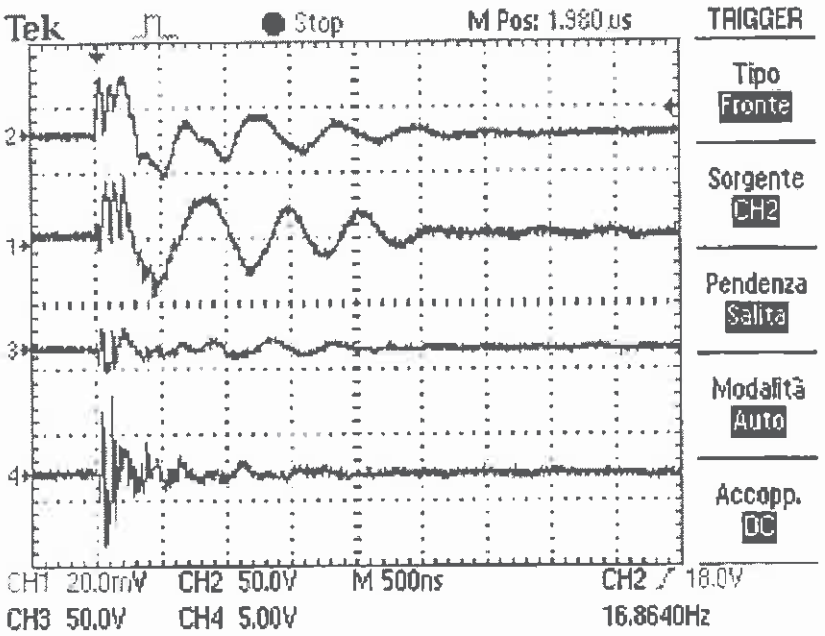


Figure 80: Side A Voltage Spike Transient +120V for 0.15usec

Step SC-03.18

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

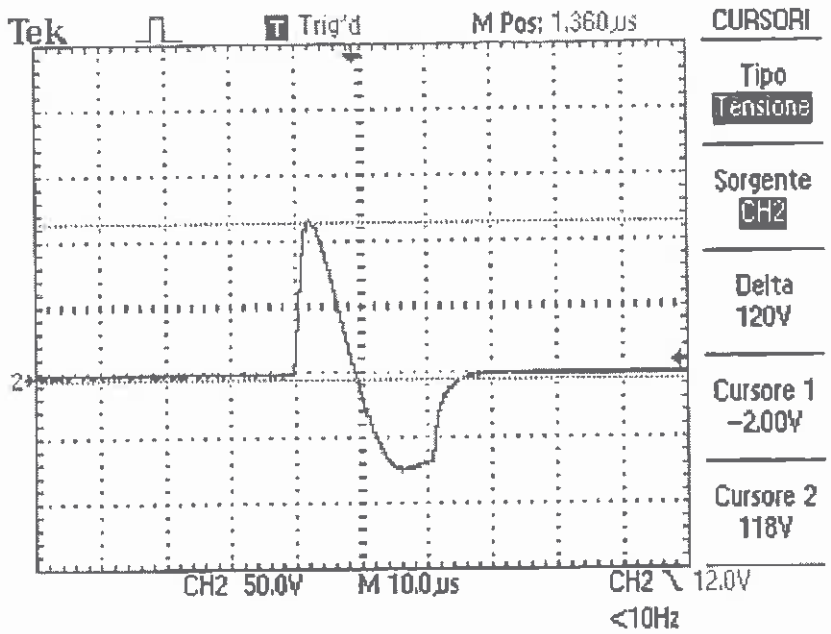


Figure 81: Side A Voltage Spike Transient calibration +120V for 10usec

Step SC-03.27

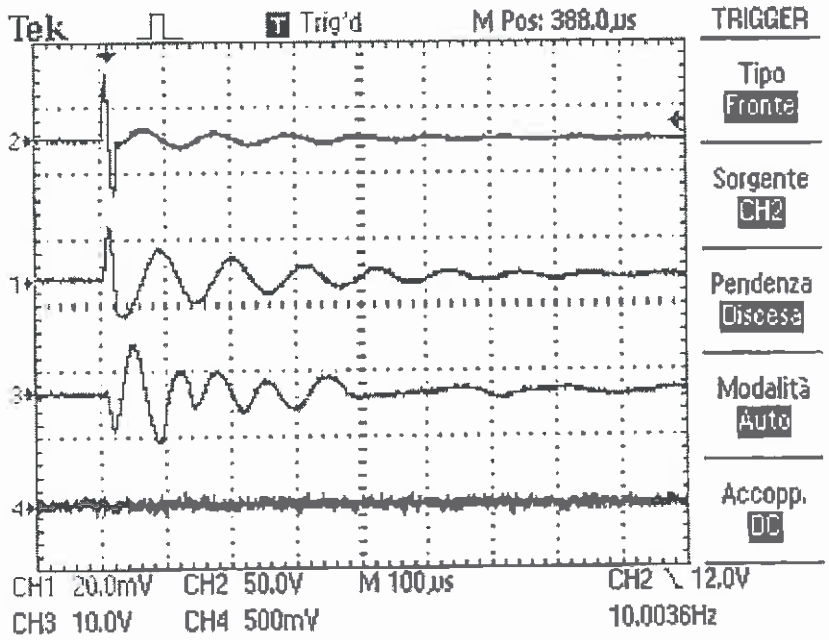


Figure 82: Side A Voltage Spike Transient +120V for 10usec

Step SC-03.39

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

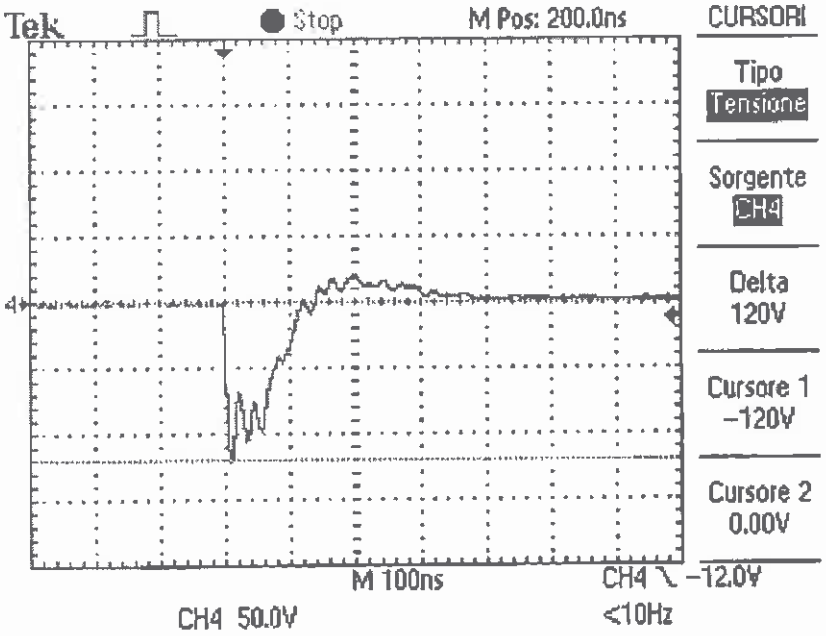


Figure 83: Side A Voltage Spike Transient calibration -120V for 0.15usec

Step SC-03.48

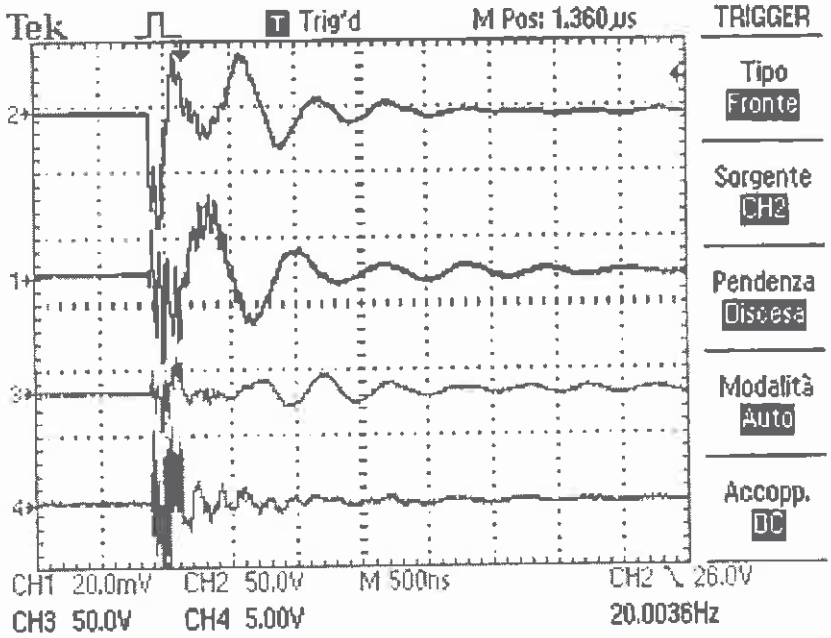


Figure 84: Side A Voltage Spike Transient -120V for 0.15usec

Step SC-03.60

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

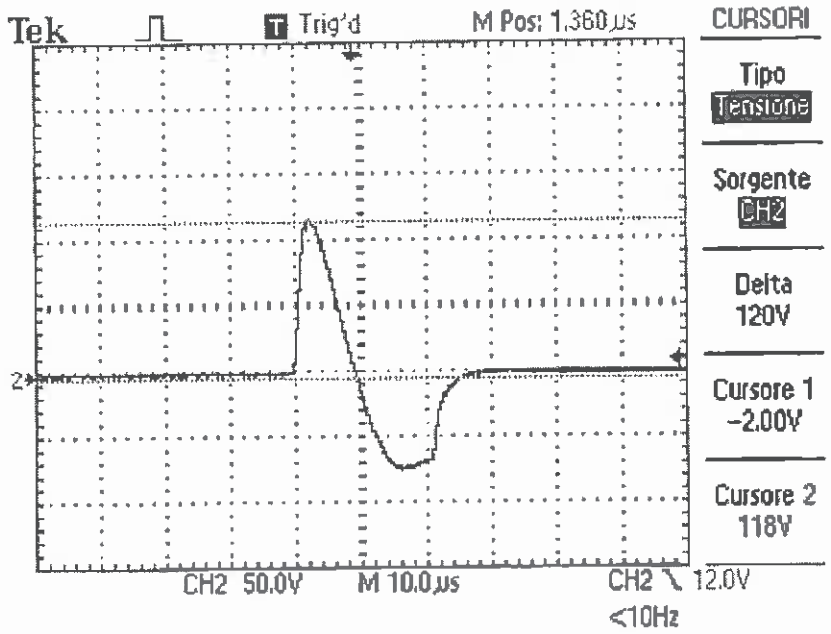


Figure 85: Side A Voltage Spike Transient calibration -120V for 10usec

Step SC-03.69

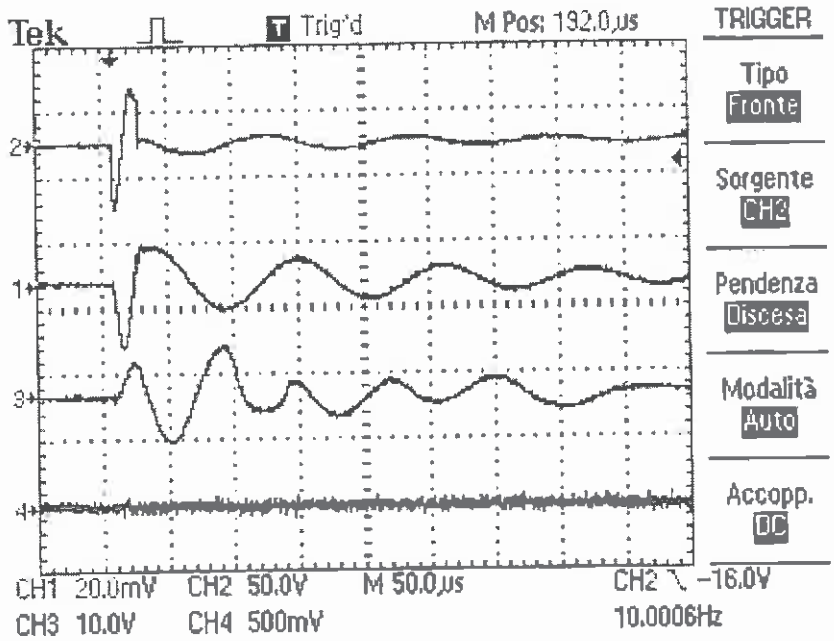


Figure 86: Side A Voltage Spike Transient -120V for 10usec

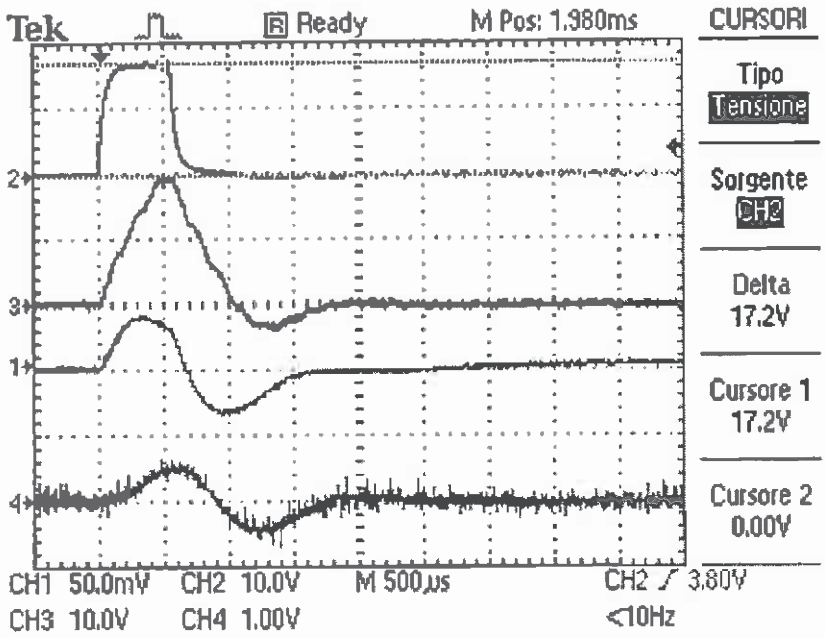
Step SC-03.60

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)



Step SC-04.14

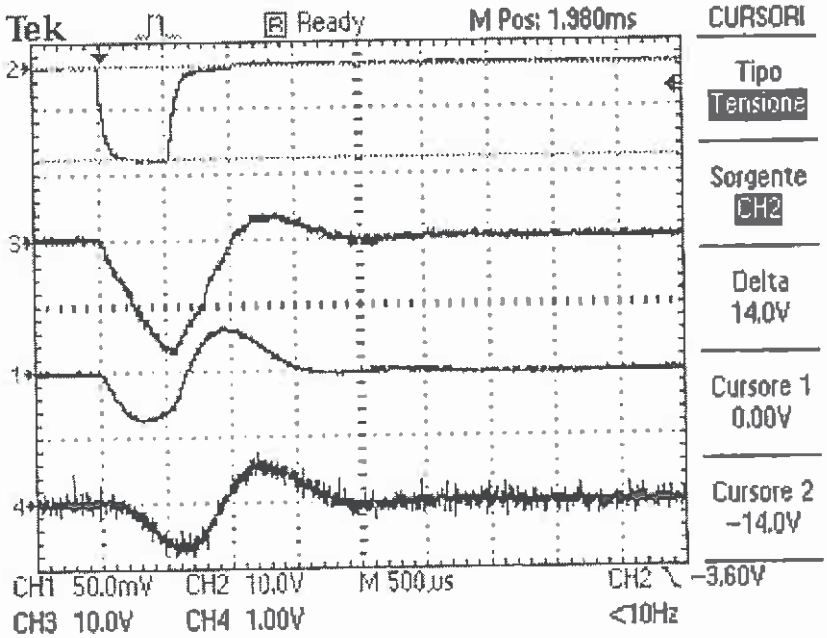
Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)

Figure 87: Side A Normal Voltage Transient - positive



Step SC-04.14

Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)

Figure 88: Side A Normal Voltage Transient - negative

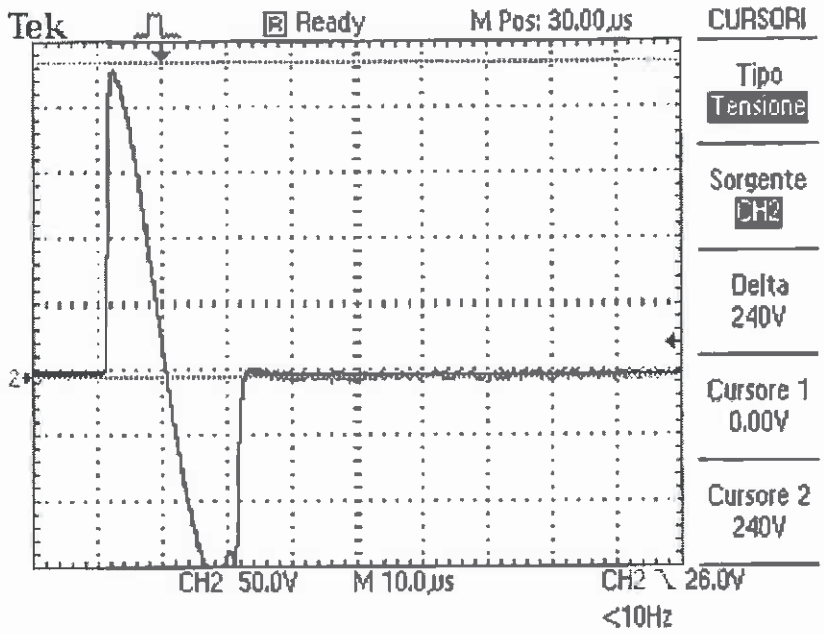


Figure 89: Side A Abnormal Voltage Transient 240V 12usec – calibration

Step SC-05.3

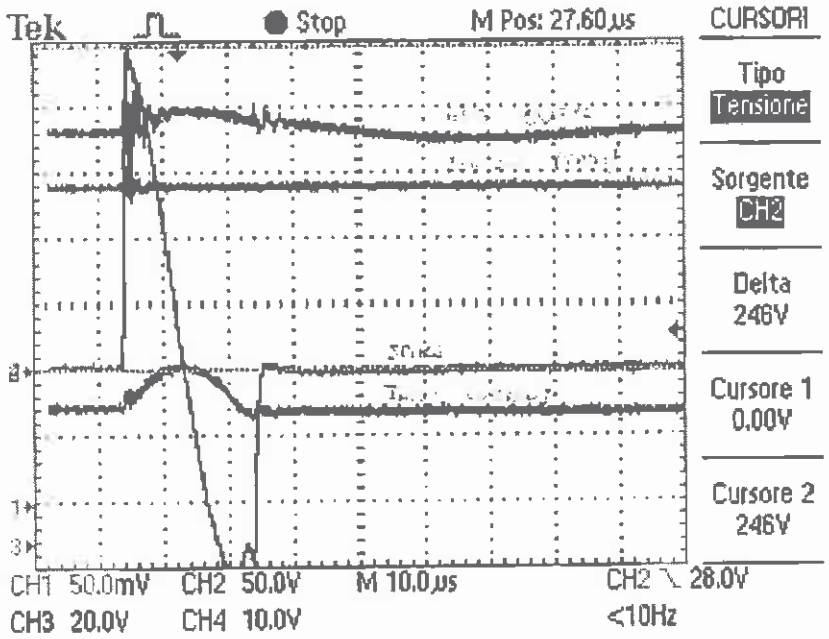


Figure 90: Side A Abnormal Voltage Transient 240V 12usec

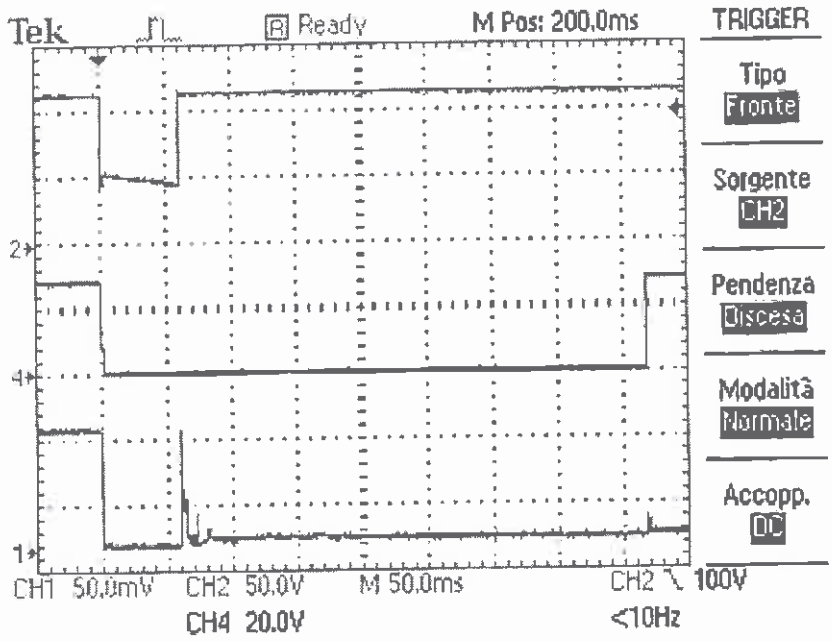
Step SC-05.11

Ch2= spike

Ch3= Vout_120V

Ch1= Input_curr 2A/10mV

Ch4= Vout_28V



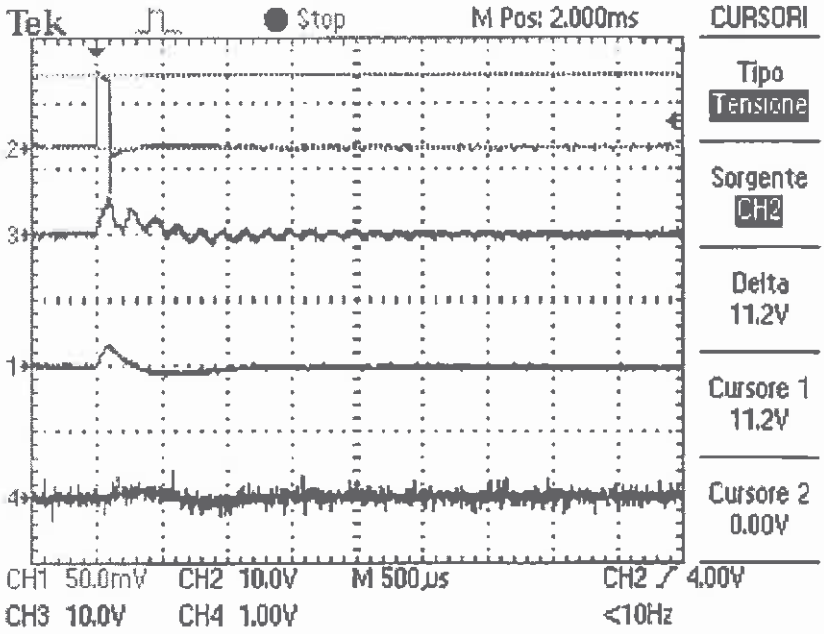
Step SC-05.19

Ch2= Vinput

Ch4= Vout_28V

Ch1= Input_curr 2A/10mV

Figure 91: Side A Abnormal Voltage Transient 0V 60msec



Step LSS-0.15 LSS-0.16

Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)

Figure 92:Side A Large Signal Stability – 100us

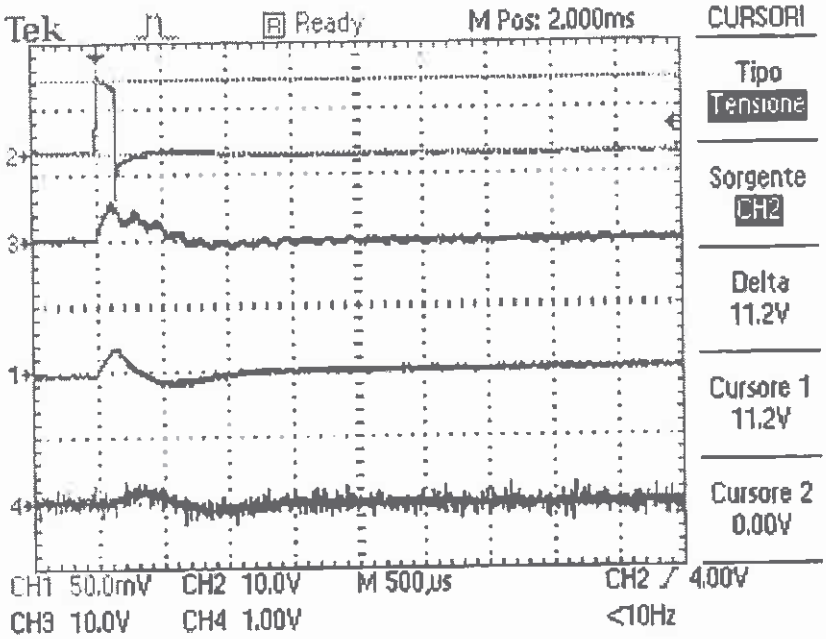


Figure 93: Side A Large Signal Stability – 150us

Step
LSS-0.20
LSS-0.21

Ch2=
Vinput (ac)

Ch3=
Vout_120V
(ac)

Ch1=
Input_curr
(ac)
2A/10mV

Ch4=
Vout_28V
(ac)

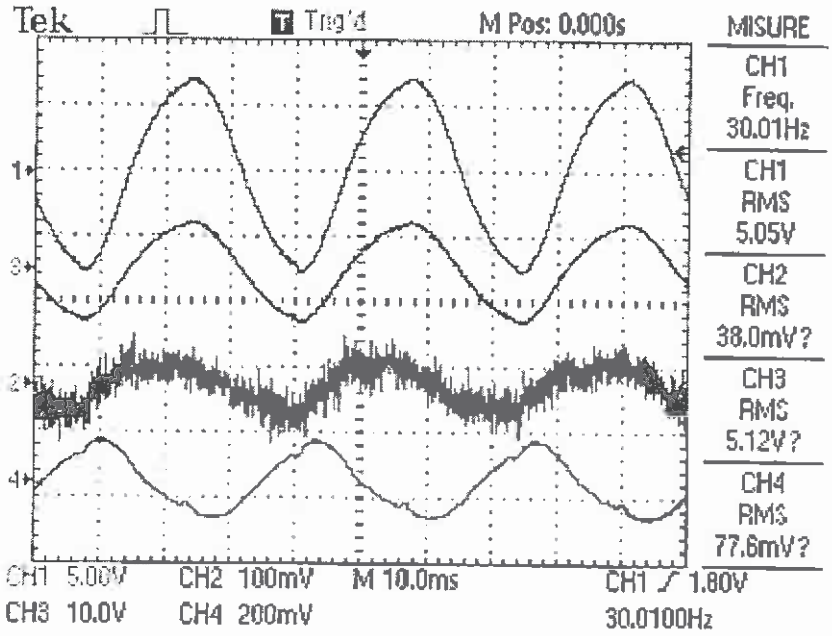


Figure 94:Side B Sine Wave Injection 30Hz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

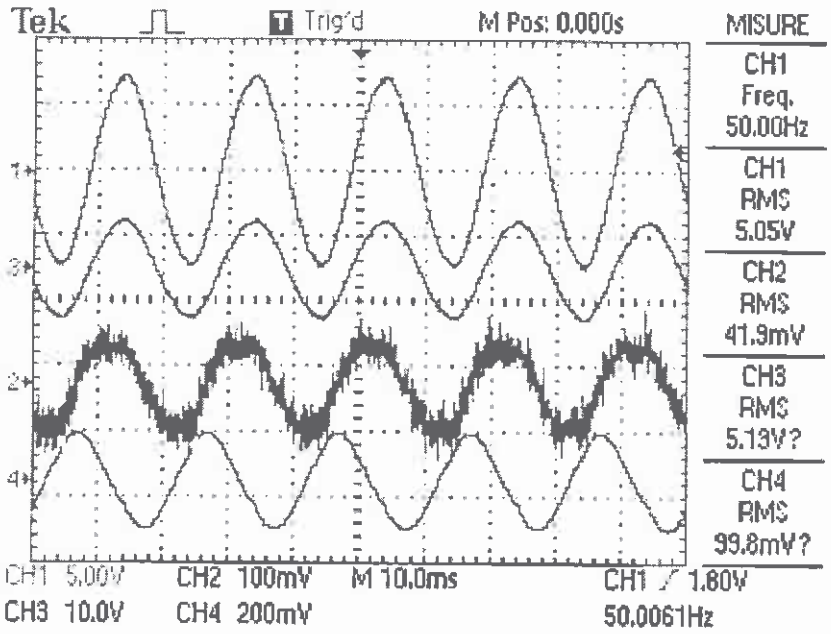


Figure 95: :Side B Sine Wave Injection 50Hz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

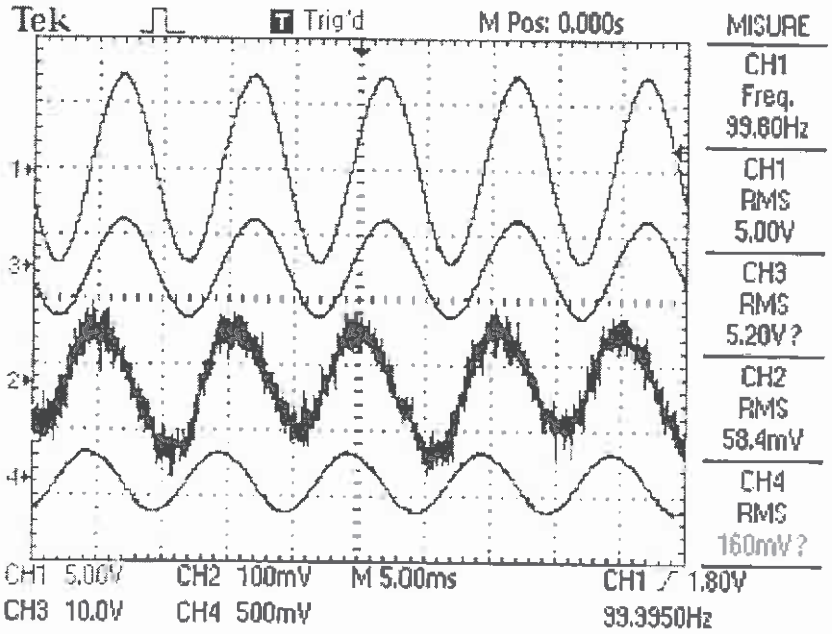


Figure 96: Side B Sine Wave Injection 100Hz

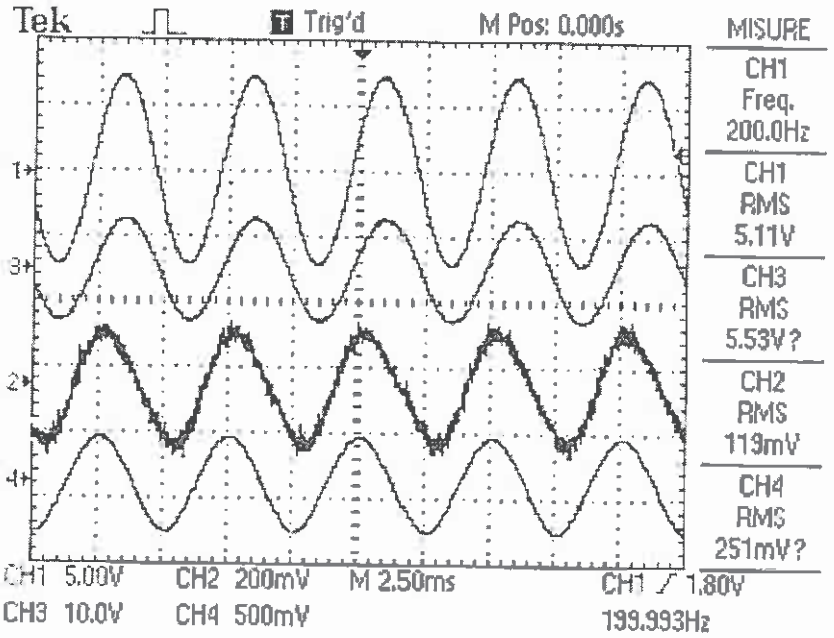
Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Para10.5.1
Step
SC-01.17
SC-01.18

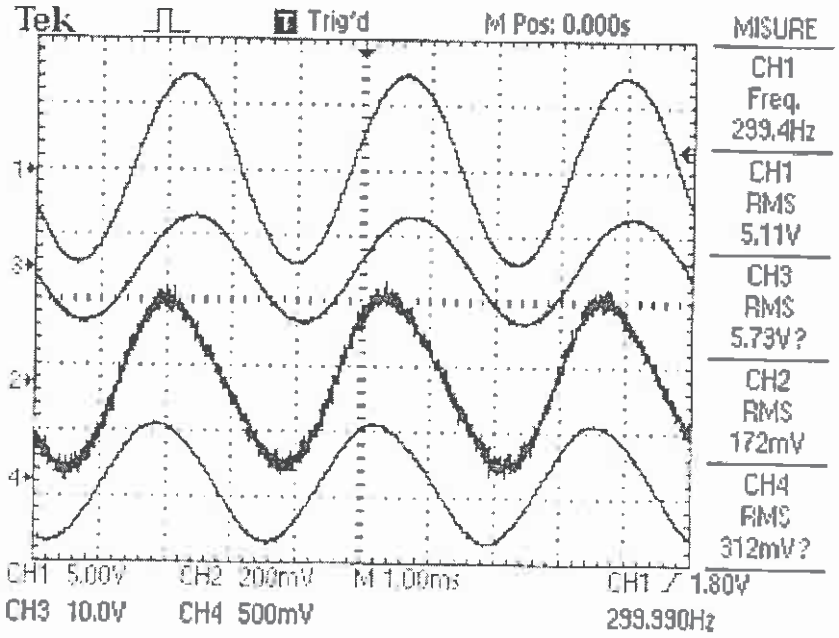
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 97: Side B Sine Wave Injection 200Hz



Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 98: Side B Sine Wave Injection 300Hz

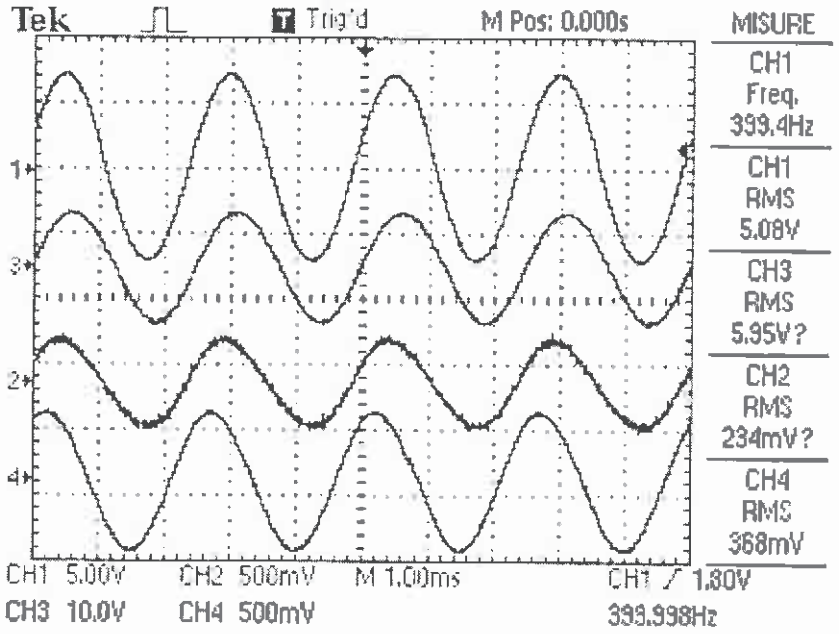


Figure 99: Side B Sine Wave Injection 400Hz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

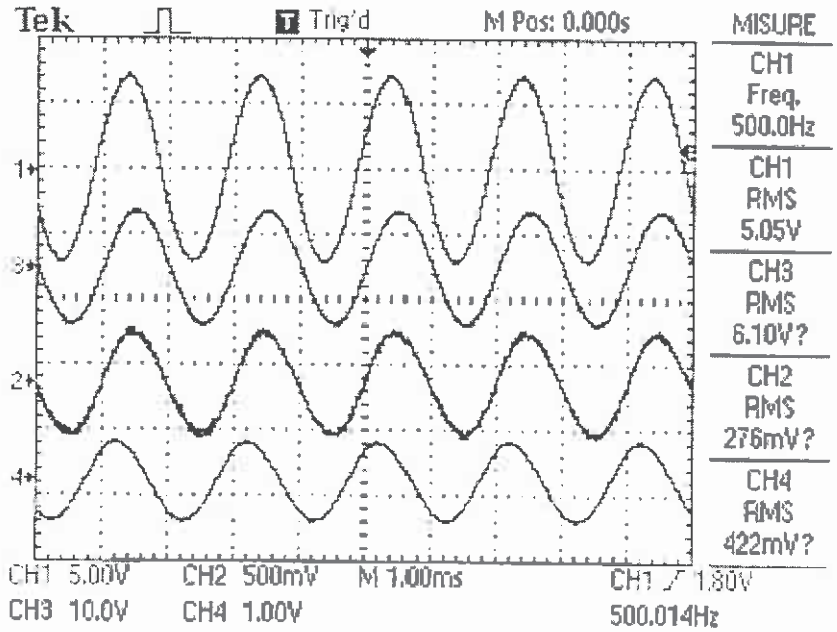


Figure 100: Side B Sine Wave Injection 500Hz

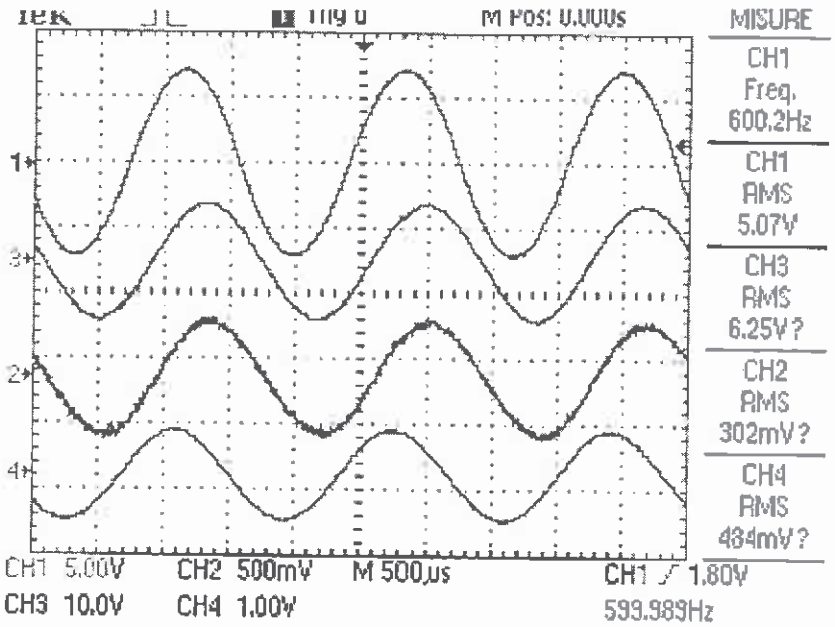
Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Para10.5.1
Step
SC-01.17
SC-01.18

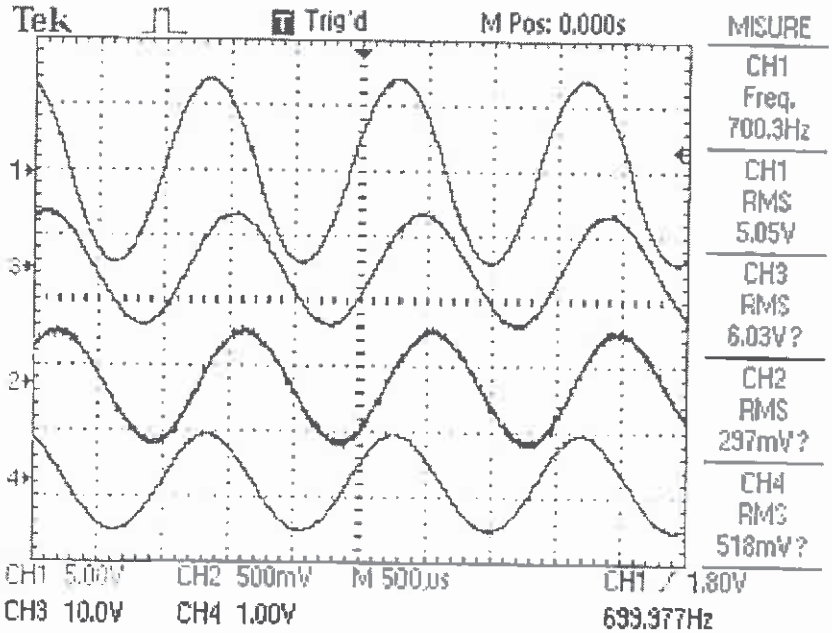
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 101: Side B Sine Wave Injection 600Hz



Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 102: Side B Sine Wave Injection 700Hz

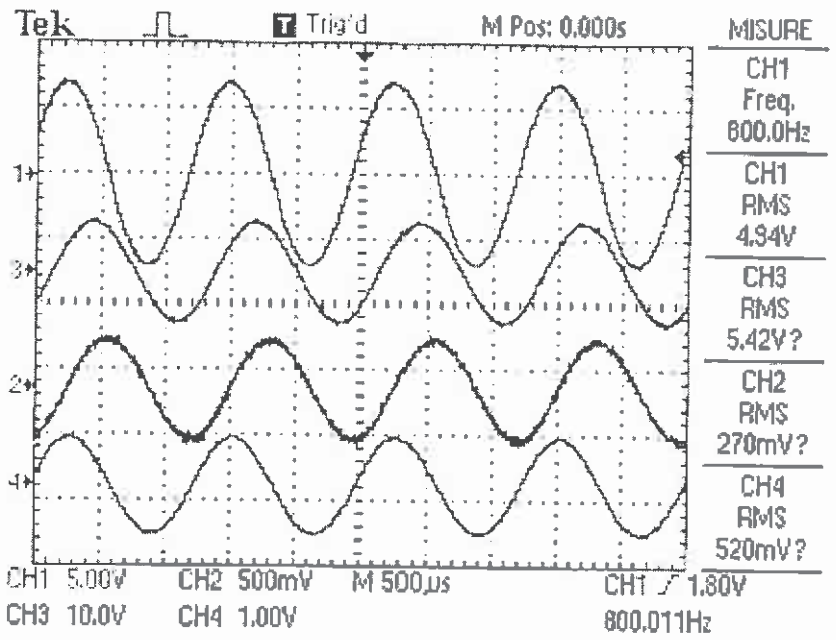


Figure 103: Side B Sine Wave Injection 800Hz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

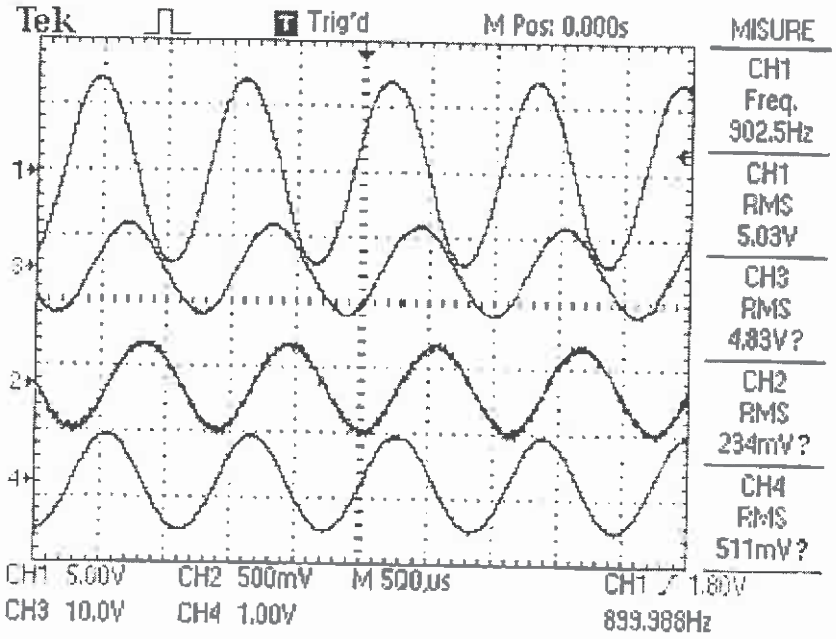


Figure 104: Side B Sine Wave Injection 900Hz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

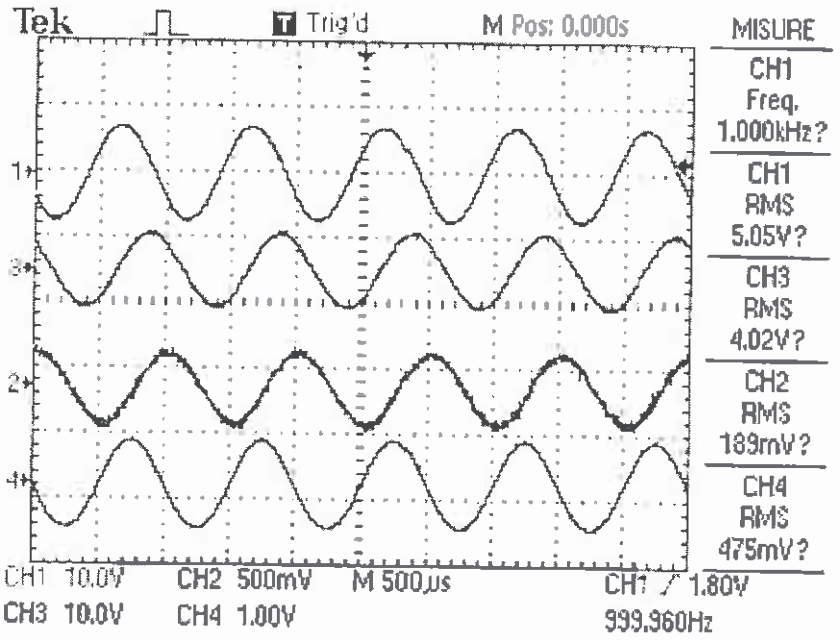


Figure 105: Side B Sine Wave Injection 1KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

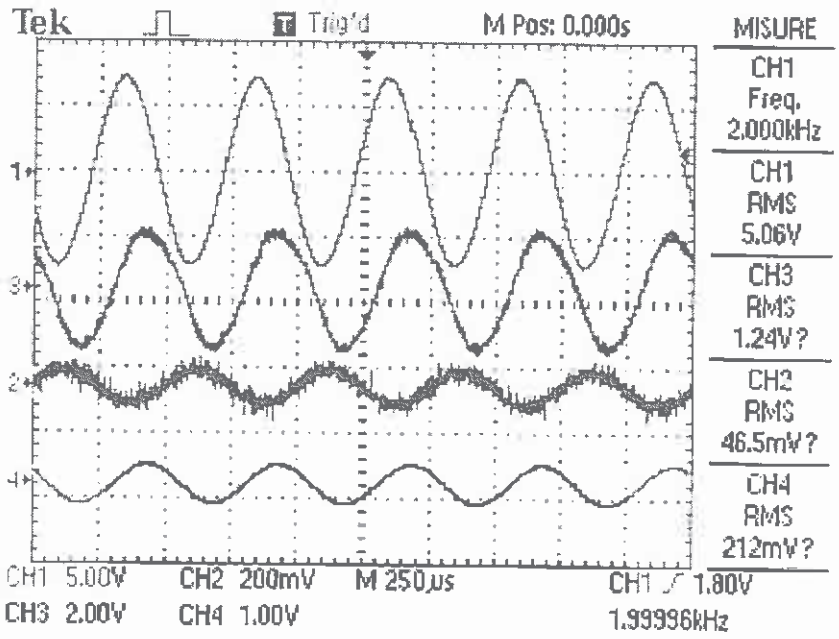


Figure 106: Side B Sine Wave Injection 2KHz

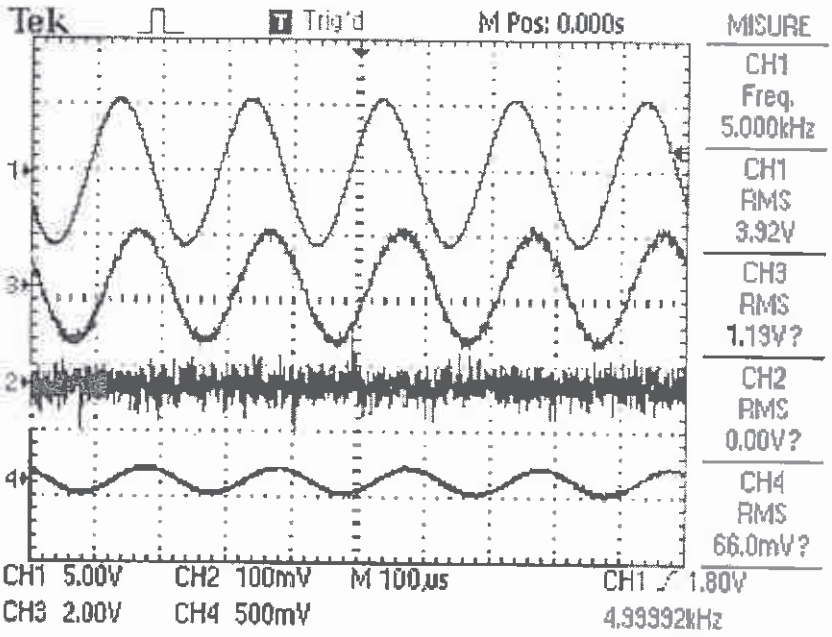
Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Para10.5.1
Step
SC-01.17
SC-01.18

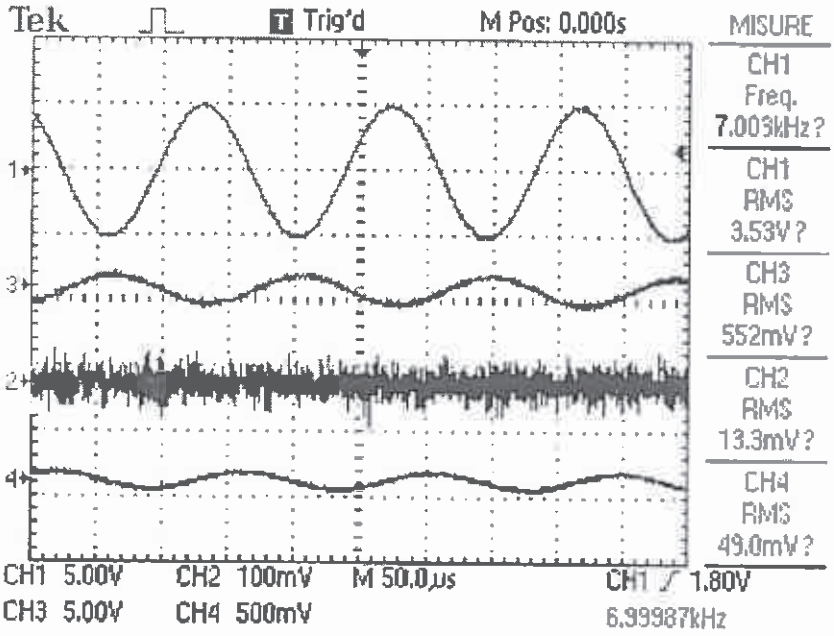
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 107: Side B Sine Wave Injection 5KHz



Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 108: Side B Sine Wave Injection 7KHz

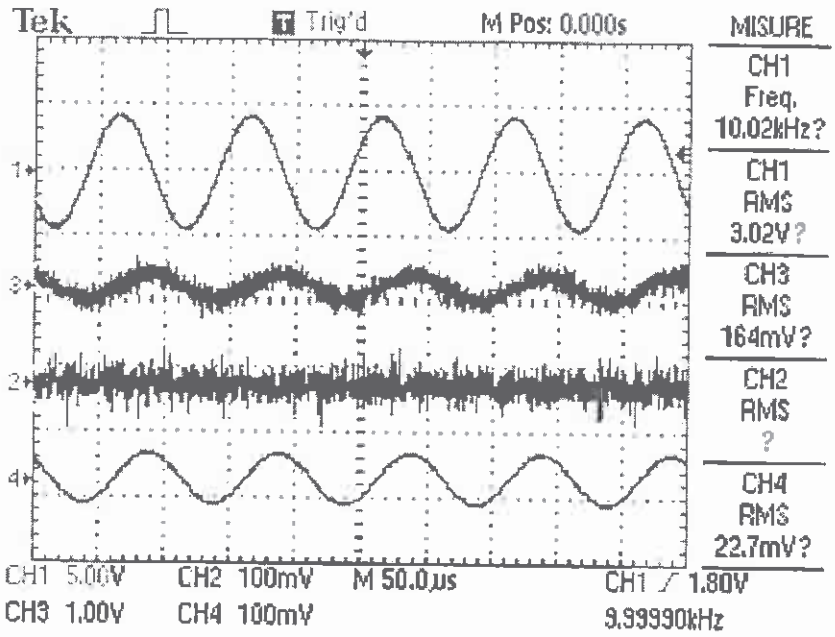


Figure 109: Side B Sine Wave Injection 10KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

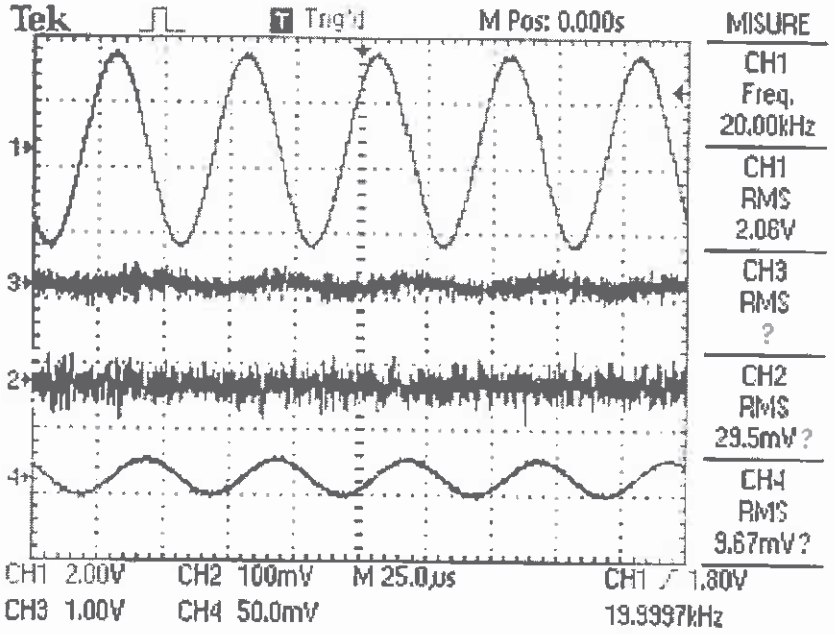


Figure 110: Side B Sine Wave Injection 20KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

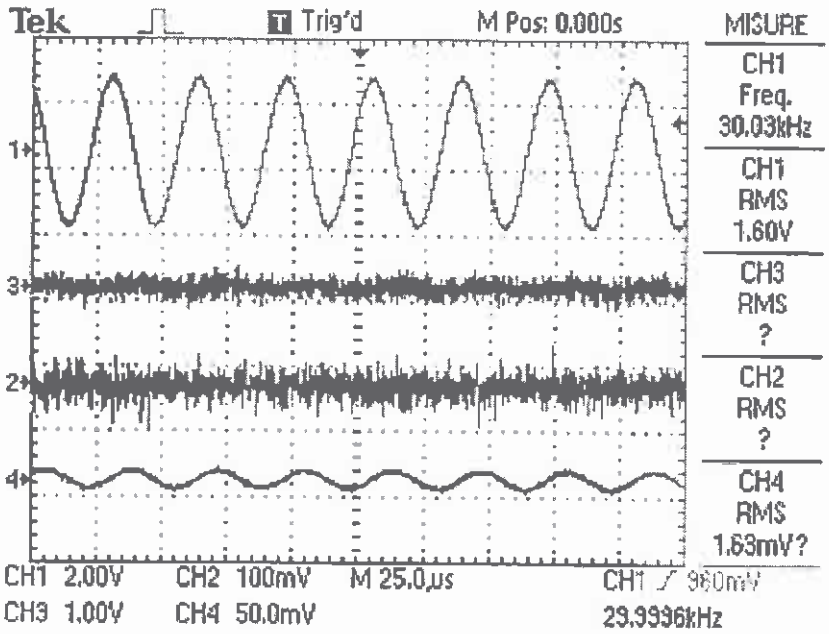


Figure 111: Side B Sine Wave Injection 30KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

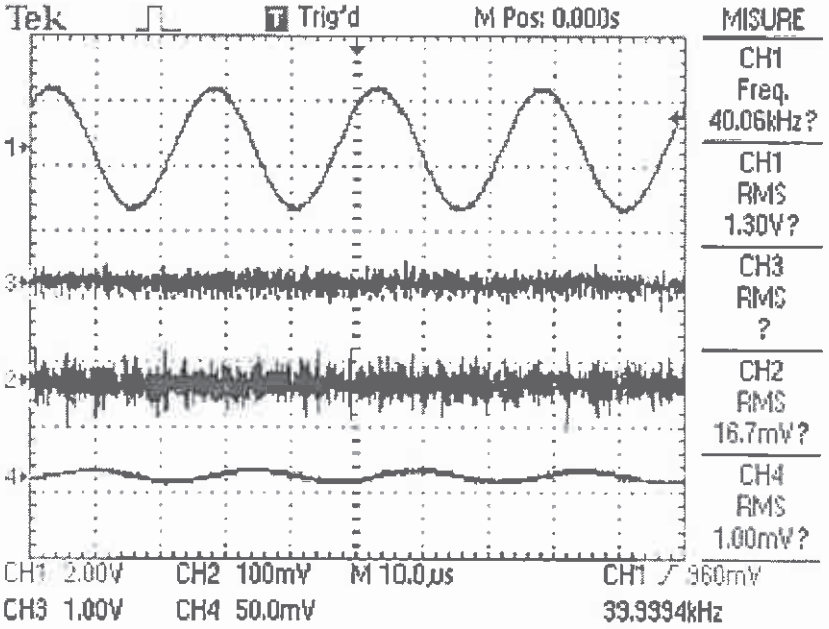


Figure 112: Side B Sine Wave Injection 40KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

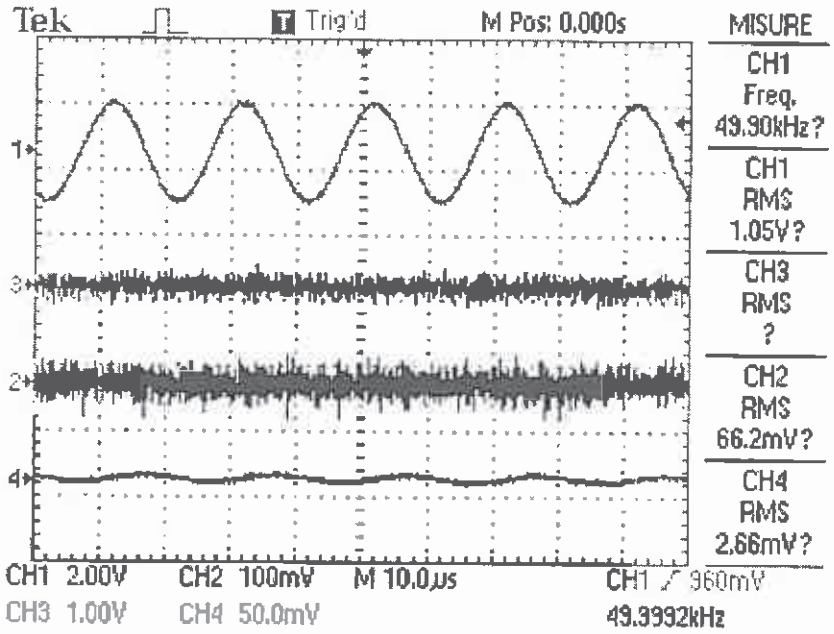


Figure 113: Side B Sine Wave Injection 50KHz

Para10.5.1
Step
SC-01.17
SC-01.18

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

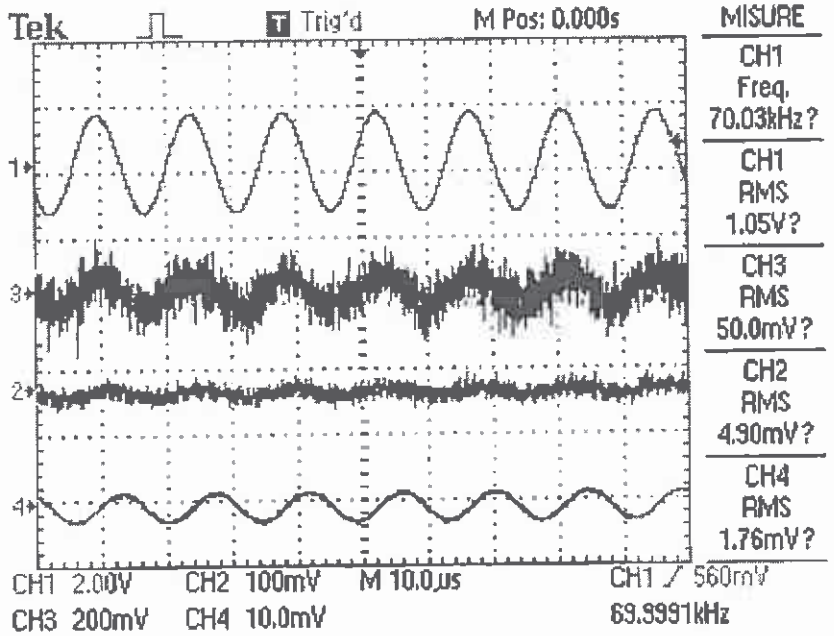


Figure 114: Side B Sine Wave Injection 70KHz

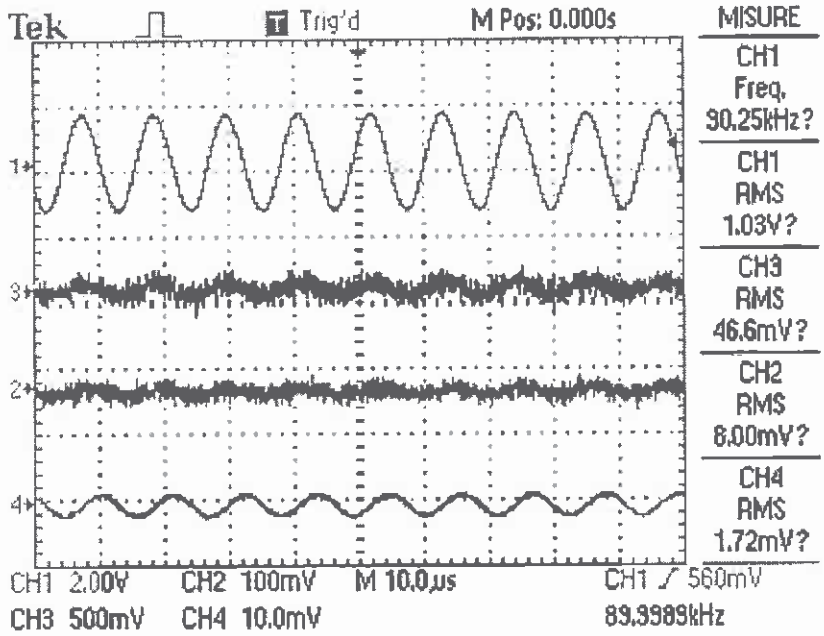
Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Para10.5.1
Step
SC-01.36
SC-01.37

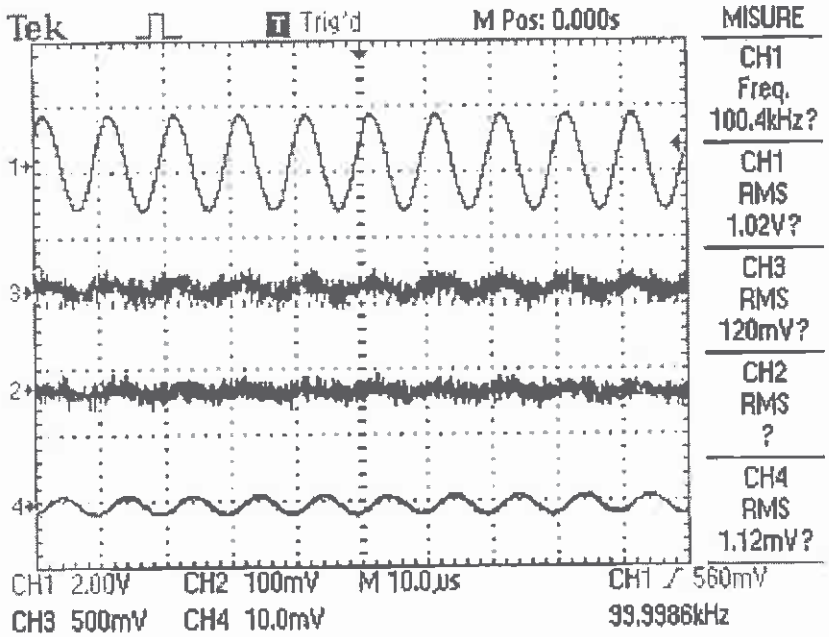
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 115: Side B Sine Wave Injection 90KHz



Para10.5.1
Step
SC-01.36
SC-01.37

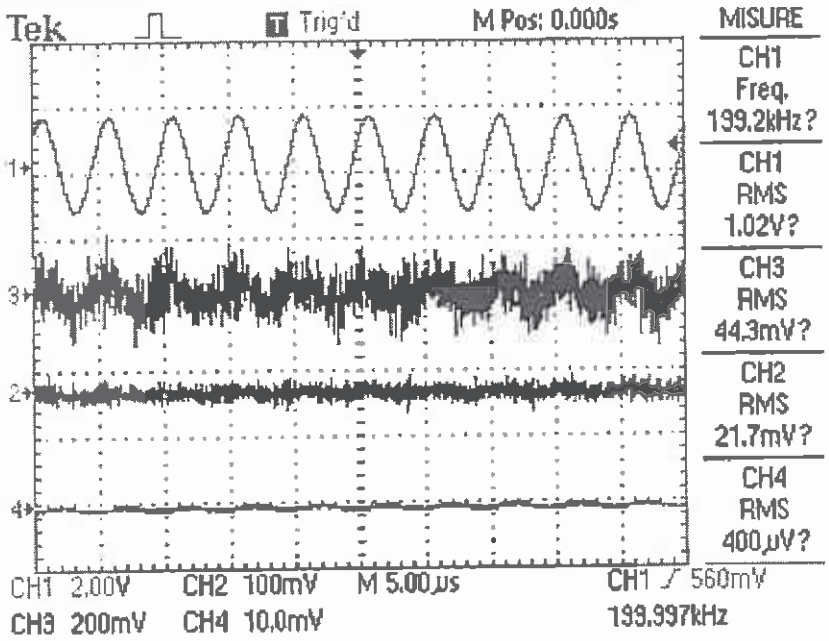
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 116: Side B Sine Wave Injection 100KHz



Para10.5.1
Step
SC-01.36
SC-01.37

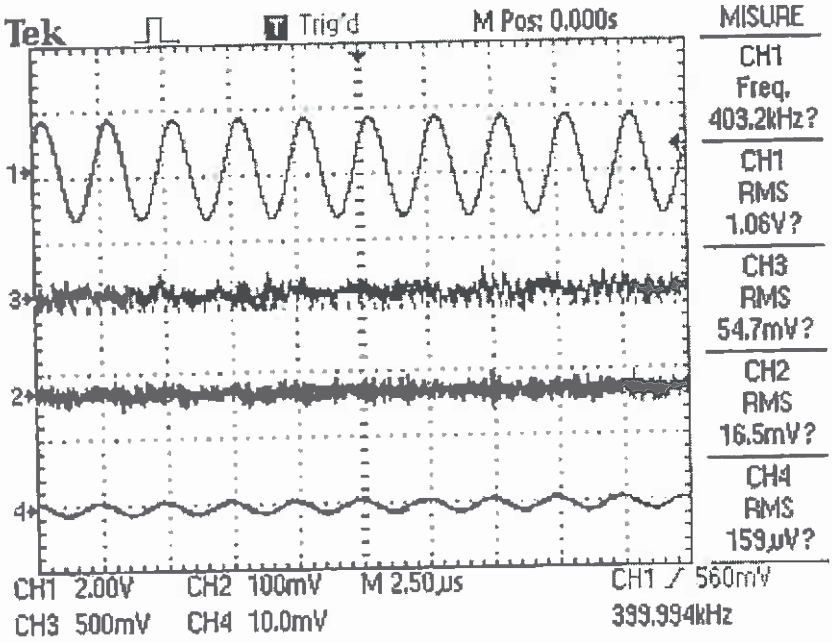
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 117: Side B Sine Wave Injection 200KHz



Para10.5.1
Step
SC-01.36
SC-01.37

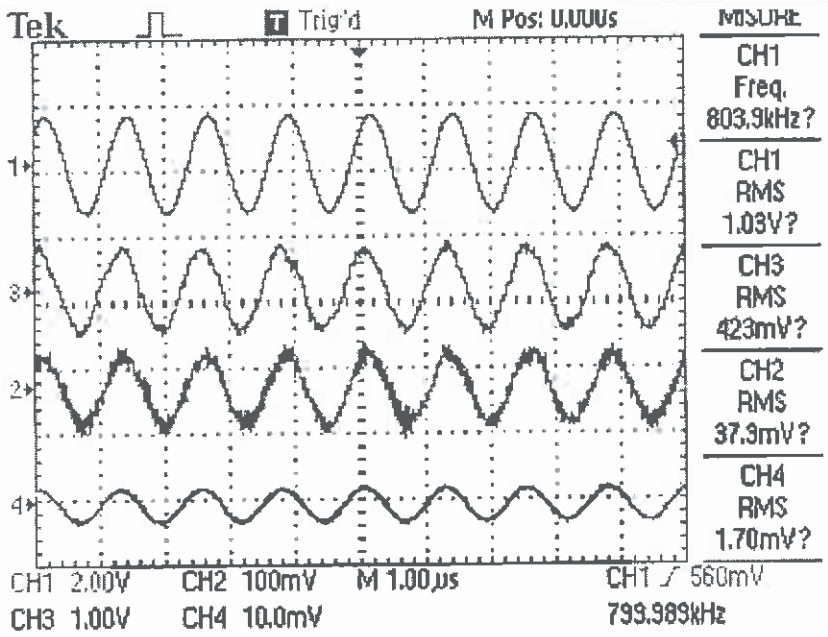
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 118: Side B Sine Wave Injection 400KHz



Para10.5.1
Step
SC-01.36
SC-01.37

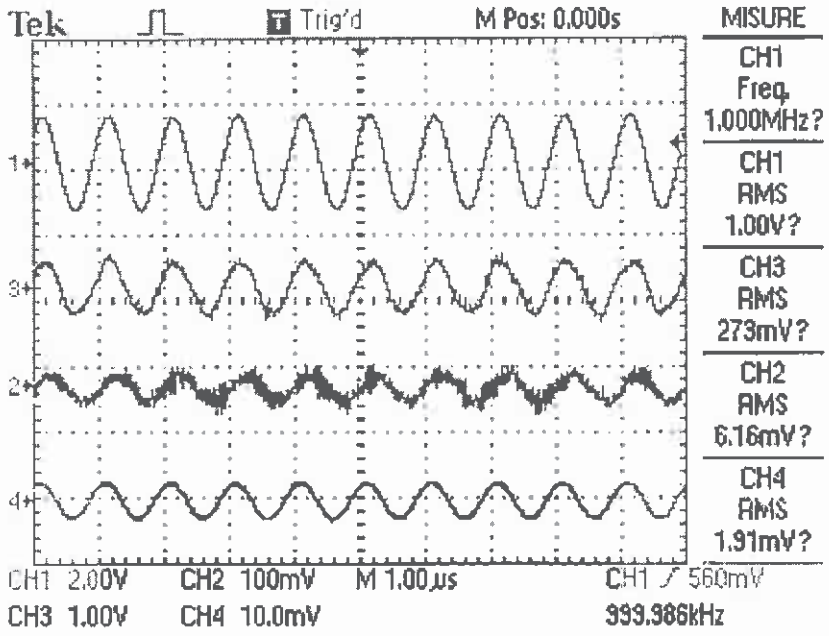
Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 119: Side B Sine Wave Injection 800KHz



Para10.5.1
Step
SC-01.36
SC-01.37

Ch1=
Vinput

Ch3=
Vout_120V

Ch2=
Vout_28V

Ch4=
Input_curr.
1A/100mV

Figure 120: Side B Sine Wave Injection 1MHz

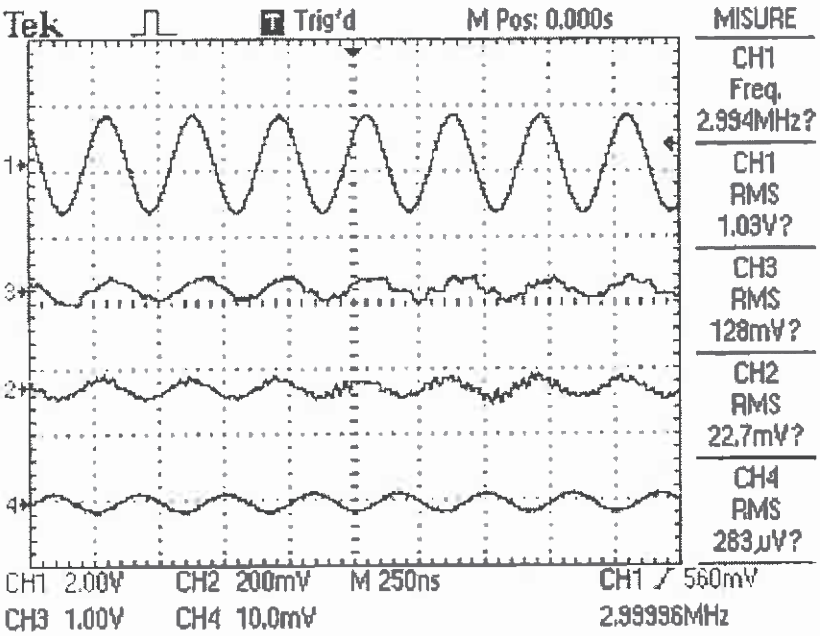


Figure 121: Side B Sine Wave Injection 3MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

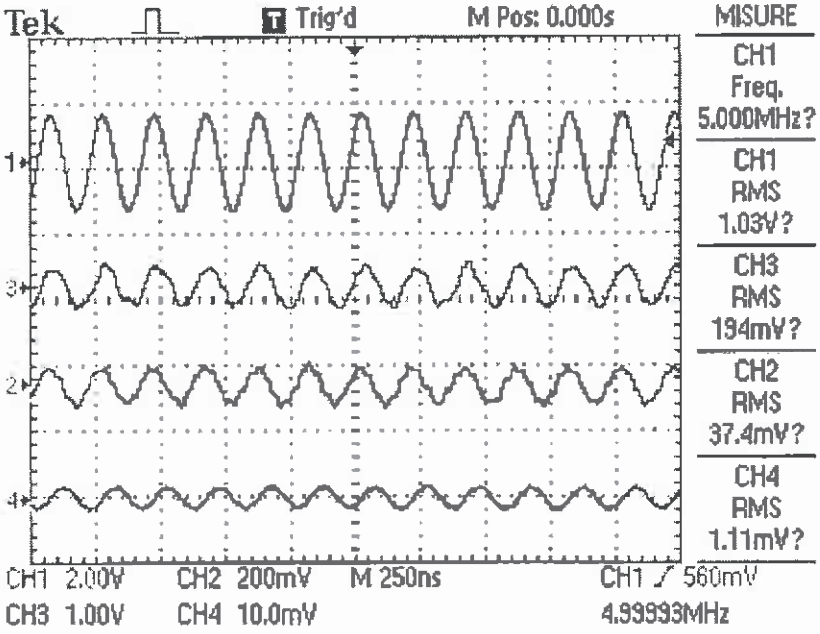


Figure 122: Side B Sine Wave Injection 5MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

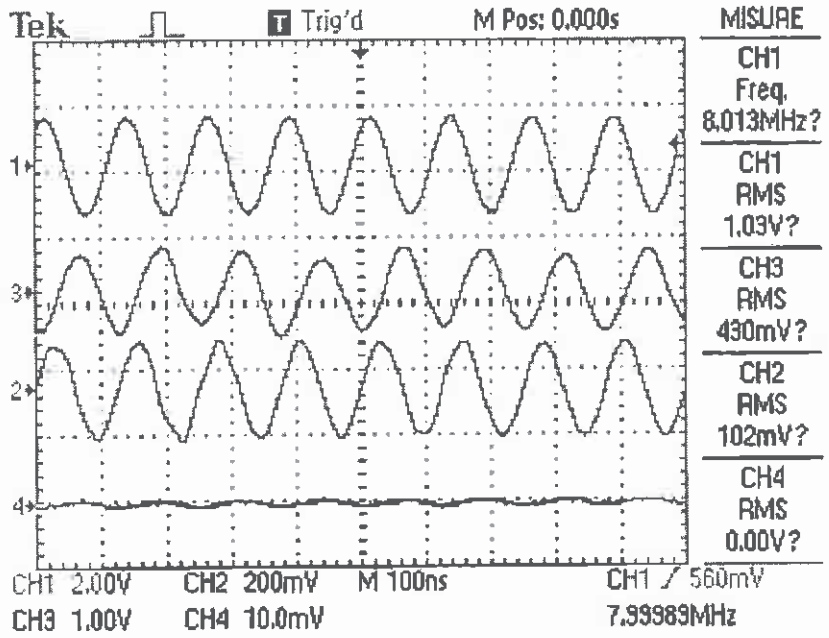


Figure 123: Side B Sine Wave Injection 8MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

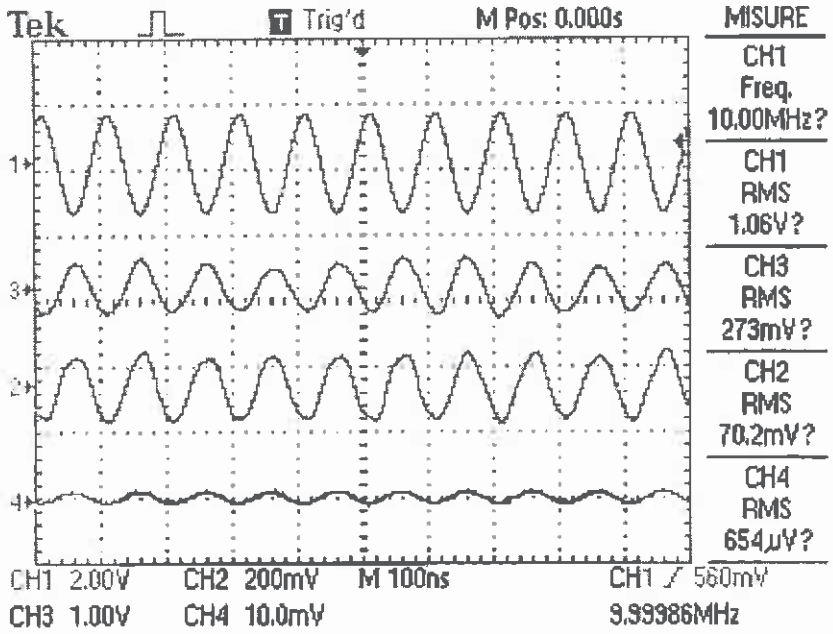


Figure 124: Side B Sine Wave Injection 10MHz

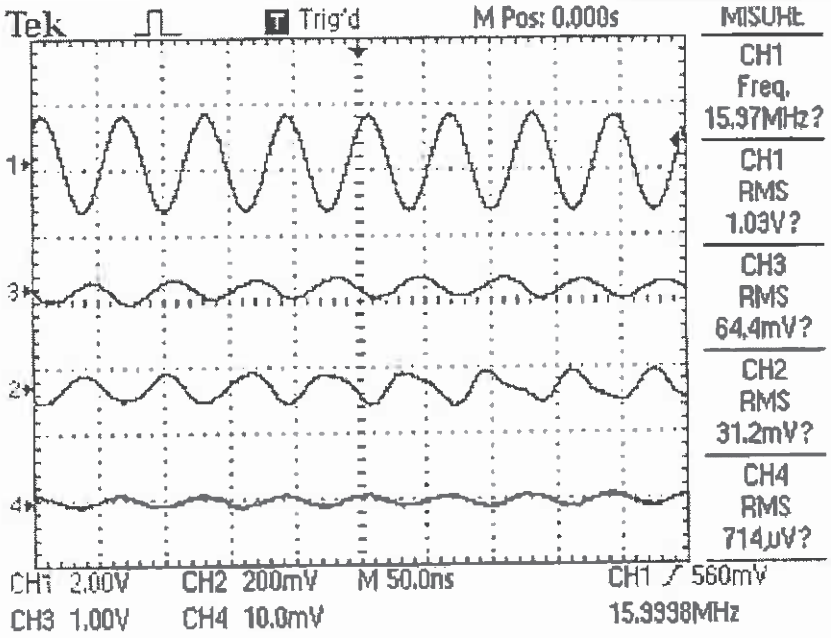
Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV



Para10.5.1
Step
SC-01.36
SC-01.37

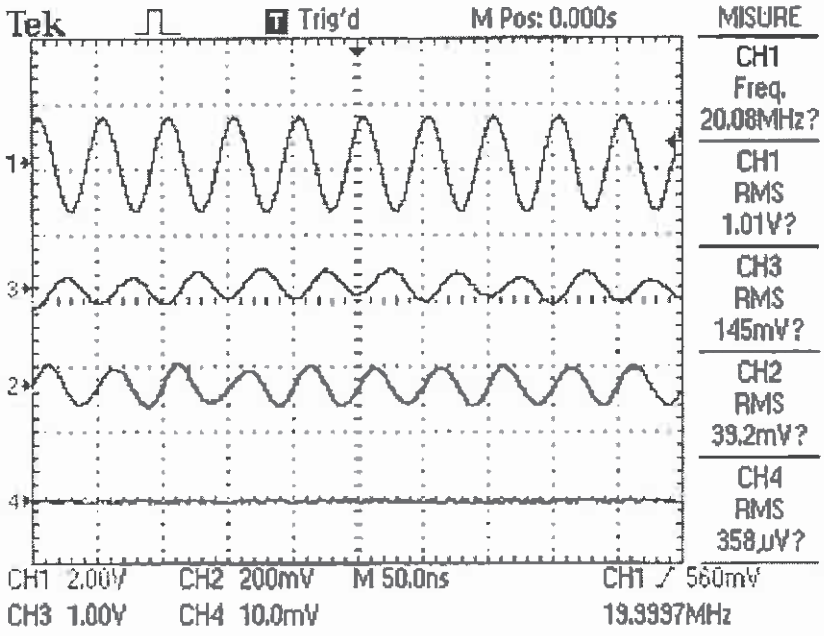
Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 125: Side B Sine Wave Injection 16MHz



Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

Figure 126: Side B Sine Wave Injection 20MHz

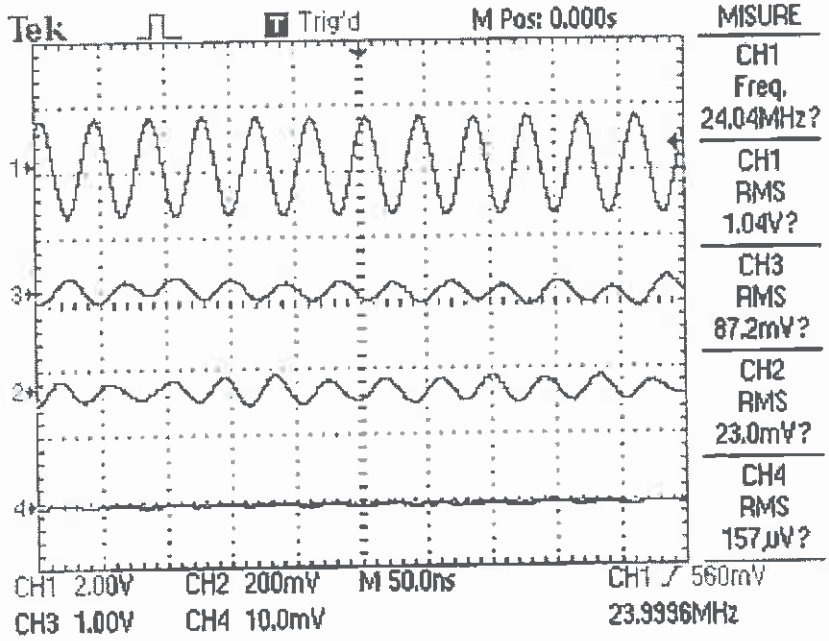


Figure 127: Side B Sine Wave Injection 24MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

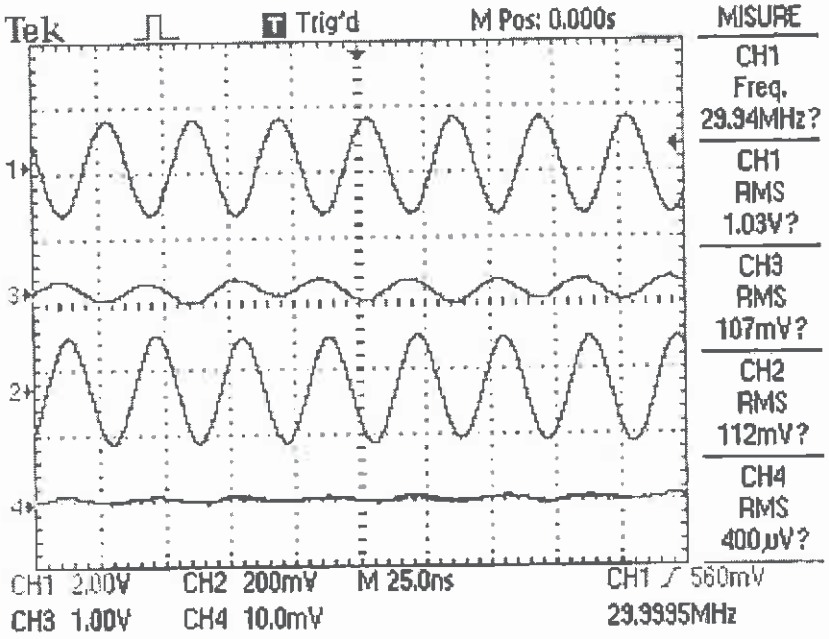


Figure 128: Side B Sine Wave Injection 30MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

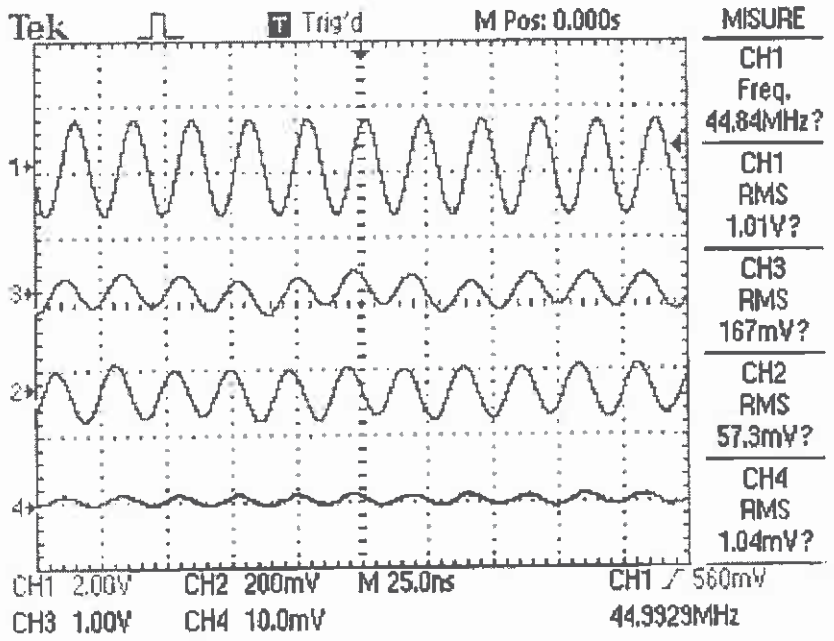


Figure 129: Side B Sine Wave Injection 45MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

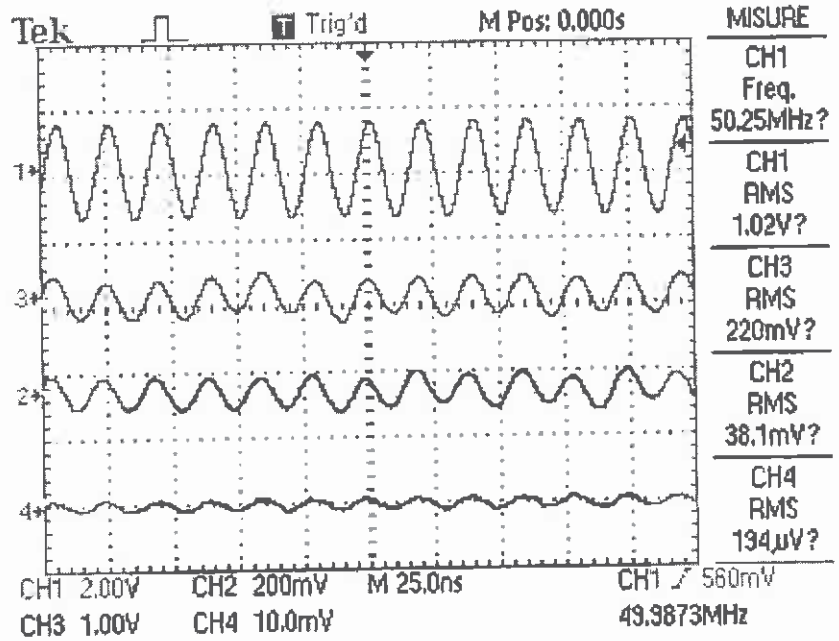


Figure 130: Side B Sine Wave Injection 50MHz

Para10.5.1
Step
SC-01.36
SC-01.37

Ch1= Vinput

Ch3= Vout_120V

Ch2= Vout_28V

Ch4= Input_curr. 1A/100mV

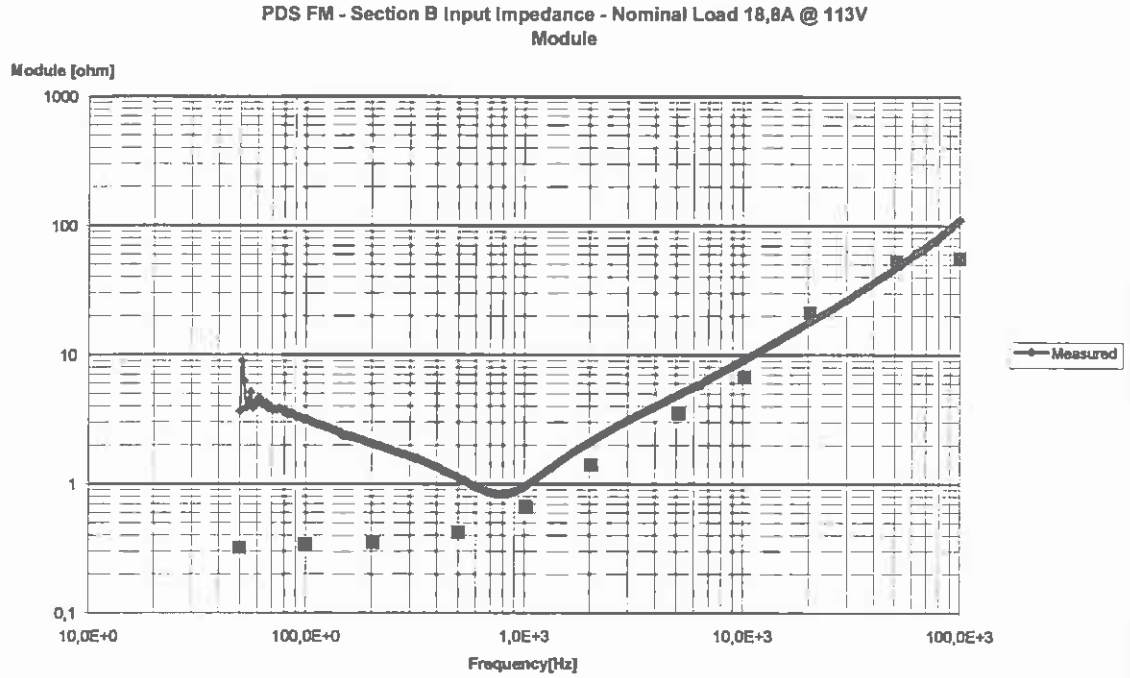


Figure 131: Side B Input impedance module – nominal load @113V

Para 10.5.2

Step SC-02.15

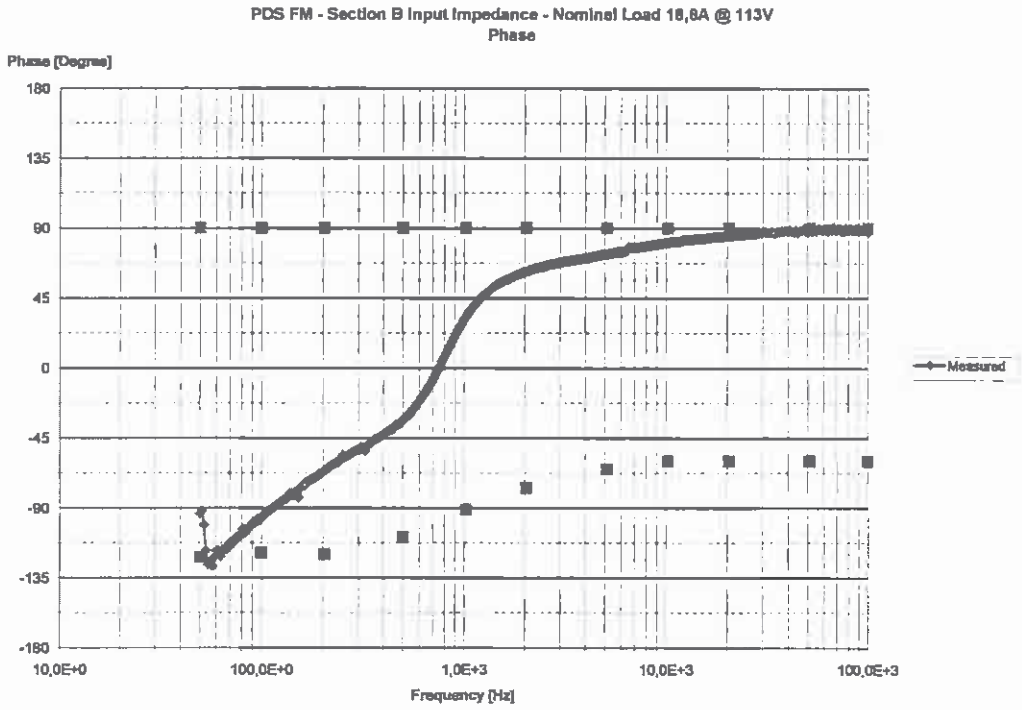


Figure 132: Side B Input impedance phase – nominal load @113V

Para 10.5.2

Step SC-02.15

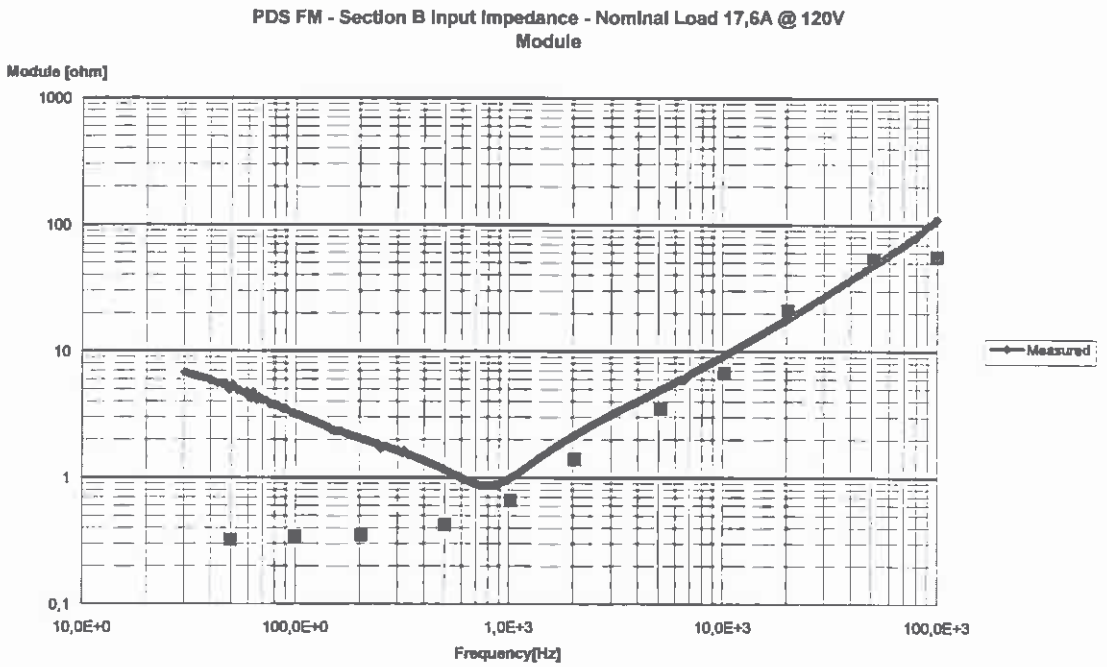


Figure 133: Side B Input impedance module – nominal load @120V

Para 10.5.2

Step SC-02.20

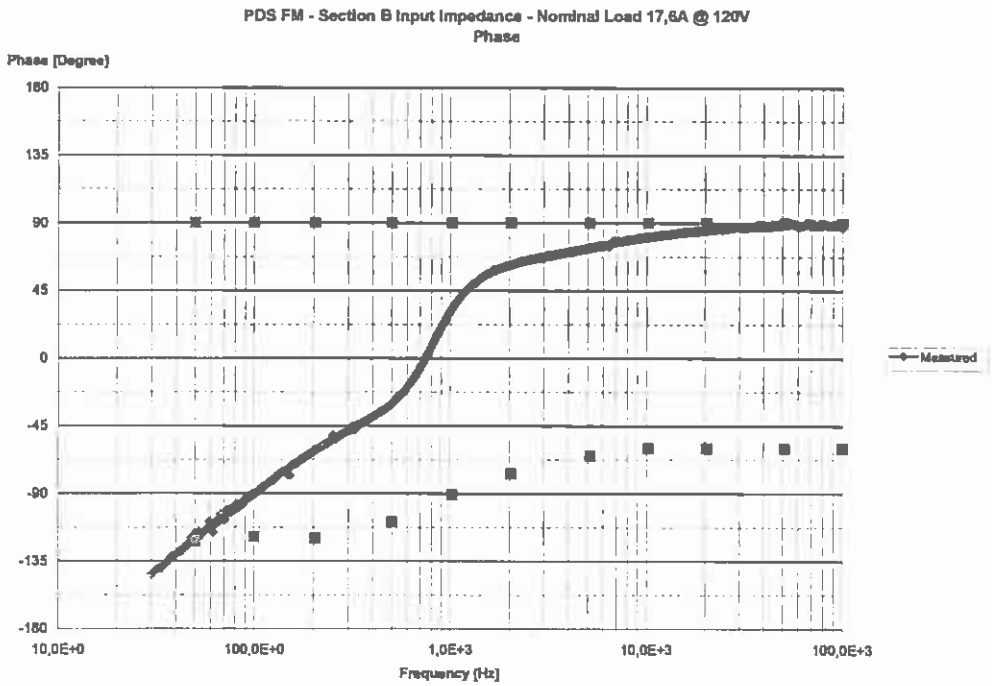


Figure 134: Side B Input impedance phase – nominal load @120V

Para 10.5.2

Step SC-02.20

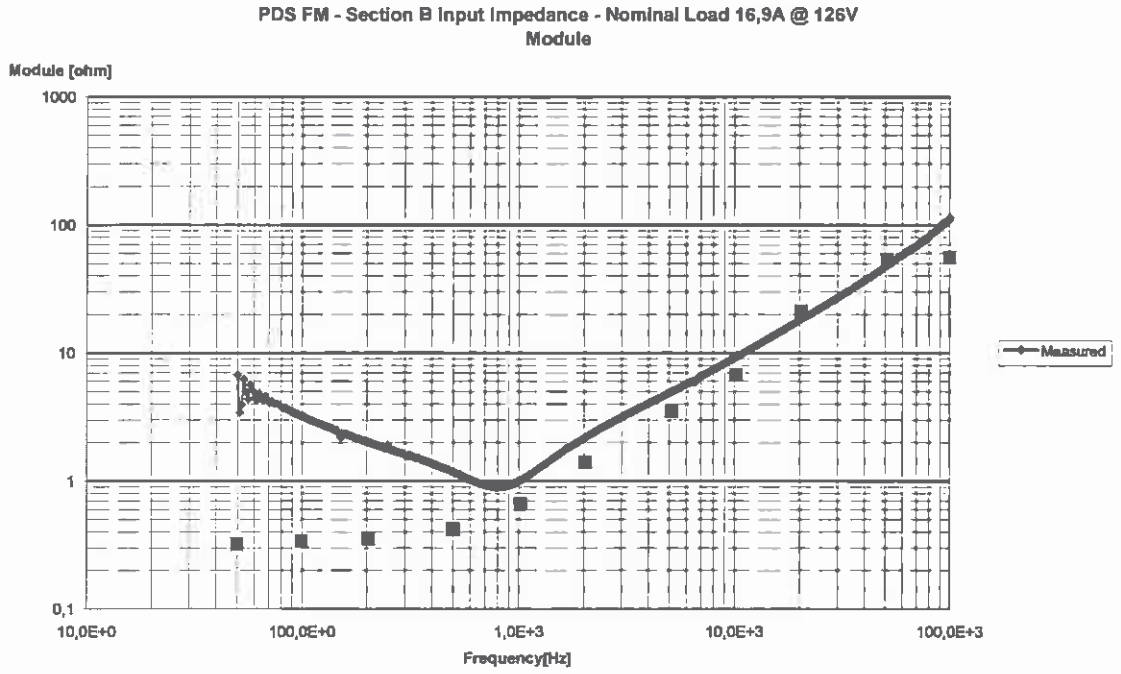


Figure 135: Side B Input impedance module – nominal load @126V

Para 10.5.2

Step SC-02.25

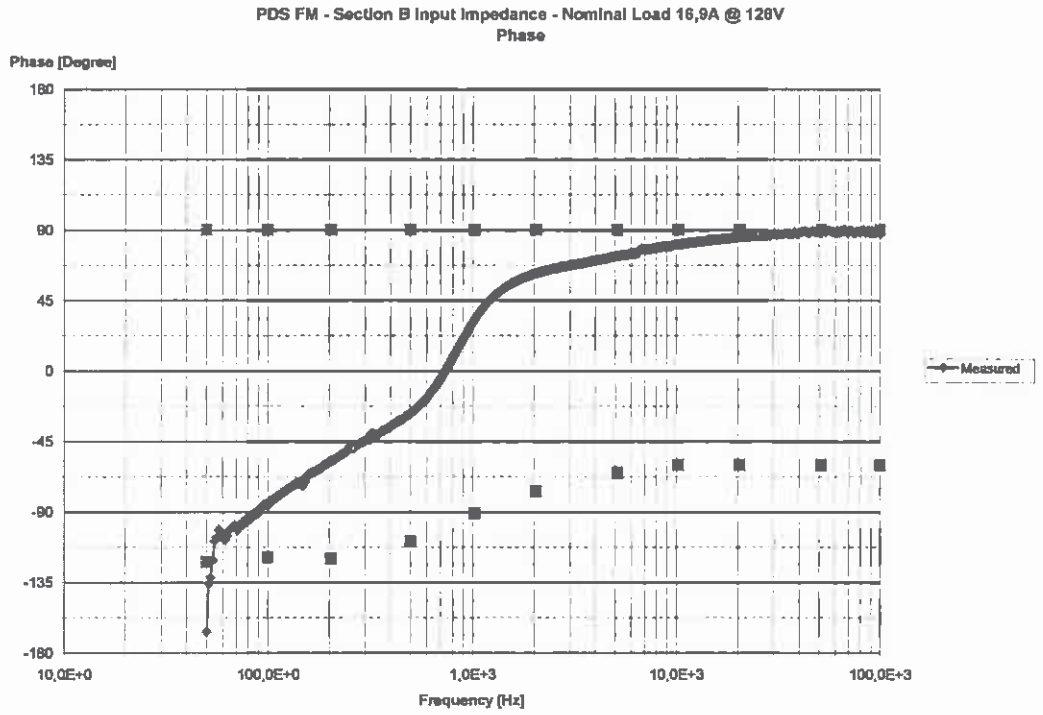


Figure 136: Side B Input impedance phase – nominal load @126V

Para 10.5.2

Step SC-02.25

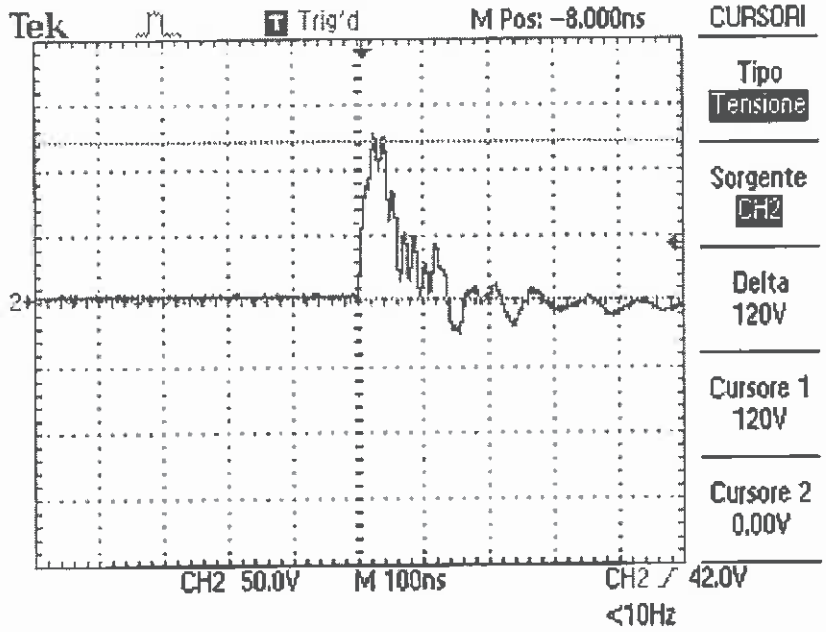


Figure 137: Side B Voltage Spike Transient calibration +120V for 0.15usec

Para. 10.5.3

Step SC-03.6

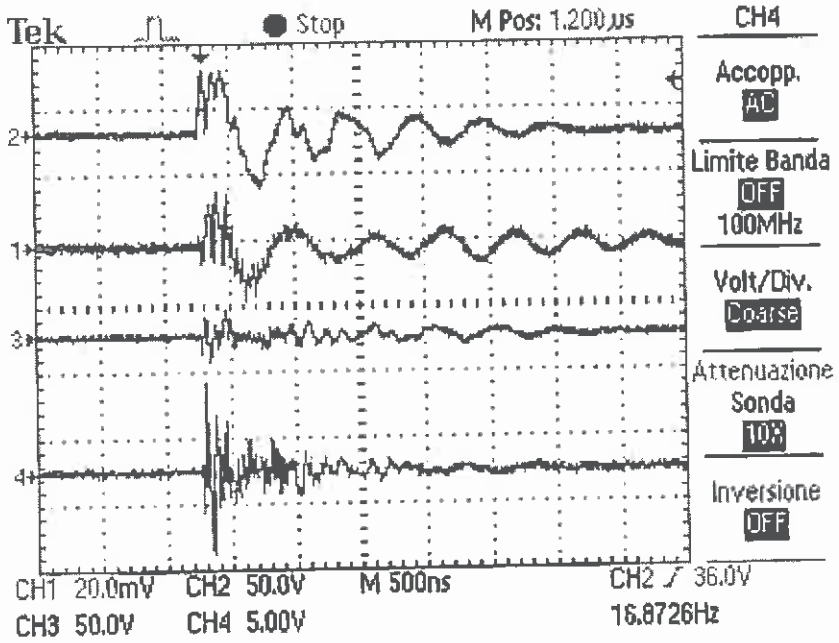


Figure 138: Side B Voltage Spike Transient +120V for 0.15usec

Para 10.5.3

Step SC-03.18

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

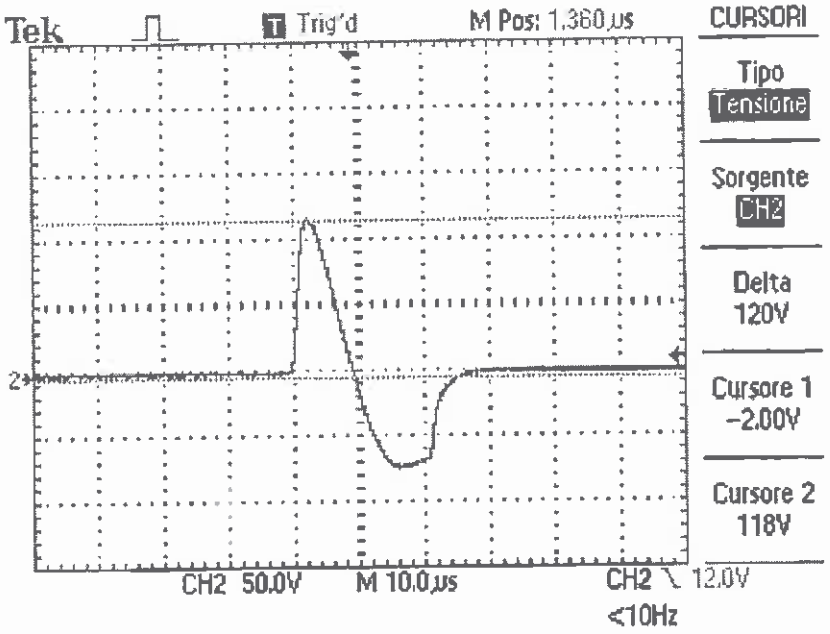


Figure 139: Side B Voltage Spike Transient calibration +120V for 10usec

Para. 10.5.3

Step SC-03.29

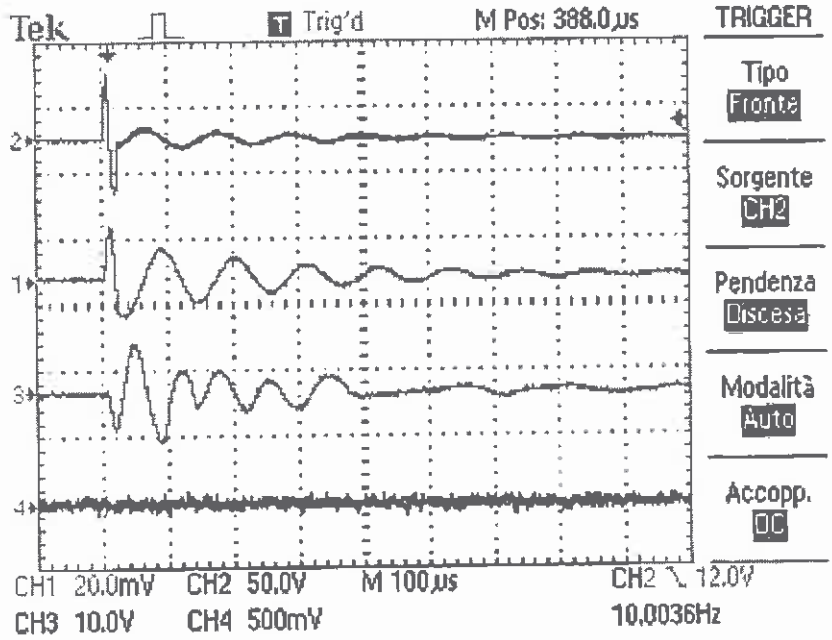


Figure 140: Side B Voltage Spike Transient +120V for 10usec

Para 10.5.3

Step SC-03.40

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

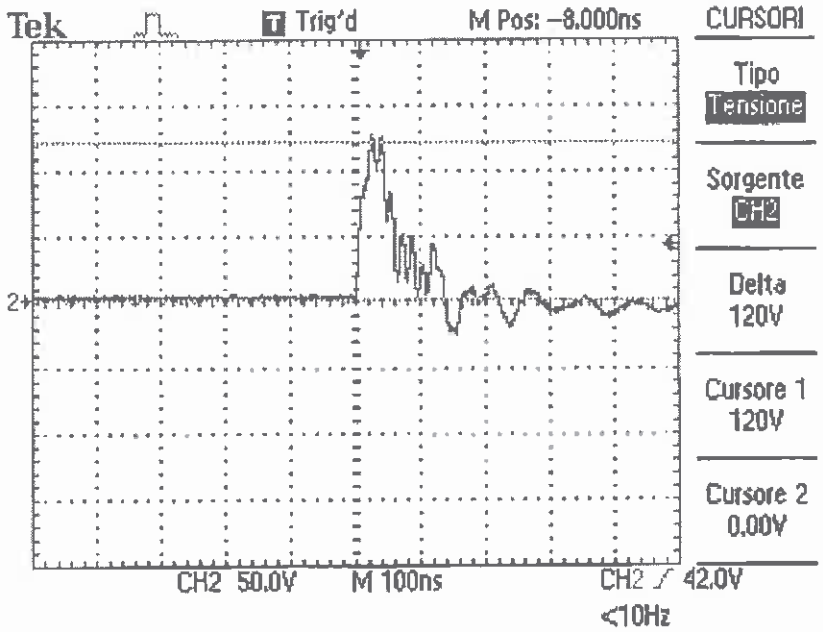


Figure 141: Side B Voltage Spike Transient calibration -120V for 0.15usec

Para. 10.5.3

Step SC-03.50

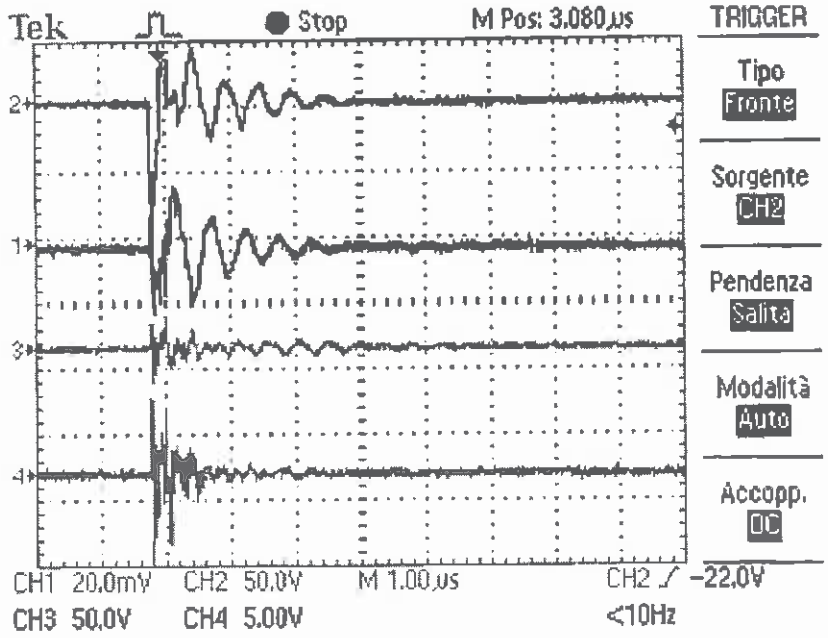


Figure 142: Side B Voltage Spike Transient -120V for 0.15usec

Para 10.5.3

Step SC-03.61

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

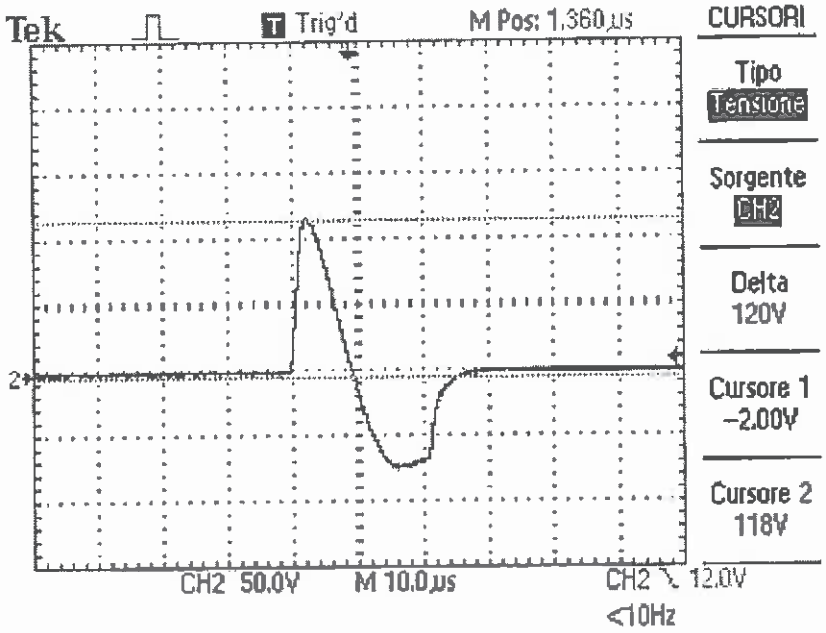


Figure 143: Side B Voltage Spike Transient calibration -120V for 10usec

Para. 10.5.3

Step SC-03.71

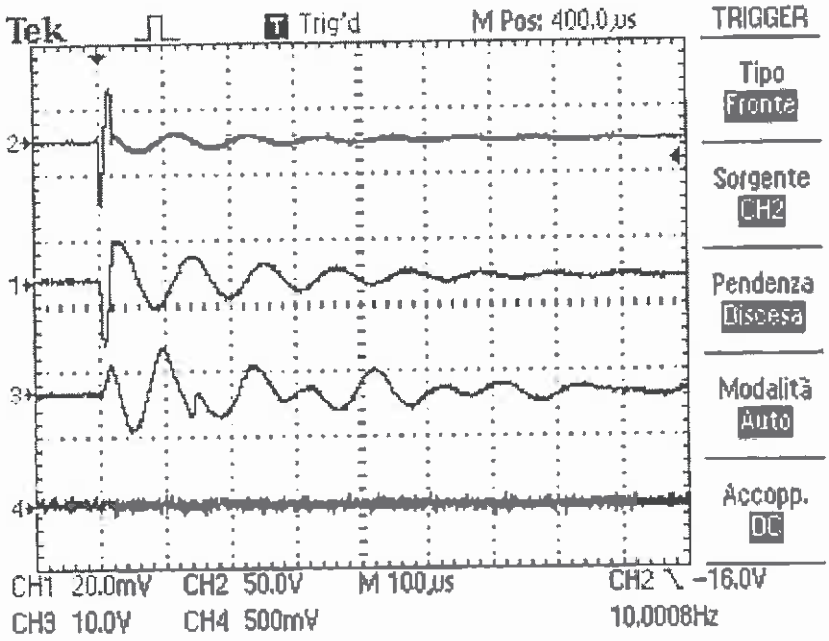


Figure 144: Side B Voltage Spike Transient -120V for 10usec

Para 10.5.3

Step SC-03.82

Ch2= Vinput(ac)

Ch1= Input_curr (ac) 2A/10mV

Ch3= Vout_120V (ac)

Ch4= Vout_28V (ac)

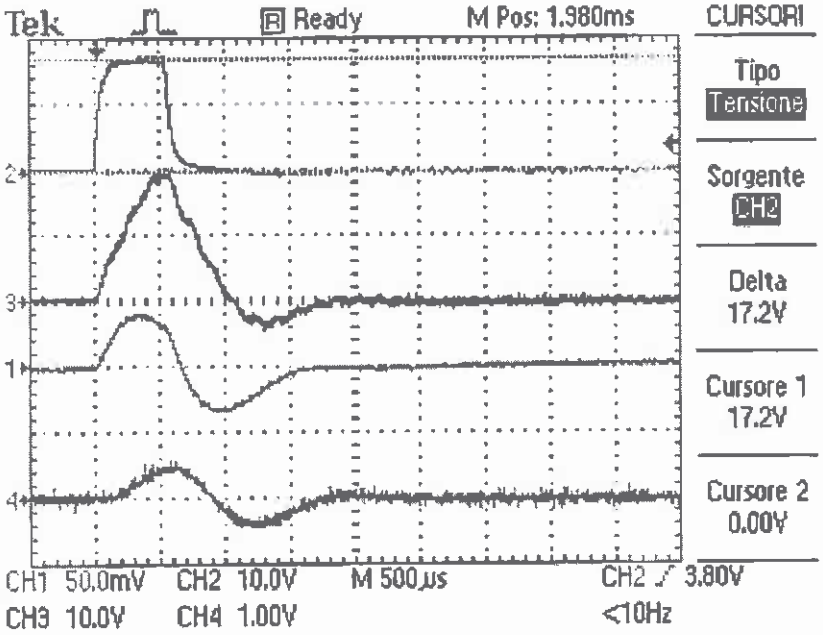


Figure 145: Side B Normal Voltage Transient - positive

Para. 10.5.4

Step SC-04.52

Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)

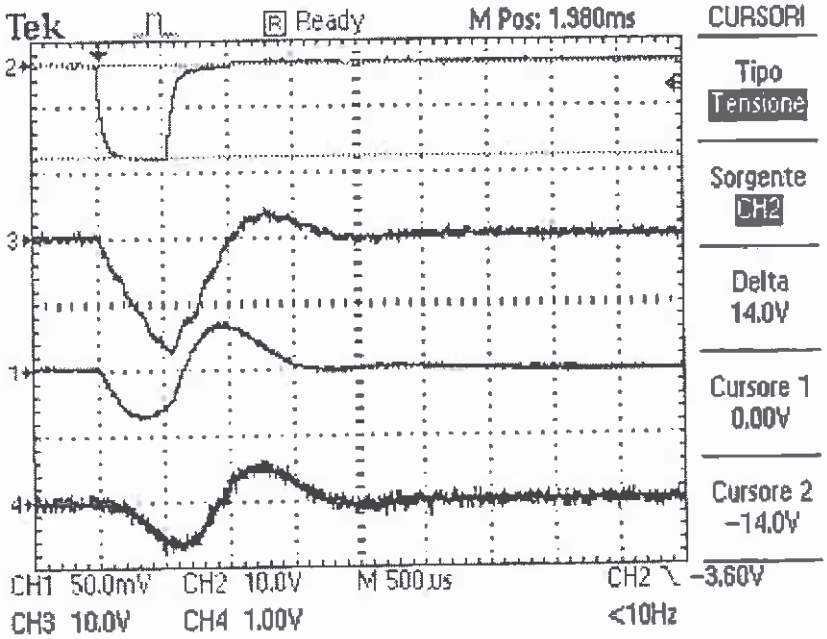


Figure 146: Side B Normal Voltage Transient - negative

Para. 10.5.4

Step SC-04.52

Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)

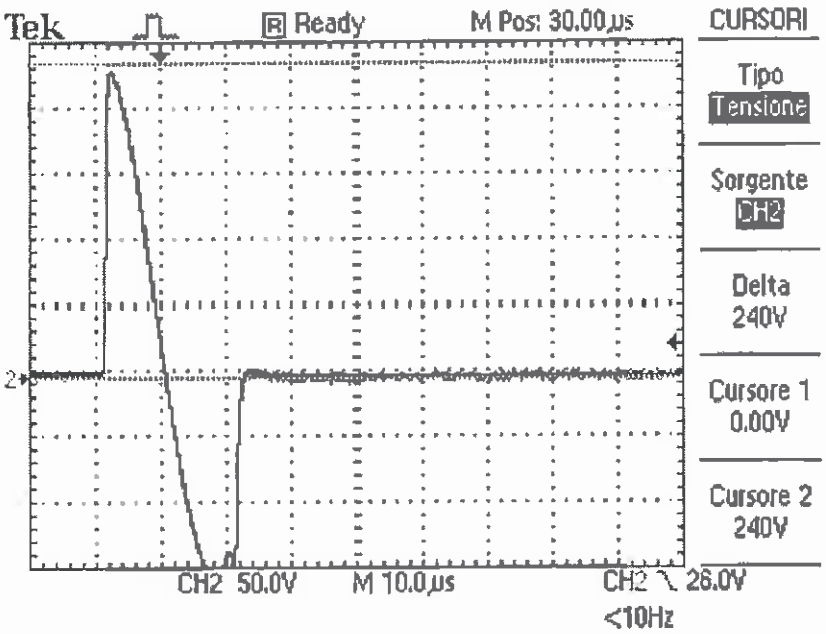


Figure 147: Side A Abnormal Voltage Transient 240V 12usec – calibration

Step SC-05.30

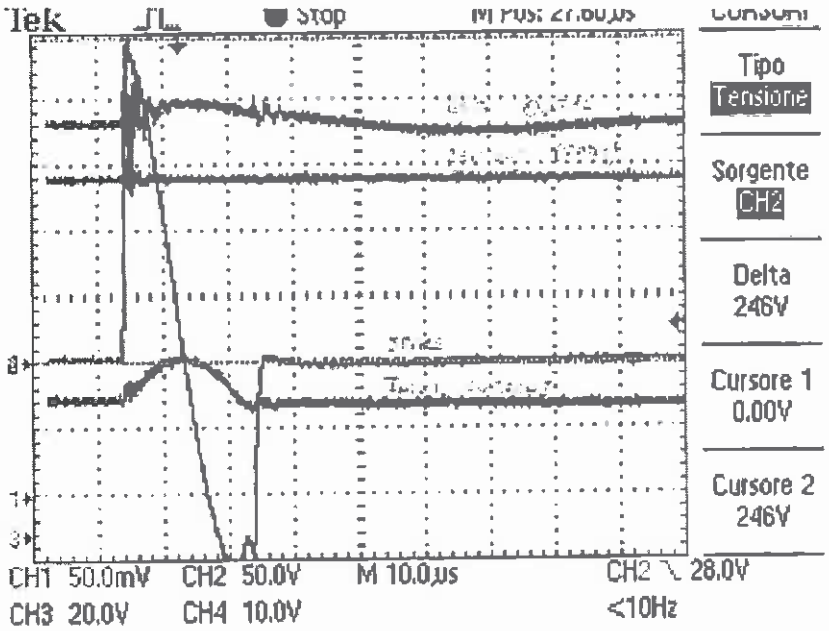


Figure 148: Side B Abnormal Voltage Transient 240V 12usec

Step SC-05.37

Ch2= spike

Ch3= Vout_120V

Ch1= Input_curr 2A/10mV

Ch4= Vout_28V

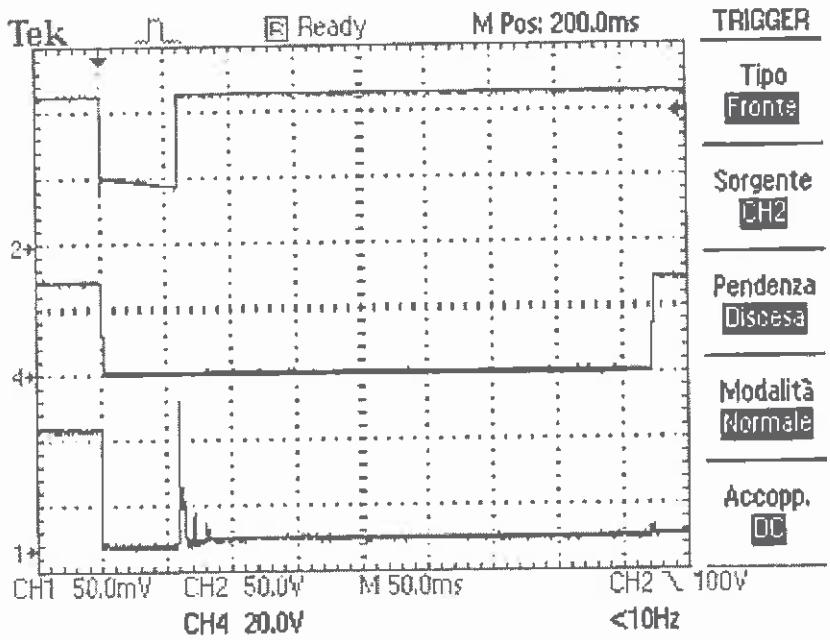


Figure 149: Side B Abnormal Voltage Transient 0V 60msec

Step SC-05.45

Ch2= Vinput

Ch4= Vout_28V

Ch1= Input_curr 2A/10mV

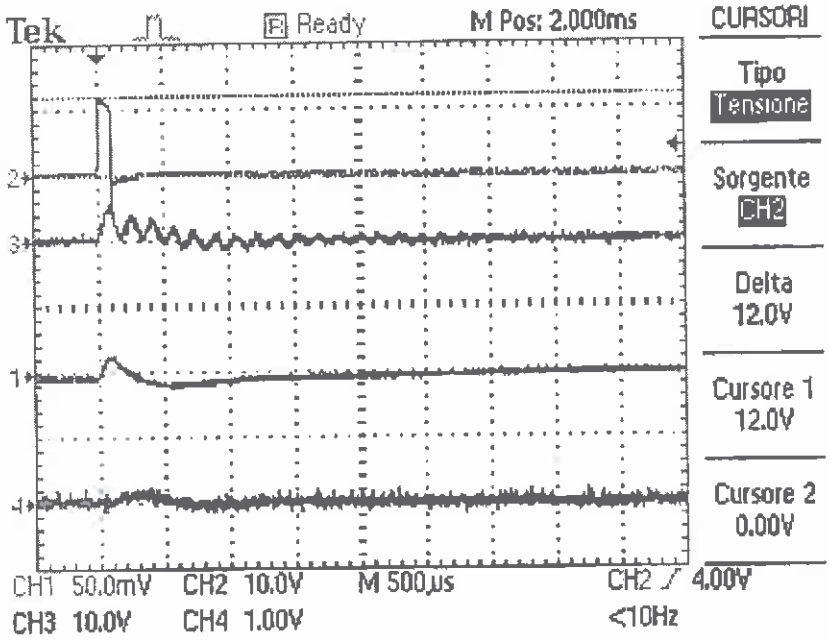


Figure 150: Side B Large Signal Stability – 100us

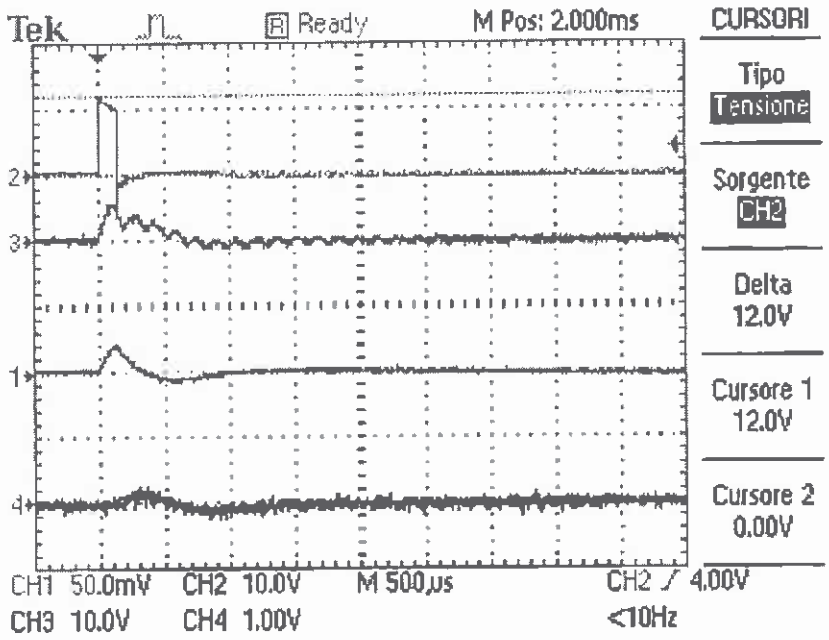
Step LSS-0.40 LSS-0.41

Ch2= Vinput (ac)

Ch3= Vout_120V (ac)

Ch1= Input_curr (ac) 2A/10mV

Ch4= Vout_28V (ac)



Step
LSS-0.45
LSS-0.46

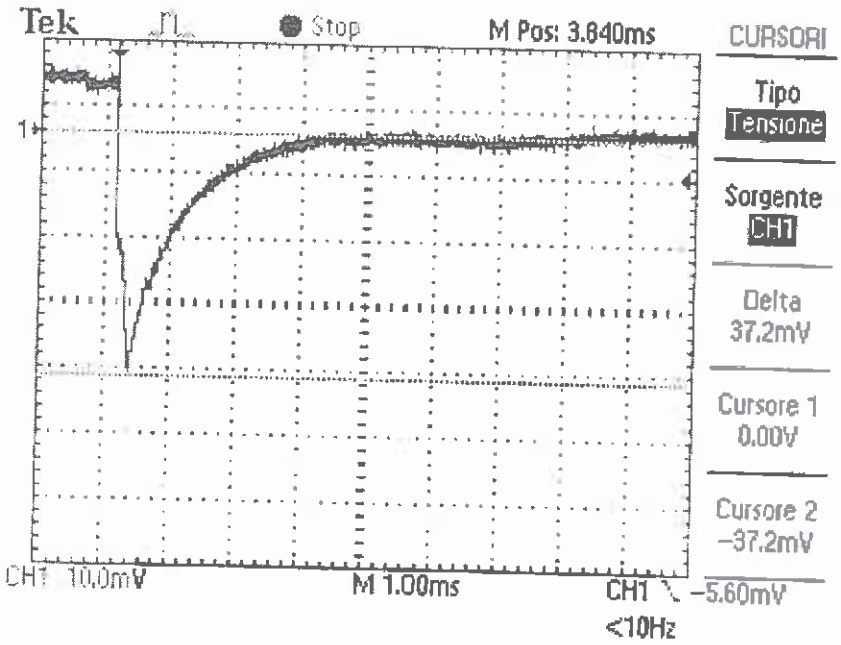
Ch2=
Vinput (ac)

Ch3=
Vout_120V
(ac)

Ch1=
Input_curr
(ac)
2A/10mV

Ch4=
Vout_28V
(ac)

Figure 151: Side B Large Signal Stability – 150us



Step
RC-11

Ch1=
Input
current
20A/10mv

Figure 152: Side A Reverse current test - Nominal load config (CCEB resistive load)

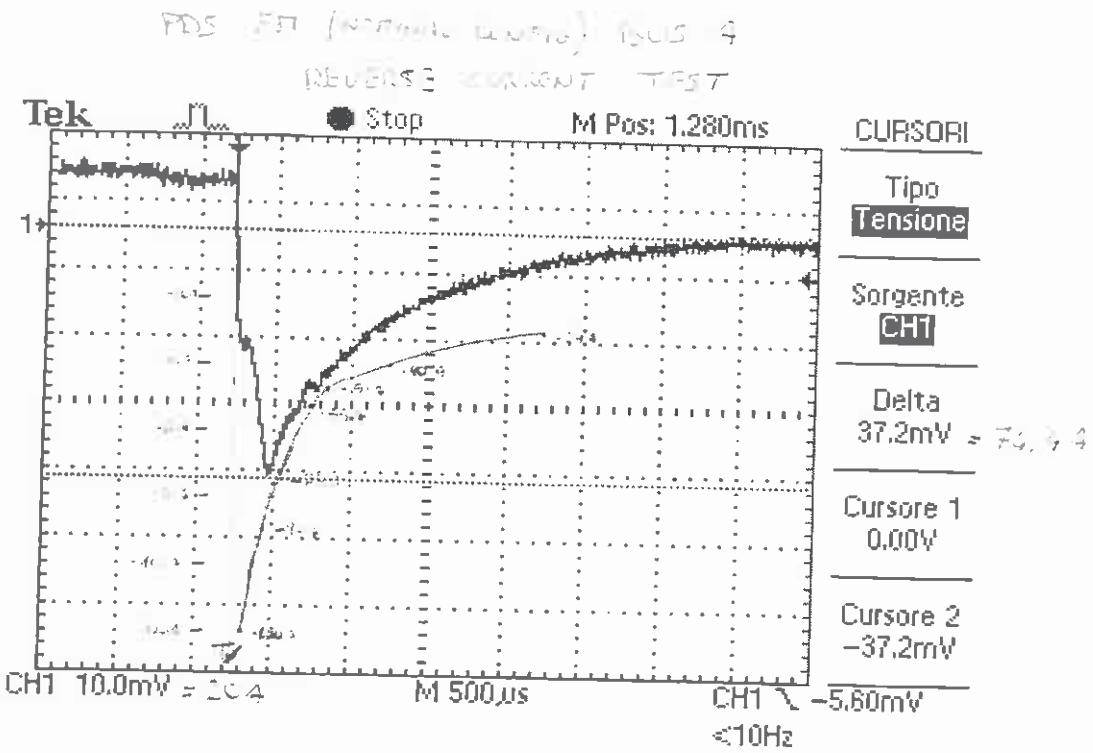


Figure 153: Side A Reverse current test - Nominal load config (CCEB resistive load)

Step RC-11

Ch1= Input current 20A/10mv

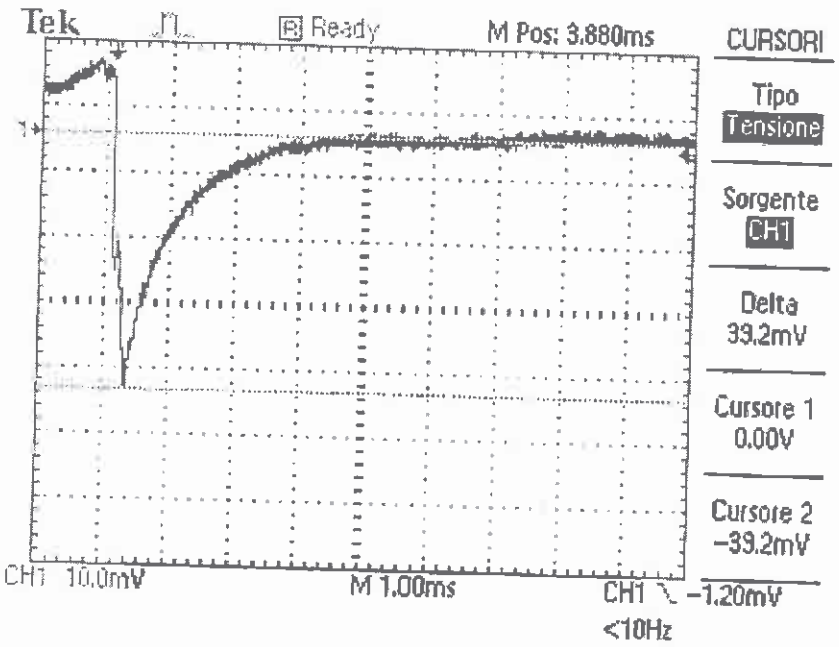


Figure 154: Side B Reverse current test - Nominal load config (CCEB resistive load)

Step RC-20

Ch1= Input current 20A/10mv

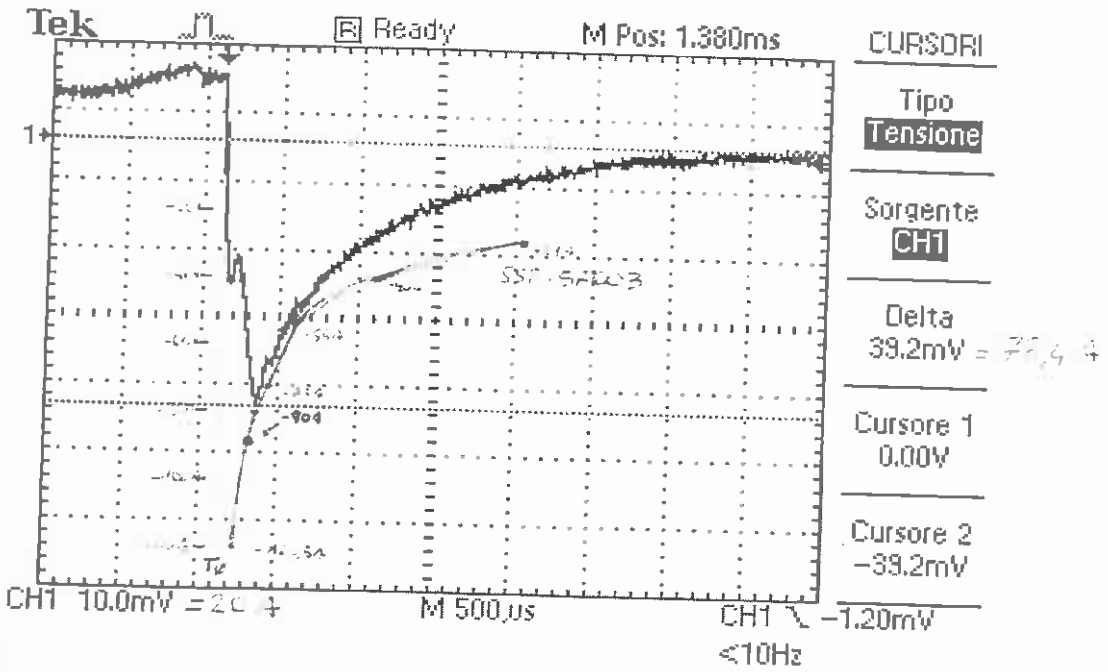


Figure 155: Side B Reverse current test - Nominal load config (CCEB resistive load)

Step RC-20

Ch1= Input current 20A/10mv

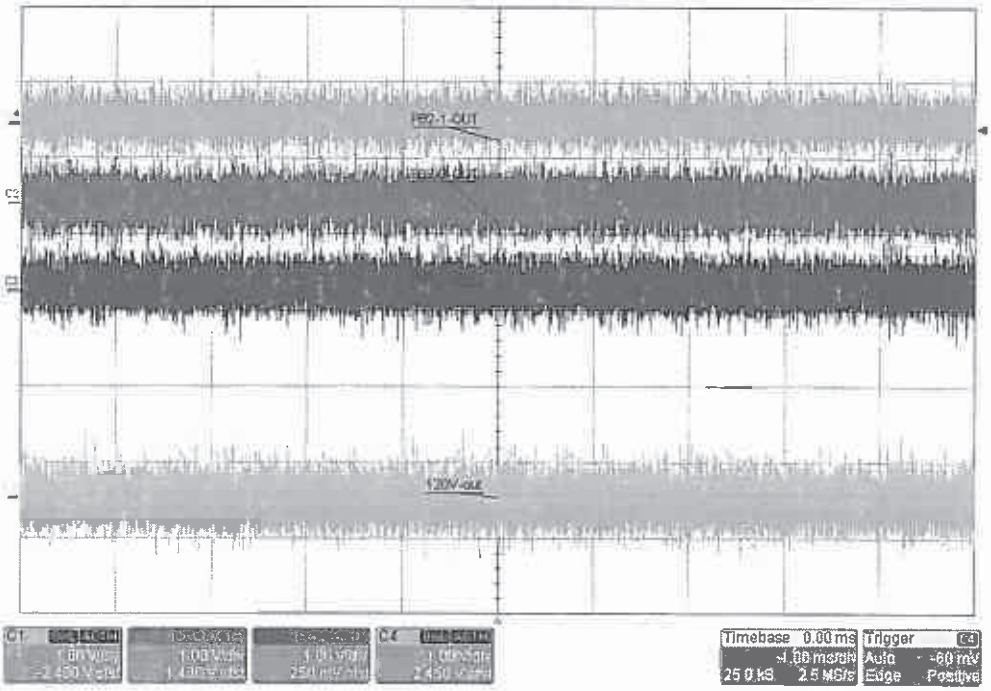


Figure 156: Side A Radiated Susceptibility 500MHz 60V/m -orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

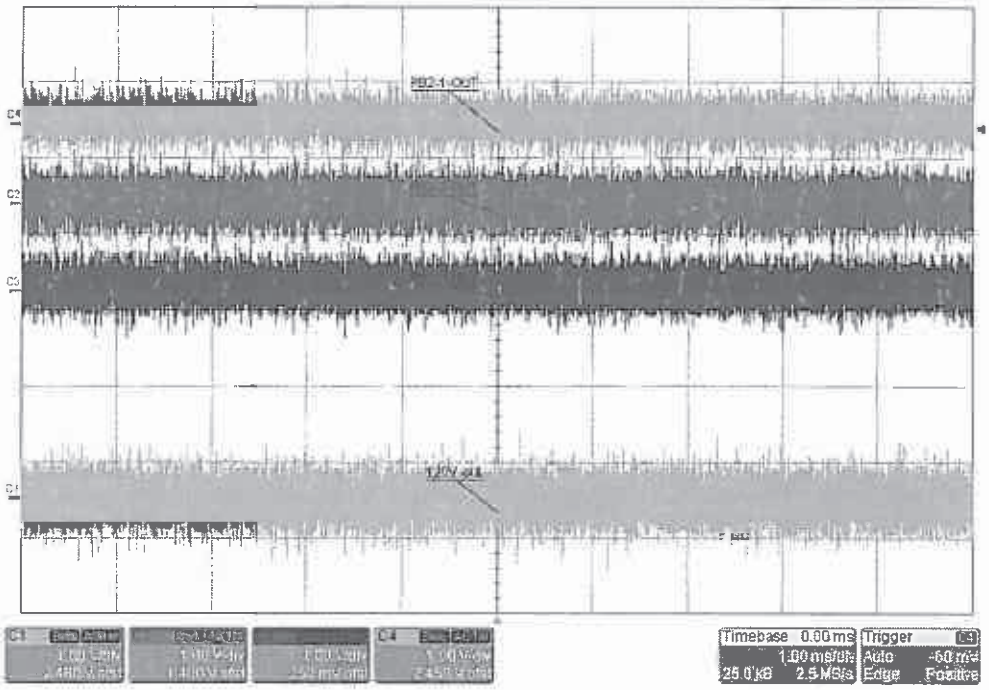


Figure 157: Side A Radiated Susceptibility 500MHz 60V/m -vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

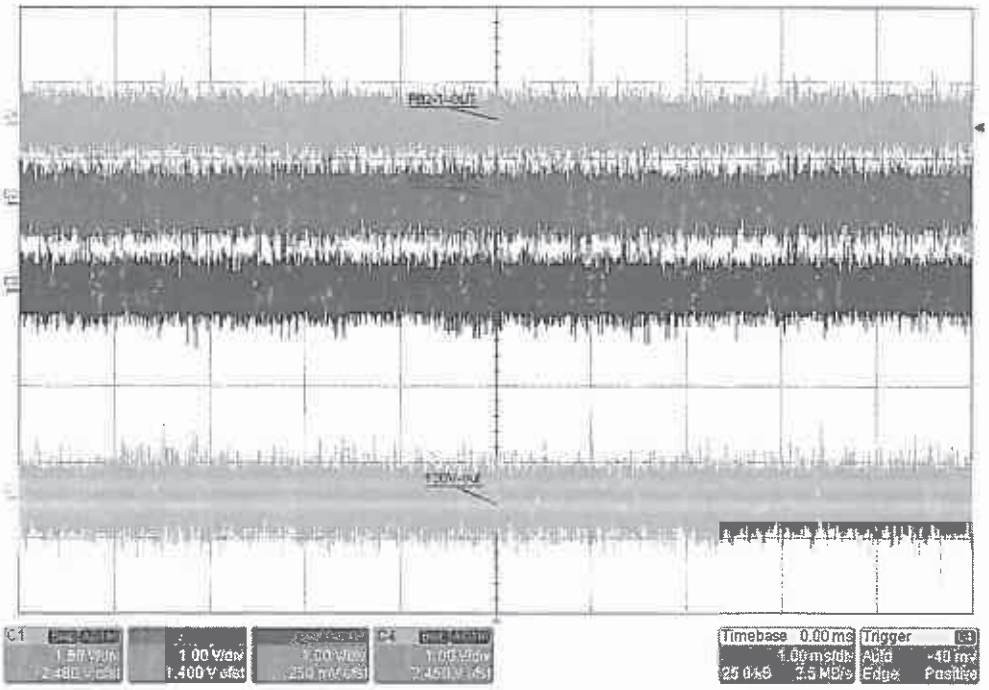


Figure 158: Side A Radiated Susceptibility 900MHz 60V/m - oriz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

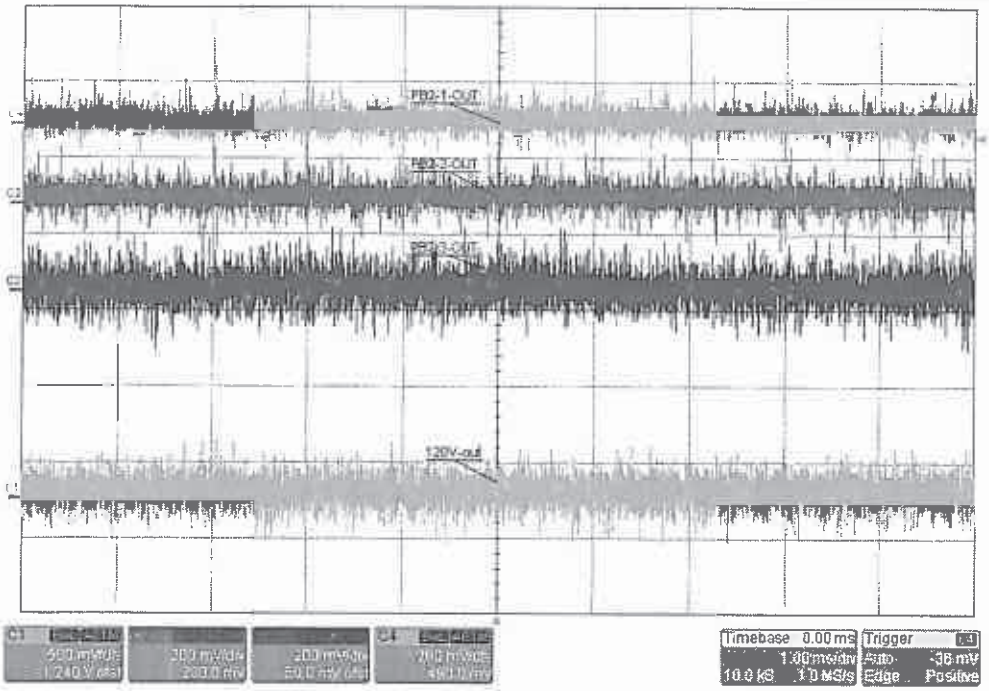


Figure 159: Side A Radiated Susceptibility 900MHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

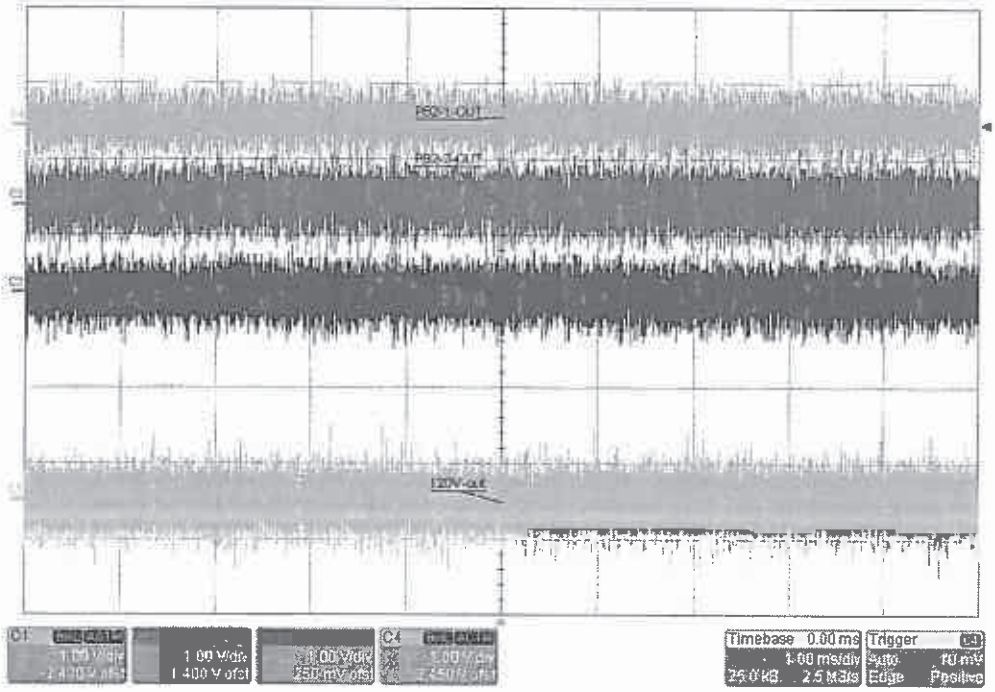


Figure 160: Side A Radiated Susceptibility 100KHz 5V/m

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

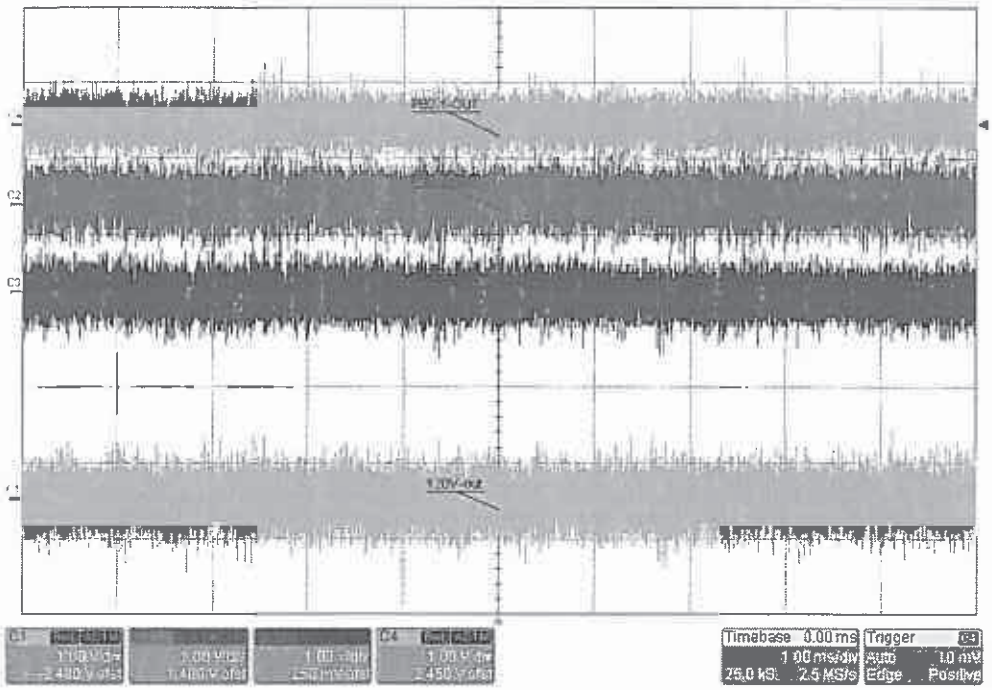


Figure 161: Side A Radiated Susceptibility 500KHz 5V/m

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

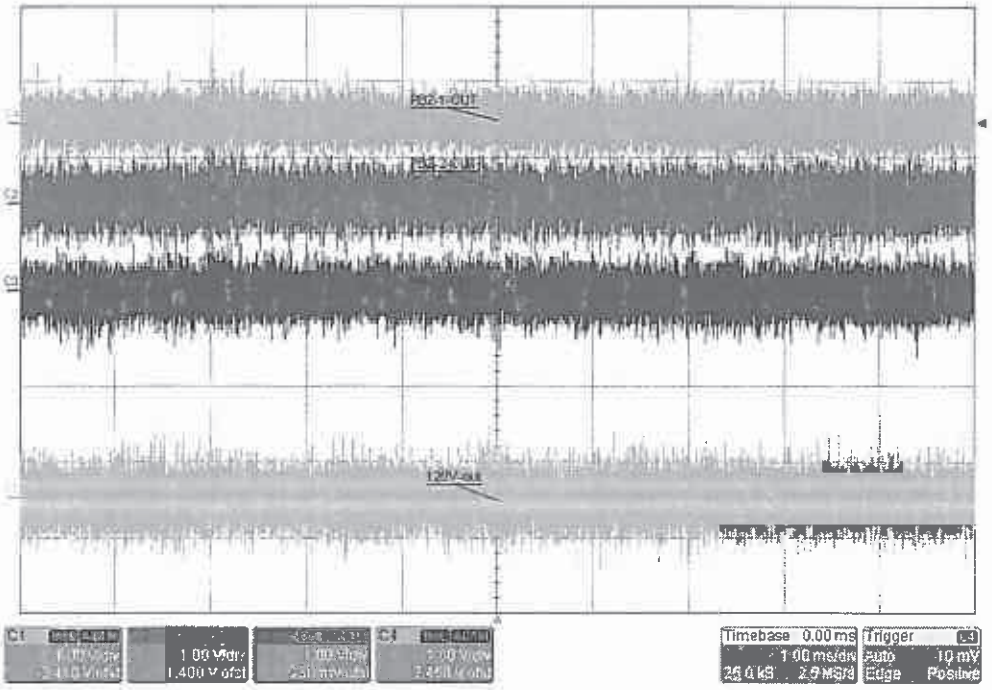


Figure 162: Side A Radiated Susceptibility 5MHz 5V/m

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

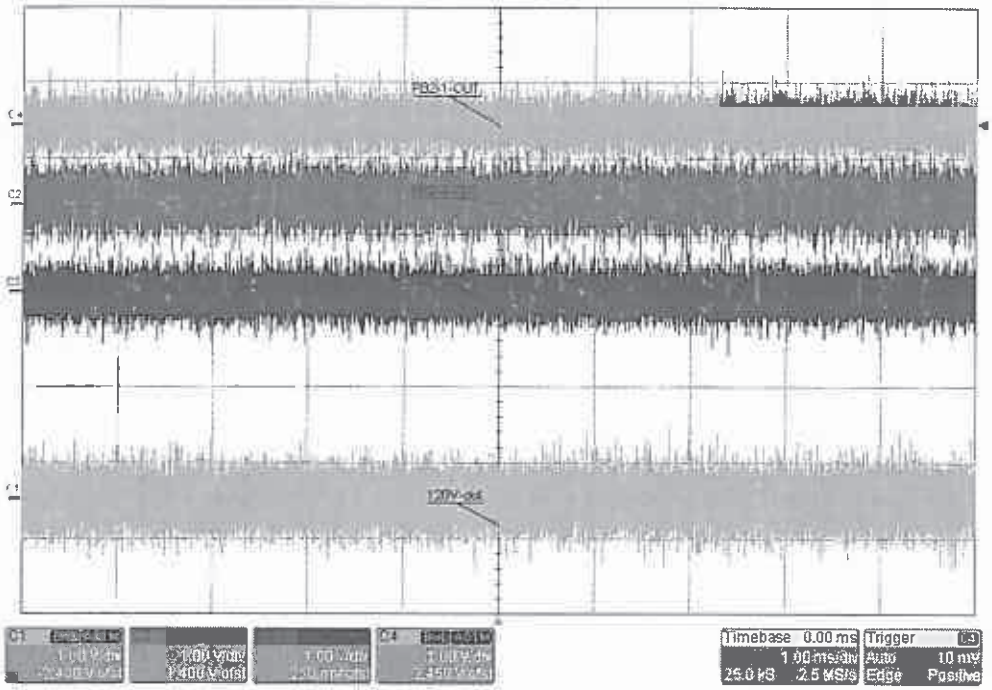


Figure 163: Side A Radiated Susceptibility 10MHz 5V/m

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

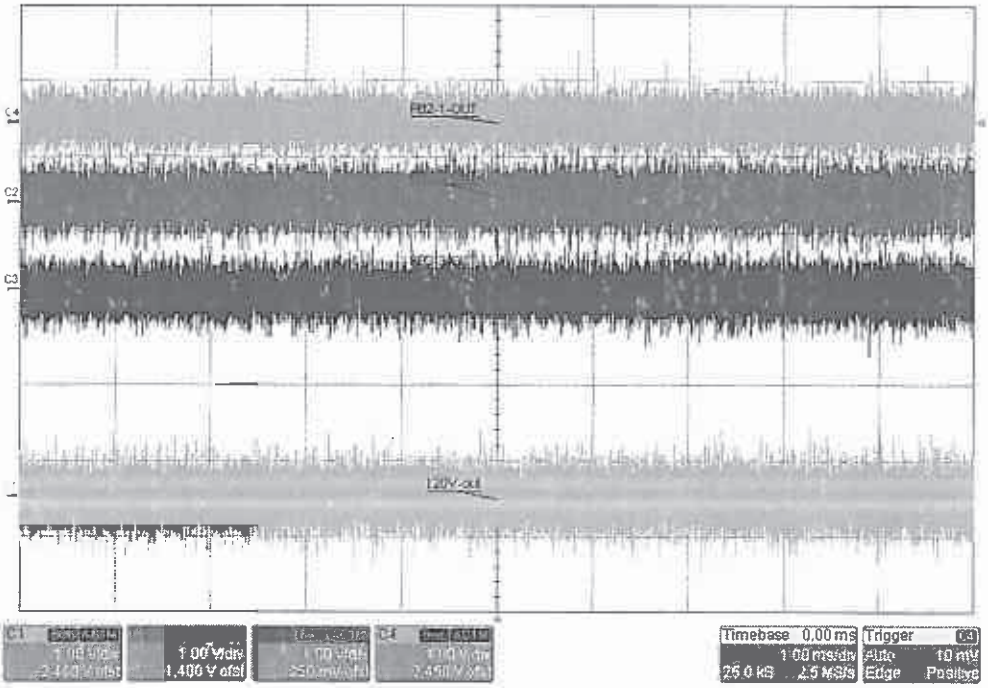


Figure 164: Side A Radiated Susceptibility 1GHz 60V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

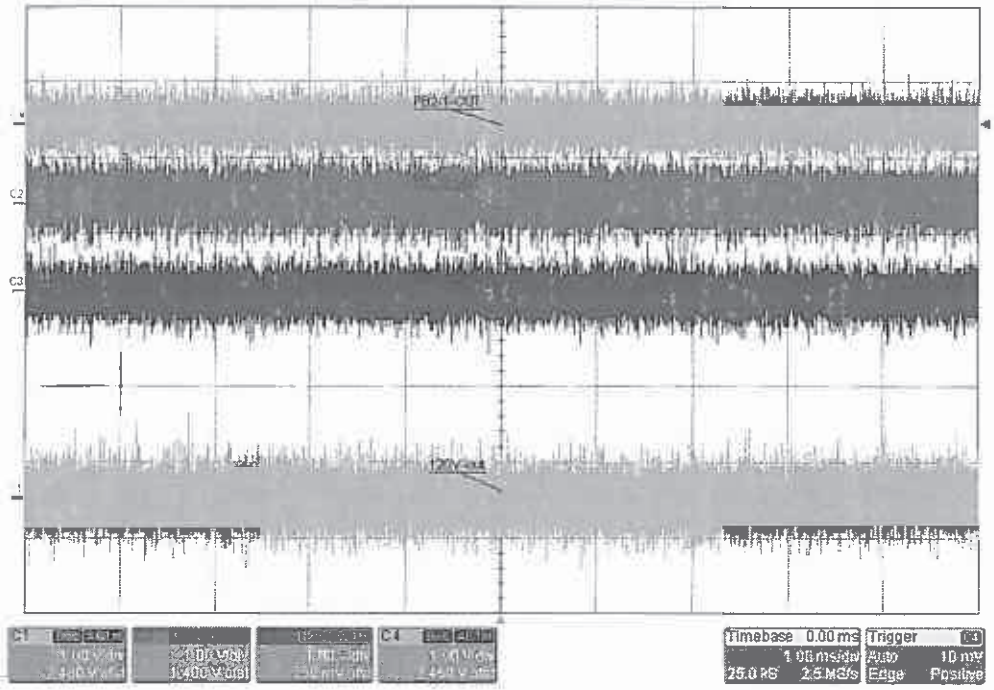


Figure 165: Side A Radiated Susceptibility 2GHz 60V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

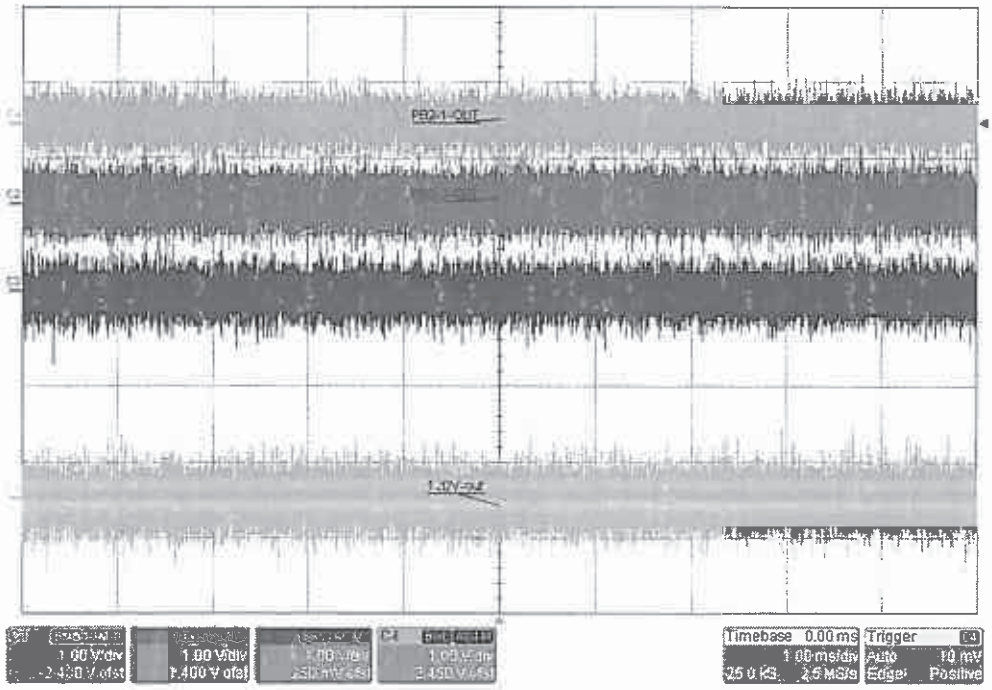


Figure 166: Side A Radiated Susceptibility 1GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

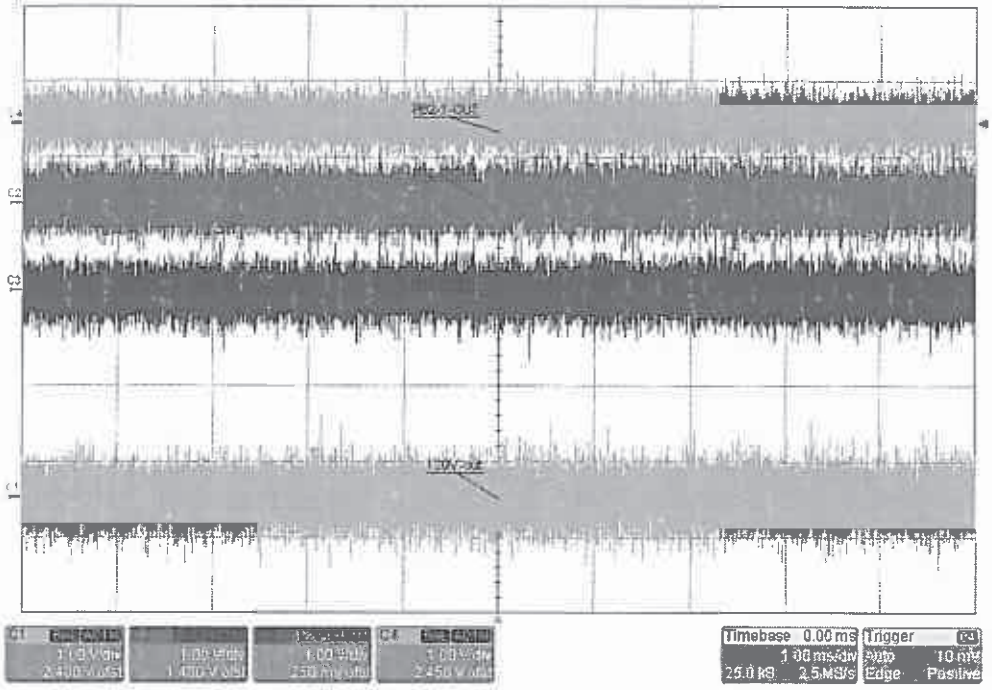


Figure 167: Side A Radiated Susceptibility 2GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

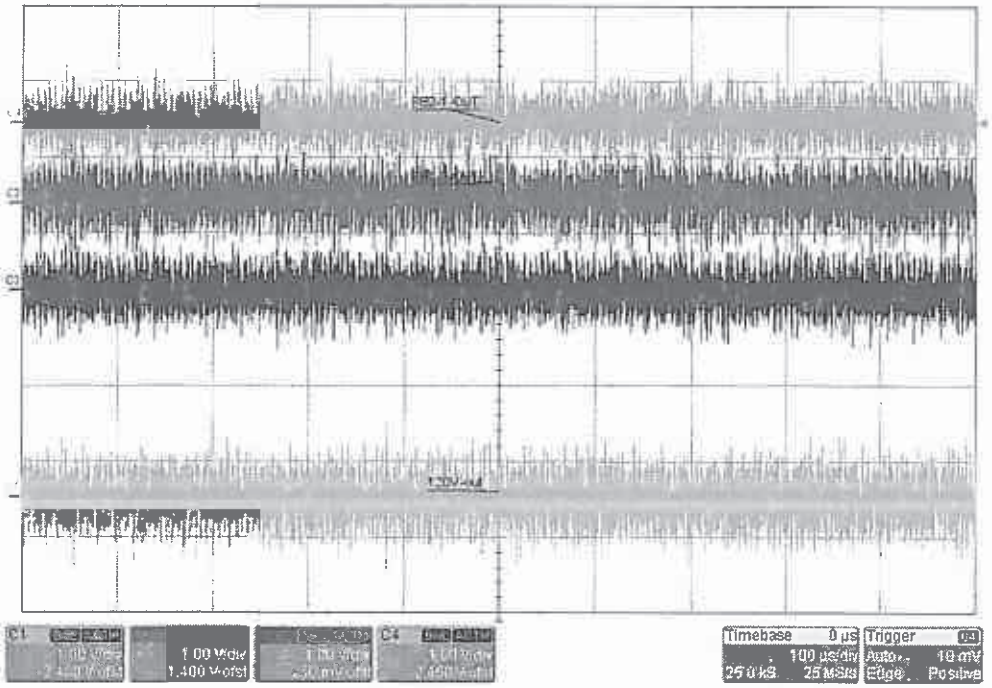


Figure 168: Side A Radiated Susceptibility 3GHz 60V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

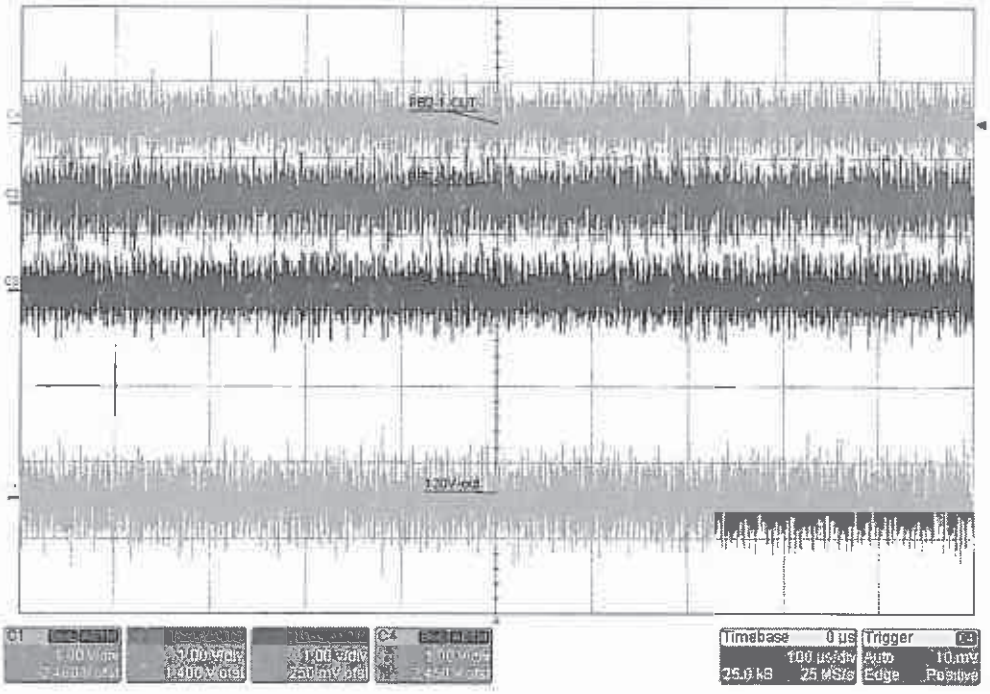


Figure 169: Side A Radiated Susceptibility 4GHz 60V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

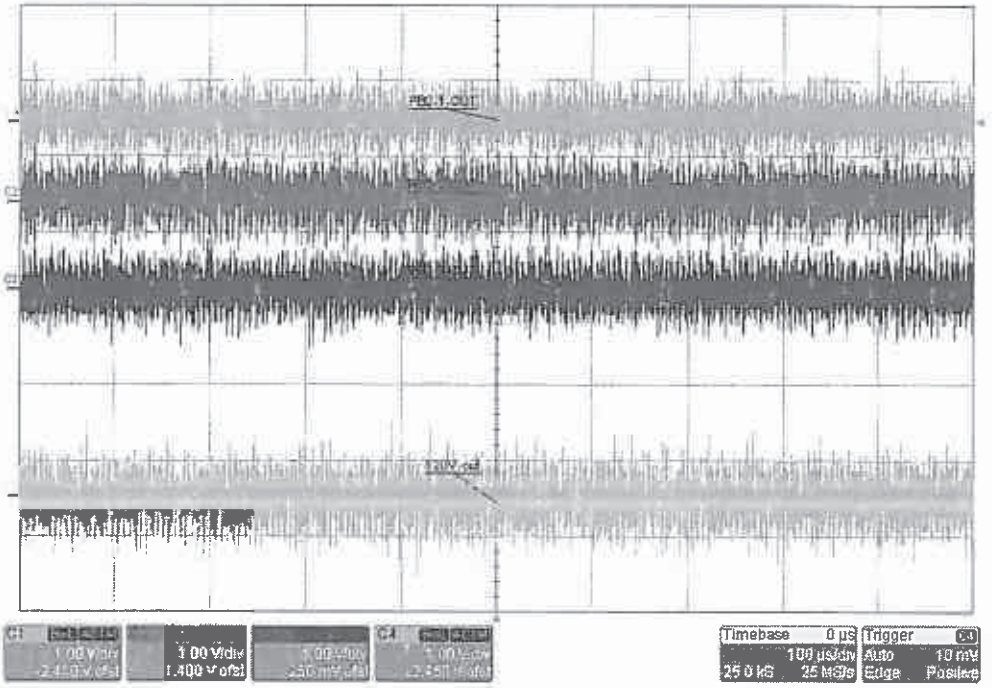


Figure 170: Side A Radiated Susceptibility 3GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

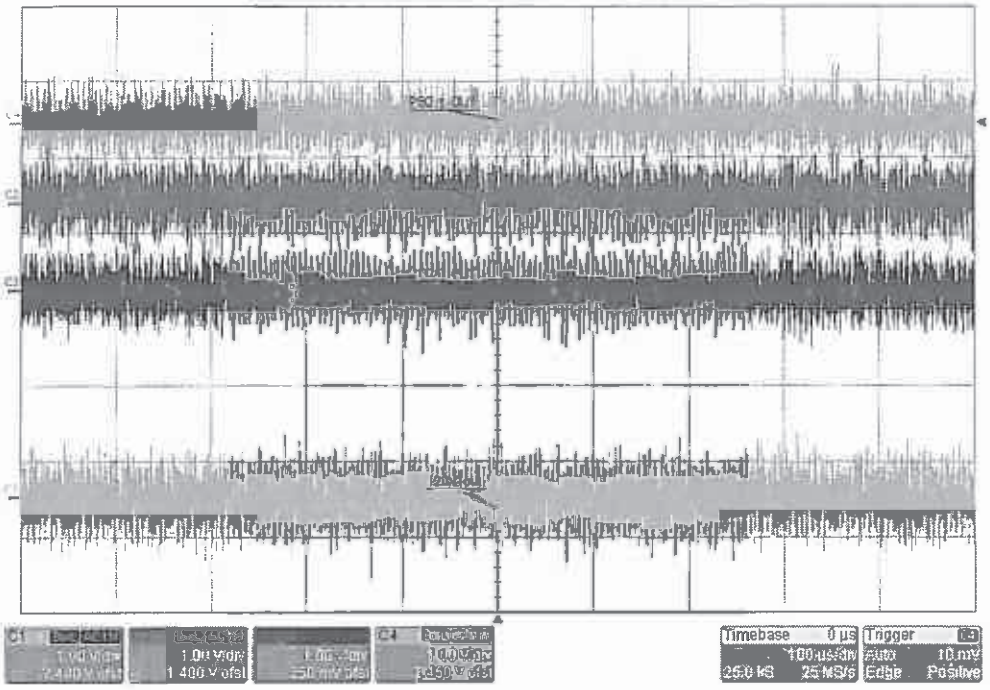


Figure 171: Side A Radiated Susceptibility 4GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

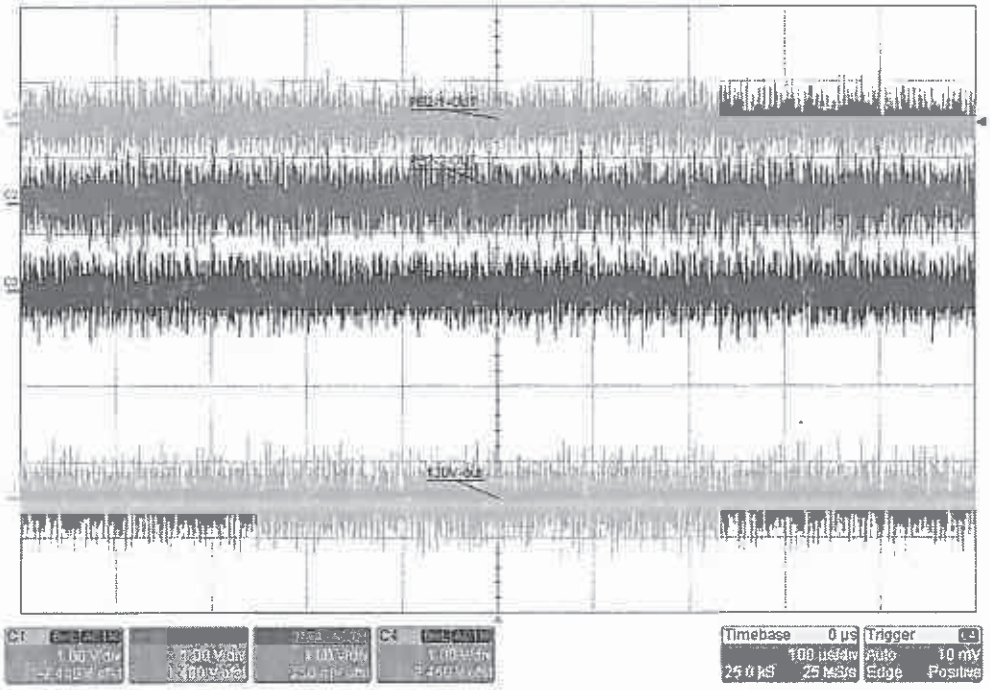


Figure 172: Side A Radiated Susceptibility 2.2GHz 161V/m - orizz

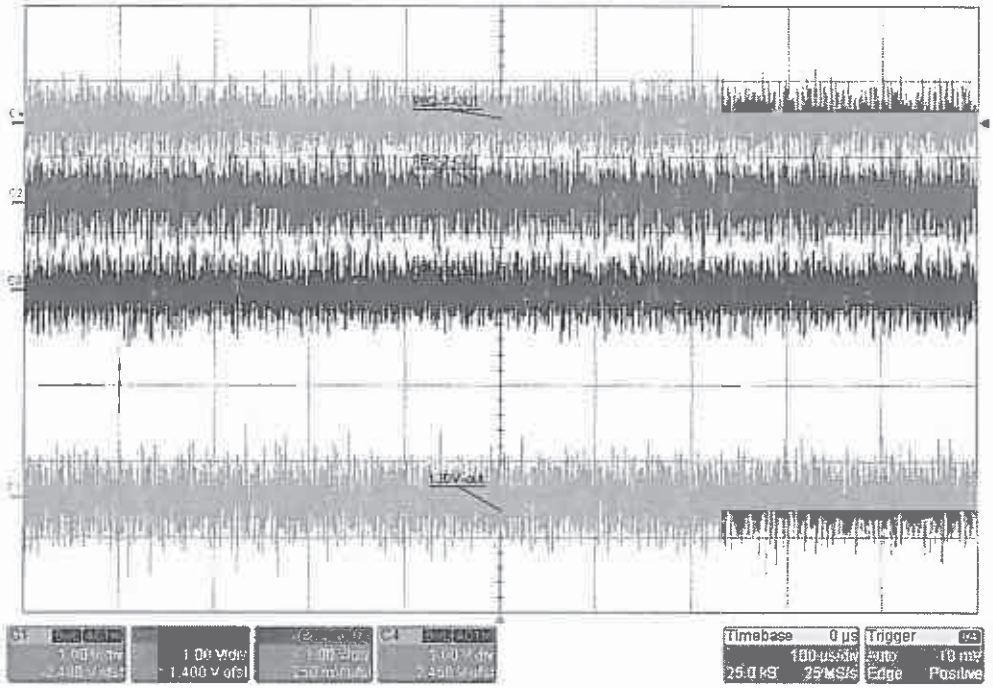
Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)



Step RS-E_R-0.16

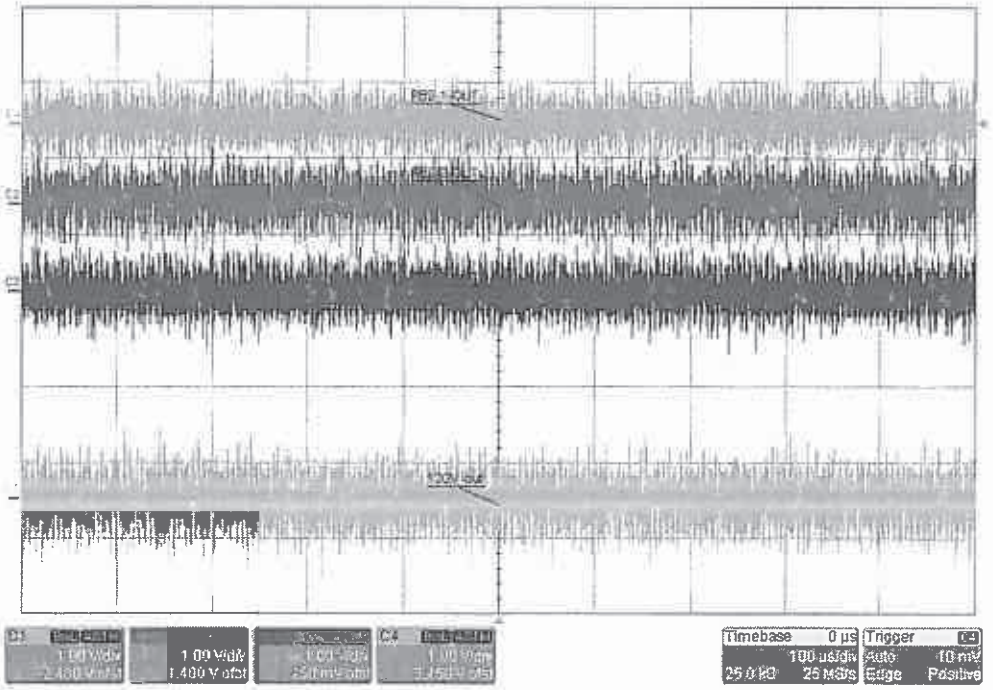
Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

Figure 173: Side A Radiated Susceptibility 2.2GHz 161V/m - vert



Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

Figure 174: Side A Radiated Susceptibility 5GHz 60V/m - orizz

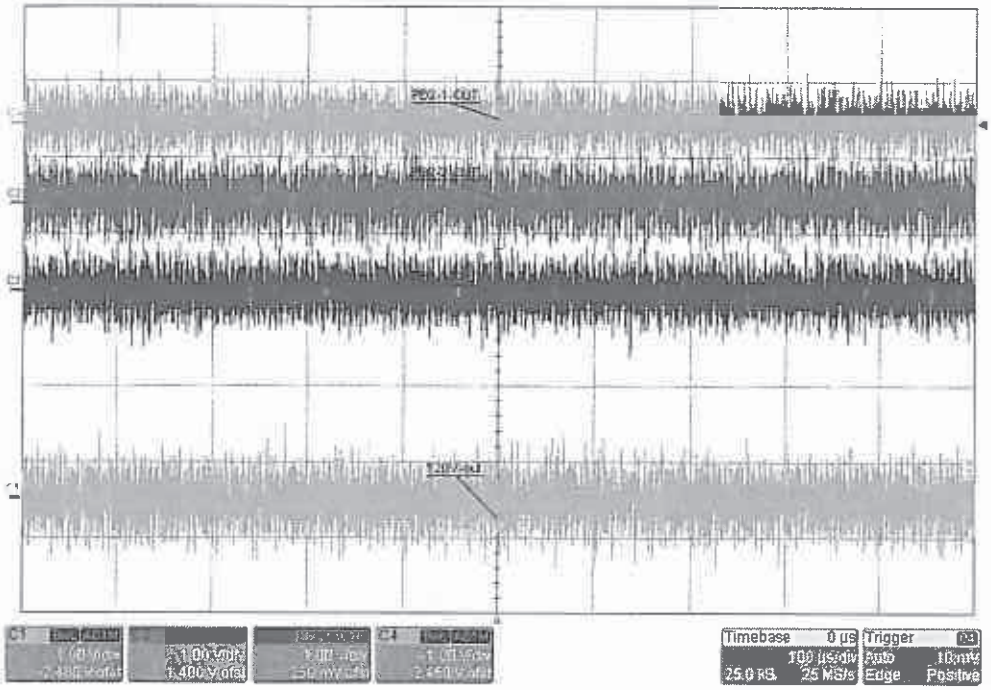


Figure 175: Side A Radiated Susceptibility 8GHz 60V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

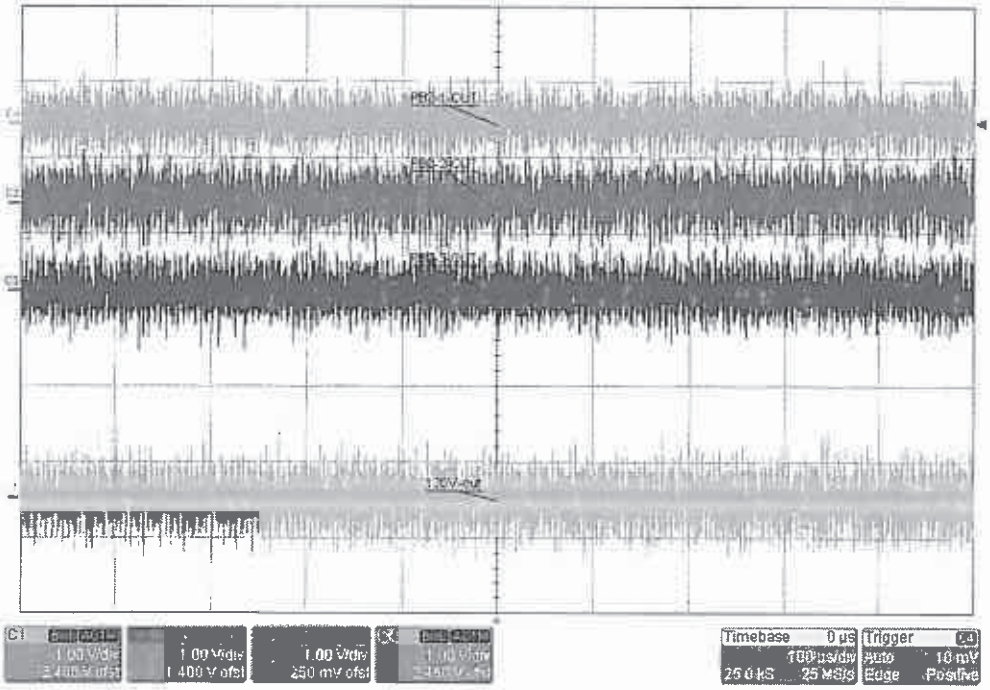


Figure 176: Side A Radiated Susceptibility 5GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

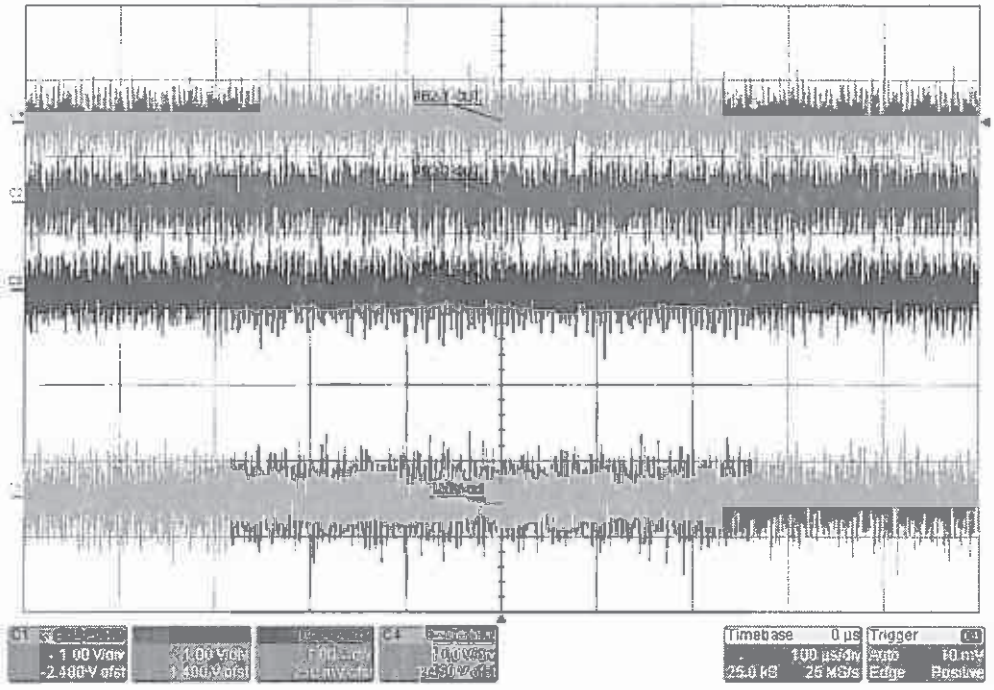


Figure 177: Side A Radiated Susceptibility 8GHz 60V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

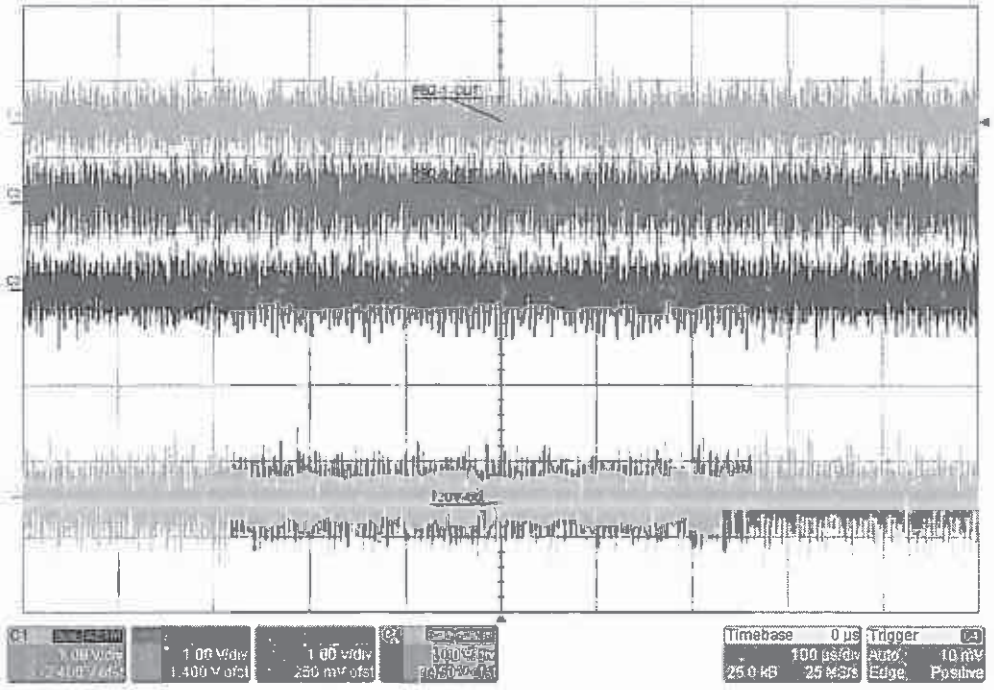


Figure 178: Side A Radiated Susceptibility 9GHz 20V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

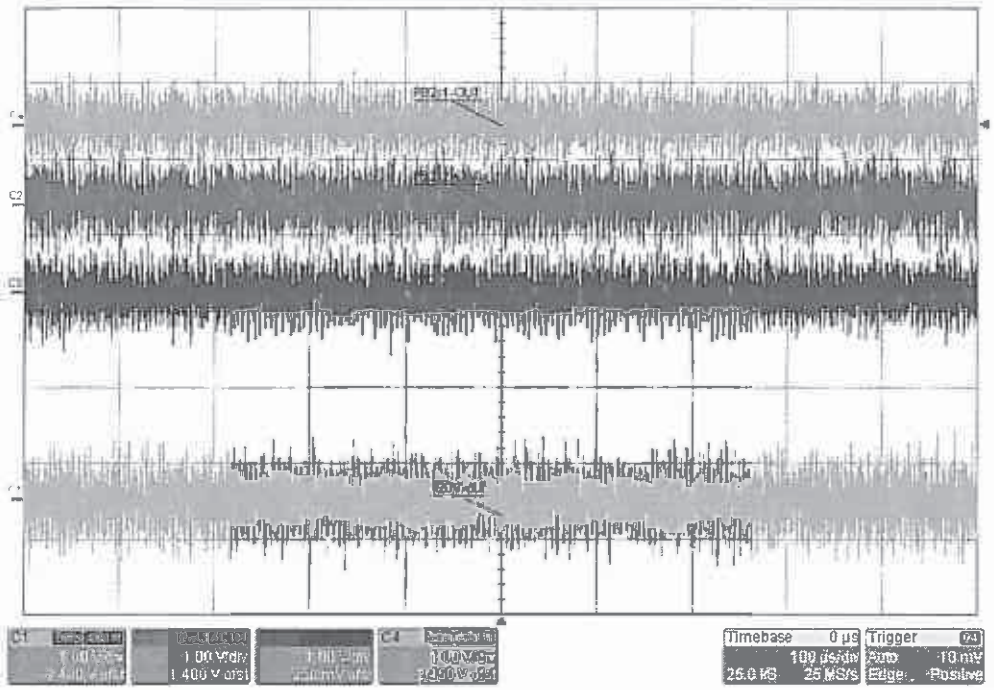


Figure 179: Side A Radiated Susceptibility 10GHz 20V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

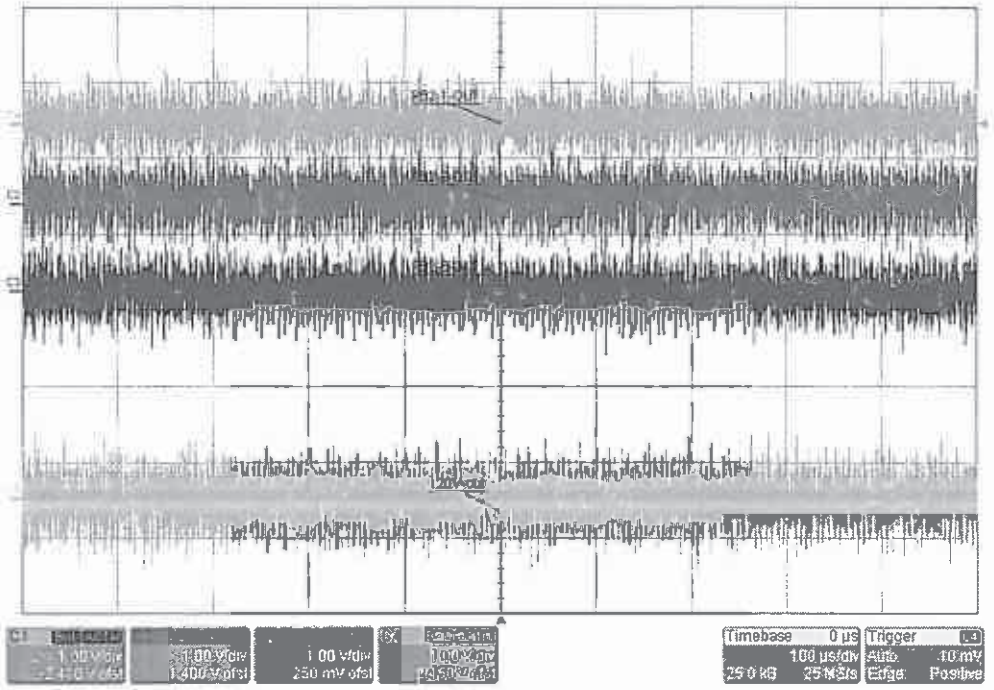


Figure 180: Side A Radiated Susceptibility 9GHz 20V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

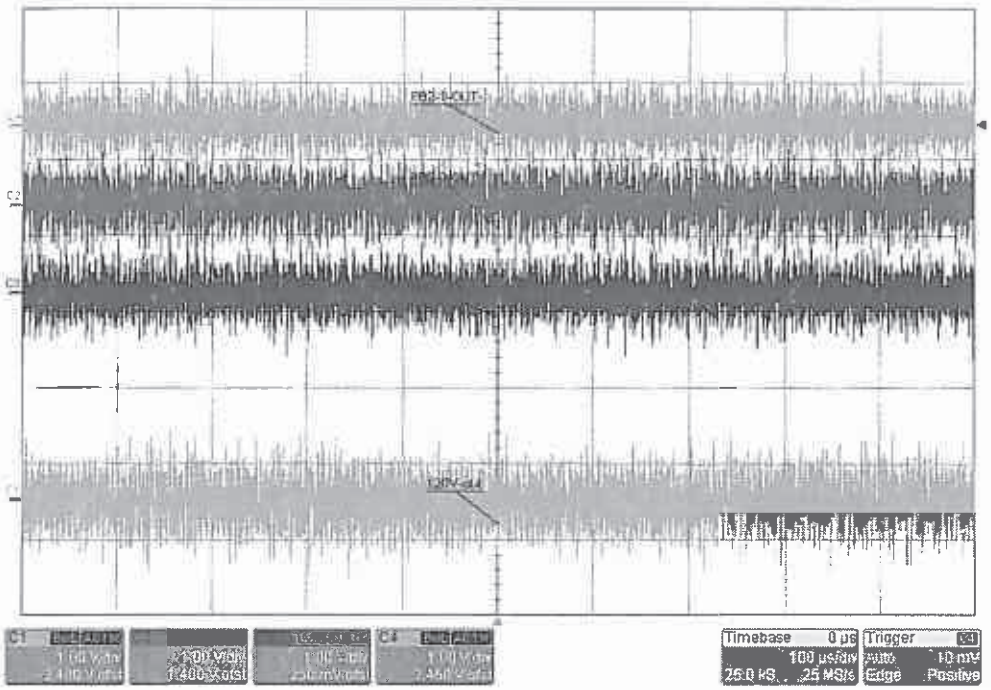


Figure 181: Side A Radiated Susceptibility 10GHz 20V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

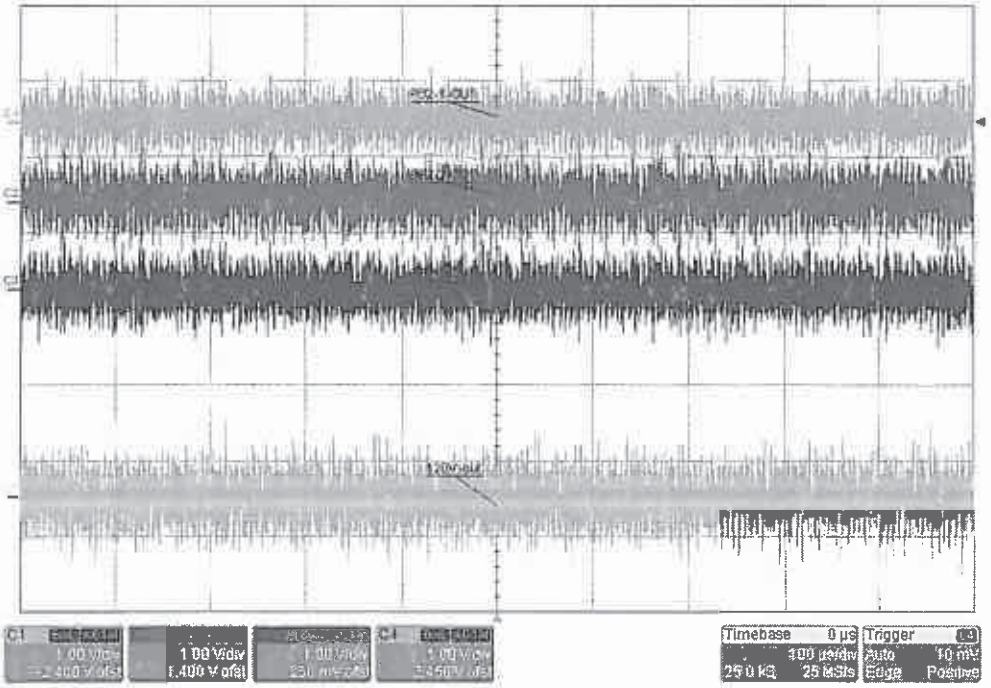


Figure 182: Side A Radiated Susceptibility 8.5GHz 79V/m - orizz

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

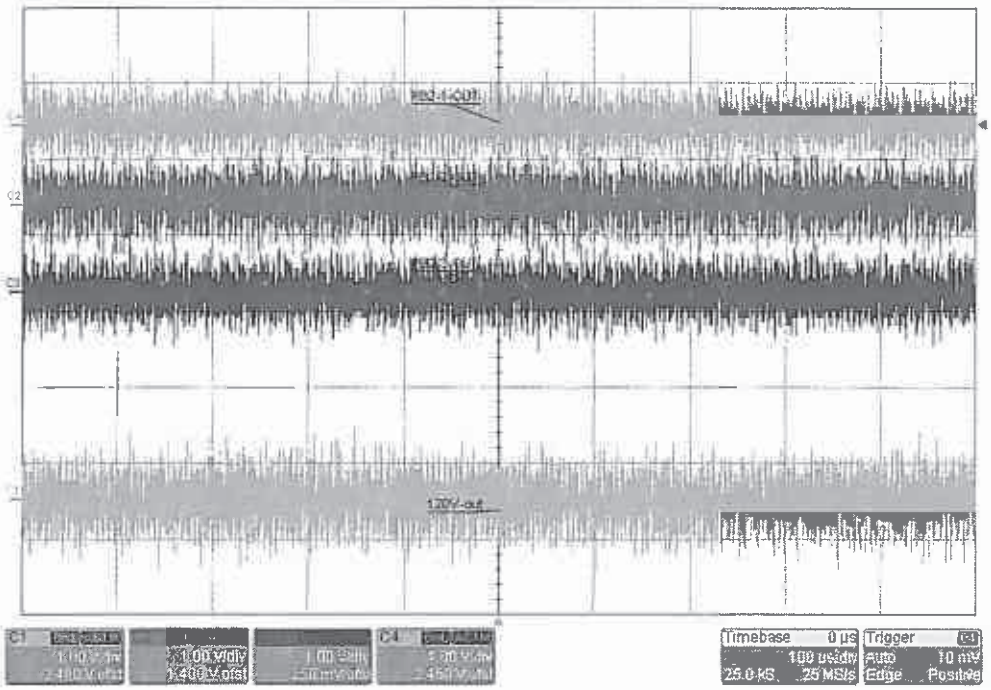


Figure 183: Side A Radiated Susceptibility 8.5GHz 79V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

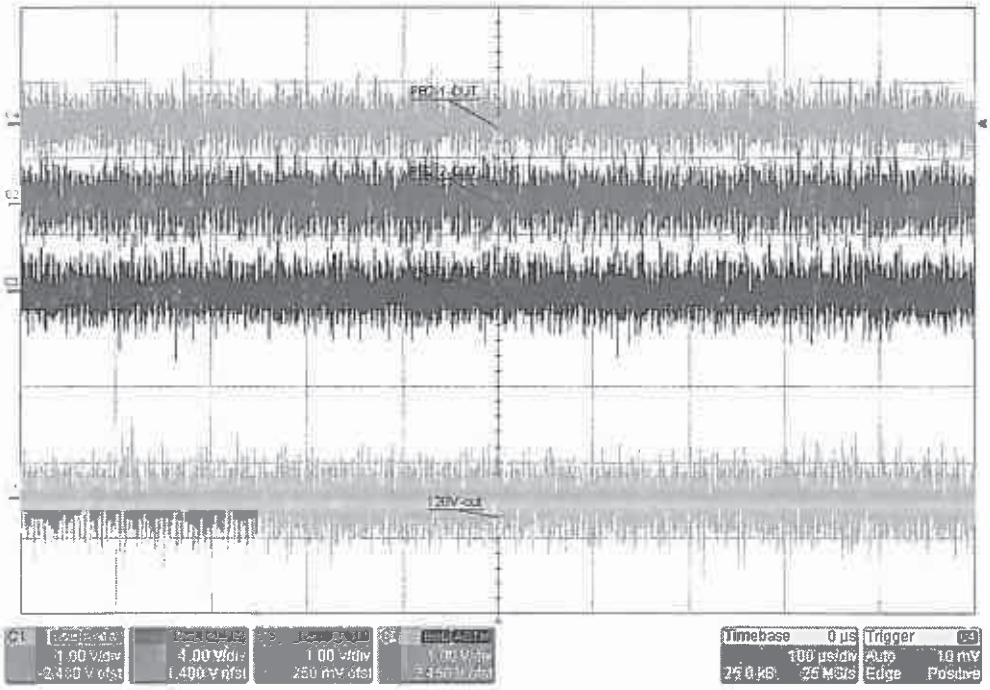


Figure 184: Side A Radiated Susceptibility 13.7GHz 250V/m - orizz

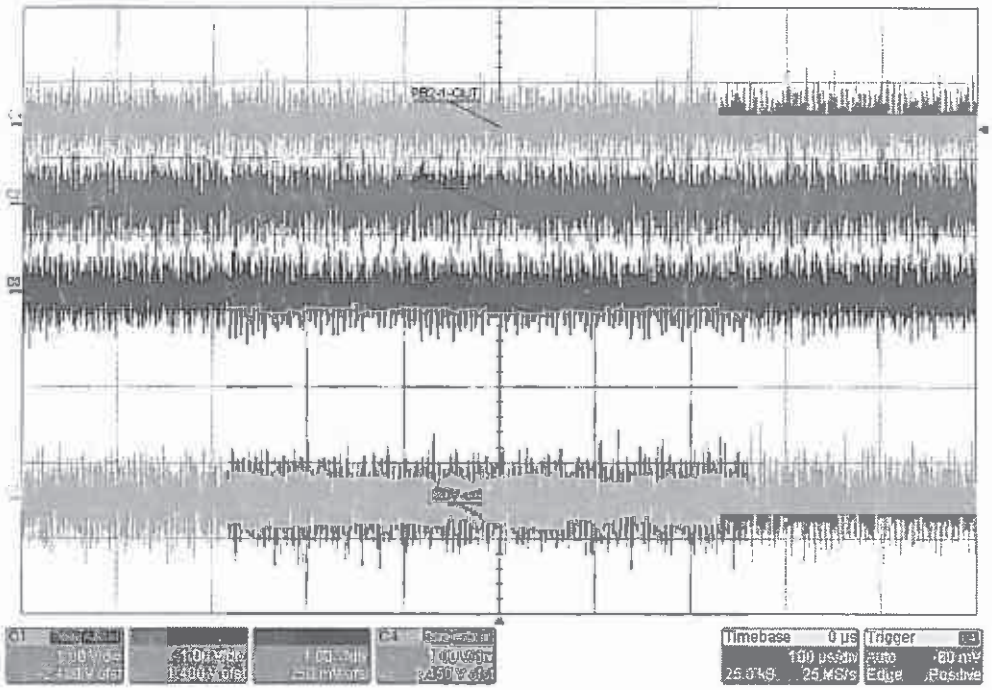
Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)



Step RS-E_R-0.16

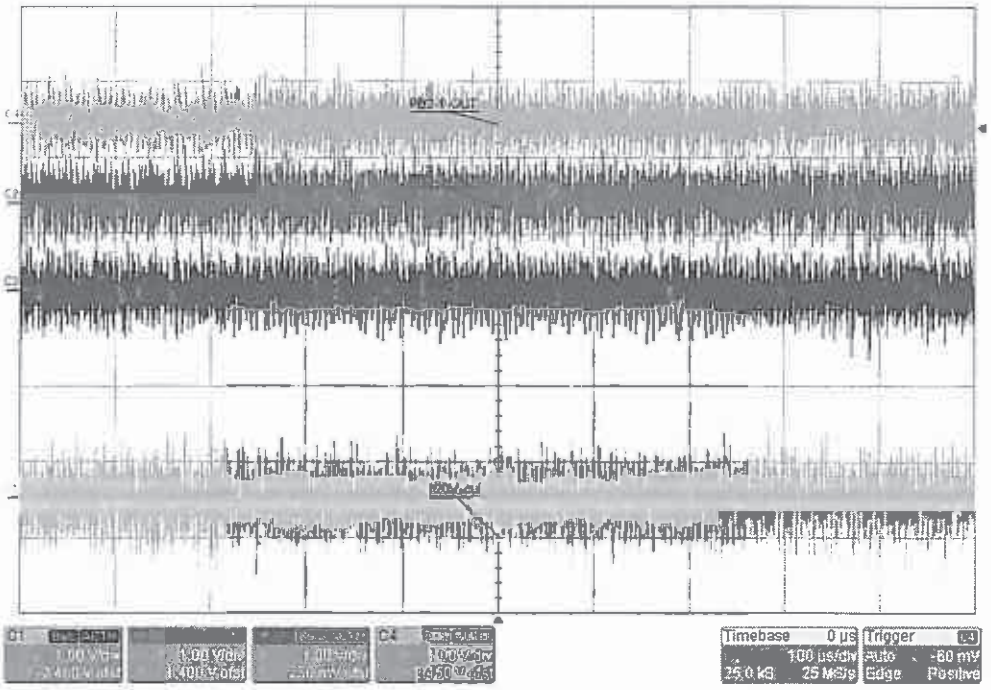
Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

Figure 185: Side A Radiated Susceptibility 15.2GHz 250V/m - orizz



Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

Figure 186: Side A Radiated Susceptibility 13.7GHz 250V/m - vert

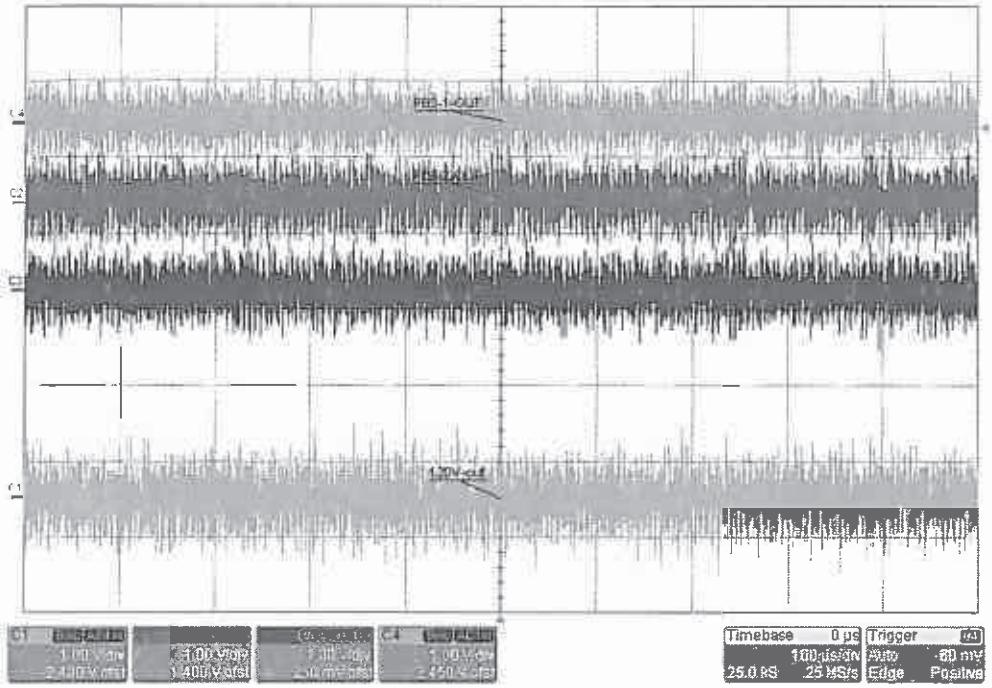


Figure 187: Side A Radiated Susceptibility 15.2GHz 250V/m - vert

Step RS-E_R-0.16

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

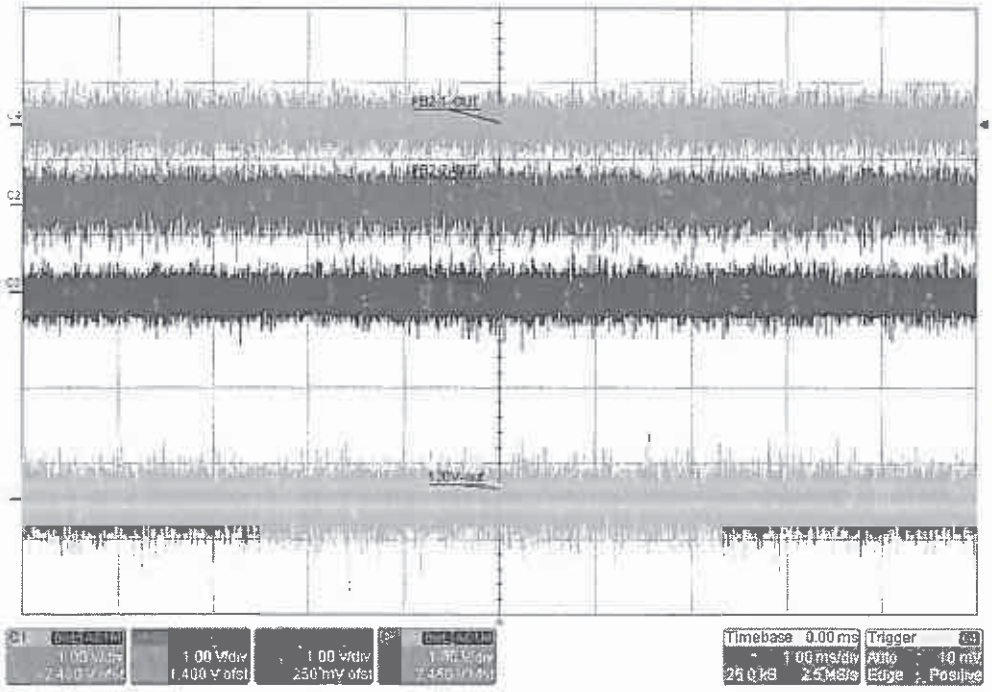


Figure 188: Side B Radiated Susceptibility 500MHz 60V/m -orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

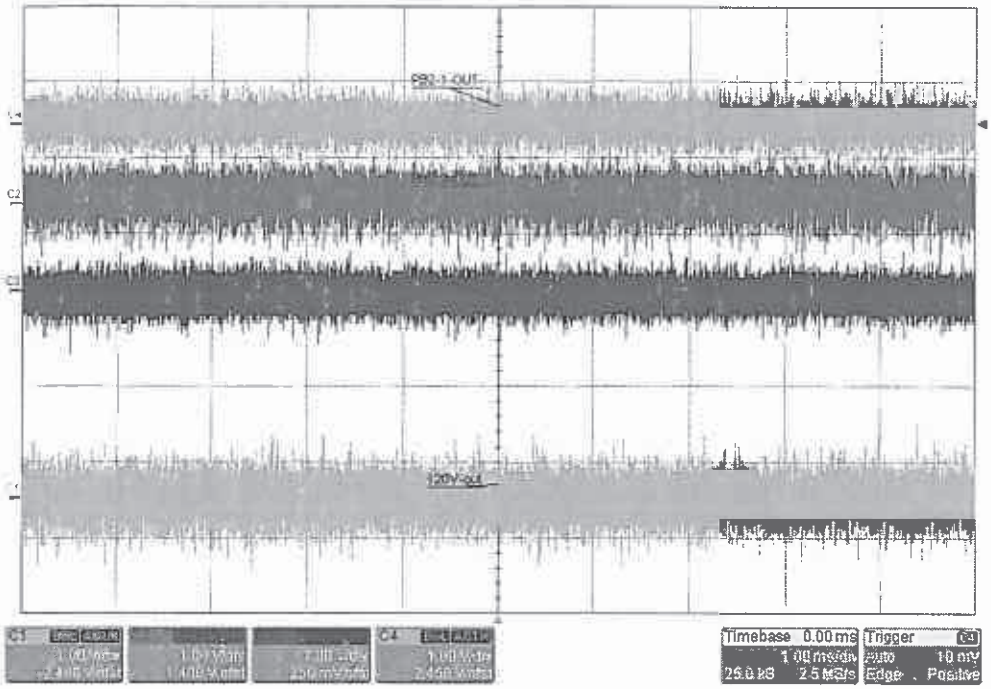


Figure 189: Side B Radiated Susceptibility 600MHz 60V/m -vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

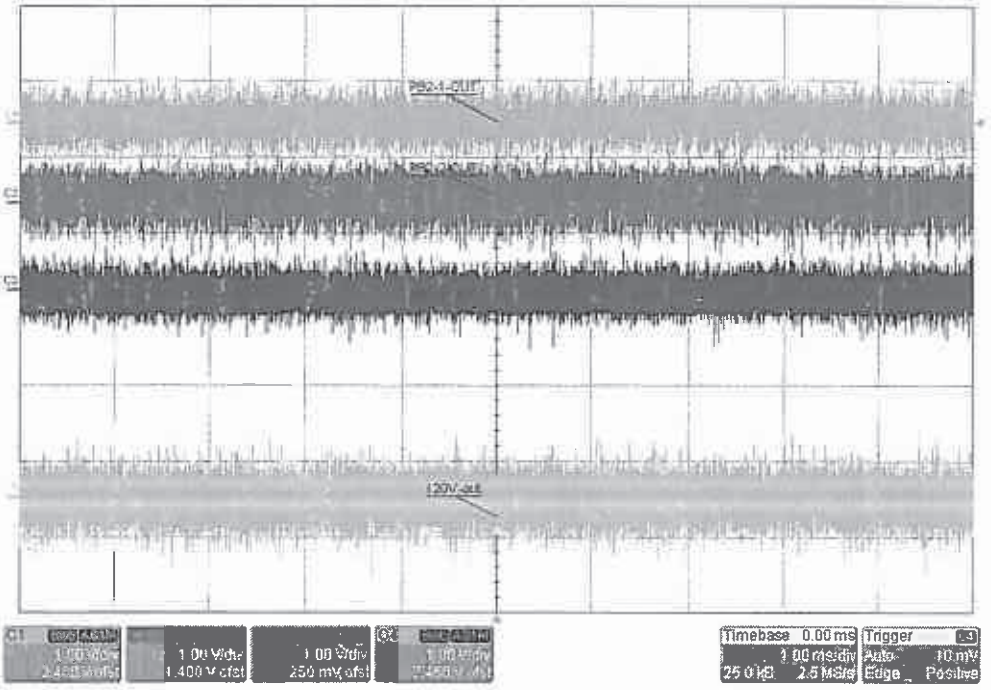


Figure 190: Side B Radiated Susceptibility 900MHz 60V/m - oriz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

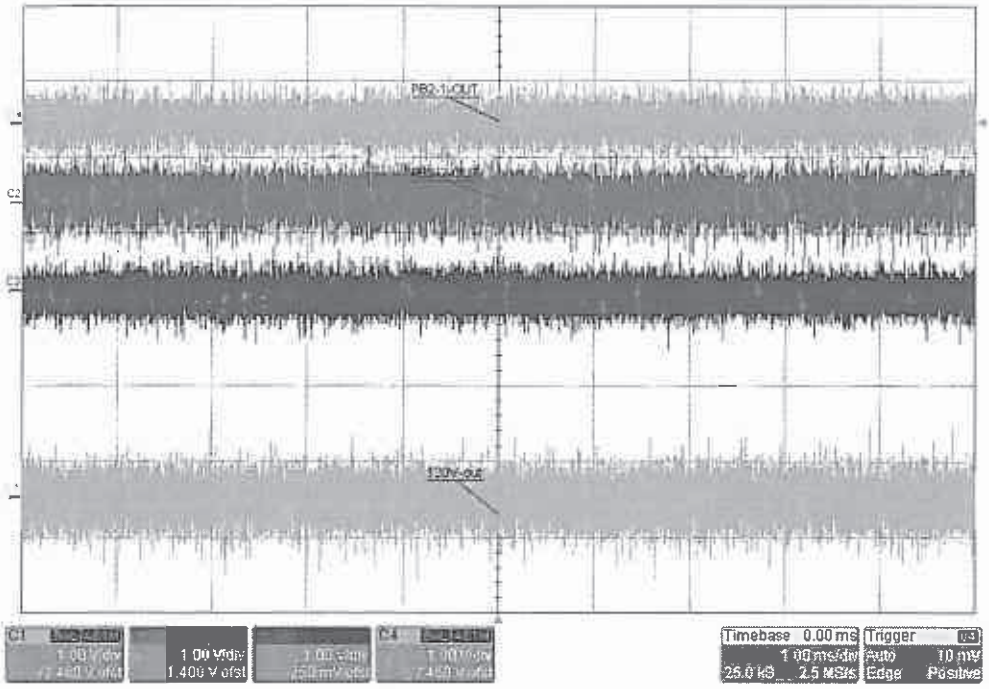


Figure 191: Side B Radiated Susceptibility 800MHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

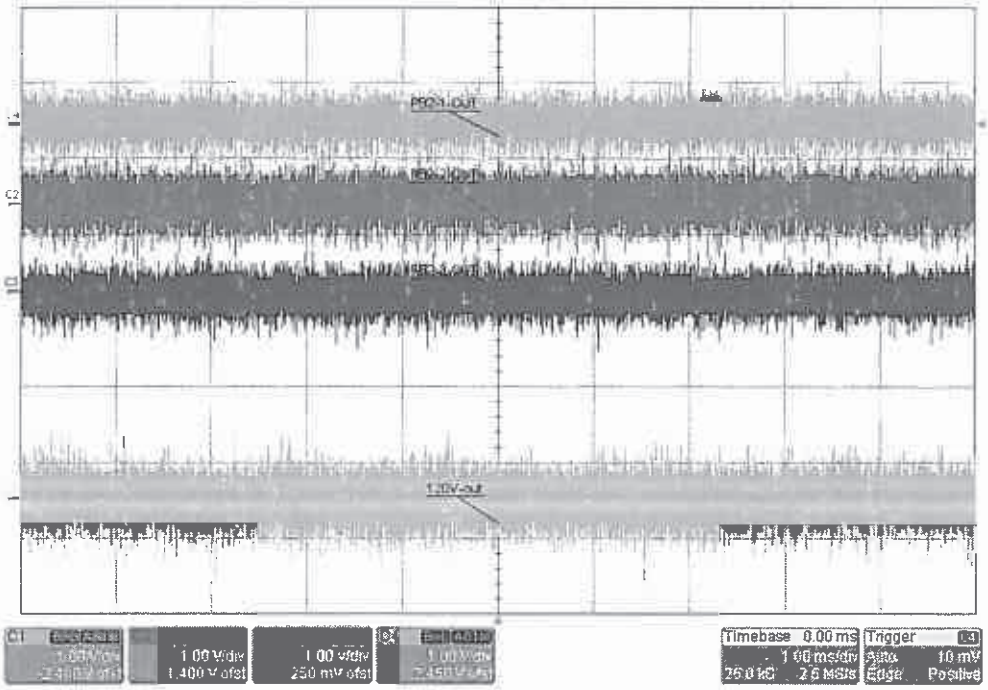


Figure 192: Side B Radiated Susceptibility 100KHz 5V/m

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

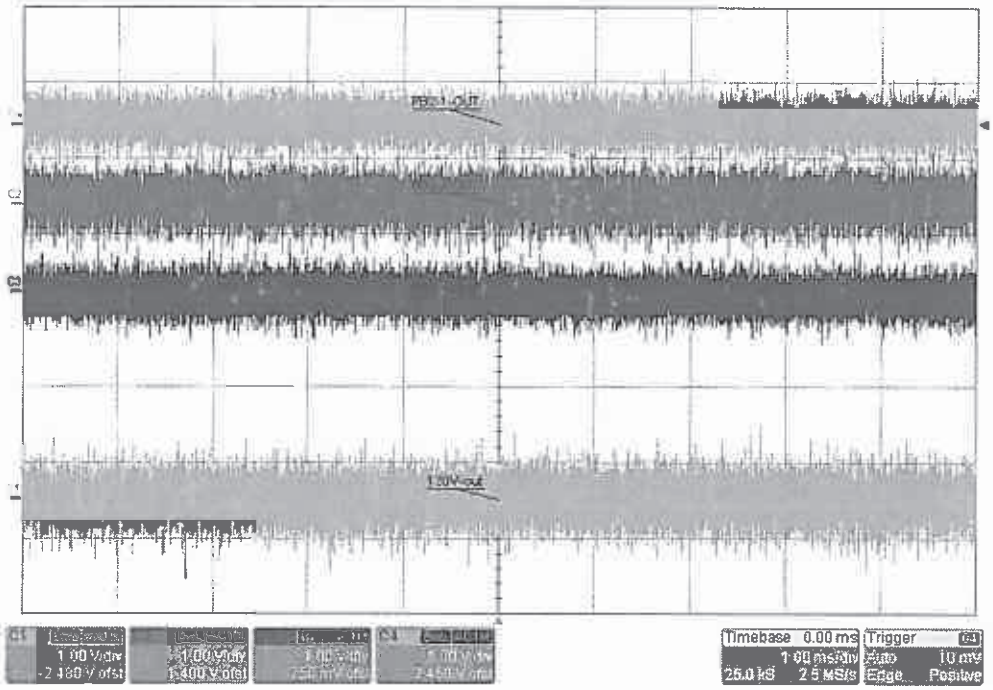


Figure 193: Side B Radiated Susceptibility 500KHz 5V/m

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

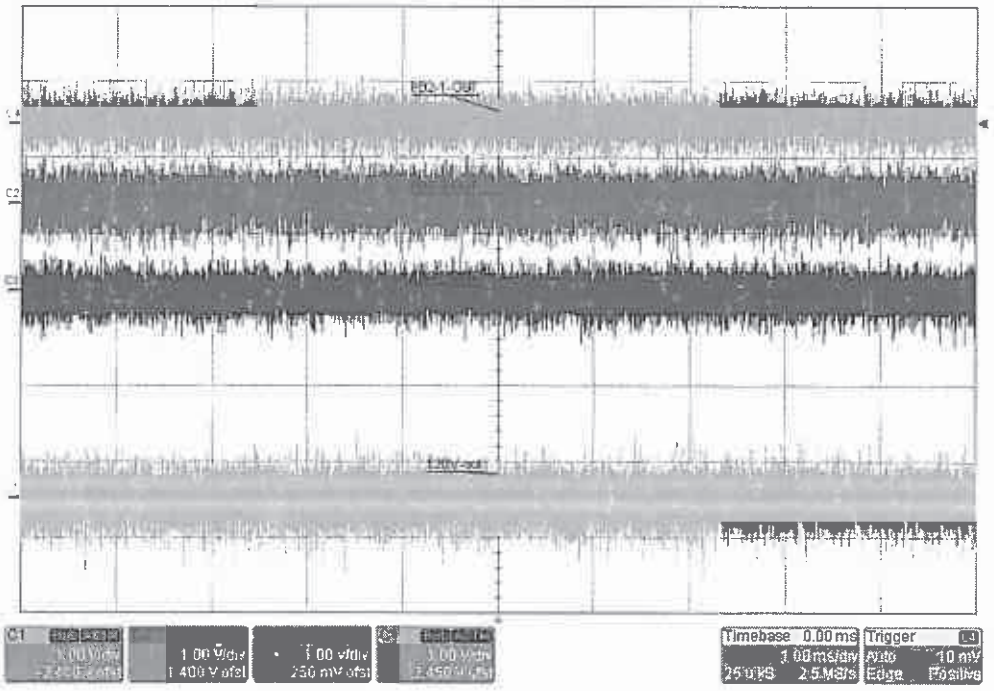


Figure 194: Side B Radiated Susceptibility 5MHz 5V/m

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

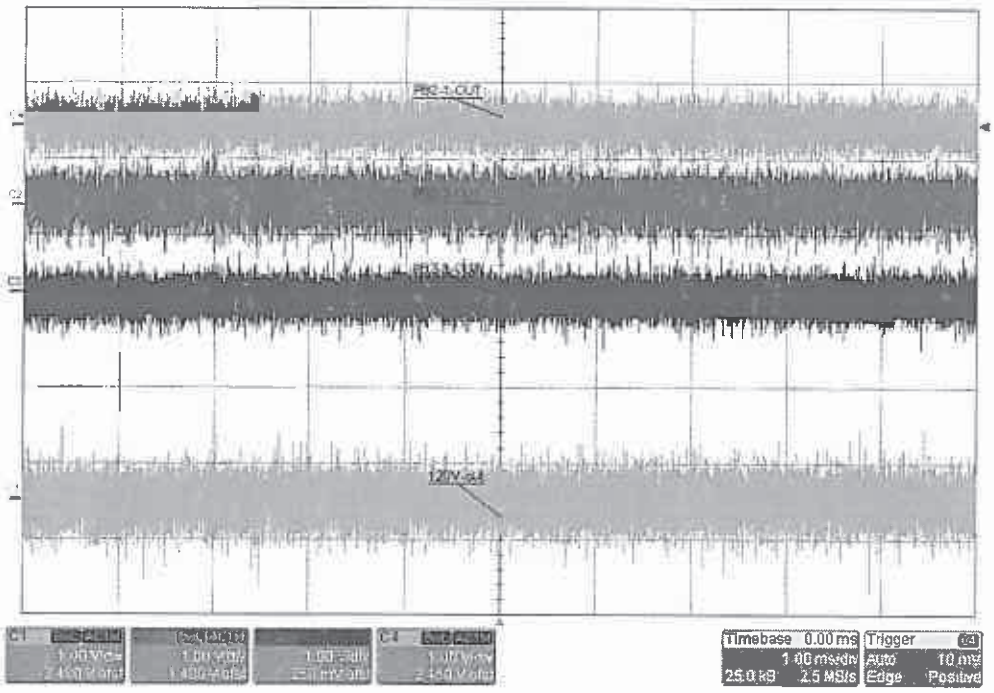


Figure 195: Side B Radiated Susceptibility 10MHz 5V/m

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

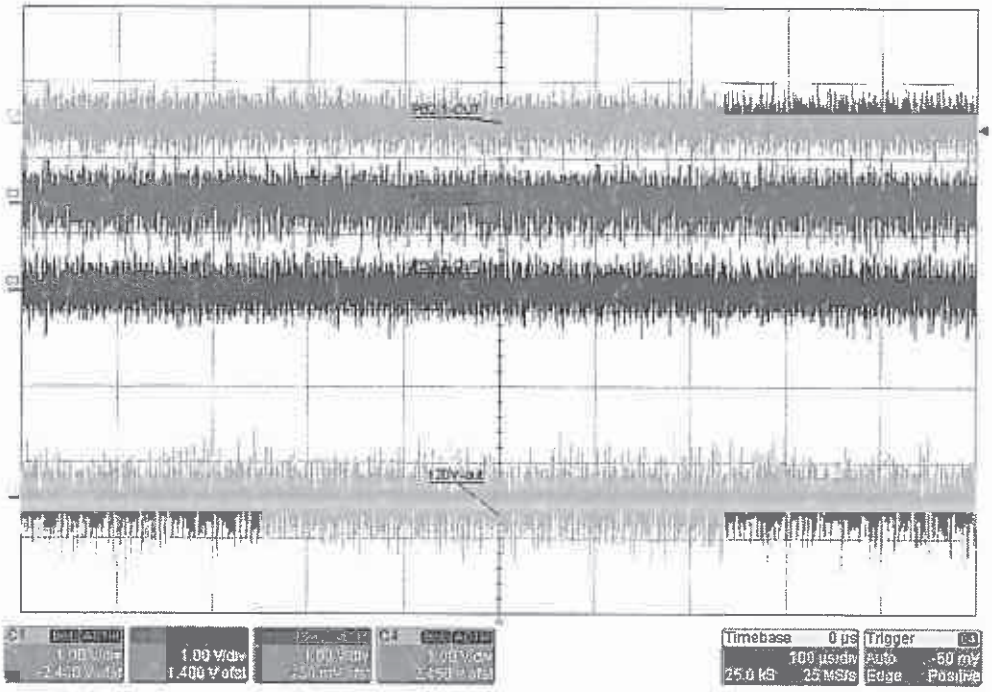


Figure 196: Side B Radiated Susceptibility 1GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

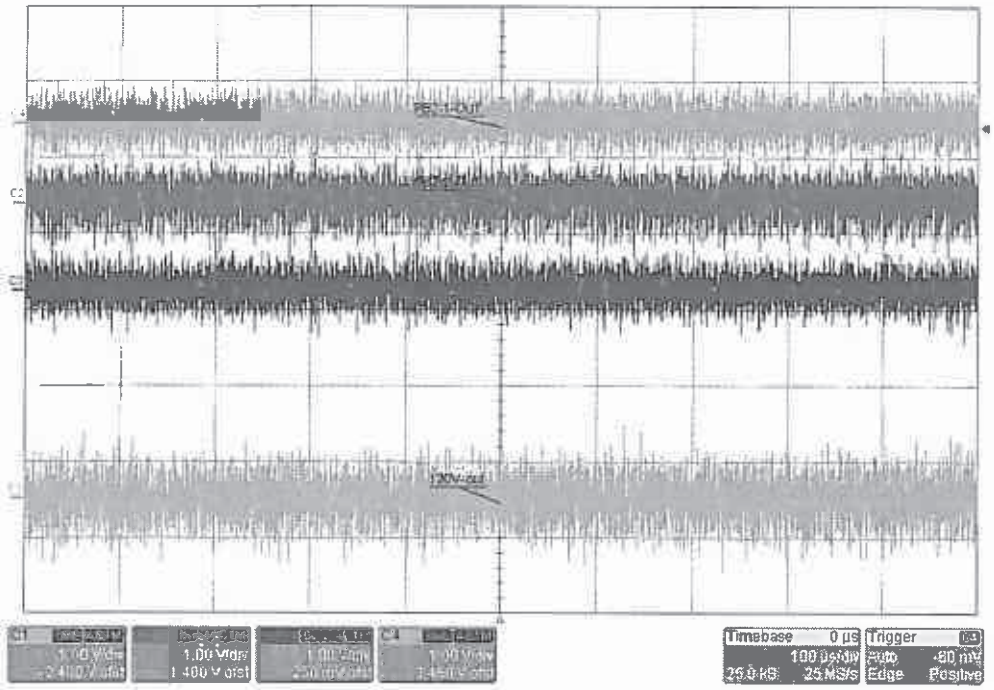


Figure 197: Side B Radiated Susceptibility 2GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

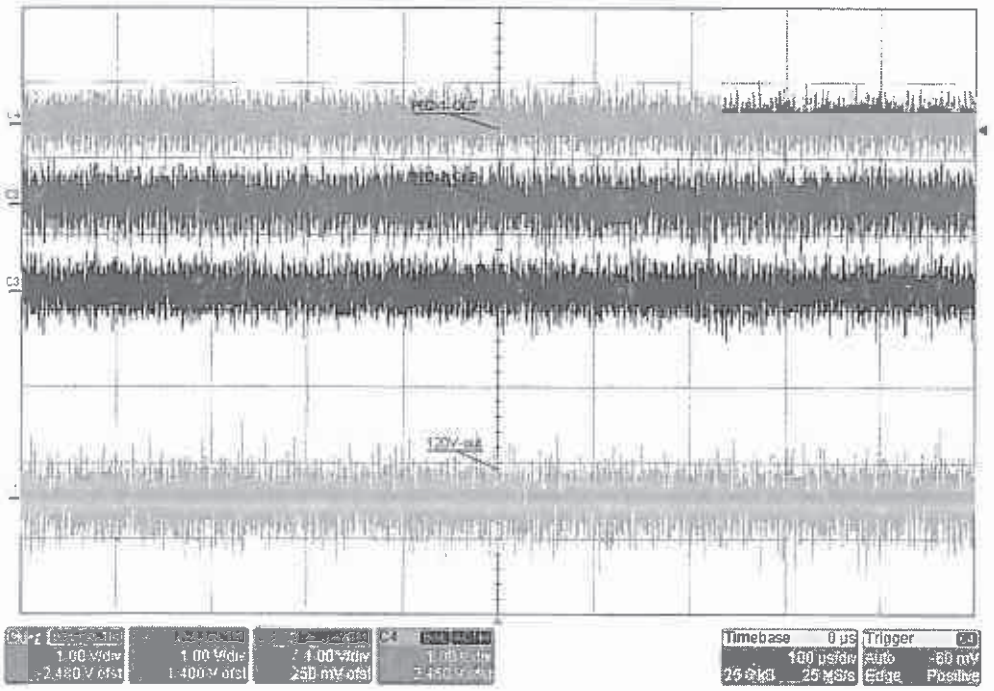


Figure 198: Side B Radiated Susceptibility 1GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

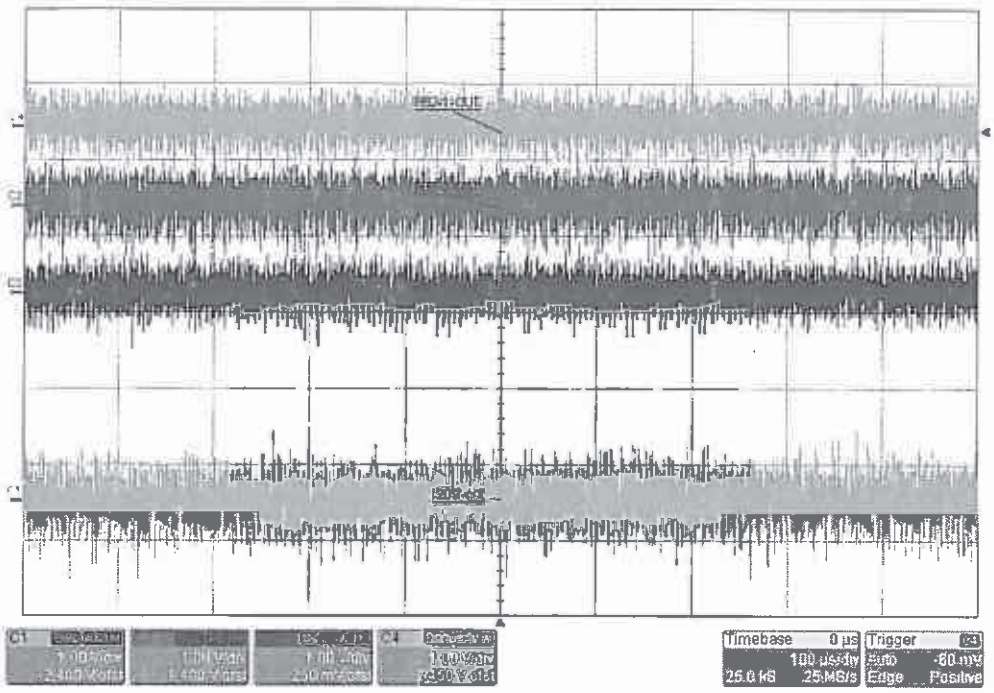


Figure 199: Side B Radiated Susceptibility 2GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

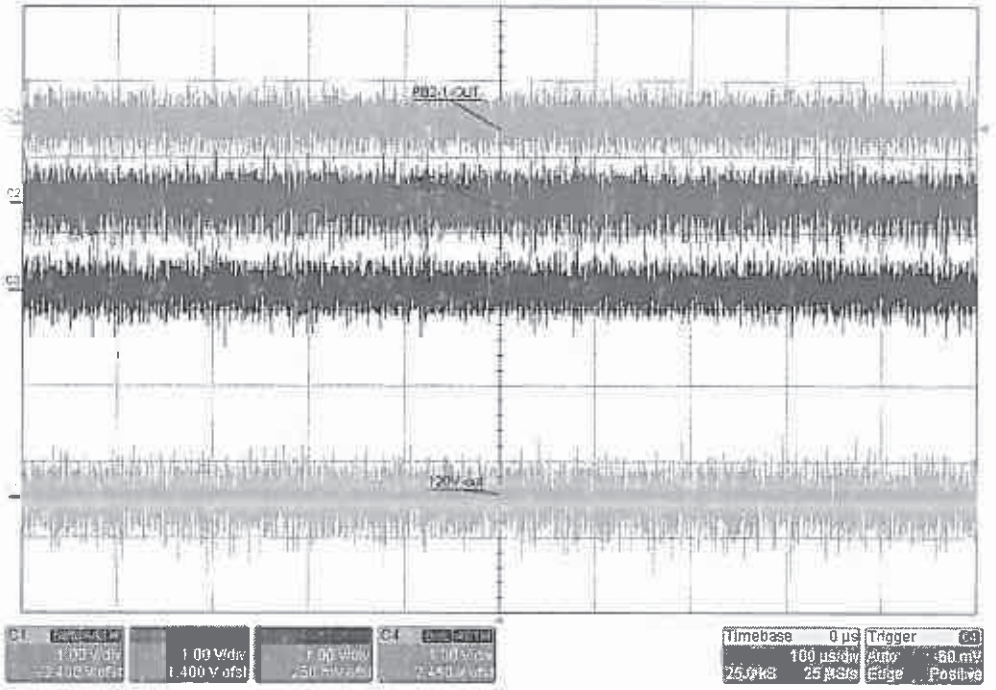


Figure 200: Side B Radiated Susceptibility 3GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

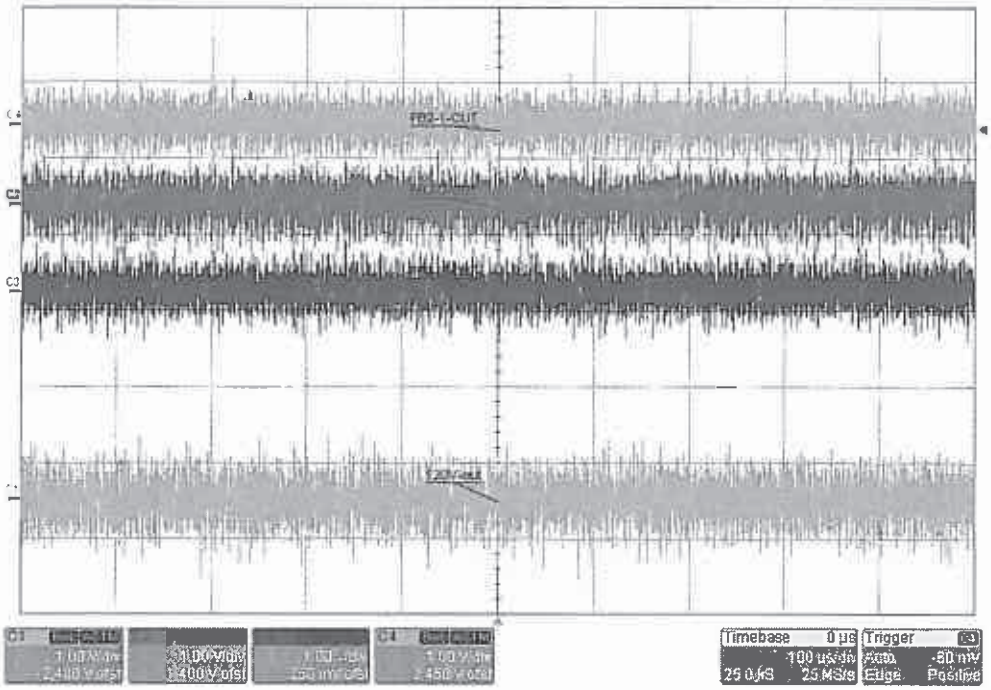


Figure 201: Side B Radiated Susceptibility 4GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

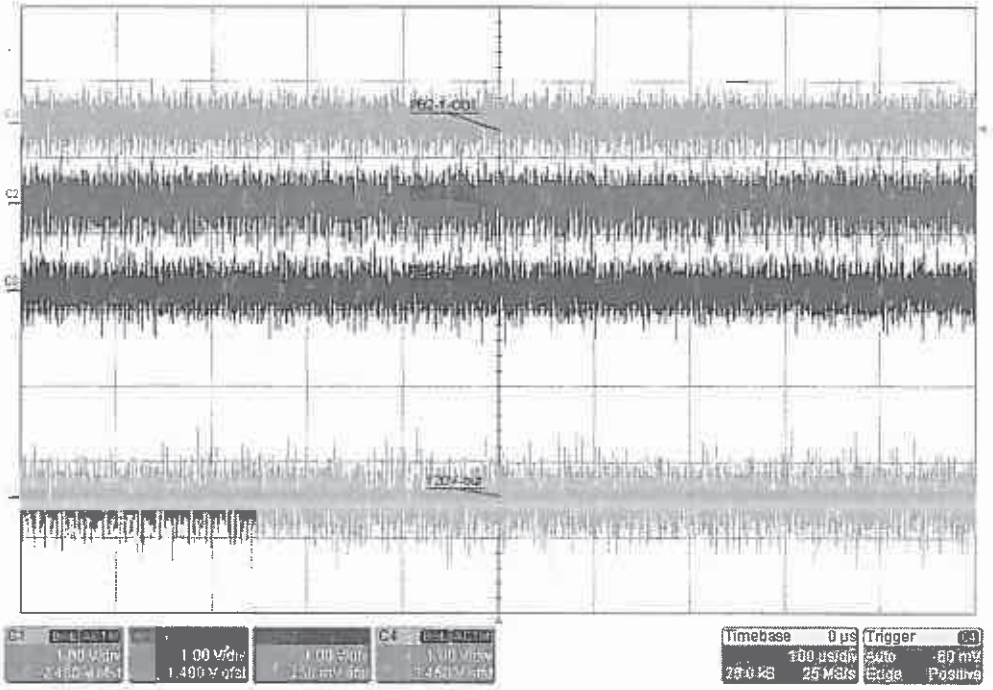


Figure 202: Side B Radiated Susceptibility 3GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

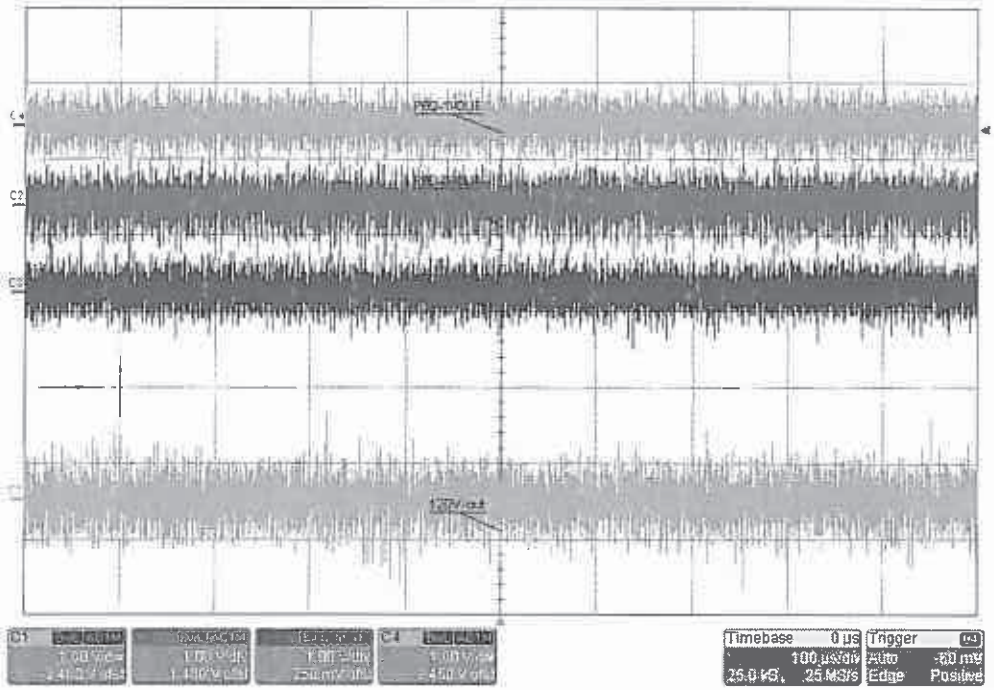


Figure 203: Side B Radiated Susceptibility 4GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

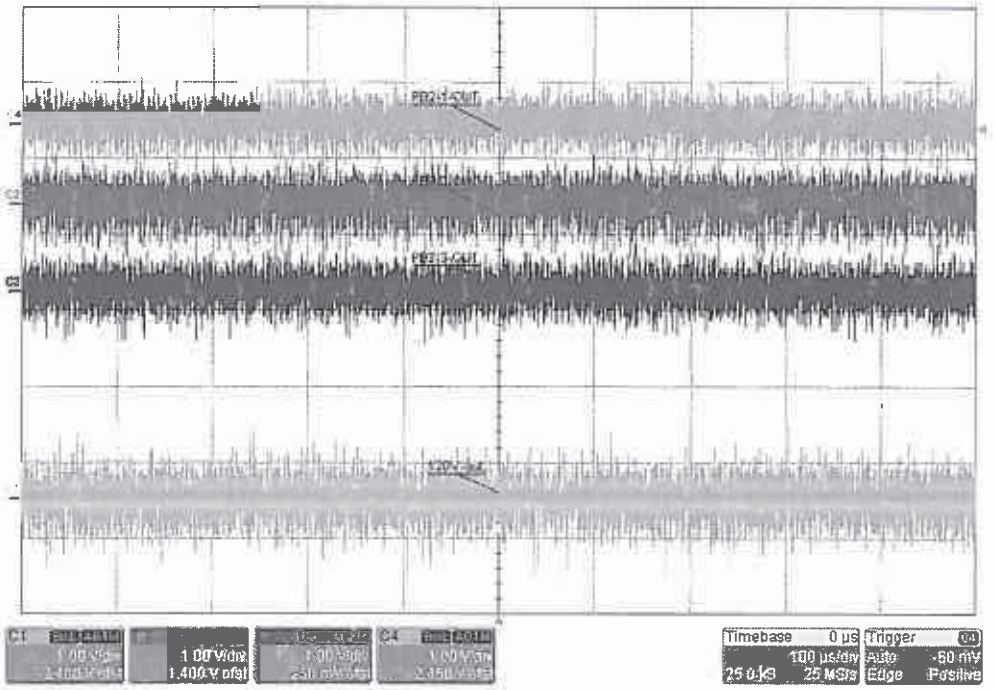


Figure 204: Side B Radiated Susceptibility 2.2GHz 161V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

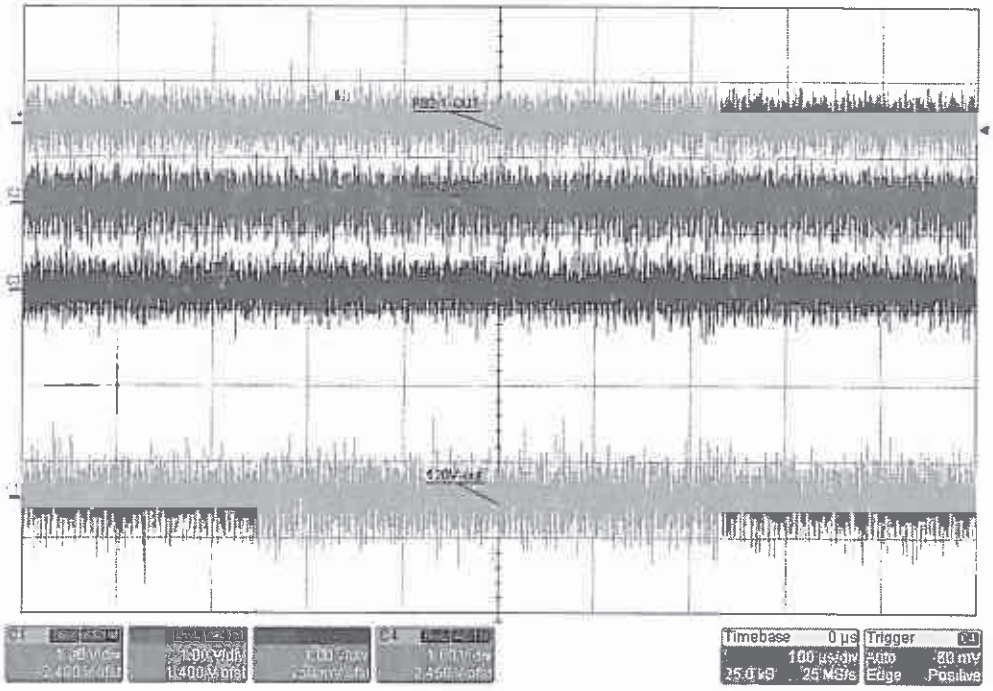


Figure 205: Side B Radiated Susceptibility 2.2GHz 161V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

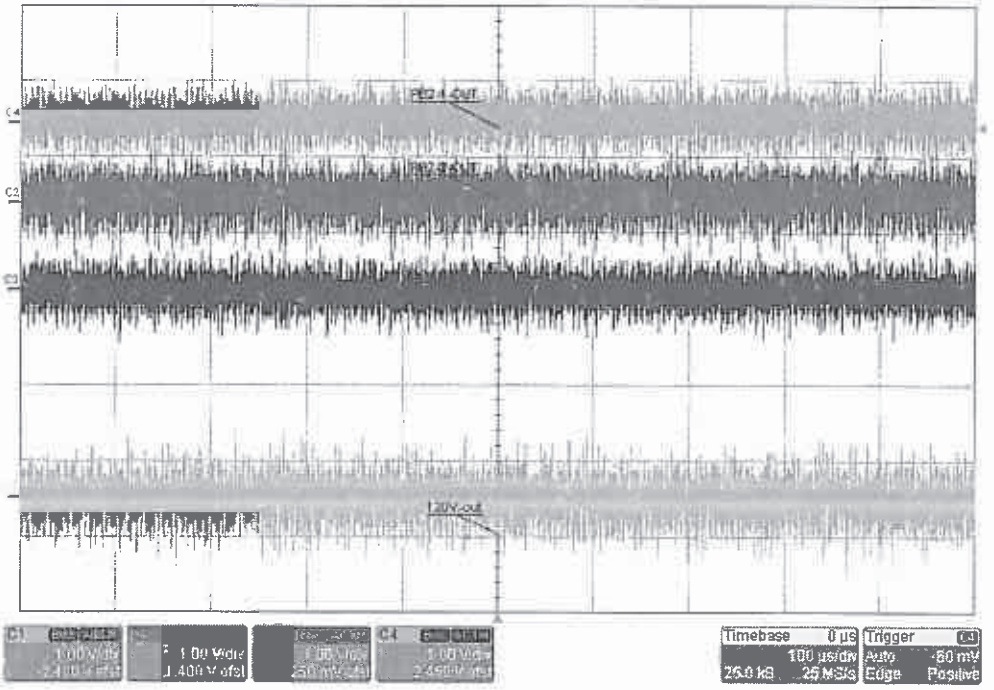


Figure 206: Side B Radiated Susceptibility 5GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

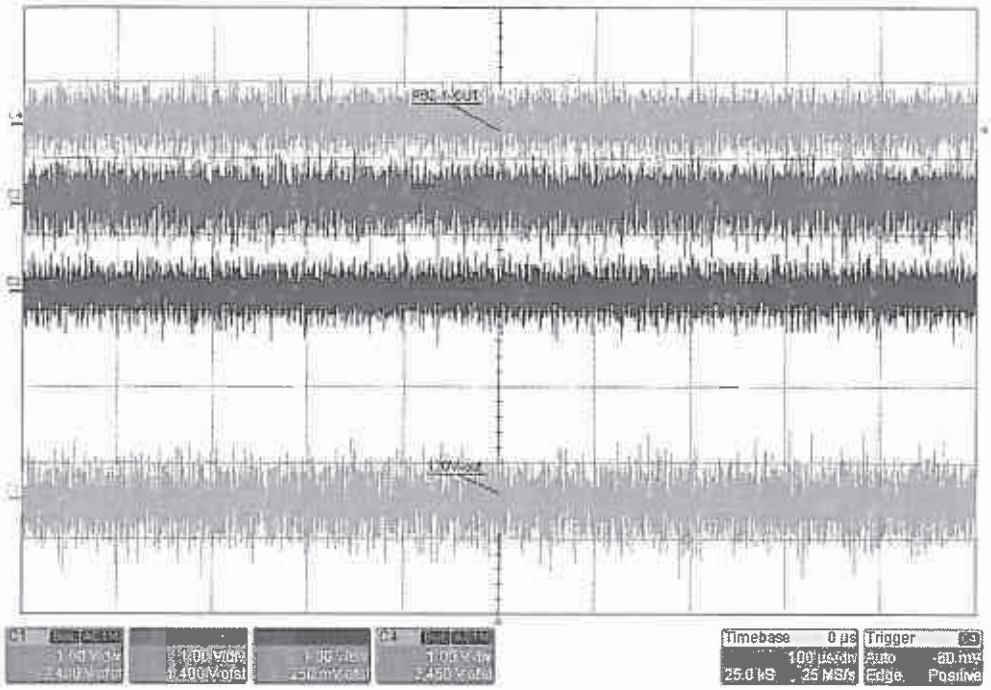


Figure 207: Side B Radiated Susceptibility 8GHz 60V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

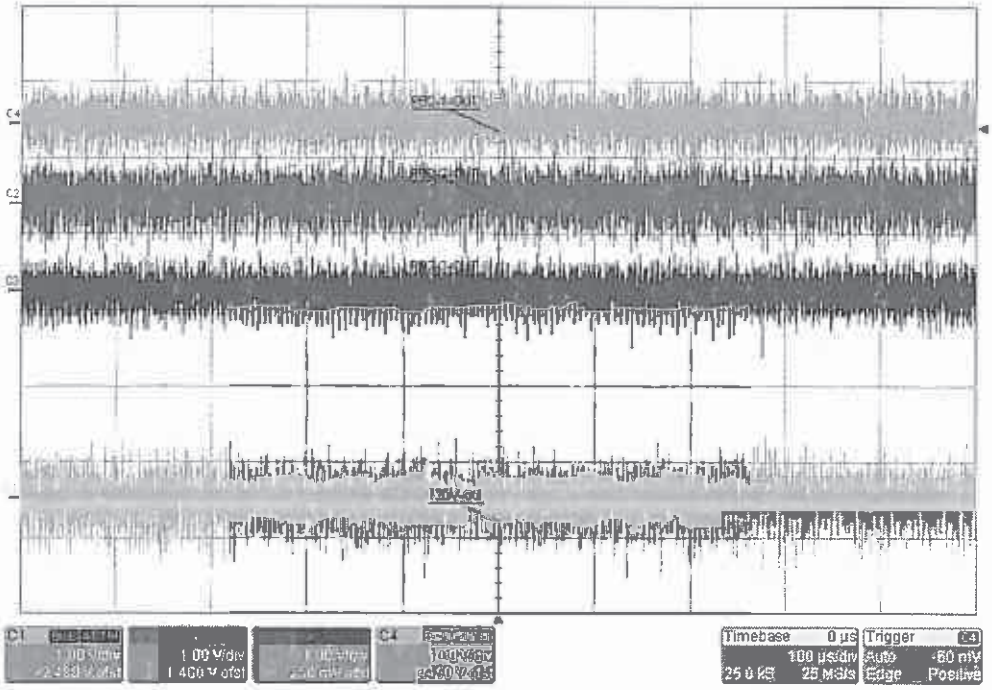


Figure 208: Side B Radiated Susceptibility 5GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

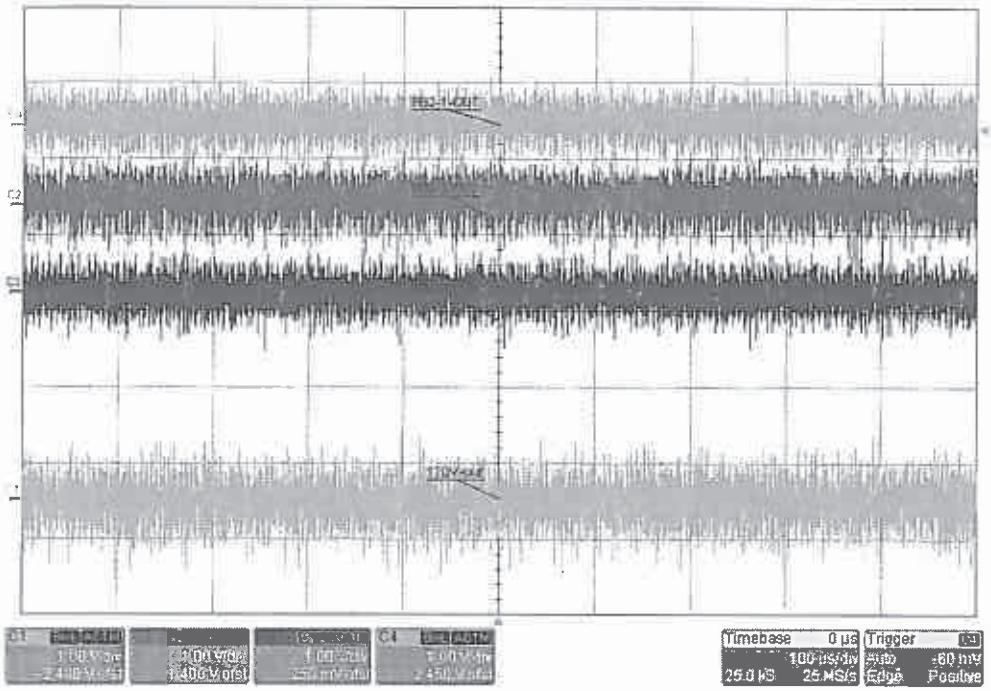


Figure 209: Side B Radiated Susceptibility 8GHz 60V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

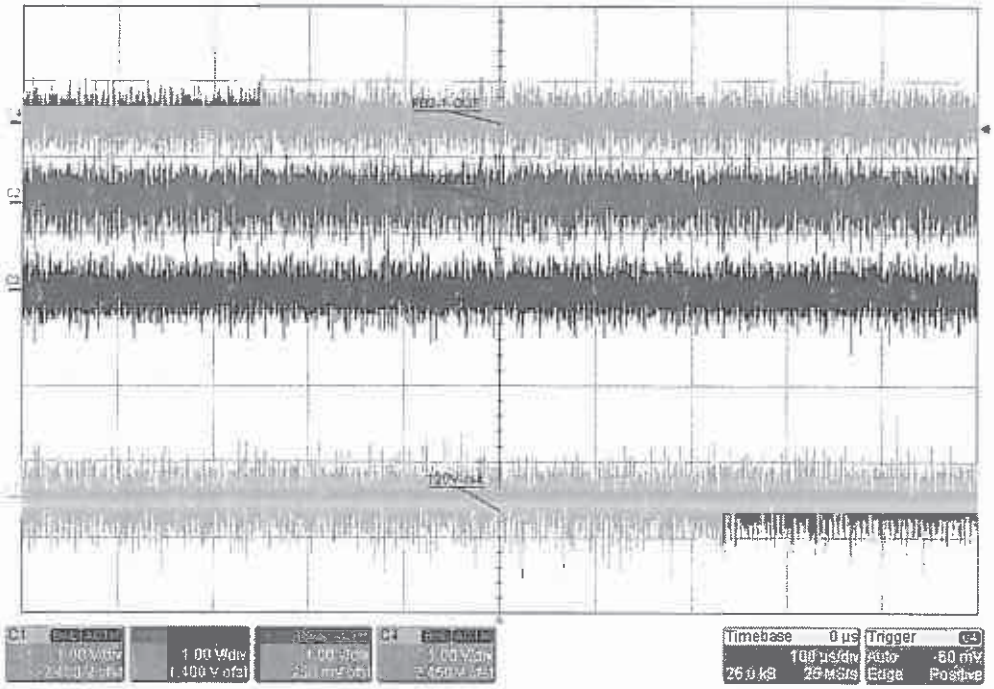


Figure 210: Side B Radiated Susceptibility 9GHz 20V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

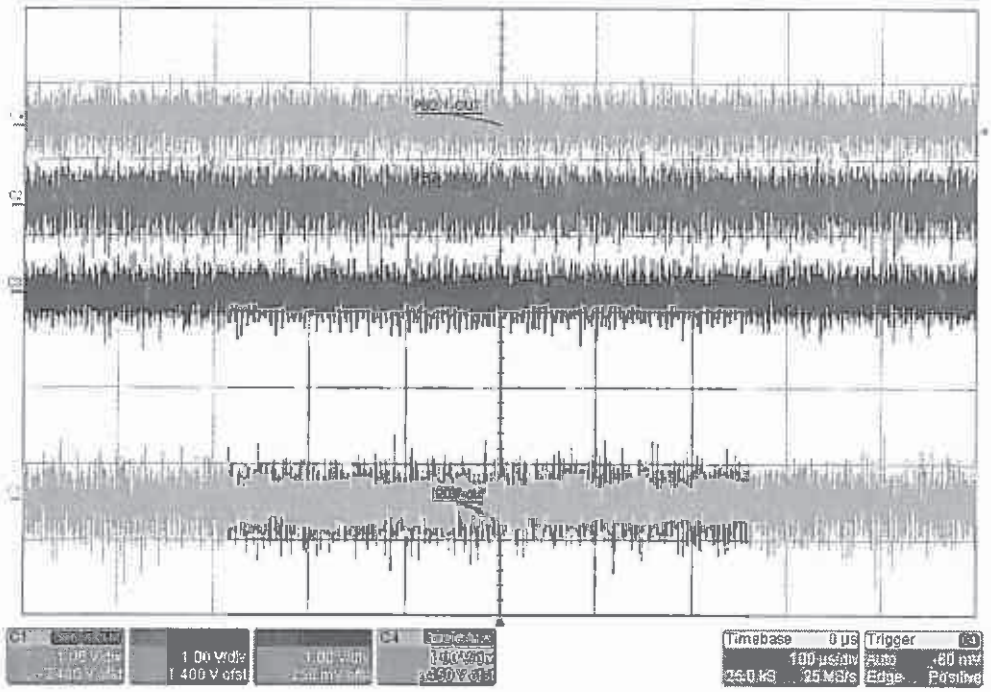


Figure 211: Side B Radiated Susceptibility 10GHz 20V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

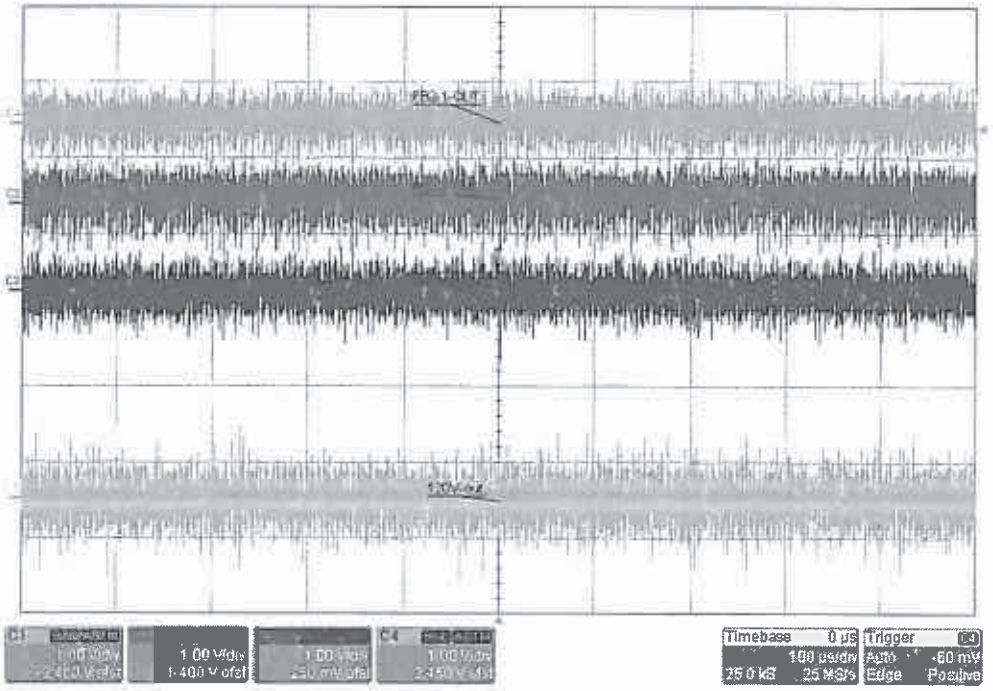


Figure 212: Side B Radiated Susceptibility 9GHz 20V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

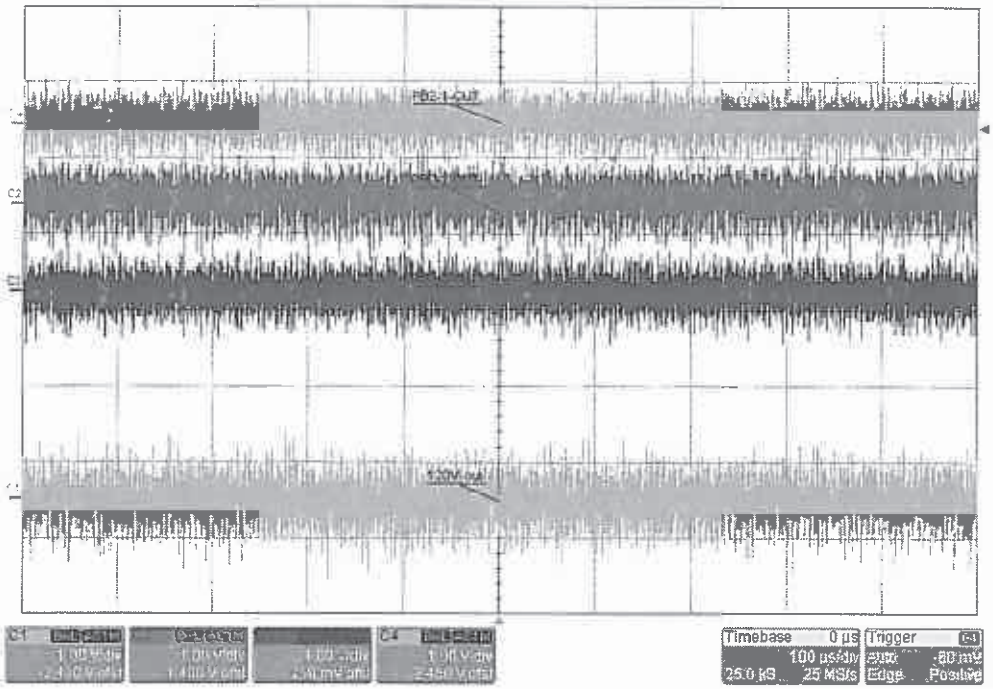


Figure 213: Side B Radiated Susceptibility 10GHz 20V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

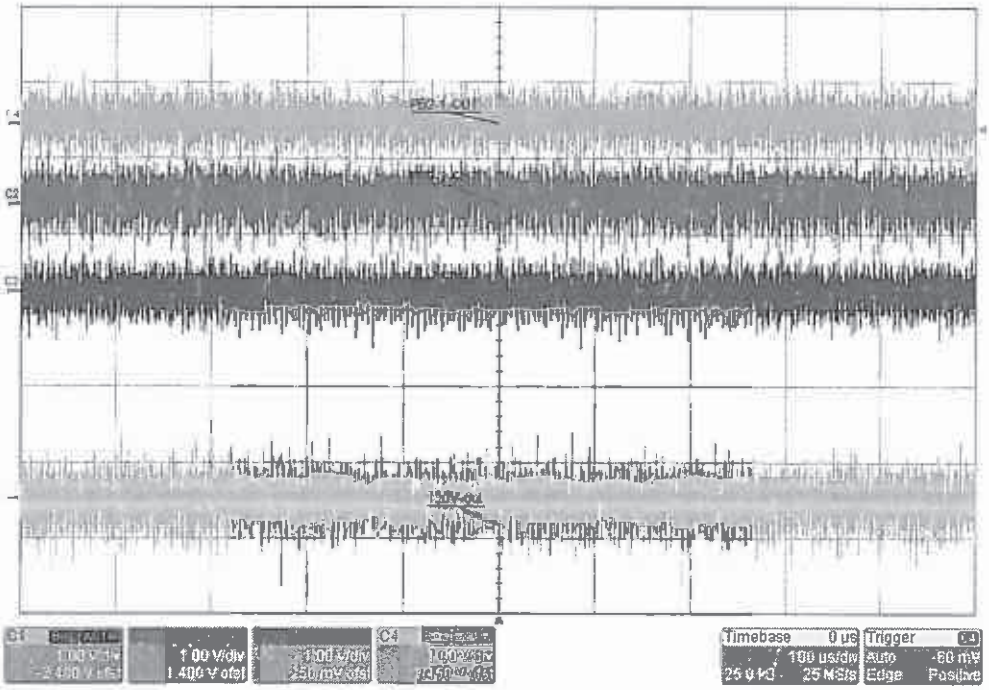


Figure 214: Side B Radiated Susceptibility 8.5GHz 79V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

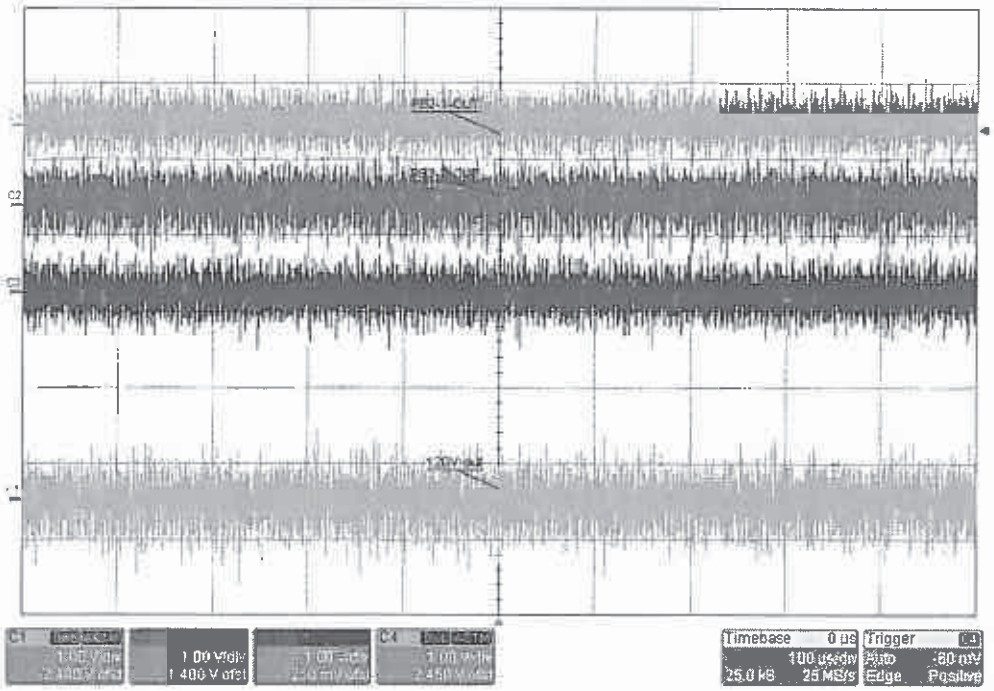


Figure 215: Side B Radiated Susceptibility 8.5GHz 79V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

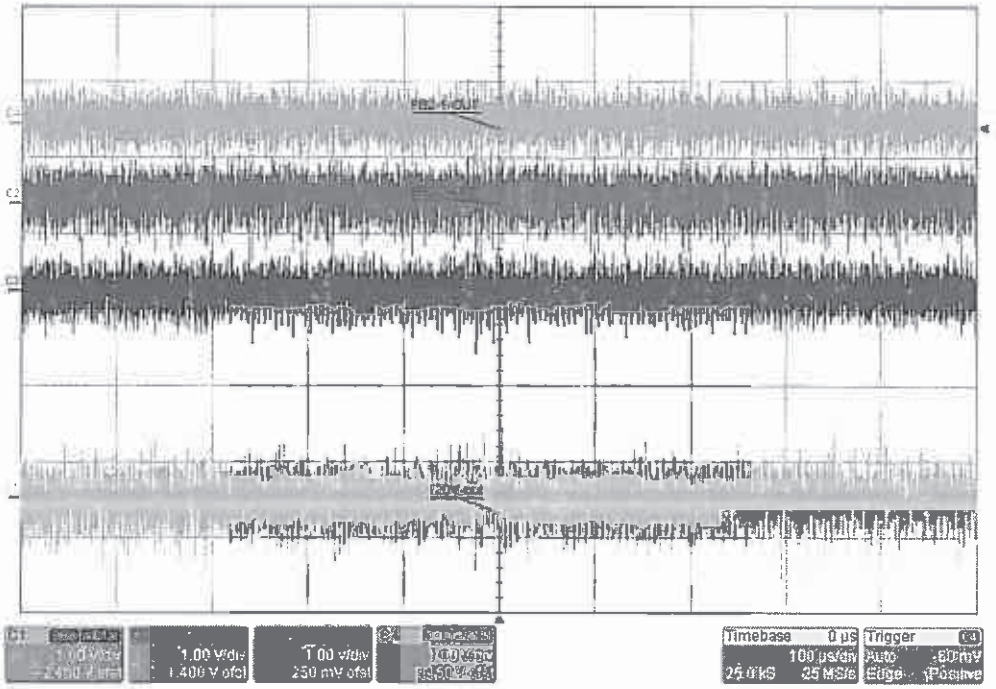


Figure 216: Side B Radiated Susceptibility 13.7GHz 250V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

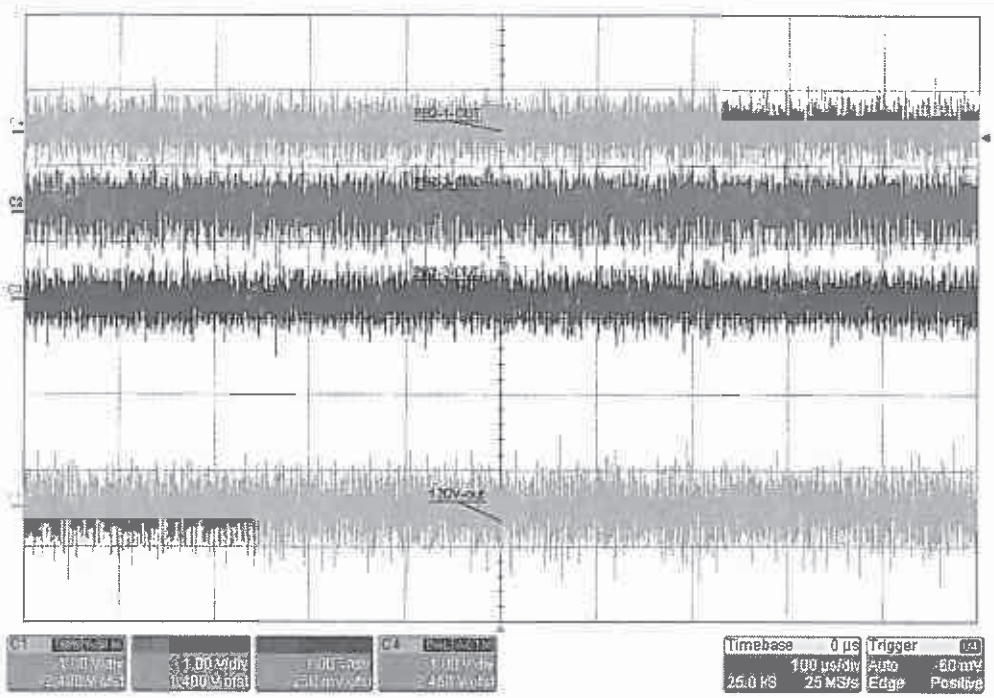


Figure 217: Side B Radiated Susceptibility 15.2GHz 250V/m - orizz

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

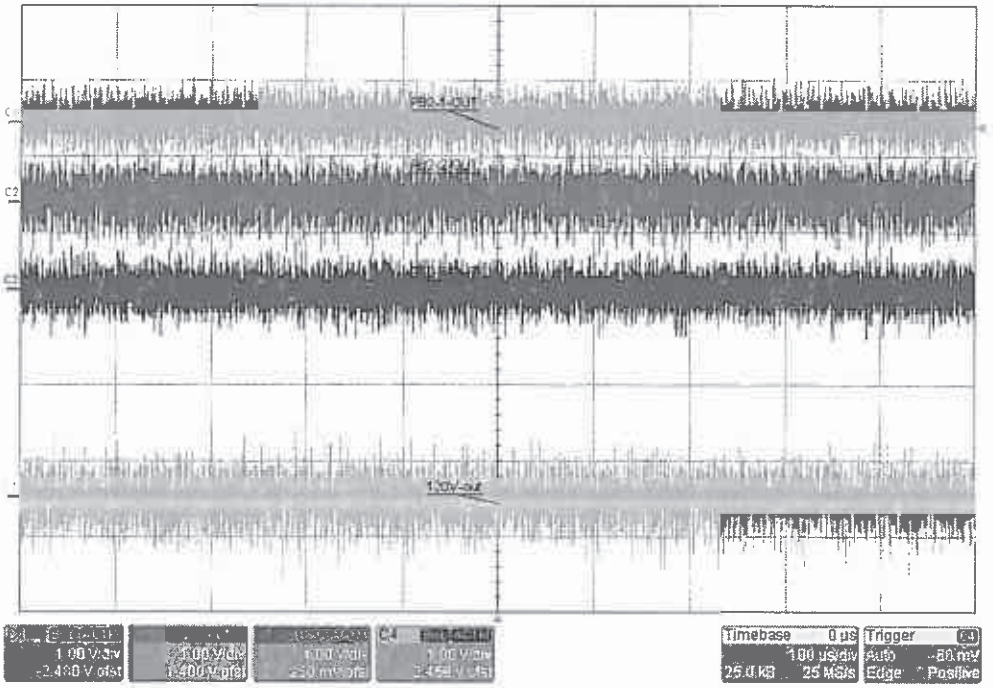


Figure 218: Side B Radiated Susceptibility 13.7GHz 250V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

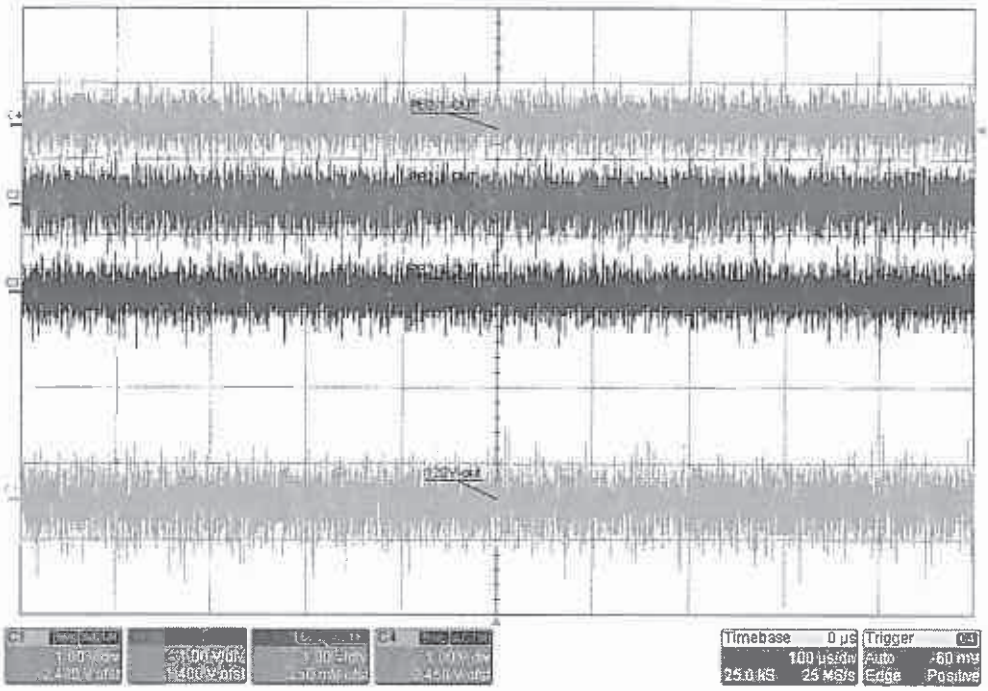


Figure 219: Side B Radiated Susceptibility 15.2GHz 250V/m - vert

Step RS-E_R-0.37

Ch4= Vout_28V (ac)

Ch2= Vout_28V (ac)

Ch3= Vout_28V (ac)

Ch1= Vout_120V (ac)

14.ANNEX B – CEM LAB REPORT (N° 158 REV.0)

This Annex collects the report of the test performed at CEM lab facility:

- Conducted emission test
- Radiated Emission test
- Radiated susceptibility test
- ESD test

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ANNEX B TO : PDS-RP-CGS-126 ISSUE 1

UNIVERSITA' DEGLI STUDI DI PERUGIA
POLO SCIENTIFICO E DIDATTICO DI TERNI
Facoltà di Ingegneria

Laboratorio di Caratterizzazione Elettromagnetica

TEST REPORT
N° 158, Rev. 0

Equipment Under Test (EUT)
Power Distribution Unit
S/N: FM01
P/N: 10-AMS02PDS-000.00
Produced by
Carlo Gavazzi Space

OBJECT

TEST	REFERENCE DOCUMENTS
Radiated Emission RE02, 14 kHz ÷ 15.5 GHz	PDS-PR-CGS-016, Issue 2, Date: 24/07/2009
Radiated Susceptibility RS03, 14 kHz - 15.2 GHz	
Arc Discharge Susceptibility	
Conducted Emission, 15 kHz-50 MHz	

Terni, 20 011. 2009

Realized by
P.I. Francesco Tissi

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

CEM Laboratorio di Caratterizzazione ElettroMagnetica
Polo Scientifico e Didattico di Terni – Facoltà di Ingegneria
Strada di Pentima, 4, 05100 Terni
Tel. +39 0744/492912 – Fax. +39 0744/492950

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2. Test site ..... pag. 4
3. Radiated Emission RE02, 14 kHz ÷ 15.5 GHz ..... pag. 5
4. Radiated Susceptibility RS 03, 14 kHz - 15.2 GHz ..... pag. 6
5. Arc Discharge Susceptibility ..... pag. 7
6. Conducted Emission, 15 kHz-50 MHz ..... pag. 8

Attachments

Attachment A (3 pages): Photographic Documentation
Attachment B (17 pages): Results of RE02 Test
Attachment C (10 pages): Results of CE02 Test

Realized by
P.I. Francesco Tissi

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

1. EUT

The equipment under test (EUT) is:

Power Distribution Unit
S/N: FM01
P/N: 10-AMS02PDS-000.00

produced by

Carlo Gavazzi Space
ViaGallarate 150, 20151 Milano – Italy

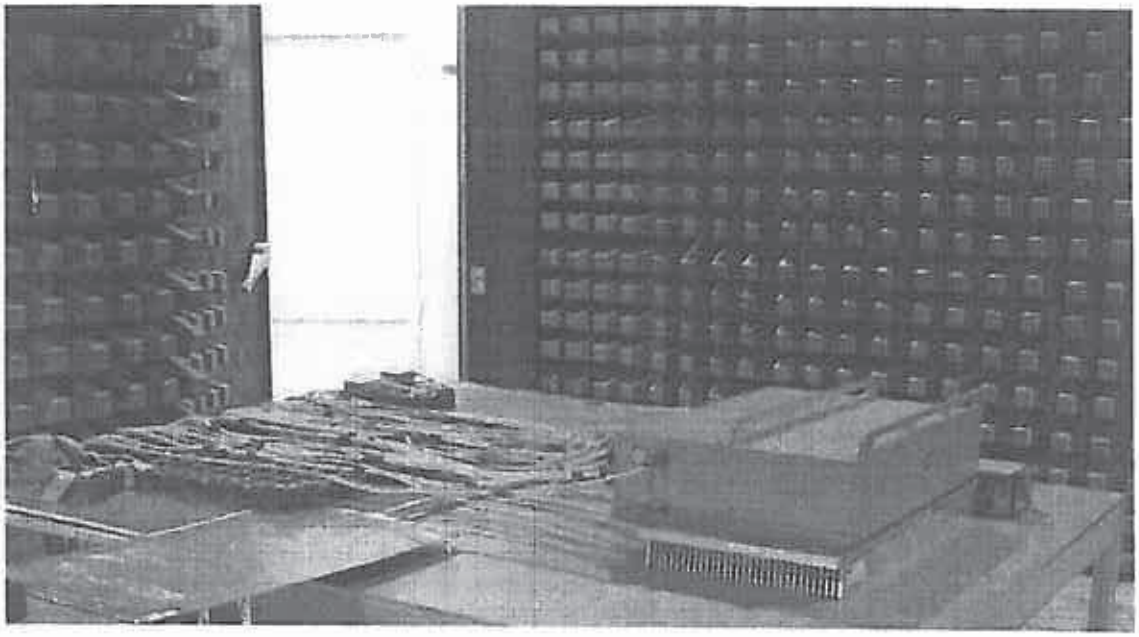


Figure 1: EUT

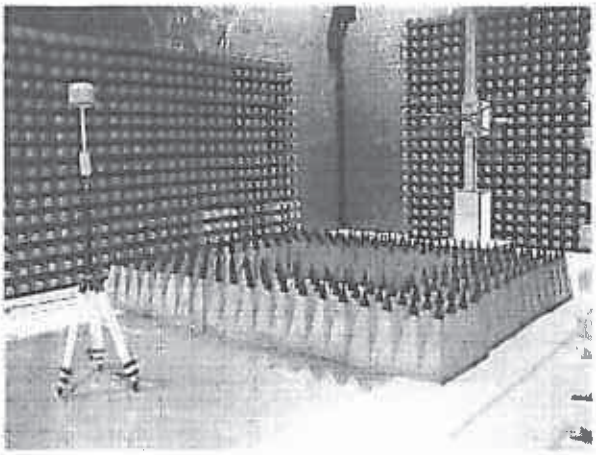
Realized by
P.I. Francesco Tissi

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

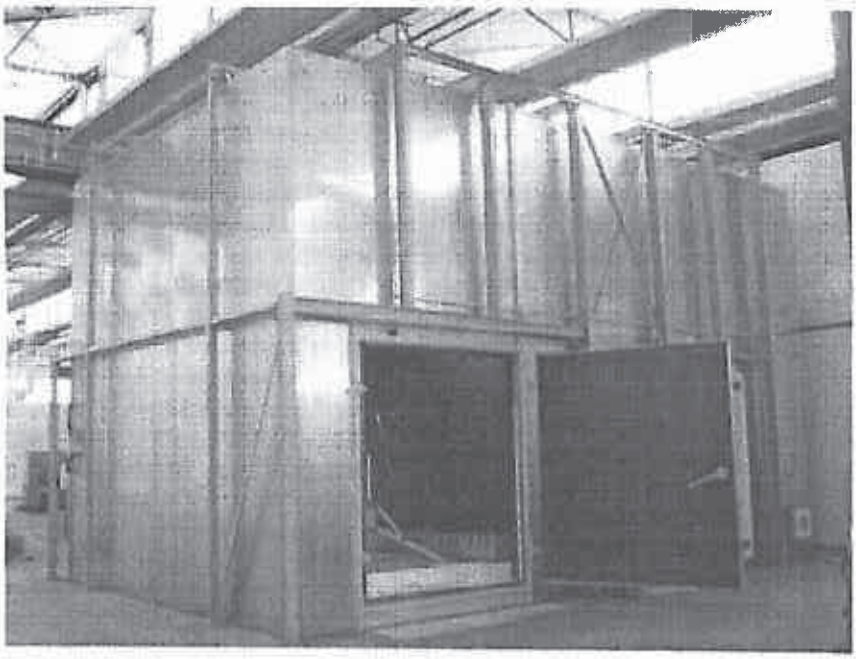
2. TEST SITE

The EMC tests have been performed in the Laboratory of Electromagnetic Characterization of the "Polo Scientifico e Didattico di Terni", University of Perugia, Faculty of Engineering, Strada di Pentima, 4, 05100 Terni.



Semi-anechoic chamber:

- Dimensions: 9.15 m, 8.00 m, 5.55 m.
- Turn table capacity: 1000 kg.
- Automatic mast for antenna mouvement.
- Electromagnetic absorbing: ferrite and cones.
- Anechoic range: 30 MHz ÷ 18 GHz.
- Shielding range: 10 kHz ÷ 18 GHz.



Realized by
P.I. Francesco Tissi
Tissi Francesco

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

3. Radiated Emission RE02, 14 kHz ÷ 15.5 GHz

Reference Document: PDS-PR-CGS-016, Issue 2, Date: 24/07/2009

Scope
The scope of this test is to verify that EUT radiated electromagnetic emission (related only to the unit) due to electric field does not exceed the limits.

Test procedures
This test is performed in agreement with the requirements of Reference Document, Par. 10.8.

Environmental Conditions
Temperature 23°C
Humidity 38%

Test equipment

Type	Manufacture	Model	Serial Number	Calibration Due Date
Spectrum Analyzer	Agilent	E4407B	MY41441068	05/08/2010
Active Monopole Antenna	A.H. System	SAS-550-1B	313	04/09/2010
Log - periodic antenna	Electro-metrics	EM-6950	848	11/08/2010
Bi - conical Antenna	Electro-metrics	EM-6912A	704	10/08/2010
Double Ridge Guide Horn Antenna	A.H. Systems	SAS-571	539	11/08/2010
Data Acquisition	Personal computer	–	–	n.r.

(n.r. = not required)

Results
The results are shown in attachment B.

Realized by
P.I. Francesco Tissi
Tissi Francesco

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

4. Radiated Susceptibility RS03, 14 kHz - 15.2 GHz

Reference Document: PDS-PR-CGS-016, Issue 2, Date: 24/07/2009

Scope
The scope of this test is to verify the immunity of the EUT to radiated electromagnetic susceptibility due to electrical field. The test is performed at closed box.

Test procedures
This test is performed in agreement with the requirements of Reference Document, Par. 10.10.

Environmental Conditions
Temperature 21°C
Humidity 37%

Test equipment

Type	Manufacture	Model	Serial Number	Calibration Due Date
Power Amplifier	Huges	1277-H09 F0000	129	07/08/2010
Power Amplifier	Huges	1177-H01 F0000	185	07/08/2010
Power Amplifier	Huges	1177-H02 F0000	248	07/08/2010
Power Amplifier	Varian	V7U6991K1D	6208	10/08/2010
Signal Generator	HP	8673C	2645A00405	02/09/2010
Signal Generator	Rode & Schwartz	SMY01	833104/011	27/08/2010
Power Amplifier	Schaffner	CBA9413A	9908	10/08/2010
Power Amplifier	Amplifier Research	25A250A	307913	05/08/2010
Double Ridge Guide Horn Antenna	A.H. System	SAS-571	539	11/08/2010
Double ridged guide antenna	Electro-metrics	EM-6960	164	03/09/2010
Monopole Antenna	A.H. System	SAS-551	202	04/09/2010
El.magn. Field Meter + Electric Field Probe	Wandel & Goltermann	EMC-200+TYP-8	AC-0020+AE0017	03/09/2010

(n.r. = not required)

Results
In the range between 200 MHz and 500 MHz, the EUT telemetry presents various malfunctioning. With shielded cables, the malfunctioning disappear.

Realized by
P.I. Francesco Tissi
Tissi Francesco

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

5. Arc Discharge Susceptibility

Reference Document: PDS-PR-CGS-016, Issue 2, Date: 24/07/2009

Scope
The scope of this test is to verify the immunity of the EUT to due to a repetitive electrostatic arc discharge The test shall be performed at closed box on the four corners of the unit.

Test procedures
This test is performed in agreement with the requirements of Reference Document, Par. 10.7.

Environmental Conditions
Temperature 20°C
Humidity 38%

Test equipment

Tipo	Costruttore	Modello	Serial Number	Scadenza taratura
Electrostatic Discharge Hand Device	Hofbauer	CEG-4500 + HVT 4500	1260 + 1265	31/08/2010

(n r = not required)

Results
No failures, degradations of performances and permanent damages are noted after test.

Realized by
P.I. Francesco Tissi
Tissi Francesco

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

6. Conducted Emission, 15 kHz-50 MHz

Reference Document: PDS-PR-CGS-016, Issue 2, Date: 24/07/2009

Scope
The scope of this test is to verify the current ripple appearing on the input power lines in the frequency domain. The test is performed at closed box.

Test procedures
This test is performed in agreement with the requirements of Reference Document, Par. 10.2.1 and Par. 10.3.1.

Environmental Conditions
Temperature 19°C
Humidity 37%

Test equipment

Tipo	Costruttore	Modello	Serial Number	Scadenza taratura
Spectrum Analyzer	Agilent	E4407B	MY41441068	05/08/2010
R.F. Current Probe	Solar Electronics	6741-1	882720	03/08/2010

(n.r. = not required)

Results
The results are shown in attachment C.

Realized by
P.I. Francesco Tissi

Checked by
Ing. Antonio Faba

Approved by
Prof. Ing. Ermanno Cardelli

Attachment A

PHOTOGRAPHIC DOCUMENTATION

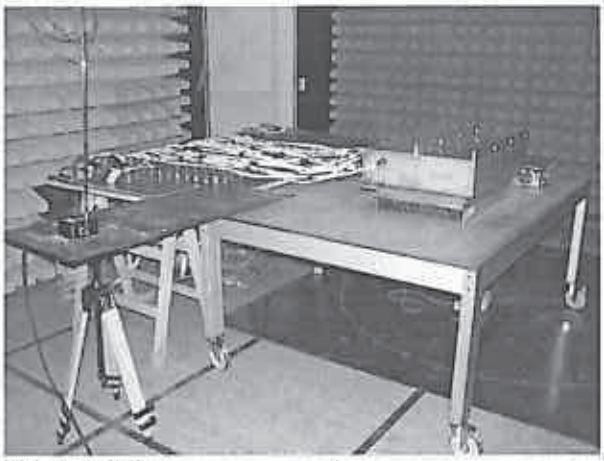


Fig. 1 – RE02, 14 KHz ÷ 30 MHz

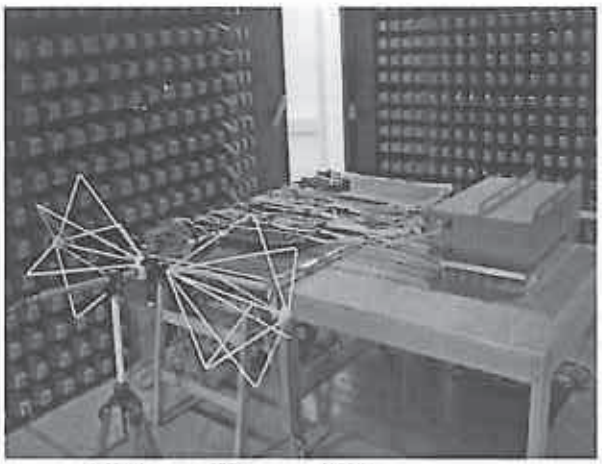


Fig. 2 - RE02, 30 MHz ÷ 300 MHz

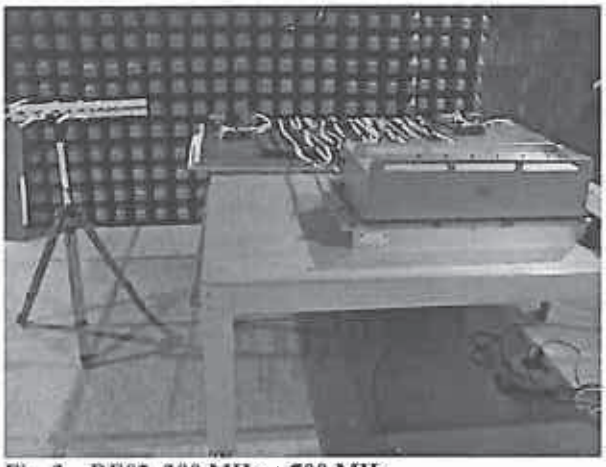


Fig. 3 – RE02, 300 MHz ÷ 700 MHz

Fig. 4 - RE02, 700 MHz ÷ 15.5 GHz

Fig. 5 – RS03, 14 KHz ÷ 10 MHz, Side B

Fig. 6 - RS03, 200 MHz ÷ 1 GHz, Side A

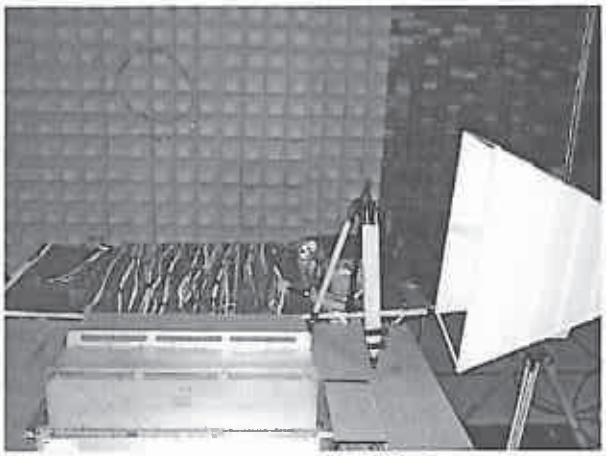


Fig. 7 – RS03, 200 MHz ÷ 1 GHz, Side B

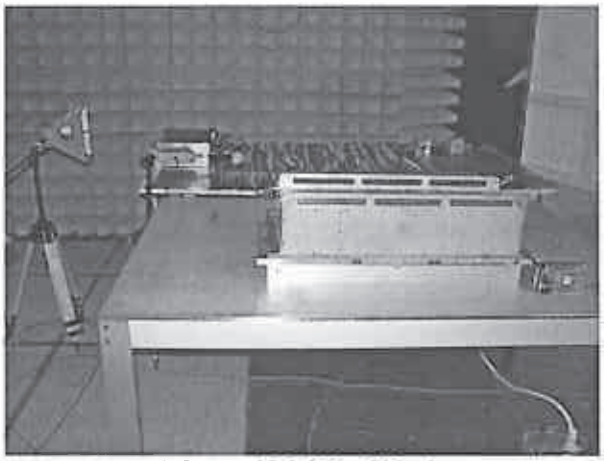


Fig. 8 - RS03, 1 GHz ÷ 15.2 GHz, Side A

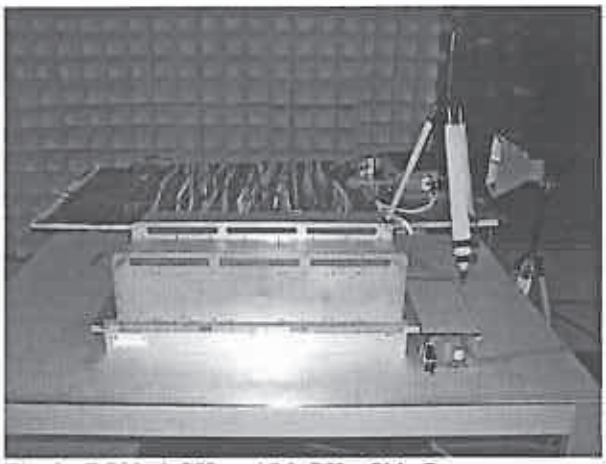


Fig. 9 - RS03, 1 GHz ÷ 15.2 GHz, Side B

Fig. 10 - Arc Discharge Susceptibility

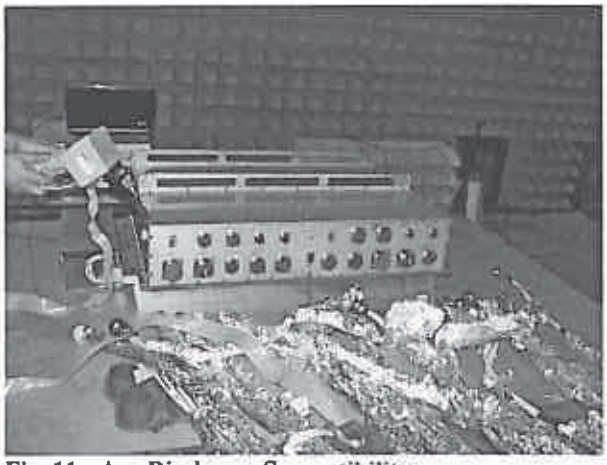


Fig. 11 - Arc Discharge Susceptibility

Fig. 12 – RS03, Particular of cables shielding

Attachment B

RESULTS OF RADIATED ENERGY EMISSION TEST

The following images show the Radiated Emission Test Result. When signature "Side A" or "Side B"is reported, intend that Side A or respectively Side B is running and test antenna is placed in front of named side.

Side A:

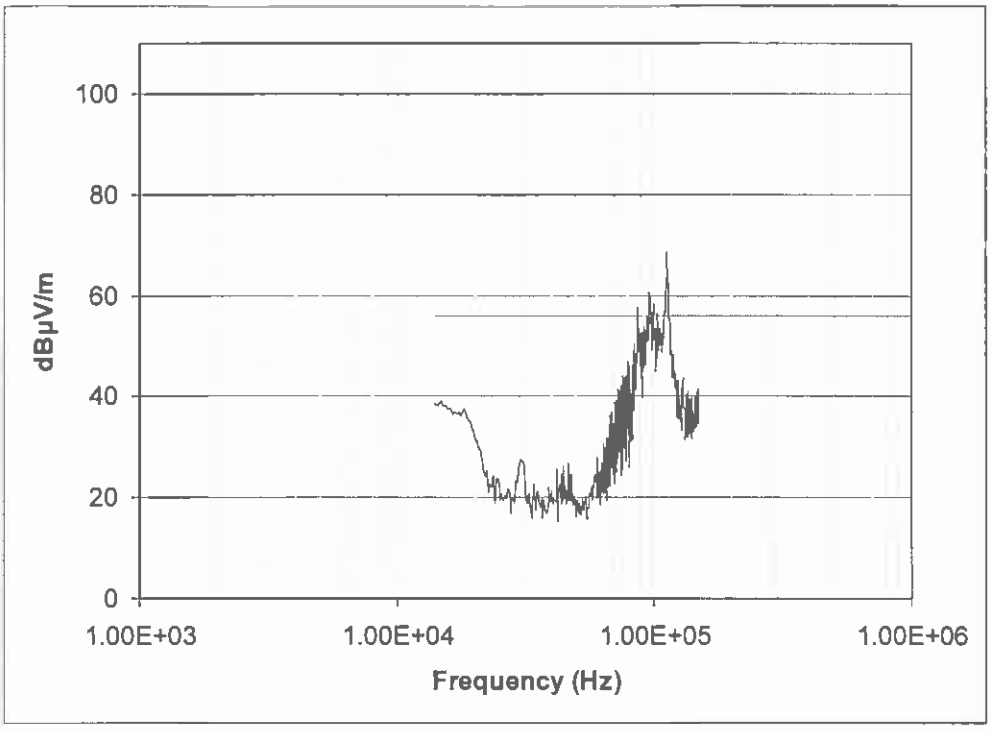


Fig. 1 – 14 KHz ÷ 150 KHz, Noise Floor, Side A, Cables not shielded

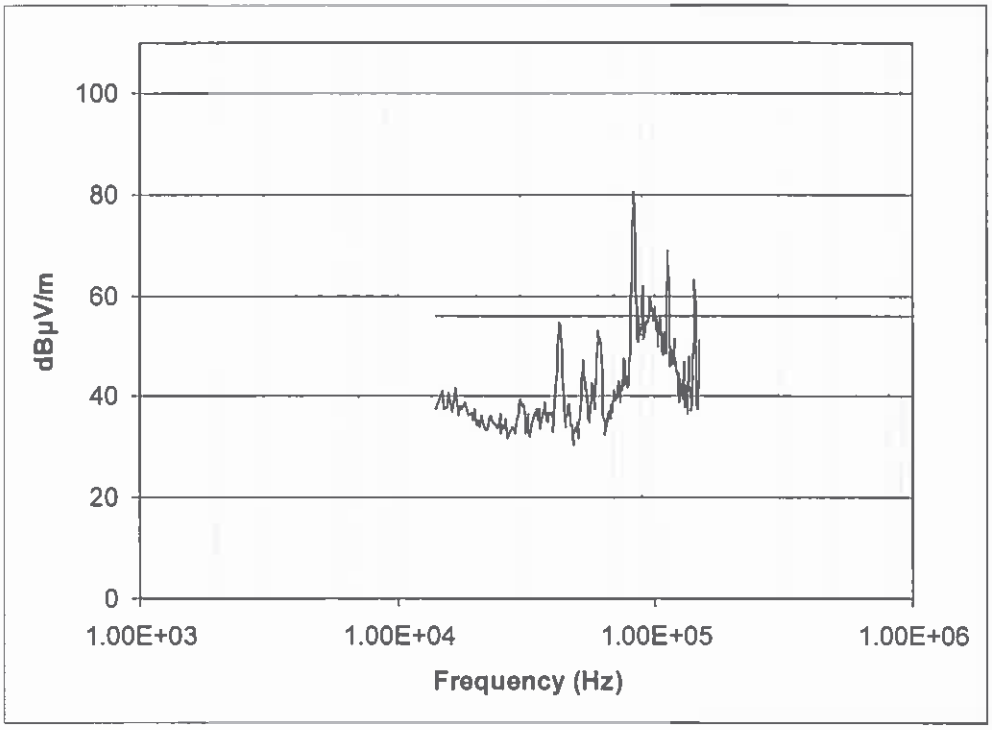


Fig. 2 – 14 KHz ÷ 150 KHz, Full Load, Side A, Cables not shielded

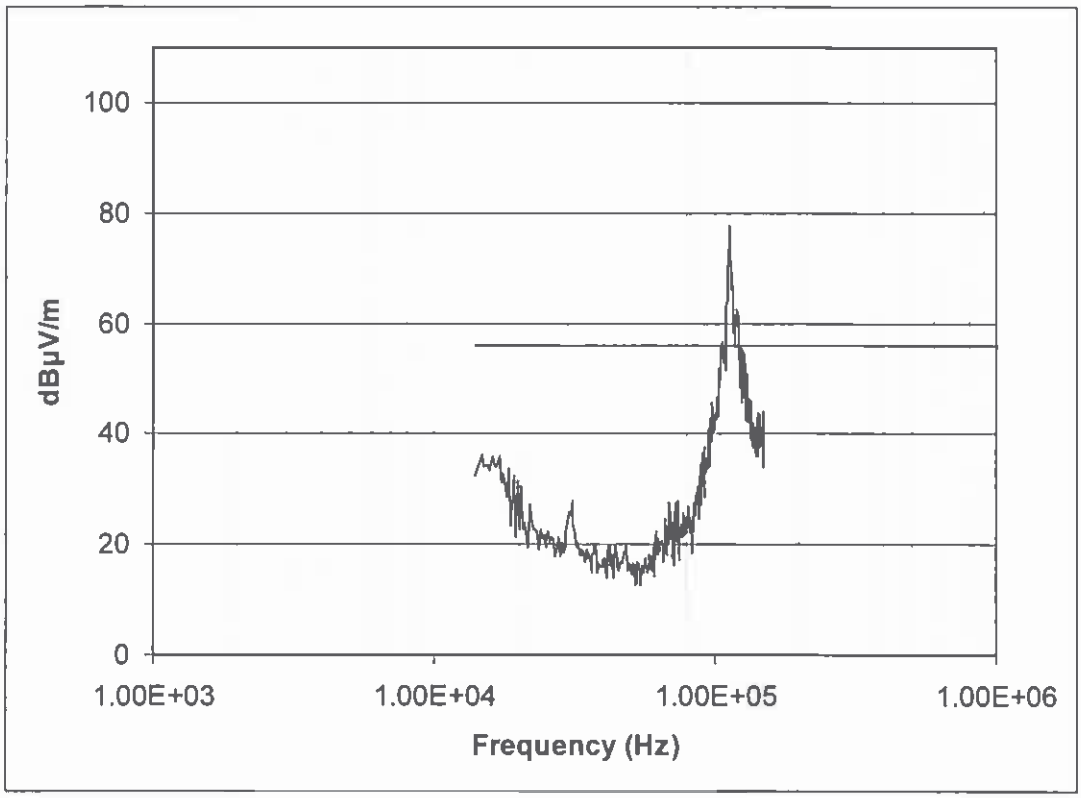


Fig. 3 – 14 KHz ÷ 150 KHz, Noise Floor, Side A, All cables shielded

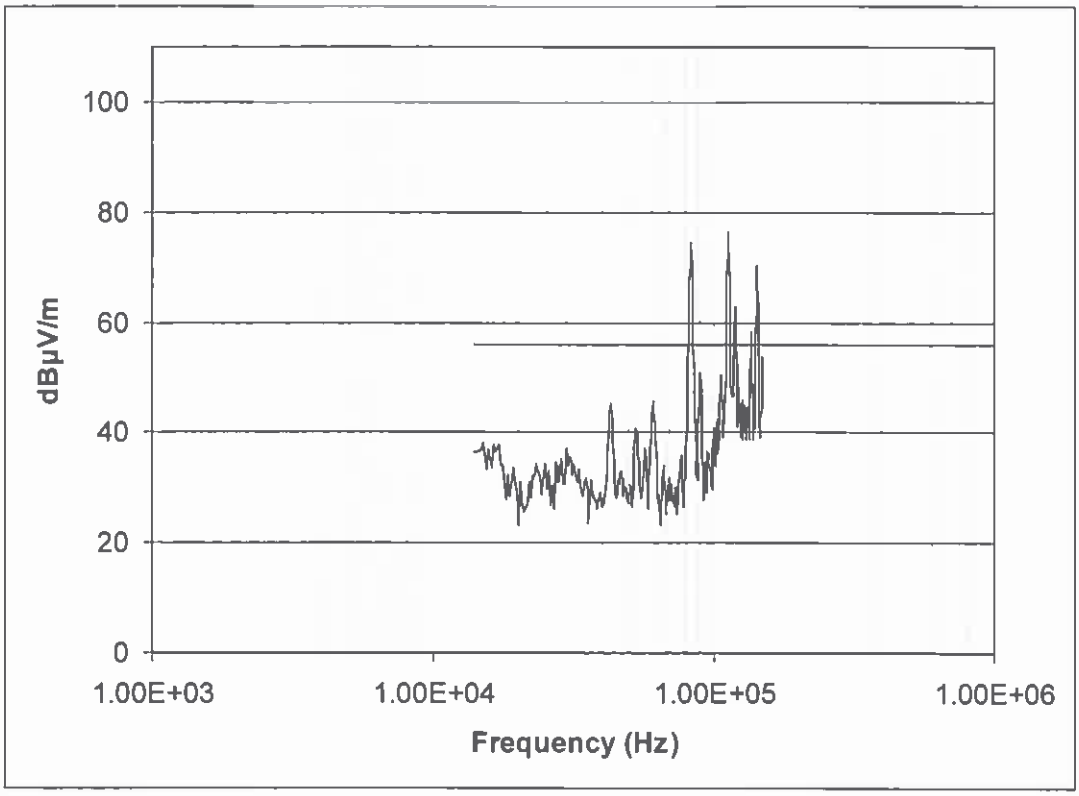


Fig. 4 – 14 KHz ÷ 150 KHz, Full Load, Side A, All cables shielded

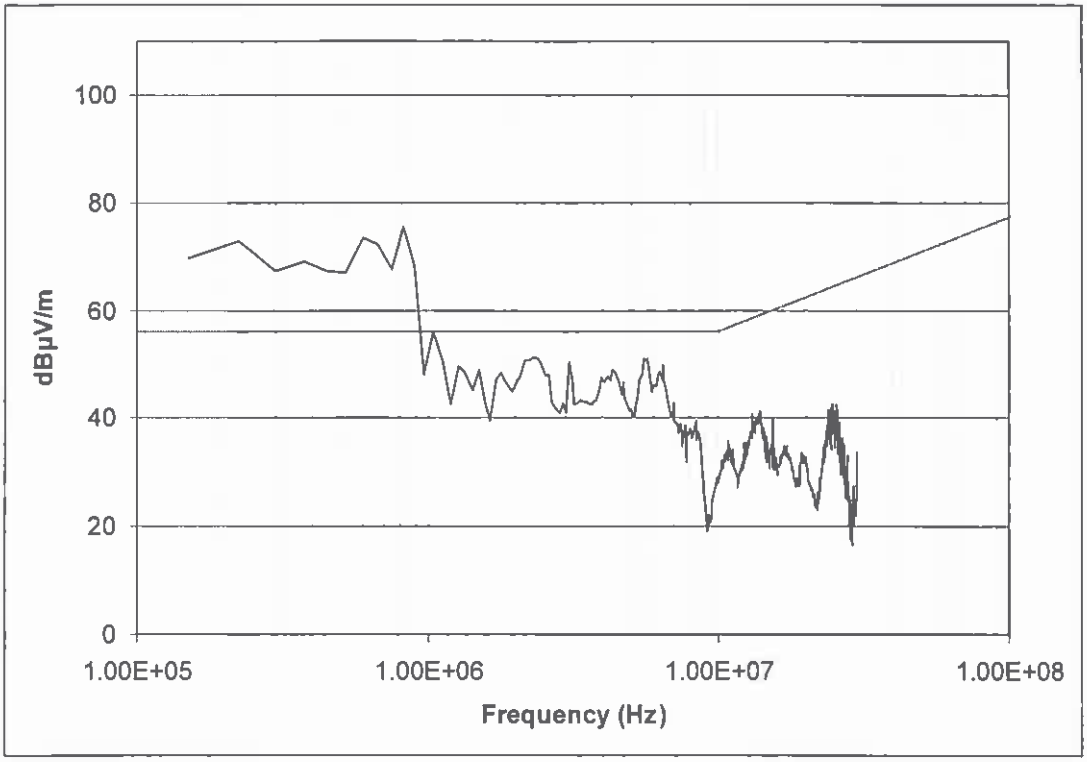


Fig. 5 – 150 KHz ÷ 30 MHz, Noise Floor, Side A, Cables not shielded

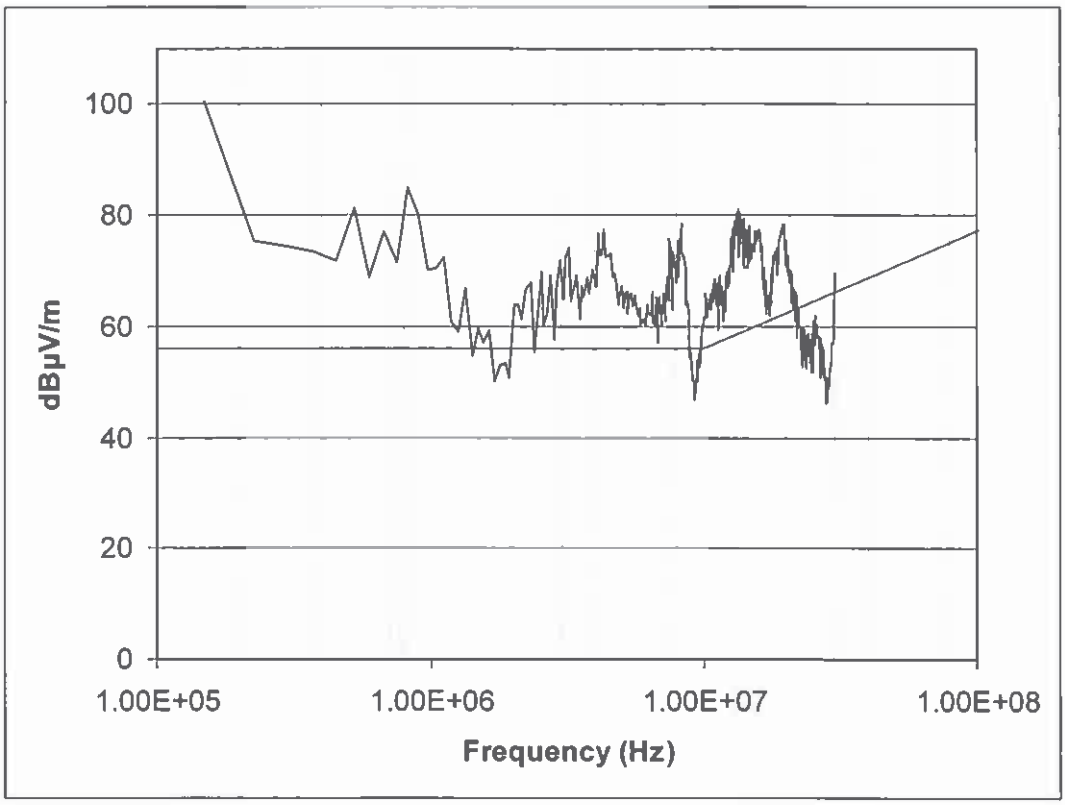


Fig. 6 – 150 KHz ÷ 30 MHz, Full Load, Side A, Cables not shielded

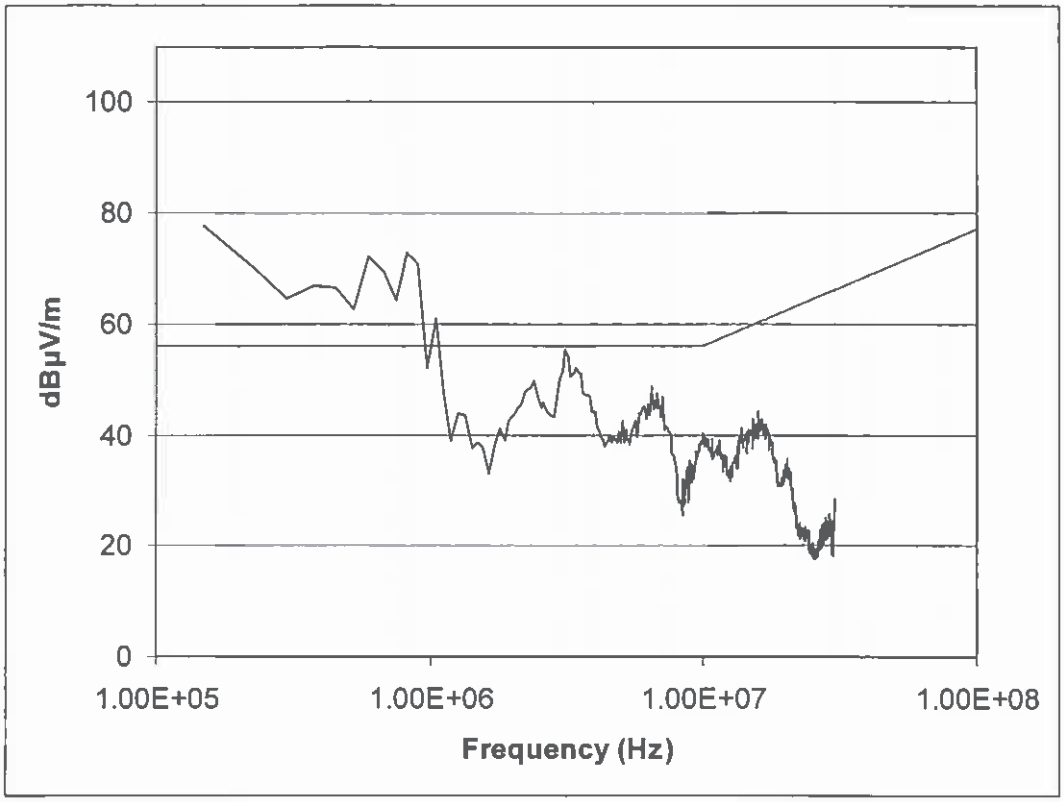


Fig. 7 – 150 KHz ÷ 30 MHz, Noise Floor, Side A, All cables shielded

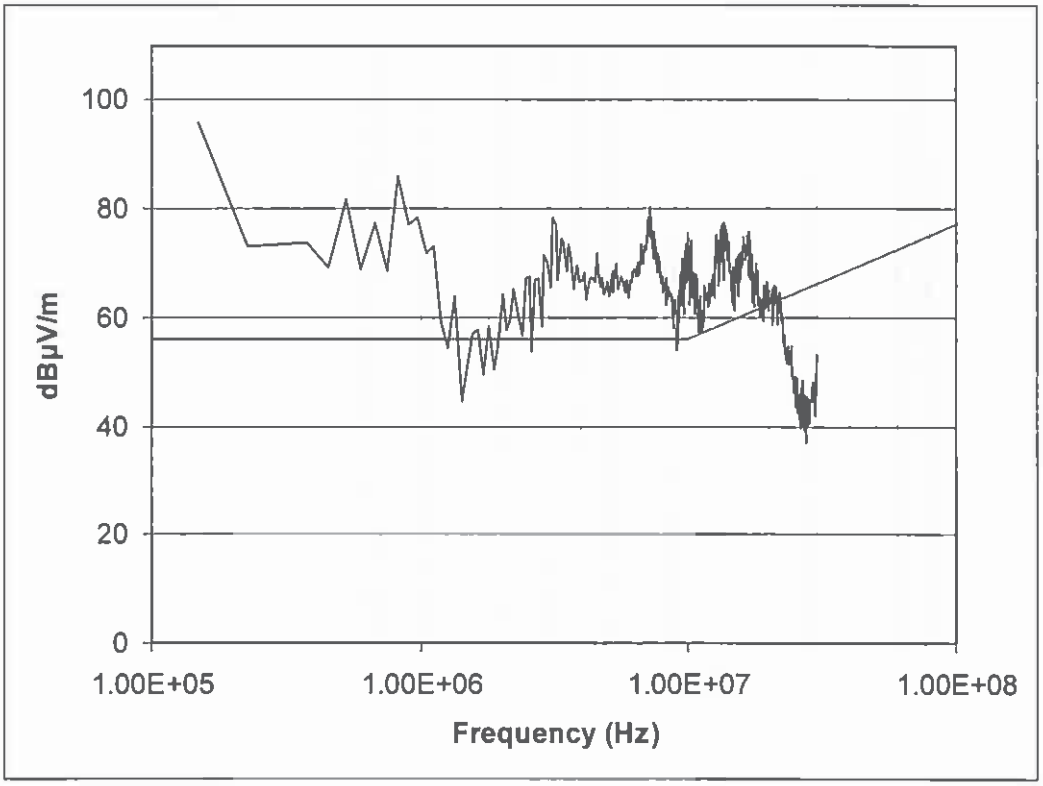


Fig. 8 – 150 KHz ÷ 30 MHz, Full Load, Side A, All cables shielded

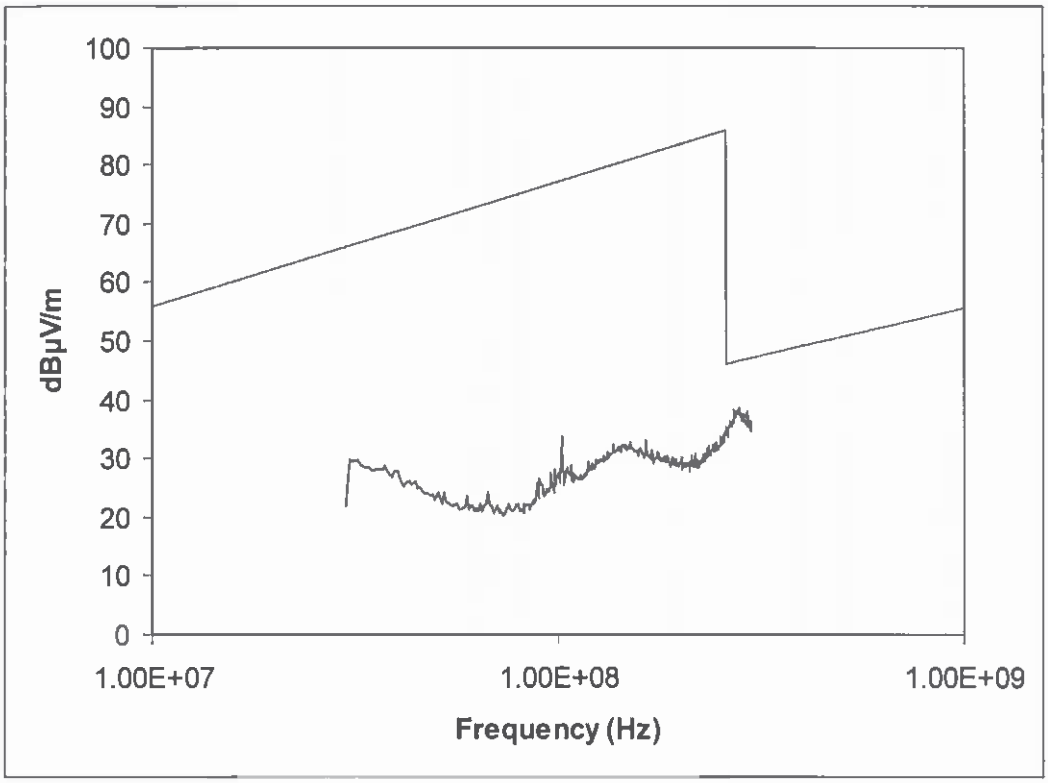


Fig. 9 – 30 MHz ÷ 300 MHz, Noise Floor, Side A, Cables not shielded

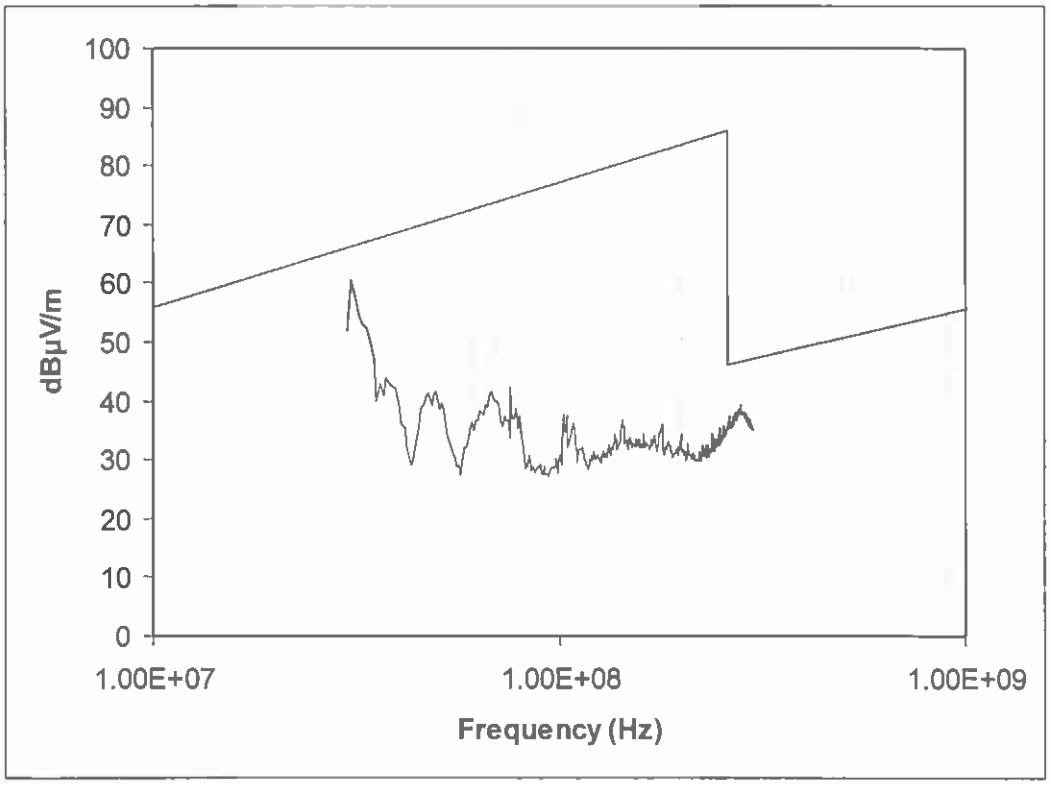


Fig. 10 – 30 MHz ÷ 300 MHz, Full Load, Side A, Cables not shielded, Pol. H

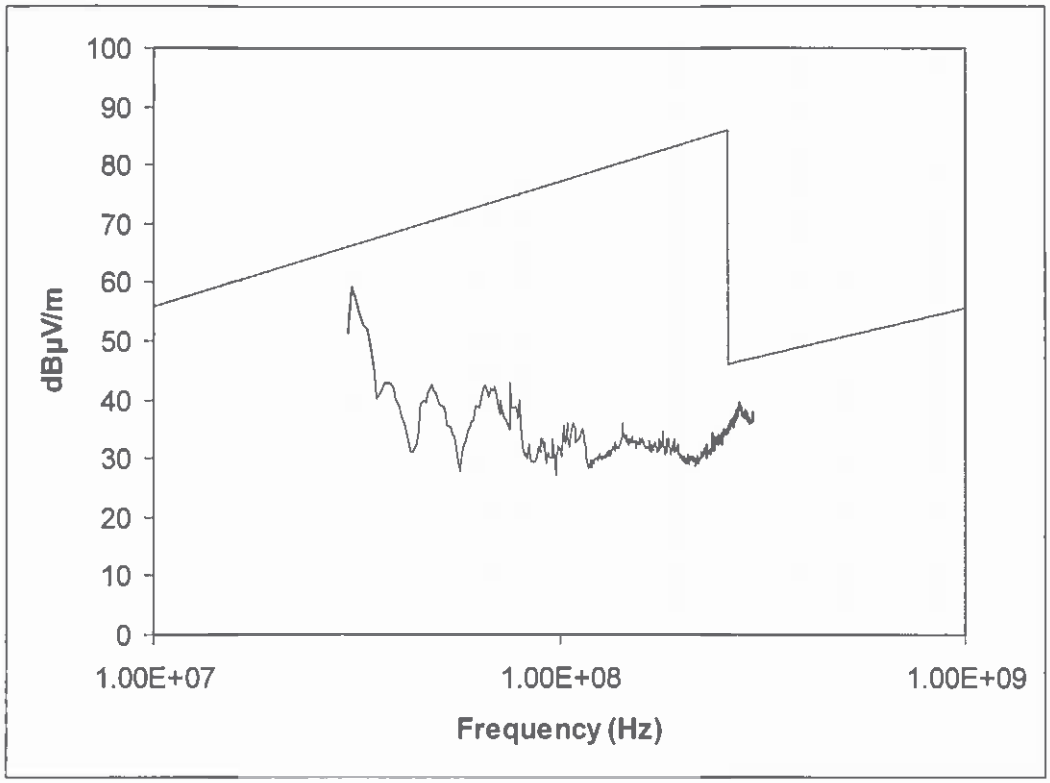


Fig. 11 – 30 MHz ÷ 300 MHz, Full Load, Side A, Cables not shielded, Pol. V

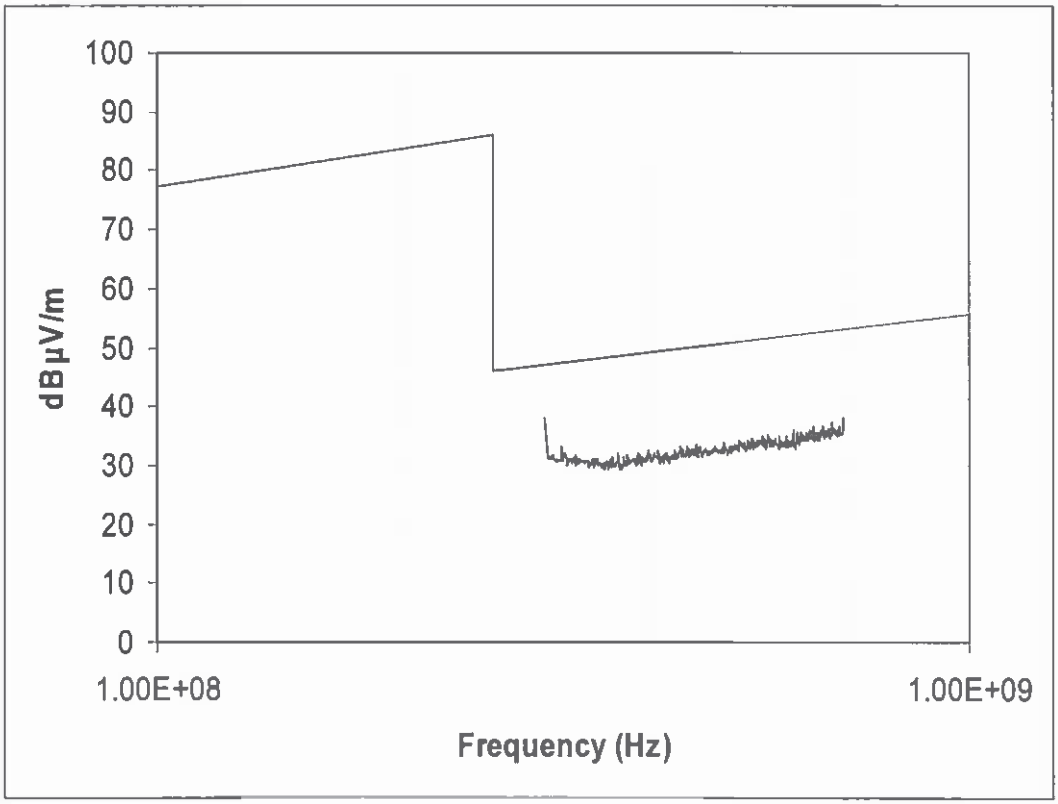


Fig. 12 – 300 MHz ÷ 700 MHz, Noise Floor, Side A, Cables not shielded

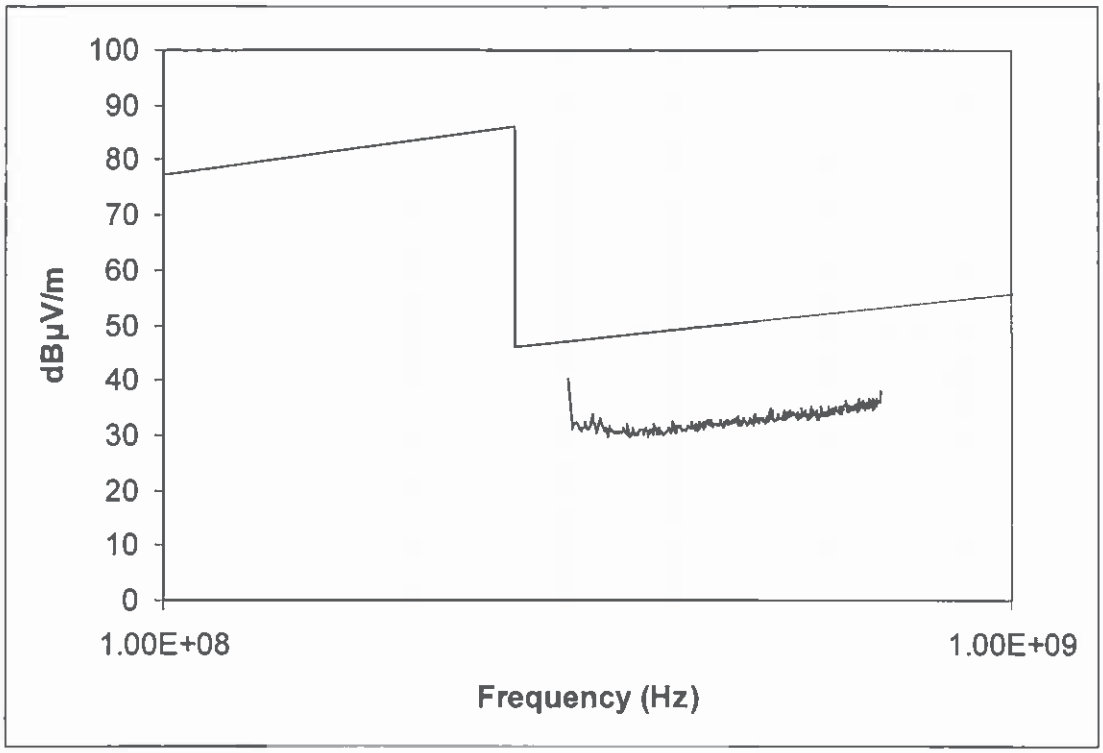


Fig. 13 – 300 MHz ÷ 700 MHz, Full Load, Side A, Cables not shielded, Pol. H

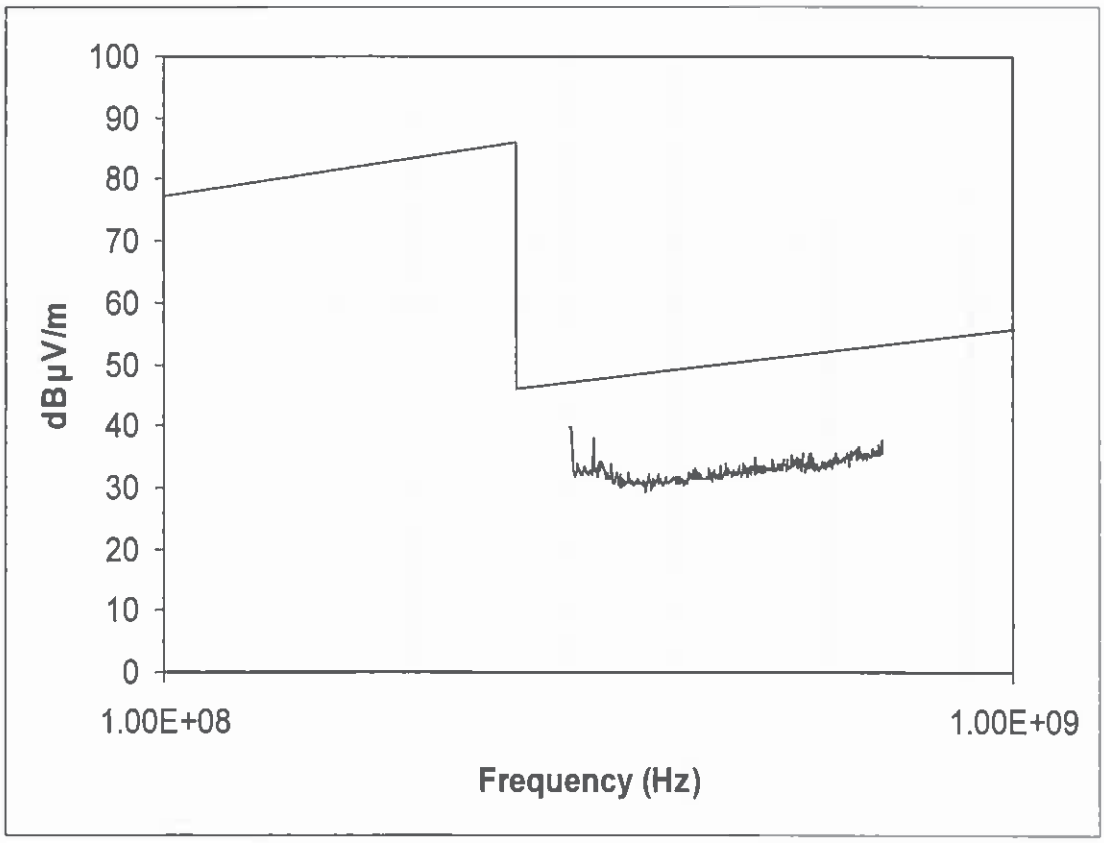


Fig. 14 – 300 MHz ÷ 700 MHz, Full Load, Side A, Cables not shielded, Pol. V

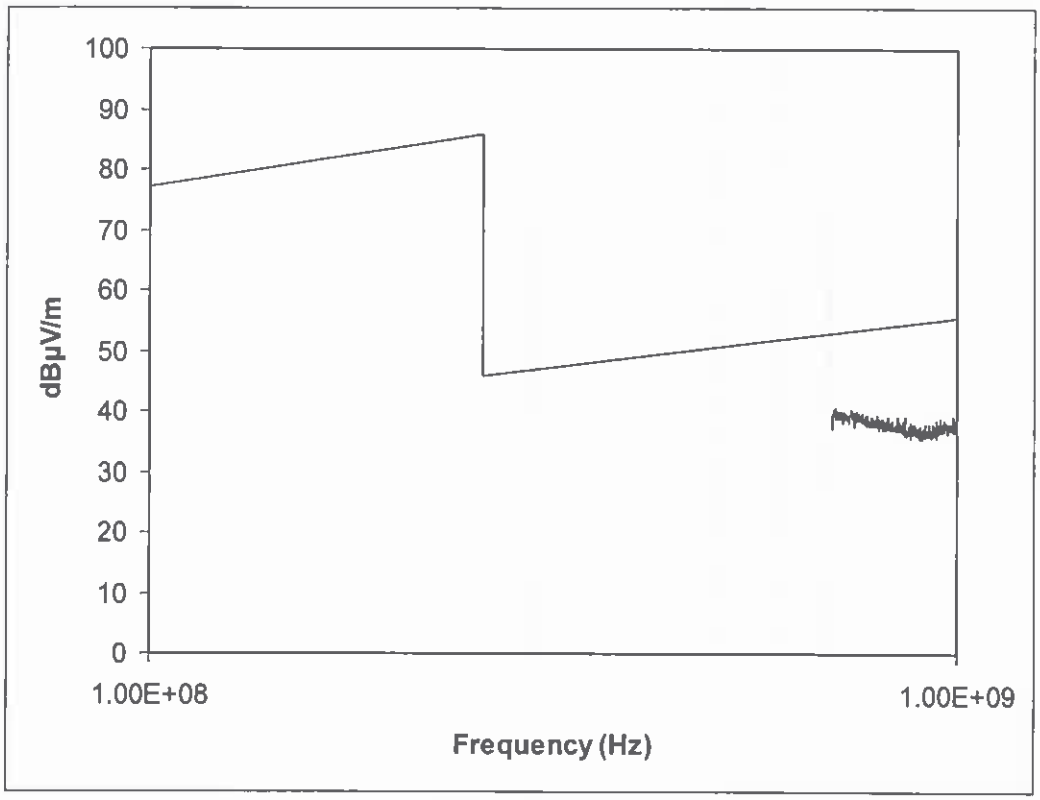


Fig. 15 – 700 MHz ÷ 1 GHz, Noise Floor, Side A, Cables not shielded

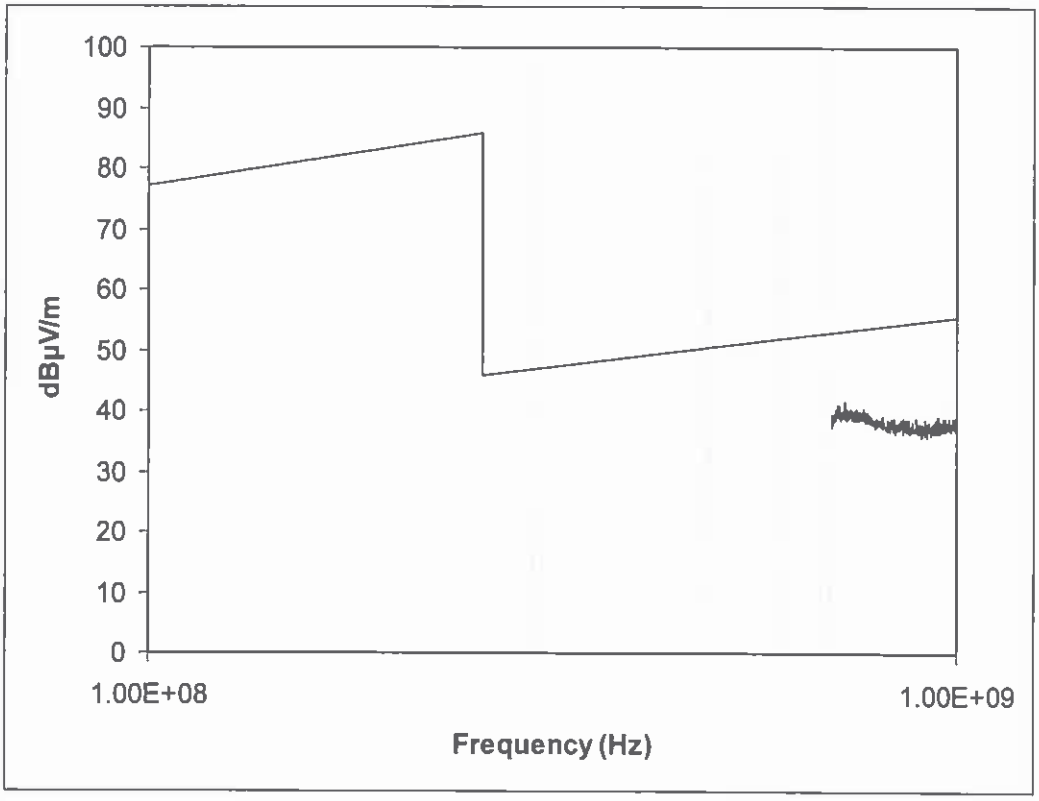


Fig. 16 – 700 MHz ÷ 1 GHz, Full Load, Side A, Cables not shielded, Pol. V

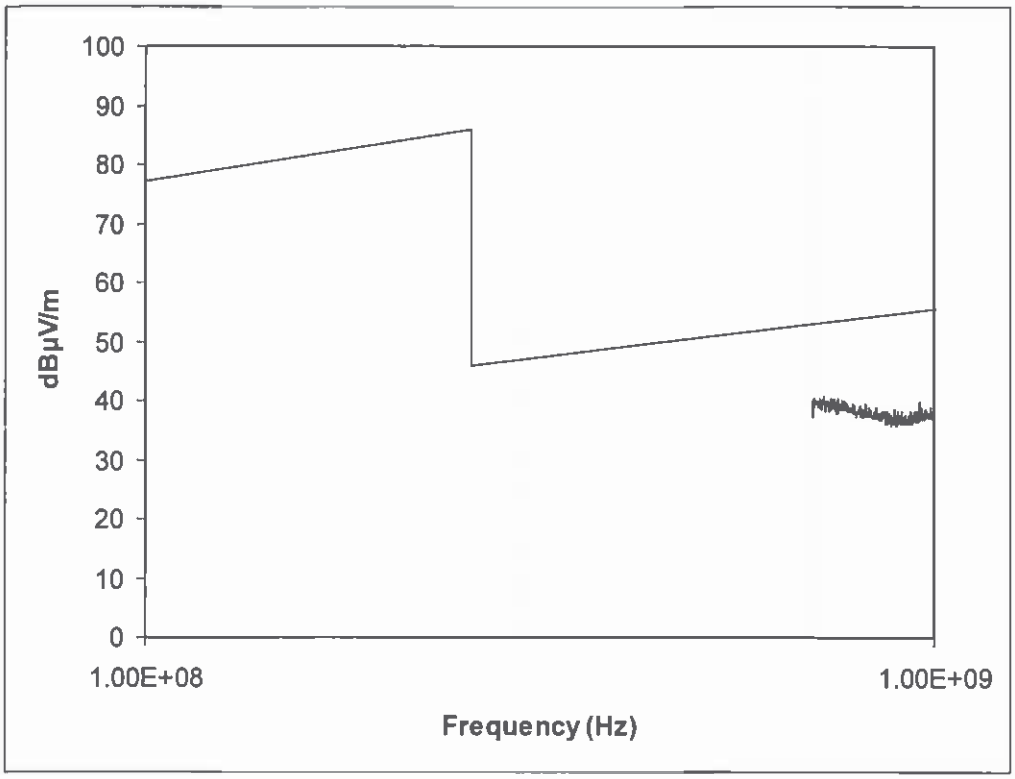


Fig. 17 – 700 MHz ÷ 1 GHz, Full Load, Side A, Cables not shielded, Pol. H

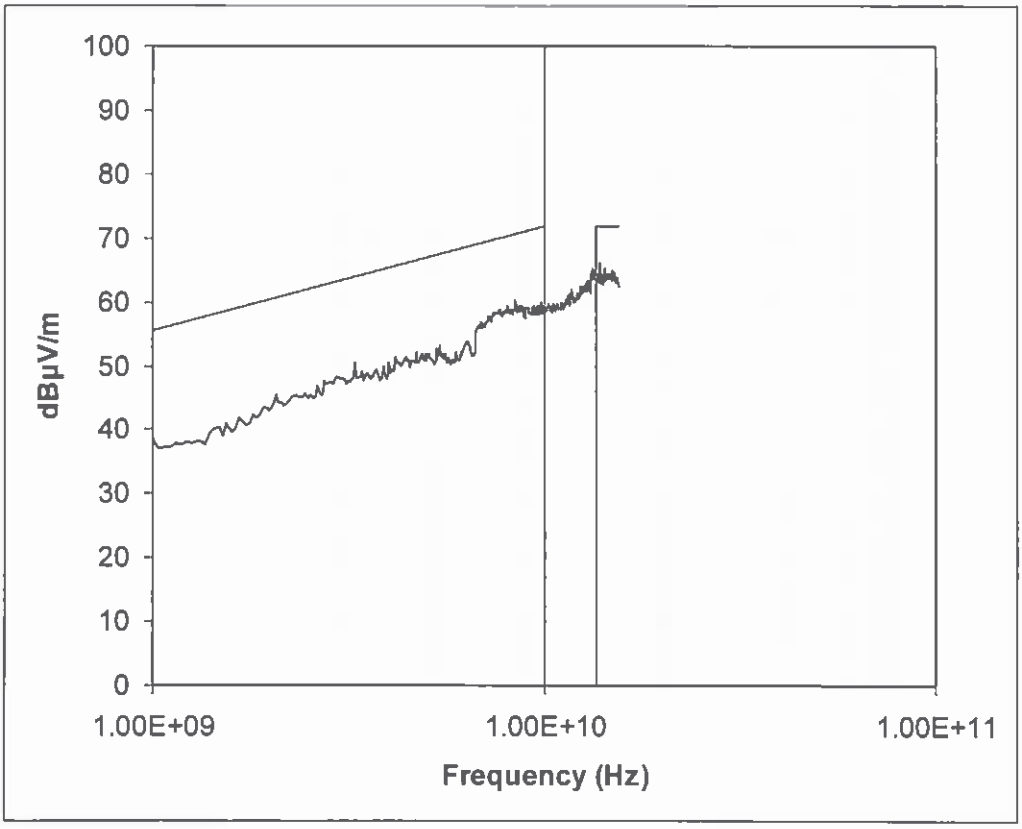


Fig. 18 – 1 GHz ÷ 15.5 GHz, Full Load, Side A, Cables not shielded, Pol. H

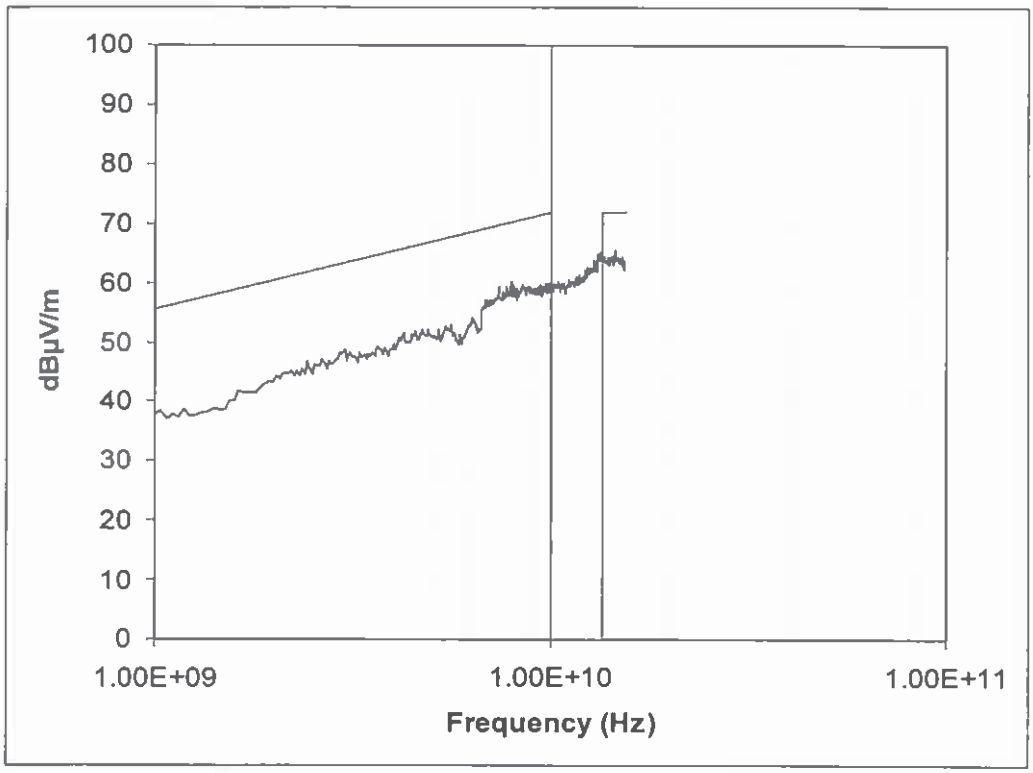


Fig. 19 – 1 GHz ÷ 15.5 GHz, Full Load, Side A, Cables not shielded, Pol. V

Side B:

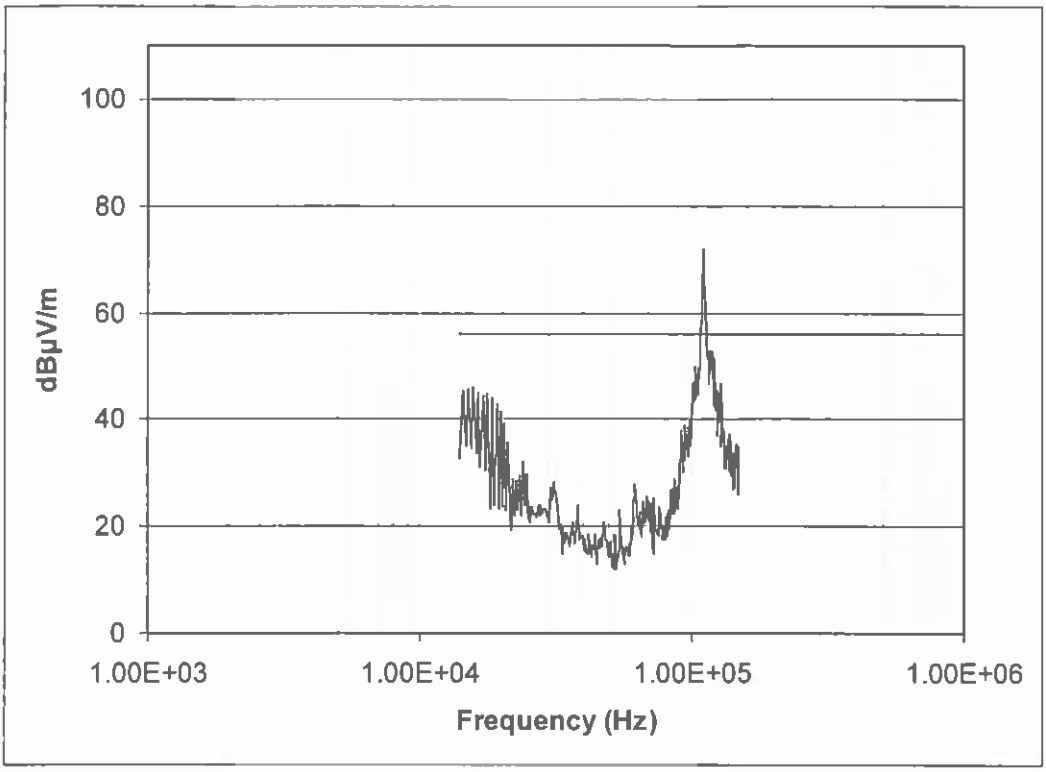


Fig. 20 – 14 KHz ÷ 150 KHz, Noise Floor, Side B, All cables shielded

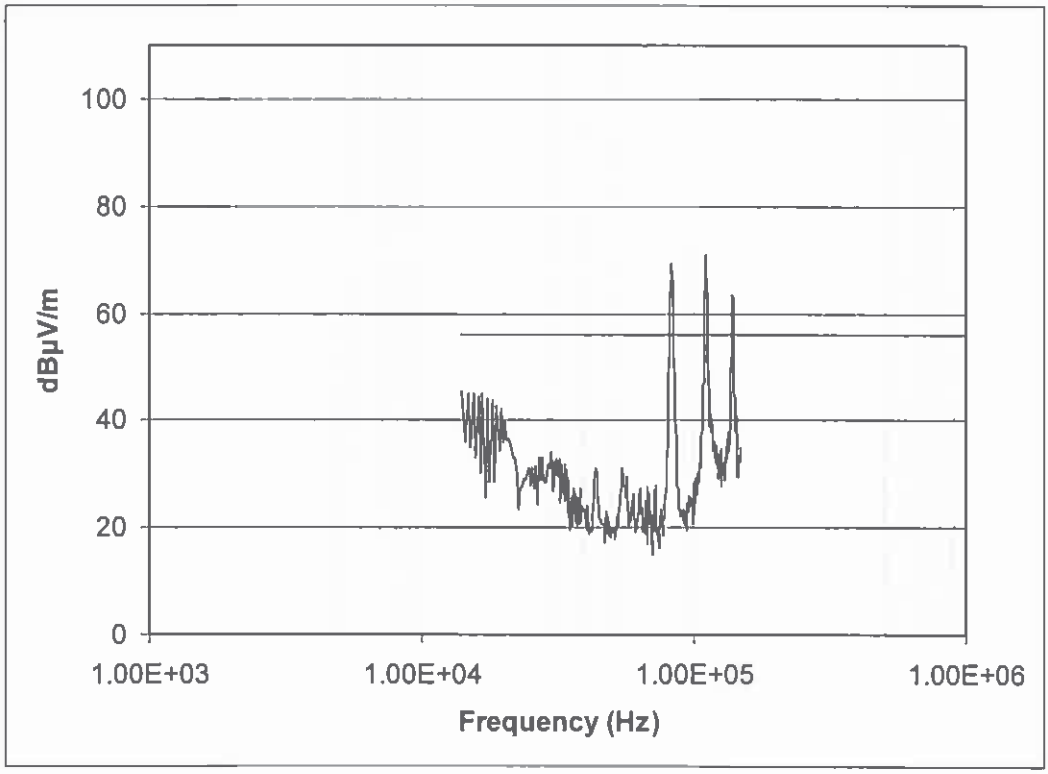


Fig. 21 – 14 KHz ÷ 150 KHz, Full Load, Side B, All cables shielded

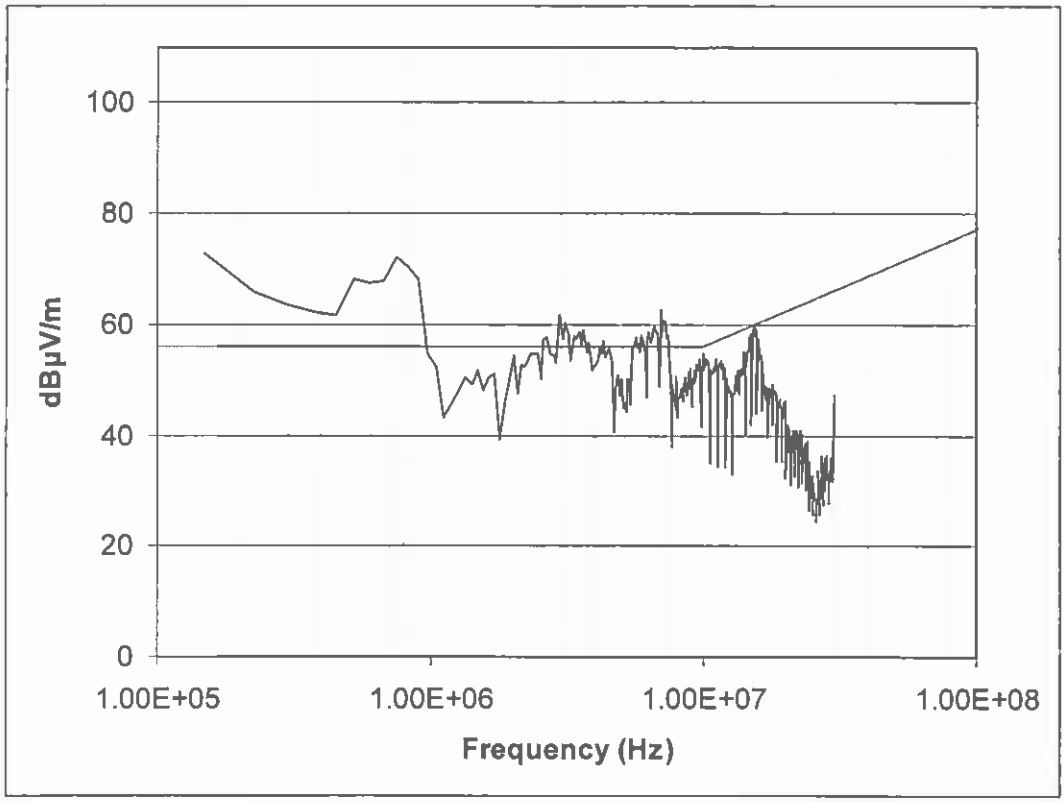


Fig. 22 – 150 KHz ÷ 30 MHz, Noise Floor, Side B, All cables shielded

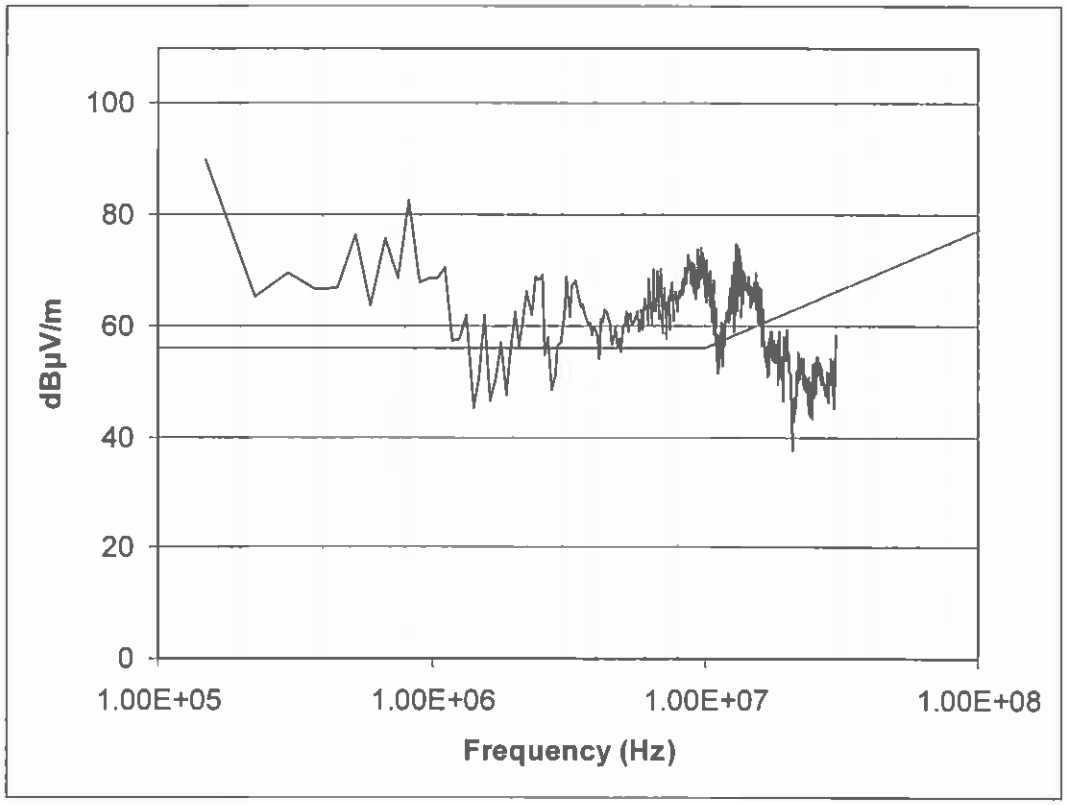


Fig. 23 – 150 KHz ÷ 30 MHz, Full Load, Side B, All cables shielded

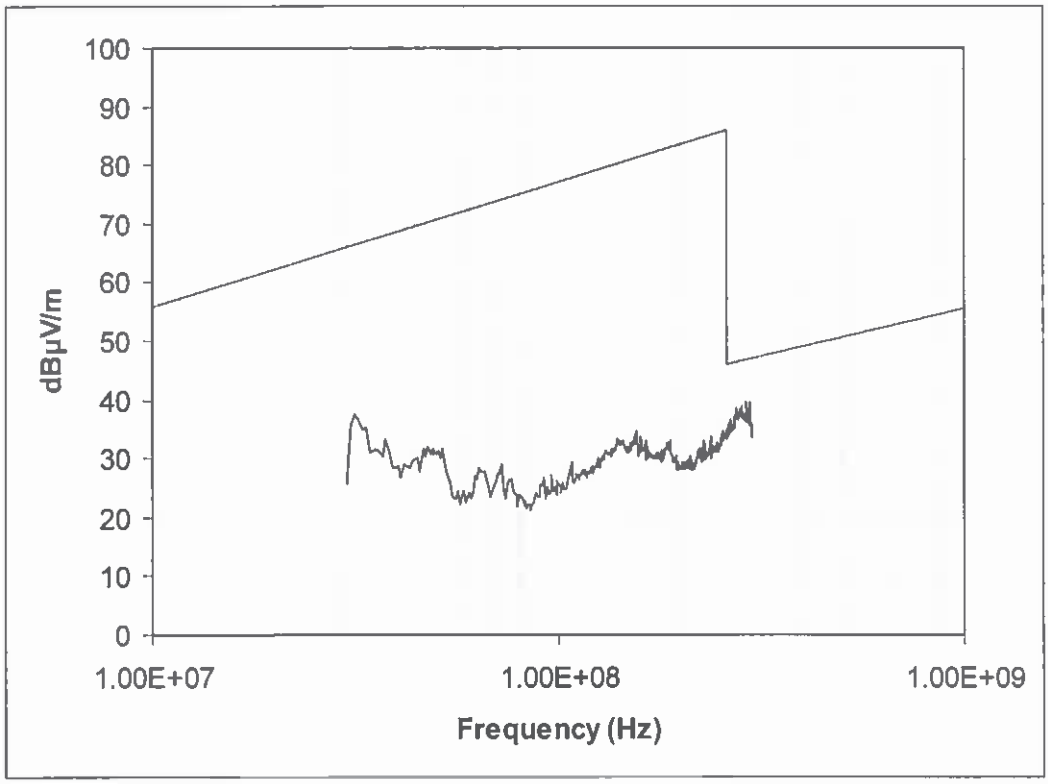


Fig. 24 – 30 MHz ÷ 300 MHz, Full Load, Side B, All cables shielded, Pol. H

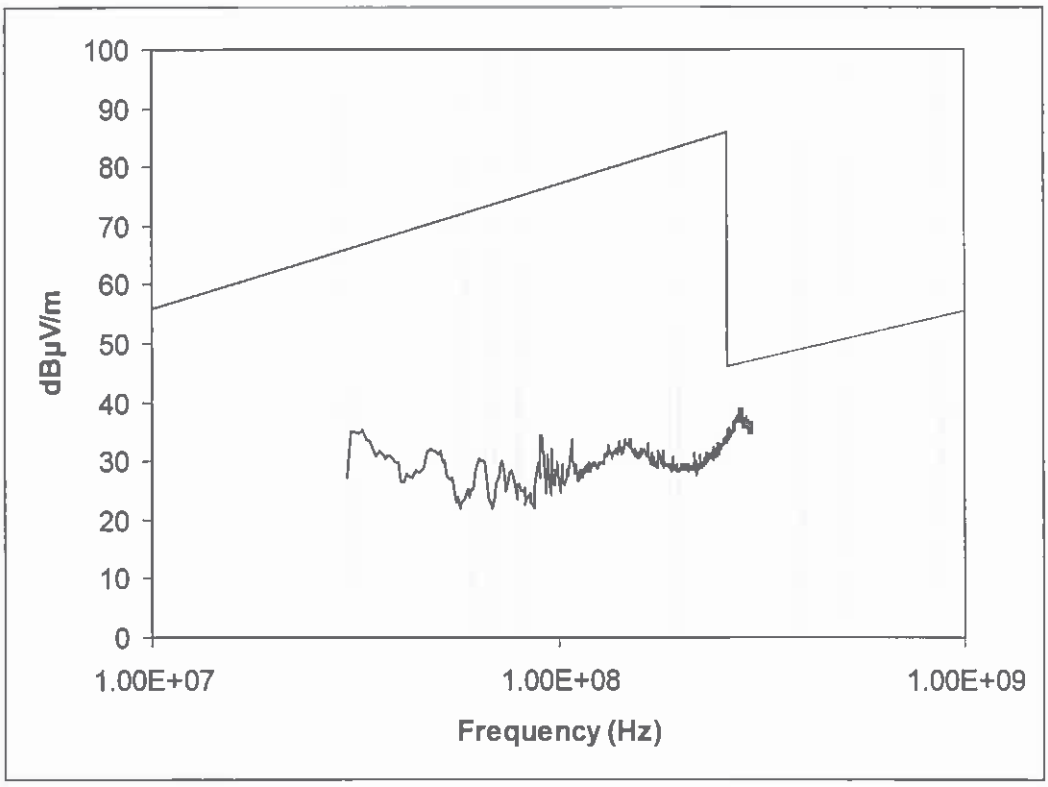


Fig. 25 – 30 MHz ÷ 300 MHz, Full Load, Side B, All cables shielded, Pol. V

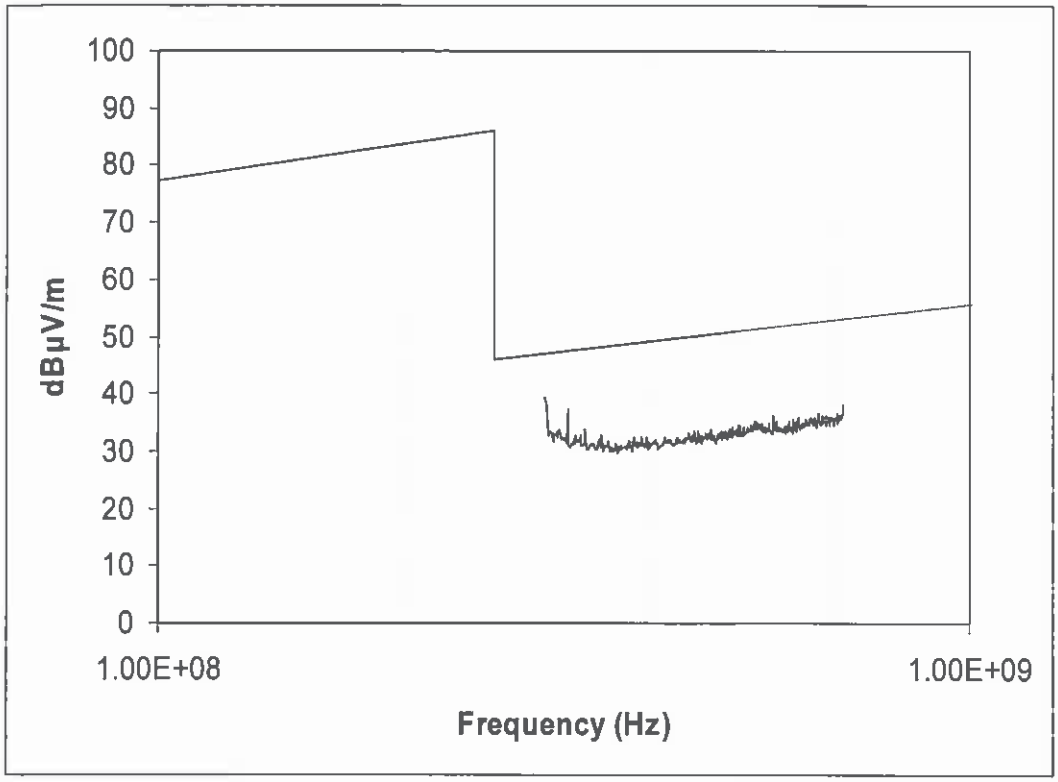


Fig. 26 – 300 MHz ÷ 700 MHz, Full Load, Side B, All cables shielded, Pol. H

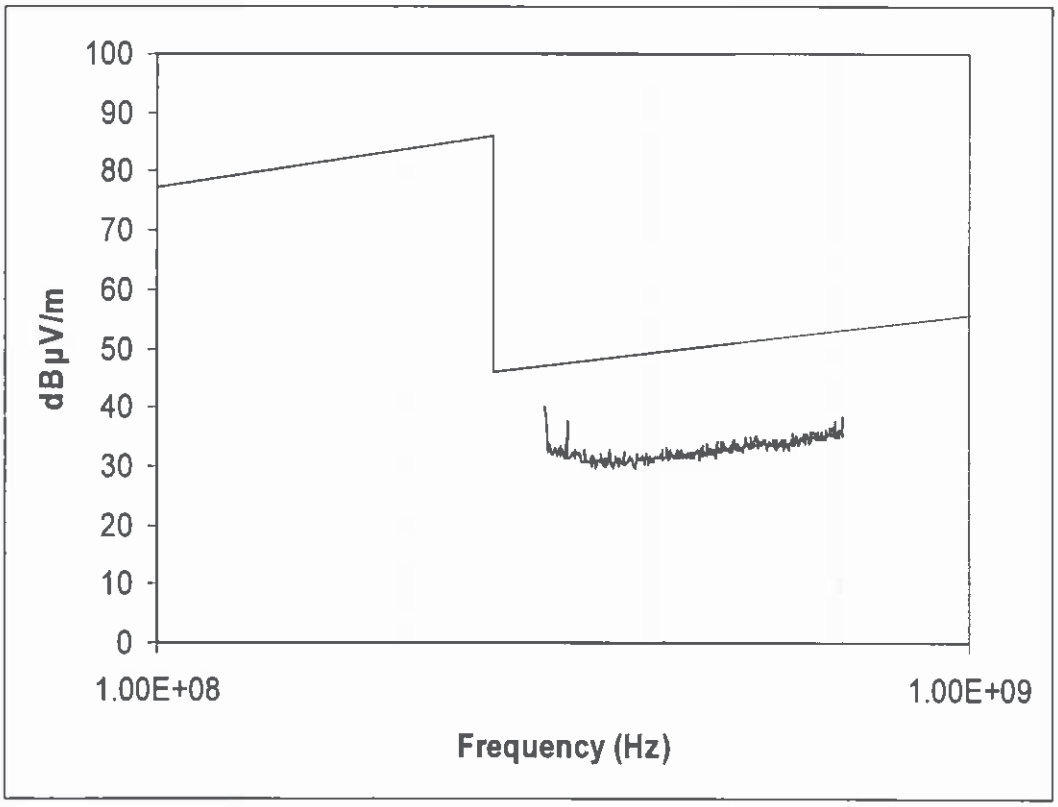


Fig. 27 – 300 MHz ÷ 700 MHz, Full Load, Side B, All cables shielded, Pol. V

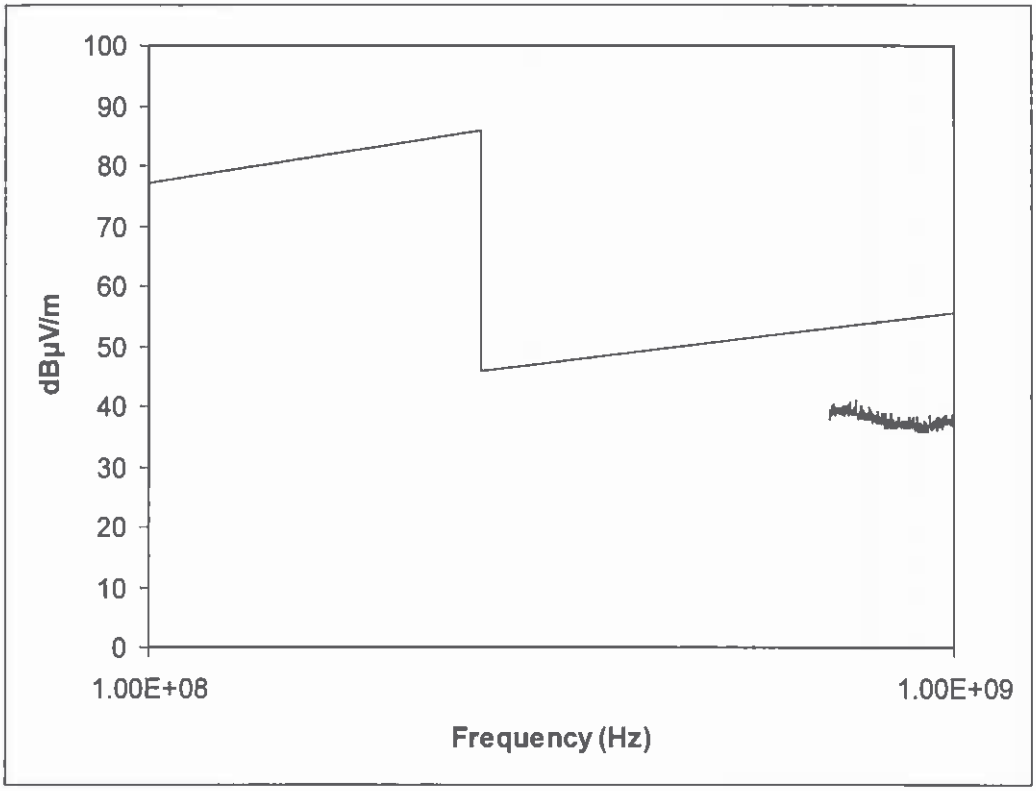


Fig. 28 – 700 MHz ÷ 1 GHz, Full Load, Side B, All cables shielded, Pol. V

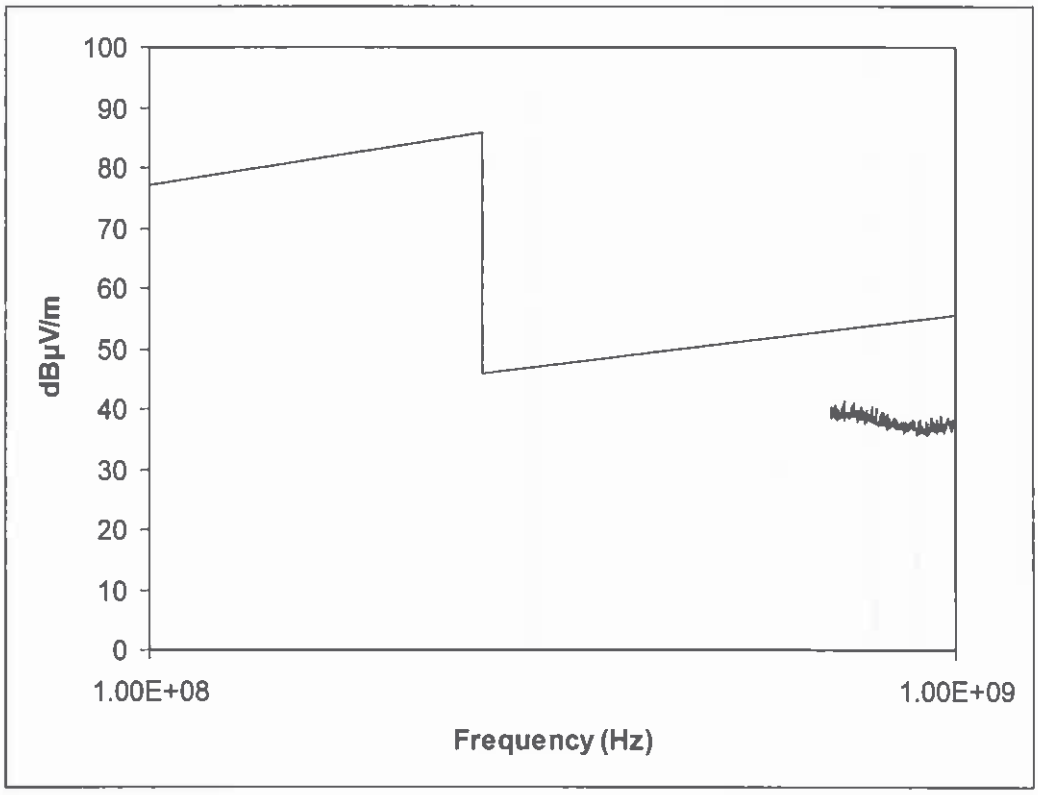


Fig. 29 – 700 MHz ÷ 1 GHz, Full Load, Side B, All cables shielded, Pol. H

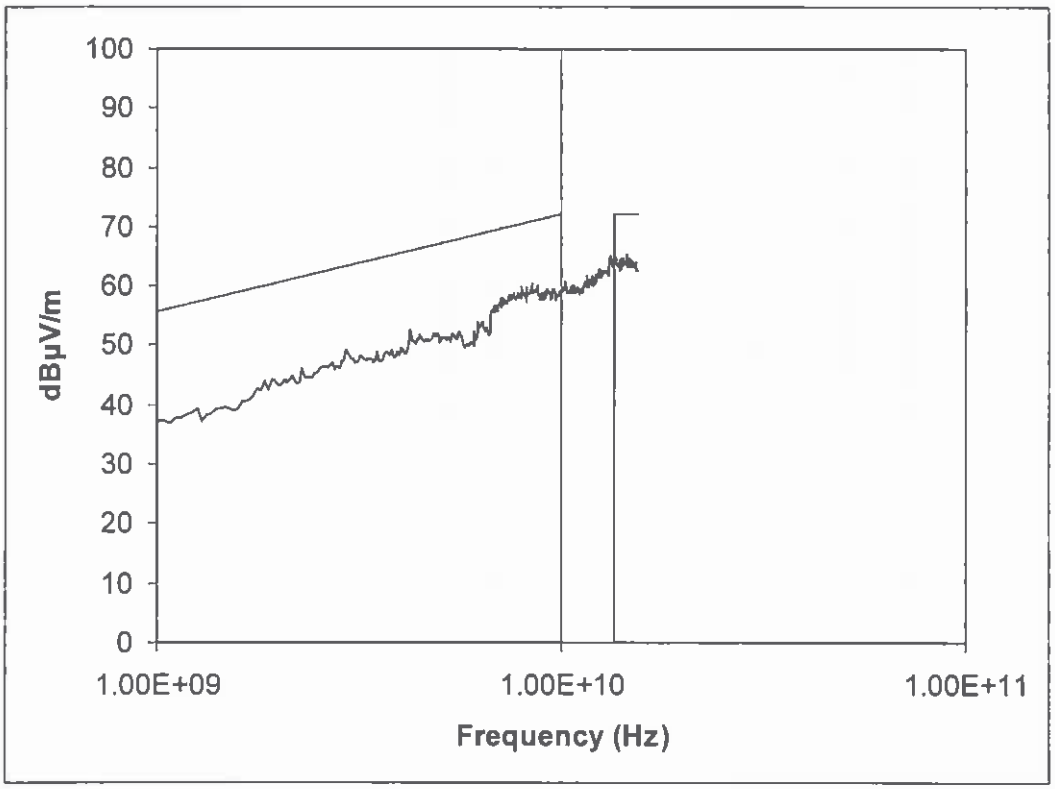


Fig. 30 – 1 GHz ÷ 15.5 GHz, Full Load, Side B, All cables shielded, Pol. H

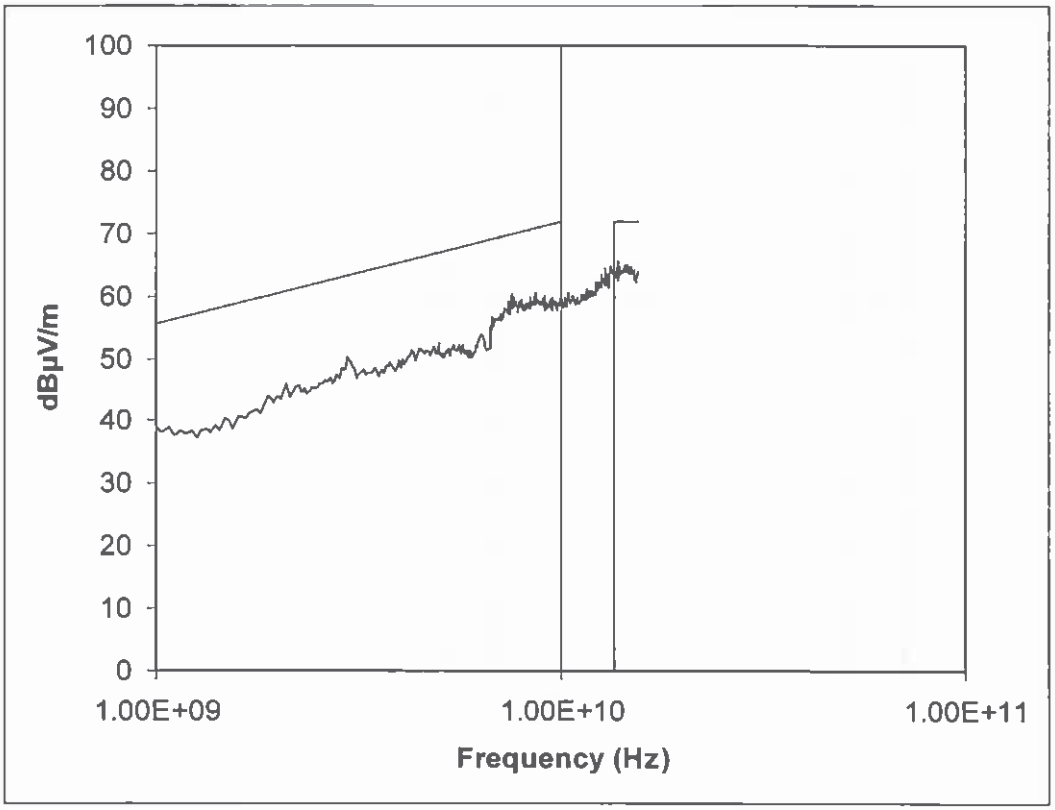


Fig. 31 – 1 GHz ÷ 15.5 GHz, Full Load, Side B, All cables shielded, Pol. V

Attachment C

RESULTS OF CONDUCTED EMISSION TEST

The following images show the Conducted Emission Test Result.

- Side A:

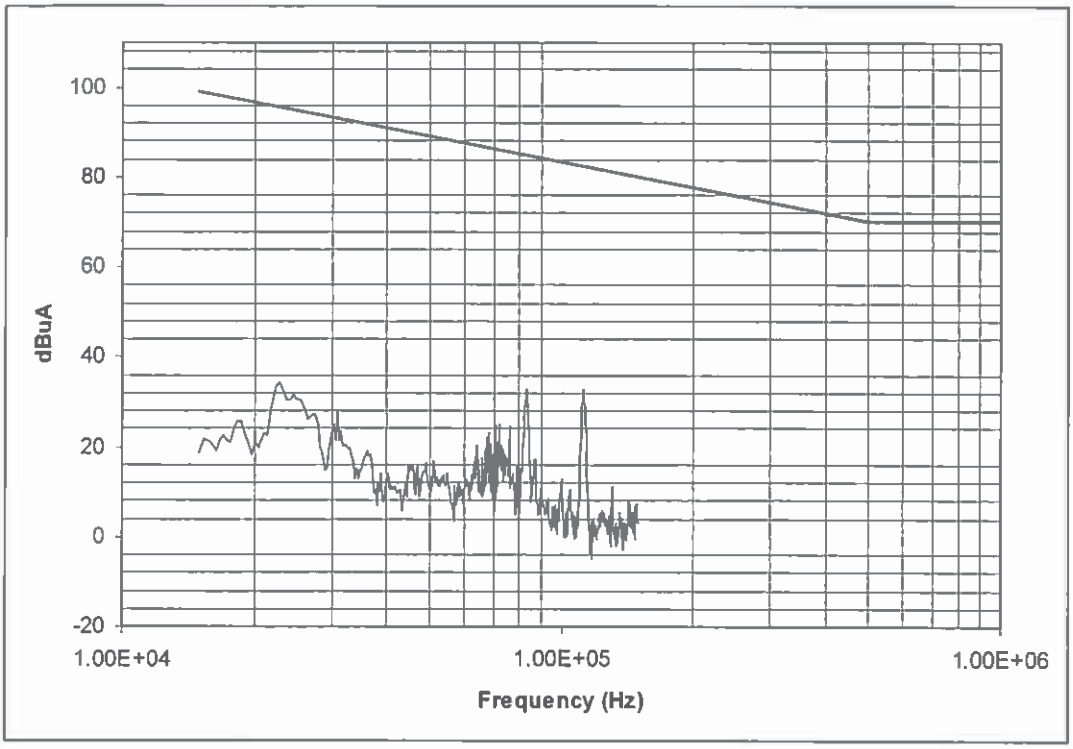


Fig. 1 – 15 KHz – 150 KHz, Side A, Positive, Full Load

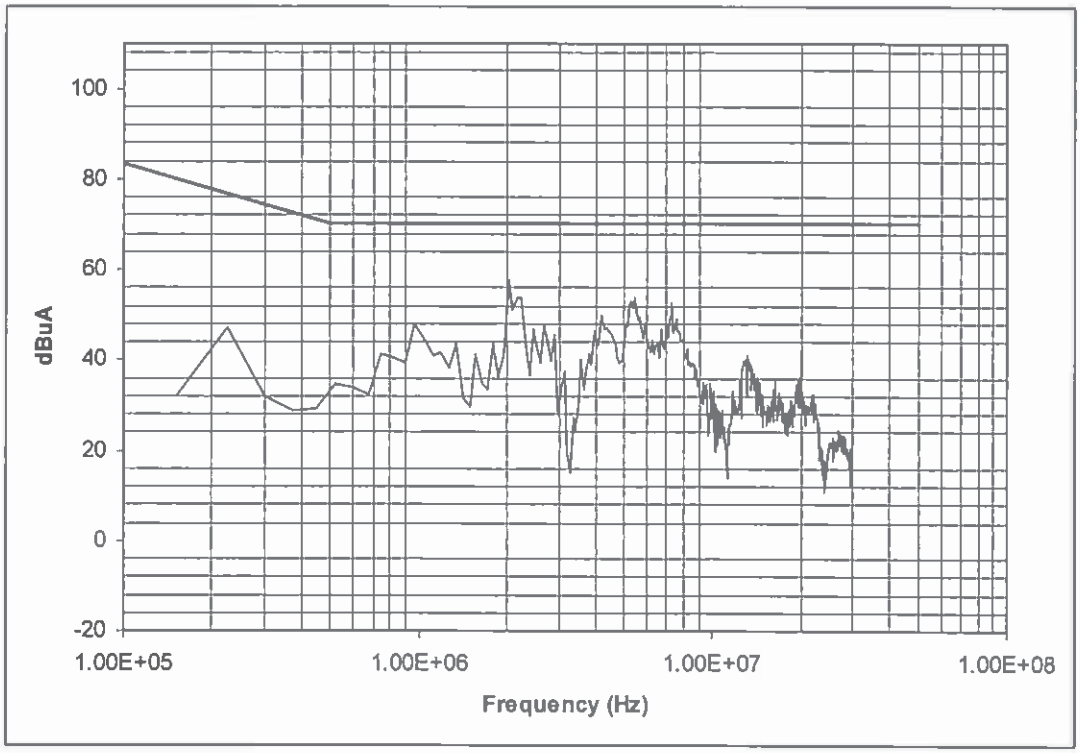


Fig. 2 – 150 KHz – 30 MHz, Side A, Positive, Full Load

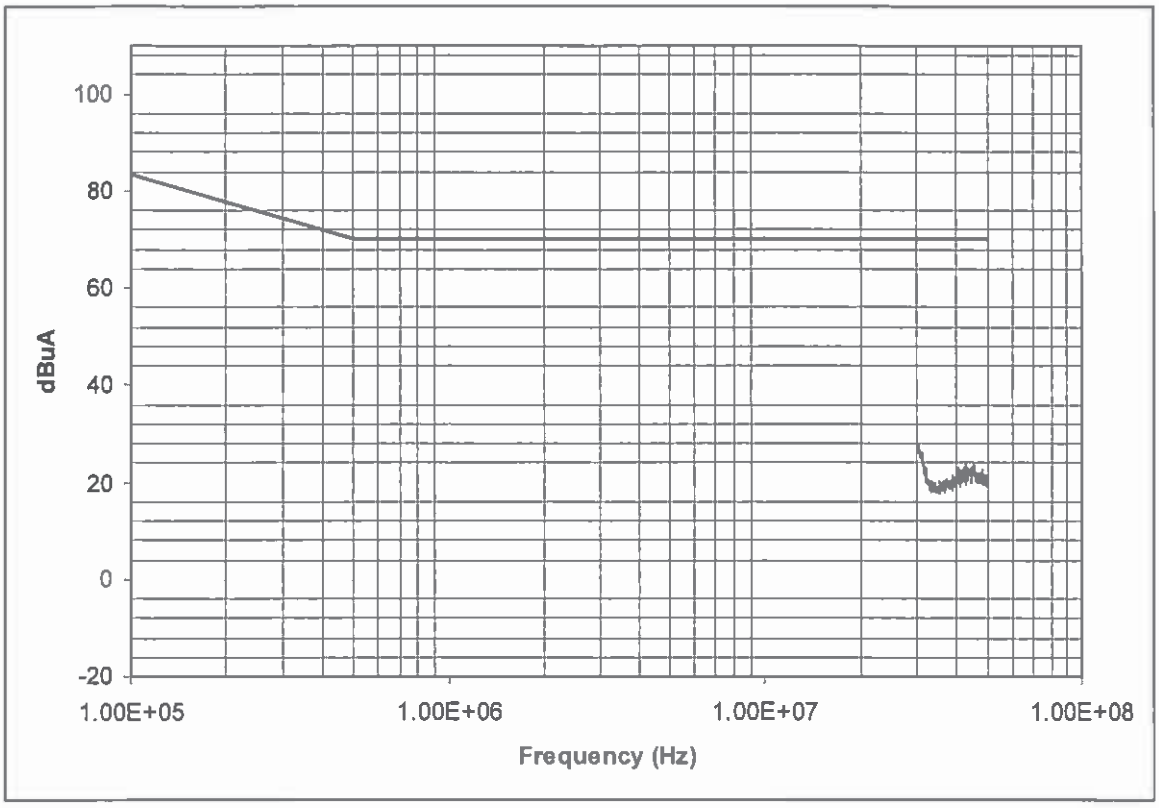


Fig. 3 – 30 MHz – 50 MHz, Side A, Positive, Full Load

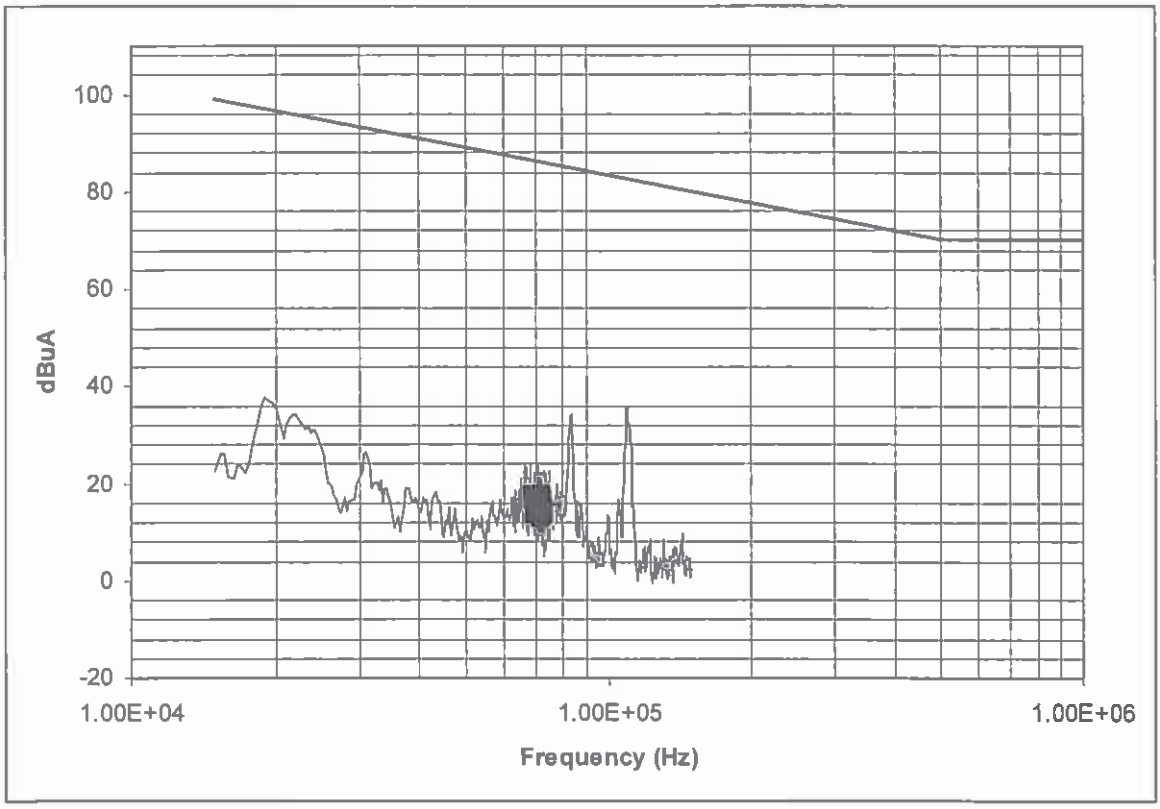


Fig. 4 – 15 KHz – 150 KHz, Side A, Return, Full Load

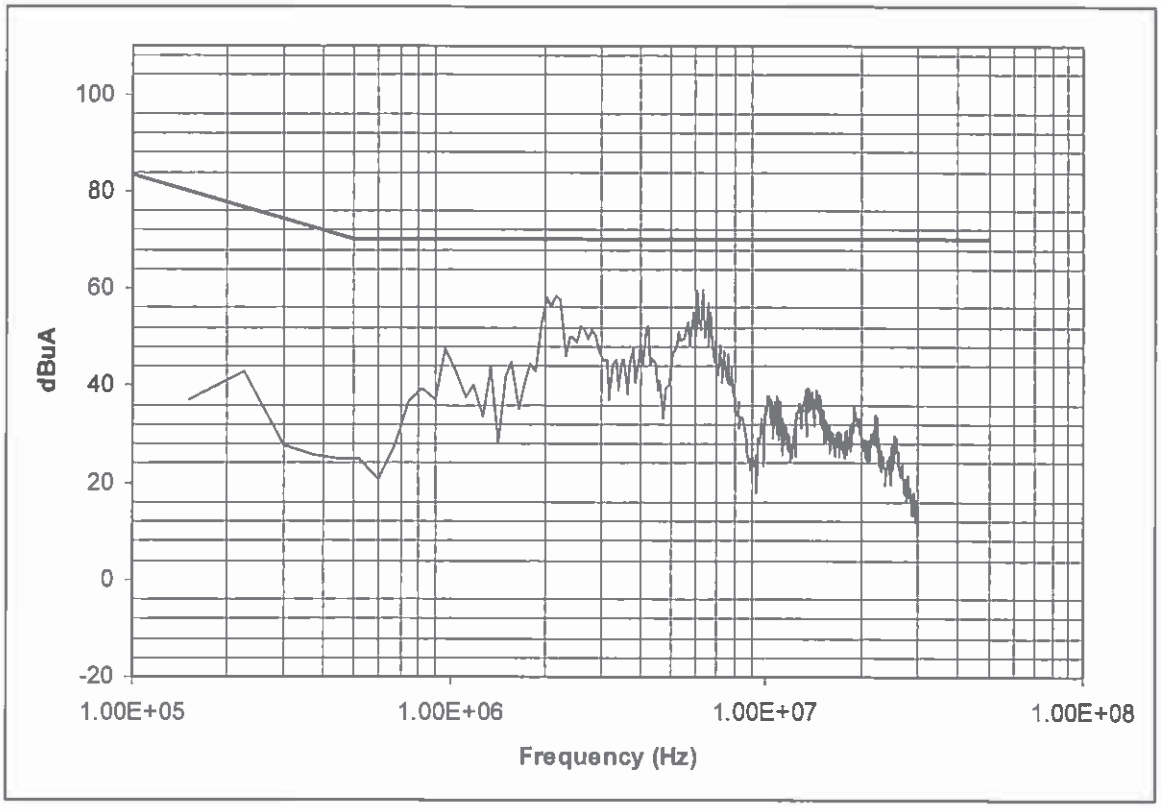


Fig. 5 – 150 KHz – 30 MHz, Side A, Return, Full Load

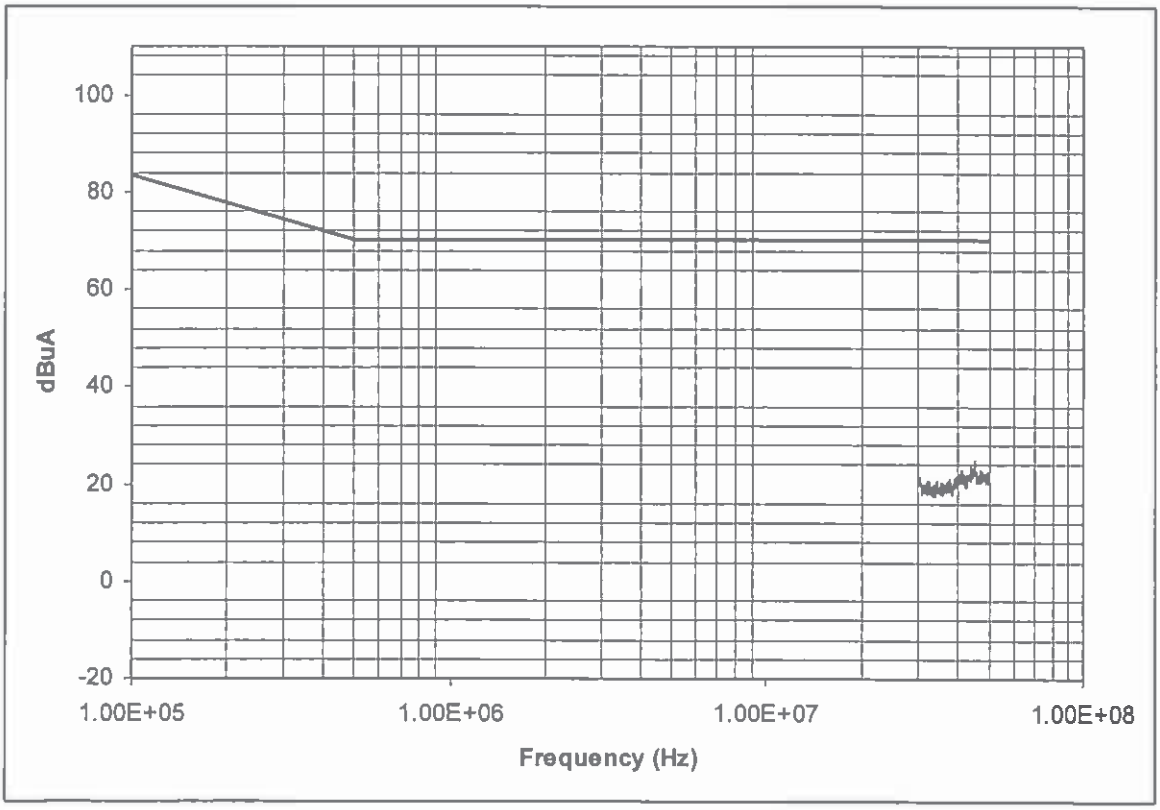


Fig. 6 – 30 MHz – 50 MHz, Side A, Return, Full Load

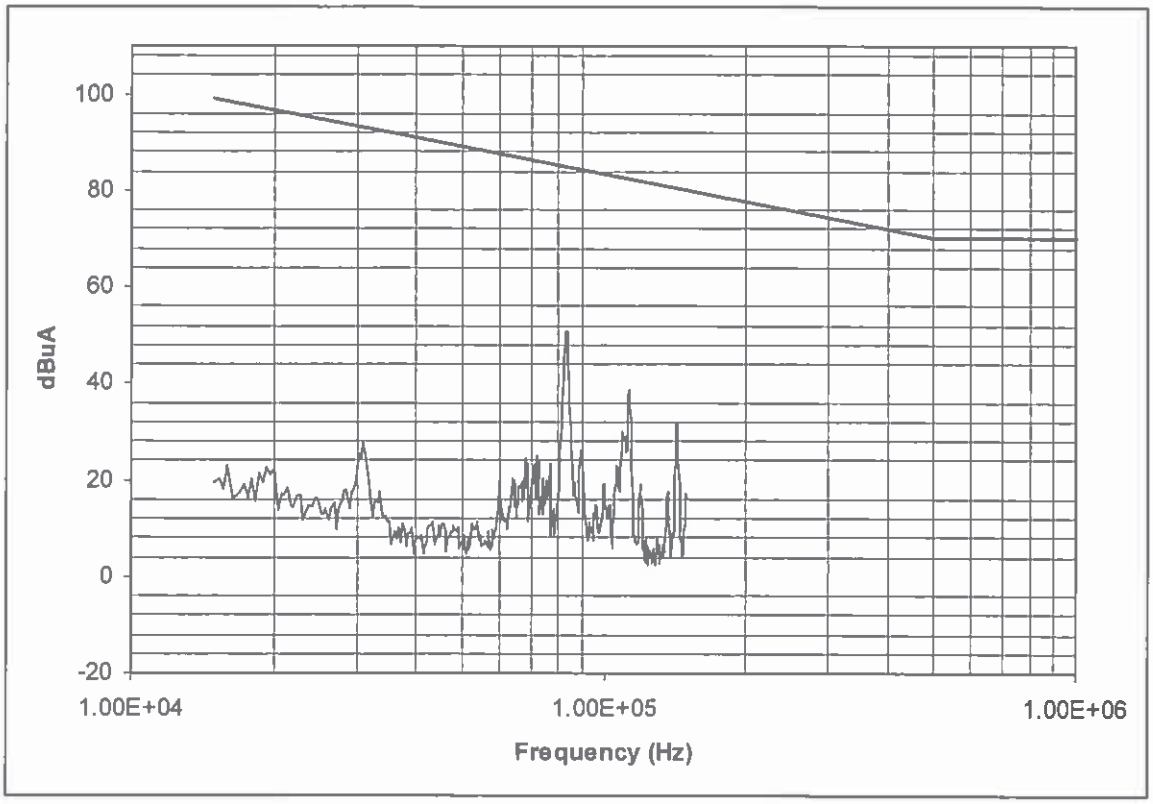


Fig. 7 – 15 KHz – 150 KHz, Side A, Common Mode, Full Load

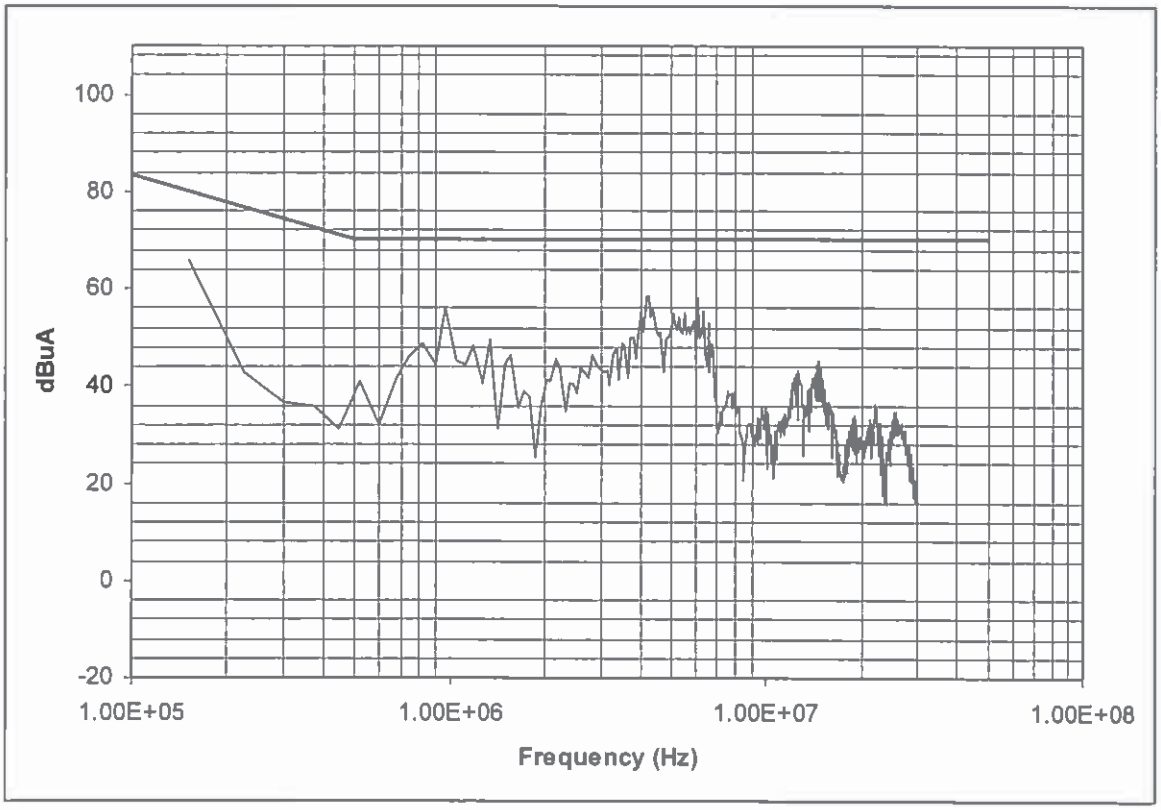


Fig. 8 – 150 KHz – 30 MHz, Side A, Common Mode, Full Load

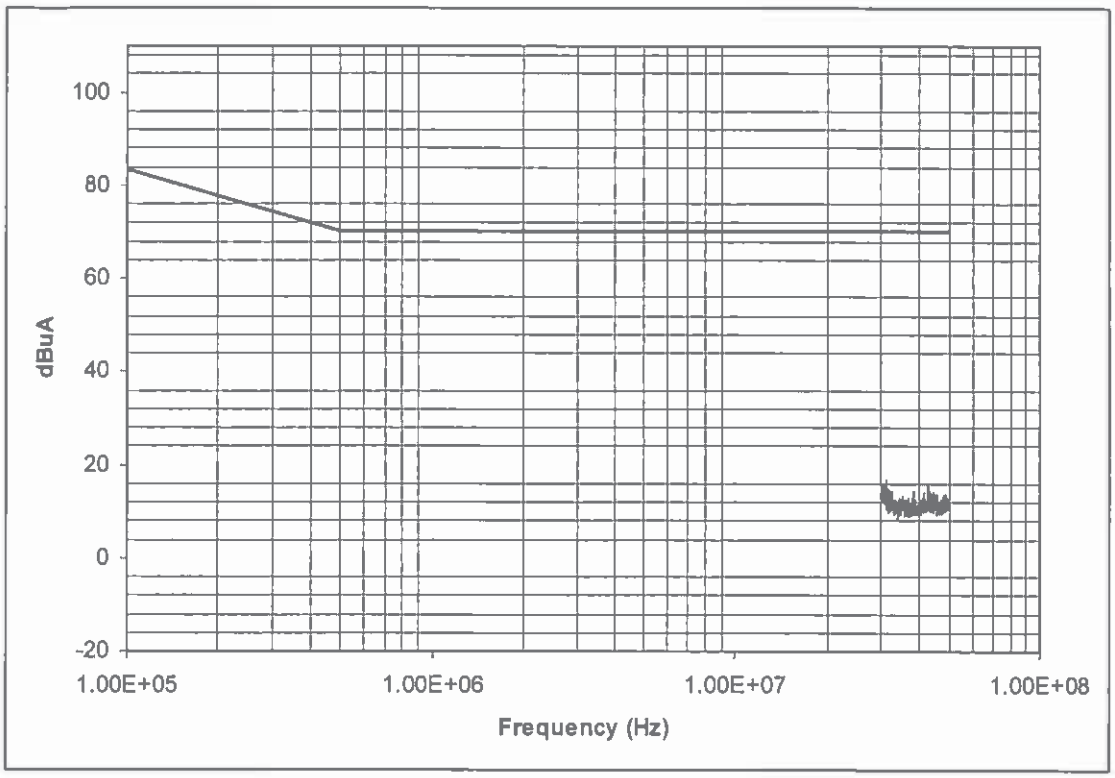


Fig. 9 – 30 MHz – 50 MHz, Side A, Common Mode, Full Load

- Side B:

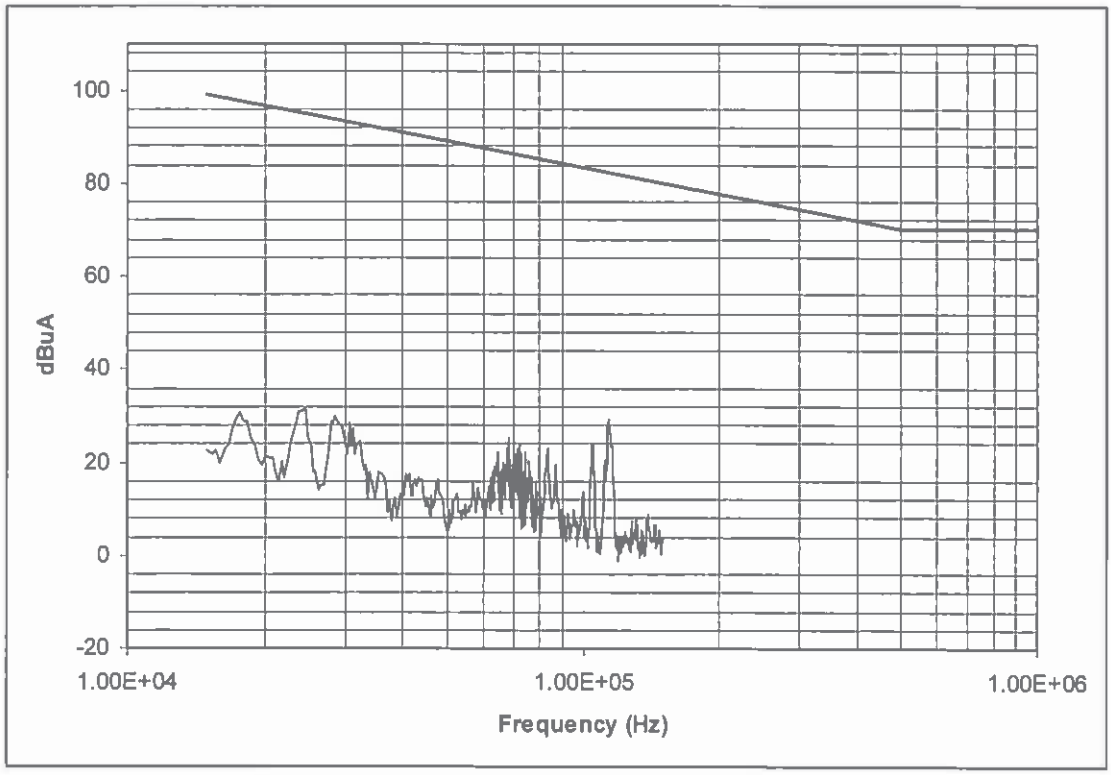


Fig. 10 – 15 KHz – 150 KHz, Side B, Positive, Full Load

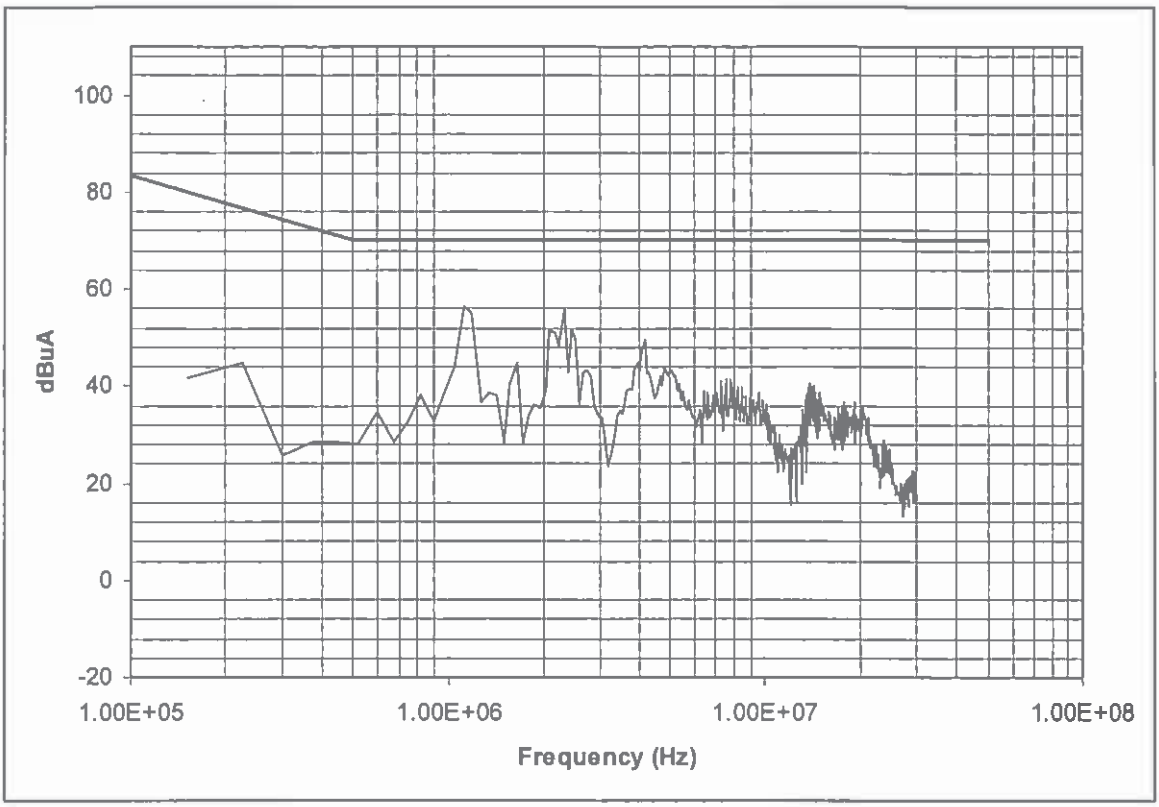


Fig. 11 – 150 KHz – 30 MHz, Side B, Positive, Full Load

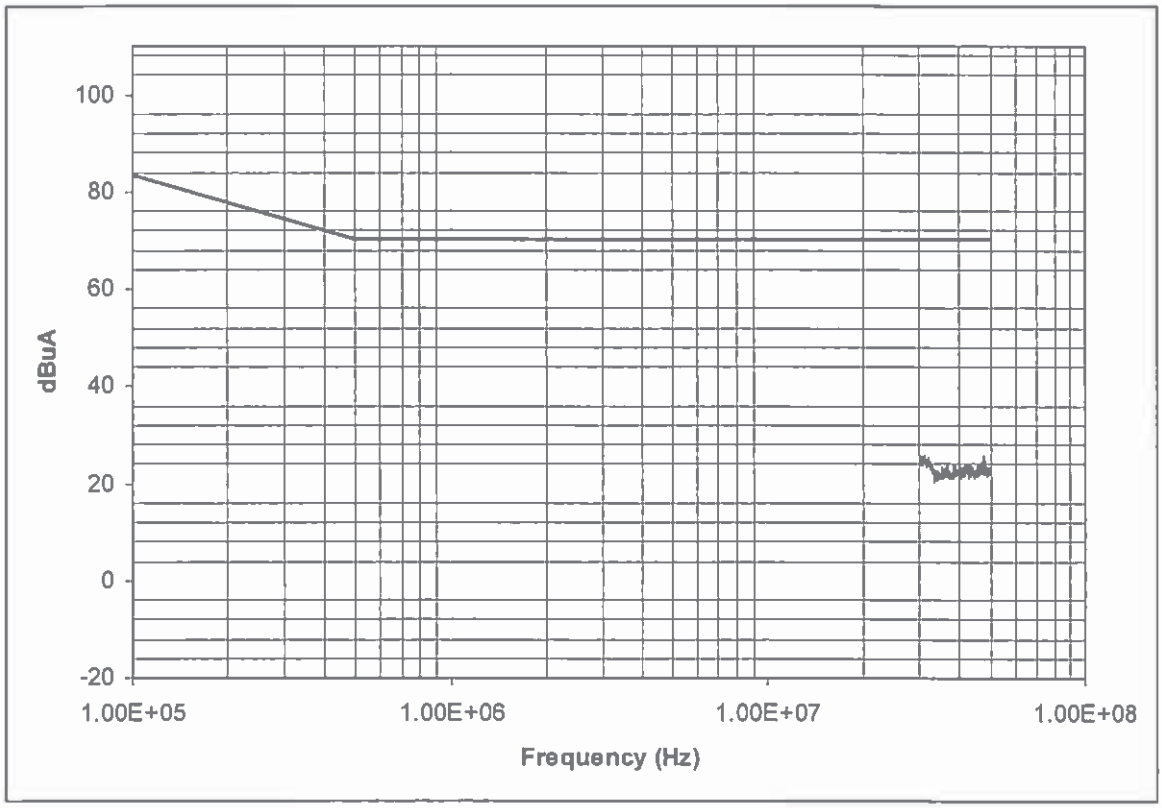


Fig. 12 – 30 MHz – 50 MHz, Side B, Positive, Full Load

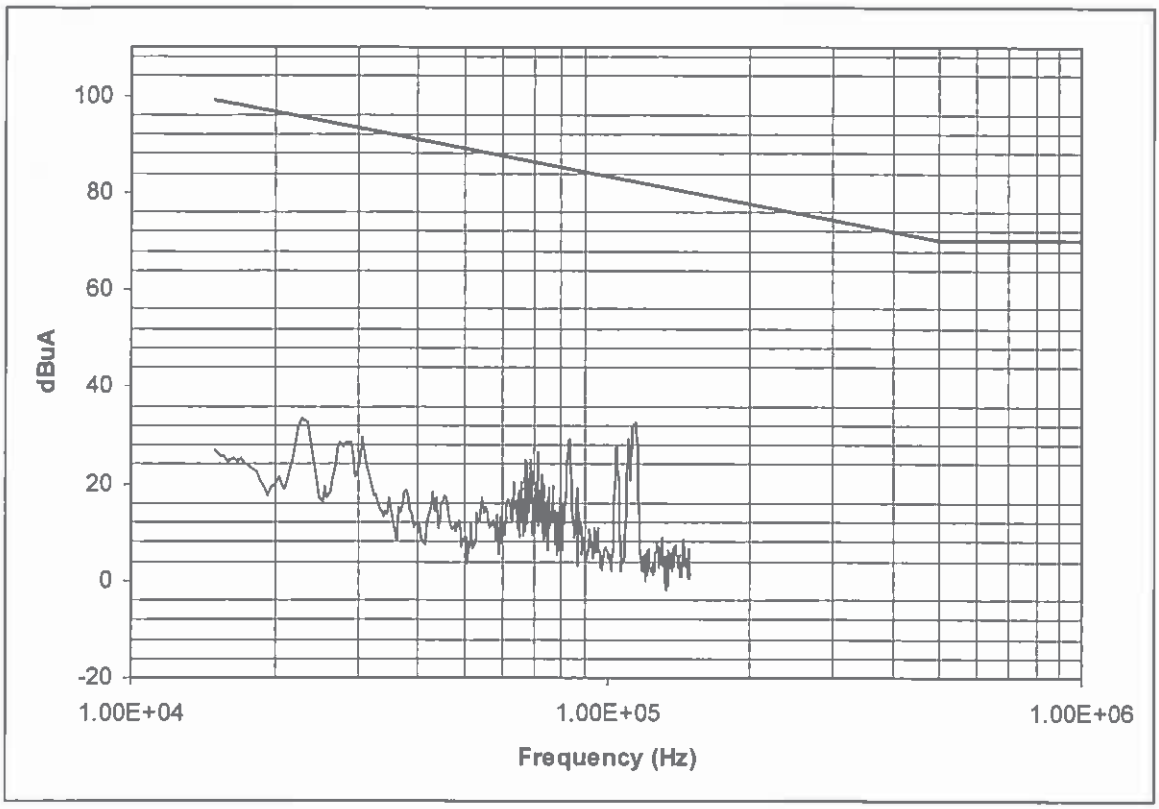


Fig. 13 – 15 KHz – 150 KHz, Side B, Return, Full Load

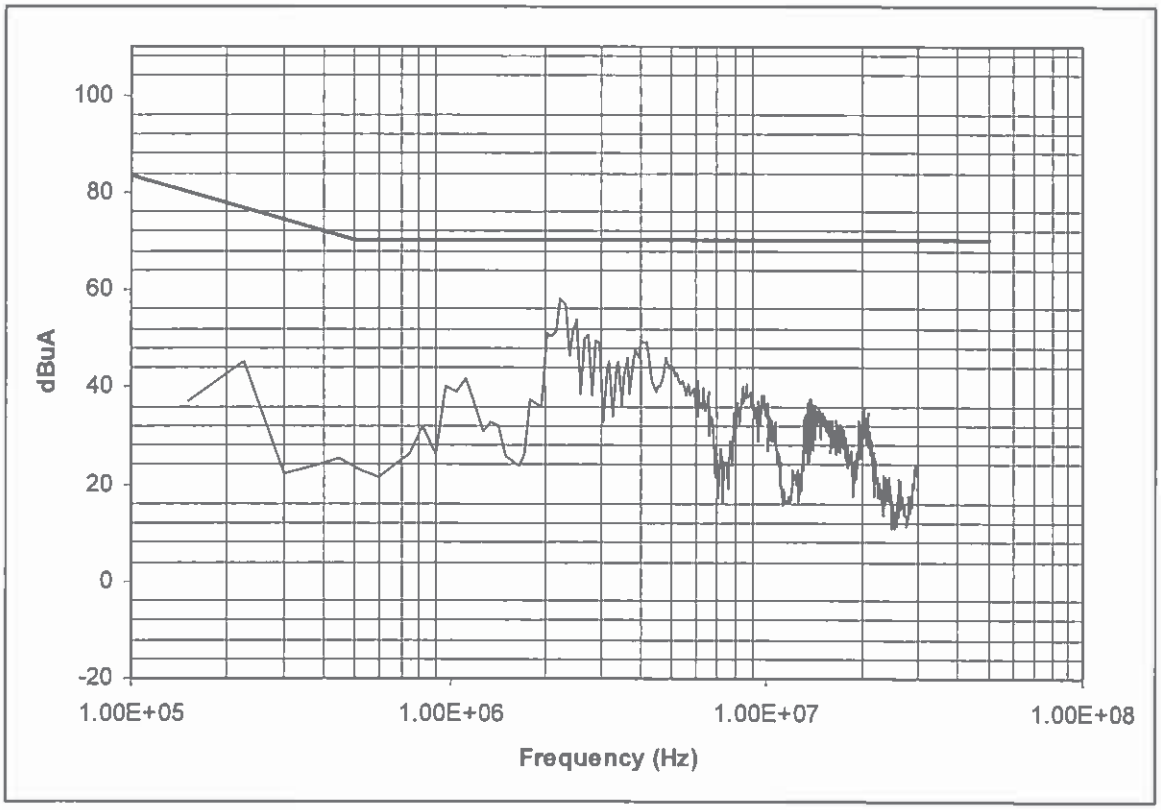


Fig. 14 – 150 KHz – 30 MHz, Side B, Return, Full Load

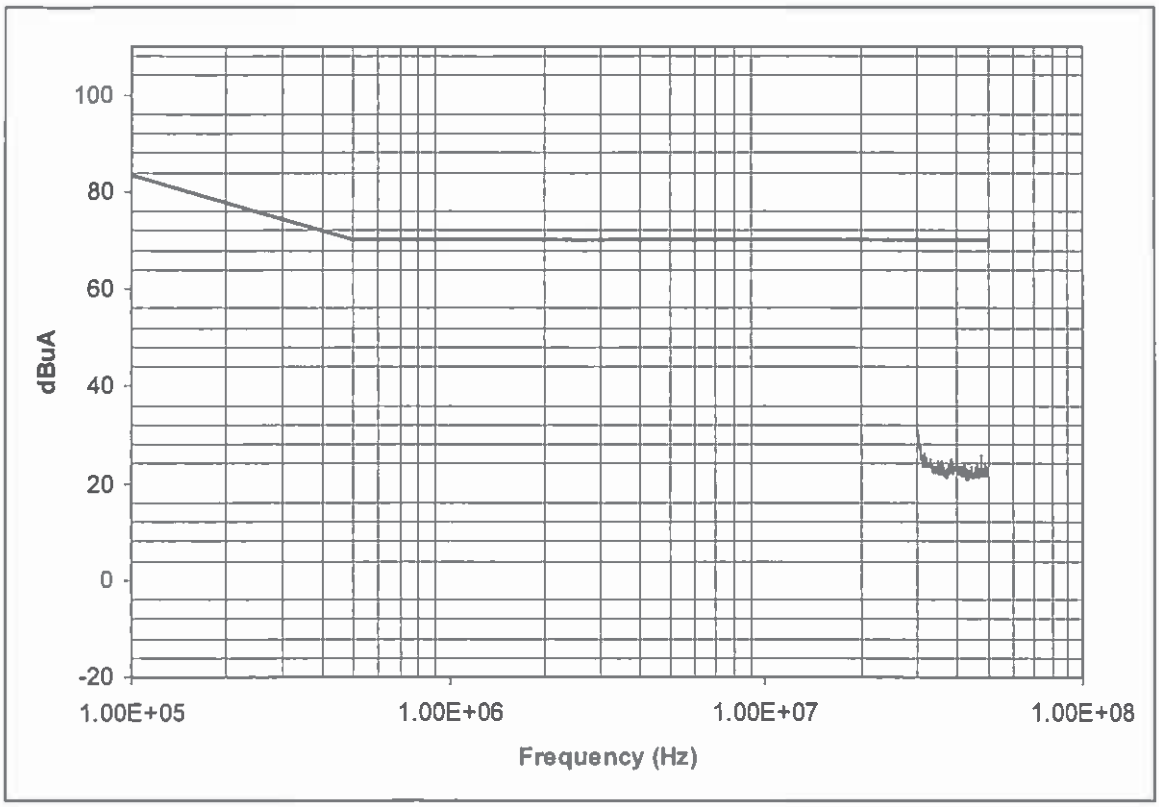


Fig. 15 – 30 MHz – 50 MHz, Side B, Return, Full Load

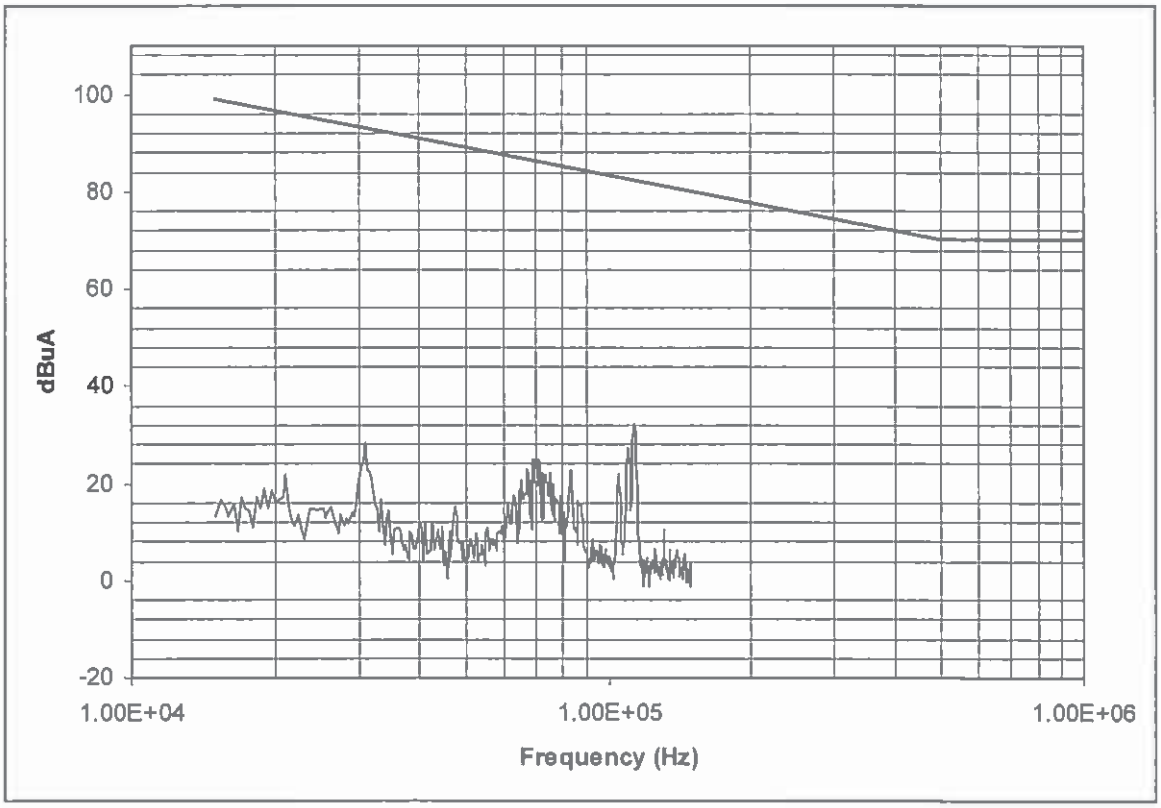


Fig. 16 – 15 KHz – 150 KHz, Side B, Common Mode, Full Load

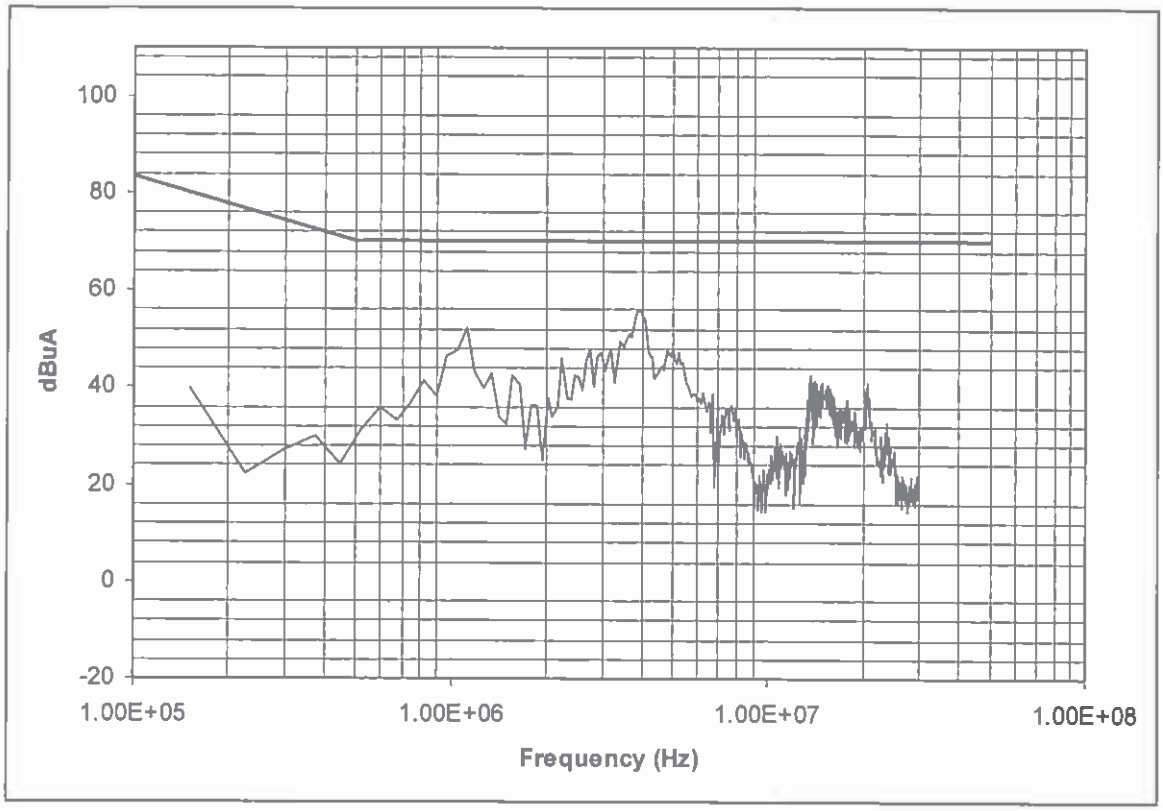


Fig. 17 – 150 KHz – 30 MHz, Side B, Common Mode, Full Load

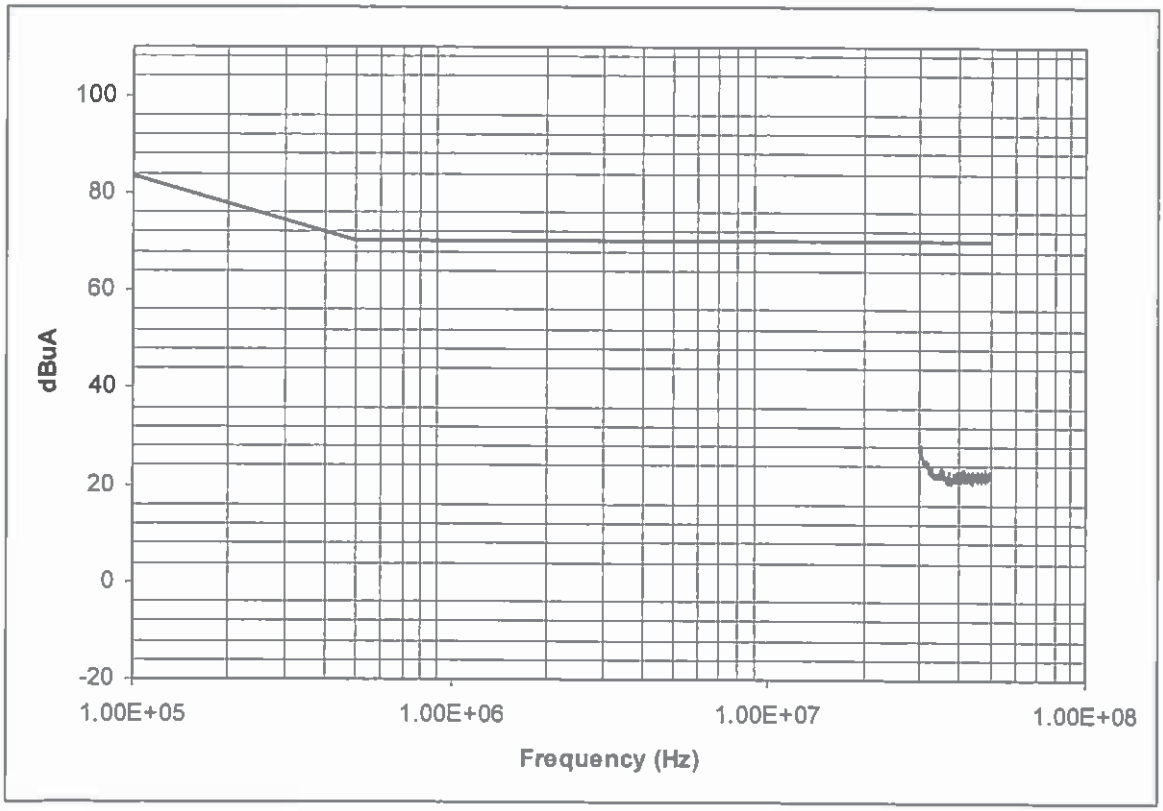


Fig. 18 – 30 MHz – 50 MHz, Side B, Common Mode, Full Load