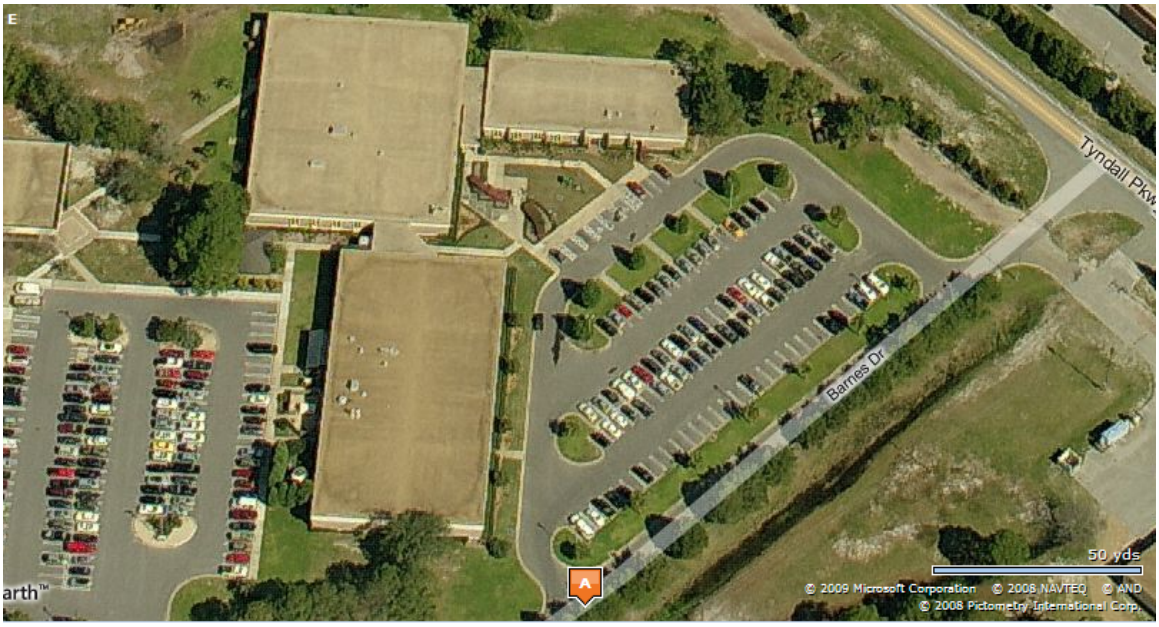
phaseservices

solutions for power quality

Evaluation of a Protection System to Reduce a Facility Electrical Budget



12/09/2008

Evaluation of a Protection System To Reduce A Facility Electrical Budget

phaseservices

solutions for power quality

Power Quality Survey Performed By
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222 N. Center Street
Bonham, TX 75439
Tel. 903.436.4669 Fax: 877.295.6511

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- **Site Frequency Analysis on 12/09/2009**

SECTION 1

Report Overview

Test Site Location:
USAF HQ AFCESA/CEOA
139 Barnes Dr. Suite 1
Panama City, Tyndall AFB, FL 32403-5319
(888)-232-3721

Executive Summary

The Air Force Civil Engineer Support Agency, headquartered at Tyndall Air Force Base, Fla., provides the best tools, practices and professional support to maximize Air Force civil engineer capabilities in base and contingency operations. AFCESA, a field-operating agency of the Office of the Civil Engineer of the Air Force, Washington, D.C., provides products and services in these major product areas:

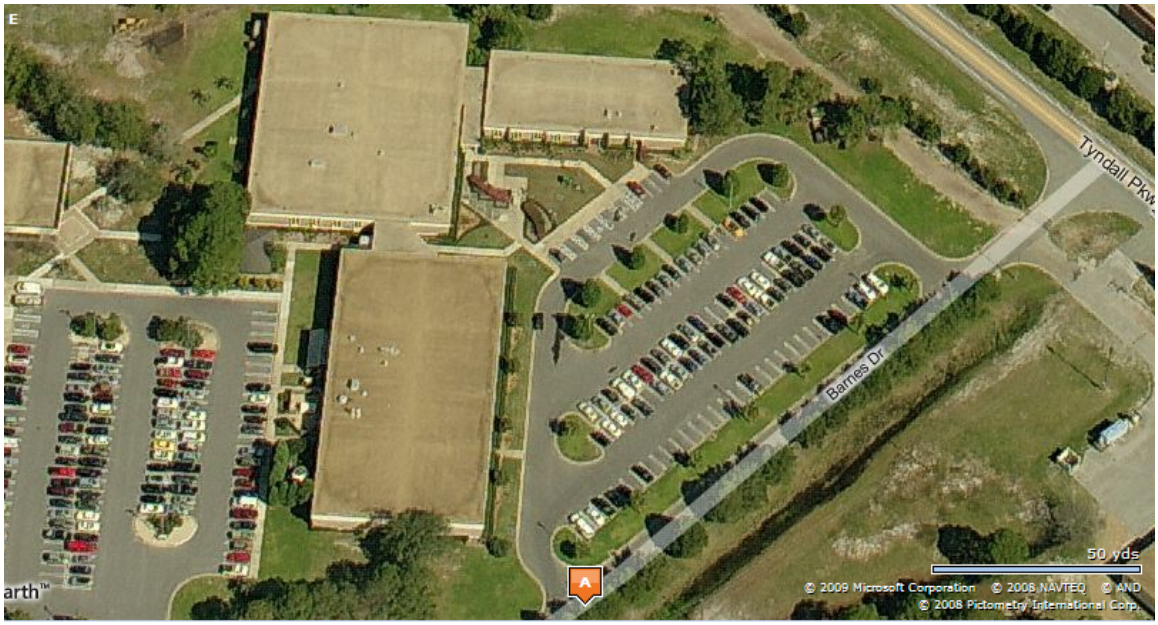
- Readiness and Emergency Management
- Facility Energy
- Fire Emergency Services
- Explosive Ordnance Disposal
- Operations and Readiness Support
- Infrastructure Engineering
- Direct Field Support
- Career Field Management
- Civil Engineer Training
- Civil Engineer Automation
- Project Execution Support

In this evaluation, ACESA will evaluate the potential to improve facility electrical performance and reduce its facility electrical maintenance budget by deploying power quality filters and surge protection throughout the facility and parking lot.

To accomplish this facility wide goal, AFCESA investigated, then purchased a number of filter protectors from two companies, Environmental Potentials and ACT Communications. Based on performance data reviewed in the commercial sector and information provided by each company, it is believed that AFCESA can develop a facility system protection strategy that can be deployed worldwide that could provide commands with a very quick return on investment goal of 12 months or less, with many years of continual savings in their facility Electrical budget. This system once deployed will not only protect and extend the life of existing electrical equipment but also future energy savings initiatives for that facility that will be connected to the facility power load.

Once validated, this investigation will continue with a yearly review of facility maintenance information to ensure initial savings continued year over year at the AFCESA Headquarters.

Selected Site Location



139 Barnes Dr. Suite 1
Panama City, Tyndall AFB, FL 32403

AFCESA headquarters was selected as the first field trial, because of its location in Florida and being a known hot spot for power quality related issues, the availability of local engineering resources and because its location allowed easier access to the research required by the engineers at AFCESA.

Scope of Evaluation

The scope of this evaluation was to discover the viability of a facility protection system to reduce the facility electrical budget. This system would also be expanded to protect facility Green initiatives implementing Wind and solar power and energy savings expected from the deployment of electronic ballast and LED lighting to be specified in the future.

This evaluation will be presented in two parts, Historical and Current

1. Analyze the historical facility electrical part and labor budget over the last 2 years (2007 and 2008). With this data, establish a facility expenditure baseline to use to determine Return On Investment calculations.
2. Analyze 2009 facility electrical part & labor budget since Protector/Filters were installed in December 2009.
3. Using Power Quality meters, evaluate ambient frequency noise generated from outside and inside the facility in December 2008 and then again after the Environmental Potentials Filter Protectors where installed on the power panels. With this information compare a before / after analysis to determine the initial effectiveness of the filters to reduce facility noise.
    a. See Panel schedule and product installation list

SECTION 2
Historical Data

Data and Evaluation of a Protection System to Reduce a Facility Electrical Budget

Two Year Historical Electrical Facility Maintenance Data

- *INSERT AVERAGE LABOR ASSOCIATED SPECIFICALLY WITH FACILITY ELECTRICAL MAINTENANCE & TROUBLE CALLS*
- *INSERT MONTHLY AVERAGE ASSOCIATED WITH MATERIAL REPLACEMENT (BALLAST, LIGHTS, HVAC, etc…)*

SECTION 3
Frequency Analysis Data

2008 Data and Evaluation of a Protection System to Reduce a Facility Electrical Budget

- **Analyze the Frequency Data on Site Before and After Filter/Protection equipment was installed**

Filter / Protection System

A Filter/Protection system for a facility is designed to focus on removing higher frequency that range from 3 kHz to 1 MHz but MUST also convert electrical noise to heat, are used specifically to reduce high frequency noise and transients generated inside and outside the facility created by power company, VFD, Ballast and other digital loads (computers, control cards). It has been demonstrated that reduction of these frequencies by removal of the unwanted noise from the building, improves efficiencies in transformers, motors, and hot spot's in the electrical wiring and increases the life of the motors and digital devices, significantly lowering the yearly facility maintenance budget. These filters have also demonstrated the ability to reduce the facility electrical kilowatt hour usage on motors, thus lowering the facility electrical budget.

Report of Findings

The findings in this report are compared to the guidelines suggested by the Standard Handbook For Engineers 13th Edition, IEEE STD. 519-1992 , Recommended Practices and Requirements For Harmonic Control In Electrical power Systems, IEEE STD. C62 Guides and Standards for Surge Protection, ANSI (American National Standards Institute), and the NEC (National Electrical Code).

Report Parameters

Based on the existing conditions at the point of monitoring and the aforementioned standards and guidelines, the quantitative limits are pre-programmed into the RPM (Reliable Power Meter). All recorded data is subsequently analyzed in comparison to these values.

Test Equipment

Item	Qty	Model #	Description
1	1	PK4533	System includes PS4500 with three (3) FX3000 Flexible Current Probes, DXV Voltage Leads, CAS3 Hard-Shell Carrying Case, 120 or 240 Volt Charging Unit, USB communication, Secure.
2	1	FAO	Frequency Analysis Option Power-line spectrum analysis from 3kHz to 100kHz, detecting 0.1mVrms to 1Vrms

Data Analysis

While EP Filter / Protectors were placed on all key panels at this facility and ACT Surge Protection Devices were installed in all light poles powered by this facility, a before and after test was conducted to allow a base line of the power condition at this facility reflecting status of power condition before and after the filters were installed. At the end of 2009, a frequency analysis on the six selected sample panels will again be conducted to demonstrate continual performance over a twelve month period and show any degradation in the Filter / Protectors (none expected).

Panel L2B2 – 120/208 V – Receptacles

This was a quiet panel even before filer installation with most of the noise focused in two primary areas; the first frequency band was at 3 – 10 kHz which is most likely caused from the lighting ballast. Based on the how the noise strength on the P1 –P3 test, an electrical device operating most likely on a phase-phase was generating most of the 2nd frequency at around 60 kHz. This frequency can be attributed to computer power supplies. Regardless the EP 2000 filter/protector was able to quiet the noise on all phases.

Panel L4B – 277/480 V - Lighting

This panel was very noisy and typical of a large lighting panel. Three tests were conducted on this panel to reflect Pre-protection install, Post-protection install, and Post-protection install after 4 hours. This experiment was to determine how the facility reacted to the filter over time. One of the observations during the testing phase was that all of the filter/protectors installed got warm to touch over time, and the highest heat felt was on the panels showing the most noise

being filtered off of the wires (i.e. the more noise seen, the harder the filter work burning off the noise). The filter is designed to reduce the energy towards -50 db and significant reduction was seen, but on some of the wave forms on the phases it appeared that some resonant frequencies developed between the filters and the impedance of the wire and capacitance of the electronic ballast causing some peaking. Regardless the total amount of energy in the random noise was thinned and no further filtering is recommended at this panel, particularly at the electronic ballast key transmission frequencies of 20kHz to 40 kHz.

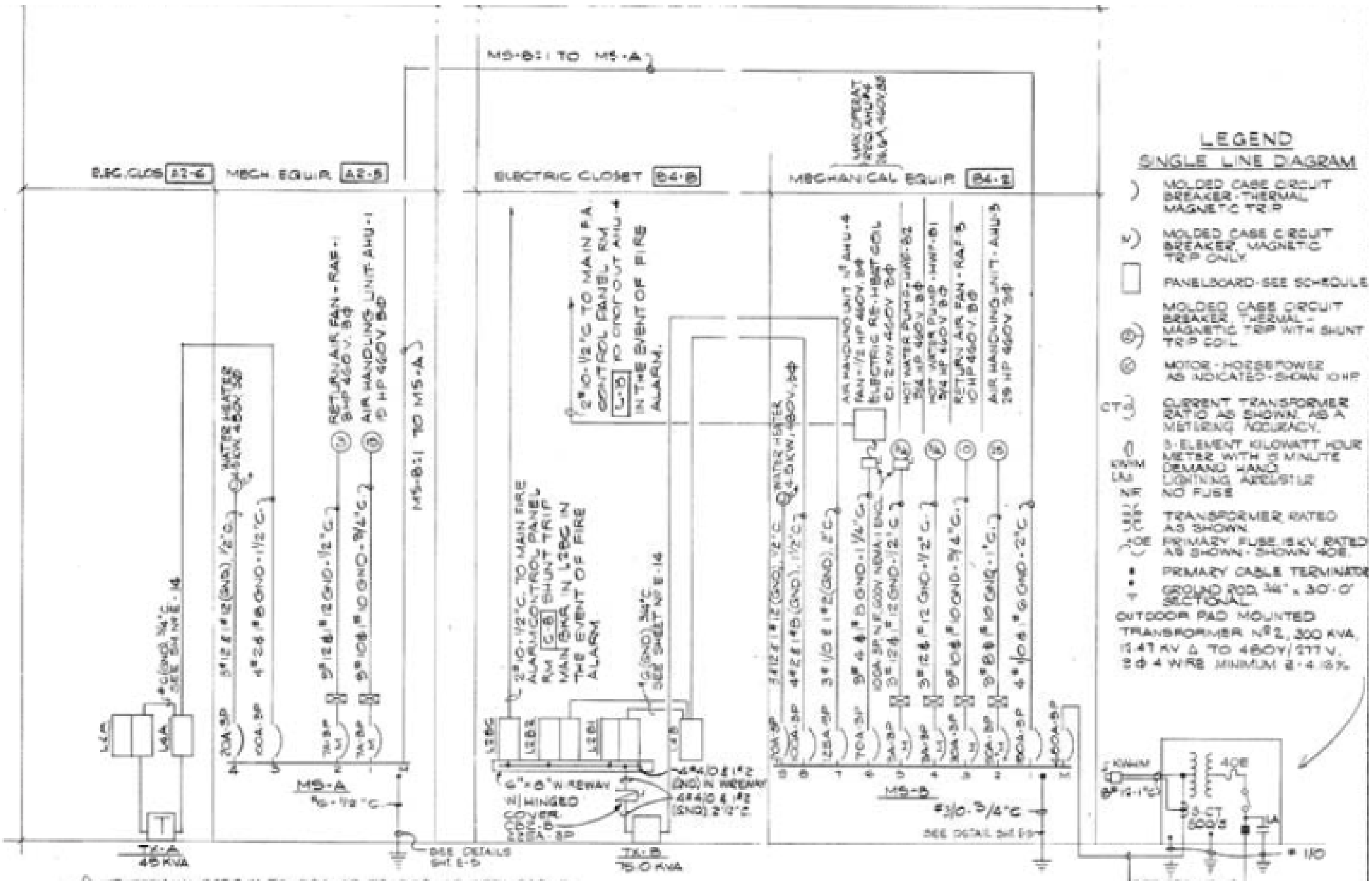
Panel L2C2 – 120/208 V – Receptacles, Kitchen
This panel was a quiet panel and after review, very little load was actually turned on at the time of test. A strong 60 kHz noise spike was present which was likely attributed to a digital circuit applied to the load. The filter had no problem reducing this frequency/noise by at least -10 db.

Panel L4C2 – 277/480 V – Lighting
This panel was very noisy and was listed as providing power to lighting. With that addition of the filter/protector at least -5db was seen on the panel up to -12 db reduction in noise (particularly at the higher frequencies).

Panel L2A Section 3 – 120/208 V – Receptacles
This panel was providing power to a small office area where there was only 3 computers on at the time verses the 75 offices. This lack of load provided the team with a data sample of how quiet a panel can be without many electronic devices creating noise on the circuit.

Panel L4A Section 3 – 277/480 V – Main Switch Panel
While this office area was definitely operating with very low load on this day of the test, lighting ballast transmission frequency signature of 20 kHz to 40 kHz was still clearly visible on this main panel power. While the noise level was reduced, the filter still clearly showed a reduction in the overall level of the noise.

Conclusion
After review of the gathered information regarding noise level on the power panels at the time of this survey, it is believed that the EP 2000, and EP 2500 Filter Protectors clearly had a positive effect on the overall facility electrical system. Based on the data seen, no other filters are recommended at this time and should be sufficient to allow monitoring of the facility maintenance budget for the year of 2009. Based on the data gathered at other similar facilities, AFCESA Headquarters can expect a reduction to their facility maintenance. This will be validated in Section 4 of this report.



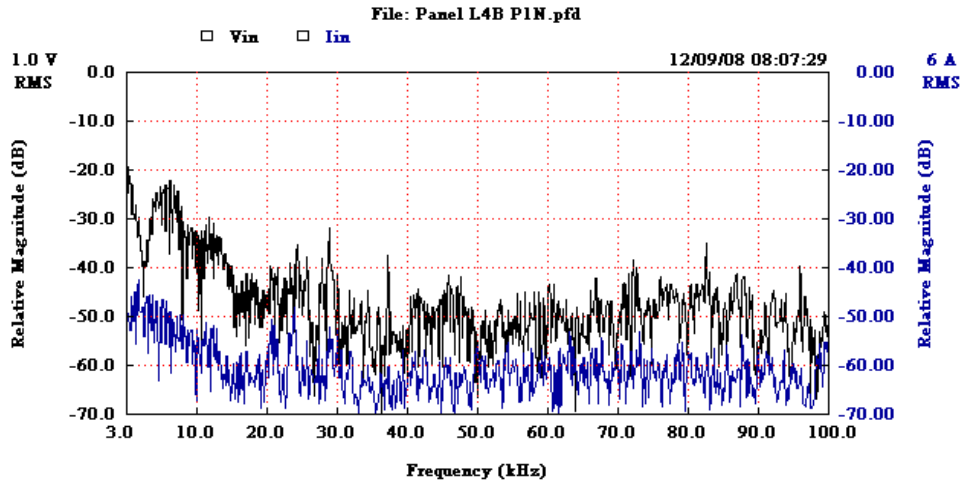
MS-B:1 TO MS-A
ELEC. CLOS A2-6
MECH. EQUIP. A2-5
ELECTRIC CLOSET B4-8
MECHANICAL EQUIP. B4-2
MAX OPERAT REQ AHU #4 36.9A 460V 3Ø
LEGEND
SINGLE LINE DIAGRAM
MOLDED CASE CIRCUIT BREAKER - THERMAL MAGNETIC TRIP
MOLDED CASE CIRCUIT BREAKER, MAGNETIC TRIP ONLY
PANELBOARD - SEE SCHEDULE
MOLDED CASE CIRCUIT BREAKER, THERMAL - MAGNETIC TRIP WITH SHUNT TRIP COIL
MOTOR - HORSEPOWER AS INDICATED - SHOWN 10 HP
CURRENT TRANSFORMER RATIO AS SHOWN. ASA METERING ACCURACY.
3 ELEMENT KILOWATT HOUR METER WITH 15 MINUTE DEMAND HAND
LIGHTNING ARRESTER
NO FUSE
TRANSFORMER RATED AS SHOWN.
PRIMARY FUSE 15KV RATED AS SHOWN - SHOWN 40E.
PRIMARY CABLE TERMINATOR
GROUND ROD, 3/4" x 30'-0" SECTIONAL
OUTDOOR PAD MOUNTED TRANSFORMER Nº2, 300 KVA, 13.47 KV Δ TO 480Y/277 V, 3Ø 4 WIRE MINIMUM Z - 4.18%
WATER HEATER 4.5KW 480V 3Ø
RETURN AIR FAN - RAF-1 3HP 460V 3Ø
AIR HANDLING UNIT AHU-1 15 HP 460V 3Ø
MS-B:1 TO MS-A
MS-A
TX-A 45 KVA
SEE DETAILS SHT. E-5
2"C (GND) 3/4"C SEE SH Nº E-14
2#10 - 1/2"C TO MAIN F.A. CONTROL PANEL RM L-13 TO DROP OUT AHU-4 IN THE EVENT OF FIRE ALARM.
2#10 - 1/2"C TO MAIN FIRE ALARM CONTROL PANEL RM C-8 SHUNT TRIP MAIN BKR IN L3BC IN THE EVENT OF FIRE ALARM
6"x8" W. REWAY W/ HINGED COVER CDC-B 225A - 3P
TX-B 75.0 KVA
WATER HEATER 45KW, 480V, 3Ø
AIR HANDLING UNIT Nº AHU-4 FAN - 1/2 HP 460V 3Ø ELECTRIC RE-HEAT COIL 31.2 KW 460V 3Ø
HOT WATER PUMP - HWP-B2 3/4 HP 460V 3Ø
HOT WATER PUMP - HWP-B1 3/4 HP 460V 3Ø
RETURN AIR FAN - RAF-3 10 HP 460V 3Ø
AIR HANDLING UNIT - AHU-3 29 HP 460V 3Ø
100A 3P N.F. 600V NEMA 1 ENCL.
MS-B
#3/0 - 3/4"C
SEE DETAIL SHT E-5
KWHM
40E
3-CT 600/5
LA
#1/0

Panel Board	Voltage	EP Part Number	EP Serial Number	Actual Circuit Installed On Breaker
L2A Sect. 3	120/208	EP2000-120/208	014264.AB	38, 40, 42
L2A Sect. 2	120/208	EP2000-120/208	014265.AB	63, 65, 67
L2A Sect. 1				
E2A	120/208	EP2000-120/208	None installed	None installed
MPE Main; E4A	277/480	EP2500-277/480	0147016RC	6; 3pole breaker

L4A MP-A	277/480	EP2500-277/480	014717RC	8, 10, 12
E2B	120/208	EP2000-120/208	014258.AB	25, 27, 29
E4B	277/480	EP2500-277/480	014714RC	2 (stripped screw), 4, 6 Federal Pacific Panel
L2B3	120/208	EP2000-120/208	014267.AB	34, 36, 38
L2B2 Section 1 & 2 ganged together (Put PQ meter on this panel)	120/208	EP2000-120/208	014262.AB	76, 78, 80

L2B1 Section 1	120/208	EP2000-120/208	014257.AB	37, 39, 41
L2B1 Section 2	120/208	EP2000-120/208	014260.AB	73, 75, 77
L4B (put PQ meter on this panel)	277/408	EP2500-277/480	014713RC	26, 28, 30
L2C2A	120/208	EP2000-120/208	014263.AB	37, 39, 41
L2C1 Section 2	120/208	EP2000-120/208	014259.AB	75, 77, 79
L2C2 Section 2 (put PQ meter on this panel)	120/208	EP2000-120/208	014261.AB	38, 40, 42

L4C2 (put PQ meter on this panel)	277/480	EP2500-277/480	014718RC	14, 16, 18
L2C1A	120/208	EP2000-120/208	014266.AB	37, 39, 41
E4C2	277/480	EP2500-277/480	014719RC	1, 3, 5
L4C1	277/480	EP2500-277/480	014715RC	14, 16, 18
	277/480	ACT LP-480Y-100-RL	Installed in 8 poles	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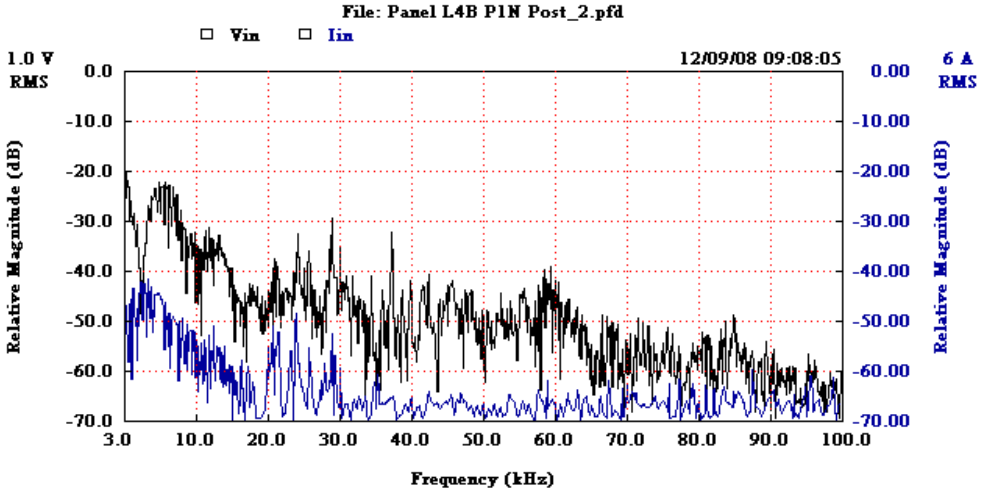
Frequency (kHz)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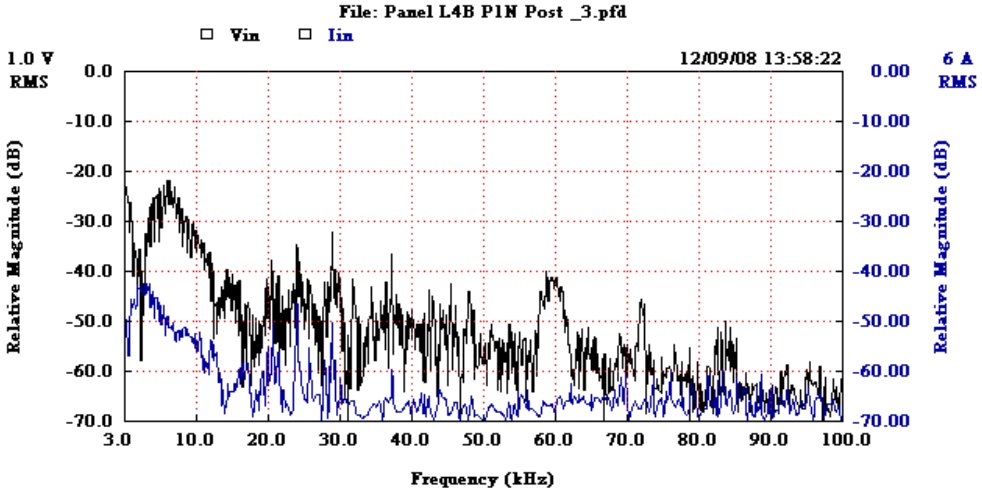
Frequency (kHz)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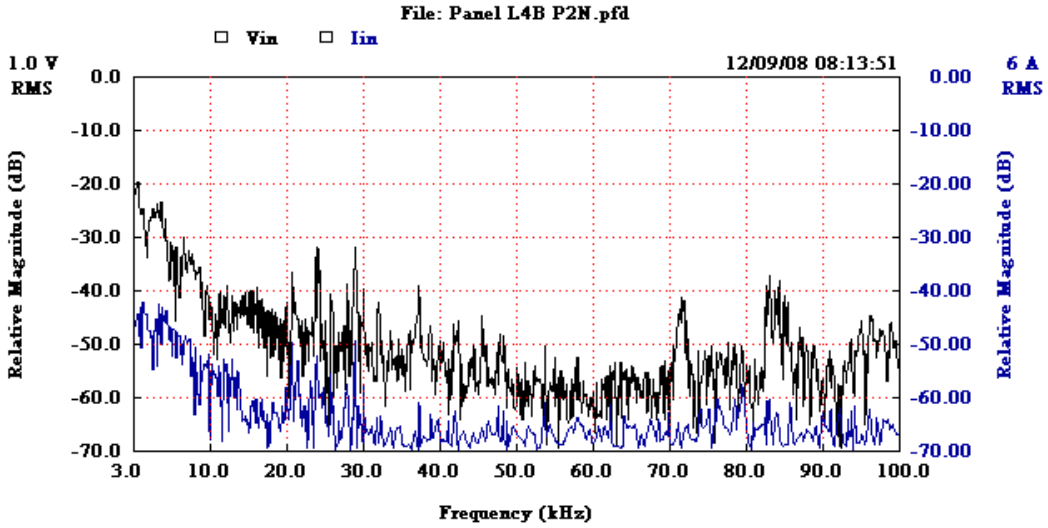
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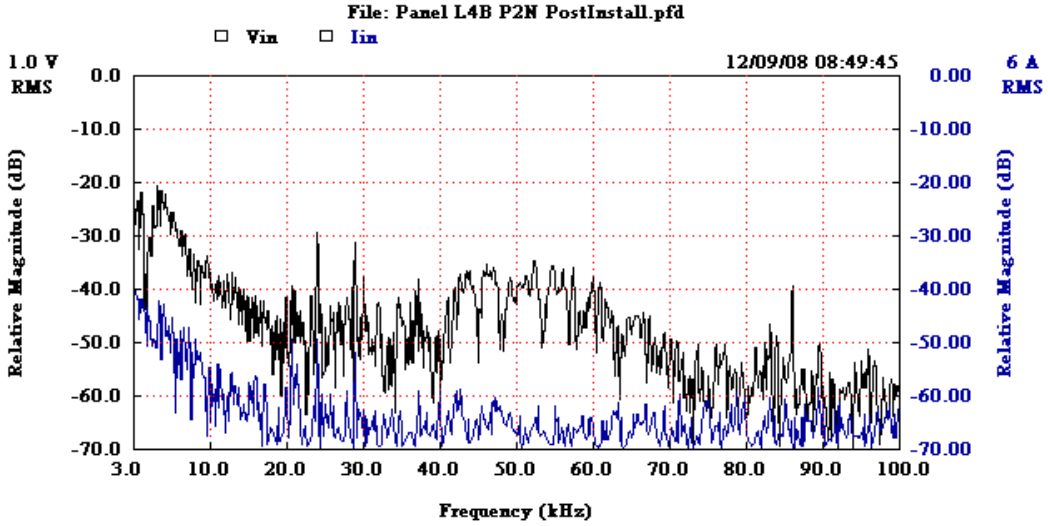
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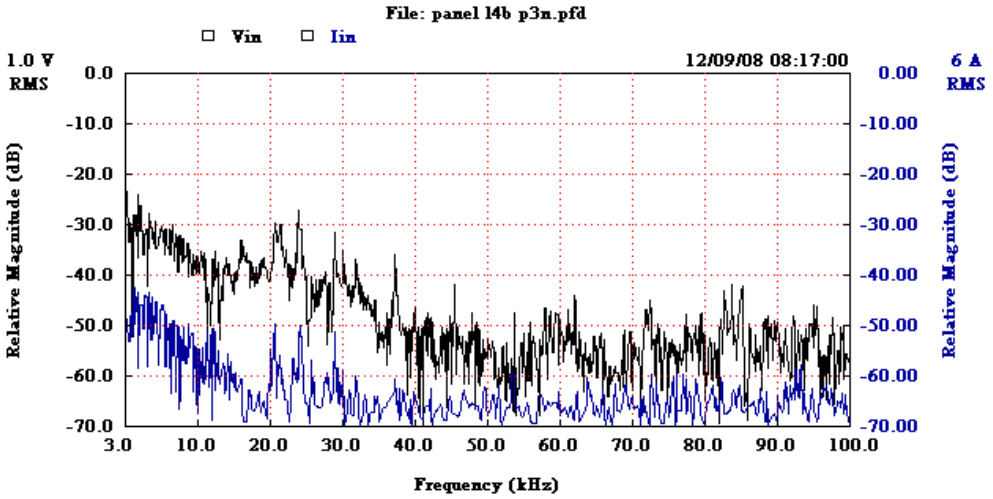
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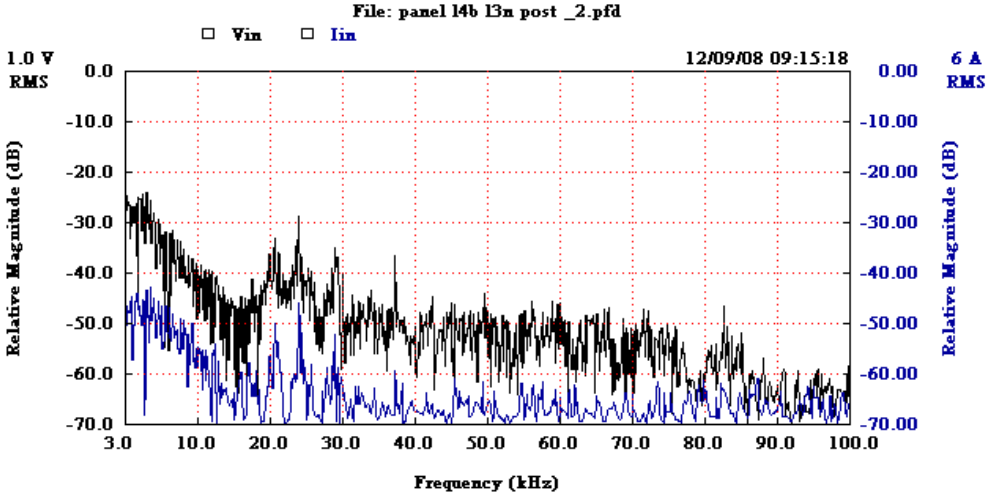
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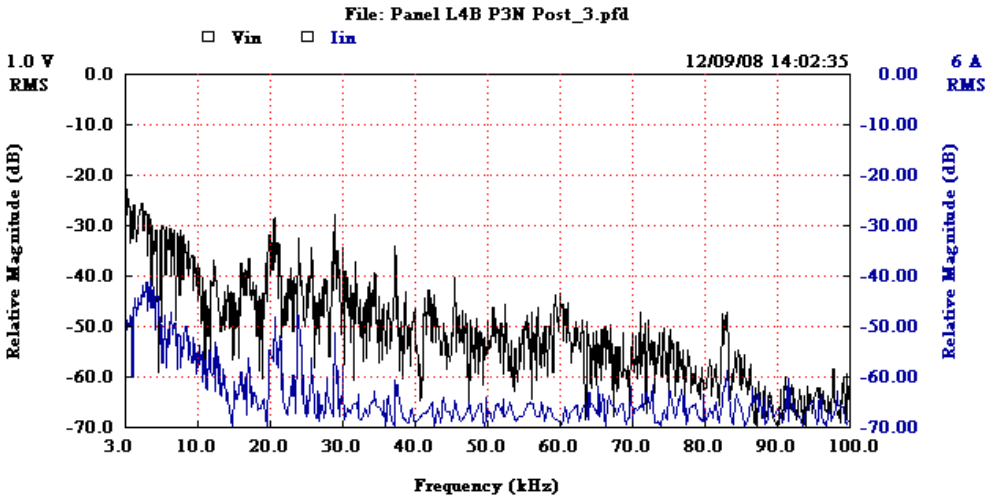
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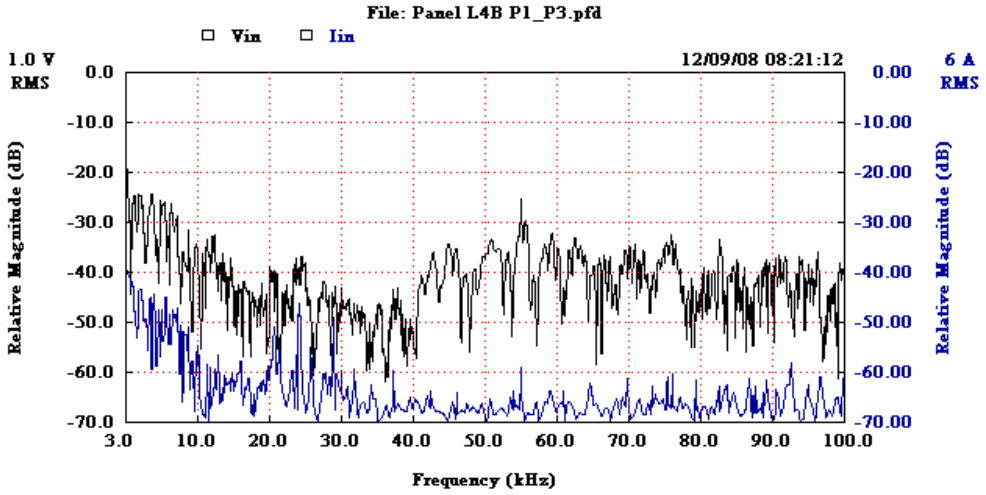
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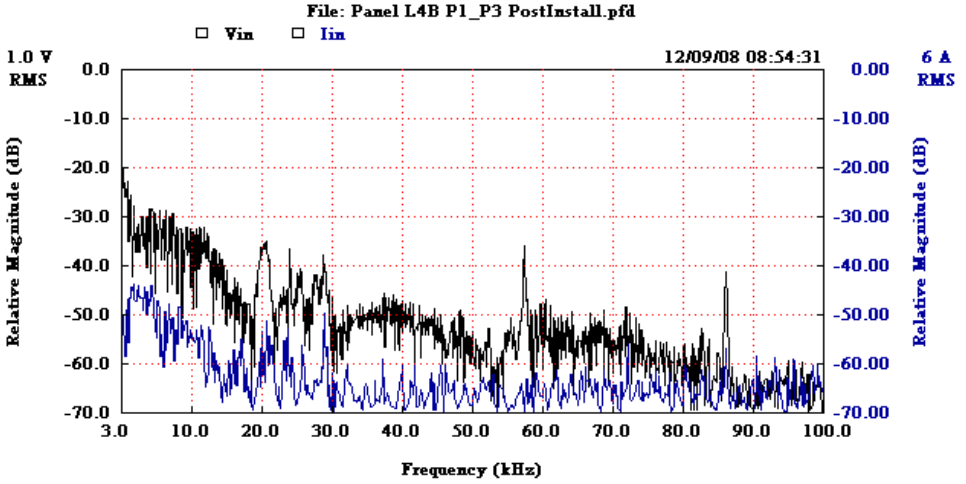
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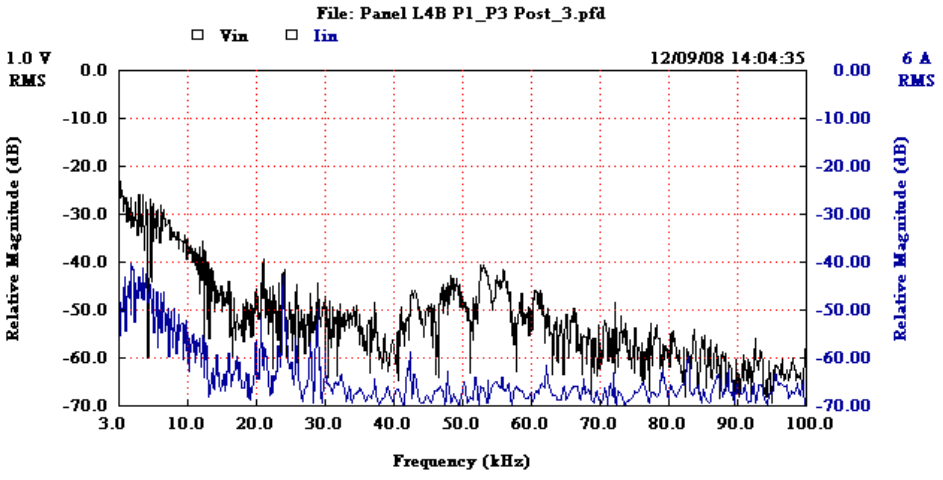
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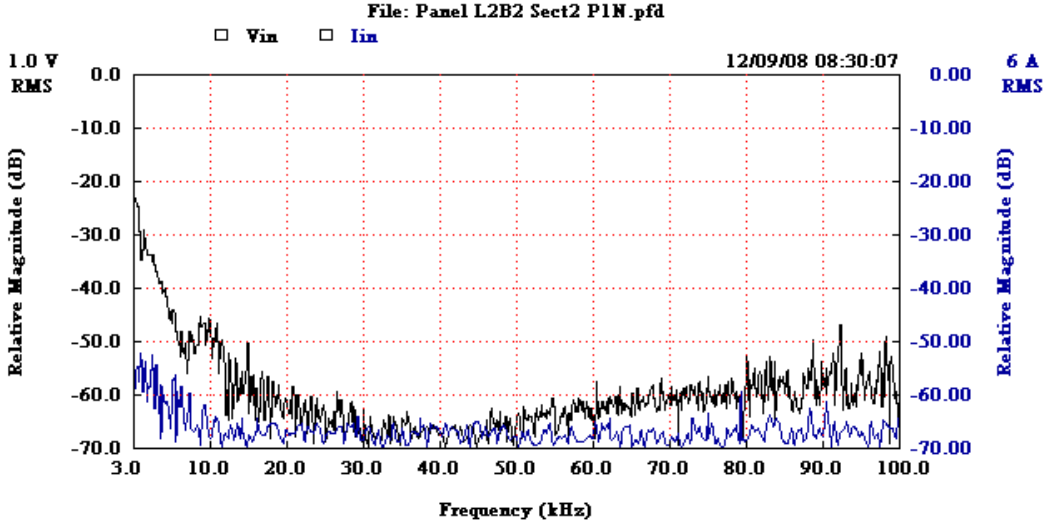
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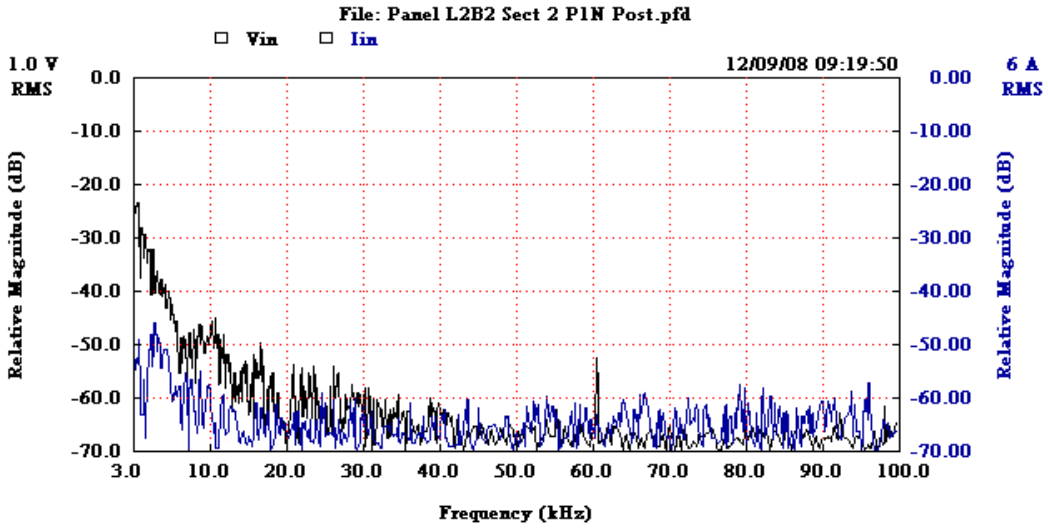
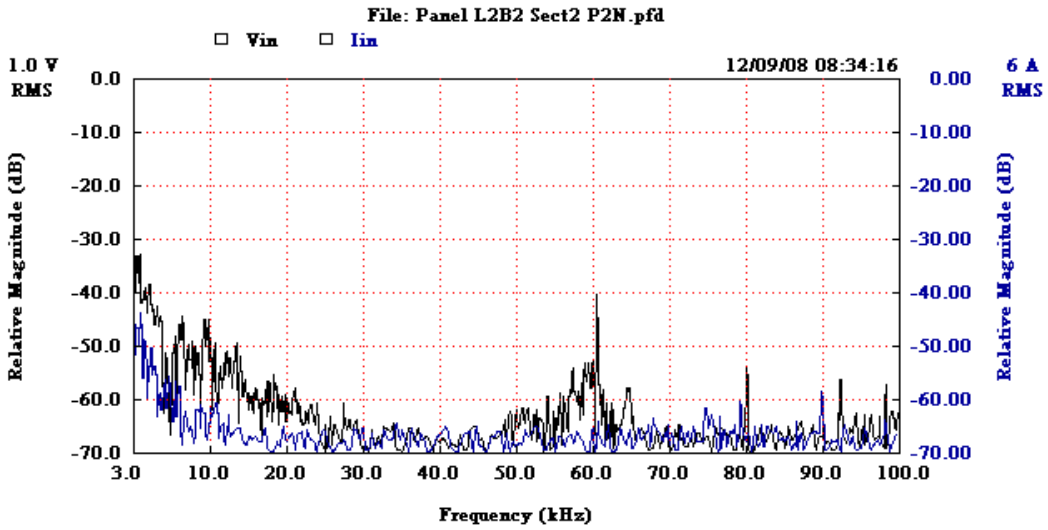
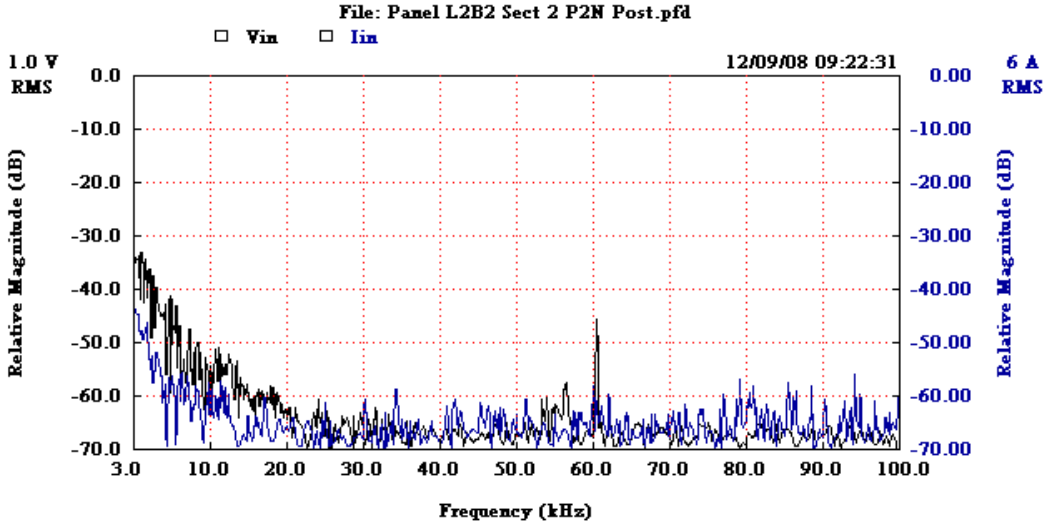
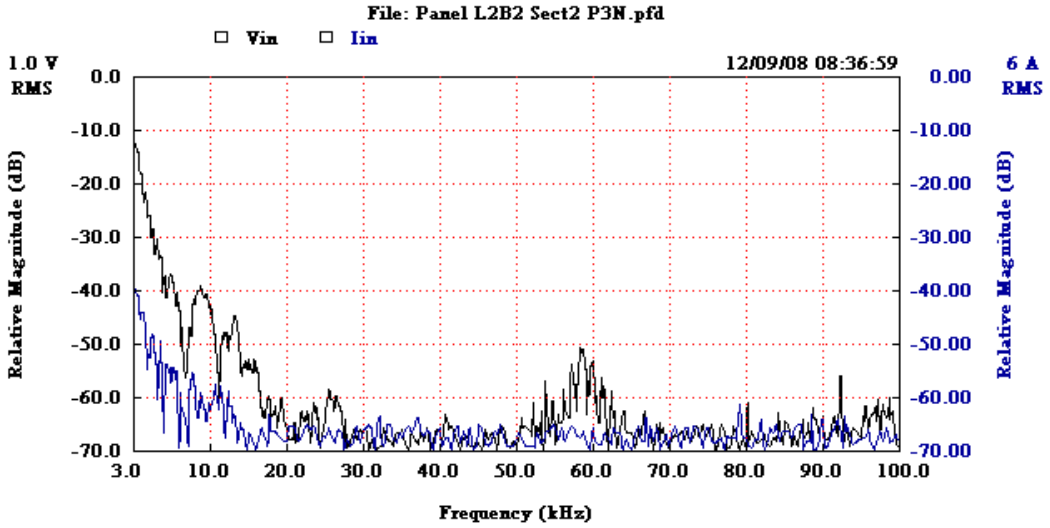
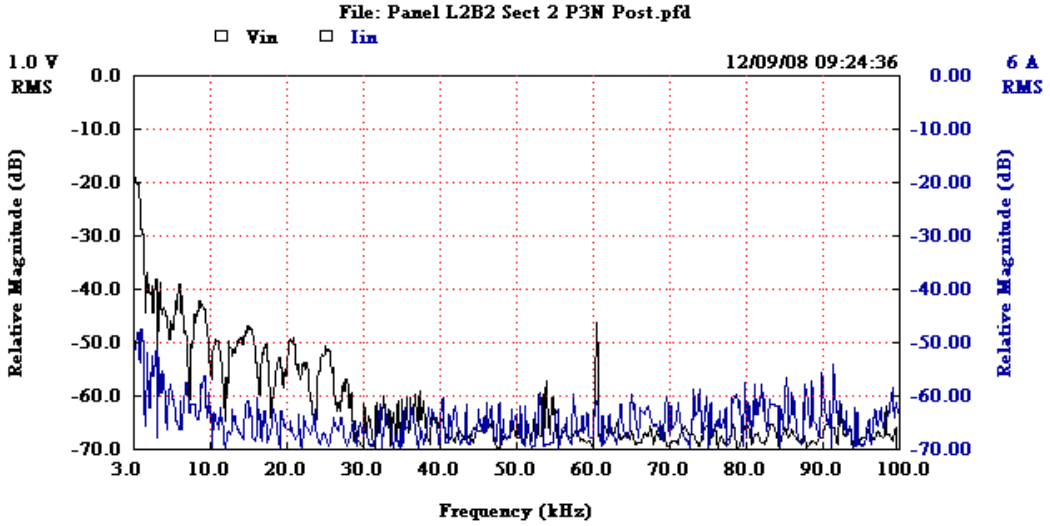
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

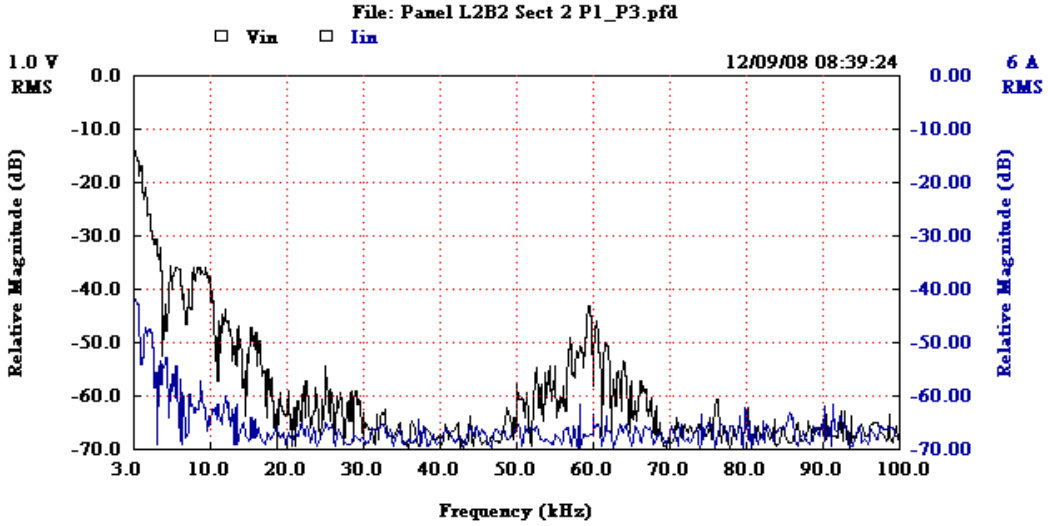

File: Panel L2B2 Sect 2 P1N Post.pfd
Vin
Iin
12/09/08 09:19:50
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

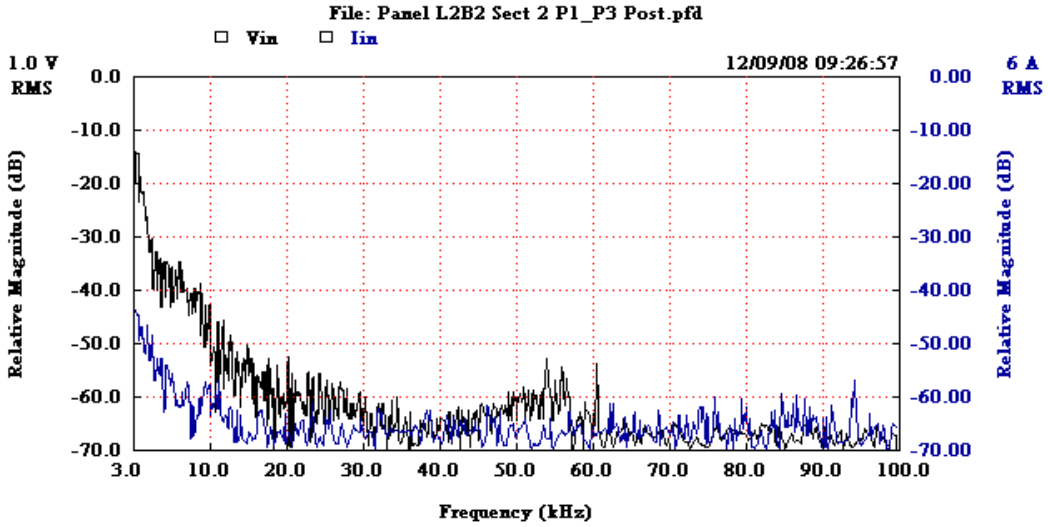

File: Panel L2B2 Sect2 P2N.pfd
Vin
Iin
12/09/08 08:34:16
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

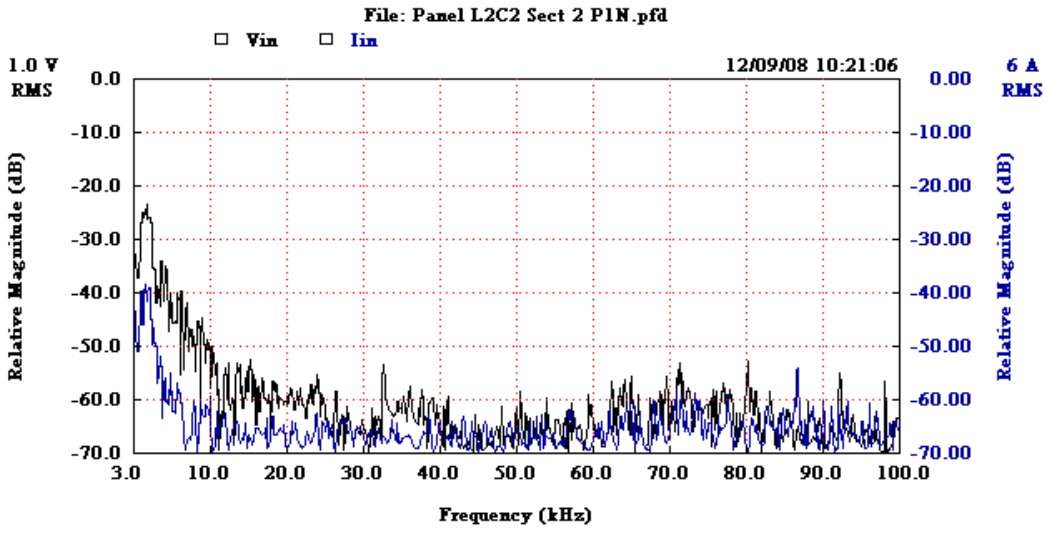

File: Panel L2B2 Sect 2 P2N Post.pfd
Vin
Iin
12/09/08 09:22:31
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

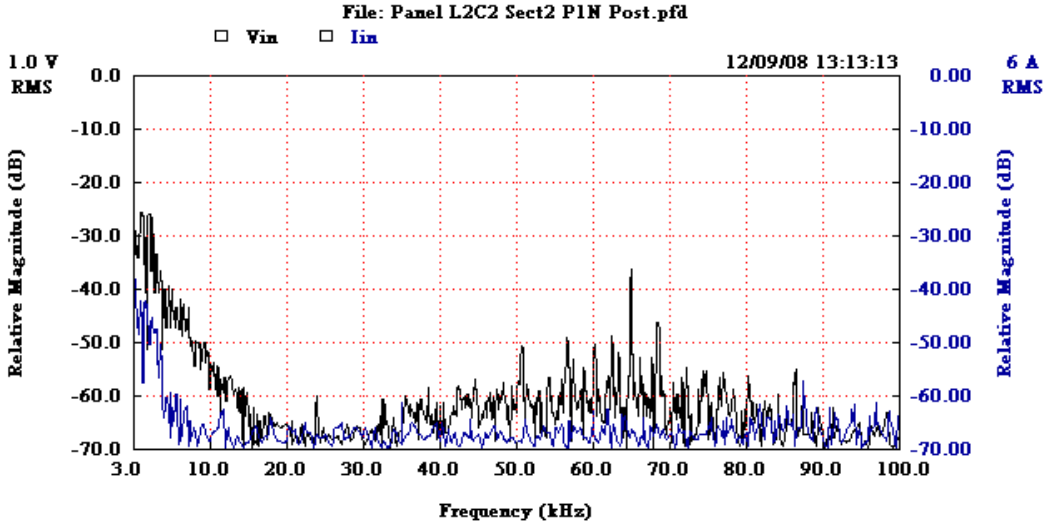

File: Panel L2B2 Sect2 P3N.pfd
Vin
Iin
12/09/08 08:36:59
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

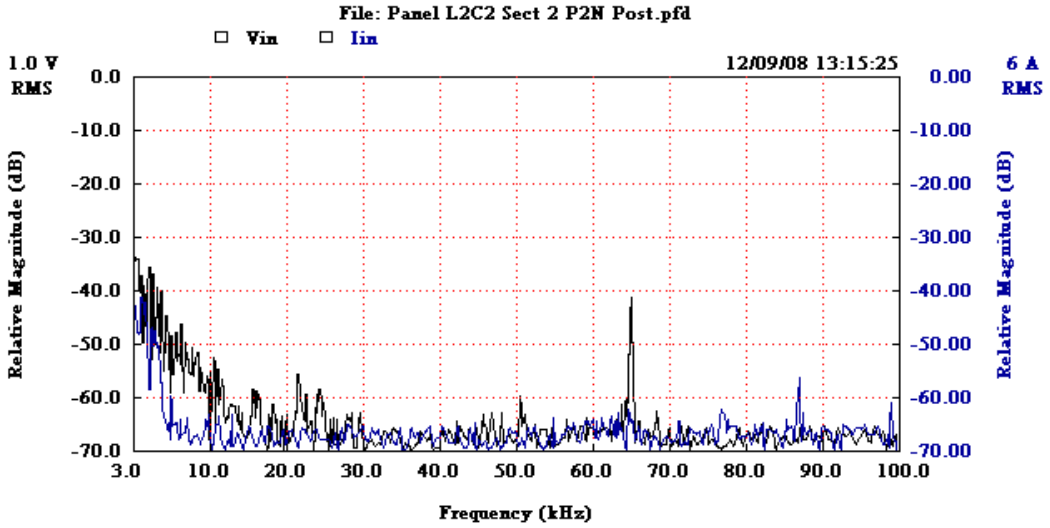

File: Panel L2B2 Sect 2 P3N Post.pfd
Vin
Iin
12/09/08 09:24:36
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

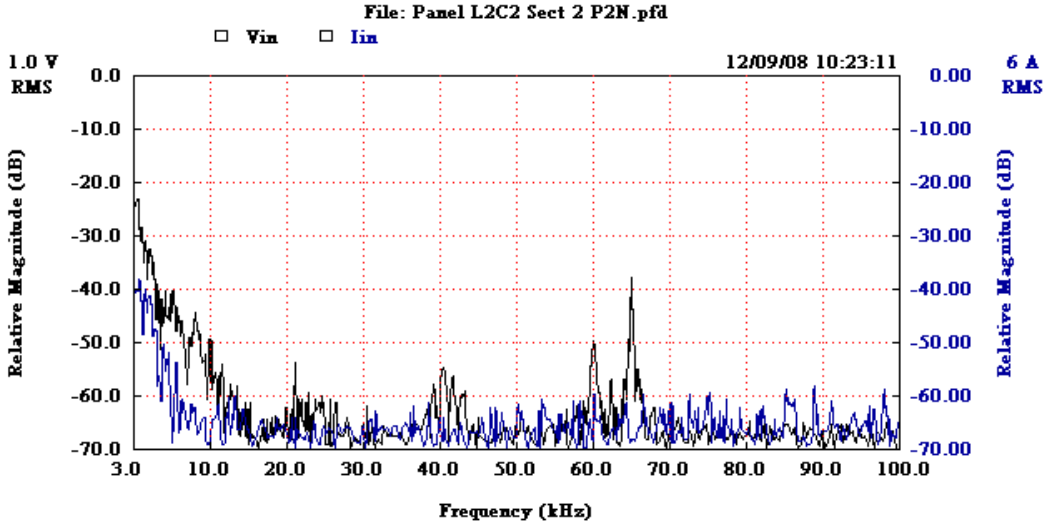

File: Panel L2B2 Sect 2 P1_P3.pfd
Vin
Iin
12/09/08 08:39:24
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

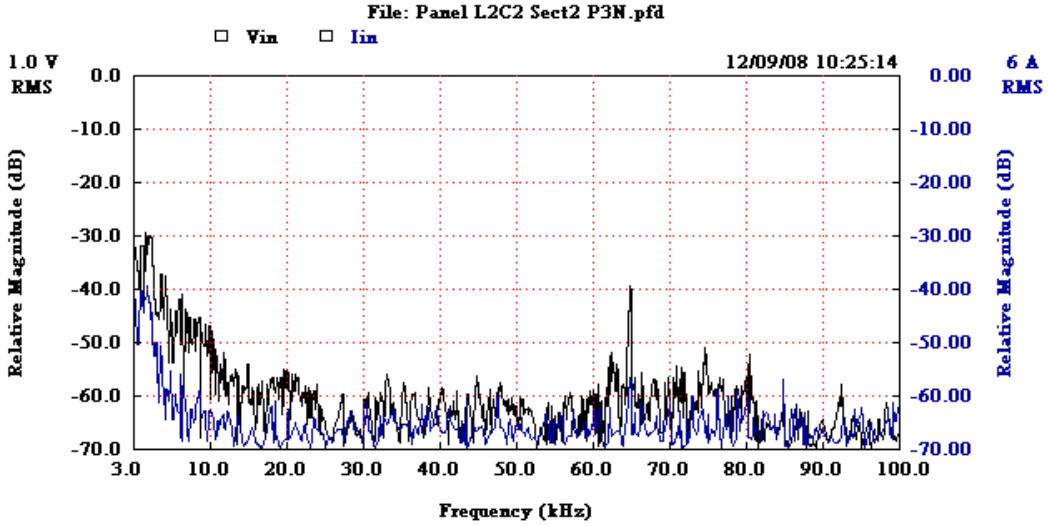

File: Panel L2B2 Sect 2 P1_P3 Post.pfd
Vin
Iin
12/09/08 09:26:57
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

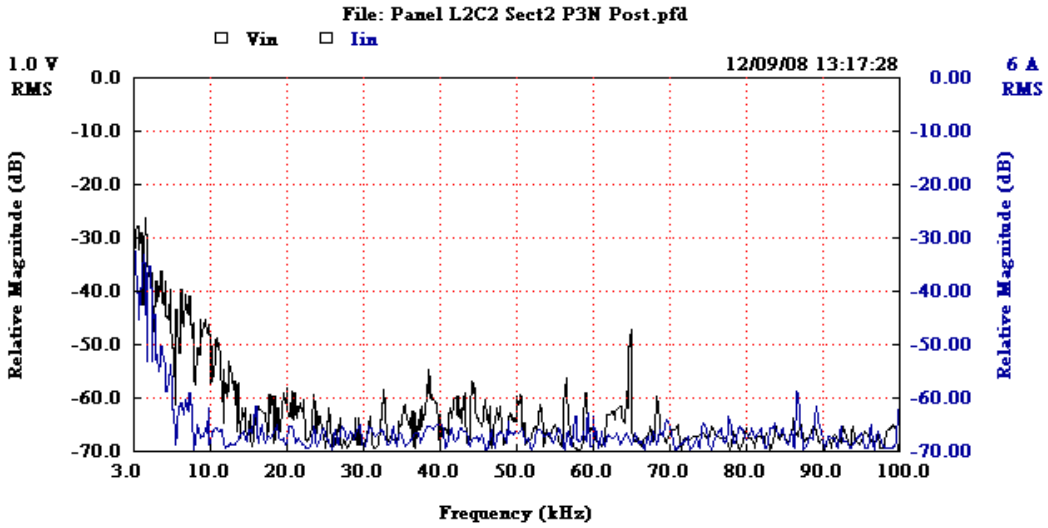

File: Panel L2C2 Sect 2 P1N.pfd
Vin
Iin
12/09/08 10:21:06
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

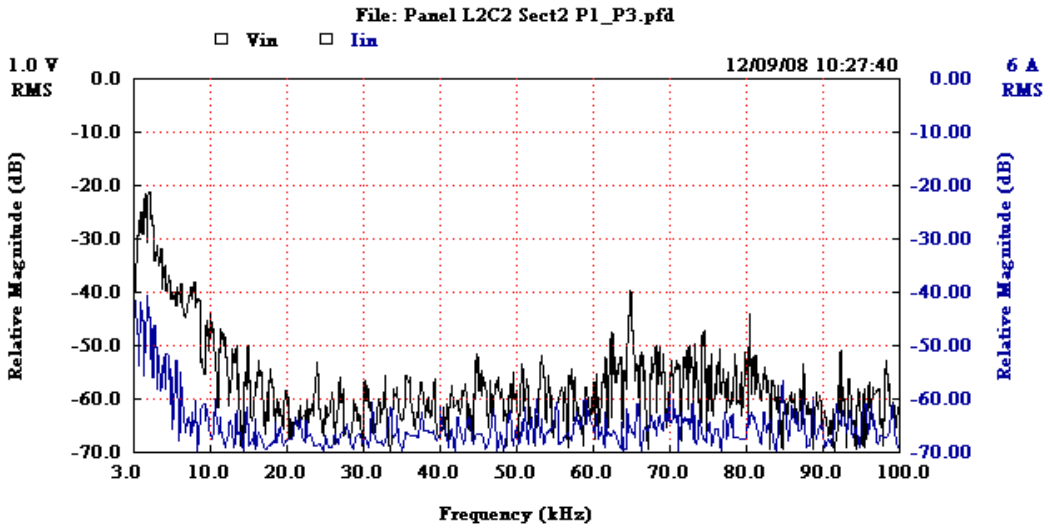

File: Panel L2C2 Sect2 P1N Post.pfd
Vin
Iin
12/09/08 13:13:13
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

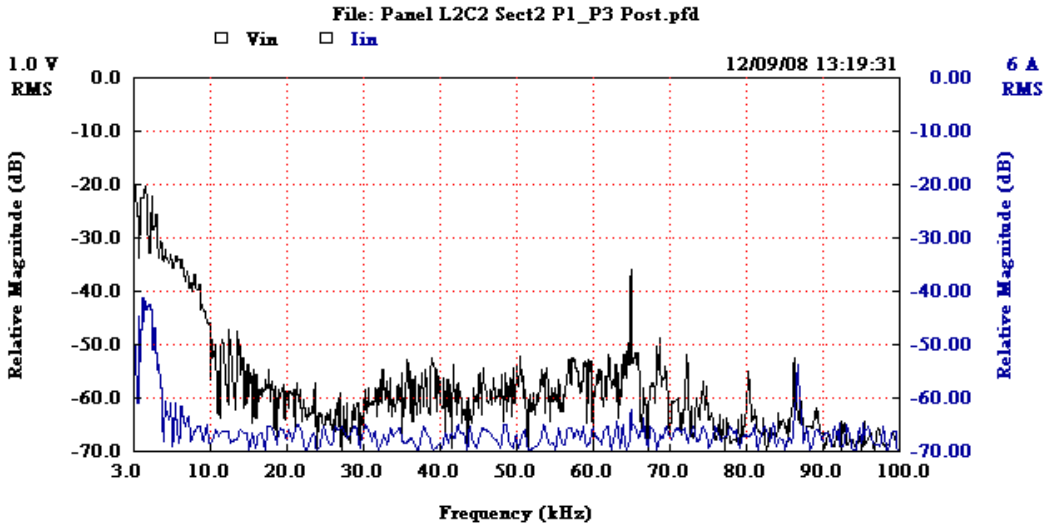

File: Panel L2C2 Sect 2 P2N Post.pfd
Vin
Iin
12/09/08 13:15:25
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

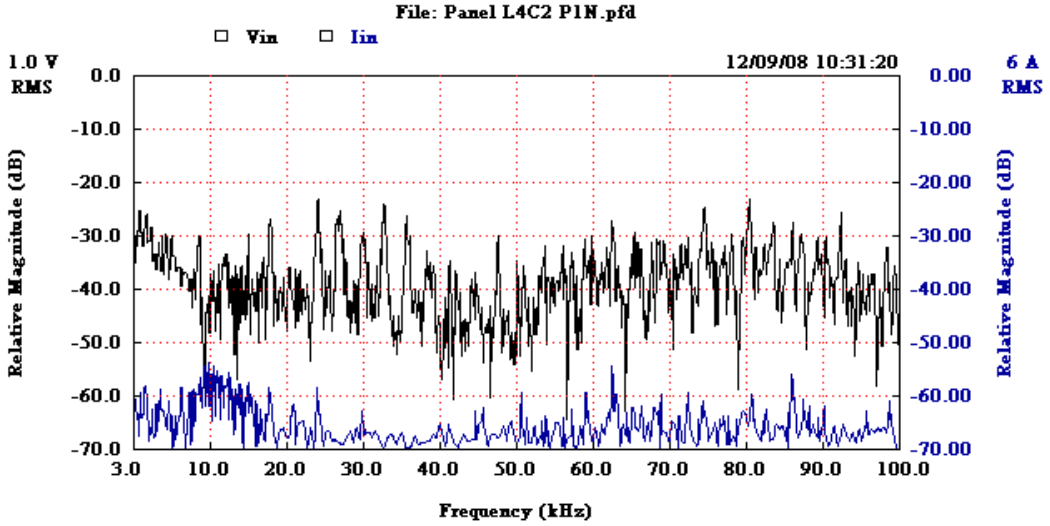

File: Panel L2C2 Sect 2 P2N.pfd
Vin
Iin
12/09/08 10:23:11
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

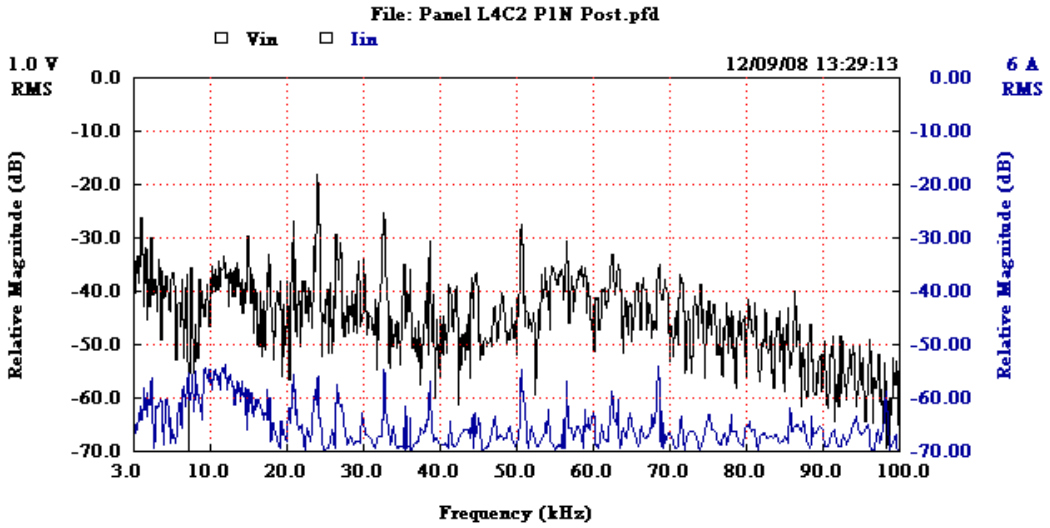

File: Panel L2C2 Sect2 P3N.pfd
Vin
Iin
12/09/08 10:25:14
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

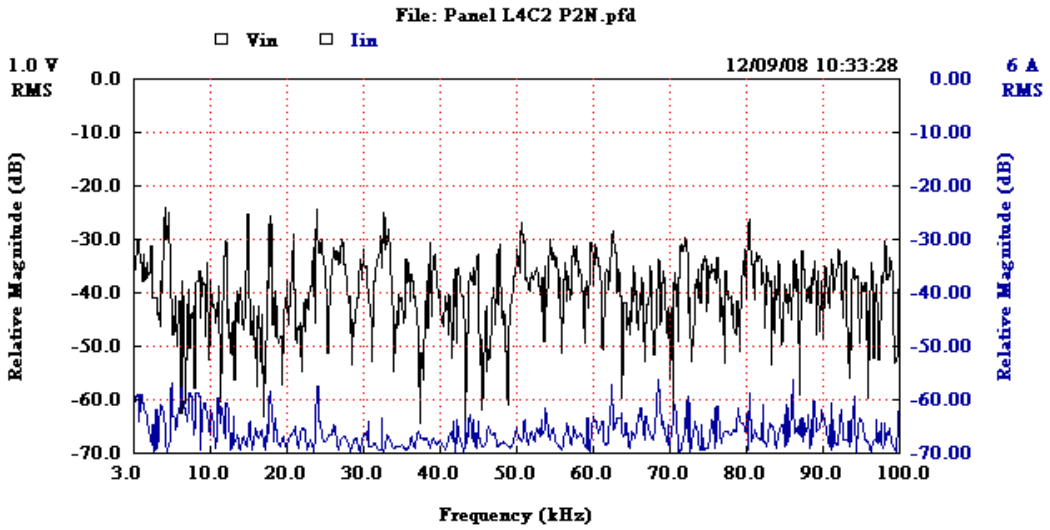

File: Panel L2C2 Sect2 P3N Post.pfd
Vin
Iin
12/09/08 13:17:28
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

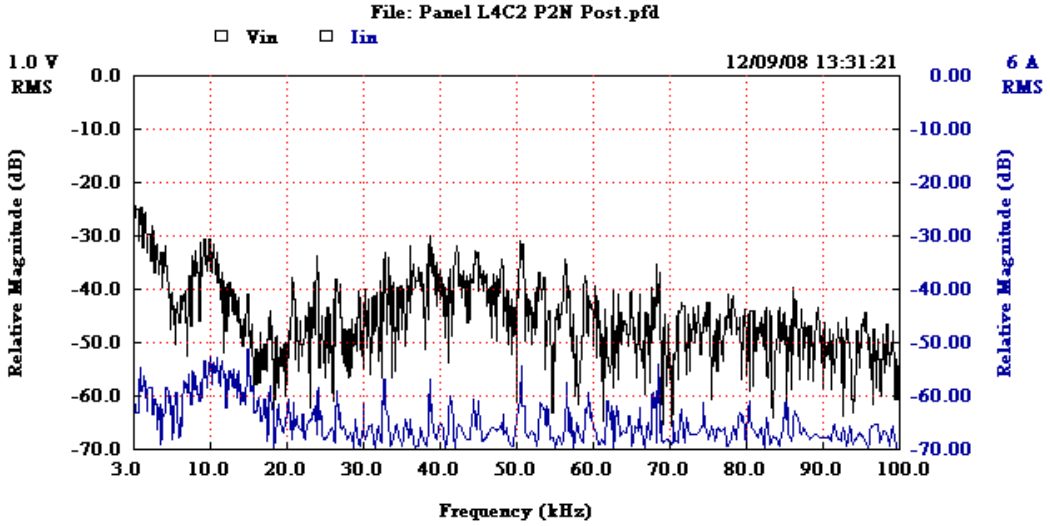

File: Panel L2C2 Sect2 P1_P3.pfd
Vin
Iin
12/09/08 10:27:40
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

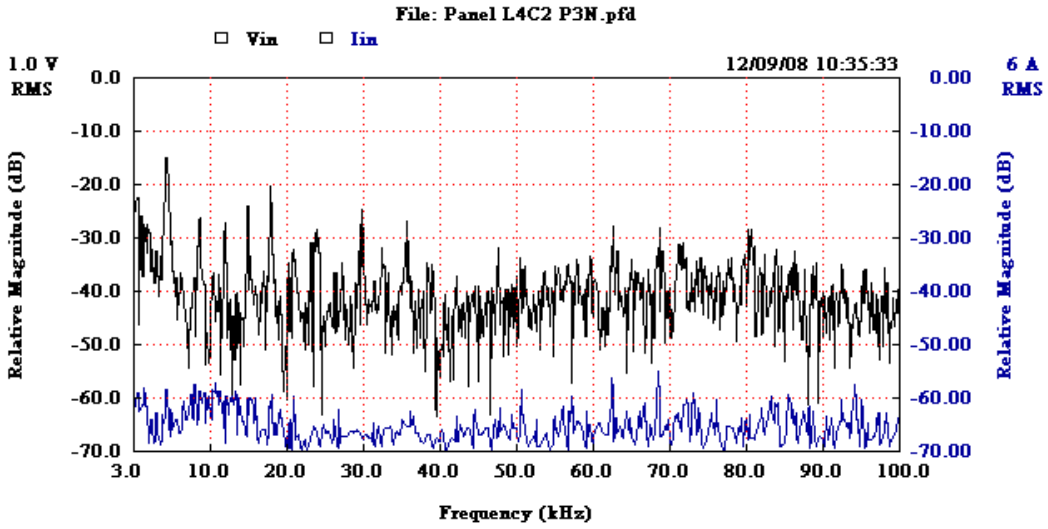

File: Panel L2C2 Sect2 P1_P3 Post.pfd
Vin
Iin
12/09/08 13:19:31
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

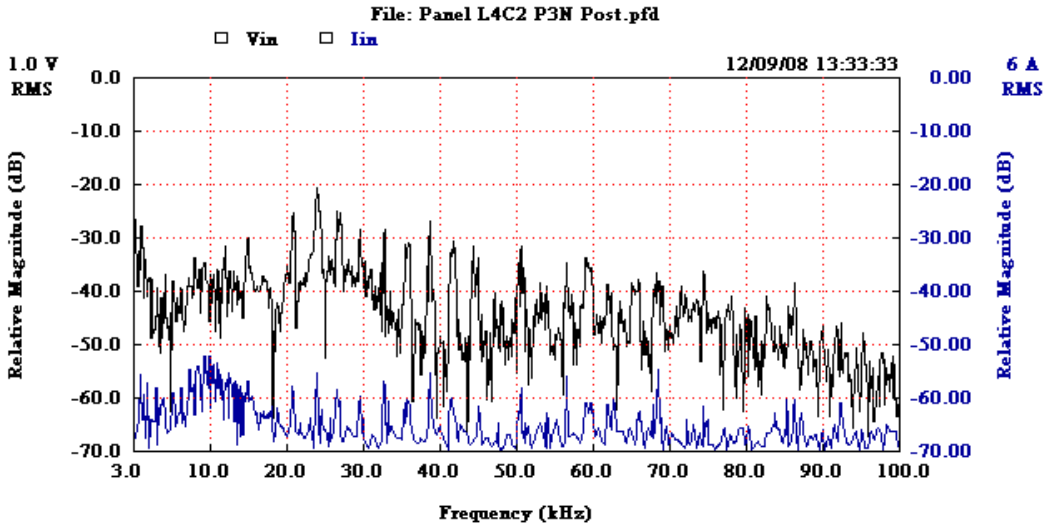

File: Panel L4C2 P1N.pfd
Vin
Iin
12/09/08 10:31:20
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

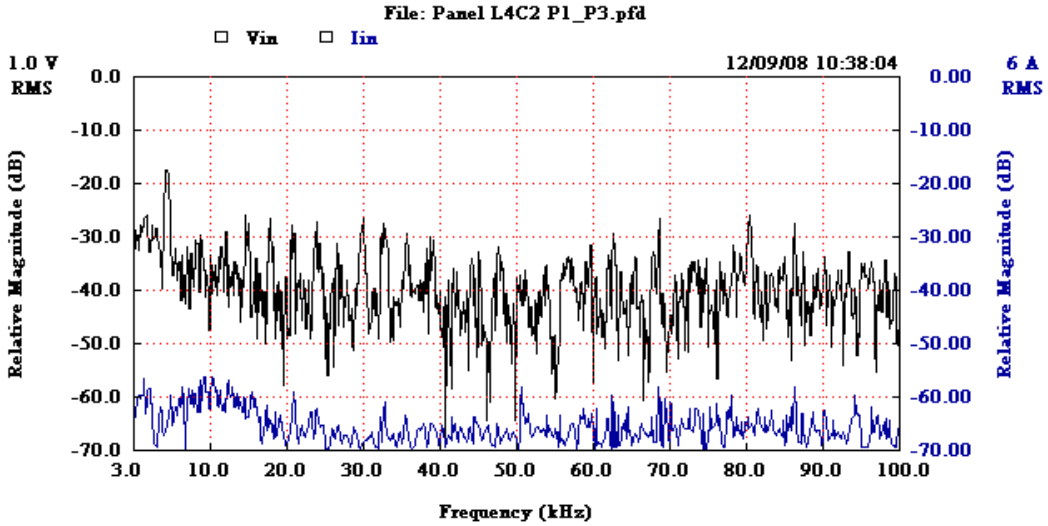

File: Panel L4C2 P1N Post.pfd
Vin
Iin
12/09/08 13:29:13
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

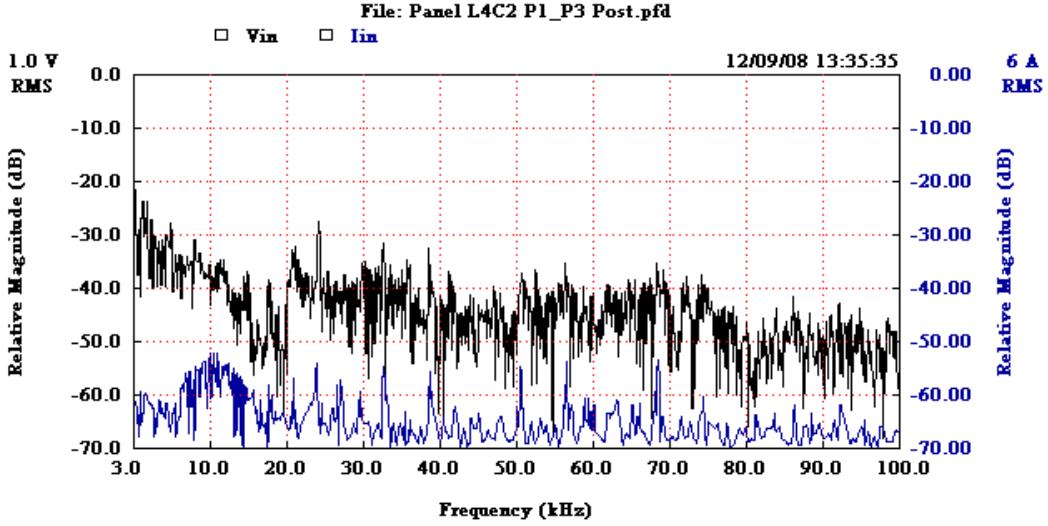

File: Panel L4C2 P2N.pfd
Vin
Iin
12/09/08 10:33:28
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

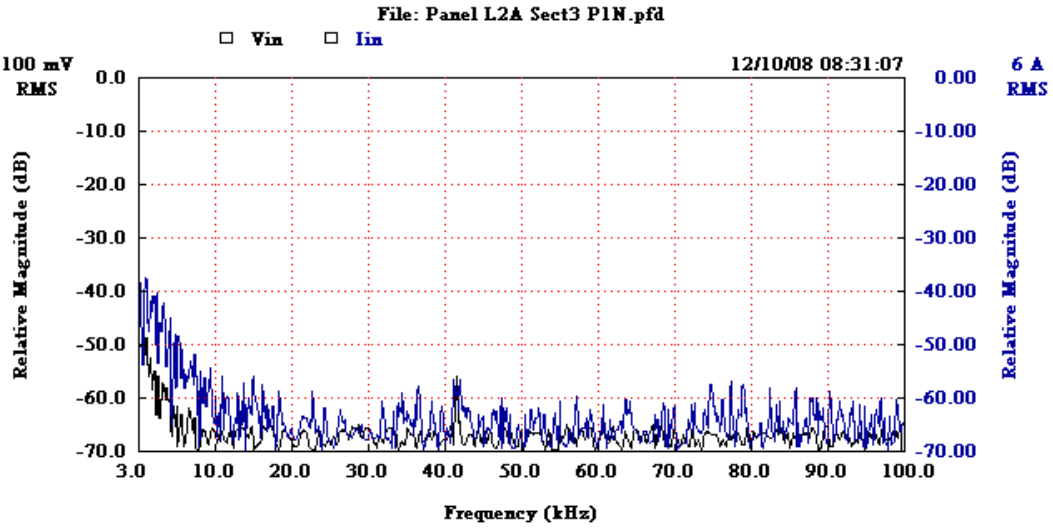

File: Panel L4C2 P2N Post.pfd
Vin
Iin
12/09/08 13:31:21
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

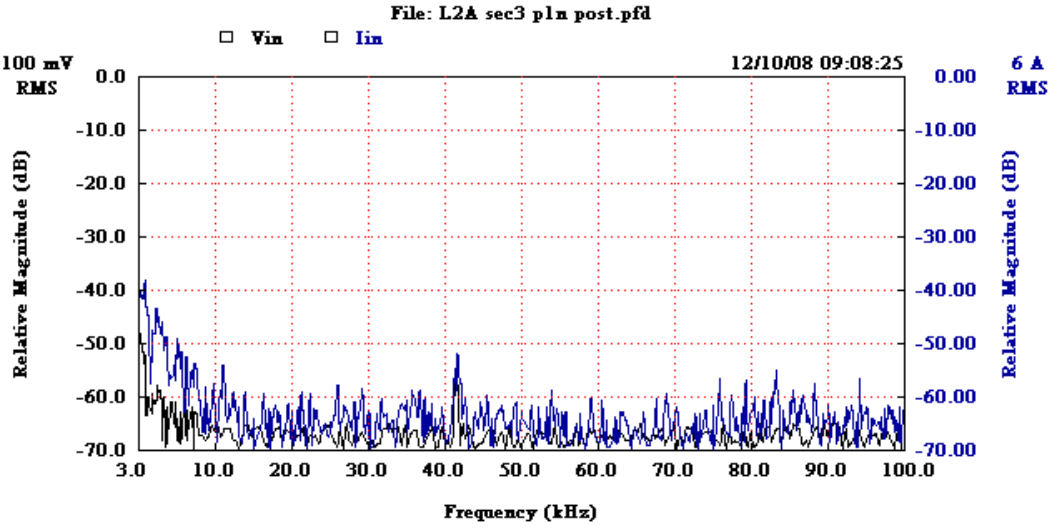

File: Panel L4C2 P3N.pfd
Vin
Iin
1.0 V RMS
12/09/08 10:35:33
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

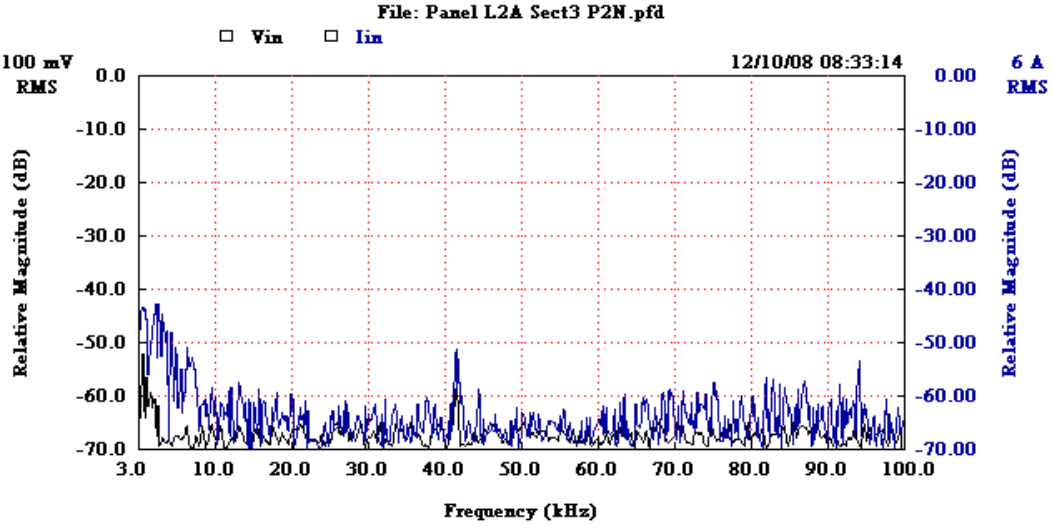

File: Panel L4C2 P3N Post.pfd
Vin
Iin
1.0 V RMS
12/09/08 13:33:33
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

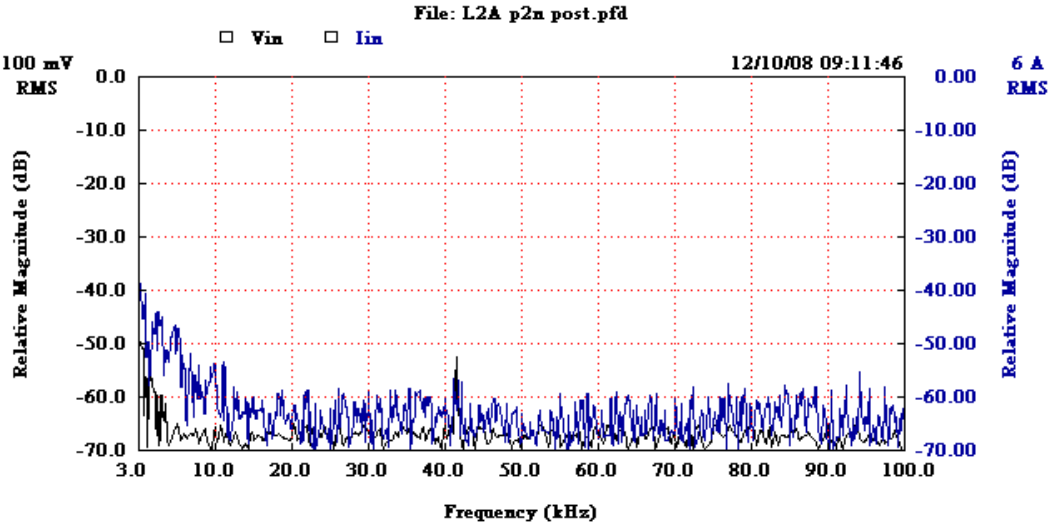

File: Panel L4C2 P1_P3.pfd
Vin
Iin
12/09/08 10:38:04
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L4C2 P1_P3 Post.pfd
Vin
Iin
12/09/08 13:35:35
1.0 V RMS
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L2A Sect3 P1N.pfd
Vin
Iin
100 mV RMS
12/10/08 08:31:07
6 A RMS
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
Relative Magnitude (dB)
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: L2A sec3 p1n post.pfd
Vin
Iin
100 mV RMS
12/10/08 09:08:25
6 A RMS
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
Relative Magnitude (dB)
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L2A Sect3 P2N.pfd
Vin
Iin
100 mV RMS
12/10/08 08:33:14
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)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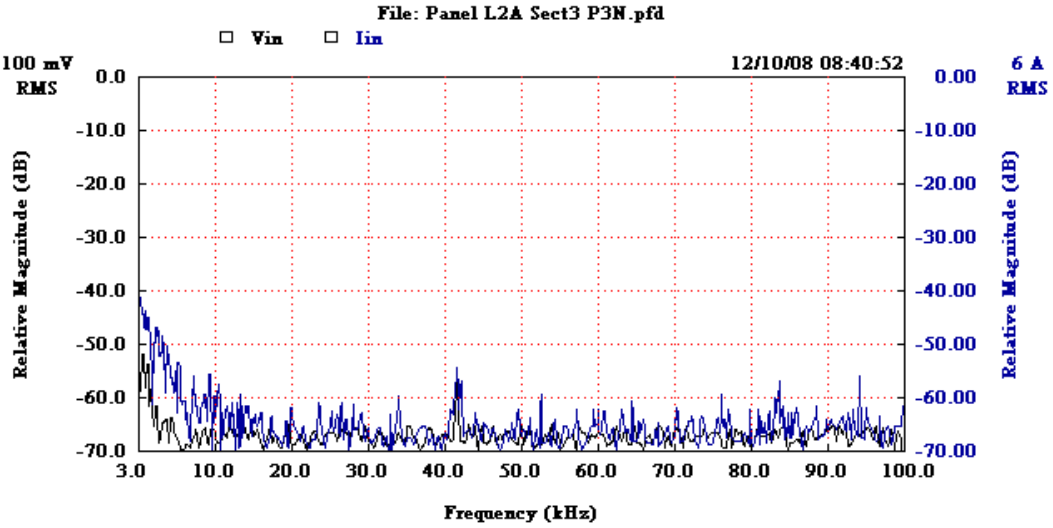
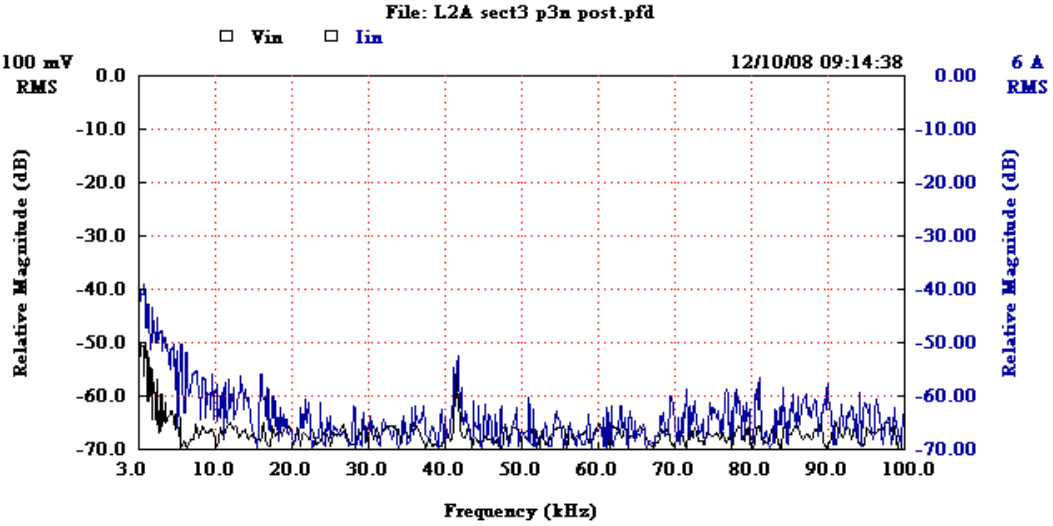
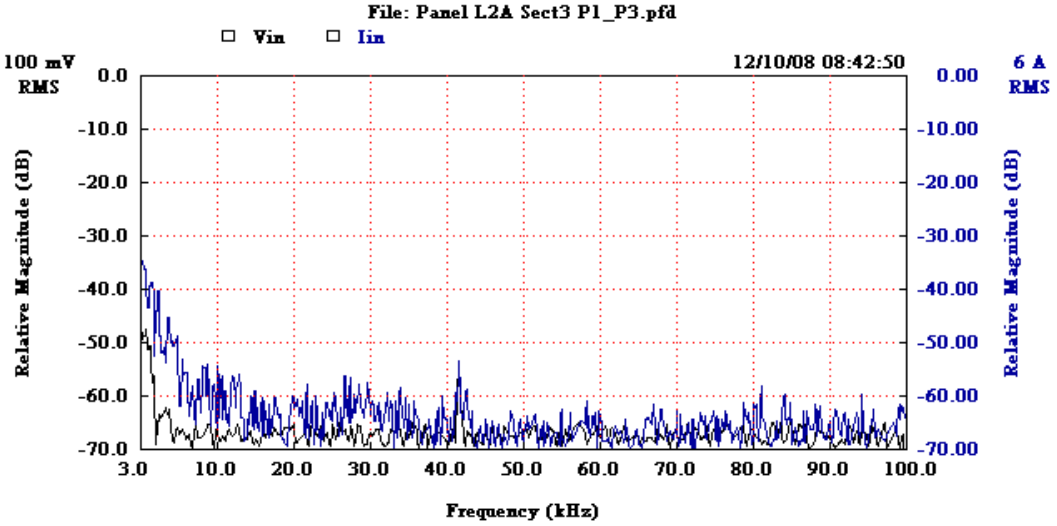
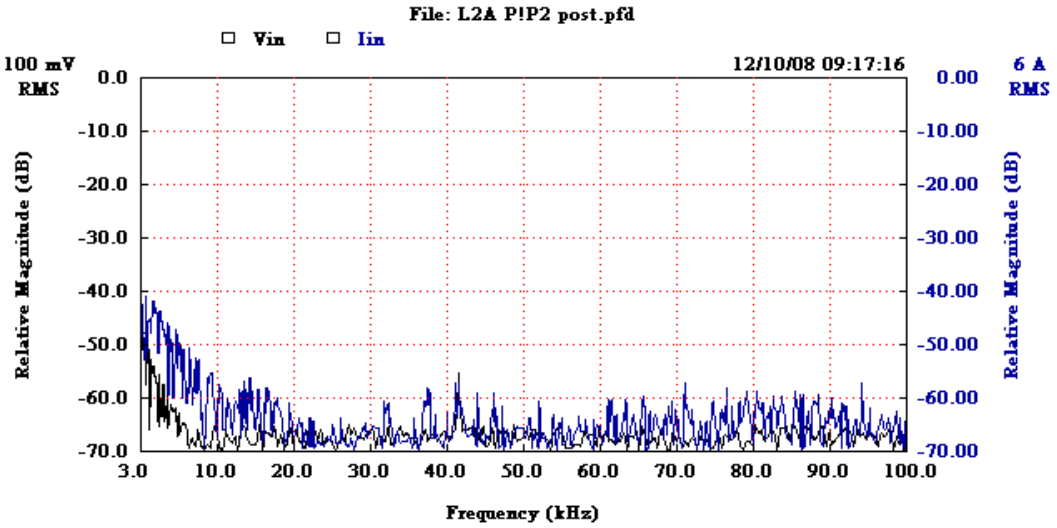
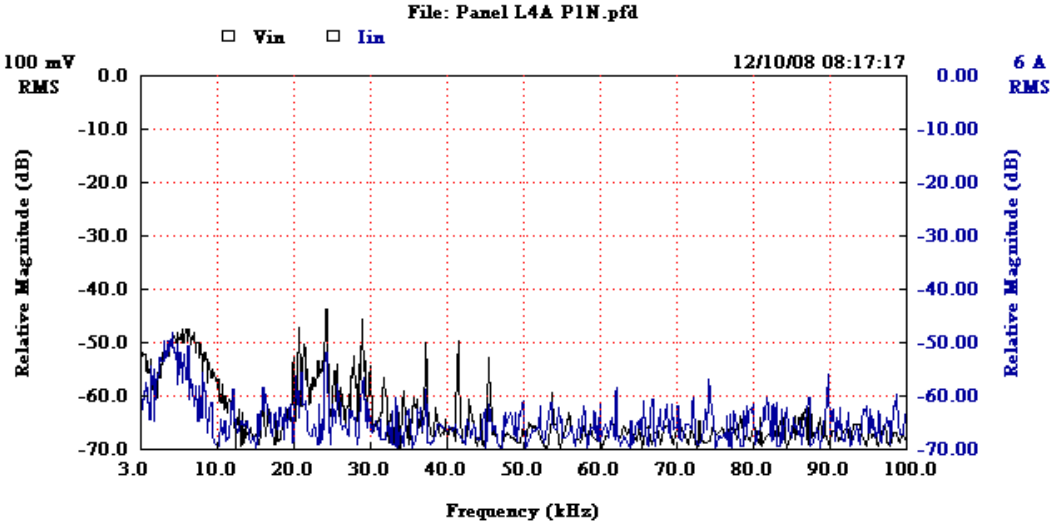
Vin
Iin
100 mV RMS
12/10/08 09:11:46
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

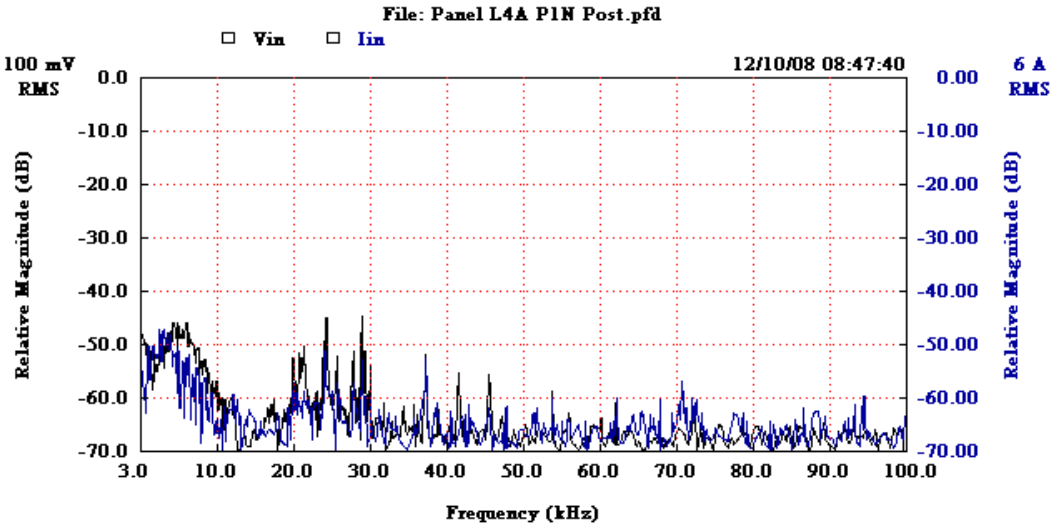

File: Panel L2A Sect3 P3N.pfd
Vin
Iin
100 mV RMS
12/10/08 08:40:52
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

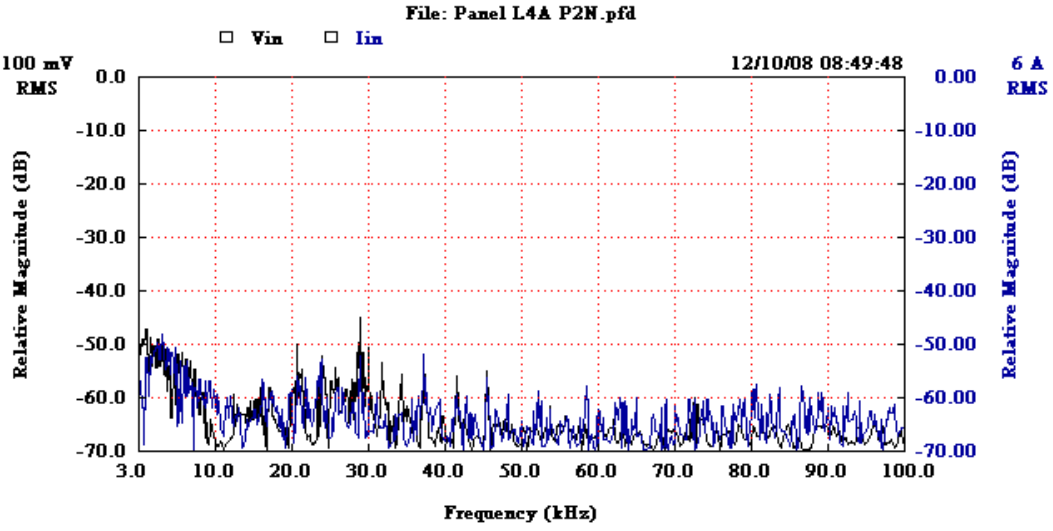

File: L2A sect3 p3n post.pfd
Vin
Iin
100 mV RMS
12/10/08 09:14:38
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

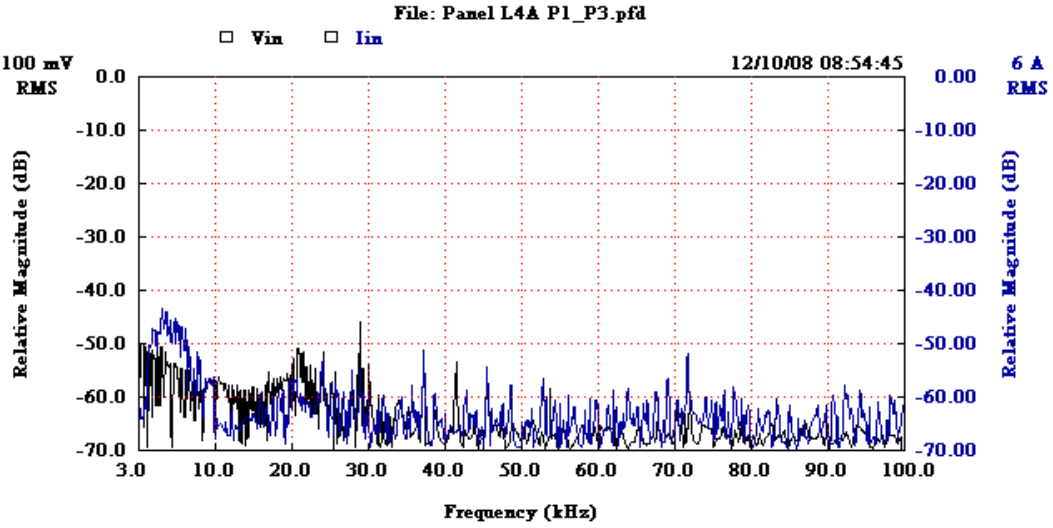

File: Panel L2A Sect3 P1_P3.pfd
Vin
Iin
100 mV RMS
12/10/08 08:42:50
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: L2A P!P2 post.pfd
Vin
Iin
100 mV RMS
12/10/08 09:17:16
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

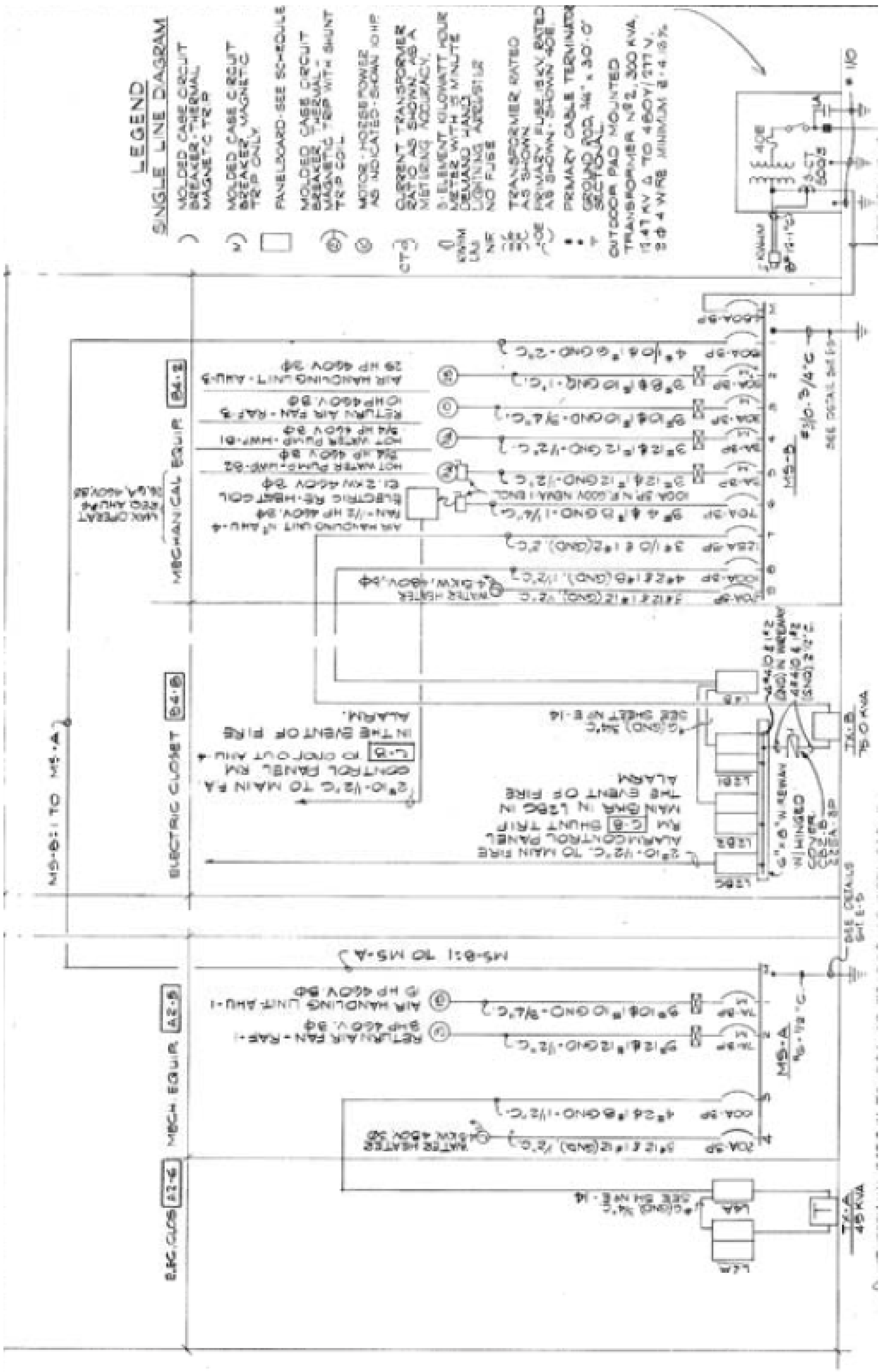

File: Panel L4A P1N.pfd
Vin
Iin
100 mV
RMS
12/10/08 08:17:17
6 A
RMS
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
Relative Magnitude (dB)
Relative Magnitude (dB)
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L4A P1N Post.pfd
Vin
Iin
100 mV
RMS
12/10/08 08:47:40
6 A
RMS
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
Relative Magnitude (dB)
Relative Magnitude (dB)
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L4A P2N.pfd
Vin
Iin
100 mV RMS
12/10/08 08:49:48
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)


File: Panel L4A P1_P3.pfd
Vin
Iin
100 mV RMS
12/10/08 08:54:45
6 A RMS
Relative Magnitude (dB)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
3.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Frequency (kHz)

One Line Sample – Page 97



SECTION 4

Year End
Frequency Spectrum Report

2009 Electrical Facility Maintenance Data review and compared with year 2007 and 2008 Data

Facility Frequency Analysis on 6 designated panels 12/09/2009

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Evaluation of Protection System To Reduce A Facility Electrical Budget