

# SPIRE SPT EMC CS Pre-calibration test

Ref: SPIRE-RAL-REP-003039

Issue: 1.0

Date: 20-02-2008

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## 1. Introduction

Conducted Susceptibility tests carried out during the SPIRE PFM ILT indicated that there is a spurious source of noise on the PMW detector array when subjected to un-modulated conducted disturbances on the primary power line. It has been agreed that time will be allocated to a CS test during the SPT test campaign to determine if this is an anomaly associated with the particular details of the ILT configuration or if there will be problems seen in the flight-like environment.

The CS test carried out within the SPT campaign will use the flight 28V power harnesses which connect the PCDU to the SPIRE PSU (Power Supply Unit). A test adaptor close to the PCDU will be used so that BCI clamps and current probes can be used to monitor the test conditions. It is physically not practical practicable to inject or monitor the EMI currents close to the SPIRE Interface. As the length of the SPIRE harness exceeds the threshold where the primary power harness can be considered to be electrically short, a pre-calibration test will be conducted to determine the relation between the amplitude of the currents close to the SPIRE interface when they are injected close to the PCDU.

Harness	Length
DPU_N	3.891m
DPU_R	3.628m
FCU_N (i.e. Prime PSU)	3.820m
FCU_R	3.579m

Table 1 – SPIRE 28V Power Harness lengths (N=Prime and R=Redundant)

## 2. Test Configuration

### 2.1 EUT and test Equipment

Item	Description
FPU	Not integrated
Cryoharness	Not Integrated to DRCU
WIH	GSE harness. Note WIH = Warm Interconnect Harness which interconnects the units of the DRCU and the DPU. Carries digital communication and secondary power
DCU	QM2 – Qualification
PSU	QM2
FCU	QM2
DPU	Confidence Model
DPU 28V Power Harness	Non flight like
FCU/PSU Power Harness	28V Same wire gauge (20 AWG) as flight and similar number of twists per length as flight. Harness routed close to the SVM ground plane.
SVM	Aluminium ground plane with similar bolt hole pattern to flight SVM panel
PCDU	Breadboard Class III Herschel-Planck LCL from Thales
BCI Clamp	One Chase 36A: 2-200MHz Injection Probe injecting ~ 300mm from LCL

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Item	Description
Current Probe	Two Fischer F-35: 200Hz – 100MHz Current Probes. The first probe is located close to the injection probe to monitor the current injected into the system close to the PCDU/LCL and the second is mounted close to the SPIRE interface
Signal generator Amplifier	Rhode &Schwarz GW-PA300E
Spectrum Analyzer	Anritsu MS2721A Serial # 601157 (for probe close to the breadboard LCL) Anritsu MS2667C Serial # 6200122418 (for probe close to SPIRE)

## 2.2 Bonding and grounding

The DRCU and DPU are bonded to the SVM simulator panel via the interface bolts. The SVM panel is bonded to the cryostat via braided copper straps. The Cryostat is connected to the lab ground plane via braided copper straps. The LCL ground is connected to the SVM panel via 3mm Banana plugs and leads.

## 3. Test Procedure

### 3.1 Differential Mode

Step	Description
1.	Connect all test equipment: <ul style="list-style-type: none"><li>• Bench power supply</li><li>• LISN</li><li>• LCL</li><li>• Injection clamp</li><li>• Current Probe near LCL</li><li>• Current Probe near SPIRE</li><li>• Oscilloscope</li><li>• Power Amplifier</li><li>• Signal Generator</li></ul>
2.	Document test configuration with Photographs
3.	Record the distances between the current probes along the power harness
4.	Power on SPIRE
5.	Set instrument to Photometer Stand-by Mode
6.	Turn on the Signal Generator and Power Amplifier
7.	Set the frequency of the Signal Generator to the first frequency in Table 2 – Frequency Table for DM test.
8.	Adjust the level on the Power Amplifier until the injected level is 250mV rms (-6dB from IID-A) as measured on the output of the LCL. (Note: on previous test, the input impedance of the
9.	Record the output from the Current probe near the LCL
10.	Record the output from the Current probe near SPIRE
11.	Record the amplitude of the disturbance near the input to SPIRE
12.	Step the input to the next frequency in Table 2 – Frequency Table for DM test and return to Step 7.
13.	Power off SPIRE and disconnect test equipment

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## 3.2 Common Mode

Step	Description
------	-------------

- |     |   |
|-----|---|
| 1.  | Connect all test equipment: <ul style="list-style-type: none"><li>• Bench power supply</li><li>• LISN</li><li>• LCL</li><li>• Injection clamp</li><li>• Current Probe near LCL</li><li>• Current Probe near SPIRE</li><li>• Oscilloscope</li><li>• Power Amplifier</li><li>• Signal Generator</li></ul> |
| 2.  | Document test configuration with Photographs  |
| 3.  | Power on SPIRE  |
| 4.  | Set instrument to Photometer Stand-by Mode  |
| 5.  | Turn on the Signal Generator and Power Amplifier  |
| 6.  | Set the frequency of the Signal Generator to the first frequency in Table 3 – Frequency Table for CM test   |
| 7.  | Adjust the level on the Power Amplifier until the injected level is 707mV rms (-6dB from IID-A) as measured between the return line on SPIRE and chassis or the induced CM current reaches 354mA rms (-6dB from IID-A).   |
| 8.  | Record the output from the Current probe near the LCL   |
| 9.  | Record the output from the Current probe near SPIRE   |
| 10. | Record the amplitude of the disturbance near the input to SPIRE   |
| 11. | Step the input to the next frequency in Table 3 – Frequency Table for CM test and return to Step 7.   |

## 4. Test results

### 4.1 Differential Mode

#### 4.1.1 Test setup photographs

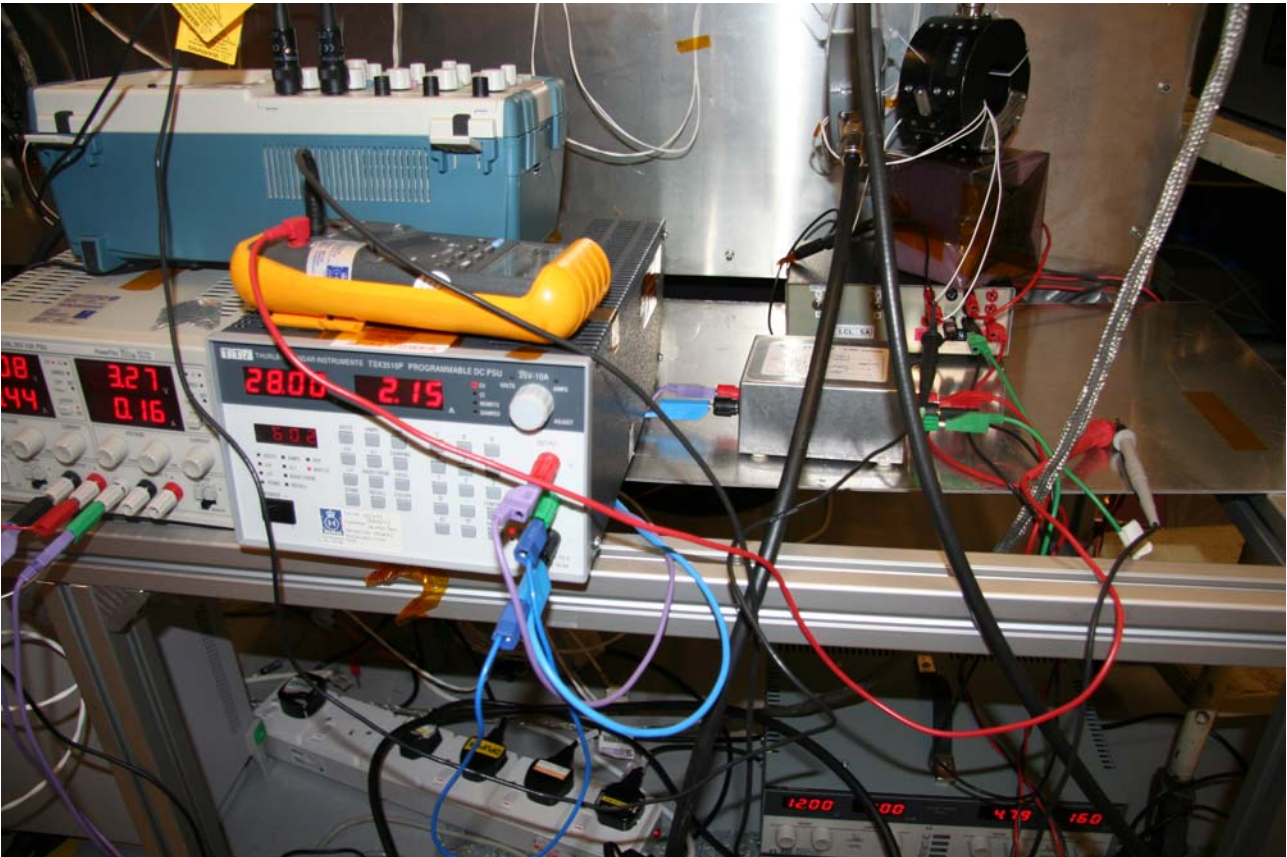
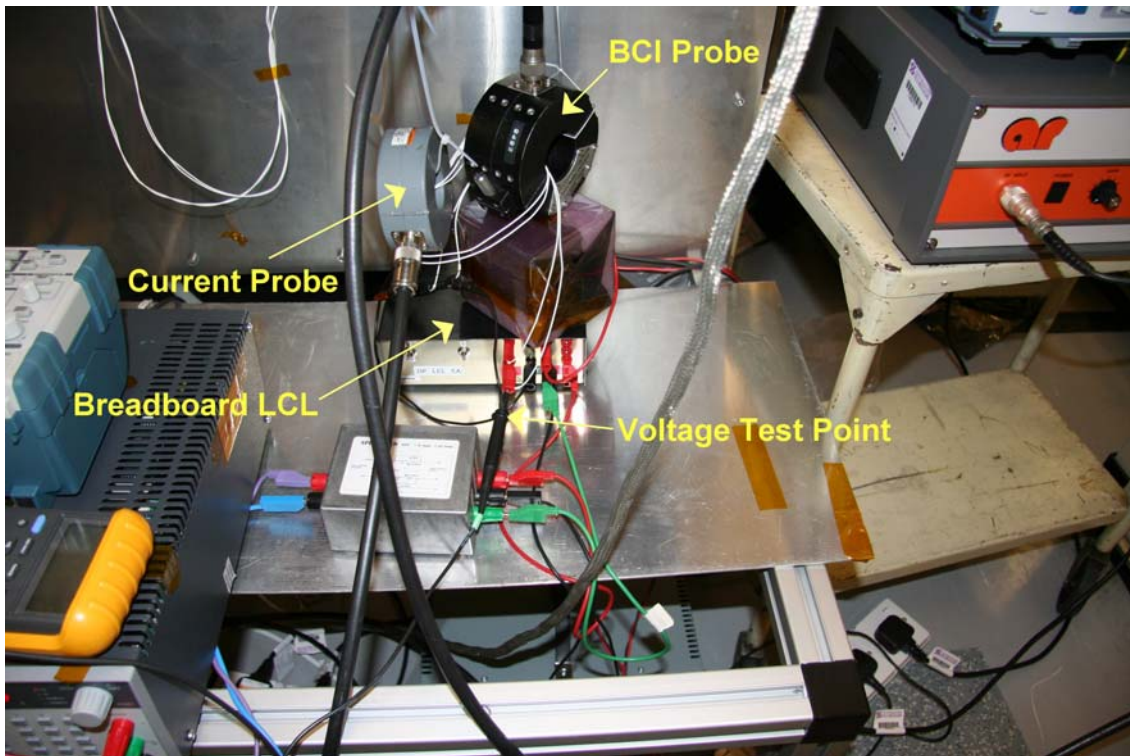


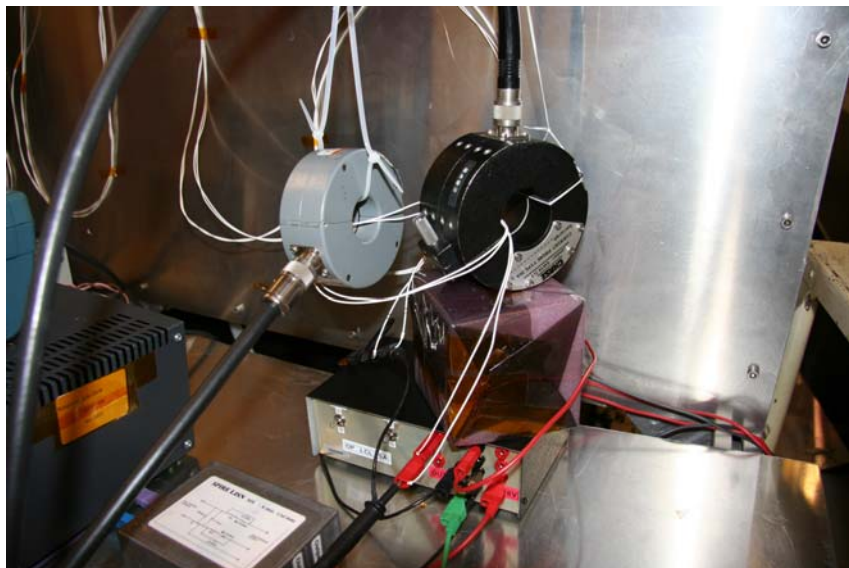
Figure 1 - DM Test configuration (power supply)

The primary power from the DRCU was supplied by a TTI bench power supply. The +28V is carried to the LISN on the mauve wire. The return is carried by the light blue wire. The return is bridged by the dark blue wire to the power supply reference.



**Figure 2 – DM Test configuration (LCL)**

The +28V and references are carried between LISN and the LCL. The current is injected on the +28V wire ~300mm from the breadboard LCL.



**Figure 3 - DM Test configuration (BCI and test current probes)**

The +28V wires pass directly through the BCI clamp, while the return is looped back (as per Fig 9.5.6-6 of IID-A Iss. 4.0)

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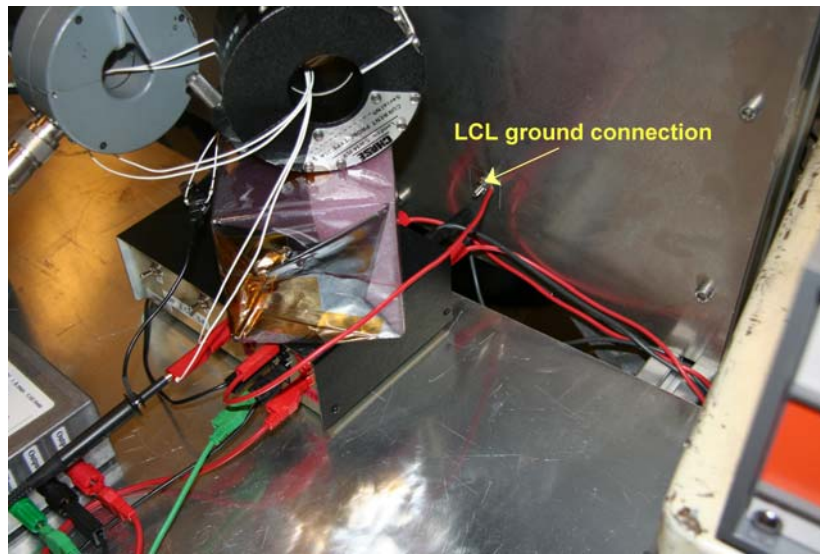


Figure 4 - DM Test configuration (Ground point of LCL)

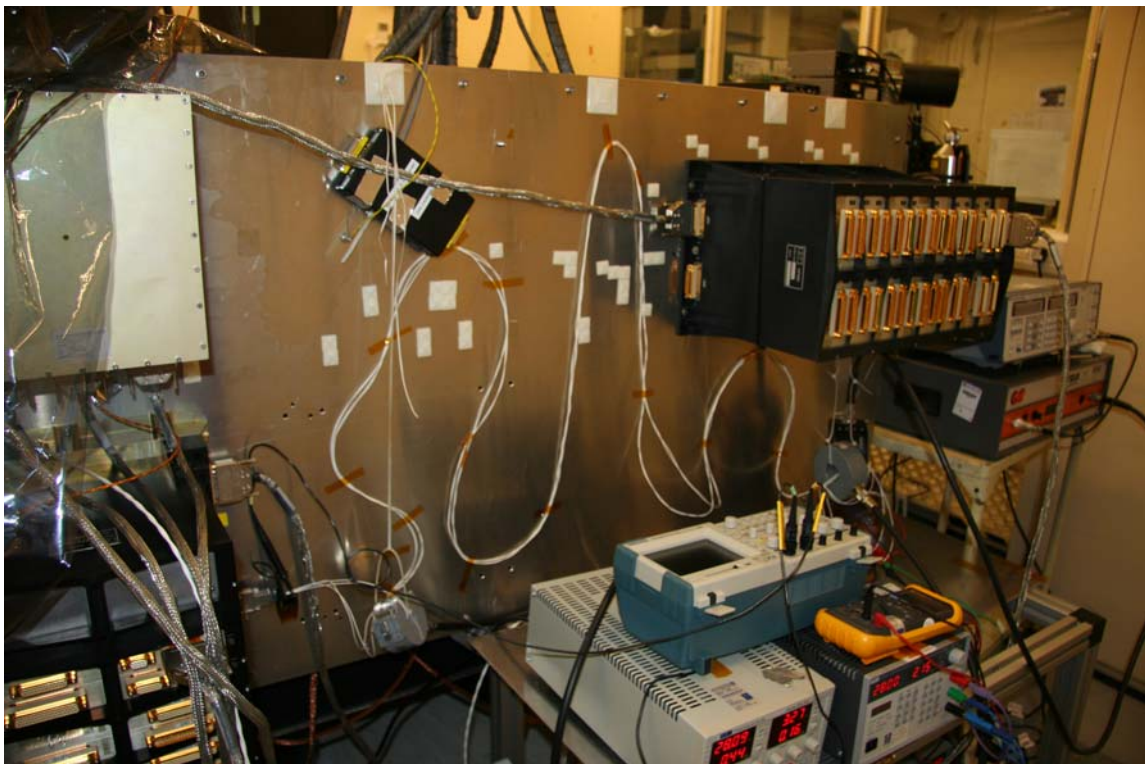


Figure 5- DM Test configuration (routing of SPIRE DRCU 28V power harness simulator)

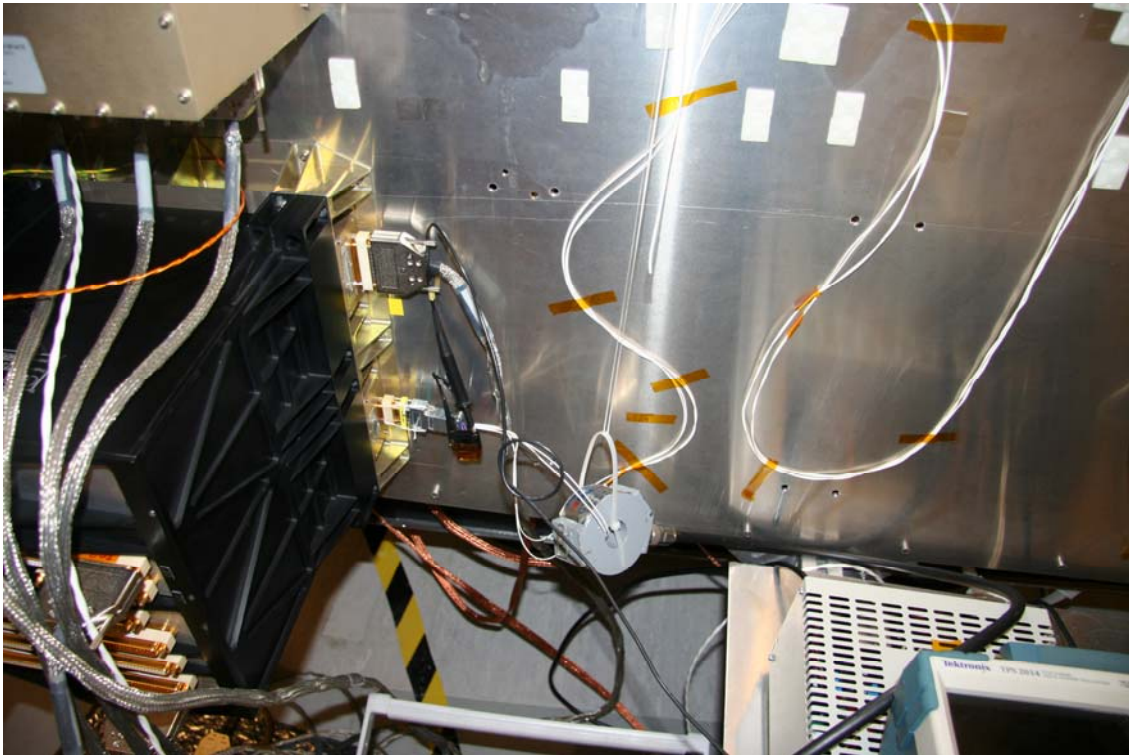


Figure 6 - DM Test configuration (Current probe near SPIRE)

## 4.1.2 DM Test Plots

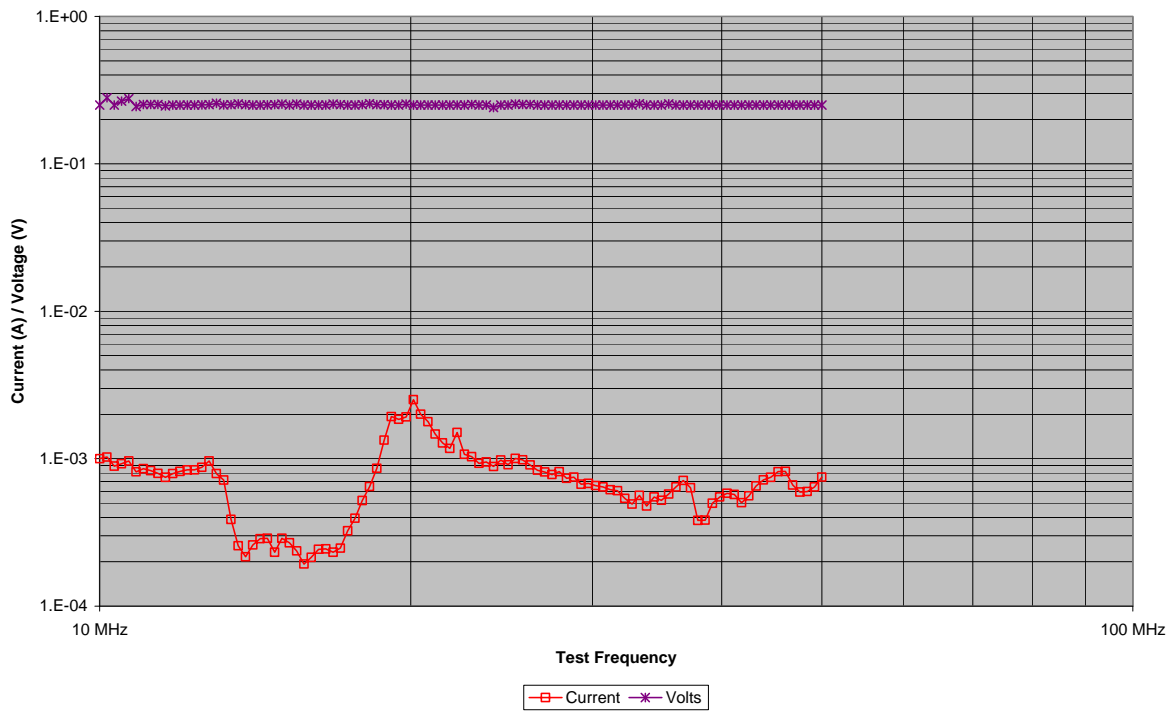


Figure 7 - Differential voltage and current injected into the SPIRE 28V power line close to the LCL



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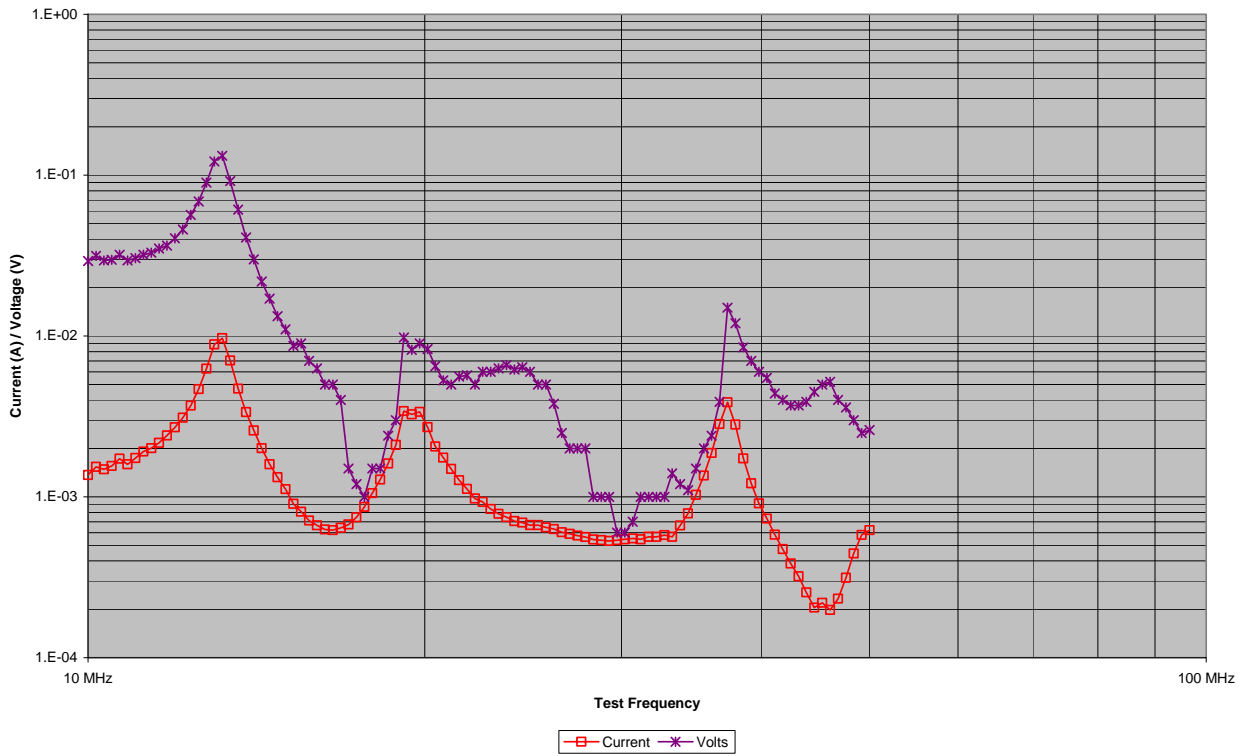


Figure 8 - Differential voltage and current developed on the 28V power line close to the SPIRE I/F.

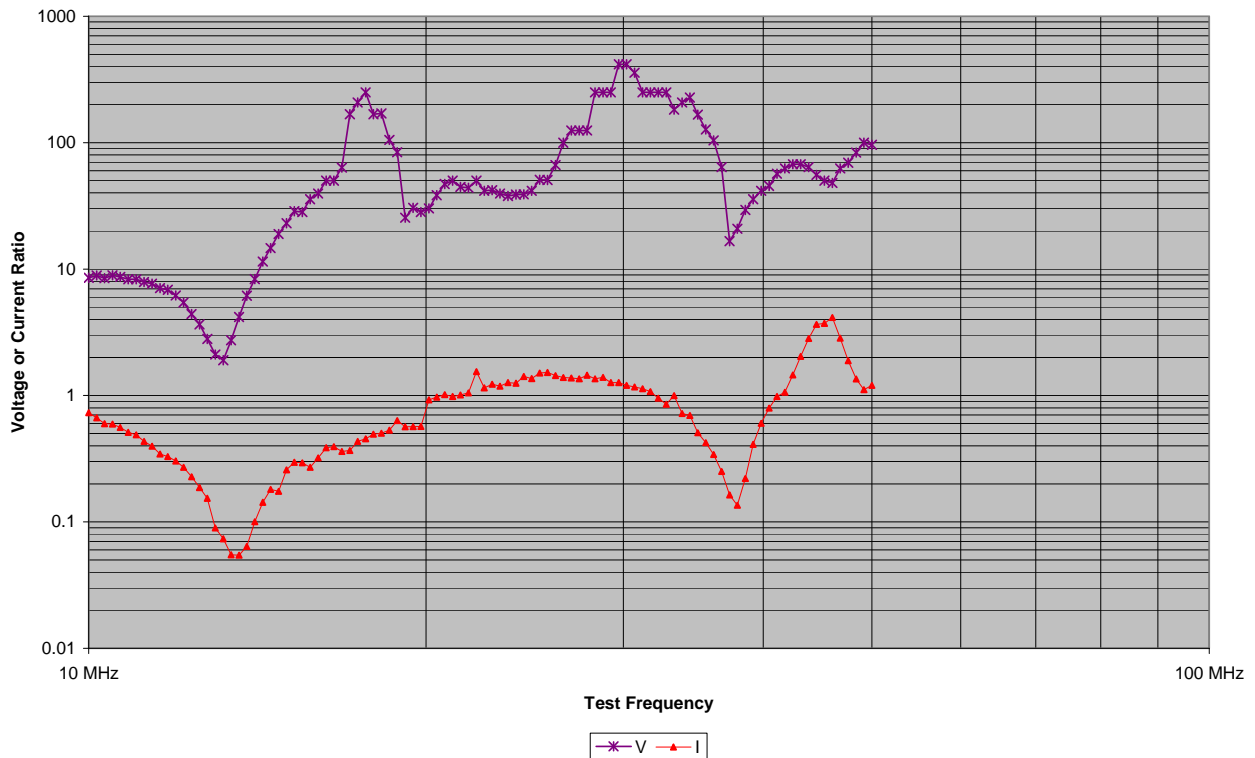


Figure 9 - Ratio of the differential mode voltages and currents injected close to the LCL to the ones developed close to the SPIRE interface.

## 4.2 CM Test

### 4.2.1 Test setup photographs

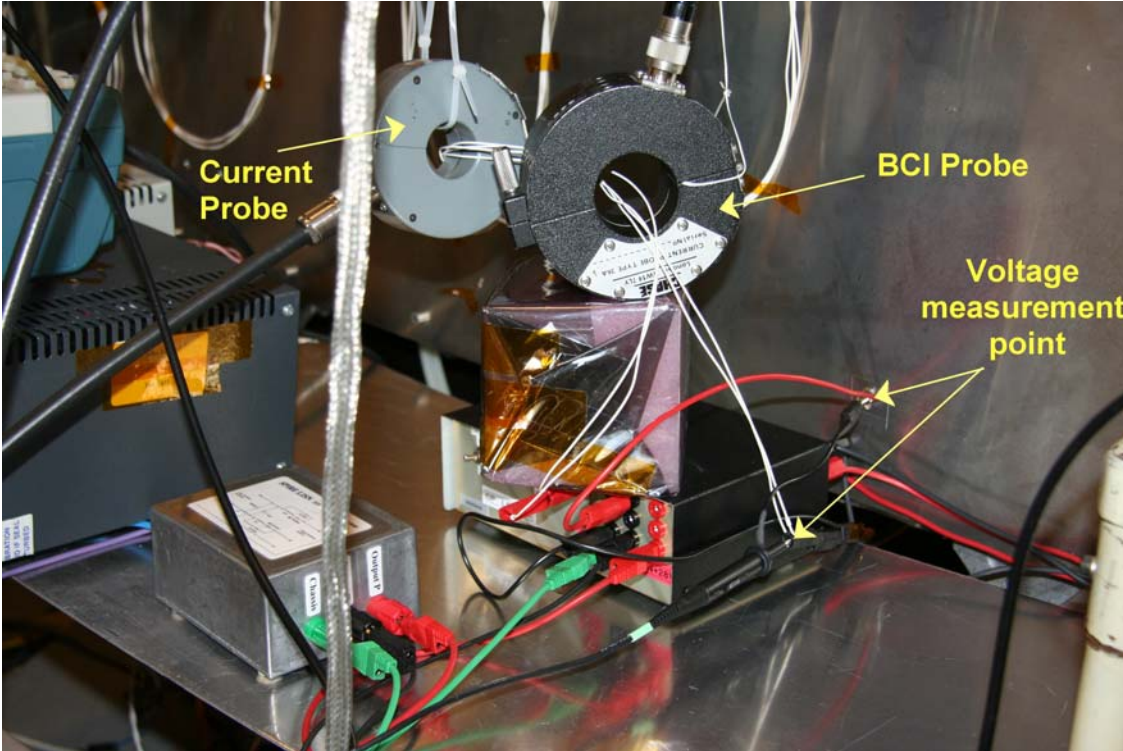


Figure 10 - CM Test configuration (Current probe near the breadboard LCL)

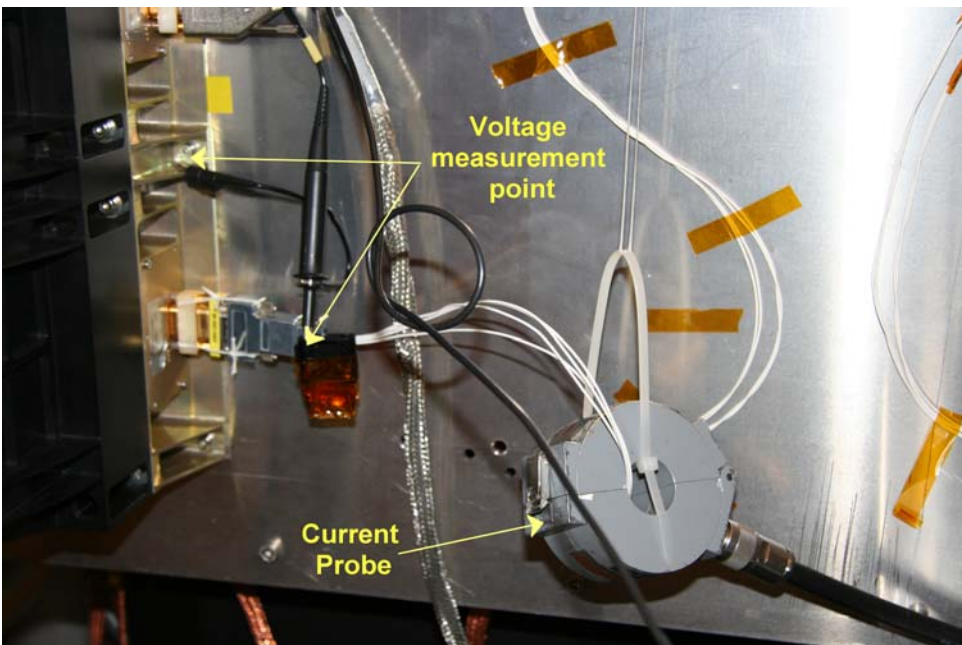


Figure 11 - CM Test configuration (Current probe near SPIRE)

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## 4.2.2 CM Test Plots

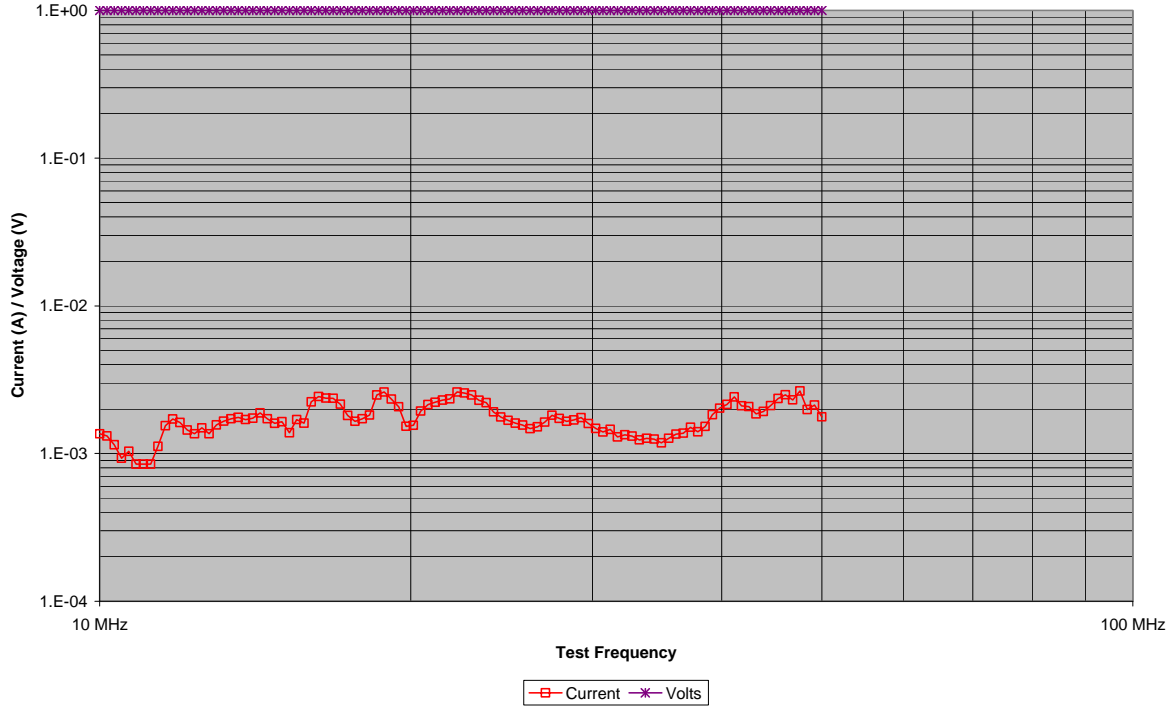


Figure 12 – Common mode voltage and current injected into the SPIRE 28V power line close to the LCL

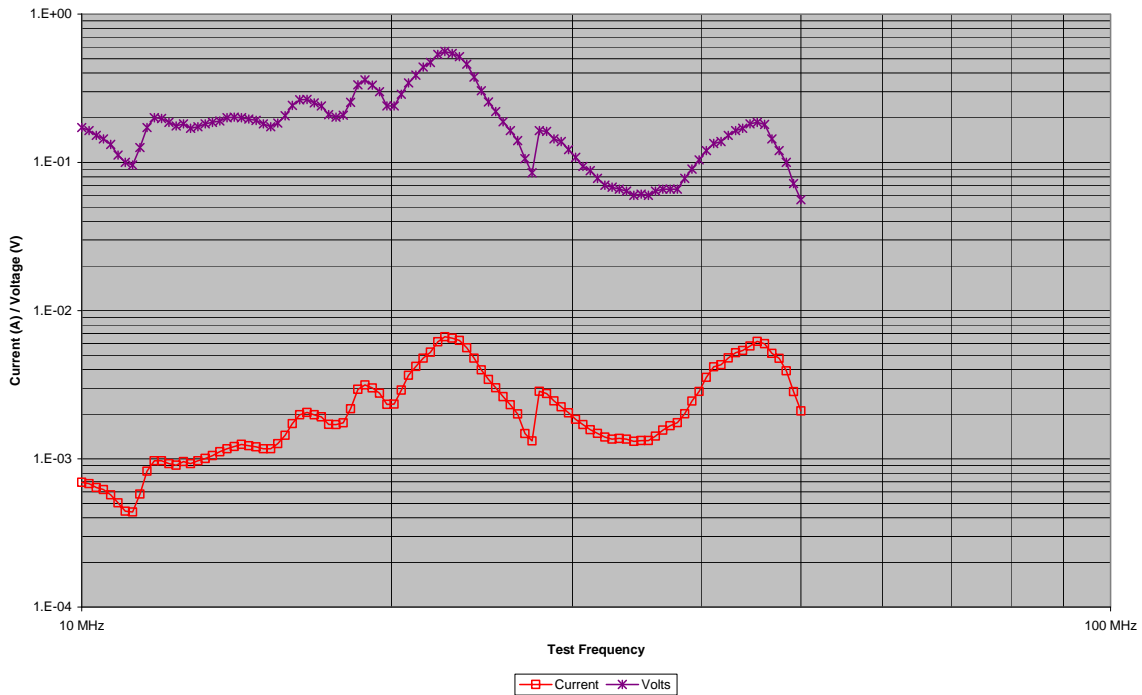


Figure 13 - Common mode voltage and current developed on the 28V power line close to the SPIRE I/F.

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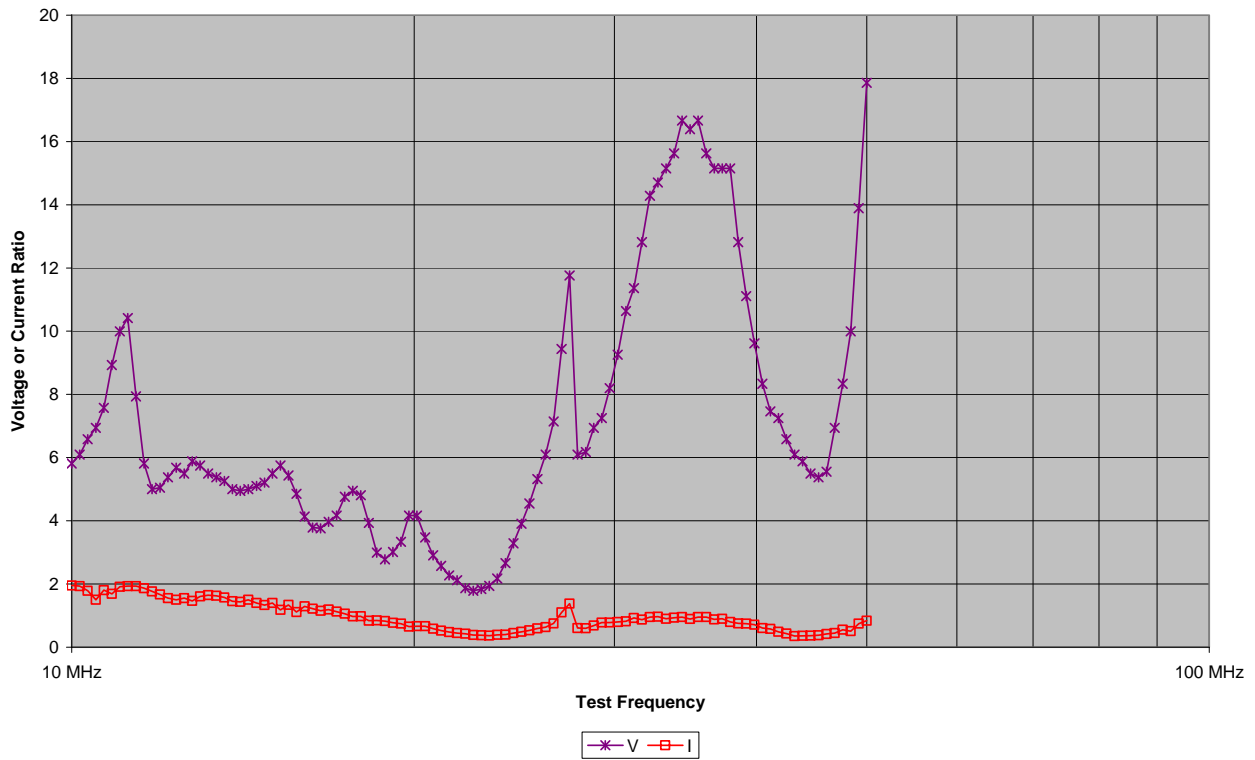


Figure 14 - Ratio of the common mode voltages and currents injected close to the LCL to the ones developed close to the SPIRE interface.

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## 5. Frequency Table

### 5.1 DM Test

Table 2 – Frequency Table for DM test

Step	Test Frequency	LCL					PSU				
		Z (dB)	Probe OP dbuV	Probe Output	Current	Volts	Z (dB)	Probe OP dbuV	Probe	Current	Volts
1	10.00 MHz	-0.17	59.84	0.0010 V	1.00E-3 A	0.25	-0.44	62.30	0.0013 V	1.37E-3 A	0.0293
2	10.16 MHz	-0.17	60.04	0.0010 V	1.02E-3 A	0.28	-0.44	63.30	0.0015 V	1.54E-3 A	0.0315
3	10.33 MHz	-0.17	58.81	0.0009 V	8.89E-4 A	0.25	-0.44	63.00	0.0014 V	1.49E-3 A	0.0295
4	10.50 MHz	-0.17	59.15	0.0009 V	9.25E-4 A	0.266	-0.44	63.40	0.0015 V	1.56E-3 A	0.0298
5	10.67 MHz	-0.17	59.50	0.0009 V	9.63E-4 A	0.277	-0.44	64.30	0.0016 V	1.73E-3 A	0.032
6	10.85 MHz	-0.18	58.05	0.0008 V	8.15E-4 A	0.245	-0.44	63.60	0.0015 V	1.59E-3 A	0.0295
7	11.02 MHz	-0.18	58.46	0.0008 V	8.55E-4 A	0.253	-0.44	64.40	0.0017 V	1.75E-3 A	0.0305
8	11.21 MHz	-0.18	58.20	0.0008 V	8.30E-4 A	0.253	-0.44	65.20	0.0018 V	1.92E-3 A	0.032
9	11.39 MHz	-0.18	57.84	0.0008 V	7.96E-4 A	0.253	-0.44	65.60	0.0019 V	2.01E-3 A	0.033
10	11.58 MHz	-0.18	57.30	0.0007 V	7.48E-4 A	0.247	-0.44	66.28	0.0021 V	2.17E-3 A	0.035
11	11.77 MHz	-0.18	57.80	0.0008 V	7.93E-4 A	0.25	-0.45	67.20	0.0023 V	2.41E-3 A	0.0365
12	11.96 MHz	-0.18	58.10	0.0008 V	8.21E-4 A	0.25	-0.45	68.20	0.0026 V	2.71E-3 A	0.0405
13	12.15 MHz	-0.18	58.30	0.0008 V	8.40E-4 A	0.25	-0.45	69.40	0.0030 V	3.11E-3 A	0.046
14	12.35 MHz	-0.18	58.30	0.0008 V	8.40E-4 A	0.25	-0.45	70.90	0.0035 V	3.69E-3 A	0.0567
15	12.56 MHz	-0.19	58.66	0.0009 V	8.76E-4 A	0.251	-0.45	72.95	0.0044 V	4.68E-3 A	0.0687
16	12.76 MHz	-0.19	59.50	0.0009 V	9.65E-4 A	0.252	-0.45	75.50	0.0060 V	6.27E-3 A	0.09
17	12.97 MHz	-0.19	57.80	0.0008 V	7.93E-4 A	0.257	-0.45	78.50	0.0084 V	8.86E-3 A	0.122
18	13.18 MHz	-0.19	56.90	0.0007 V	7.15E-4 A	0.251	-0.45	79.30	0.0092 V	9.72E-3 A	0.132
19	13.40 MHz	-0.19	51.58	0.0004 V	3.88E-4 A	0.252	-0.45	76.50	0.0067 V	7.04E-3 A	0.092
20	13.62 MHz	-0.19	48.00	0.0003 V	2.57E-4 A	0.255	-0.45	73.00	0.0045 V	4.70E-3 A	0.061
21	13.84 MHz	-0.19	46.50	0.0002 V	2.16E-4 A	0.252	-0.45	70.10	0.0032 V	3.37E-3 A	0.041
22	14.07 MHz	-0.19	48.10	0.0003 V	2.60E-4 A	0.25	-0.45	67.80	0.0025 V	2.59E-3 A	0.03

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Step	Test Frequency	LCL					PSU				
		Z (dB)	Probe OP dbuV	Probe Output	Current	Volts	Z (dB)	Probe OP dbuV	Probe	Current	Volts
23	14.30 MHz	-0.20	48.95	0.0003 V	2.87E-4 A	0.25	-0.45	65.60	0.0019 V	2.01E-3 A	0.0218
24	14.53 MHz	-0.20	49.00	0.0003 V	2.88E-4 A	0.251	-0.45	63.60	0.0015 V	1.59E-3 A	0.0171
25	14.77 MHz	-0.20	47.10	0.0002 V	2.32E-4 A	0.252	-0.45	62.00	0.0013 V	1.33E-3 A	0.0133
26	15.01 MHz	-0.20	49.00	0.0003 V	2.88E-4 A	0.254	-0.46	60.50	0.0011 V	1.12E-3 A	0.011
27	15.26 MHz	-0.20	48.40	0.0003 V	2.69E-4 A	0.25	-0.46	58.70	0.0009 V	9.07E-4 A	0.0087
28	15.51 MHz	-0.20	47.30	0.0002 V	2.37E-4 A	0.254	-0.46	57.70	0.0008 V	8.09E-4 A	0.009
29	15.76 MHz	-0.20	45.50	0.0002 V	1.93E-4 A	0.25	-0.46	56.60	0.0007 V	7.13E-4 A	0.007
30	16.02 MHz	-0.21	46.40	0.0002 V	2.14E-4 A	0.25	-0.46	56.00	0.0006 V	6.65E-4 A	0.0063
31	16.29 MHz	-0.21	47.50	0.0002 V	2.43E-4 A	0.25	-0.46	55.50	0.0006 V	6.28E-4 A	0.005
32	16.55 MHz	-0.21	47.55	0.0002 V	2.44E-4 A	0.25	-0.46	55.40	0.0006 V	6.21E-4 A	0.005
33	16.82 MHz	-0.21	47.10	0.0002 V	2.32E-4 A	0.254	-0.46	55.70	0.0006 V	6.43E-4 A	0.004
34	17.10 MHz	-0.21	47.65	0.0002 V	2.47E-4 A	0.252	-0.46	56.10	0.0006 V	6.73E-4 A	0.0015
35	17.38 MHz	-0.21	50.00	0.0003 V	3.24E-4 A	0.25	-0.46	57.00	0.0007 V	7.47E-4 A	0.0012
36	17.66 MHz	-0.22	51.70	0.0004 V	3.94E-4 A	0.25	-0.46	58.30	0.0008 V	8.67E-4 A	0.001
37	17.95 MHz	-0.22	54.12	0.0005 V	5.21E-4 A	0.252	-0.46	60.00	0.0010 V	1.05E-3 A	0.0015
38	18.25 MHz	-0.22	56.00	0.0006 V	6.47E-4 A	0.256	-0.46	61.70	0.0012 V	1.28E-3 A	0.0015
39	18.55 MHz	-0.22	58.47	0.0008 V	8.60E-4 A	0.252	-0.47	63.70	0.0015 V	1.62E-3 A	0.0024
40	18.85 MHz	-0.22	62.30	0.0013 V	1.34E-3 A	0.252	-0.47	66.00	0.0020 V	2.11E-3 A	0.003
41	19.16 MHz	-0.22	65.50	0.0019 V	1.93E-3 A	0.25	-0.47	70.20	0.0032 V	3.41E-3 A	0.0098
42	19.47 MHz	-0.23	65.11	0.0018 V	1.85E-3 A	0.25	-0.47	69.80	0.0031 V	3.26E-3 A	0.0082
43	19.79 MHz	-0.23	65.44	0.0019 V	1.92E-3 A	0.254	-0.47	70.10	0.0032 V	3.38E-3 A	0.009
44	20.12 MHz	-0.23	67.77	0.0024 V	2.51E-3 A	0.25	-0.47	68.20	0.0026 V	2.71E-3 A	0.0083
45	20.45 MHz	-0.23	65.80	0.0019 V	2.00E-3 A	0.25	-0.47	65.80	0.0019 V	2.06E-3 A	0.0065
46	20.78 MHz	-0.23	64.80	0.0017 V	1.78E-3 A	0.25	-0.47	64.40	0.0017 V	1.75E-3 A	0.0053
47	21.12 MHz	-0.23	63.10	0.0014 V	1.47E-3 A	0.25	-0.48	63.00	0.0014 V	1.49E-3 A	0.005
48	21.47 MHz	-0.23	61.92	0.0012 V	1.28E-3 A	0.25	-0.48	61.60	0.0012 V	1.27E-3 A	0.0056
49	21.82 MHz	-0.23	61.16	0.0011 V	1.17E-3 A	0.25	-0.48	60.50	0.0011 V	1.12E-3 A	0.0057

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Step	Test Frequency	LCL					PSU				
		Z (dB)	Probe OP dbuV	Probe Output	Current	Volts	Z (dB)	Probe OP dbuV	Probe	Current	Volts
50	22.18 MHz	-0.23	63.33	0.0015 V	1.51E-3 A	0.25	-0.48	59.30	0.0009 V	9.75E-4 A	0.005
51	22.54 MHz	-0.24	60.35	0.0010 V	1.07E-3 A	0.25	-0.48	58.90	0.0009 V	9.31E-4 A	0.006
52	22.91 MHz	-0.24	60.03	0.0010 V	1.03E-3 A	0.253	-0.48	58.00	0.0008 V	8.40E-4 A	0.006
53	23.29 MHz	-0.24	59.12	0.0009 V	9.29E-4 A	0.25	-0.49	57.40	0.0007 V	7.84E-4 A	0.0063
54	23.67 MHz	-0.24	59.31	0.0009 V	9.49E-4 A	0.25	-0.49	57.00	0.0007 V	7.49E-4 A	0.0066
55	24.06 MHz	-0.24	58.70	0.0009 V	8.85E-4 A	0.241	-0.49	56.50	0.0007 V	7.07E-4 A	0.0062
56	24.45 MHz	-0.24	59.57	0.0010 V	9.78E-4 A	0.25	-0.49	56.30	0.0007 V	6.91E-4 A	0.0064
57	24.85 MHz	-0.24	58.95	0.0009 V	9.11E-4 A	0.25	-0.49	56.00	0.0006 V	6.68E-4 A	0.006
58	25.26 MHz	-0.24	59.80	0.0010 V	1.00E-3 A	0.254	-0.50	56.00	0.0006 V	6.68E-4 A	0.005
59	25.67 MHz	-0.24	59.60	0.0010 V	9.82E-4 A	0.253	-0.50	55.70	0.0006 V	6.46E-4 A	0.005
60	26.10 MHz	-0.24	58.90	0.0009 V	9.06E-4 A	0.253	-0.50	55.50	0.0006 V	6.31E-4 A	0.0038
61	26.52 MHz	-0.24	58.20	0.0008 V	8.36E-4 A	0.25	-0.50	55.10	0.0006 V	6.03E-4 A	0.0025
62	26.96 MHz	-0.24	57.94	0.0008 V	8.11E-4 A	0.25	-0.50	54.90	0.0006 V	5.89E-4 A	0.002
63	27.40 MHz	-0.24	57.60	0.0008 V	7.80E-4 A	0.25	-0.51	54.70	0.0005 V	5.76E-4 A	0.002
64	27.85 MHz	-0.25	57.99	0.0008 V	8.16E-4 A	0.25	-0.51	54.50	0.0005 V	5.63E-4 A	0.002
65	28.30 MHz	-0.25	57.10	0.0007 V	7.37E-4 A	0.25	-0.51	54.20	0.0005 V	5.44E-4 A	0.001
66	28.77 MHz	-0.25	57.26	0.0007 V	7.51E-4 A	0.25	-0.51	54.10	0.0005 V	5.38E-4 A	0.001
67	29.24 MHz	-0.25	56.30	0.0007 V	6.72E-4 A	0.25	-0.52	54.00	0.0005 V	5.32E-4 A	0.001
68	29.72 MHz	-0.25	56.40	0.0007 V	6.80E-4 A	0.25	-0.52	54.10	0.0005 V	5.38E-4 A	0.0006
69	30.21 MHz	-0.25	56.10	0.0006 V	6.57E-4 A	0.25	-0.52	54.20	0.0005 V	5.45E-4 A	0.0006
70	30.70 MHz	-0.25	55.92	0.0006 V	6.43E-4 A	0.25	-0.53	54.30	0.0005 V	5.51E-4 A	0.0007
71	31.20 MHz	-0.25	55.55	0.0006 V	6.17E-4 A	0.25	-0.53	54.20	0.0005 V	5.45E-4 A	0.001
72	31.72 MHz	-0.25	55.40	0.0006 V	6.06E-4 A	0.25	-0.53	54.50	0.0005 V	5.64E-4 A	0.001
73	32.24 MHz	-0.25	54.38	0.0005 V	5.39E-4 A	0.25	-0.54	54.50	0.0005 V	5.65E-4 A	0.001
74	32.76 MHz	-0.25	53.60	0.0005 V	4.93E-4 A	0.25	-0.54	54.70	0.0005 V	5.78E-4 A	0.001
75	33.30 MHz	-0.25	54.77	0.0005 V	5.64E-4 A	0.256	-0.54	54.50	0.0005 V	5.65E-4 A	0.0014
76	33.85 MHz	-0.25	53.33	0.0005 V	4.78E-4 A	0.25	-0.55	55.90	0.0006 V	6.64E-4 A	0.0012

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Step	Test Frequency	LCL					PSU				
		Z (dB)	Probe OP dbuV	Probe Output	Current	Volts	Z (dB)	Probe OP dbuV	Probe	Current	Volts
77	34.40 MHz	-0.25	54.55	0.0005 V	5.50E-4 A	0.25	-0.55	57.40	0.0007 V	7.90E-4 A	0.0011
78	34.97 MHz	-0.25	54.10	0.0005 V	5.22E-4 A	0.25	-0.56	59.70	0.0010 V	1.03E-3 A	0.0015
79	35.54 MHz	-0.25	54.96	0.0006 V	5.76E-4 A	0.255	-0.56	62.10	0.0013 V	1.36E-3 A	0.002
80	36.12 MHz	-0.25	55.90	0.0006 V	6.42E-4 A	0.25	-0.57	64.90	0.0018 V	1.88E-3 A	0.0024
81	36.71 MHz	-0.25	56.80	0.0007 V	7.12E-4 A	0.25	-0.57	68.50	0.0027 V	2.84E-3 A	0.0039
82	37.32 MHz	-0.25	55.80	0.0006 V	6.35E-4 A	0.25	-0.57	71.20	0.0036 V	3.88E-3 A	0.015
83	37.93 MHz	-0.25	51.37	0.0004 V	3.81E-4 A	0.25	-0.58	68.40	0.0026 V	2.81E-3 A	0.012
84	38.55 MHz	-0.25	51.40	0.0004 V	3.83E-4 A	0.25	-0.58	64.20	0.0016 V	1.73E-3 A	0.0085
85	39.18 MHz	-0.25	53.70	0.0005 V	4.99E-4 A	0.25	-0.59	61.10	0.0011 V	1.21E-3 A	0.007
86	39.82 MHz	-0.25	54.54	0.0005 V	5.49E-4 A	0.25	-0.59	58.60	0.0009 V	9.11E-4 A	0.006
87	40.47 MHz	-0.26	55.06	0.0006 V	5.83E-4 A	0.25	-0.60	56.70	0.0007 V	7.33E-4 A	0.0055
88	41.14 MHz	-0.26	54.89	0.0006 V	5.72E-4 A	0.25	-0.60	54.70	0.0005 V	5.82E-4 A	0.0044
89	41.81 MHz	-0.26	53.77	0.0005 V	5.03E-4 A	0.25	-0.61	52.90	0.0004 V	4.74E-4 A	0.004
90	42.50 MHz	-0.26	54.70	0.0005 V	5.60E-4 A	0.25	-0.61	51.10	0.0004 V	3.85E-4 A	0.0037
91	43.19 MHz	-0.26	56.03	0.0006 V	6.52E-4 A	0.25	-0.62	49.50	0.0003 V	3.21E-4 A	0.0037
92	43.90 MHz	-0.26	56.88	0.0007 V	7.19E-4 A	0.25	-0.62	47.50	0.0002 V	2.55E-4 A	0.0039
93	44.62 MHz	-0.26	57.21	0.0007 V	7.47E-4 A	0.25	-0.63	45.60	0.0002 V	2.05E-4 A	0.0045
94	45.35 MHz	-0.26	58.00	0.0008 V	8.18E-4 A	0.25	-0.64	46.20	0.0002 V	2.20E-4 A	0.005
95	46.10 MHz	-0.26	58.02	0.0008 V	8.20E-4 A	0.25	-0.64	45.30	0.0002 V	1.98E-4 A	0.0052
96	46.85 MHz	-0.26	56.18	0.0006 V	6.64E-4 A	0.25	-0.65	46.70	0.0002 V	2.33E-4 A	0.004
97	47.62 MHz	-0.26	55.22	0.0006 V	5.94E-4 A	0.25	-0.65	49.30	0.0003 V	3.14E-4 A	0.0036
98	48.40 MHz	-0.26	55.30	0.0006 V	6.00E-4 A	0.25	-0.66	52.30	0.0004 V	4.45E-4 A	0.003
99	49.19 MHz	-0.26	55.91	0.0006 V	6.43E-4 A	0.25	-0.66	54.60	0.0005 V	5.80E-4 A	0.0025
100	50.00 MHz	-0.26	57.24	0.0007 V	7.50E-4 A	0.25	-0.67	55.20	0.0006 V	6.22E-4 A	0.0026



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## 5.2 CM Test

Table 3 – Frequency Table for CM test

	Test Frequency	LCL					PSU				
		Z (dB)	Probe OP dbuV	Probe Output	Current	V Ret - Chassis (pk-pk)	Z (dB)	Probe OP dbuV	Probe	Current	V Ret - Chassis (pk-pk)
1	10.00 MHz	-0.17	62.50	0.0013 V	1.36E-3 A	1	-0.44	56.40	0.0007 V	6.95E-4 A	0.172
2	10.16 MHz	-0.17	62.20	0.0013 V	1.31E-3 A	1	-0.44	56.20	0.0006 V	6.79E-4 A	0.164
3	10.33 MHz	-0.17	61.00	0.0011 V	1.14E-3 A	1	-0.44	55.70	0.0006 V	6.41E-4 A	0.152
4	10.50 MHz	-0.17	59.20	0.0009 V	9.30E-4 A	1	-0.44	55.40	0.0006 V	6.20E-4 A	0.144
5	10.67 MHz	-0.17	60.12	0.0010 V	1.03E-3 A	1	-0.44	54.70	0.0005 V	5.72E-4 A	0.132
6	10.85 MHz	-0.18	58.40	0.0008 V	8.49E-4 A	1	-0.44	53.60	0.0005 V	5.04E-4 A	0.112
7	11.02 MHz	-0.18	58.40	0.0008 V	8.49E-4 A	1	-0.44	52.50	0.0004 V	4.44E-4 A	0.1
8	11.21 MHz	-0.18	58.40	0.0008 V	8.49E-4 A	1	-0.44	52.40	0.0004 V	4.39E-4 A	0.096
9	11.39 MHz	-0.18	60.80	0.0011 V	1.12E-3 A	1	-0.44	54.80	0.0005 V	5.78E-4 A	0.126
10	11.58 MHz	-0.18	63.60	0.0015 V	1.55E-3 A	1	-0.44	57.90	0.0008 V	8.26E-4 A	0.172
11	11.77 MHz	-0.18	64.50	0.0017 V	1.71E-3 A	1	-0.45	59.30	0.0009 V	9.71E-4 A	0.2
12	11.96 MHz	-0.18	64.00	0.0016 V	1.62E-3 A	1	-0.45	59.30	0.0009 V	9.71E-4 A	0.198
13	12.15 MHz	-0.18	63.00	0.0014 V	1.44E-3 A	1	-0.45	58.90	0.0009 V	9.28E-4 A	0.186
14	12.35 MHz	-0.18	62.50	0.0013 V	1.36E-3 A	1	-0.45	58.70	0.0009 V	9.06E-4 A	0.176
15	12.56 MHz	-0.19	63.30	0.0015 V	1.49E-3 A	1	-0.45	59.20	0.0009 V	9.60E-4 A	0.182
16	12.76 MHz	-0.19	62.50	0.0013 V	1.36E-3 A	1	-0.45	58.90	0.0009 V	9.28E-4 A	0.17
17	12.97 MHz	-0.19	63.70	0.0015 V	1.56E-3 A	1	-0.45	59.30	0.0009 V	9.72E-4 A	0.174
18	13.18 MHz	-0.19	64.20	0.0016 V	1.66E-3 A	1	-0.45	59.60	0.0010 V	1.01E-3 A	0.182
19	13.40 MHz	-0.19	64.50	0.0017 V	1.72E-3 A	1	-0.45	60.00	0.0010 V	1.05E-3 A	0.186
20	13.62 MHz	-0.19	64.70	0.0017 V	1.76E-3 A	1	-0.45	60.50	0.0011 V	1.12E-3 A	0.19
21	13.84 MHz	-0.19	64.40	0.0017 V	1.70E-3 A	1	-0.45	60.90	0.0011 V	1.17E-3 A	0.2
22	14.07 MHz	-0.19	64.60	0.0017 V	1.74E-3 A	1	-0.45	61.20	0.0011 V	1.21E-3 A	0.202
23	14.30 MHz	-0.20	65.30	0.0018 V	1.88E-3 A	1	-0.45	61.50	0.0012 V	1.25E-3 A	0.2
24	14.53 MHz	-0.20	64.50	0.0017 V	1.72E-3 A	1	-0.45	61.30	0.0012 V	1.22E-3 A	0.196

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		Z (dB)	Probe OP dbuV	Probe Output	Current	V Ret - Chassis (pk-pk)	Z (dB)	Probe OP dbuV	Probe	Current	V Ret - Chassis (pk-pk)
25	14.77 MHz	-0.20	63.90	0.0016 V	1.60E-3 A	1	-0.45	61.15	0.0011 V	1.20E-3 A	0.192
26	15.01 MHz	-0.20	64.10	0.0016 V	1.64E-3 A	1	-0.46	60.90	0.0011 V	1.17E-3 A	0.182
27	15.26 MHz	-0.20	62.60	0.0013 V	1.38E-3 A	1	-0.46	60.90	0.0011 V	1.17E-3 A	0.174
28	15.51 MHz	-0.20	64.40	0.0017 V	1.70E-3 A	1	-0.46	61.60	0.0012 V	1.27E-3 A	0.184
29	15.76 MHz	-0.20	63.90	0.0016 V	1.60E-3 A	1	-0.46	62.70	0.0014 V	1.44E-3 A	0.206
30	16.02 MHz	-0.21	66.80	0.0022 V	2.24E-3 A	1	-0.46	64.30	0.0016 V	1.73E-3 A	0.242
31	16.29 MHz	-0.21	67.50	0.0024 V	2.43E-3 A	1	-0.46	65.50	0.0019 V	1.99E-3 A	0.264
32	16.55 MHz	-0.21	67.30	0.0023 V	2.37E-3 A	1	-0.46	65.80	0.0019 V	2.06E-3 A	0.266
33	16.82 MHz	-0.21	67.27	0.0023 V	2.37E-3 A	1	-0.46	65.50	0.0019 V	1.99E-3 A	0.252
34	17.10 MHz	-0.21	66.47	0.0021 V	2.16E-3 A	1	-0.46	65.20	0.0018 V	1.92E-3 A	0.24
35	17.38 MHz	-0.21	64.95	0.0018 V	1.81E-3 A	1	-0.46	64.20	0.0016 V	1.71E-3 A	0.21
36	17.66 MHz	-0.22	64.15	0.0016 V	1.65E-3 A	1	-0.46	64.15	0.0016 V	1.70E-3 A	0.202
37	17.95 MHz	-0.22	64.48	0.0017 V	1.72E-3 A	1	-0.46	64.40	0.0017 V	1.75E-3 A	0.208
38	18.25 MHz	-0.22	65.00	0.0018 V	1.82E-3 A	1	-0.46	66.30	0.0021 V	2.18E-3 A	0.254
39	18.55 MHz	-0.22	67.70	0.0024 V	2.49E-3 A	1	-0.47	68.90	0.0028 V	2.94E-3 A	0.334
40	18.85 MHz	-0.22	68.10	0.0025 V	2.61E-3 A	1	-0.47	69.50	0.0030 V	3.15E-3 A	0.36
41	19.16 MHz	-0.22	67.14	0.0023 V	2.33E-3 A	1	-0.47	69.10	0.0029 V	3.01E-3 A	0.332
42	19.47 MHz	-0.23	66.10	0.0020 V	2.07E-3 A	1	-0.47	68.40	0.0026 V	2.78E-3 A	0.3
43	19.79 MHz	-0.23	63.45	0.0015 V	1.53E-3 A	1	-0.47	66.89	0.0022 V	2.33E-3 A	0.24
44	20.12 MHz	-0.23	63.60	0.0015 V	1.55E-3 A	1	-0.47	66.90	0.0022 V	2.34E-3 A	0.24
45	20.45 MHz	-0.23	65.50	0.0019 V	1.93E-3 A	1	-0.47	68.80	0.0028 V	2.91E-3 A	0.288
46	20.78 MHz	-0.23	66.40	0.0021 V	2.15E-3 A	1	-0.47	70.80	0.0035 V	3.66E-3 A	0.344
47	21.12 MHz	-0.23	66.70	0.0022 V	2.22E-3 A	1	-0.48	72.00	0.0040 V	4.21E-3 A	0.388
48	21.47 MHz	-0.23	67.00	0.0022 V	2.30E-3 A	1	-0.48	73.10	0.0045 V	4.77E-3 A	0.44
49	21.82 MHz	-0.23	67.15	0.0023 V	2.34E-3 A	1	-0.48	73.90	0.0050 V	5.24E-3 A	0.472
50	22.18 MHz	-0.23	68.10	0.0025 V	2.61E-3 A	1	-0.48	75.30	0.0058 V	6.15E-3 A	0.536
51	22.54 MHz	-0.24	67.97	0.0025 V	2.57E-3 A	1	-0.48	75.99	0.0063 V	6.66E-3 A	0.56

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		Z (dB)	Probe OP dbuV	Probe Output	Current	V Ret - Chassis (pk-pk)	Z (dB)	Probe OP dbuV	Probe	Current	V Ret - Chassis (pk-pk)
52	22.91 MHz	-0.24	67.70	0.0024 V	2.49E-3 A	1	-0.48	75.80	0.0062 V	6.52E-3 A	0.544
53	23.29 MHz	-0.24	66.96	0.0022 V	2.29E-3 A	1	-0.49	75.50	0.0060 V	6.30E-3 A	0.516
54	23.67 MHz	-0.24	66.64	0.0021 V	2.21E-3 A	1	-0.49	74.50	0.0053 V	5.62E-3 A	0.46
55	24.06 MHz	-0.24	65.40	0.0019 V	1.91E-3 A	1	-0.49	73.10	0.0045 V	4.78E-3 A	0.376
56	24.45 MHz	-0.24	64.70	0.0017 V	1.77E-3 A	1	-0.49	71.50	0.0038 V	3.98E-3 A	0.304
57	24.85 MHz	-0.24	64.24	0.0016 V	1.67E-3 A	1	-0.49	70.20	0.0032 V	3.43E-3 A	0.256
58	25.26 MHz	-0.24	63.87	0.0016 V	1.61E-3 A	1	-0.50	69.10	0.0029 V	3.02E-3 A	0.22
59	25.67 MHz	-0.24	63.60	0.0015 V	1.56E-3 A	1	-0.50	67.90	0.0025 V	2.63E-3 A	0.188
60	26.10 MHz	-0.24	63.12	0.0014 V	1.47E-3 A	1	-0.50	66.80	0.0022 V	2.32E-3 A	0.164
61	26.52 MHz	-0.24	63.36	0.0015 V	1.51E-3 A	1	-0.50	65.56	0.0019 V	2.01E-3 A	0.14
62	26.96 MHz	-0.24	64.00	0.0016 V	1.63E-3 A	1	-0.50	62.90	0.0014 V	1.48E-3 A	0.106
63	27.40 MHz	-0.24	64.95	0.0018 V	1.82E-3 A	1	-0.51	61.90	0.0012 V	1.32E-3 A	0.085
64	27.85 MHz	-0.25	64.50	0.0017 V	1.73E-3 A	1	-0.51	68.60	0.0027 V	2.85E-3 A	0.164
65	28.30 MHz	-0.25	64.12	0.0016 V	1.65E-3 A	1	-0.51	68.30	0.0026 V	2.76E-3 A	0.162
66	28.77 MHz	-0.25	64.30	0.0016 V	1.69E-3 A	1	-0.51	67.30	0.0023 V	2.46E-3 A	0.144
67	29.24 MHz	-0.25	64.60	0.0017 V	1.75E-3 A	1	-0.52	66.50	0.0021 V	2.24E-3 A	0.138
68	29.72 MHz	-0.25	63.80	0.0015 V	1.59E-3 A	1	-0.52	65.70	0.0019 V	2.05E-3 A	0.122
69	30.21 MHz	-0.25	63.14	0.0014 V	1.48E-3 A	1	-0.52	64.80	0.0017 V	1.85E-3 A	0.108
70	30.70 MHz	-0.25	62.67	0.0014 V	1.40E-3 A	1	-0.53	64.10	0.0016 V	1.70E-3 A	0.094
71	31.20 MHz	-0.25	63.00	0.0014 V	1.45E-3 A	1	-0.53	63.40	0.0015 V	1.57E-3 A	0.088
72	31.72 MHz	-0.25	62.00	0.0013 V	1.30E-3 A	1	-0.53	62.90	0.0014 V	1.48E-3 A	0.078
73	32.24 MHz	-0.25	62.30	0.0013 V	1.34E-3 A	1	-0.54	62.40	0.0013 V	1.40E-3 A	0.07
74	32.76 MHz	-0.25	62.10	0.0013 V	1.31E-3 A	1	-0.54	62.10	0.0013 V	1.36E-3 A	0.068
75	33.30 MHz	-0.25	61.60	0.0012 V	1.24E-3 A	1	-0.54	62.20	0.0013 V	1.37E-3 A	0.066
76	33.85 MHz	-0.25	61.80	0.0012 V	1.27E-3 A	1	-0.55	62.10	0.0013 V	1.36E-3 A	0.064
77	34.40 MHz	-0.25	61.70	0.0012 V	1.25E-3 A	1	-0.55	61.80	0.0012 V	1.31E-3 A	0.06
78	34.97 MHz	-0.25	61.20	0.0011 V	1.18E-3 A	1	-0.56	61.90	0.0012 V	1.33E-3 A	0.061

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		Z (dB)	Probe OP dbuV	Probe Output	Current	V Ret - Chassis (pk-pk)	Z (dB)	Probe OP dbuV	Probe	Current	V Ret - Chassis (pk-pk)
79	35.54 MHz	-0.25	61.80	0.0012 V	1.27E-3 A	1	-0.56	61.90	0.0012 V	1.33E-3 A	0.06
80	36.12 MHz	-0.25	62.38	0.0013 V	1.35E-3 A	1	-0.57	62.50	0.0013 V	1.42E-3 A	0.064
81	36.71 MHz	-0.25	62.50	0.0013 V	1.37E-3 A	1	-0.57	63.30	0.0015 V	1.56E-3 A	0.066
82	37.32 MHz	-0.25	63.30	0.0015 V	1.51E-3 A	1	-0.57	63.90	0.0016 V	1.67E-3 A	0.066
83	37.93 MHz	-0.25	62.70	0.0014 V	1.41E-3 A	1	-0.58	64.30	0.0016 V	1.75E-3 A	0.066
84	38.55 MHz	-0.25	63.40	0.0015 V	1.52E-3 A	1	-0.58	65.50	0.0019 V	2.01E-3 A	0.078
85	39.18 MHz	-0.25	65.00	0.0018 V	1.83E-3 A	1	-0.59	67.20	0.0023 V	2.45E-3 A	0.09
86	39.82 MHz	-0.25	65.90	0.0020 V	2.03E-3 A	1	-0.59	68.50	0.0027 V	2.85E-3 A	0.104
87	40.47 MHz	-0.26	66.40	0.0021 V	2.15E-3 A	1	-0.60	70.40	0.0033 V	3.55E-3 A	0.12
88	41.14 MHz	-0.26	67.40	0.0023 V	2.41E-3 A	1	-0.60	71.80	0.0039 V	4.17E-3 A	0.134
89	41.81 MHz	-0.26	66.20	0.0020 V	2.10E-3 A	1	-0.61	72.10	0.0040 V	4.32E-3 A	0.138
90	42.50 MHz	-0.26	66.11	0.0020 V	2.08E-3 A	1	-0.61	73.00	0.0045 V	4.79E-3 A	0.152
91	43.19 MHz	-0.26	65.10	0.0018 V	1.85E-3 A	1	-0.62	73.70	0.0048 V	5.20E-3 A	0.164
92	43.90 MHz	-0.26	65.42	0.0019 V	1.92E-3 A	1	-0.62	74.00	0.0050 V	5.39E-3 A	0.17
93	44.62 MHz	-0.26	66.22	0.0020 V	2.11E-3 A	1	-0.63	74.60	0.0054 V	5.77E-3 A	0.182
94	45.35 MHz	-0.26	67.20	0.0023 V	2.36E-3 A	1	-0.64	75.20	0.0058 V	6.19E-3 A	0.186
95	46.10 MHz	-0.26	67.70	0.0024 V	2.50E-3 A	1	-0.64	74.90	0.0056 V	5.98E-3 A	0.18
96	46.85 MHz	-0.26	67.00	0.0022 V	2.31E-3 A	1	-0.65	73.60	0.0048 V	5.16E-3 A	0.144
97	47.62 MHz	-0.26	68.20	0.0026 V	2.65E-3 A	1	-0.65	72.90	0.0044 V	4.76E-3 A	0.12
98	48.40 MHz	-0.26	65.70	0.0019 V	1.99E-3 A	1	-0.66	71.20	0.0036 V	3.92E-3 A	0.1
99	49.19 MHz	-0.26	66.30	0.0021 V	2.13E-3 A	1	-0.66	68.40	0.0026 V	2.84E-3 A	0.072
100	50.00 MHz	-0.26	64.70	0.0017 V	1.77E-3 A	1	-0.67	65.80	0.0019 V	2.11E-3 A	0.056