Global EMC Labs
EMC / EMI Test Report

As per

CISPR 22:2008/EN55022:2010 (Class A),
CISPR 24:2010/EN55024:2010,
ICES-003:2012 (Class A),
&
FCC Part 15 Subpart B:2014 (Class A)

Emissions & Immunity for Information Technology Equipment

on the

WS-12-400-AC, WS-10-250-AC, WS-12-250-AC/WS-14-250-AC, WS-12-250-DC, WS-12-DC, & WS-6-100

Raymond Lee Au
Project Engineer
Global EMC Inc.
11 Gordon Collins Dr.
Gormley, ON, L0H 1G0, Canada
Ph: (905) 883-8189

Testing produced for

Netonix®

See *Appendix A* for full customer & EUT details.

Industry Canada
REGISTRATION #6844A-3

CE

ACCREDITED
Testing Laboratory Certificate #2555.01

VCCI
R-4023, G-506 C-4498, T-1246

FEDERAL COMMUNICATIONS COMMISSION · USA ·
REG#377448

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Report Scope

This report addresses the EMC verification testing and test results of the following units for Netonix LLC.

- WS-12-400-AC
- WS-12-250-AC (a.k.a. WS-14-250-AC)
- WS-10-250-AC
- WS-12-250-DC
- WS-12-DC
- WS-6-100

These units are herein referred to collectively as EUT (Equipment Under Test), except where they are referred to separately, or indicated as otherwise. Testing is performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

CISPR 22:2008

CISPR 24:2010

ICES-003 Issue 5:2012

FCC Part 15 Subpart B:2013

For a more detailed list of the standards and the revision used, see the "Applicable Standards, Specifications and Methods" section of this report.

Emissions and immunity testing were evaluated on the EUT. Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Summary

The results contained in this report relate only to the item(s) tested. This report does not imply product endorsement by any government, or Global EMC.

Equipment under test	WS-12-400-AC WS-12-250-AC (a.k.a. WS-14-250-AC) WS-10-250-AC WS-12-250-DC WS-12-DC WS-6-100
EUT Passed all tests performed.	Yes
Tests conducted by	Raymond Lee Au

For testing dates see 'Testing Environmental Conditions'.

Test Results Summary

Standard/ Method	Description	Criteria Required	Class / Level	Result
CISPR 22 FCC 15.107 ICES-003:2012	Mains Conducted Emissions [α]	N/A	Class A	Pass
CISPR 22	Telecommunications port conducted emissions	N/A	Class A	Pass
CISPR 22 FCC 15.109 ICES-003:2012	Radiated Emissions	N/A	Class A	Pass
IEC 61000-3-2	Harmonics Emissions [α]	N/A	Category A	Pass
IEC 61000-3-3	Flicker Emissions [α]	N/A	N/A	Pass
IEC 61000-4-2	Electrostatic Discharge	B	±4kV Contact ±8kV Air	Pass
IEC 61000-4-3	Radiated Susceptibility	A	80MHz – 1GHz 3 V/m	Pass
IEC 61000-4-4	Electrical Fast Transients	B	AC power input: 1 kV DC power input: 500 V I/O: 500V	Pass
IEC 61000-4-5	Surge [α]	B	1 kV Line – Line 2 kV Line - Ground	Pass
IEC 61000-4-6	Conducted Susceptibility	A	3 V_{RMS}	Pass
IEC 61000-4-8	Magnetic Susceptibility	A	1 A/m	Pass
IEC 61000-4-11	Dips & Interrupts [α]	A/C	Various	Pass
Overall Result				**PASS**

Notes:

[α] Test is applicable to AC powered mains units only.

If the product as tested complies with the specification or requirement, the EUT is deemed to comply and is issued a ‘PASS’ grade. If not ‘FAIL’ grade will be issued. A pass requiring modifications is denoted with a ‘*,’ and the modifications are listed in ‘Appendix A – Client Provided Details’.

Notes, Justifications, or Deviations

The following are notes, justifications for tests not performed, or deviations from the above listed specifications.

This report contains information regarding the testing of multiple units as identified in the *Report Scope* section, and in *Appendix A*.

During ESD testing on the WS-6-100 unit, red LEDs on the RJ45 ports arranged in a group of four cease to operate after discharge on the metal shell around these ports. However, the unit is still functional, with PoE power still available and configurable. The manufacturer is informed of this result, and had determined it to be acceptable performance for the unit, as functionality is not compromised. See *Electro-Static Discharge* in the *Detailed Test Result Section* for more details.

This report covers multiple EUT units as identified in the *Report Scope* section. All units are network switches. For a description of their similarities and differences, see *EUT Description* in *Appendix A*.

As per the manufacturer, the "WS-12-250-AC" is also known as "WS-14-250-AC." These are just alternate names for identical units, and may be referred to interchangeably in this report.

Testing and test results apply to all units, except where they are identified individually.

As per the manufacturer, the units will not be used in a Telecom environment, and should not be considered as a Telecom device. However, telecom line conducted emissions testing has been performed to meet the requirements.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used are listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR 47 FCC 15:2014	- Code of Federal Regulations – Radio Frequency Devices
CISPR22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
CISPR24:2010	- Information technology equipment – Immunity characteristics – Limits and methods of measurement
EN 55022:2010	- Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN 55024:2010	- Information technology equipment - Immunity characteristics - Limits and methods of measurement
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
IEC 61000-3-2:2009	- Limits for harmonic current emissions (equipment input current ≤16 A per phase)
IEC 61000-3-3:2008	- Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection
IEC 61000-4-2:2008	- Testing and measurement techniques –Electrostatic discharge immunity test
IEC 61000-4-3:2006+A1:2007+A2:2010	- Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4:2004	- Testing and measurement techniques – Electrical fast transient/burst immunity test
IEC 61000-4-5:2005	- Testing and measurement techniques - Surge immunity test
IEC 61000-4-6:2008	- Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-8:2009	- Testing and measurement techniques – Power frequency magnetic field immunity test
IEC 61000-4-11:2004	- Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests

ISO 17025:2005 - General Requirements for the competence of testing and calibration laboratories

Document Revision Status

Release 1 - September 4, 2015
- First Release.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiliary Equipment.

Class A device – A device that is marketed for use in a commercial, industrial or business environment. A 'Class A' device should not be marketed for use by the general public . A 'Class A' device should contain the following warning in its user manual: "**Warning:** This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures."

Class B device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environments. A 'Class B' device may also be defined as a device to which a broadcast radio or television receivers would be expected within a distance of 10 m of the device concerned.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment - has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer.

LISN – Line impedance stabilization network

NCR – No calibration required

RF – Radio Frequency

Test Plan – See 'Appendix B – Client Provided Details'. This should be made available prior to testing.

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog or Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 377448), Industry Canada (IC, 6844A-3) and VCCI (R-4023, C-4498, and T-1246). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at Global EMC. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at Global EMC. Global EMC Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratories current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Aug. 11, 2015	RE	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 11, 2015	CE	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 11, 2015	TLCE	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 21, 2015	Harmonics	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 24, 2015	Flicker	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 25, 2015	ESD	RA	21-23	43.4-46.1	101.4 – 101.9
Aug. 12, 2015	RI	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 19 & 20, 2015	EFT/B	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 18, 2015	Surge	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 14 & 17, 2015	CI	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 14, 2015	MI	RA	21-25	43.4-46.1	101.4 – 101.9
Aug. 13, 2015	PQF	RA	21-25	43.4-46.1	101.4 – 101.9

RE = Radiated Emissions
CE = Conducted Emissions / Power Line Conducted Emissions
TLCE = Telecom Line Conducted Emissions
ESD = Electrostatic Discharge
RI = Radiated Field Immunity / Radiated Susceptibility
EFT/B = Electrical Fast Transients / Bursts
MI = Magnetic Immunity / Magnetic Susceptibility
CI = Conducted RF Immunity / Conducted Susceptibility
PQF = Power Quality Factor / Voltage Dips, Interruptions and Variations

Detailed Test Result Section

Electro-Static Discharge

Purpose

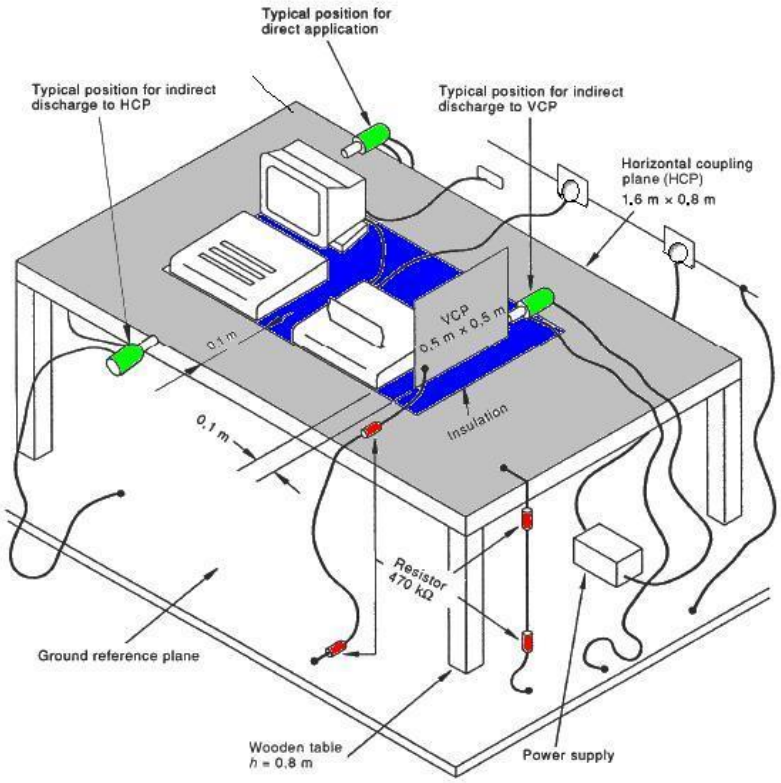
The purpose of this immunity test is to apply a static electricity discharge from the operator to the EUT, or create a nearby discharge field. An example of this can be seen in low humidity when a person touches an object and creates is a small spark. This spark may be potentially harmful to the operation of the EUT. Most real life discharges are 'air' as shown in the previous example. The 'contact' method, with related reduced voltages, has been shown to be roughly equivalent 'air' in it is severity. 'Contact' is the preferred method due to its reproducibility. Contact method will be performed unless the discharge point is significantly insulated and the insulation cannot be easily broken through. This test ensures a minimum level of immunity which is likely to occur. This test does not guarantee that the EUT will not experience a higher level which may cause it to fail.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-2. 10 hits in negative and positive polarity will be performed at each defined discharge point on the EUT. These are called direct discharges, irrespective of contact or air being applied. Also, Horizontal Coupling Plane (HCP) and the Vertical Coupling Plane (VCP) discharges will be performed. These are called indirect discharges. For a picture representation of the EUT, see *Appendix B - EUT and Test Setup Photos*. For a description of the EUT discharge points, see *Test Results* further below. For EUT criteria description, see *Appendix A - Client Provided Details*.

A level of ±4kV contact, or ±8kV air where applicable, was applied to each defined discharge point. Each level was ramped up by applying the lower levels first. Criteria level 'B' as defined in "Appendix A - Client Provided Details" was applied to this test, however all anomalies are noted.

Typical ESD Setup



Application Level Accuracy

Contact discharge: ± 15% as measured at tip.

Test Results

The EUT passed ESD testing. See table below for discharge locations tested on the EUT, and observations for these locations. Results specified are obtained with the EUT enclosure connected to ground via its protective earth terminal.

During contact discharge testing of the WS-6-100 at -4 kV on the metal shell surrounding the group of four RJ45 ports, the red LED, which indicates that the PoE output power supply is active, turns off permanently. It does not recover, even after system reboot. The unit continues to operate and supply power through the PoE port, and remains configurable via a web browser. The manufacturer is informed of this occurrence, and it was decided that the functionality of the unit was the paramount criteria for passing. Since the unit still functions correctly, it will be considered to pass and meet the requirements.

ESD Test Results - Chart 1
WS-12-250-AC

Location	Test Voltage	Discharge Type	Pass / Fail
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. Fan	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
4. “Console” DB9 connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. “13/14” optical connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. RJ45 connector shells	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
7. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
8. Mains inlet & cord	+/- 8 kV	Air	Pass. Criteria A. No discharge.
9. “PWR” LED	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
10. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

ESD Test Results - Chart 2
WS-10-250-AC

Location	Test Voltage	Discharge Type	Pass / Fail
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. Fan	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
4. “Console” DB9 connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. “13/14” optical connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. RJ45 connector shells	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
7. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
8. Mains inlet & cord	+/- 8 kV	Air	Pass. Criteria A. No discharge.
9. “PWR” LED	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
10. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

ESD Test Results - Chart 3
WS-12-400-AC

Location	Test Voltage	Discharge Type	Pass / Fail
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. Fan	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
4. “Console” DB9 connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. “13/14” optical connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. RJ45 connector shells	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
7. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
8. Mains inlet & cord	+/- 8 kV	Air	Pass. Criteria A. No discharge.
9. “PWR” LED	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
10. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

ESD Test Results - Chart 4
WS-12-250-DC

Location	Test Voltage	Discharge Type	Pass / Fail
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. Fan	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
4. “Console” DB9 connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. “13/14” optical connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. RJ45 connector shells	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
7. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
8. “PWR” LED	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
9. DC input (+)	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
10. DC input (–)	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
11. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

ESD Test Results – Chart 5
WS-12-DC

Location	Test Voltage	Discharge Type	Pass / Fail
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. Fan	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
4. “Console” DB9 connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. “13/14” optical connector shell	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. RJ45 connector shells	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
7. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
8. “PWR” LED	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
9. DC input (+)	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
10. DC input (–)	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
11. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

ESD Test Results - Chart 6 WS-6-100			
Location	**Test Voltage**	**Discharge Type**	**Pass / Fail**
1. Enclosure	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
2. Vents	+/- 4 kV	Contact	Pass. Criteria A. No anomalies. Air discharge arcs to enclosure.
3. RJ45 connector shells (group of 4)	+/- 4 kV	Contact	At +4kV, Criteria A. No anomalies. At -4kV, red LED indicating powered PoE is active turned off permanently, and does not return even after reset. However, it still supplies power, and remains configurable via web browser interface. Operation of unit does not appear to be compromised.
4. RJ45 connector shells (group of 2)	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
5. Protective earth terminal	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.
6. VCP & HCP	+/- 4 kV	Contact	Pass. Criteria A. No anomalies.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
ESD Simulator	Minizap	Thermo Electron Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 1
ESD HCP	80CMX160CM	Global EMC	NCR	NCR	GEMC 50
ESD VCP	50CMX50CM1	Global EMC	NCR	NCR	GEMC 51
ESD 470K A	2X470KOHM100CM	Global EMC	NCR	NCR	GEMC 52
ESD 470K B	2X470KOHM100CM	Global EMC	NCR	NCR	GEMC 53

Radiated Field Immunity

Purpose

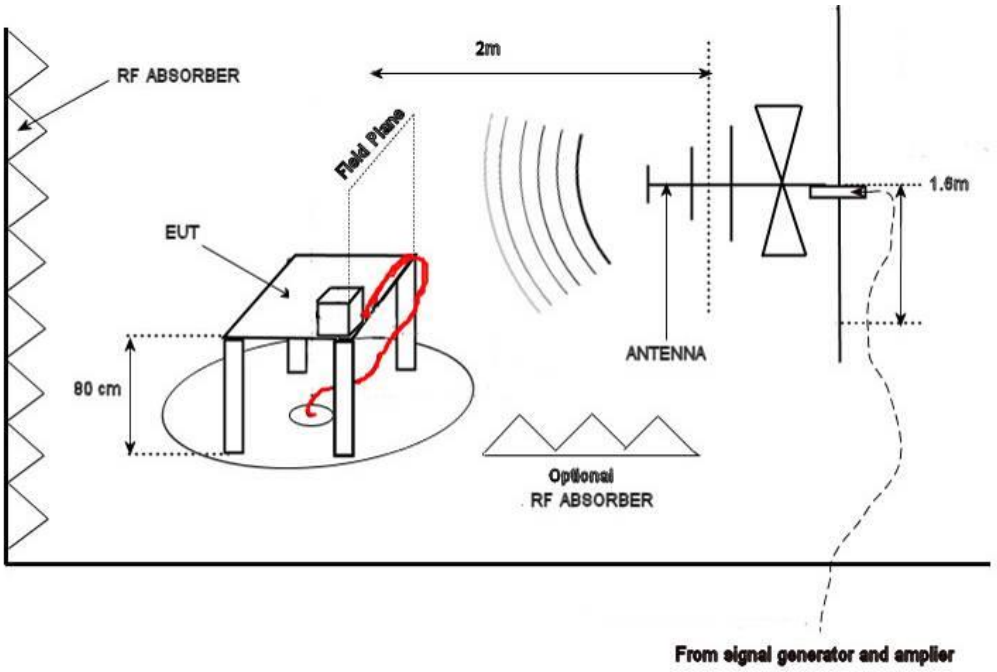
The EUT will likely be exposed to intentional sources of RF energy during the EUT's application. Sources of such radiations can be cellular phones, FM radio, television, remote car alarms, garage door openers, and other broadcast transmissions. These sources of radiations are licensed or certified for broadcast; hence the EUT should be immune to their RF energy. This test gives the test levels that the EUT should be immune to in order to assure the EUT's operation in expected field strengths. This test does not guarantee that the EUT will not experience a higher level field during its operation, which may cause the EUT to fail.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-3. The immunity test is performed over the frequency range of 80 MHz – 1 GHz. Frequency steps used were calculated at 1% step size of the previous frequency, rounded down to the nearest kHz, as the frequency range is ramped up. Known clock frequencies, local oscillators, etc, shall be analyzed separately (where applicable); these are defined in "Appendix B – Client Provided Details." The field uniformity was calibrated at 3 V/m. A modulation of 80% AM 1 kHz sine wave was applied during the application of the RF energy at each frequency. Both horizontal and vertical polarization was applied. 4 sides of the EUT were subjected to RF field. The dwell time used was 3 seconds. Forward power was monitored, and kept on file at Global EMC Inc. An isotropic field probe was placed in near proximity of the EUT to verify the application of the field. Criteria level 'A' as defined in "Appendix A – Client Provided Details" was applied to this test.

Input Voltage and Frequency	WS-12-250-AC: 230V, 50Hz WS-10-250-AC: 230V, 50Hz WS-12-400-AC: 230V, 50Hz WS-12-250-DC: 24VDC WS-12-DC: 48VDC WS-6-100: 48VDC (PoE)
Frequency range and signal strength	80 MHz – 1 GHz 3 V/m (80% AM)
Sweep step	1% of fundamental.
Dwell time	3 s
EUT type	Table top

Typical Test Setup



Application Level Accuracy

As per IEC61000-4-3, the RF field is specified as 0 to +6 dB for at least 12 of the 16 calibration points. For a 10 V/m field, this allows for the EUT to be subjected to a field of 10 V/m to 20 V/m with at least 75% coverage at this level.

Test Results

The EUT passed the requirements of 3 V/m from 80MHz – 1GHz. All units of the EUT met Criteria A as defined in "Appendix A – Client Provided Details." No anomalies were observed, and the EUT was not damaged.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Signal Generator	SMHU	Rhode and Schwarz	Jan. 21, 2015	Jan. 21, 2017	GEMC 155
BiLog Antenna	3142-C	ETS	Feb 10, 2015	Feb 10, 2017	GEMC 137
Power Amplifier	250W1000B	AR	NCR	NCR	GEMC 192
Field Mon.	FM7004	AR	NCR	NCR	GEMC 13
Field probe	FL 7018	AR	Feb. 3, 2014	Feb. 3, 2016	GEMC 164
Power Head	PH 2000	AR	Jan. 22, 2015	Jan. 22, 2017	GEMC 15
Power meter	PM 2002	AR	Jan. 21, 2015	Jan. 21, 2017	GEMC 16

Electrical Fast Transients / Bursts

Purpose

Electronic fast transients / bursts are simulated in this test on the supply and I/O lines of the EUT. In a typical application environment, fast voltage disturbances may be injected into these ports of the EUT. These signals usually arise from nearby switching circuitry such as a light switch, relay bounces, electric motor noise, or other such electrical phenomenon. The EUT should be immune to such disturbances. This test does not guarantee that the EUT will not experience a higher level field during its operation, which may cause the EUT to fail.

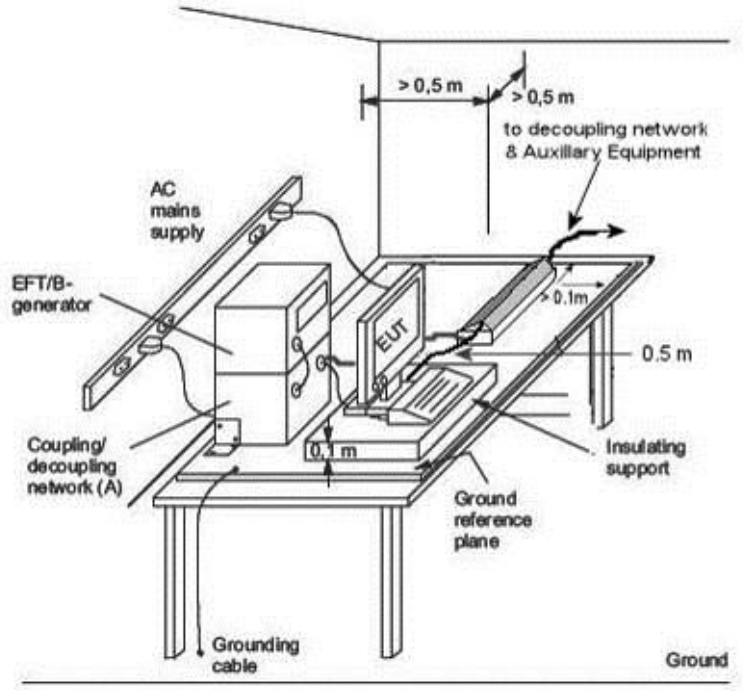
Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-4. The voltage waveform applied has the following characteristics:

- Pulse rise time 5 ns ± 30%
- Pulse duration (to 50% value) 50ns ± 30%
- Pulse repetition frequency 5kHz (75 pulses per burst train)
- Burst duration should be 15 ms ± 20%
- Burst period should be 300 ms ± 20%
- Bursts are applied for 1 minute each at positive and negative for L1-N-PE at the mains lines, and for each I/O line tested.

Test levels of 0.5 kV and 1 kV were applied to the AC power supply port(s), and 0.5 kV was applied to the DC power supply port(s), via a coupling/decoupling network. 0.5 kV was applied to the applicable I/O cables via a capacitive coupling clamp. Lower levels were evaluated by ramping up to the required level. Criteria level ‘B’ as defined in “Appendix A – Client Provided Details” was applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC61000-4-4, the level is specified as being within ± 20%. For an application level of 1kV, this allows for the EUT to be subjected to 980 V to 1.2 kV.

Test Results

The EUT passed the requirements of this test. The EUT met Criteria A as defined in "Appendix A – Client Provided Details." No anomalies were observed, and the EUT was not damaged by this test.

Test Voltage	Repetition rate	Coupling Lines	Result
Units: WS-12-250-AC, WS-10-250-AC, WS-12-400-AC			
± 0.5 kV ± 1 kV	5 kHz	Power Input: L1 – N – PE	Pass. Criteria A. No anomalies noticed.
± 0.5 kV	5 kHz	I/O line: RJ45 (1) Set for Ethernet communication	Pass. Criteria A. No anomalies noticed.
± 0.5 kV	5 kHz	I/O line: RJ45 (3) Set for 48Vdc	Pass. Criteria A. No anomalies noticed.
Units: WS-12-250-DC, WS-12-DC			
± 0.5 kV	5 kHz	Power Input: L1(+) – L1(–) – PE	Pass. Criteria A. No anomalies noticed.
± 0.5 kV	5 kHz	I/O line: RJ45 (1) Set for Ethernet communication	Pass. Criteria A. No anomalies noticed.
± 0.5 kV	5 kHz	I/O line: RJ45 (3) Set for 48Vdc	Pass. Criteria A. No anomalies noticed.
Units: WS-6-100			
± 0.5 kV	5 kHz	I/O line: RJ45 (1) Set for Ethernet communication & PoE	Pass. Criteria A. No anomalies noticed.
± 0.5 kV	5 kHz	I/O line: RJ45 (6) Set for 48Vdc	Pass. Criteria A. No anomalies noticed.

Equipment Used

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Immunity generator	EMC Pro Plus	Keytek Thermo Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 4
Capacitive Coupling Clamp	CCL	Keytek Thermo Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 5

Surge

Purpose

Surge occurs when a high energy disturbance takes place on the power, or less frequently I/O lines. These disturbances can cause significant temporary increases in current and/or voltage. These disturbances can arise during a nearby storm due to lightning, circuit trips, short-circuits on the same power line the equipment is connected to. The sudden rise in voltage over a very short period of time could cause damage to the components of the EUT. Surges are simulated during this test to test the EUT's immunity to surges. This test differs from EFT / B in that this waveform has more sufficient time to allow for damage to the EUT. This test does not guarantee that the EUT will not experience a higher level field during its operation, which may cause the EUT to fail. This test does not ensure operation of the EUT in the presence of direct lightning effects.

Application Level Requirement

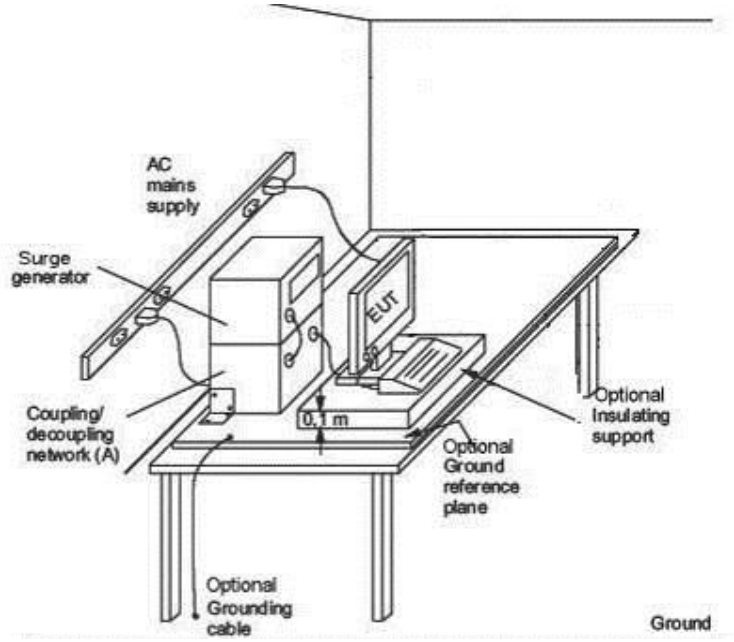
This test was performed in accordance with the methodology defined in IEC61000-4-5. Surges are simulated using a waveform generator. The characteristics of the waveform generated are as follows –

- Rise time of 1.2 µS and wave duration of 50 µS (to 50%) into an open circuit
- Rise time of 8 µS and wave duration of 20 µS (to 50%) into a short circuit
- Dwell time between each surge was 60s.
- 5 surges in positive and 5 surges in negative are performed
- For AC systems; 0 º, 90 º, and 270 º phases of waveform are tested
- For AC systems; Line – PE is performed at 2 times the Line – Line voltage

A test level of ±1 kV Line – Line and ±2 kV Line – Ground was applied to the power supply port(s) via a coupling/decoupling network.

Lower levels were evaluated by ramping up to the required level. Criteria level 'B' as defined in "Appendix A – Client Provided Details" was applied to this test. This test is

Typical Test Setup



Application Level Accuracy

As per IEC61000-4-5 the level is specified as being within ± 10% for open circuit voltage calibration or ± 10% short circuit current calibration. The EUTs input impedance or whether Line – PE or Line – Line is being performed, combined with the calibrated generators output impedance will affect the timing and voltage/current of the waveform applied to the EUT.

Test Results

This test is only applied to the units powered by AC mains (WS-12-400-AC, WS-12-250-AC, and WS-10-250-AC). These tested units passed the requirements. They met Criteria A as defined in "Appendix A – Client Provided Details." No anomalies were observed.

Test Voltage	Phase angles	Number of surges	Coupling lines	Pass / Fail
Units: WS-12-400-AC, WS-12-250-AC, WS-10-250-AC				
±1 kV, ±2 kV	0°, 90°, 270°	5	L-PE	Pass. Criteria A observed
±1 kV, ±2 kV	0°, 90°, 270°	5	N-PE	Pass. Criteria A observed
±0.5 kV, ±1 kV	0°, 90°, 270°	5	L-N	Pass. Criteria A observed

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Immunity generator	EMC Pro Plus	Keytek Thermo Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 4

Conducted RF Immunity

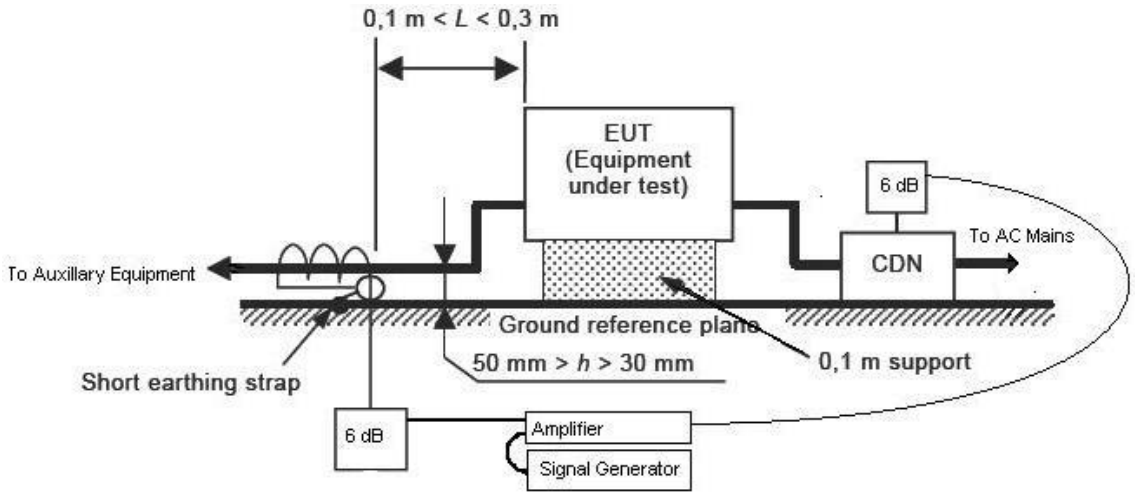
Purpose

The EUT will likely be exposed to low frequency intentional sources of RF energy during the EUT's application. Sources of such radiations can be AM radio, shortwave radio, CB transmissions, and other low frequency broadcast transmissions. These sources of radiations are licensed or certified for broadcast; hence the EUT should be immune to their RF energy. Due to the properties of radio, the power or I/O lines on the EUT would likely be the passive receiving antenna that induces the disturbance to the EUT. Since this is the main method of coupling at this frequency range, the direct application of the RF energy to the line being tested is used. At this frequency range and level, this method is easier to produce and reproduce in a laboratory environment then subjecting the EUT to an equivalent RF field.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-6. Testing is performed on the I/O cables (including the PoE input of the WS-6-100) using a bulk current injection probe, and power input lines (both AC and DC) were tested using a CDN. The immunity test is performed over the frequency range of 150 kHz to 80 MHz. Frequency steps used were calculated at 1% step size of the previous frequency, rounded down to the nearest kHz, as the frequency range is ramped up. Known clock frequencies, local oscillators, etc, shall be analyzed separately (where applicable); these are defined in "Appendix B – Client Provided Details". The level applied to the EUT was calibrated at 3 Vrms. A modulation of 80% AM 1 kHz sine wave was applied during the application of the RF energy at each frequency. The dwell time used was 3 seconds. A current probe was placed between the coupling device and the EUT to verify the application of the RF energy. Criteria level 'A' as defined in "Appendix A – Client Provided Details" was applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC 61000-4-6, the CDN must meet a common mode impedance $|Z_{CE}|$ = 150 Ω ± 20 Ω for 150 kHz to 26 MHz and $|Z_{CE}|$ = 150 Ω + 60 Ω or 150 Ω - 45 Ω for 26 MHz → 80 MHz. During tests using the bulk current injection probe, the impedance of each cable will affect the current injected, so current was monitored. The calibration performed according to IEC 61000-4-6 allows for ± 2dB.

Test Results

The EUT passed the requirements of 3 V_{RMS} from 150 kHz – 80 MHz. All units of the EUT met Criteria A as defined in "Appendix A – Client Provided Details" for power input and I/O lines. No anomalies were observed, and the EUT was not damaged.

Test Summary		
Frequency range and signal strength		150 kHz – 80 MHz, 3V_{RMS} (80% AM)
Sweep step		1% of fundamental.
Dwell time		3 s
EUT type		Table top
Power Input Voltage and Frequency	WS-12-400-AC WS-12-250-AC WS-10-250-AC	230 V_{AC}, 50 Hz
	WS-12-250-DC	24 V_{DC}
	WS-12-D	48 V_{DC}

I/O Lines	All EUT except WS-6-100	RJ45 (1): Set for Ethernet communication RJ45 (3): Set for 48Vdc
	WS-6-100	RJ45 (1): PoE input RJ45 (6): PoE output
Result		**Pass**

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Power Line CDN	FCC-801-M3-16A	FCC	Jan. 23, 2014	Jan. 23, 2016	GEMC 138
Signal Generator	SMHU	Rhode and Schwarz	Jan. 21, 2015	Jan. 21, 2017	GEMC 155
Power Amplifier	75A250A	AR	NCR	NCR	GEMC 14
Bulk Current Injection Probe	F-120-9A	FCC	Jan. 19, 2015	Jan. 19, 2017	GEMC 20
RF Current probe	F-33-2	FCC	Jan. 16, 2015	Jan. 16, 2017	GEMC 19
Power Attenuator 6 dB	100-A-FFN-06	Bird	NCR	NCR	GEMC 48

Power Frequency Magnetic Field

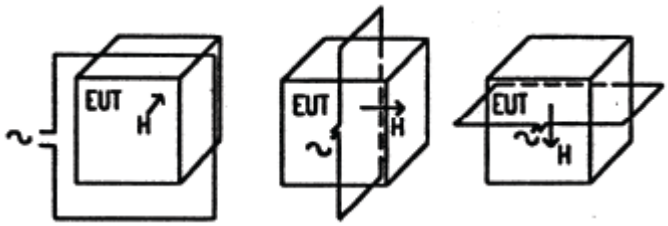
Purpose

A magnetic field with a frequency of the power line is generated around the EUT. In practice, the EUT will be subjected to power frequency magnetic fields from nearby power lines, transformers, or devices such as televisions or monitors. Since the EUT is usually used in conjunction with other electrical equipment, it is subjected to the Steady State Magnetic Fields – these are magnetic fields that the device is exposed to under constant operating conditions. These fields have a lower field strengths compared to typical Transient Magnetic fields.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-8. Three orthogonal axis of the EUT are subjected to the field within the magnetic loop. Transient magnetic field level, if applicable, was tested for 1 minute. Steady state magnetic field level was tested for 15 minutes, or longer. The frequency applied was 50Hz & 60Hz. A level of 3 A/m was applied to the EUT in each axis. Criteria level ‘A’ as defined in “Appendix A – Client Provided Details” was applied to this test.

Typical Setup Diagram



Application Level Accuracy

As per IEC61000-4-8, the field over the area the EUT occupies within the loop must be calibrated to be within ± 3 dB. For field strength of 3 A/m, this means the empty calibrated field strength will be between and 2.1 A/m and 4.2 A/m over the area the EUT occupies.

Test Results

The EUT passed the requirements. The EUT met Criteria A as defined in "Appendix A – Client Provided Details." No anomalies were observed.

Test Equipment Used

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Immunity generator	EMC Pro Plus	Keytek Thermo Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 4
Milligauss meter	4180	F W Bell	Sept. 10, 2014	Sept. 10, 2016	GEMC 74
Magnetic Loop	F-1000-4-8/9/10-L-1M	FCC	NCR	NCR	GEMC 22

Voltage Dips, Interruptions and Variations

Purpose

An AC powered device may be subjected to dips in the power line voltage, short interruptions or other various power line variations. Such conditions arise mainly when a change in network occurs; for example – a large change in load, a brown out or a black out condition occurs. This can also occur with power supplies that are not well regulated, such as emergency diesel AC generators. This test simulates the occurrence of these conditions and subjects the EUT to this phenomenon.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-11. The following dips apply:

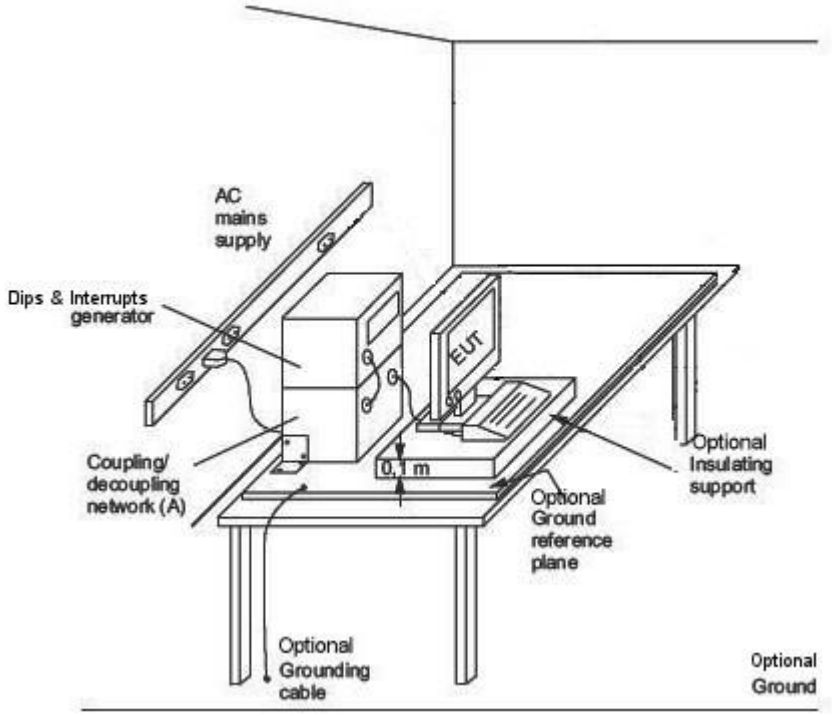
Voltage Dip Applied U_T % (V)	Duration (s)	Duration at 50 Hz (Cycles)	Criteria Level Applied
>95 % (11.5 V_{AC})	0.01 s	0.5 Cycles	B
30 % (161 V_{AC})	0.5 s	25 Cycles	C
>95 % (11.5 V_{AC})	5 s	250 Cycles	C

The voltage level in brackets presumes a normal operating voltage of 230 Vac. This should be scaled appropriately for other values of operating voltage.

Both 0º and 180º phases of the AC with 5 repetitions is applied at each of the Dips/Interrupts listed in the table above.

Criteria levels ‘A’, ‘B’, and ‘C’ as listed in the table above and defined in “Appendix A – Client Provided Details” was applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC61000-4-11, the voltage must be ± 5% of the voltage stated to be applied. The frequency must be kept within ± 2% of the stated frequency.

Test Results

This test is only applied to the units powered by AC mains (WS-12-400-AC, WS-12-250-AC, and WS-10-250-AC). These tested units passed the requirements. They meet Criteria A as defined in "Appendix A – Client Provided Details" for the >95% dip for 0.5 cycles and 30% dip for 25 cycles. No anomalies were noticed, and they operated normally without requiring operator intervention to maintain normal operating state. During the 5 second dip for >95%, the EUT meets Criteria B. The units powered down, restarted, and resumed normal operation afterwards. The EUT was not damaged by the testing.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Immunity generator	EMC Pro Plus	Keytek Thermo Corp	Feb. 10, 2015	Feb. 10, 2017	GEMC 4

Power Line Harmonics Emissions

Purpose

The purpose of this test is to ensure that power line harmonic current content generated from the EUT does not exceed the current limits listed as measured from a calibrated power source. This helps protect power line utilities ensure power line quality. Secondly, when current harmonics are generated on one phase of a three-phase system, harmonics may cause overheating of the neutral line, and these limits reduce the chances of that overheating occurring.

Limits

The limits listed below as per IEC 61000-3-2 apply to equipment which is not of the following list:
- portable tool(s); arc welding equipment lighting equipment; personal computers and personal computer monitors; televisions or television receivers

Harmonic order **n** (Frequency in Hz)	Maximum Permissible harmonic current **A**
Odd Harmonics	
3 (150 Hz)	2.30
5 (250 Hz)	1.14
7 (350 Hz)	0.77
9 (450 Hz)	0.4
11 (550 Hz)	0.33
13 (650 Hz)	0.21
15 <= n <= 39 (750 Hz – 1950 Hz)	0.15 * (15 / n)
Even Harmonics	
2 (100 Hz)	1.08
4 (200 Hz)	0.43
6 (300 Hz)	0.30
8 <= n <= 40	0.23 * (8 / n)

Measurement Accuracy

The stated measurement accuracy from the manufacturer of the measuring and output device is (±)51 mA.

Measurement Graph(s)

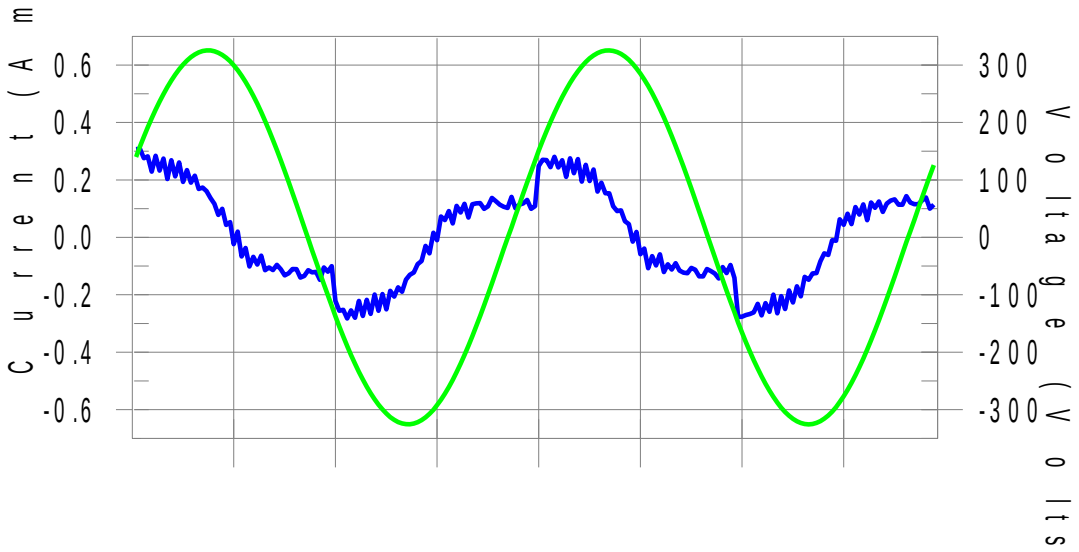
This test is only applied to the units powered by AC mains (WS-12-400-AC, WS-12-250-AC, and WS-10-250-AC). The graphs shown below are graphical illustrations of the final tabular results. For final measurements in text form please refer to the tables.

Harmonics – Class-A per Ed. 3.2 (2009) (Run time) incl. inter-harmonics
WS-12-250-AC

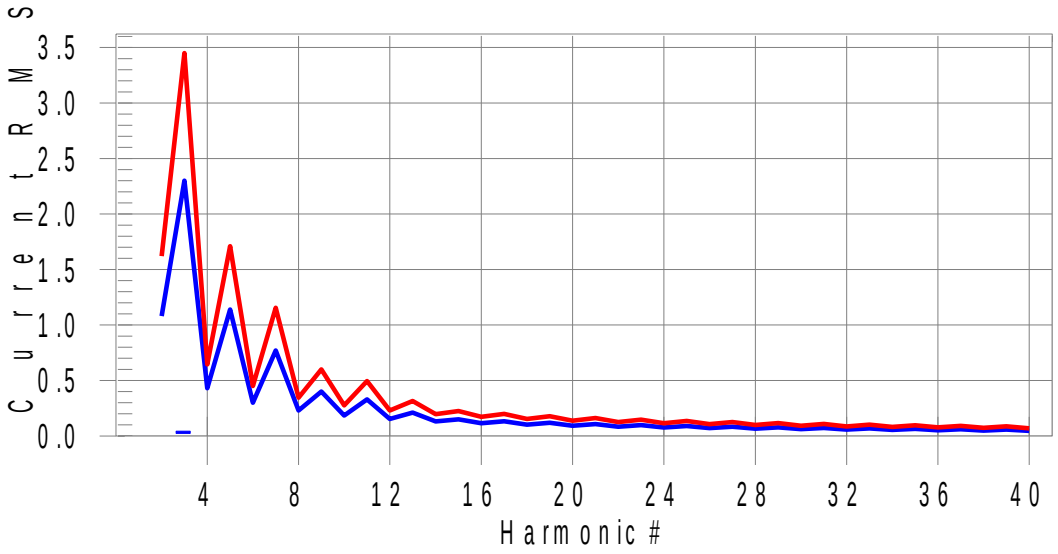
EUT: WS-12-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Current & voltage waveforms



Harmonics and Class A limit line **European Limits**



Test result: Pass Worst harmonic was #17 with 3.84% of the limit.

Current Test Result Summary (Run time)
WS-12-250-AC

EUT: WS-12-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

THC(A): 0.05 **I-THD(%): 29.92** **POHC(A): 0.000** **POHC Limit(A): 0.251**
Highest parameter values during test:

V_RMS (Volts):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.368	I_RMS (Amps):	0.167
I_Fund (Amps):	0.158	Crest Factor:	2.237
Power (Watts):	21.2	Power Factor:	0.556

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	0.1	0.001	1.620	0.09	Pass
3	0.041	2.300	1.8	0.042	3.450	1.20	Pass
4	0.001	0.430	0.2	0.001	0.645	0.15	Pass
5	0.011	1.140	0.9	0.011	1.710	0.64	Pass
6	0.001	0.300	0.2	0.001	0.450	0.17	Pass
7	0.013	0.770	1.6	0.013	1.155	1.10	Pass
8	0.001	0.230	0.3	0.001	0.345	0.22	Pass
9	0.009	0.400	2.3	0.009	0.600	1.55	Pass

10	0.001	0.184	0.4	0.001	0.276	0.27	Pass
11	0.007	0.330	2.2	0.007	0.495	1.47	Pass
12	0.001	0.153	0.5	0.001	0.230	0.36	Pass
13	0.006	0.210	3.0	0.006	0.315	2.05	Pass
14	0.001	0.131	0.6	0.001	0.197	0.42	Pass
15	0.004	0.150	3.0	0.005	0.225	2.02	Pass
16	0.001	0.115	0.6	0.001	0.173	0.43	Pass
17	0.005	0.132	3.8	0.005	0.199	2.58	Pass
18	0.001	0.102	0.6	0.001	0.153	0.42	Pass
19	0.004	0.118	3.3	0.004	0.178	2.23	Pass
20	0.000	0.092	0.5	0.001	0.138	0.38	Pass
21	0.004	0.107	4.2	0.005	0.161	2.84	Pass
22	0.000	0.084	0.5	0.000	0.125	0.39	Pass
23	0.003	0.098	3.2	0.003	0.147	2.20	Pass
24	0.000	0.077	0.6	0.001	0.115	0.46	Pass
25	0.003	0.090	3.6	0.003	0.135	2.47	Pass
26	0.001	0.071	0.9	0.001	0.106	0.65	Pass
27	0.003	0.083	3.2	0.003	0.125	2.24	Pass
28	0.001	0.066	2.0	0.001	0.099	1.39	Pass
29	0.003	0.078	3.9	0.003	0.116	2.75	Pass
30	0.001	0.061	1.2	0.001	0.092	0.87	Pass
31	0.003	0.073	4.1	0.003	0.109	2.85	Pass
32	0.001	0.058	2.0	0.001	0.086	1.40	Pass
33	0.003	0.068	4.2	0.003	0.102	2.90	Pass
34	0.000	0.054	0.9	0.001	0.081	0.70	Pass
35	0.003	0.064	3.9	0.003	0.096	2.72	Pass
36	0.000	0.051	0.8	0.000	0.077	0.61	Pass
37	0.002	0.061	3.5	0.002	0.091	2.36	Pass
38	0.000	0.048	0.9	0.001	0.073	0.72	Pass
39	0.002	0.058	4.1	0.002	0.087	2.84	Pass
40	0.000	0.046	1.0	0.001	0.069	0.86	Pass

Voltage Source Verification Data (Run time)
WS-12-250-AC

EUT: WS-12-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Highest parameter values during test:

Voltage (Vrms):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.368	I_RMS (Amps):	0.167
I_Fund (Amps):	0.158	Crest Factor:	2.237
Power (Watts):	21.2	Power Factor:	0.556

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.303	0.460	65.75	OK
3	0.414	2.072	20.00	OK
4	0.109	0.460	23.68	OK

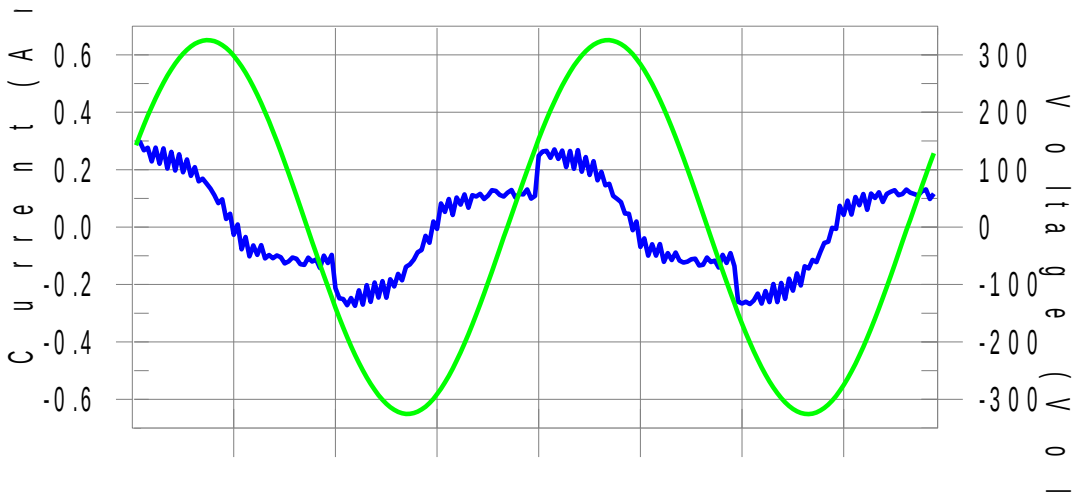
5	0.089	0.921	9.71	OK
6	0.075	0.460	16.35	OK
7	0.060	0.691	8.66	OK
8	0.055	0.460	11.90	OK
9	0.065	0.460	14.01	OK
10	0.048	0.460	10.49	OK
11	0.036	0.230	15.74	OK
12	0.046	0.230	19.79	OK
13	0.021	0.230	8.91	OK
14	0.032	0.230	14.03	OK
15	0.029	0.230	12.53	OK
16	0.031	0.230	13.45	OK
17	0.027	0.230	11.55	OK
18	0.032	0.230	13.75	OK
19	0.023	0.230	9.83	OK
20	0.024	0.230	10.31	OK
21	0.024	0.230	10.54	OK
22	0.020	0.230	8.53	OK
23	0.021	0.230	9.19	OK
24	0.021	0.230	9.10	OK
25	0.012	0.230	5.39	OK
26	0.013	0.230	5.66	OK
27	0.011	0.230	4.95	OK
28	0.014	0.230	6.15	OK
29	0.011	0.230	4.89	OK
30	0.013	0.230	5.61	OK
31	0.017	0.230	7.23	OK
32	0.011	0.230	4.73	OK
33	0.012	0.230	5.27	OK
34	0.011	0.230	4.70	OK
35	0.007	0.230	2.87	OK
36	0.012	0.230	5.00	OK
37	0.009	0.230	3.69	OK
38	0.007	0.230	3.15	OK
39	0.004	0.230	1.56	OK
40	0.007	0.230	3.18	OK

Harmonics – Class-A per Ed. 3.2 (2009) (Run time) incl. inter-harmonics
WS-10-250-AC

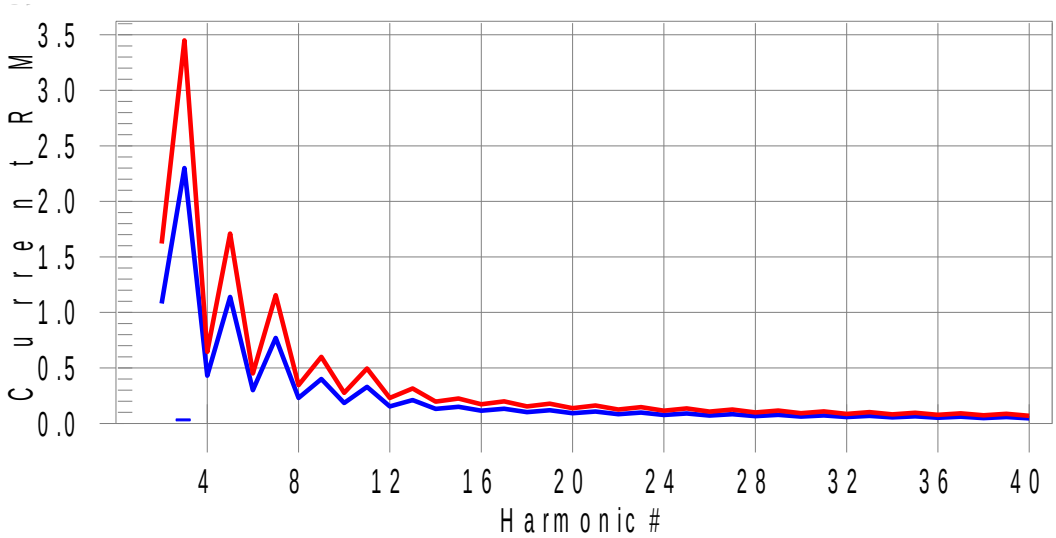
EUT: WS-10-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Current & voltage waveforms



Harmonics and Class A limit line **European Limits**



Test result: Pass Worst harmonic was #17 with 3.84% of the limit.

Current Test Result Summary (Run time)
WS-10-250-AC

EUT: WS-10-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

THC(A): 0.05 **I-THD(%): 30.42** **POHC(A): 0.000** **POHC Limit(A): 0.251**
Highest parameter values during test:

V_RMS (Volts):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.369	I_RMS (Amps):	0.167
I_Fund (Amps):	0.155	Crest Factor:	2.301
Power (Watts):	21.1	Power Factor:	0.573

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	0.1	0.001	1.620	0.09	Pass
3	0.041	2.300	1.8	0.041	3.450	1.19	Pass
4	0.001	0.430	0.2	0.001	0.645	0.15	Pass
5	0.010	1.140	0.9	0.011	1.710	0.62	Pass
6	0.001	0.300	0.3	0.001	0.450	0.18	Pass
7	0.013	0.770	1.7	0.014	1.155	1.18	Pass
8	0.001	0.230	0.3	0.001	0.345	0.23	Pass
9	0.009	0.400	2.2	0.009	0.600	1.51	Pass
10	0.001	0.184	0.4	0.001	0.276	0.26	Pass
11	0.007	0.330	2.2	0.008	0.495	1.56	Pass
12	0.001	0.153	0.4	0.001	0.230	0.33	Pass
13	0.006	0.210	2.7	0.006	0.315	1.90	Pass
14	0.001	0.131	0.5	0.001	0.197	0.40	Pass
15	0.005	0.150	3.1	0.005	0.225	2.30	Pass
16	0.001	0.115	0.6	0.001	0.173	0.43	Pass
17	0.005	0.132	3.8	0.005	0.199	2.60	Pass
18	0.001	0.102	0.7	0.001	0.153	0.49	Pass
19	0.004	0.118	3.4	0.004	0.178	2.47	Pass
20	0.001	0.092	0.6	0.001	0.138	0.47	Pass
21	0.004	0.107	4.0	0.004	0.161	2.73	Pass
22	0.000	0.084	0.6	0.001	0.125	0.49	Pass
23	0.003	0.098	3.0	0.003	0.147	2.12	Pass
24	0.000	0.077	0.6	0.001	0.115	0.48	Pass
25	0.003	0.090	3.6	0.003	0.135	2.44	Pass
26	0.001	0.071	0.8	0.001	0.106	0.60	Pass
27	0.003	0.083	3.2	0.003	0.125	2.51	Pass
28	0.001	0.066	1.9	0.001	0.099	1.37	Pass
29	0.003	0.078	4.2	0.003	0.116	2.95	Pass
30	0.001	0.061	1.2	0.001	0.092	0.88	Pass
31	0.003	0.073	3.8	0.003	0.109	2.70	Pass
32	0.001	0.058	2.1	0.001	0.086	1.50	Pass
33	0.003	0.068	4.0	0.003	0.102	2.81	Pass

34	0.001	0.054	1.1	0.001	0.081	0.84	Pass
35	0.002	0.064	3.5	0.002	0.096	2.52	Pass
36	0.000	0.051	0.8	0.001	0.077	0.67	Pass
37	0.002	0.061	3.8	0.002	0.091	2.63	Pass
38	0.000	0.048	0.7	0.001	0.073	0.75	Pass
39	0.002	0.058	4.0	0.002	0.087	2.75	Pass
40	0.000	0.046	0.7	0.001	0.069	0.74	Pass

Voltage Source Verification Data (Run time)
WS-10-250-AC

EUT: WS-10-250-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Highest parameter values during test:

Voltage (Vrms):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.369	I_RMS (Amps):	0.167
I_Fund (Amps):	0.155	Crest Factor:	2.301
Power (Watts):	21.1	Power Factor:	0.573

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.299	0.460	64.88	OK
3	0.414	2.072	19.96	OK
4	0.109	0.460	23.58	OK
5	0.092	0.921	9.96	OK
6	0.075	0.460	16.27	OK
7	0.061	0.691	8.79	OK
8	0.055	0.460	11.90	OK
9	0.063	0.460	13.69	OK
10	0.048	0.460	10.45	OK
11	0.036	0.230	15.59	OK
12	0.045	0.230	19.55	OK
13	0.021	0.230	9.00	OK
14	0.032	0.230	13.97	OK
15	0.028	0.230	12.17	OK
16	0.030	0.230	13.24	OK
17	0.026	0.230	11.19	OK
18	0.032	0.230	13.78	OK
19	0.025	0.230	10.86	OK
20	0.024	0.230	10.41	OK
21	0.024	0.230	10.28	OK
22	0.020	0.230	8.74	OK
23	0.019	0.230	8.22	OK
24	0.021	0.230	8.98	OK
25	0.012	0.230	5.31	OK
26	0.013	0.230	5.58	OK
27	0.014	0.230	6.16	OK
28	0.014	0.230	6.08	OK

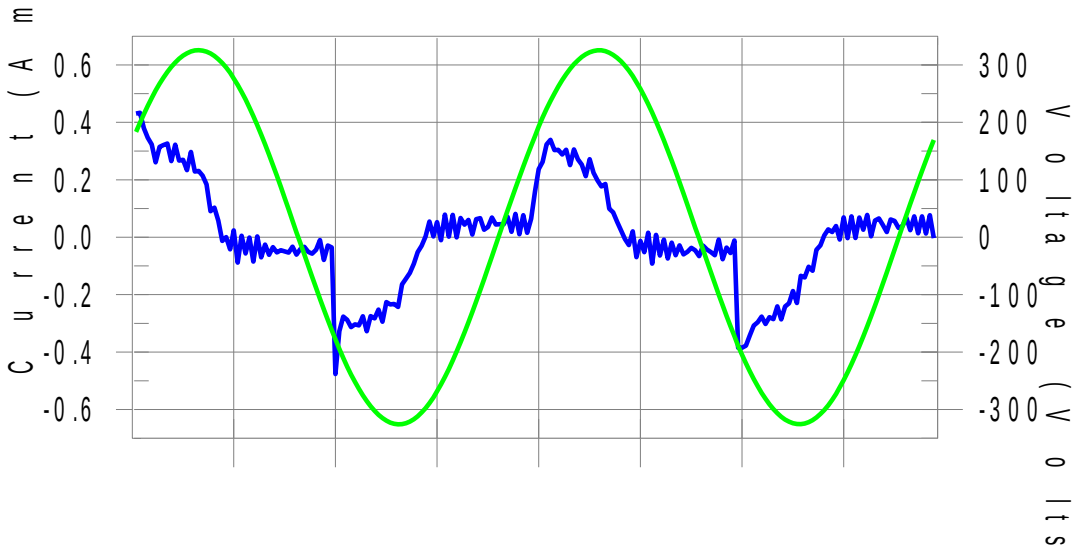
29	**0.013**	**0.230**	**5.65**	**OK**
30	**0.013**	**0.230**	**5.68**	**OK**
31	**0.017**	**0.230**	**7.20**	**OK**
32	**0.011**	**0.230**	**4.79**	**OK**
33	**0.012**	**0.230**	**5.16**	**OK**
34	**0.011**	**0.230**	**4.63**	**OK**
35	**0.006**	**0.230**	**2.46**	**OK**
36	**0.011**	**0.230**	**4.76**	**OK**
37	**0.008**	**0.230**	**3.47**	**OK**
38	**0.007**	**0.230**	**3.11**	**OK**
39	**0.006**	**0.230**	**2.42**	**OK**
40	**0.007**	**0.230**	**3.16**	**OK**

Harmonics – Class-A per Ed. 3.2 (2009) (Run time) incl. inter-harmonics
WS-12-400-AC

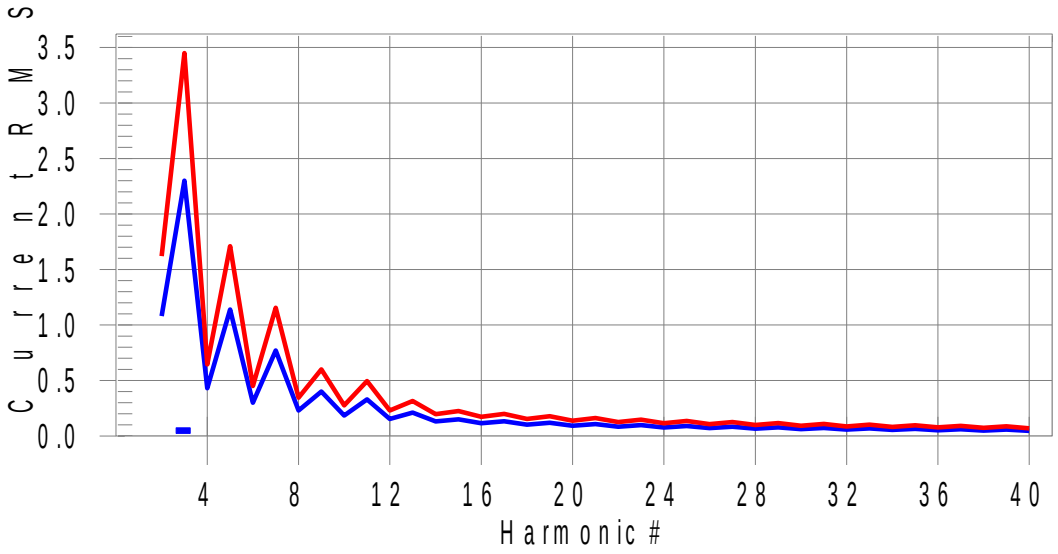
EUT: WS-12-400-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Current & voltage waveforms



Harmonics and Class A limit line **European Limits**



Test result: Pass Worst harmonic was #28 with 10.06% of the limit.

Current Test Result Summary (Run time)
WS-12-400-AC

EUT: WS-12-400-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass Source qualification: Normal
THC(A): 0.08 I-THD(%): 58.96 POHC(A): 0.015 POHC Limit(A): 0.251
Highest parameter values during test:

V_RMS (Volts):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.550	I_RMS (Amps):	0.184
I_Fund (Amps):	0.145	Crest Factor:	3.429
Power (Watts):	26.5	Power Factor:	0.699

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	0.1	0.002	1.620	0.10	Pass
3	0.072	2.300	3.1	0.073	3.450	2.10	Pass
4	0.001	0.430	0.2	0.001	0.645	0.15	Pass
5	0.017	1.140	1.5	0.018	1.710	1.07	Pass
6	0.000	0.300	0.1	0.001	0.450	0.13	Pass
7	0.022	0.770	2.8	0.023	1.155	1.96	Pass
8	0.000	0.230	0.2	0.001	0.345	0.19	Pass
9	0.015	0.400	3.7	0.015	0.600	2.53	Pass
10	0.000	0.184	0.2	0.000	0.276	0.17	Pass

11	0.013	0.330	3.9	0.013	0.495	2.60	Pass
12	0.001	0.153	0.3	0.001	0.230	0.35	Pass
13	0.012	0.210	5.6	0.012	0.315	3.78	Pass
14	0.001	0.131	0.4	0.001	0.197	0.34	Pass
15	0.009	0.150	6.2	0.010	0.225	4.40	Pass
16	0.000	0.115	0.4	0.001	0.173	0.32	Pass
17	0.009	0.132	6.6	0.009	0.199	4.41	Pass
18	0.001	0.102	0.5	0.001	0.153	0.39	Pass
19	0.007	0.118	5.6	0.007	0.178	3.81	Pass
20	0.000	0.092	0.5	0.001	0.138	0.42	Pass
21	0.007	0.107	6.6	0.007	0.161	4.63	Pass
22	0.001	0.084	0.9	0.001	0.125	0.64	Pass
23	0.006	0.098	6.1	0.006	0.147	4.29	Pass
24	0.001	0.077	1.0	0.001	0.115	0.81	Pass
25	0.006	0.090	7.1	0.007	0.135	4.86	Pass
26	0.002	0.071	2.8	0.002	0.106	1.98	Pass
27	0.006	0.083	7.2	0.007	0.125	5.38	Pass
28	0.007	0.066	10.1	0.007	0.099	6.81	Pass
29	0.006	0.078	7.7	0.007	0.116	5.75	Pass
30	0.003	0.061	5.5	0.004	0.092	3.82	Pass
31	0.005	0.073	6.8	0.006	0.109	5.06	Pass
32	0.004	0.058	7.3	0.004	0.086	5.04	Pass
33	0.005	0.068	7.6	0.006	0.102	5.78	Pass
34	0.002	0.054	4.3	0.002	0.081	2.95	Pass
35	0.004	0.064	7.0	0.005	0.096	5.03	Pass
36	0.001	0.051	1.9	0.001	0.077	1.44	Pass
37	0.004	0.061	7.3	0.005	0.091	5.09	Pass
38	0.001	0.048	1.6	0.001	0.073	1.30	Pass
39	0.005	0.058	7.9	0.005	0.087	5.47	Pass
40	0.001	0.046	1.2	0.001	0.069	1.06	Pass

Voltage Source Verification Data (Run time)
WS-12-400-AC

EUT: WS-12-400-AC **Tested by: RA**
Test category: Class-A per Ed. 3.2 (2009) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Netonix/DVD Video

Test Result: Pass **Source qualification: Normal**

Highest parameter values during test:

Voltage (Vrms):	230.23	Frequency(Hz):	50.00
I_Peak (Amps):	0.550	I_RMS (Amps):	0.184
I_Fund (Amps):	0.145	Crest Factor:	3.429
Power (Watts):	26.5	Power Factor:	0.699

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.303	0.460	65.77	OK
3	0.414	2.072	19.96	OK
4	0.109	0.460	23.76	OK
5	0.089	0.921	9.61	OK

6	0.074	0.460	16.15	OK
7	0.059	0.691	8.58	OK
8	0.055	0.460	11.89	OK
9	0.058	0.460	12.59	OK
10	0.048	0.460	10.44	OK
11	0.036	0.230	15.52	OK
12	0.047	0.230	20.32	OK
13	0.027	0.230	11.73	OK
14	0.032	0.230	13.83	OK
15	0.030	0.230	12.87	OK
16	0.031	0.230	13.30	OK
17	0.021	0.230	9.02	OK
18	0.032	0.230	14.06	OK
19	0.020	0.230	8.66	OK
20	0.024	0.230	10.50	OK
21	0.023	0.230	10.16	OK
22	0.020	0.230	8.74	OK
23	0.023	0.230	10.16	OK
24	0.020	0.230	8.90	OK
25	0.019	0.230	8.43	OK
26	0.012	0.230	5.39	OK
27	0.016	0.230	6.89	OK
28	0.014	0.230	6.13	OK
29	0.009	0.230	3.70	OK
30	0.013	0.230	5.72	OK
31	0.015	0.230	6.62	OK
32	0.011	0.230	4.89	OK
33	0.013	0.230	5.86	OK
34	0.011	0.230	4.83	OK
35	0.009	0.230	3.96	OK
36	0.012	0.230	5.03	OK
37	0.012	0.230	5.26	OK
38	0.007	0.230	2.92	OK
39	0.005	0.230	2.25	OK
40	0.007	0.230	3.25	OK

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Flicker Meter	PACS-1	California Instruments	Feb. 4, 2015	Feb. 4, 2017	GEMC 46
AC Power source	5000 iX	California Instruments	Feb. 4, 2015	Feb. 4, 2017	GEMC 47

Flicker Emissions

Purpose

The purpose of this test is to ensure that the flicker content generated from the EUT does not exceed the limits listed as measured from a calibrated power source. This helps power line utilities ensure power line quality. Secondly, flicker can create an impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time. Passing this test will help ensure the EUT does not cause nearby lights to appear to flicker.

Limits

The limits listed below as per IEC 61000-3-3 apply. Note that Pst = 1.0 is defined as the human threshold of irritability. This is defined in figure 4 of the previously mentioned standard and is related to number or changes per minute relative to amount of voltage change induced on the calibrated source impedance.

– the value of Pst shall not be greater than 1.0;
– the value of Plt shall not be greater than 0.65;
– the value of d(t) during a voltage change shall not exceed 3.3 % for more than 500 ms;
– the relative steady-state voltage change, dc, shall not exceed 3.3 %;
– the maximum relative voltage change dmax, shall not exceed 4% (without additional conditions)

Measurement Accuracy

The stated measurement accuracy from the manufacturer of the measuring and output device is:
Pst ± 4 % of reading for 0.5 < Pst < 20
Plt ± 4 % of reading for 0.5 < Plt < 20
dc ± 2 % of reading for dmax > 0.1 %

Measurement Graph(s)

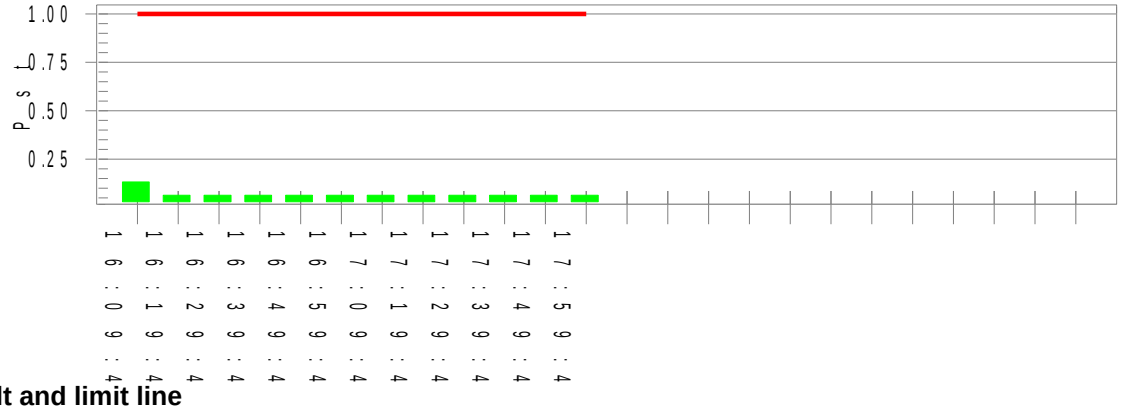
This test is only applied to the units powered by AC mains (WS-12-400-AC, WS-12-250-AC, and WS-10-250-AC). The graphs shown below are graphical illustrations of the final tabular results. For final measurements in text form please refer to the tables. The WS-12-400-AC and WS-12-250-AC were tested at the same time for worst case results. The WS-10-250-AC was tested individually.

Flicker Test Summary per EN/IEC61000-3-3 (Run time)
WS-12-400-AC & WS-12-250-AC

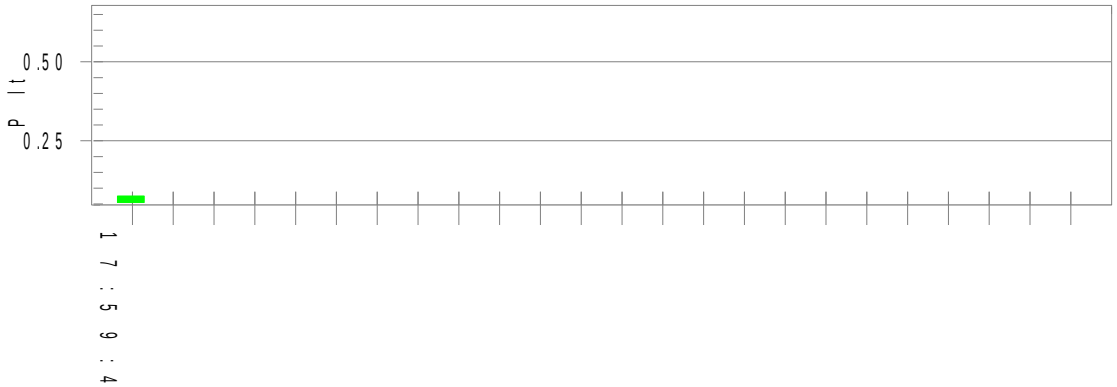
EUT: WS-12-400-AC & WS-12-250-AC **Tested by: RA**
Test category: All parameters (European limits) **Test Margin: 100**
Test duration (min): 121
Customer: Netonix/DVD Electronics

Test Result: Pass **Status: Test Completed**

Pst_i and limit line **European Limits**



Plt and limit line



Parameter values recorded during the test:

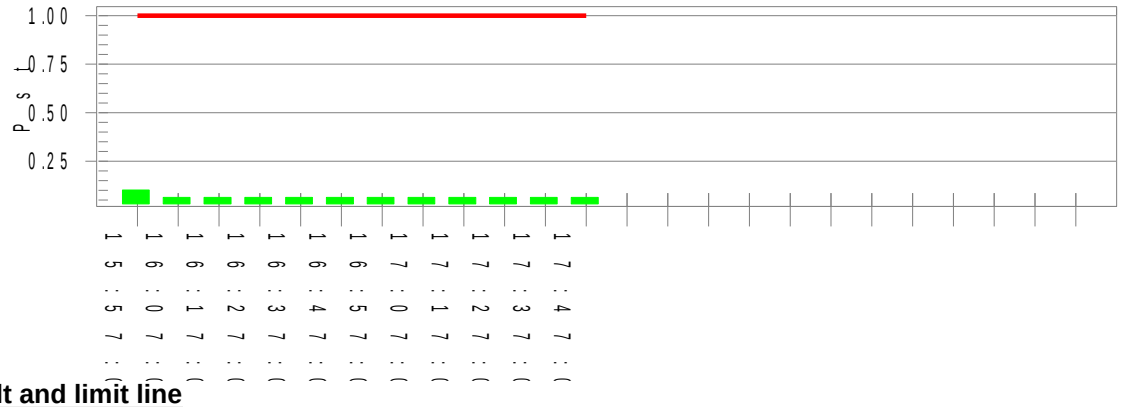
Vrms at the end of test (Volt):	**229.97**			
Highest dt (%):	**-0.34**	**Test limit (%):**	**3.30**	**Pass**
Time(mS) > dt:	**0.0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.27**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.132**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.075**	**Test limit:**	**0.650**	**Pass**

Flicker Test Summary per EN/IEC61000-3-3 (Run time)
WS-10-250-AC

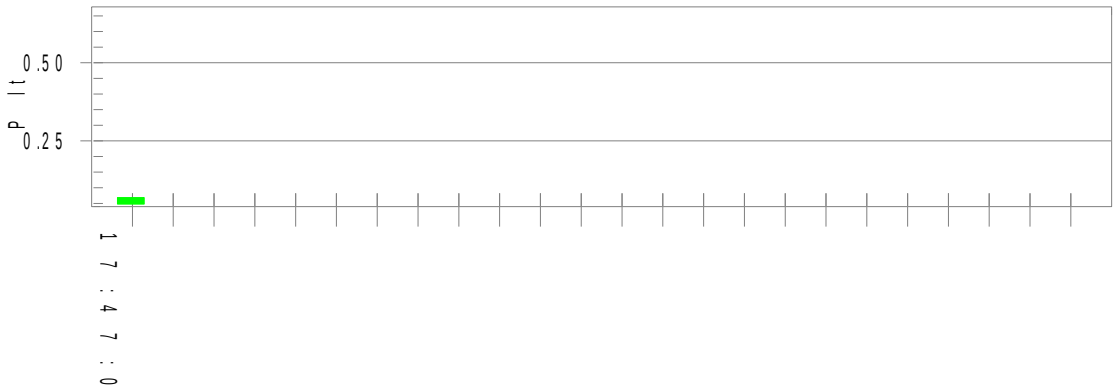
EUT: WS-10-250-AC **Tested by: RA**
Test category: All parameters (European limits) **Test Margin: 100**
Test duration (min): 121
Customer: Netonix/DVD Electronics

Test Result: Pass **Status: Test Completed**

Pst_i and limit line **European Limits**



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	**230.32**			
Highest dt (%):	**-0.26**	**Test limit (%):**	**3.30**	**Pass**
Time(mS) > dt:	**0.0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.25**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.102**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.069**	**Test limit:**	**0.650**	**Pass**

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Flicker Meter	PACS-1	California Instruments	Feb. 4, 2015	Feb. 4, 2017	GEMC 46
AC Power source	5000 iX	California Instruments	Feb. 4, 2015	Feb. 4, 2017	GEMC 47

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

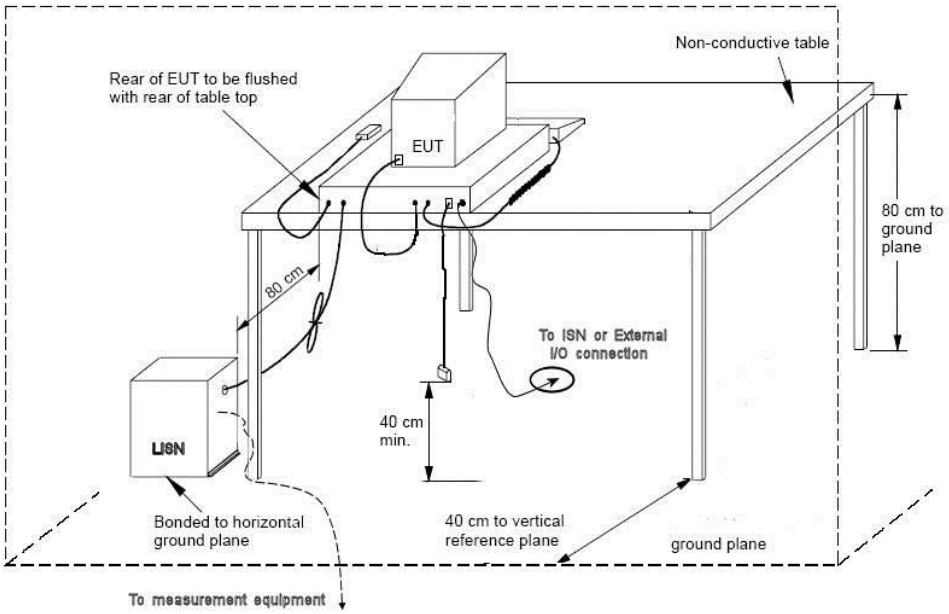
The limits and method are as defined in CISPR 22 and EN55022.

Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	66 dBµV	150 kHz – 500 kHz	79 dBµV
500 kHz – 30 MHz	60 dBµV	500 kHz – 30 MHz	73 dBµV

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Typical Setup Diagram



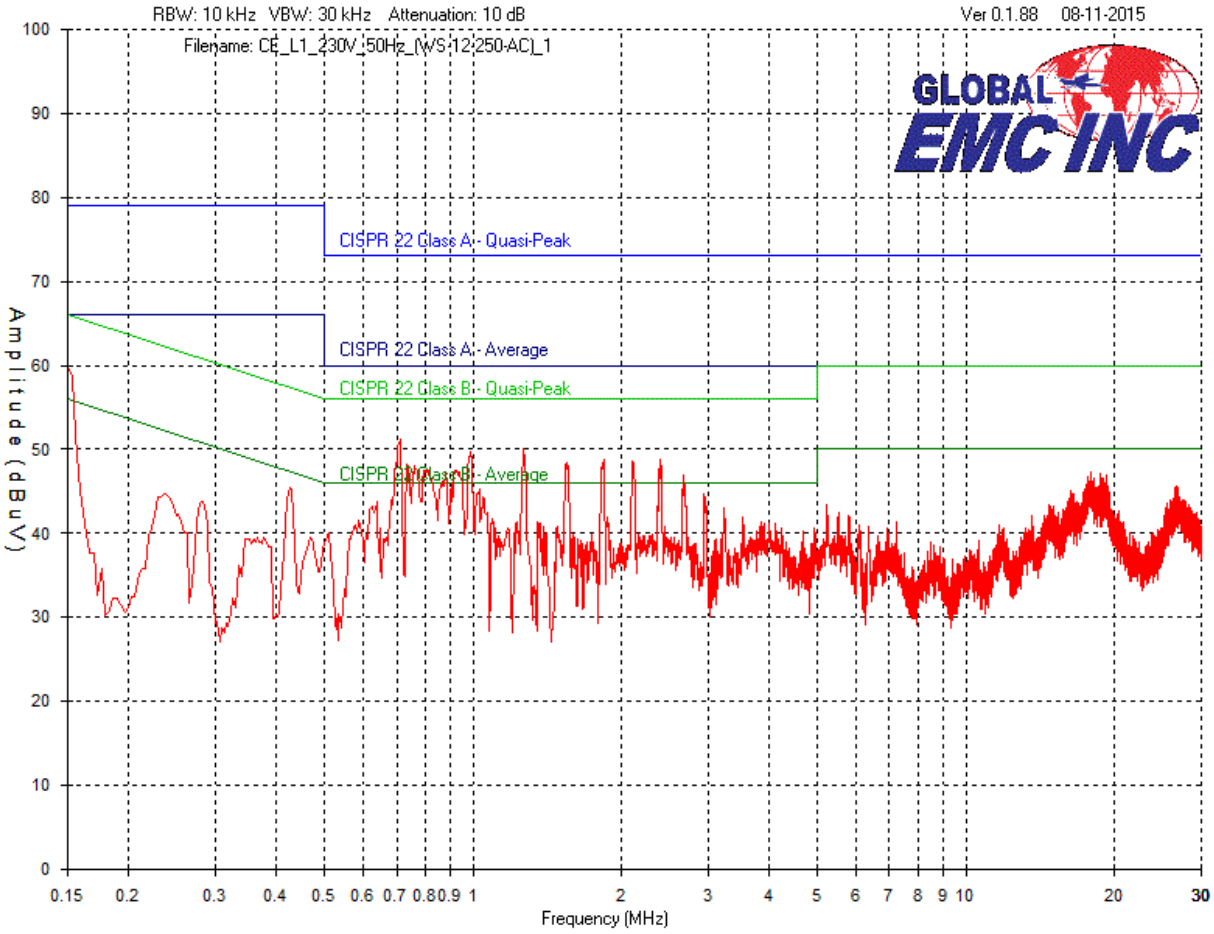
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

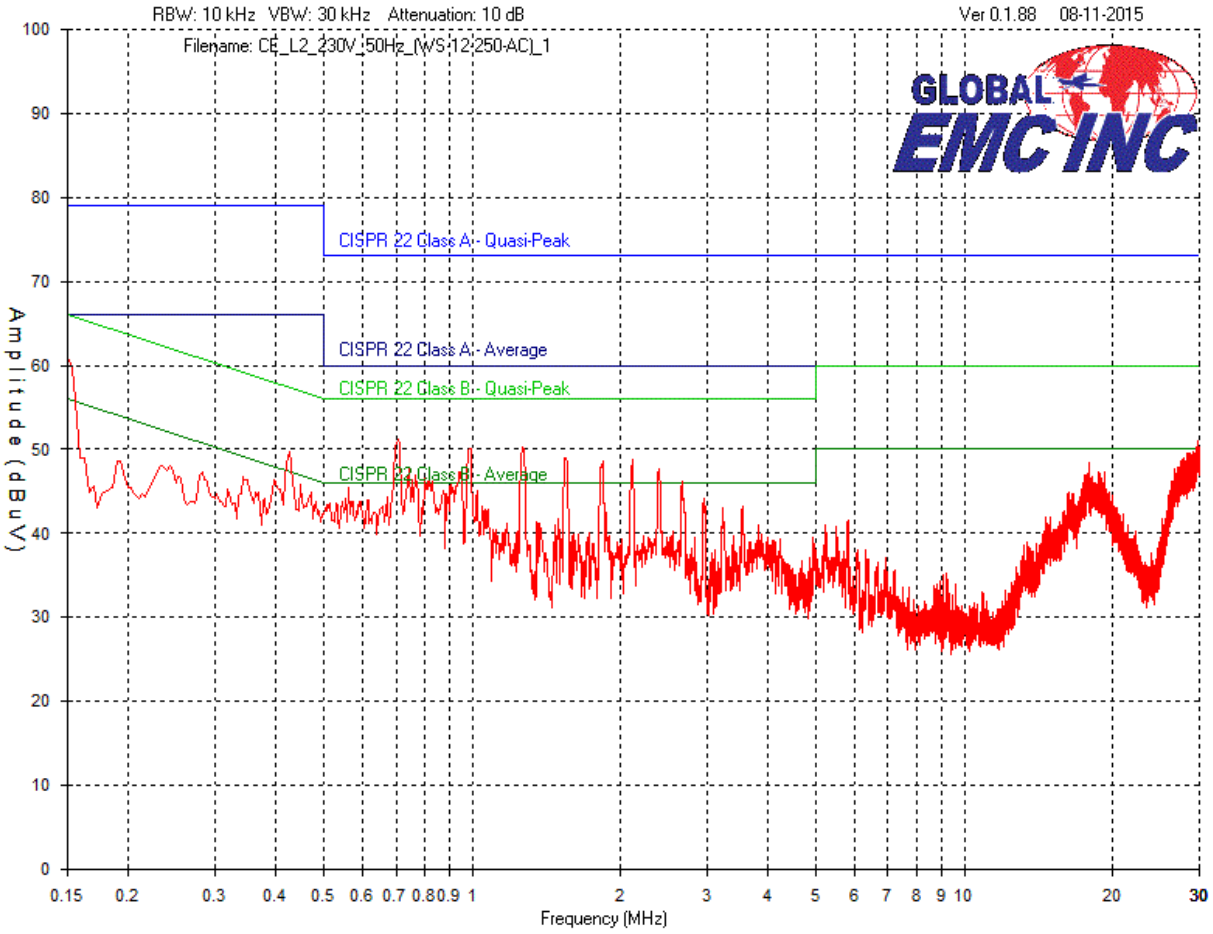
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. This test is only applied to the units powered by AC mains (WS-12-400-AC, WS-12-250-AC, and WS-10-250-AC). As per the manufacturer, the units powered by DC (WS-12-250-DC, WS-12-DC, and WS-6-100) will not be connected to a DC mains power source.

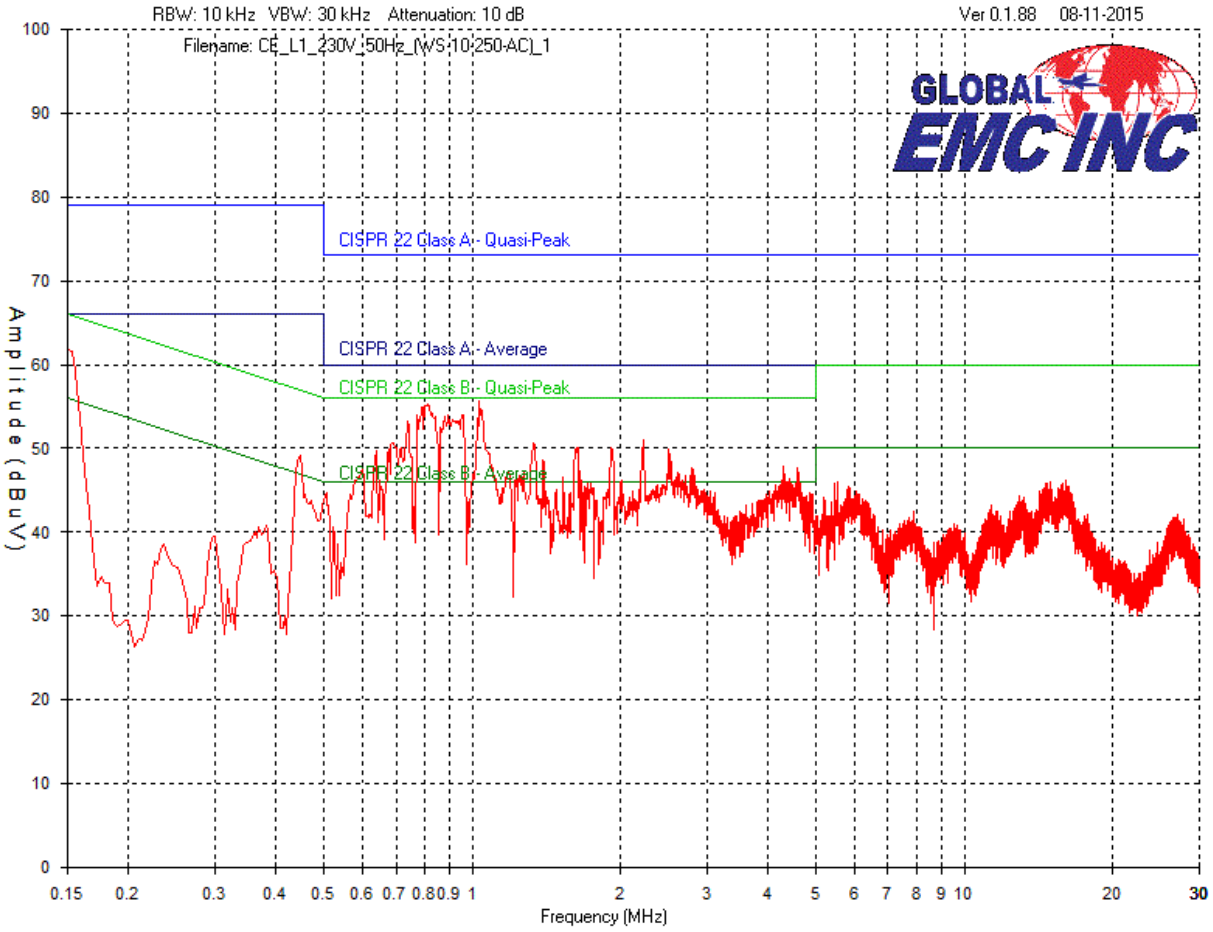
Phase Line – Peak Emissions Graph
WS-12-250-AC: 230V_{AC}, 50Hz



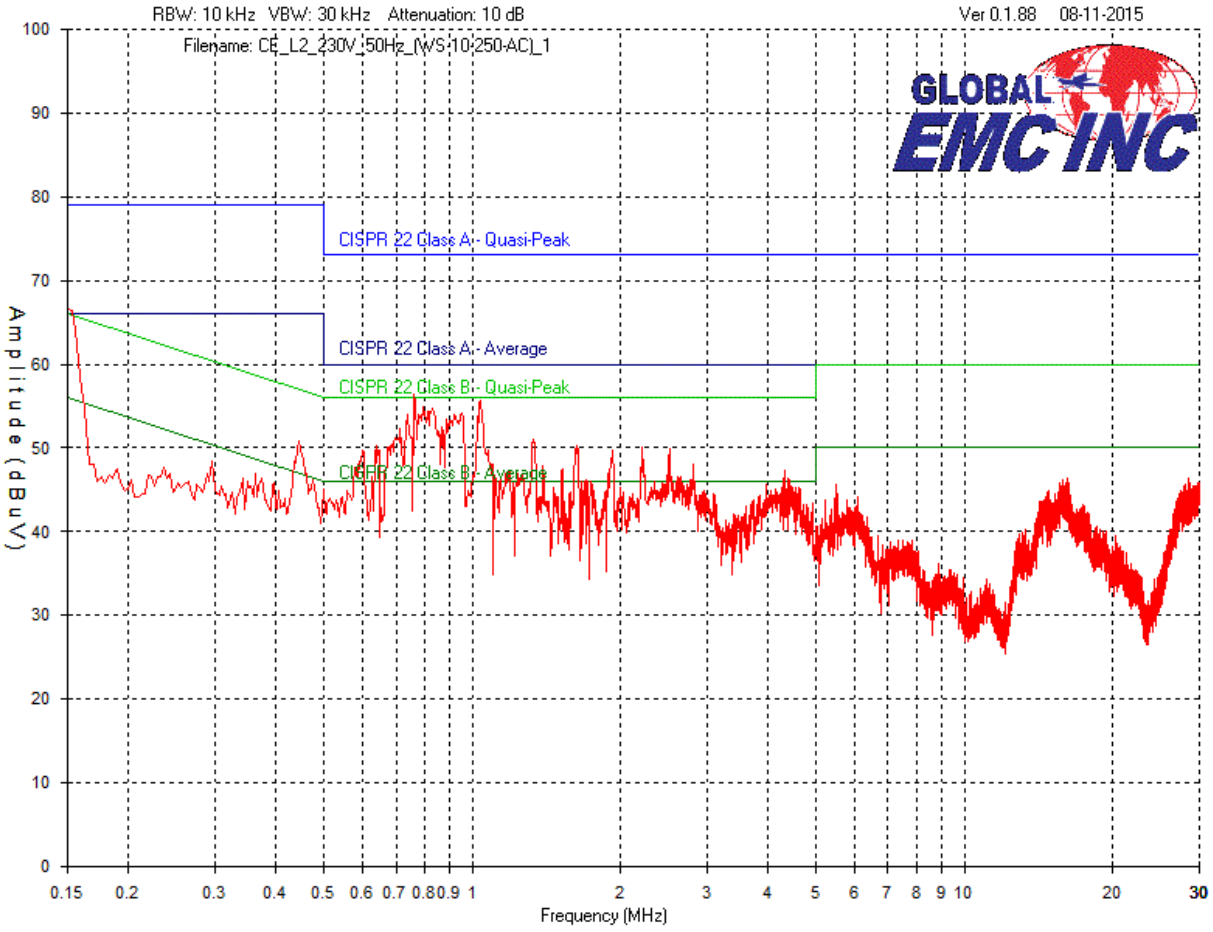
Neutral Line – Peak Emissions Graph
WS-12-250-AC: 230V_{AC}, 50Hz



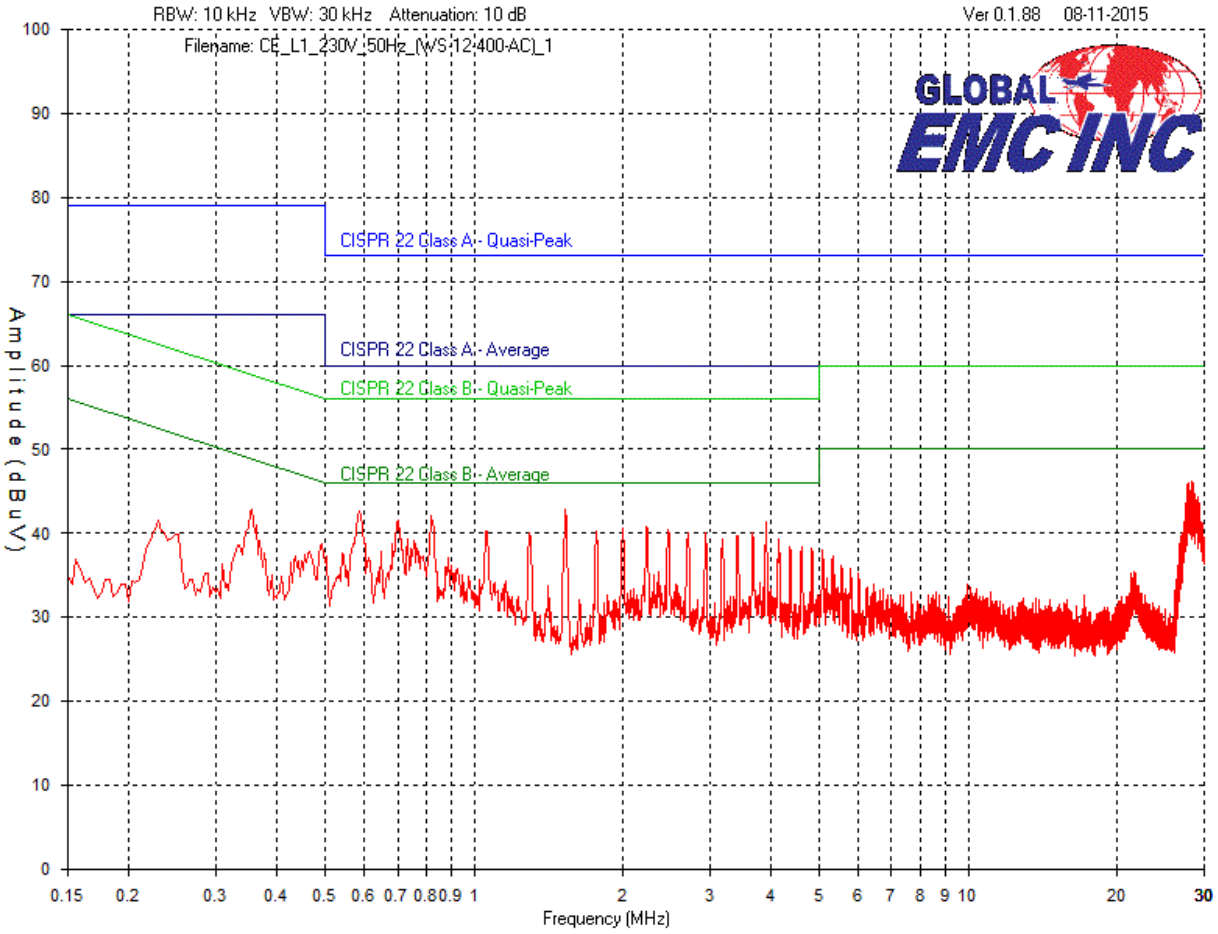
Phase Line – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz



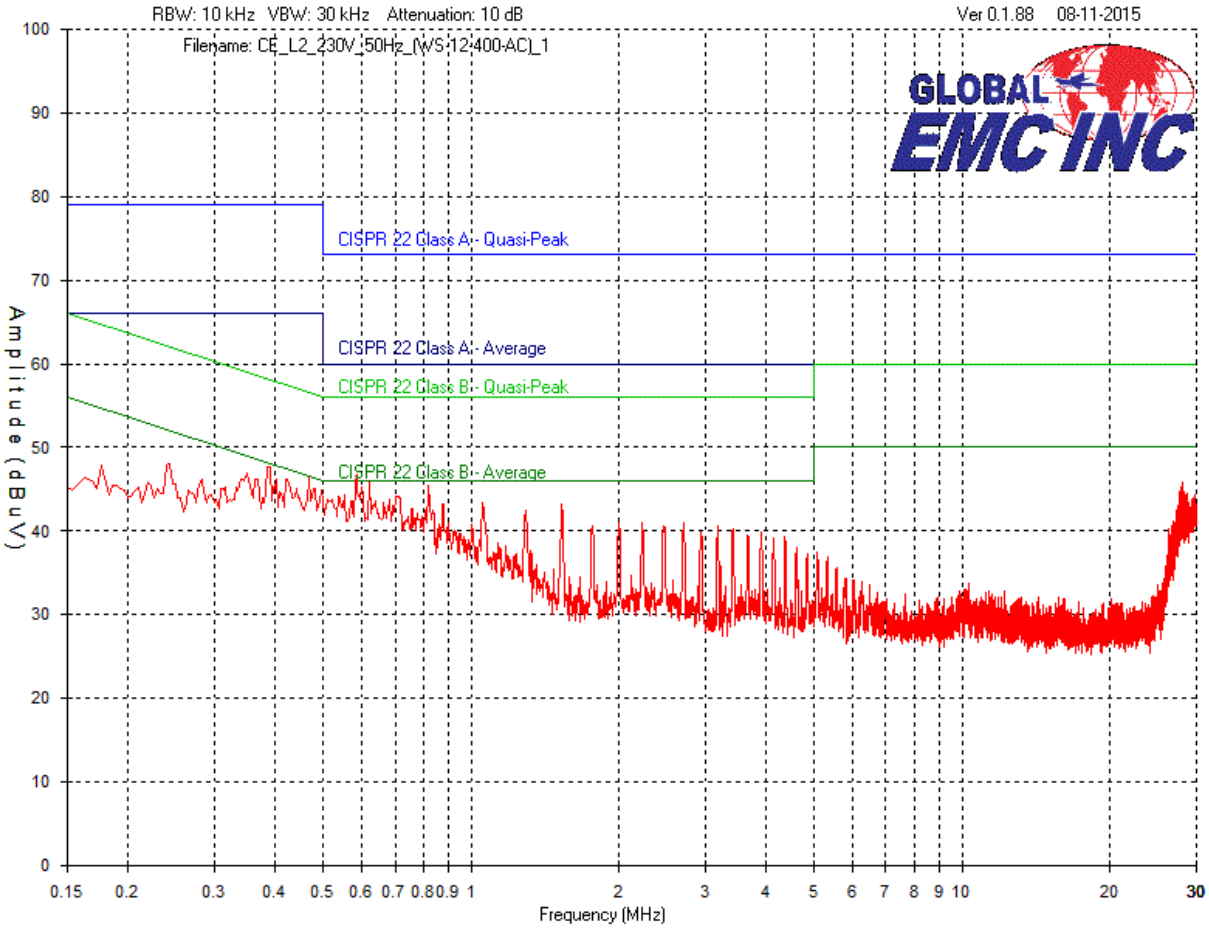
Neutral Line – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz



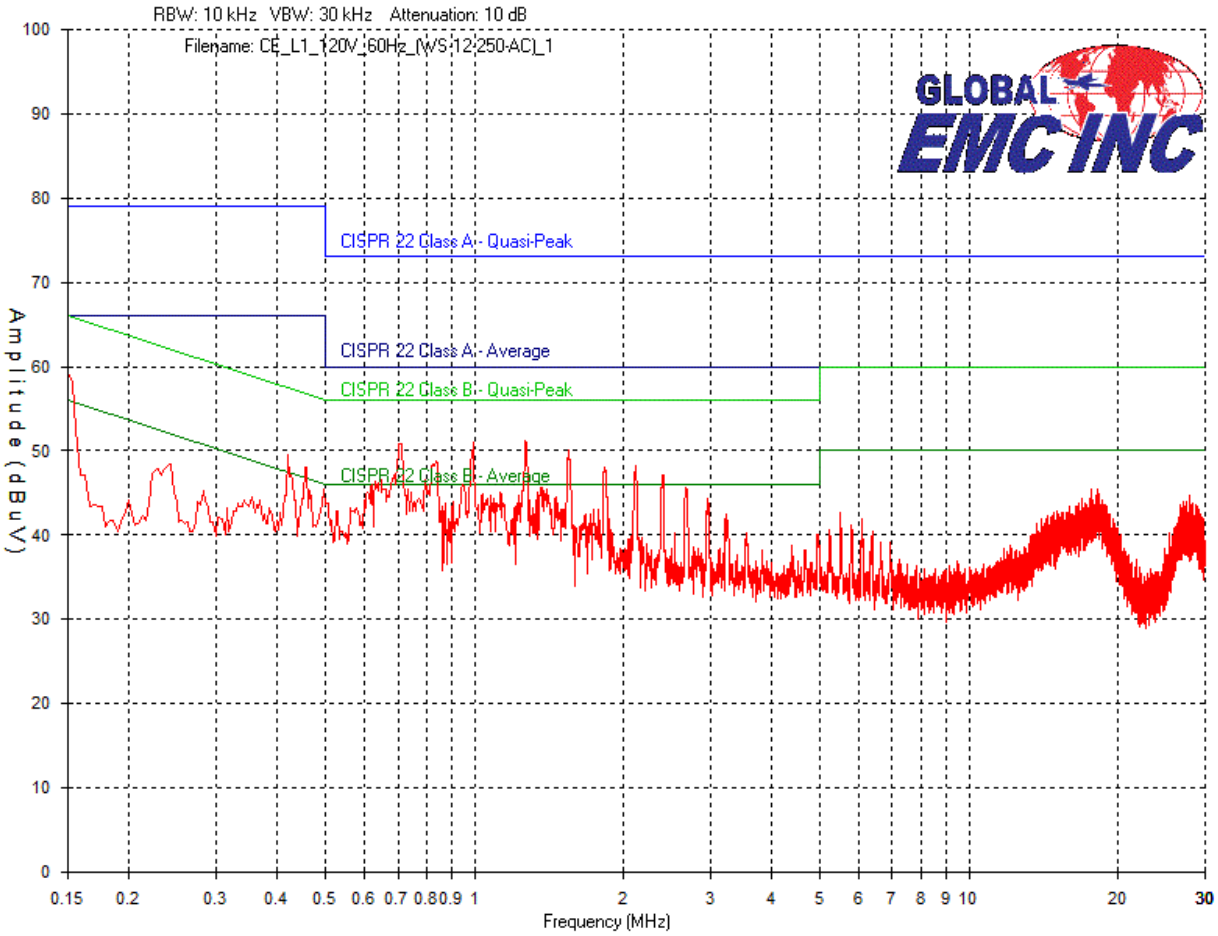
Phase Line – Peak Emissions Graph
WS-12-400-AC: 230V_{AC}, 50Hz



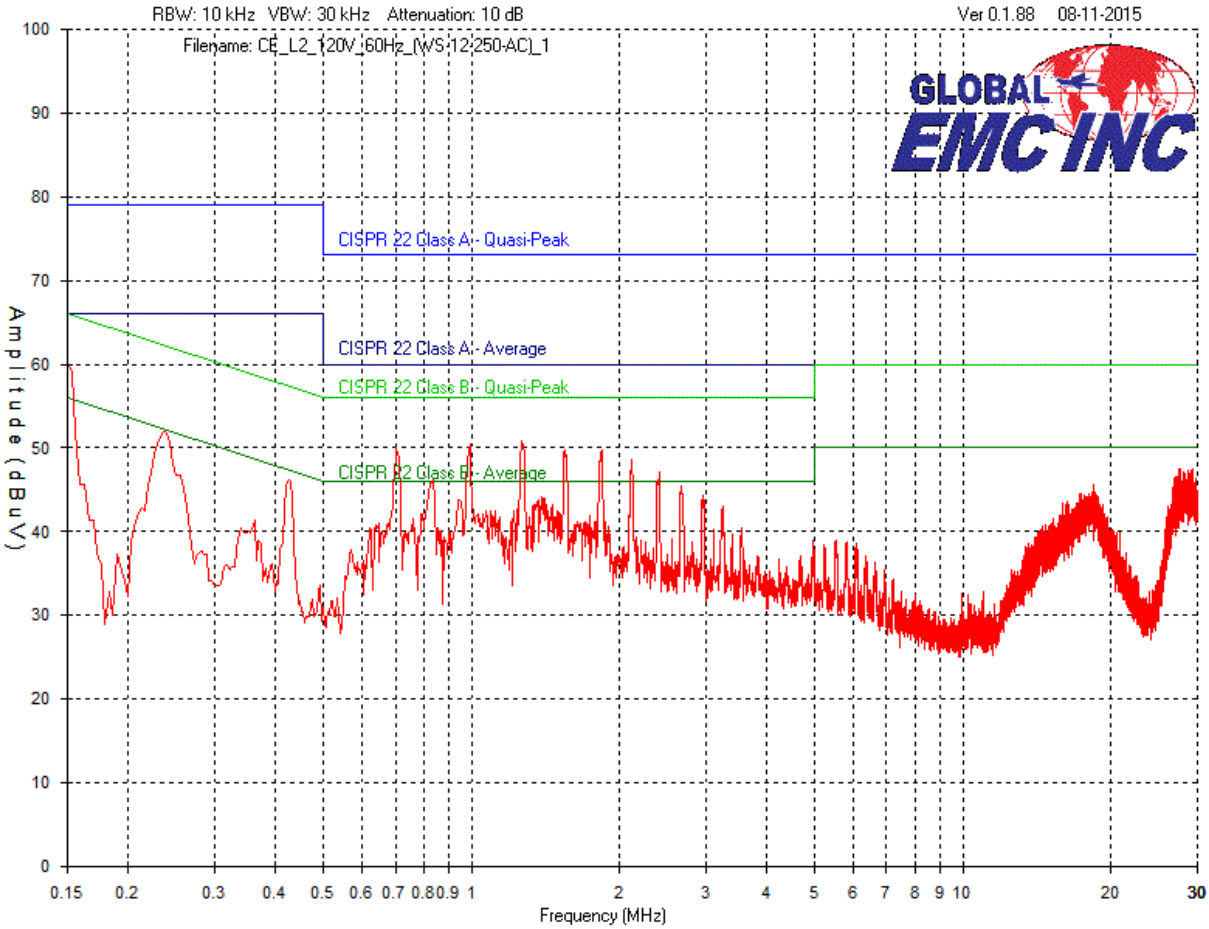
Neutral Line – Peak Emissions Graph
WS-12-400-AC: 230V_{AC}, 50Hz



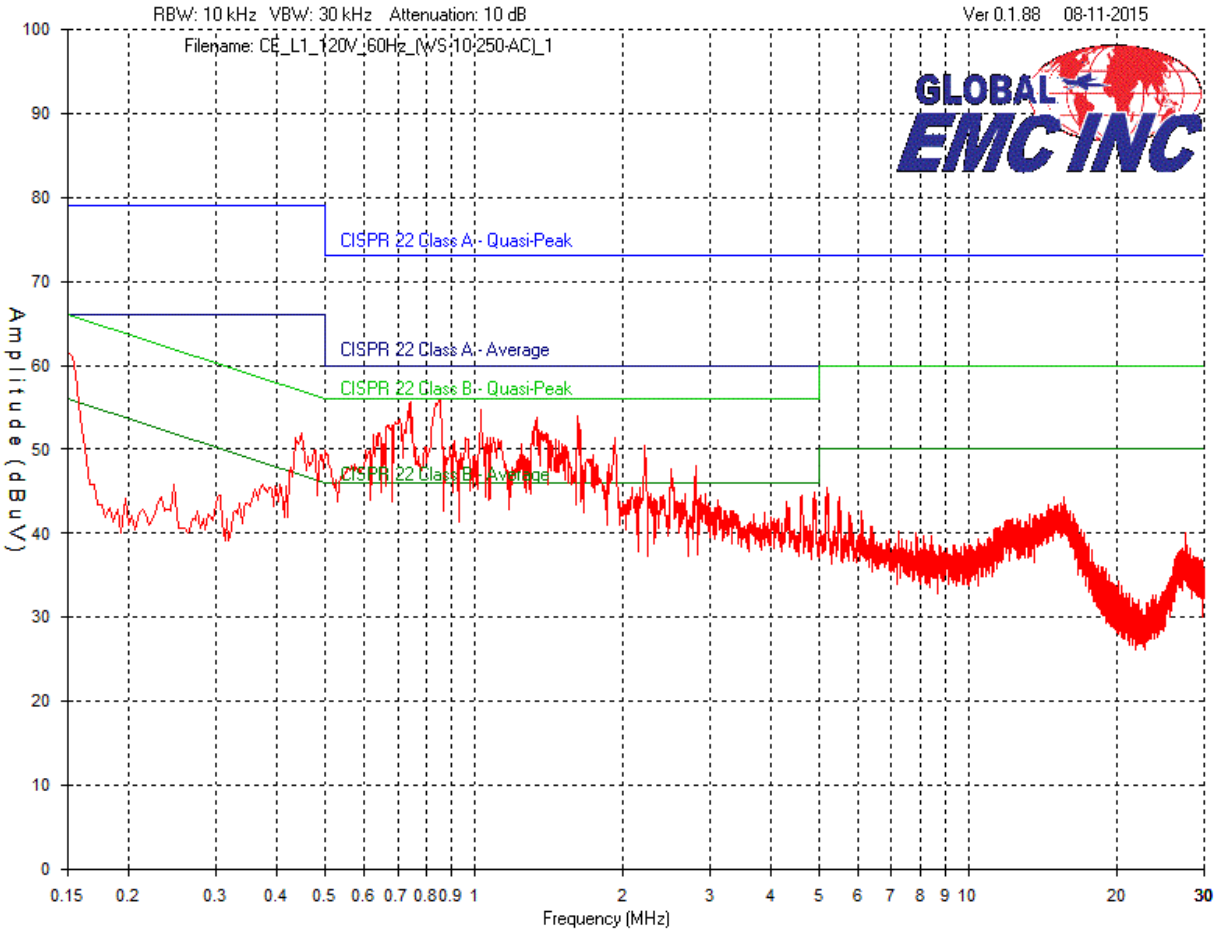
Phase Line – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz



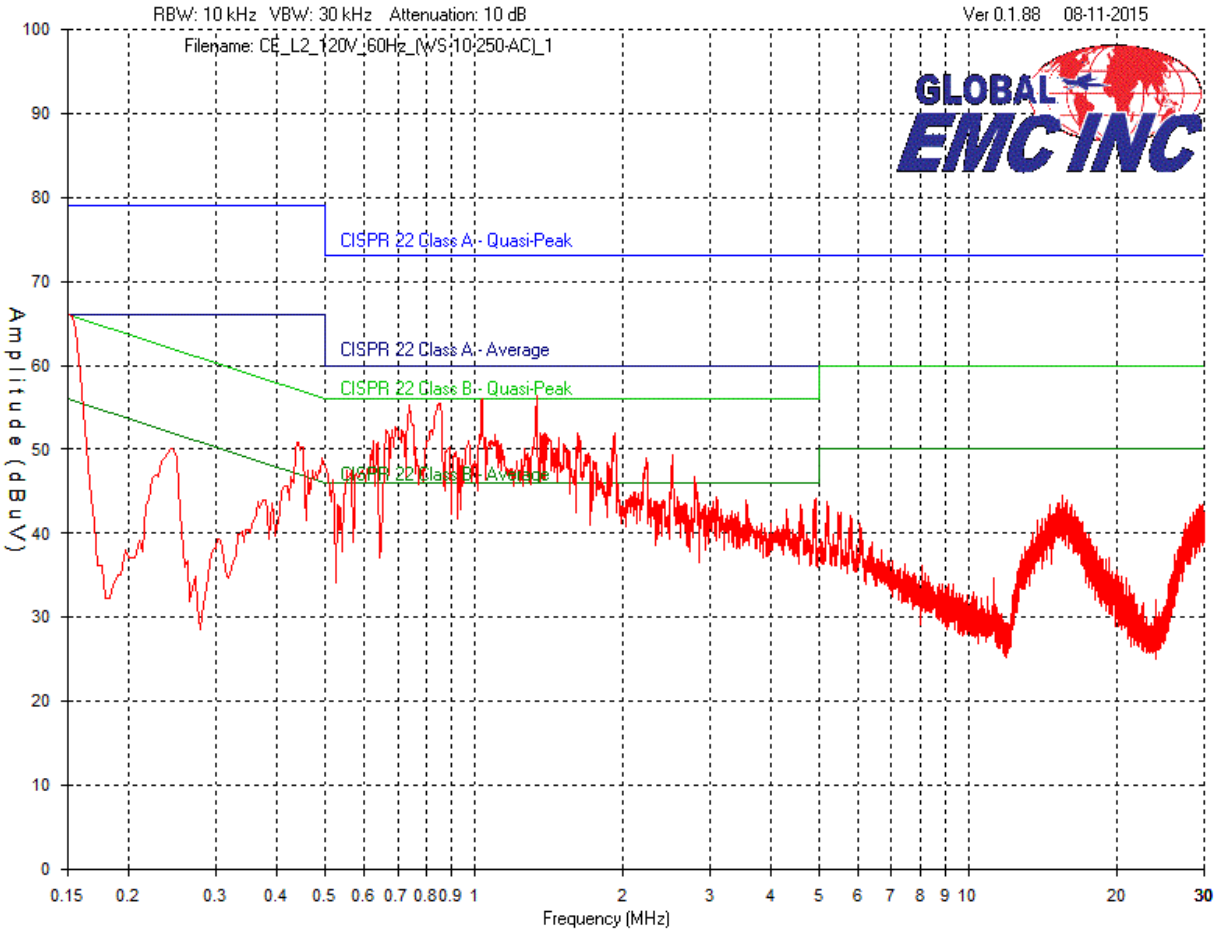
Neutral Line – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz



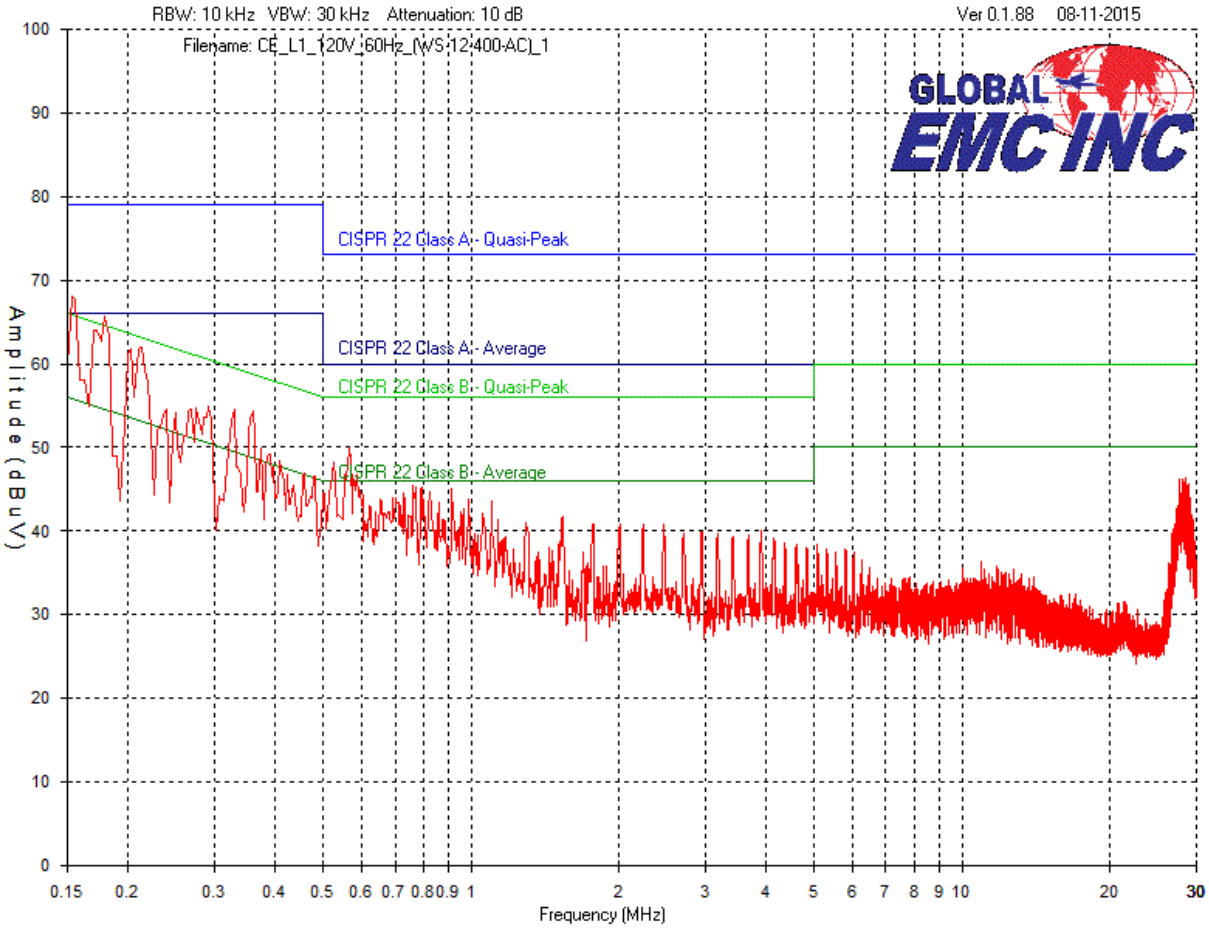
Phase Line – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz



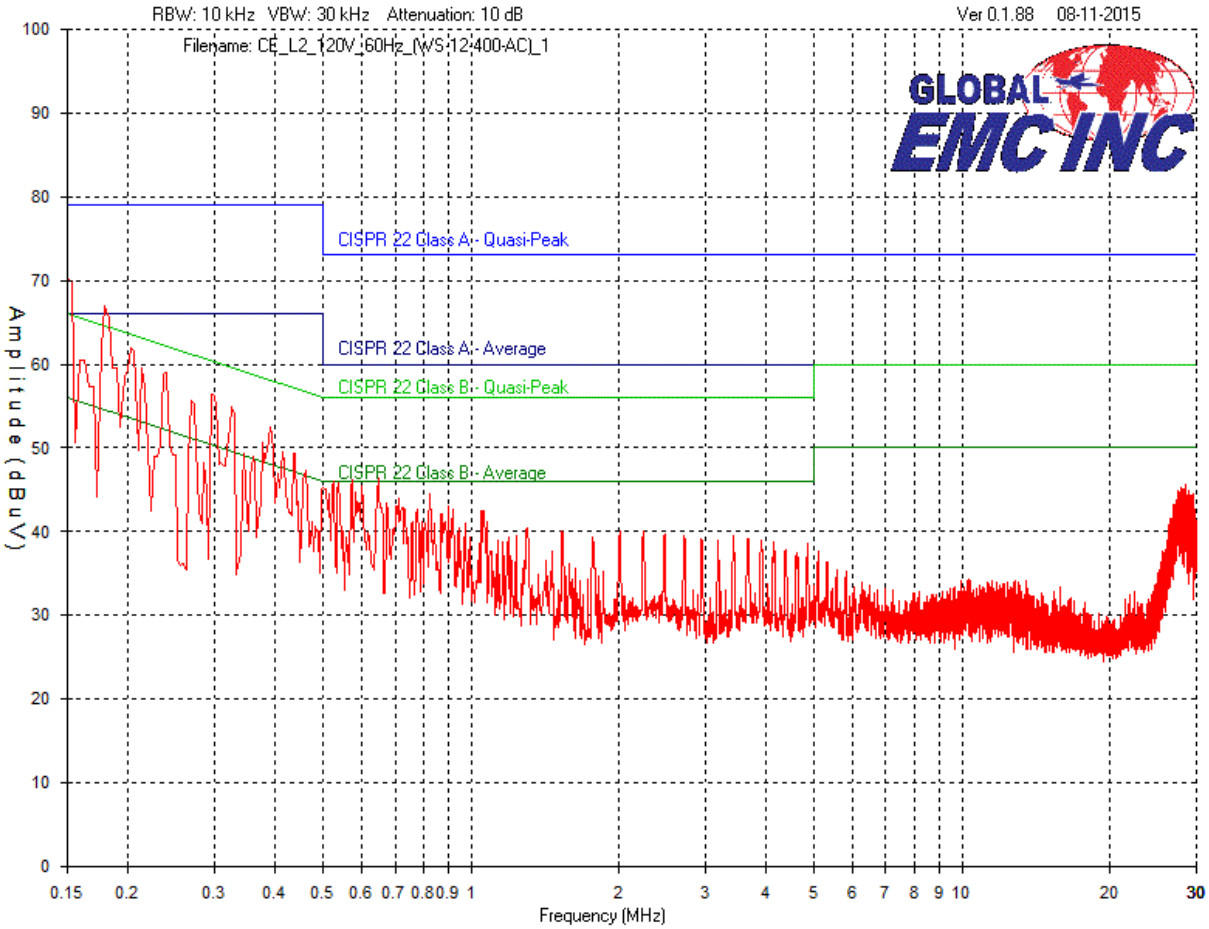
Neutral Line – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz



Phase Line – Peak Emissions Graph
WS-12-400-AC: 120V_{AC}, 60Hz



Neutral Line – Peak Emissions Graph
WS-12-400-AC: 120V_{AC}, 60Hz



Final Measurements

Emissions Table
WS-12-250-AC
230V_{AC}, 50Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.153	Peak	48.5	10	0.1	0.1	58.7	79	66	20.3	7.3	Pass
0.711	Peak	41.1	10	0.1	0	51.2	73	60	21.8	8.8	Pass
1.27	Peak	40	10	0.1	0	50.1	73	60	22.9	9.9	Pass
0.989	Peak	39.6	10	0.1	0	49.7	73	60	23.3	10.3	Pass
2.40	Peak	38.6	10	0.1	0	48.7	73	60	24.3	11.3	Pass
1.84	Peak	38.6	10	0.1	0	48.7	73	60	24.3	11.3	Pass
Neutral Line											
0.153	Peak	49.6	10	0.1	0.1	59.8	79	66	19.2	6.2	Pass
0.707	Peak	41.1	10	0.1	0	51.2	73	60	21.8	8.8	Pass
1.27	Peak	40.2	10	0.1	0	50.3	73	60	22.7	9.7	Pass
0.989	Peak	40	10	0.1	0	50.1	73	60	22.9	9.9	Pass
1.55	Peak	38.8	10	0.1	0	48.9	73	60	24.1	11.1	Pass

Emissions Table
WS-10-250-AC
230V_{AC}, 50Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
1.04	Peak	45.6	10	0.1	0	55.7	73	60	17.3	4.3	Pass
0.153	Peak	51.5	10	0.1	0.1	61.7	79	66	17.3	4.3	Pass
0.813	Peak	45.2	10	0.1	0	55.3	73	60	17.7	4.7	Pass
0.893	Peak	43.9	10	0.1	0	54	73	60	19	6	Pass
0.737	Peak	43.2	10	0.1	0	53.3	73	60	19.7	6.7	Pass
2.22	Peak	40.8	10	0.1	0	50.9	73	60	22.1	9.1	Pass
Neutral Line											
0.153	Peak	56.2	10	0.1	0.1	66.4	79	---	12.6	---	Pass
0.153	Avg.	55.6	10	0.1	0.1	65.8	---	66	---	0.2	Pass
0.764	Peak	46.2	10	0.1	0	56.3	73	60	16.7	3.7	Pass
1.04	Peak	45.5	10	0.1	0	55.6	73	60	17.4	4.4	Pass
0.953	Peak	44	10	0.1	0	54.1	73	60	18.9	5.9	Pass
0.740	Peak	43.8	10	0.1	0	53.9	73	60	19.1	6.1	Pass
1.33	Peak	40.8	10	0.1	0	50.9	73	60	22.1	9.1	Pass

Emissions Table
WS-12-400-AC
230V_{AC}, 50Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
28.3	Peak	35.5	10	0.5	0.2	46.2	73	60	26.8	13.8	Pass
1.53	Peak	32.7	10	0.1	0	42.8	73	60	30.2	17.2	Pass
0.585	Peak	32.5	10	0.1	0	42.6	73	60	30.4	17.4	Pass
0.820	Peak	31.9	10	0.1	0	42	73	60	31	18	Pass
0.701	Peak	31.5	10	0.1	0	41.6	73	60	31.4	18.4	Pass
3.91	Peak	31.2	10	0.2	0	41.4	73	60	31.6	18.6	Pass
Neutral Line											
28.1	Peak	35.1	10	0.5	0.2	45.8	73	60	27.2	14.2	Pass
27.9	Peak	34.4	10	0.5	0.2	45.1	73	60	27.9	14.9	Pass
1.06	Peak	33.2	10	0.1	0	43.3	73	60	29.7	16.7	Pass
1.53	Peak	33.1	10	0.1	0	43.2	73	60	29.8	16.8	Pass
0.880	Peak	33.1	10	0.1	0	43.2	73	60	29.8	16.8	Pass
1.29	Peak	32.3	10	0.1	0	42.4	73	60	30.6	17.6	Pass

Emissions Table
WS-12-250-AC
$120V_{AC}$, 60Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.153	Peak	47.9	10	0.1	0.1	58.1	79	66	20.9	7.9	Pass
1.27	Peak	41	10	0.1	0	51.1	73	60	21.9	8.9	Pass
0.996	Peak	40.9	10	0.1	0	51	73	60	22	9	Pass
0.711	Peak	40.7	10	0.1	0	50.8	73	60	22.2	9.2	Pass
1.55	Peak	39.9	10	0.1	0	50	73	60	23	10	Pass
0.837	Peak	38.7	10	0.1	0	48.8	73	60	24.2	11.2	Pass
Neutral Line											
0.153	Peak	48.9	10	0.1	0.1	59.1	79	66	19.9	6.9	Pass
1.26	Peak	40.7	10	0.1	0	50.8	73	60	22.2	9.2	Pass
0.992	Peak	40.4	10	0.1	0	50.5	73	60	22.5	9.5	Pass
0.701	Peak	39.9	10	0.1	0	50	73	60	23	10	Pass
1.84	Peak	39.6	10	0.1	0	49.7	73	60	23.3	10.3	Pass
1.55	Peak	39.6	10	0.1	0	49.7	73	60	23.3	10.3	Pass

Emissions Table
WS-10-250-AC
$120V_{AC}$, 60Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.853	Peak	45.7	10	0.1	0	55.8	73	60	17.2	4.2	Pass
0.747	Peak	45.6	10	0.1	0	55.7	73	60	17.3	4.3	Pass
0.153	Peak	50.9	10	0.1	0.1	61.1	79	66	17.9	4.9	Pass
1.03	Peak	44.6	10	0.1	0	54.7	73	60	18.3	5.3	Pass
1.62	Peak	43.8	10	0.1	0	53.9	73	60	19.1	6.1	Pass
1.34	Peak	43.6	10	0.1	0	53.7	73	60	19.3	6.3	Pass
Neutral Line											
0.153	Peak	55.8	10	0.1	0.1	66	79	---	13	---	Pass
0.153	Avg.	55.7	10	0.1	0.1	65.9	---	66	---	0.1	Pass
1.34	Peak	46.2	10	0.1	0	56.3	73	60	16.7	3.7	Pass
1.04	Peak	45.9	10	0.1	0	56	73	60	17	4	Pass
0.853	Peak	45.4	10	0.1	0	55.5	73	60	17.5	4.5	Pass
0.737	Peak	45.2	10	0.1	0	55.3	73	60	17.7	4.7	Pass
0.691	Peak	42.5	10	0.1	0	52.6	73	60	20.4	7.4	Pass

Emissions Table
WS-12-400-AC
$120V_{AC}$, 60Hz; Class A

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.153	Peak	57.9	10	0.1	0.1	68.1	79	---	10.9	---	Pass
0.153	Avg.	27.5	10	0.1	0.1	37.7	---	66	---	28.3	Pass
0.180	Peak	55.6	10	0.1	0	65.7	79	---	13.3	---	Pass
0.180	Avg.	26.7	10	0.1	0	36.8	---	66	---	29.2	Pass
0.213	Peak	51.9	10	0.1	0	62	79	66	17	4	Pass
0.359	Peak	44.3	10	0.1	0	54.4	79	66	24.6	11.6	Pass
0.329	Peak	44.5	10	0.1	0	54.6	79	66	24.4	11.4	Pass
0.293	Peak	44.7	10	0.1	0	54.8	79	66	24.2	11.2	Pass
Neutral Line											
0.153	Peak	59.6	10	0.1	0.1	69.8	79	---	9.2	---	Pass
0.153	Avg.	25.8	10	0.1	0.1	36	---	66	---	30	Pass
0.180	Peak	56.9	10	0.1	0	67	79	---	12	---	Pass
0.180	Avg.	22.2	10	0.1	0	32.3	---	66	---	33.7	Pass
0.203	Peak	51.8	10	0.1	0	61.9	79	66	17.1	4.1	Pass
0.163	Peak	50.4	10	0.1	0.1	60.6	79	66	18.4	5.4	Pass
0.213	Peak	49.5	10	0.1	0	59.6	79	66	19.4	6.4	Pass
0.240	Peak	48.9	10	0.1	0	59	79	66	20	7	Pass

Notes:

Peak = Peak readings
Avg. = Average readings

Where peak readings are under quasi-peak and/or average limits, the EUT passes the respective requirements, and no quasi-peak or average measurements are required.

See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up for the highest line conducted emissions.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	Oct. 9, 2014	Oct. 9, 2016	GEMC 193
Quasi-Peak Detector	85650A	HP	May. 22, 2014	May. 22, 2016	GEMC 194
LISN	FCC-LISN-50-100-1-02-MS461F	Fischer Custom Communications	Jan. 23, 2014	Jan. 23, 2016	GEMC 122
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

Telecom Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's telecom line does not exceed the limits listed below as defined in the applicable test standard, as measured from a Telecom LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference. This also protects other telecom equipment from unwanted emissions which may degrade the overall performance of the network.

Limits & Method

The voltage limits and method are as defined in CISPR 22 and EN55022.

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	84 to 74 dBuV	150 kHz – 500 kHz	97 to 87 dBuV
500 kHz – 30 MHz	74 dBuV	500 kHz – 30 MHz	87 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements. Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth. Measurements from the shielded RJ45 cable (PoE) is performed with a 50 ohm impedance to ground from the shield, and current measurements were also performed.

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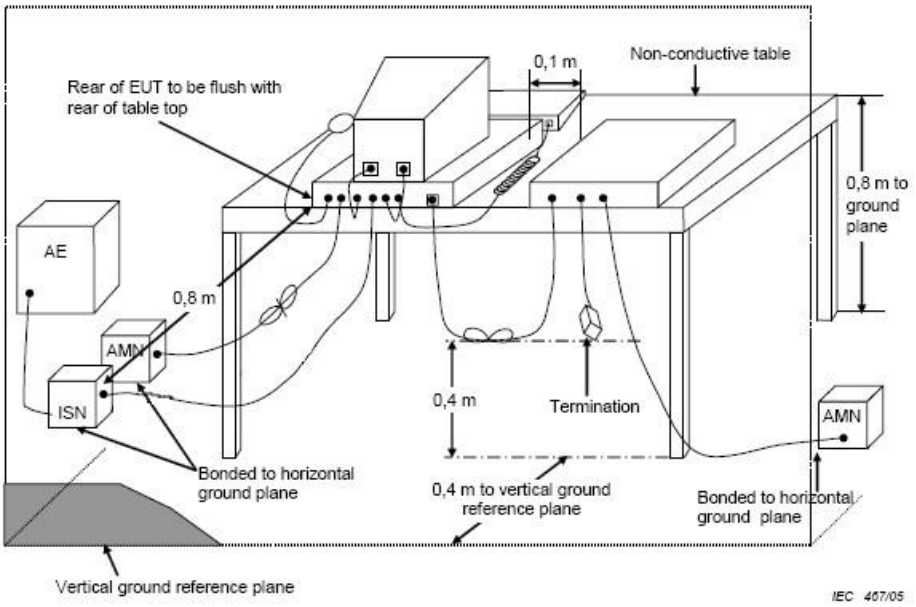
Typical Setup Diagram



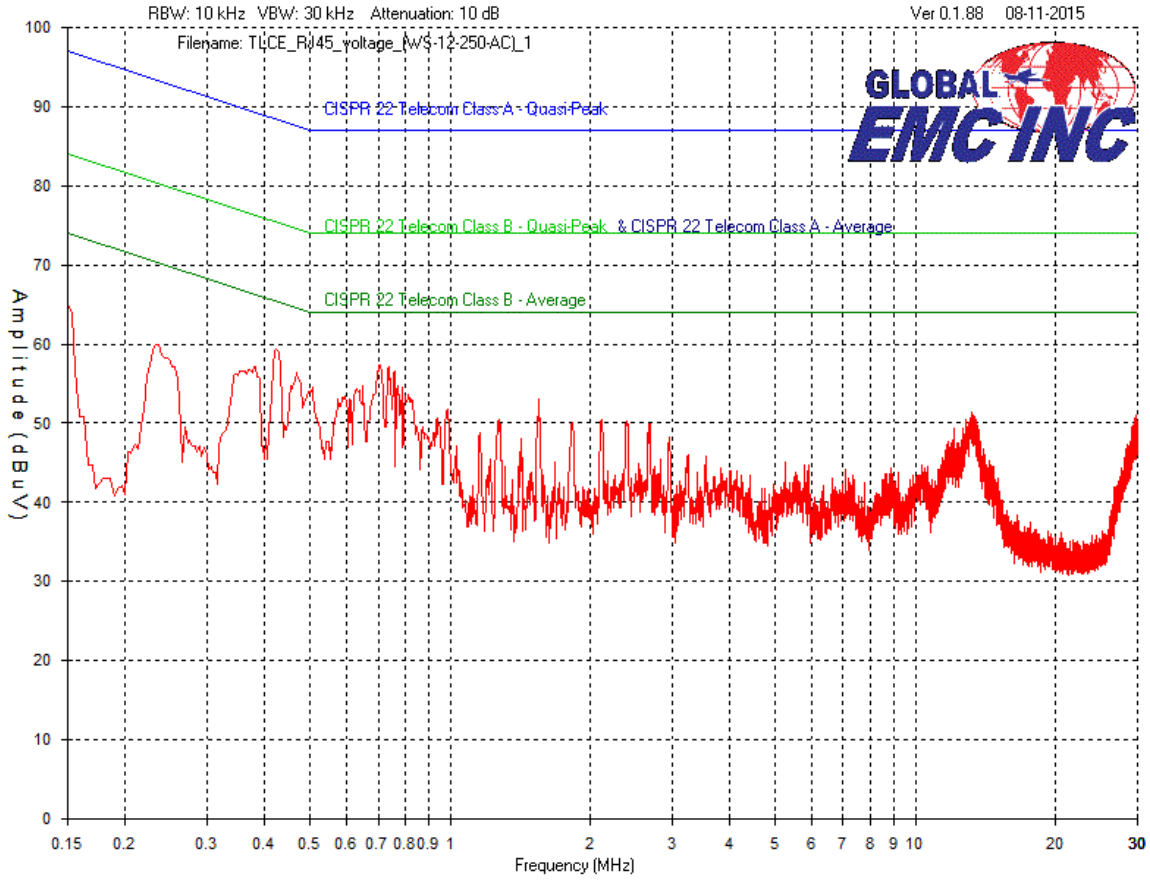
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.1 dB with a 'k=2' coverage factor and a 95% confidence level.

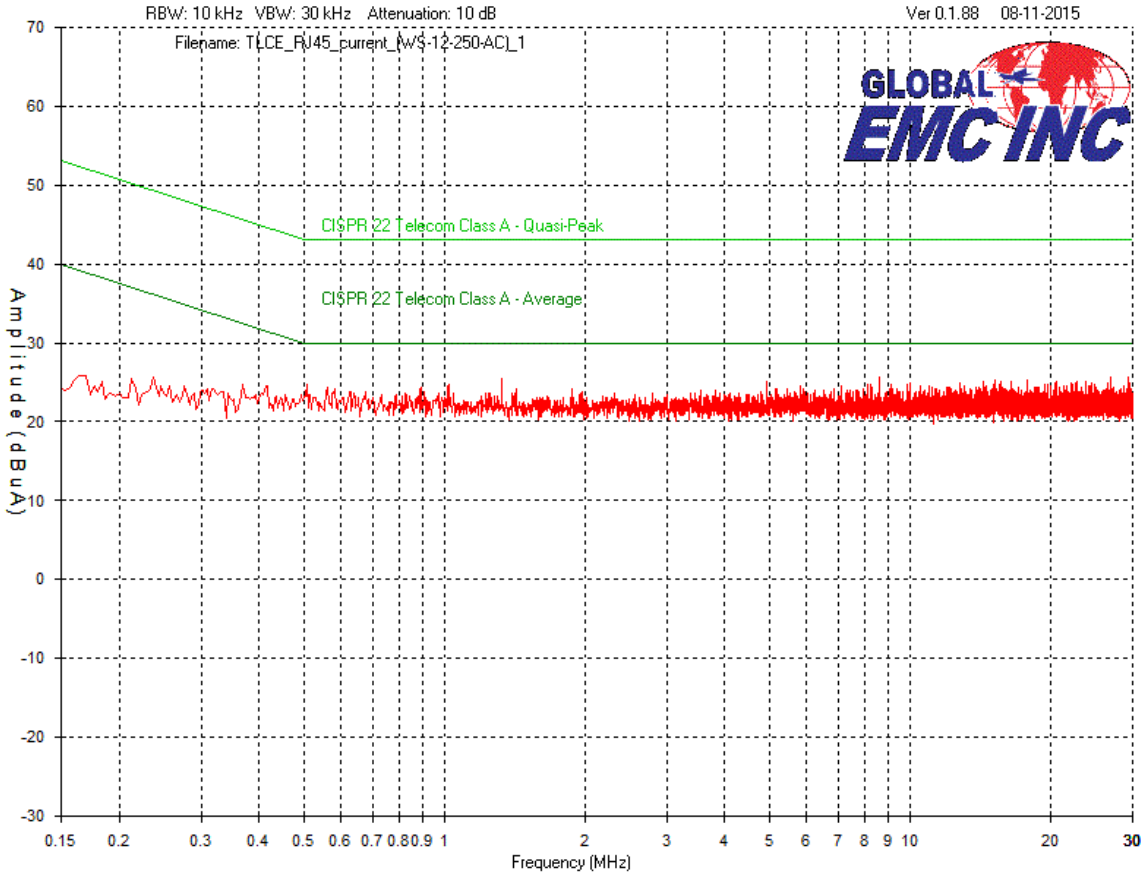
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. The graph measurements are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. Test is performed on shielded RJ45 lines. As per the client, shielded RJ45 cables are to be used when the EUT is installed in the field. Also, as per the client, all ports perform the same functions, therefore 1 port is tested from each unit as representative.

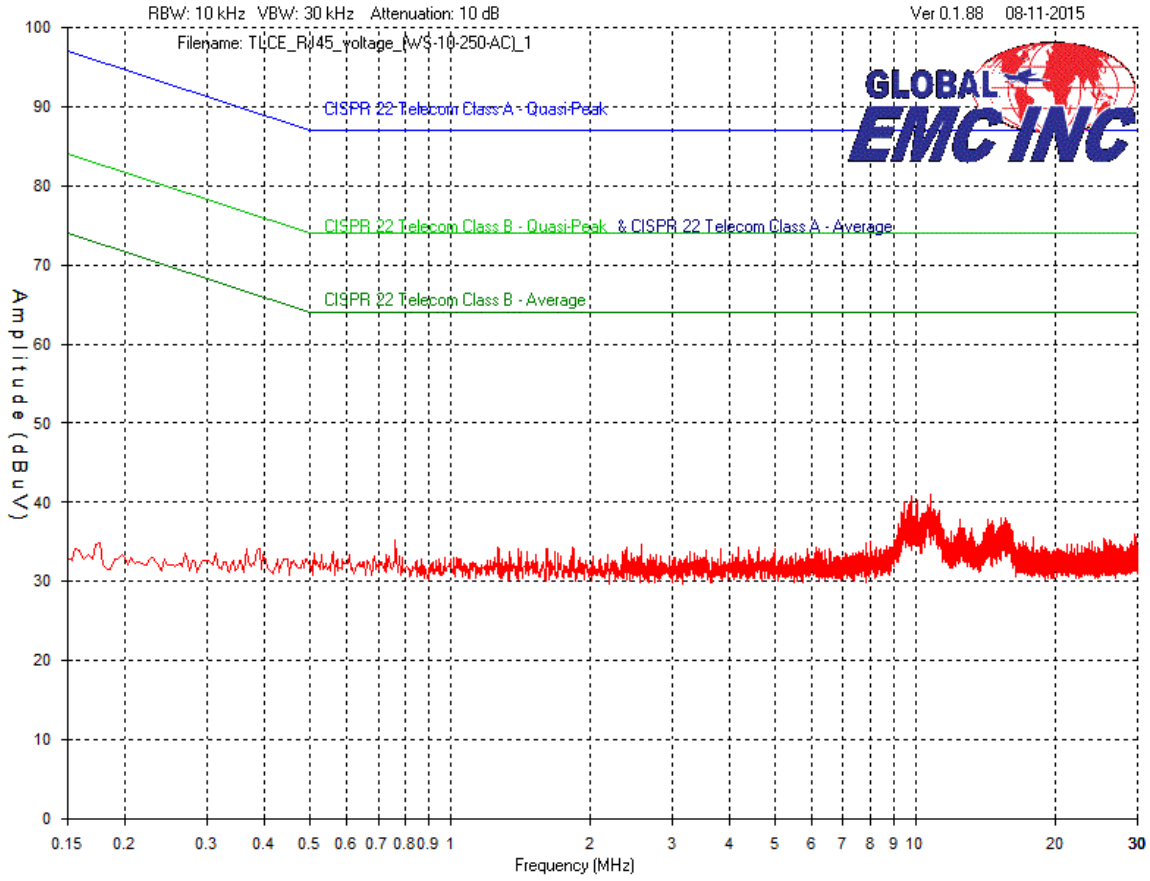
Shielded RJ45 – Peak Emissions Graph
WS-12-250-AC, Voltage Limits



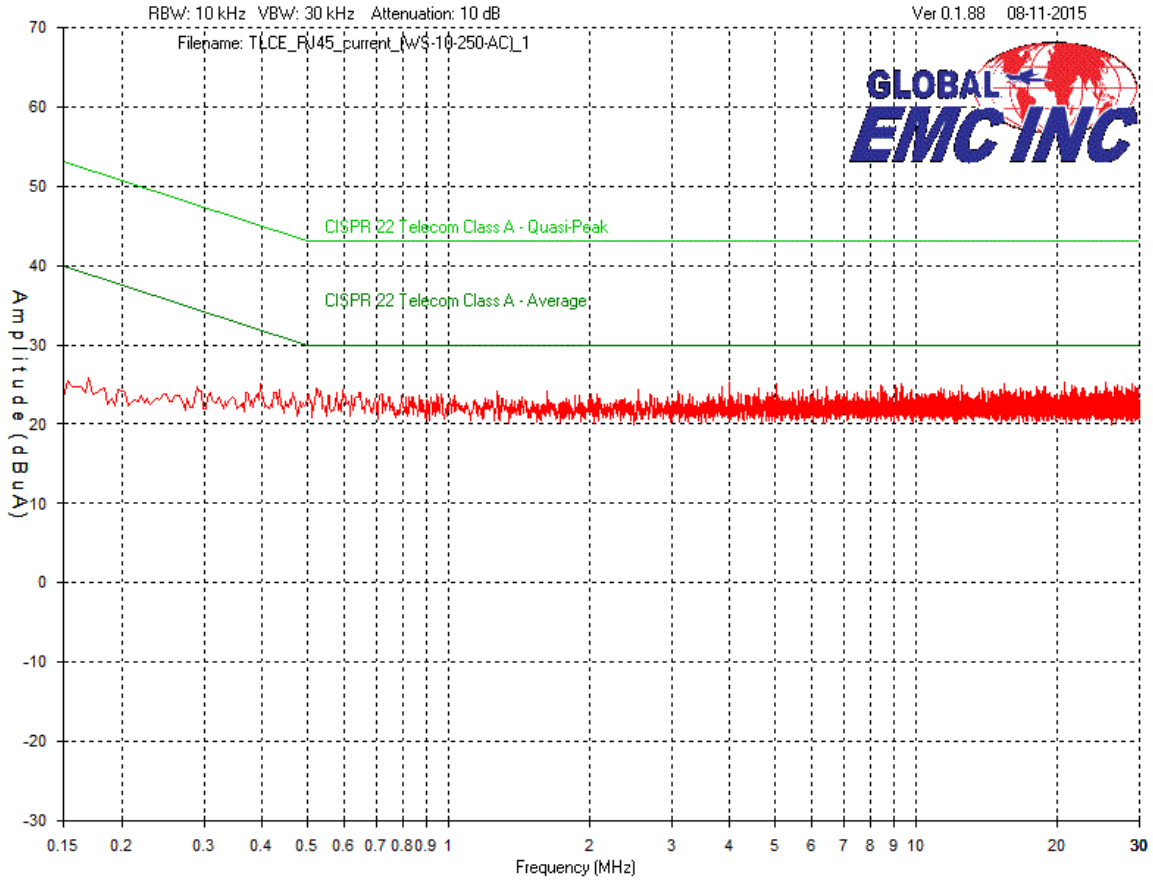
Shielded RJ45 – Peak Emissions Graph
WS-12-250-AC, Current Limits



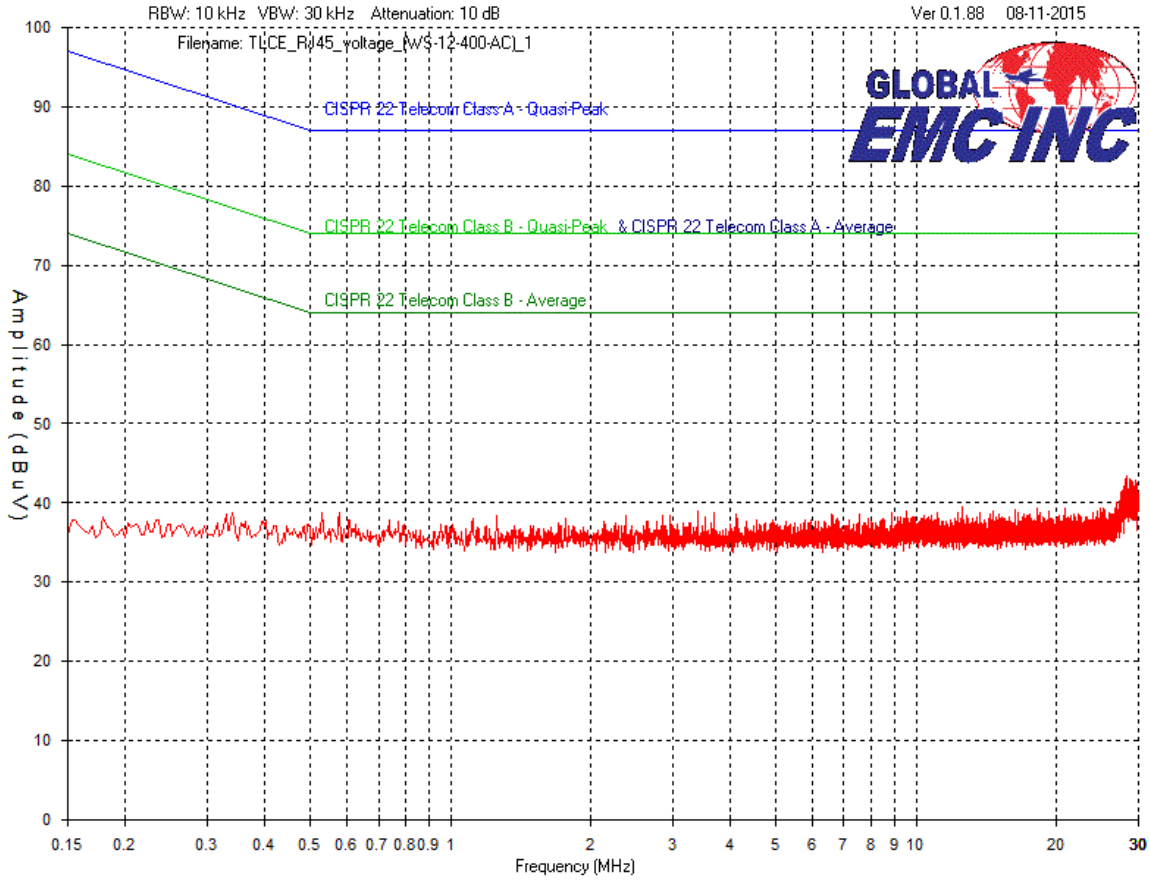
Shielded RJ45 – Peak Emissions Graph
WS-10-250-AC, Voltage Limits



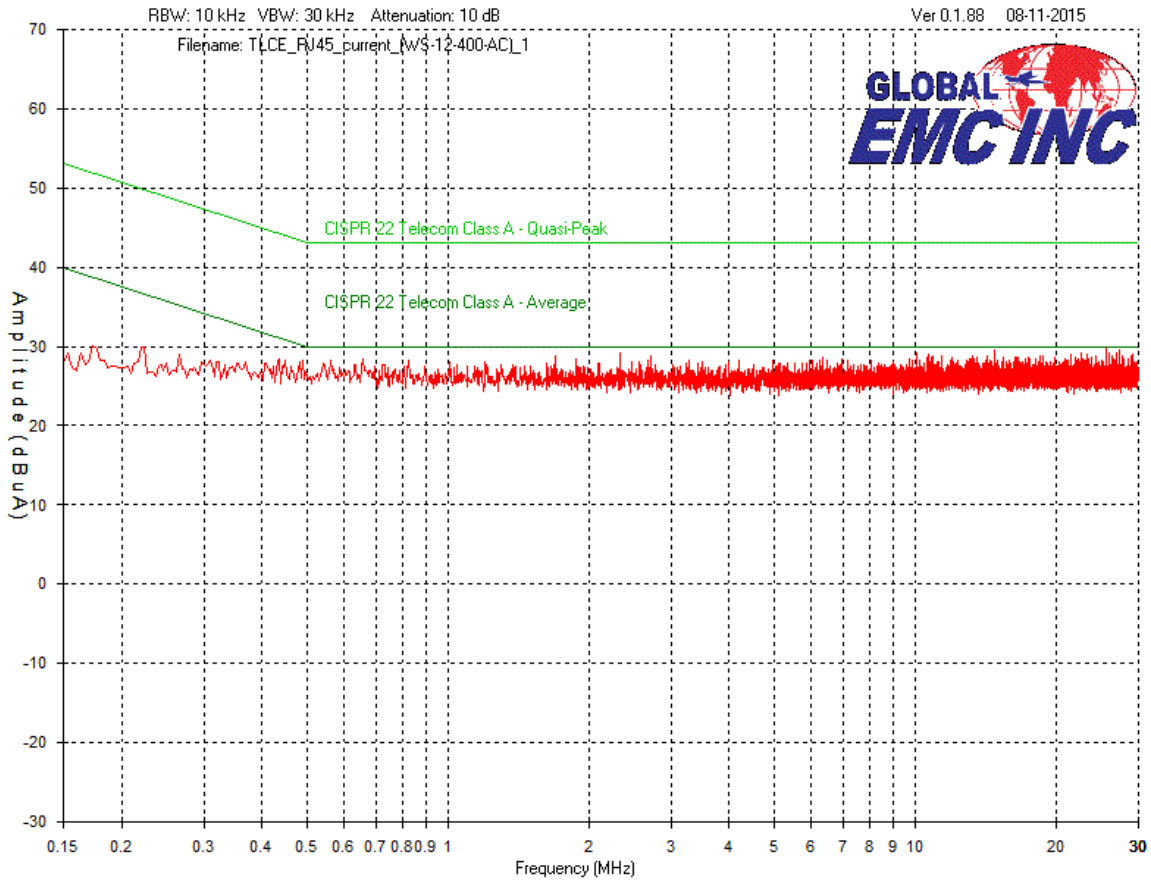
Shielded RJ45 – Peak Emissions Graph
WS-10-250-AC, Current Limits



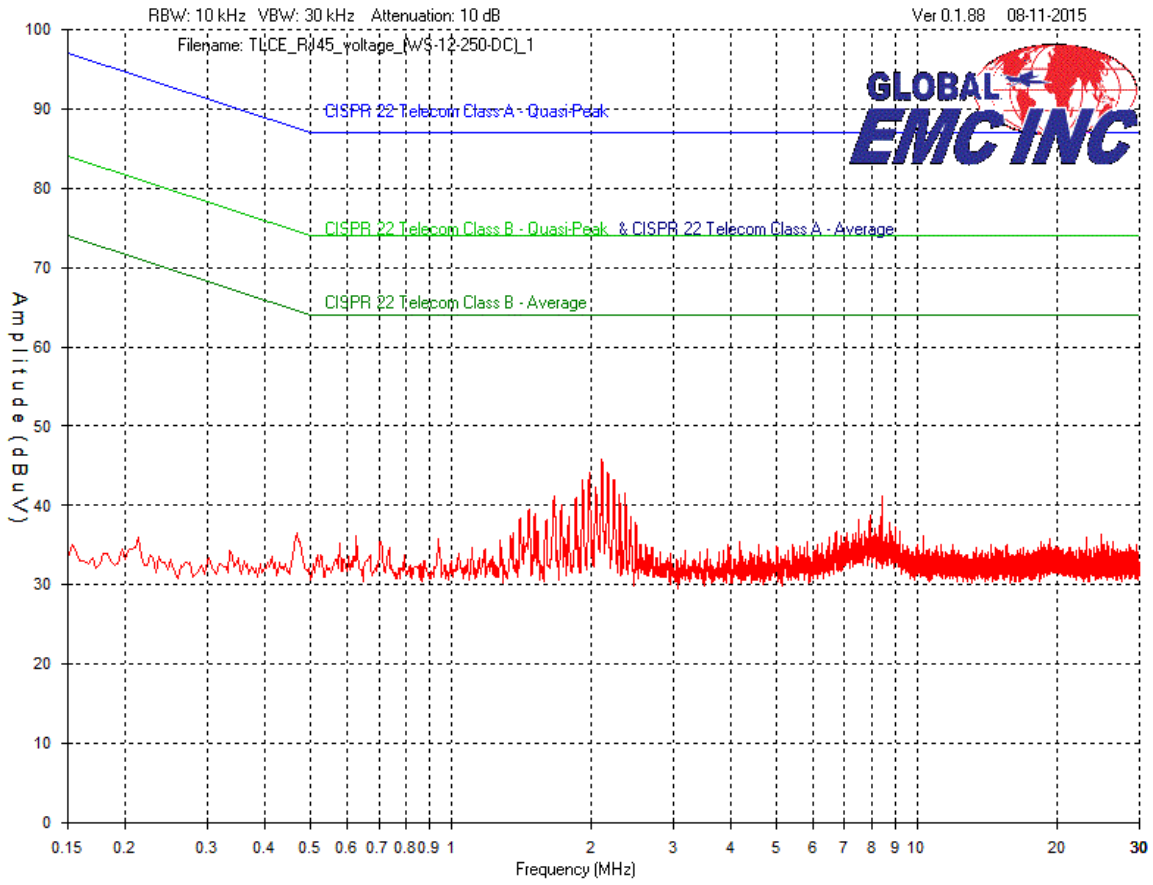
Shielded RJ45 – Peak Emissions Graph
WS-12-400-AC, Voltage Limits



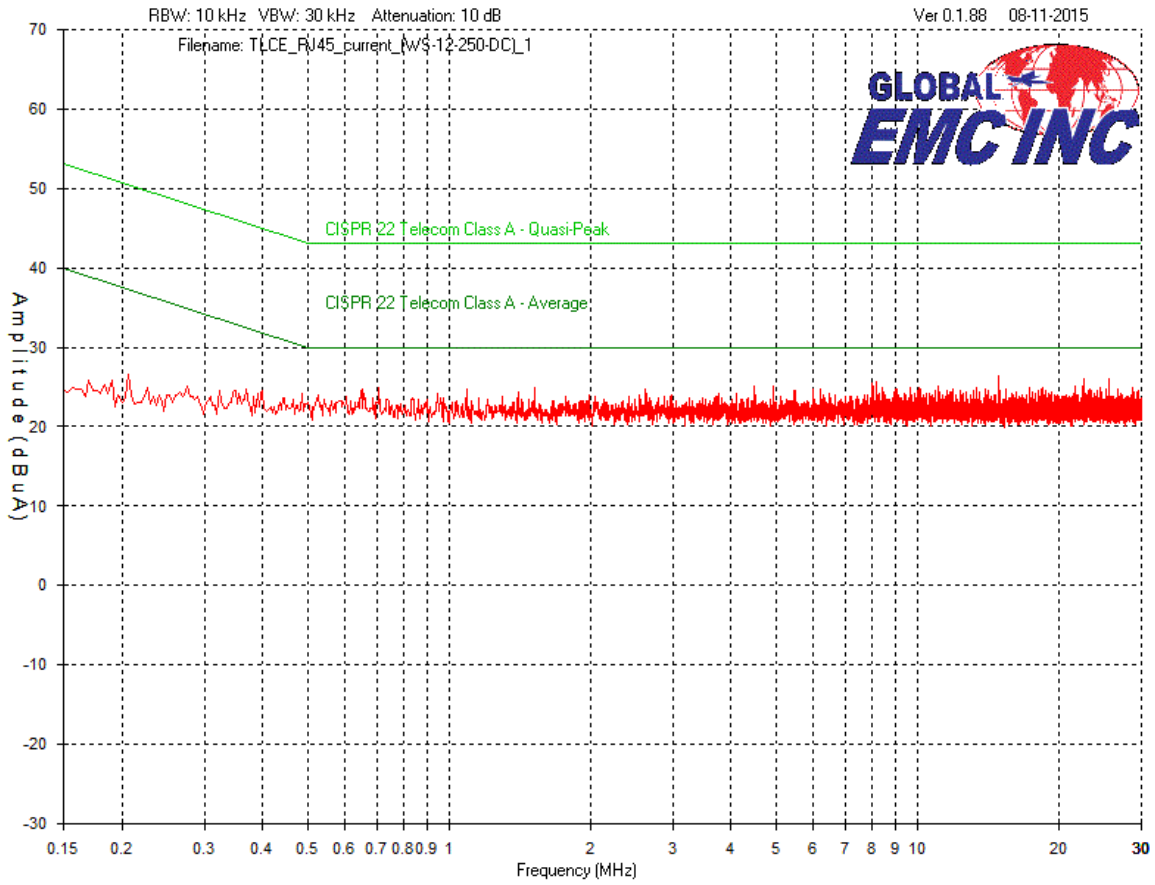
Shielded RJ45 – Peak Emissions Graph
WS-12-400-AC, Current Limits



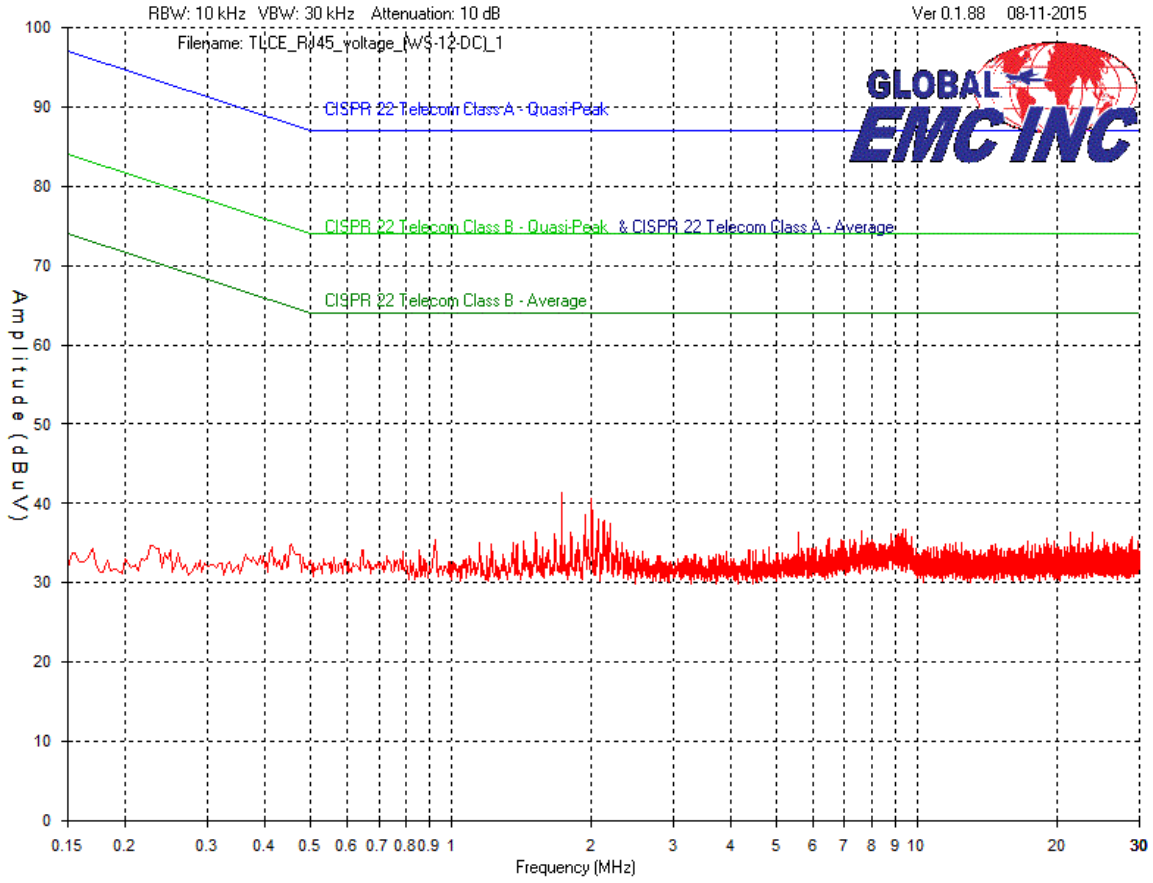
Shielded RJ45 – Peak Emissions Graph
WS-12-250-DC, Voltage Limits



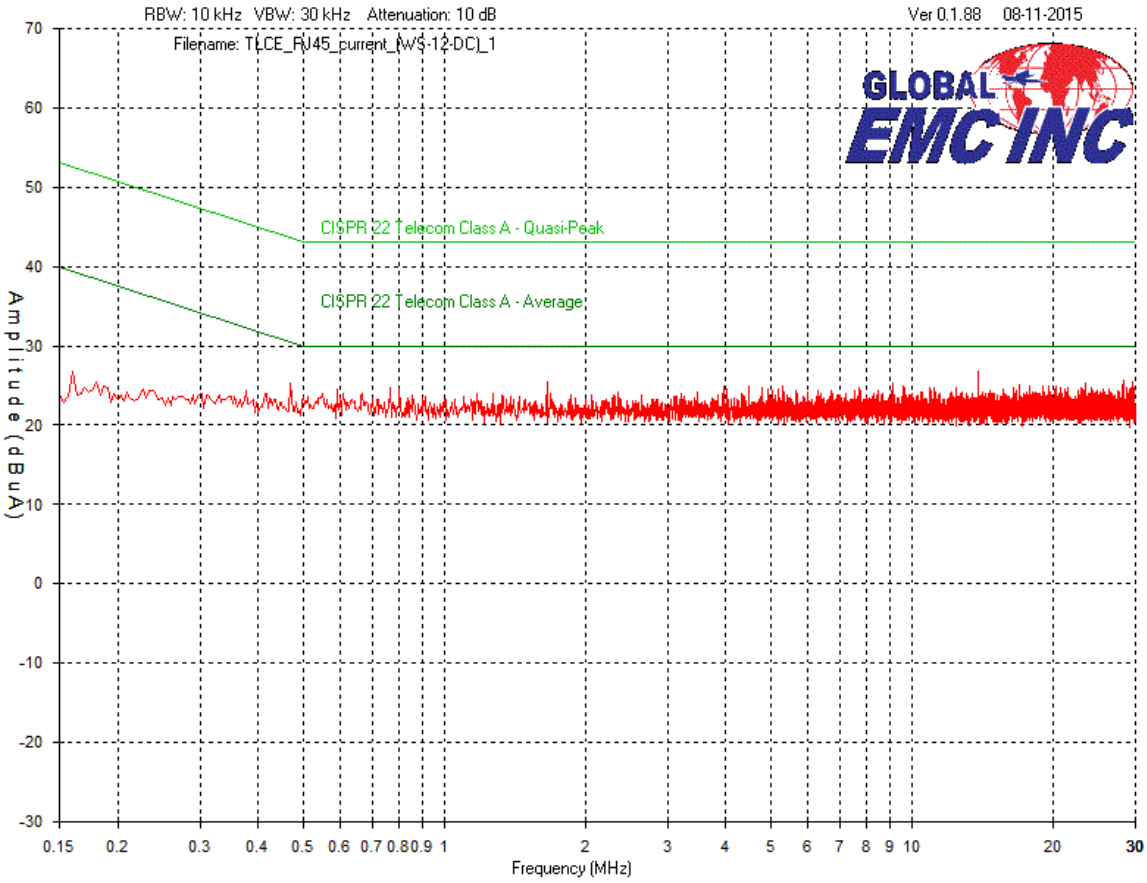
Shielded RJ45 – Peak Emissions Graph
WS-12-250-DC, Current Limits



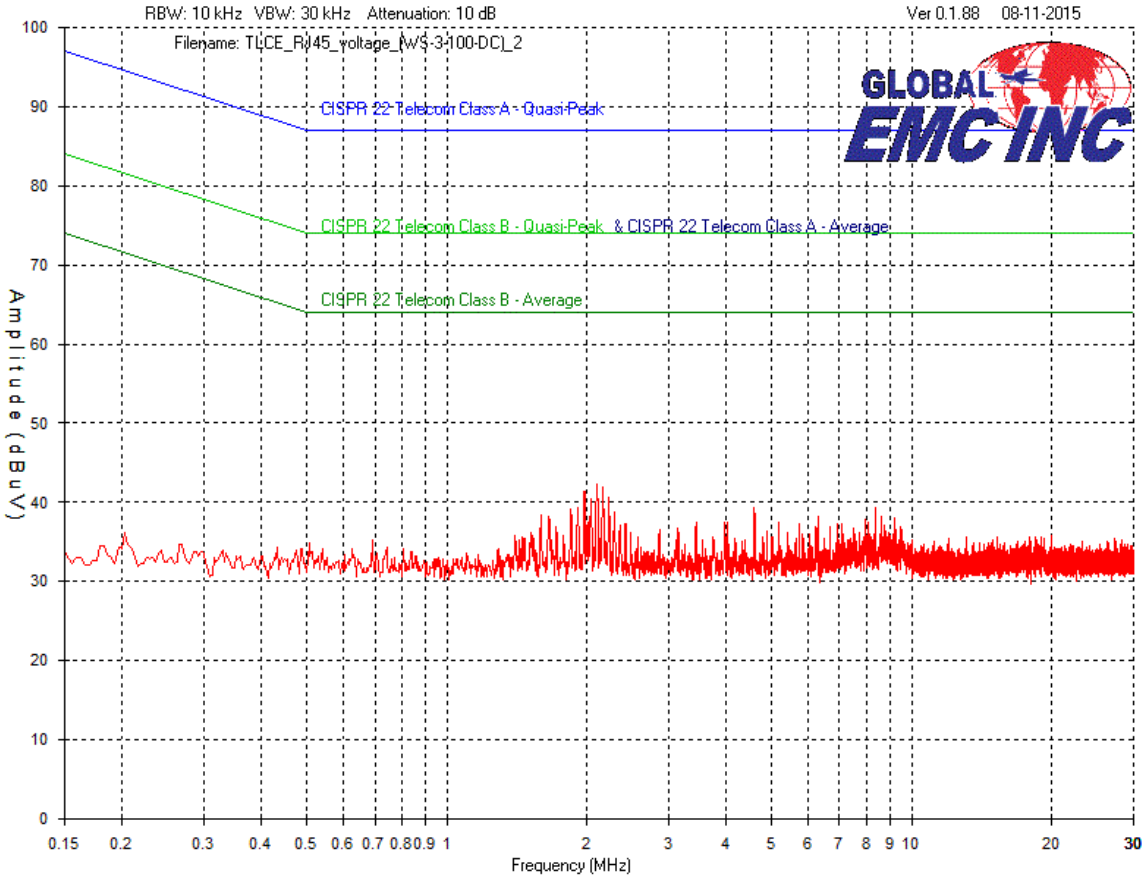
Shielded RJ45 – Peak Emissions Graph
WS-12-DC, Voltage Limits



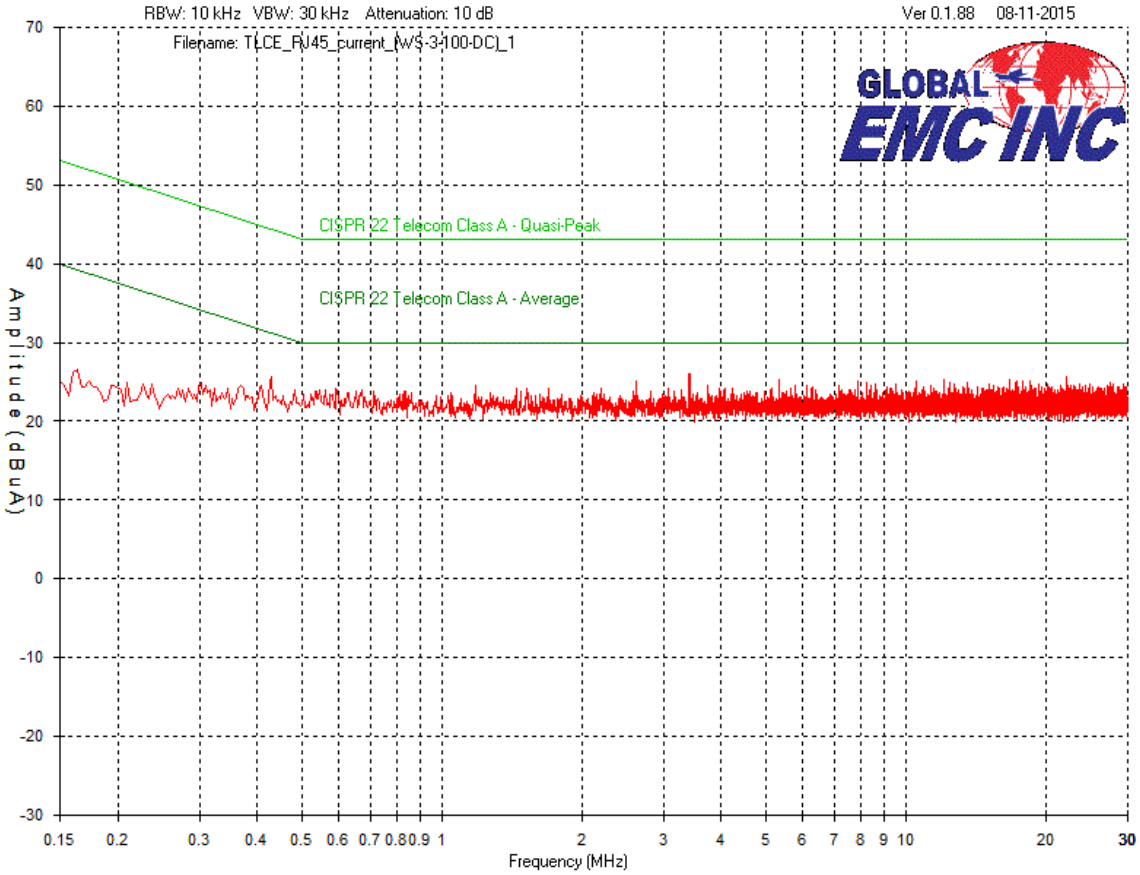
Shielded RJ45 – Peak Emissions Graph
WS-12-DC, Current Limits



Shielded RJ45 – Peak Emissions Graph
WS-6-100, Voltage Limits



Shielded RJ45 – Peak Emissions Graph
WS-6-100, Current Limits



Final Measurements

Emissions Table – Shielded RJ45
Voltage Limits, Class A
WS-12-250-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
0.422	Peak	43.6	6	0.1	9.7	59.4	88.4	75.4	29	16	Pass
0.704	Peak	41.6	6	0.1	9.7	57.4	87	74	29.6	16.6	Pass
0.737	Peak	41.3	6	0.1	9.7	57.1	87	74	29.9	16.9	Pass
0.468	Peak	40.5	6	0.1	9.7	56.3	87.5	74.5	31.2	18.2	Pass
0.379	Peak	41.3	6	0.1	9.7	57.1	89.3	76.3	32.2	19.2	Pass
0.651	Peak	39	6	0.1	9.7	54.8	87	74	32.2	19.2	Pass

Emissions Table – Shielded RJ45
Current Limits, Class A
WS-12-250-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	Probe Current Factor	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
8.57	Peak	19.5	6	0.3	-0.1	25.7	43	30	17.3	4.3	Pass
29.4	Peak	19.3	6	0.5	-0.1	25.7	43	30	17.3	4.3	Pass
27.0	Peak	19.3	6	0.4	-0.1	25.6	43	30	17.4	4.4	Pass
1.33	Peak	19.3	6	0.1	0	25.4	43	30	17.6	4.6	Pass
15.2	Peak	19	6	0.4	0	25.4	43	30	17.6	4.6	Pass
17.9	Peak	18.9	6	0.4	0	25.3	43	30	17.7	4.7	Pass

Emissions Table – Shielded RJ45
Voltage Limits, Class A
WS-10-250-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
10.8	Peak	24.8	6	0.3	9.8	40.9	87	74	46.1	33.1	Pass
9.85	Peak	24.6	6	0.3	9.8	40.7	87	74	46.3	33.3	Pass
9.78	Peak	24.2	6	0.3	9.8	40.3	87	74	46.7	33.7	Pass
15.3	Peak	21.8	6	0.4	9.9	38.1	87	74	48.9	35.9	Pass
12.5	Peak	21.7	6	0.3	9.9	37.9	87	74	49.1	36.1	Pass
25.3	Peak	14.9	6	0.4	10.1	31.4	87	74	55.6	42.6	Pass

Emissions Table – Shielded RJ45
Current Limits, Class A
WS-10-250-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	Probe Current Factor	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
3.97	Peak	19.2	6	0.2	0	25.4	43	30	17.6	4.6	Pass
20.8	Peak	18.9	6	0.4	0	25.3	43	30	17.7	4.7	Pass
25.4	Peak	18.9	6	0.4	-0.1	25.2	43	30	17.8	4.8	Pass
9.28	Peak	18.8	6	0.3	0	25.1	43	30	17.9	4.9	Pass
21.9	Peak	16	6	0.4	0	22.4	43	30	20.6	7.6	Pass
0.170	Peak	18.6	6	0.1	1.1	25.8	52	39	26.2	13.2	Pass

Emissions Table – Shielded RJ45
Voltage Limits, Class A
WS-12-400-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
28.4	Peak	22.9	10	0.5	10.1	43.5	87	74	43.5	30.5	Pass
28.7	Peak	22.4	10	0.5	10.1	43	87	74	44	31	Pass
29.8	Peak	21.8	10	0.5	10.1	42.4	87	74	44.6	31.6	Pass
27.9	Peak	21.6	10	0.4	10.1	42.1	87	74	44.9	31.9	Pass
27.5	Peak	20.8	10	0.4	10.1	41.3	87	74	45.7	32.7	Pass
12.6	Peak	19.3	10	0.3	9.9	39.5	87	74	47.5	34.5	Pass

Emissions Table – Shielded RJ45
Current Limits, Class A
WS-12-400-AC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	Probe Current Factor	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
25.7	Peak	19.3	10	0.4	-0.1	29.6	43	30	13.4	0.4	Pass
14.8	Peak	19.2	10	0.4	0	29.6	43	30	13.4	0.4	Pass
27.4	Peak	19.2	10	0.4	-0.1	29.5	43	30	13.5	0.5	Pass
10.1	Peak	18.9	10	0.3	0	29.2	43	30	13.8	0.8	Pass
22.7	Peak	18.8	10	0.4	0	29.2	43	30	13.8	0.8	Pass
2.33	Peak	19	10	0.1	0	29.1	43	30	13.9	0.9	Pass

Emissions Table – Shielded RJ45
Voltage Limits, Class A
WS-12-250-DC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
2.11	Peak	30	6	0.1	9.7	45.8	87	74	41.2	28.2	Pass
2.17	Peak	28.4	6	0.1	9.7	44.2	87	74	42.8	29.8	Pass
1.98	Peak	28.3	6	0.1	9.7	44.1	87	74	42.9	29.9	Pass
2.24	Peak	27.5	6	0.1	9.7	43.3	87	74	43.7	30.7	Pass
1.92	Peak	27.5	6	0.1	9.7	43.3	87	74	43.7	30.7	Pass
2.05	Peak	26.5	6	0.1	9.7	42.3	87	74	44.7	31.7	Pass

Emissions Table – Shielded RJ45
Current Limits, Class A
WS-12-250-DC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	Probe Current Factor	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
14.9	Peak	20	6	0.4	0	26.4	43	30	16.6	3.6	Pass
22.6	Peak	19.6	6	0.4	0	26	43	30	17	4	Pass
25.7	Peak	19.7	6	0.4	-0.1	26	43	30	17	4	Pass
8.18	Peak	19.4	6	0.3	-0.1	25.6	43	30	17.4	4.4	Pass
22.4	Peak	16.6	6	0.4	0	23	43	30	20	7	Pass
0.206	Peak	19.8	6	0.1	0.6	26.5	50.3	37.3	23.8	10.8	Pass

Emissions Table – Shielded RJ45
Voltage Limits, Class A
WS-12-DC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
1.73	Peak	25.5	6	0.1	9.7	41.3	87	74	45.7	32.7	Pass
2.00	Peak	24.9	6	0.1	9.7	40.7	87	74	46.3	33.3	Pass
1.94	Peak	22.8	6	0.1	9.7	38.6	87	74	48.4	35.4	Pass
2.07	Peak	22.2	6	0.1	9.7	38	87	74	49	36	Pass
2.13	Peak	22	6	0.1	9.7	37.8	87	74	49.2	36.2	Pass
2.20	Peak	21.7	6	0.1	9.7	37.5	87	74	49.5	36.5	Pass

Emissions Table – Shielded RJ45
Current Limits, Class A
WS-12-DC

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
13.8	Peak	20.5	6	0.3	0	26.8	43	30	16.2	3.2	Pass
28.4	Peak	19.3	6	0.5	-0.1	25.7	43	30	17.3	4.3	Pass
1.66	Peak	19.3	6	0.1	0	25.4	43	30	17.6	4.6	Pass
9.09	Peak	19.1	6	0.3	0	25.4	43	30	17.6	4.6	Pass
17.0	Peak	18.8	6	0.4	0	25.2	43	30	17.8	4.8	Pass
23.5	Peak	18.9	6	0.4	-0.1	25.2	43	30	17.8	4.8	Pass

Emissions Table – Shielded RJ4
Voltage Limits, Class A
WS-6-100

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
2.11	Peak	26.4	6	0.1	9.7	42.2	87	74	44.8	31.8	Pass
2.17	Peak	26.2	6	0.1	9.7	42	87	74	45	32	Pass
1.98	Peak	25.5	6	0.1	9.7	41.3	87	74	45.7	32.7	Pass
2.23	Peak	24.8	6	0.1	9.7	40.6	87	74	46.4	33.4	Pass
2.04	Peak	24.7	6	0.1	9.7	40.5	87	74	46.5	33.5	Pass
4.59	Peak	23.4	6	0.2	9.7	39.3	87	74	47.7	34.7	Pass

Emissions Table – Shielded RJ4
Current Limits, Class A
WS-6-100

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN Voltage factor (dB)	Emission Level (dBuV)	Emission limit (dBµV) Quasi-Peak	Emission limit (dBµV) Average	Margin (dB) Quasi-Peak	Margin (dB) Average	Result
3.41	Peak	19.9	6	0.2	0	26.1	43	30	16.9	3.9	Pass
22.1	Peak	19.2	6	0.4	0	25.6	43	30	17.4	4.4	Pass
5.32	Peak	19.1	6	0.2	0	25.3	43	30	17.7	4.7	Pass
16.8	Peak	18.9	6	0.4	0	25.3	43	30	17.7	4.7	Pass
12.1	Peak	18.9	6	0.3	0	25.2	43	30	17.8	4.8	Pass
0.163	Peak	19.3	6	0.1	1.2	26.6	52.3	39.3	25.7	12.7	Pass

Notes:

Peak = Peak readings

Where peak readings are under quasi-peak and/or average limits, the EUT passes the respective requirements, and no quasi-peak or average measurements are required.

The peak measurements of voltage and current from all units are under the quasi-peak and average limits. Therefore the EUT meets the requirements.

See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest line conducted emission.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	Oct. 9, 2014	Oct. 9, 2016	GEMC 193
Quasi-Peak Detector	85650A	HP	May. 22, 2014	May. 22, 2016	GEMC 194
TLISN	T8-02-09	FCC	Oct. 2, 2014	Oct. 2, 2016	GEMC 126
RF Current Probe	F-33-2	FCC	Jan. 16, 2015	Jan. 16, 2017	GEMC 19
Multimeter	287	Fluke	Dec. 22, 2014	Dec. 22, 2015	CANE00144
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

This report module is based on GEMC template "CISPR22 – Telecom Line Conducted Emissions Class A_Rev2"

Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The limits and method are as defined in CISPR 22 and EN55022.

30 MHz – 230 MHz , 40 dBµV/m at 10m, 50.5 dBµV/m at 3m[1]
230 MHz – 1000 MHz, 47 dBµV/m at 10m, 57.5 dBµV/m at 3m[1]
1 GHz – 3 GHz, 56 dBµV/m at 3m[2], 76 dBµV/m at 3m[3]
3 GHz – 6 GHz, 60 dBµV/m at 3m[2], 80 dBµV/m at 3m[3]

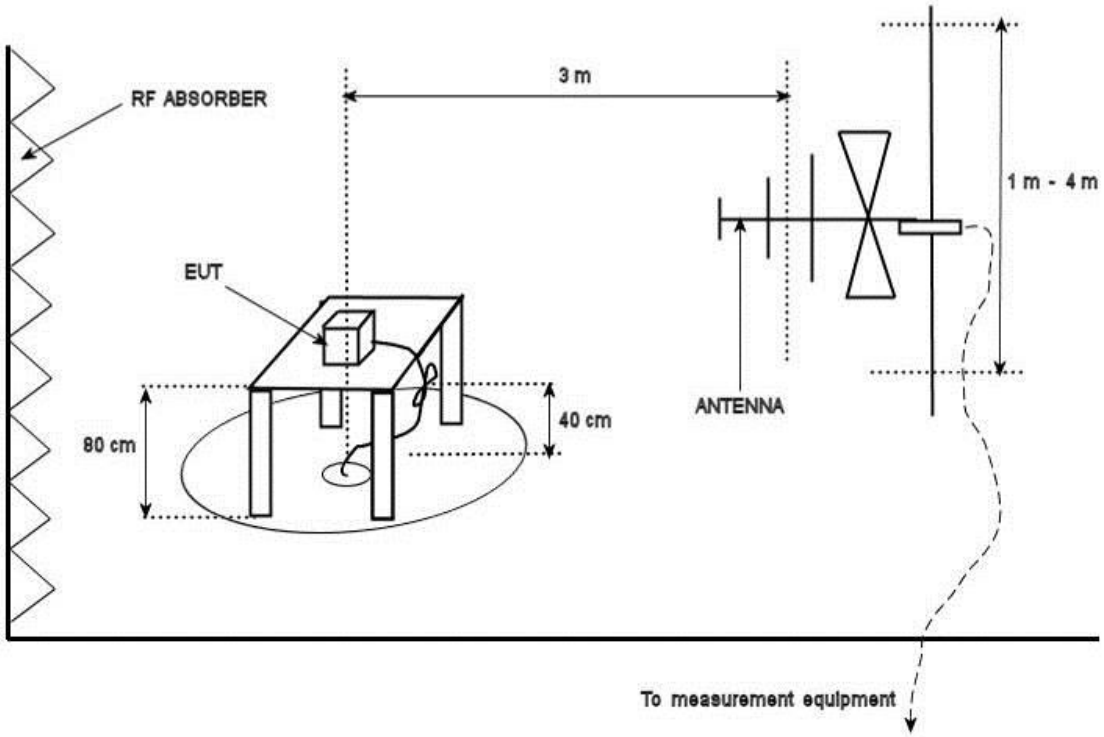
Note 1: This limit is specified as being measured with a 120 kHz measurement bandwidth and a using a Quasi Peak detector.

Note 2: This limit is specified as being measured with 1 MHz measurement bandwidth using an average detector with a 100 ms time period.

Note 3: This limit is specified as being measured with 1 MHz measurement bandwidth using a peak detector.

Note 4: If the highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz. If the highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz, the measurement shall only be made up to 2 GHz. If the highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz, the measurement shall only be made up to 5 GHz. If the highest frequency of the internal sources of the EUT is above 1 GHz, the measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less.

Typical Radiated Emissions Setup



Note: In accordance with CISPR 22 section 10.4.5, testing was performed at a 3 meter test distance. An extrapolation factor of 10.5 dB was applied in accordance with section CISPR 22 section 10.8(a).

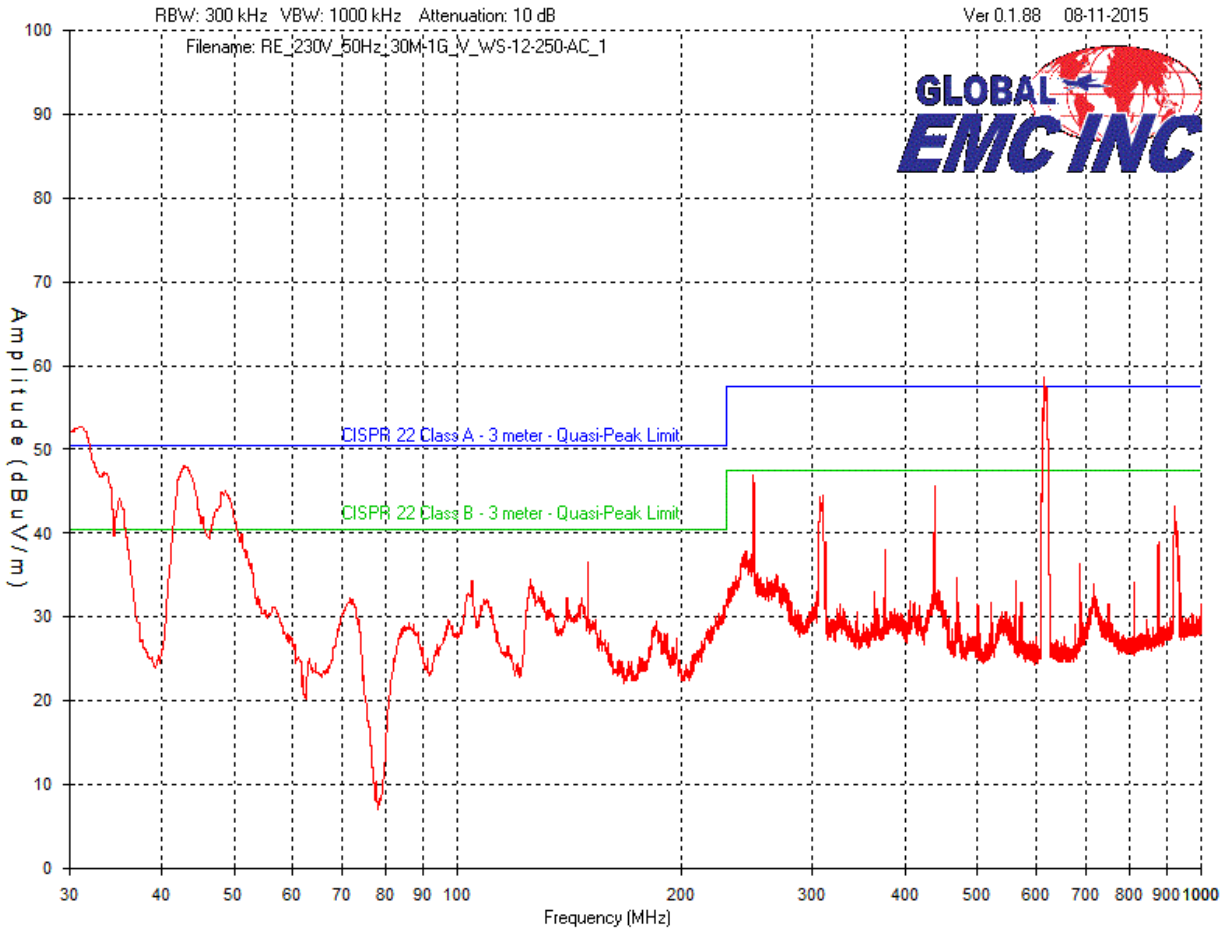
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

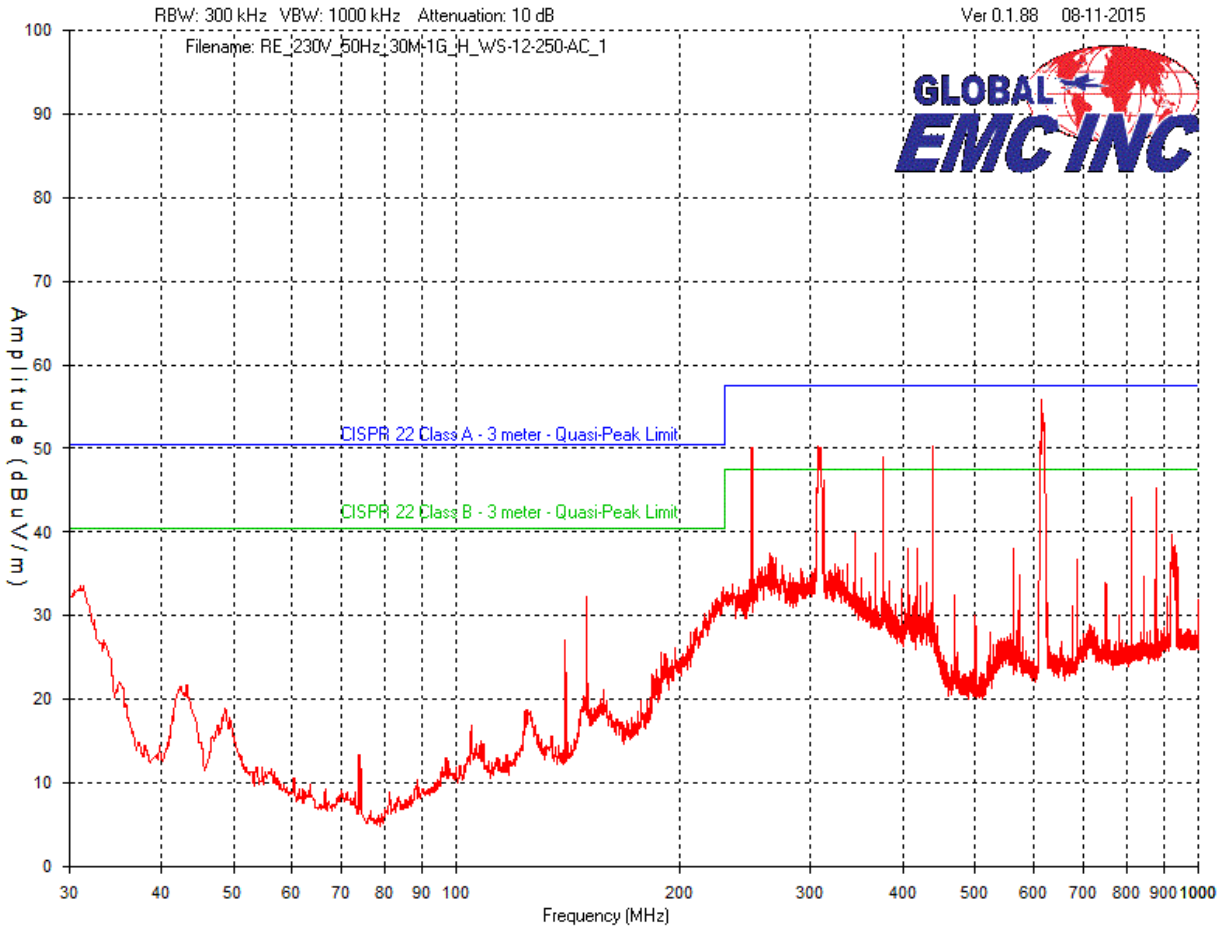
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

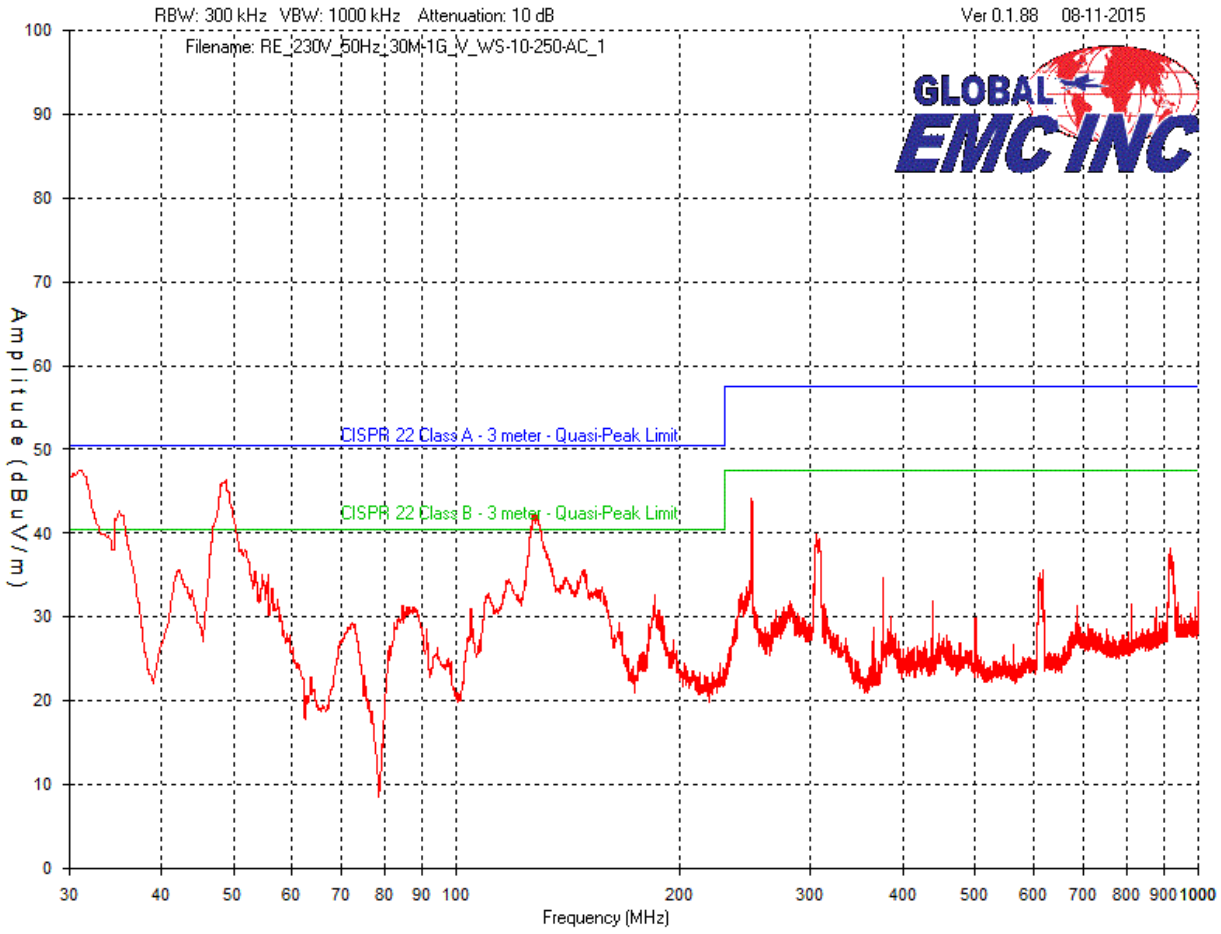
Vertical – Peak Emissions Graph
WS-12-250-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



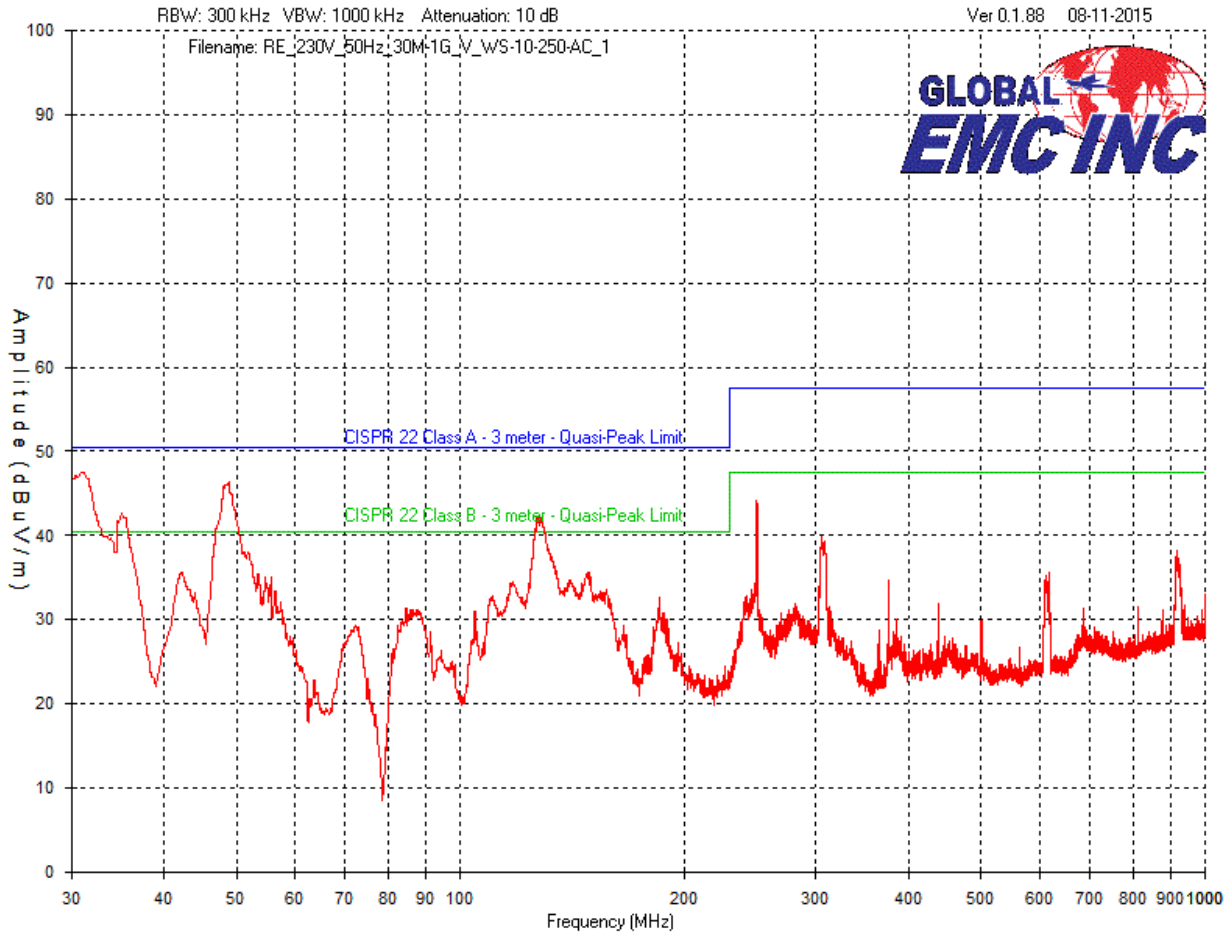
Horizontal – Peak Emissions Graph
WS-12-250-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



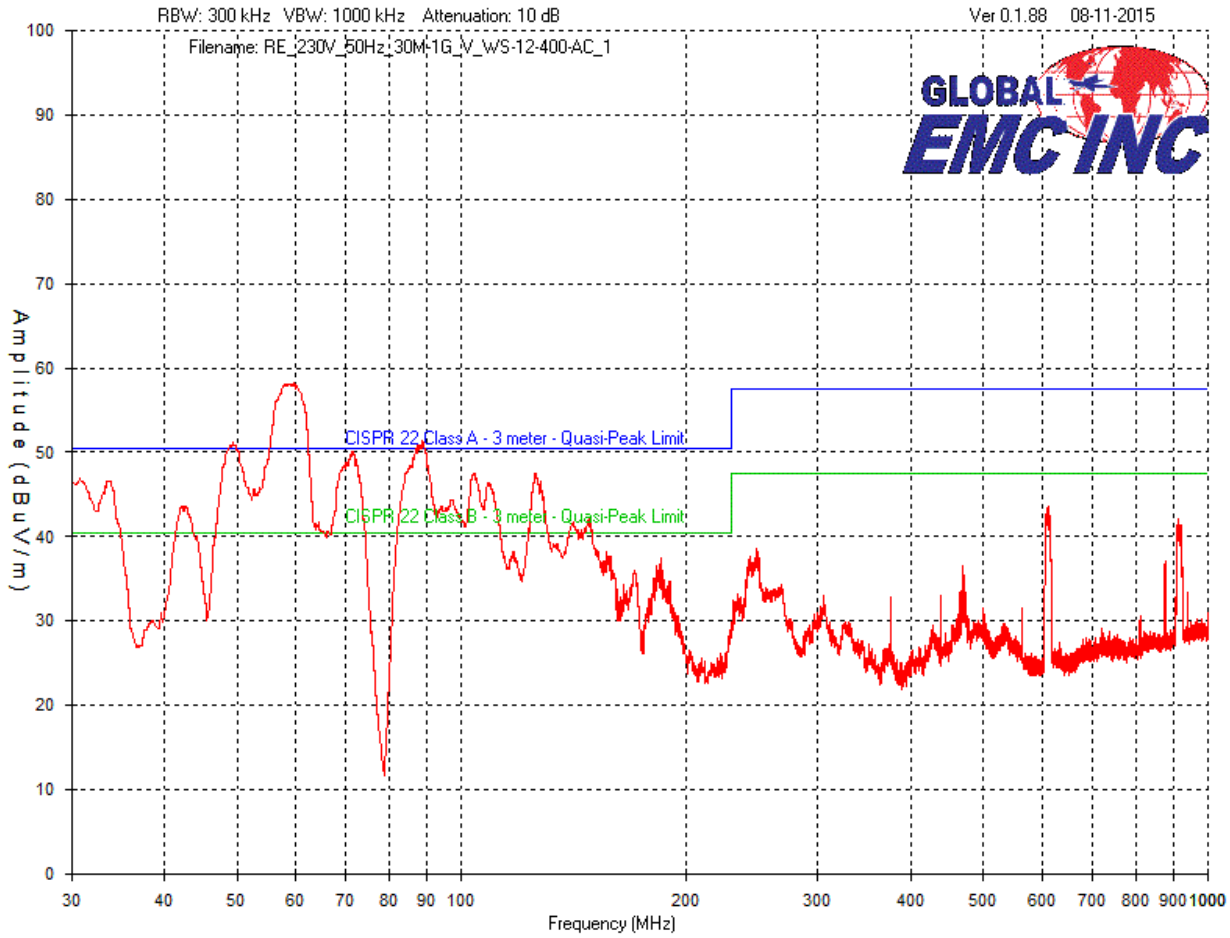
Vertical – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



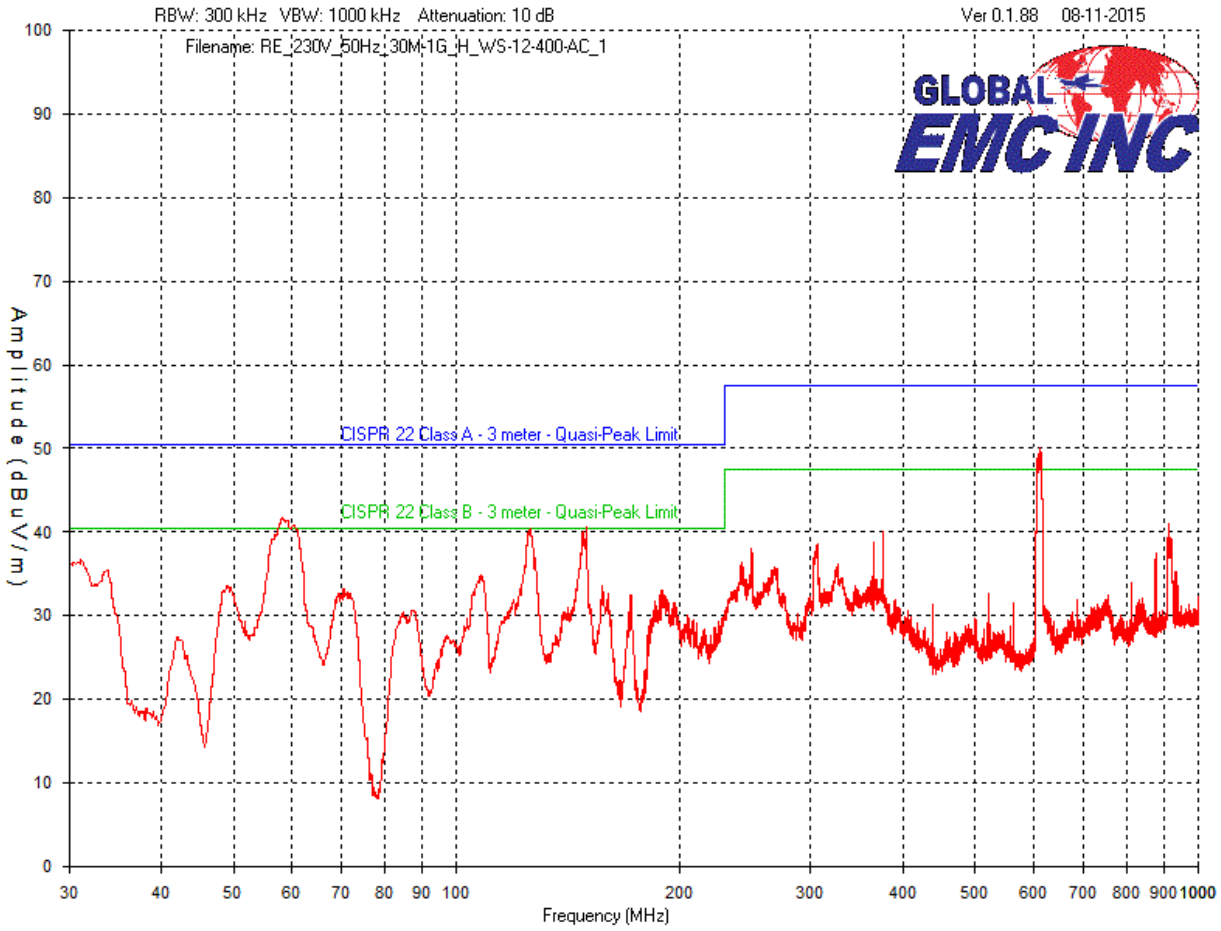
Horizontal – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



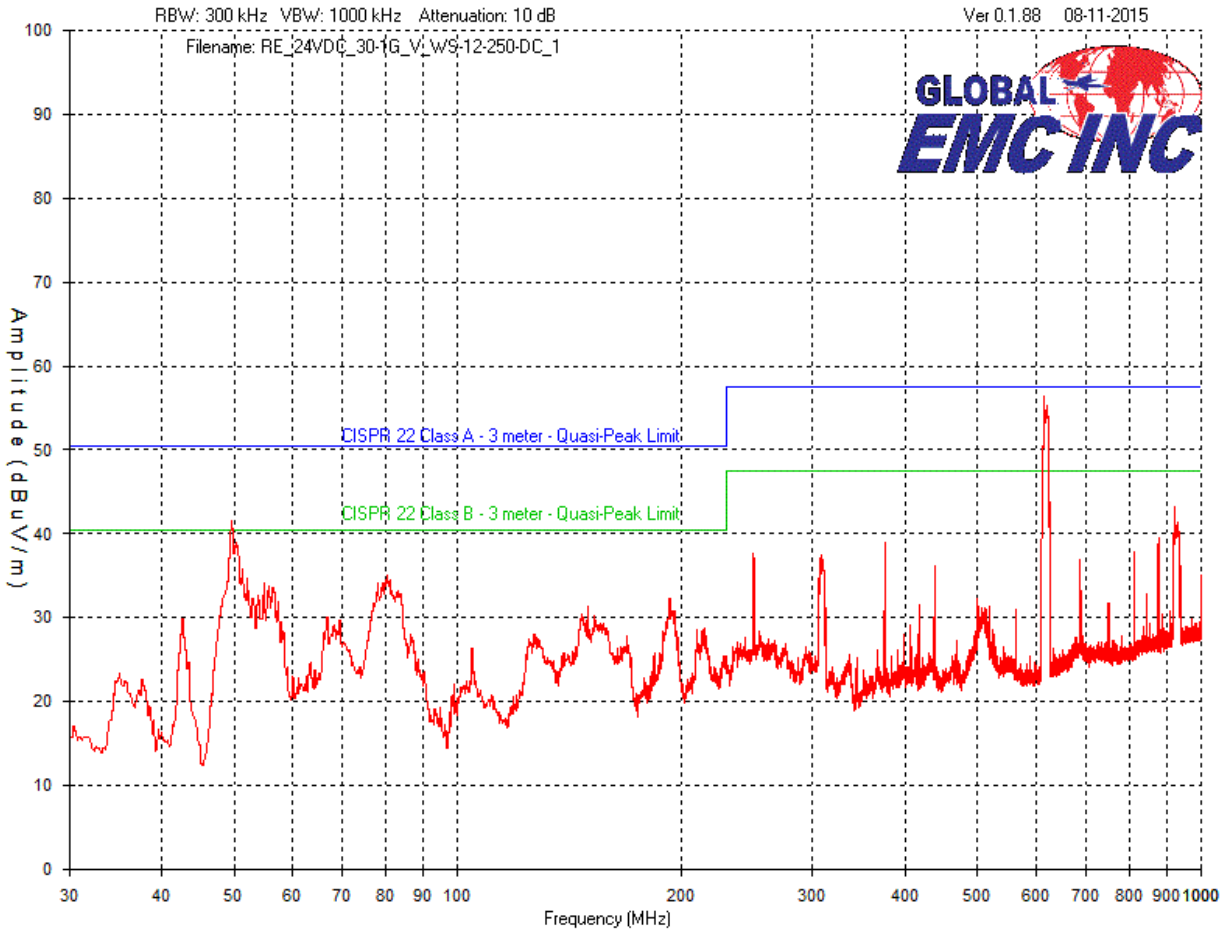
Vertical – Peak Emissions Graph
WS-12-400-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



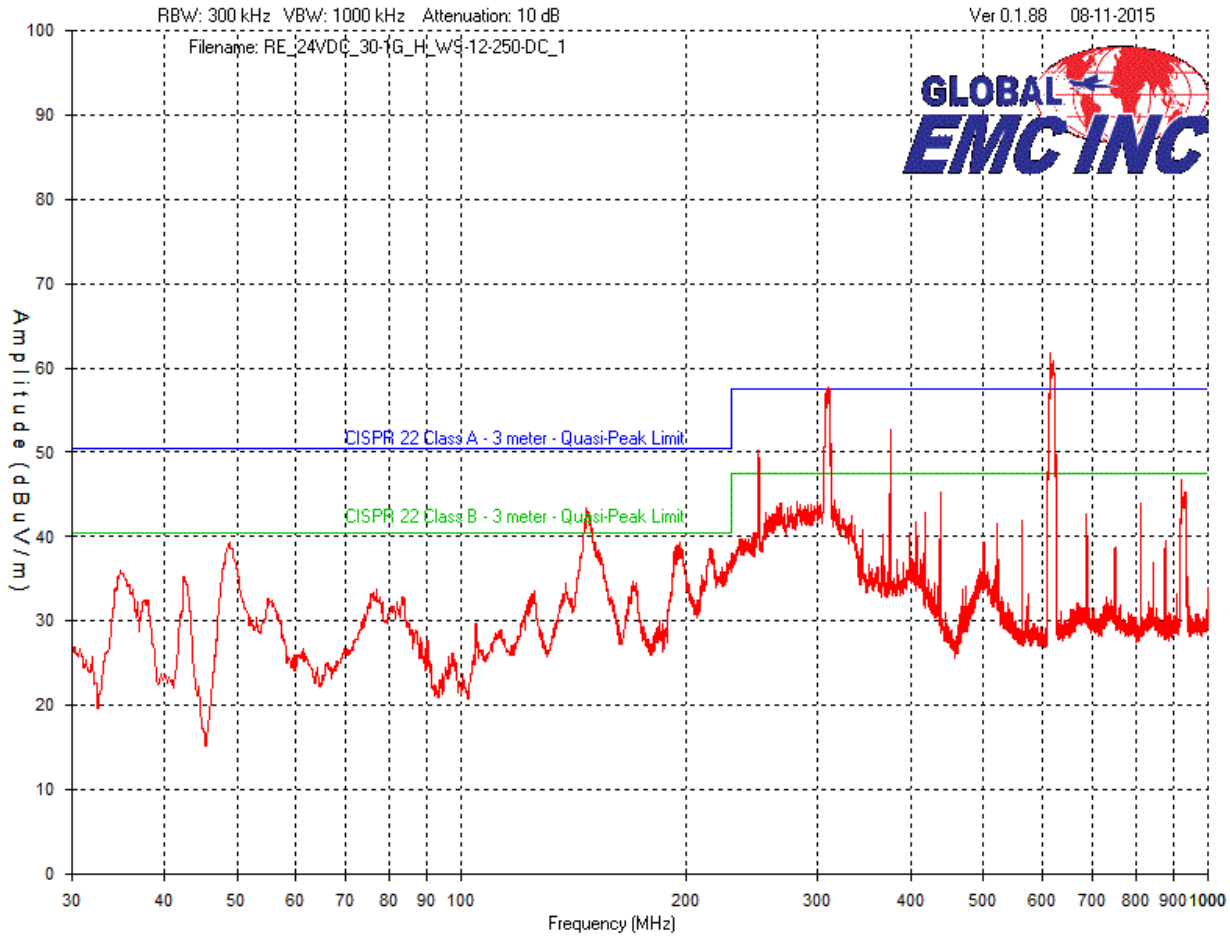
Horizontal – Peak Emissions Graph
WS-12-400-AC: 230V_{AC}, 50Hz
30MHz – 1GHz



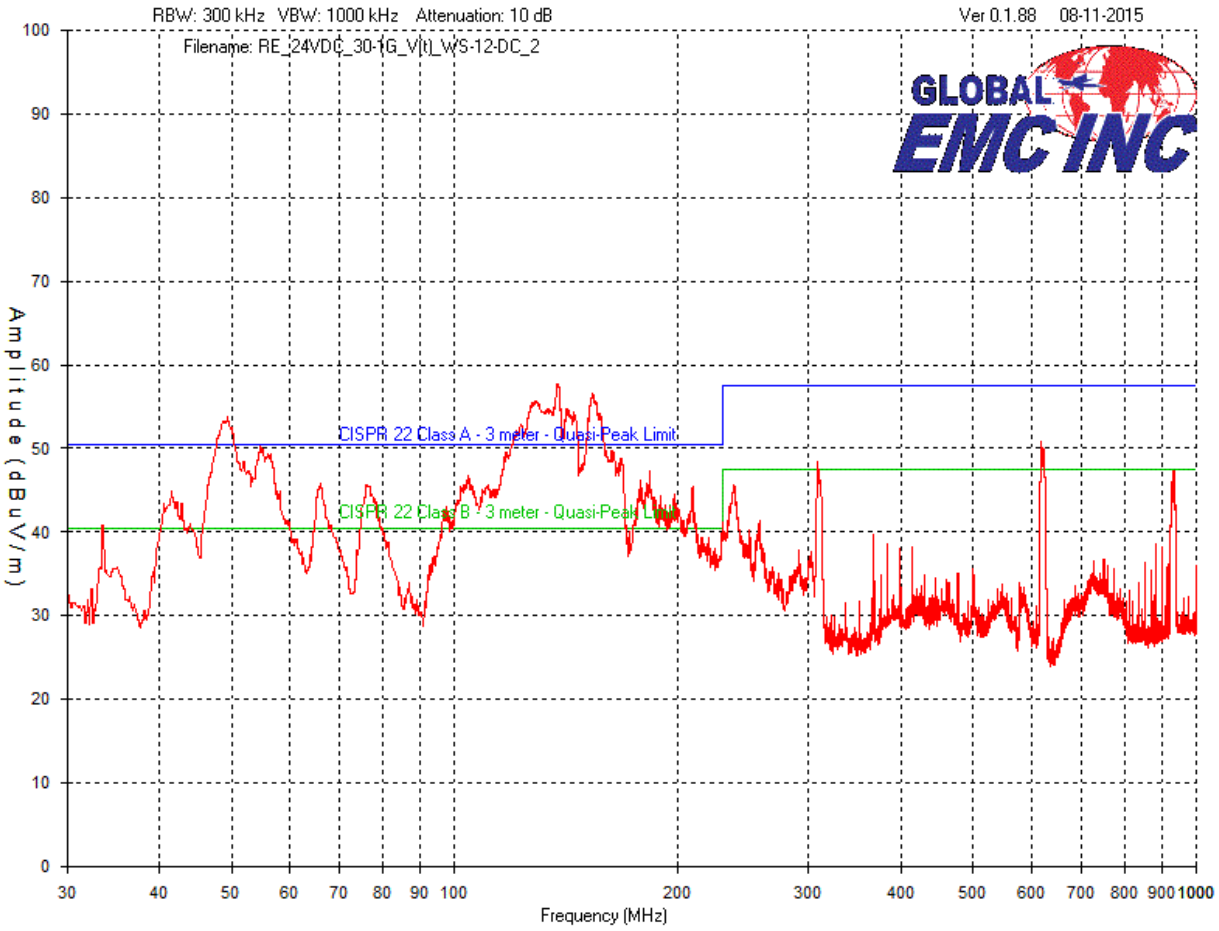
Vertical – Peak Emissions Graph
WS-12-250-DC: $24V_{DC}$
30MHz – 1GHz



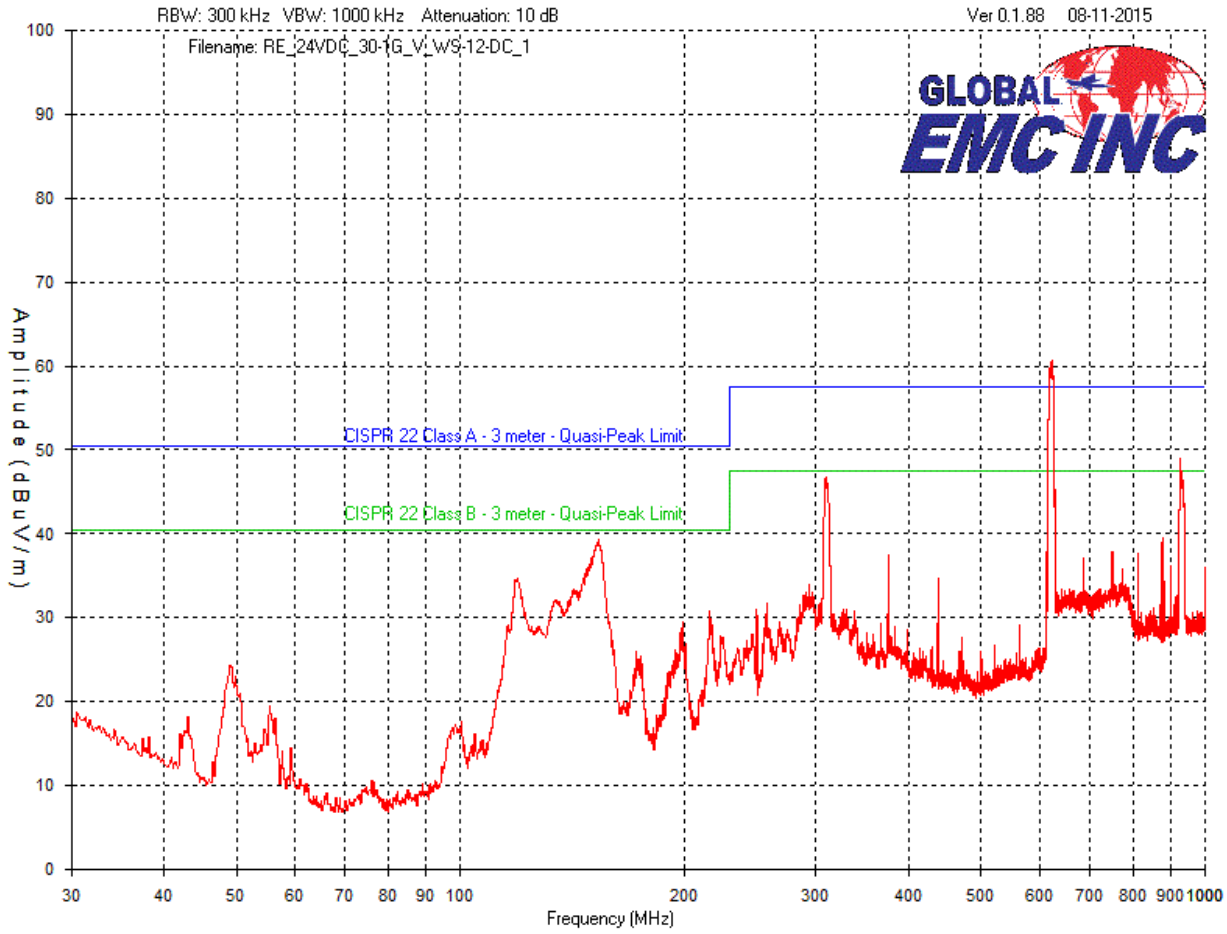
Horizontal – Peak Emissions Graph
WS-12-250-DC: $24V_{DC}$
30MHz – 1GHz



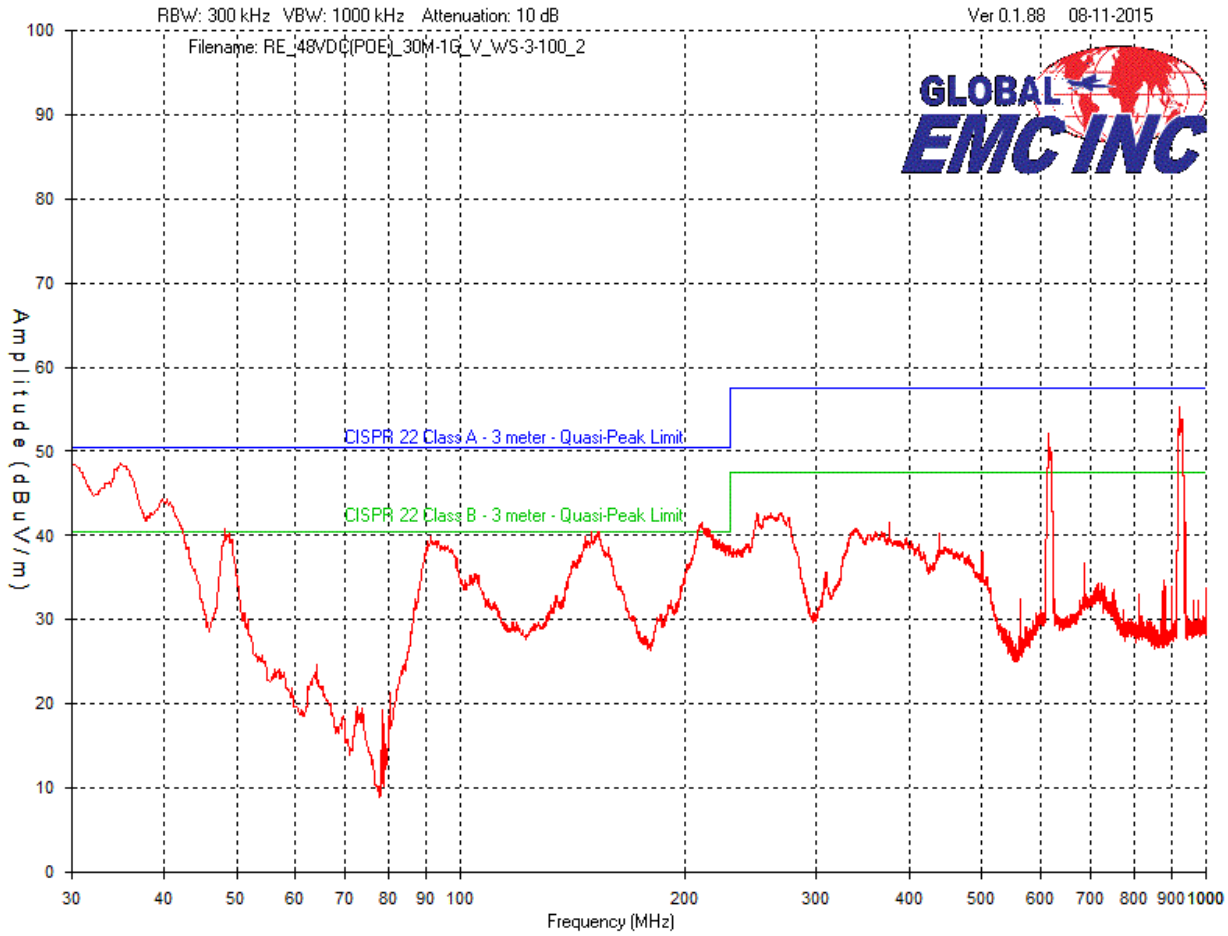
Vertical – Peak Emissions Graph
WS-12-DC: 48V_{DC}
30MHz – 1GHz



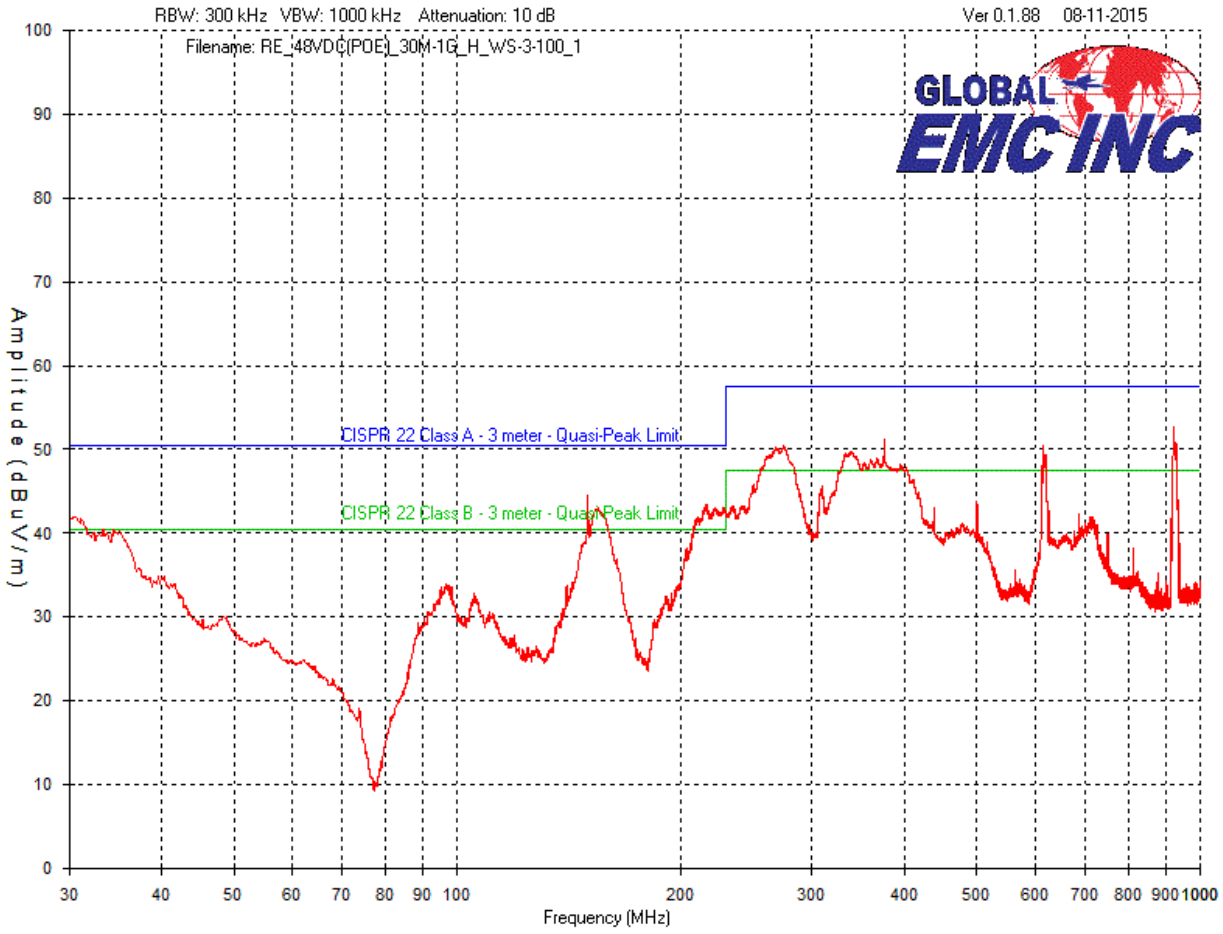
Horizontal – Peak Emissions Graph
WS-12-DC: 48V_{DC}
30MHz – 1GHz



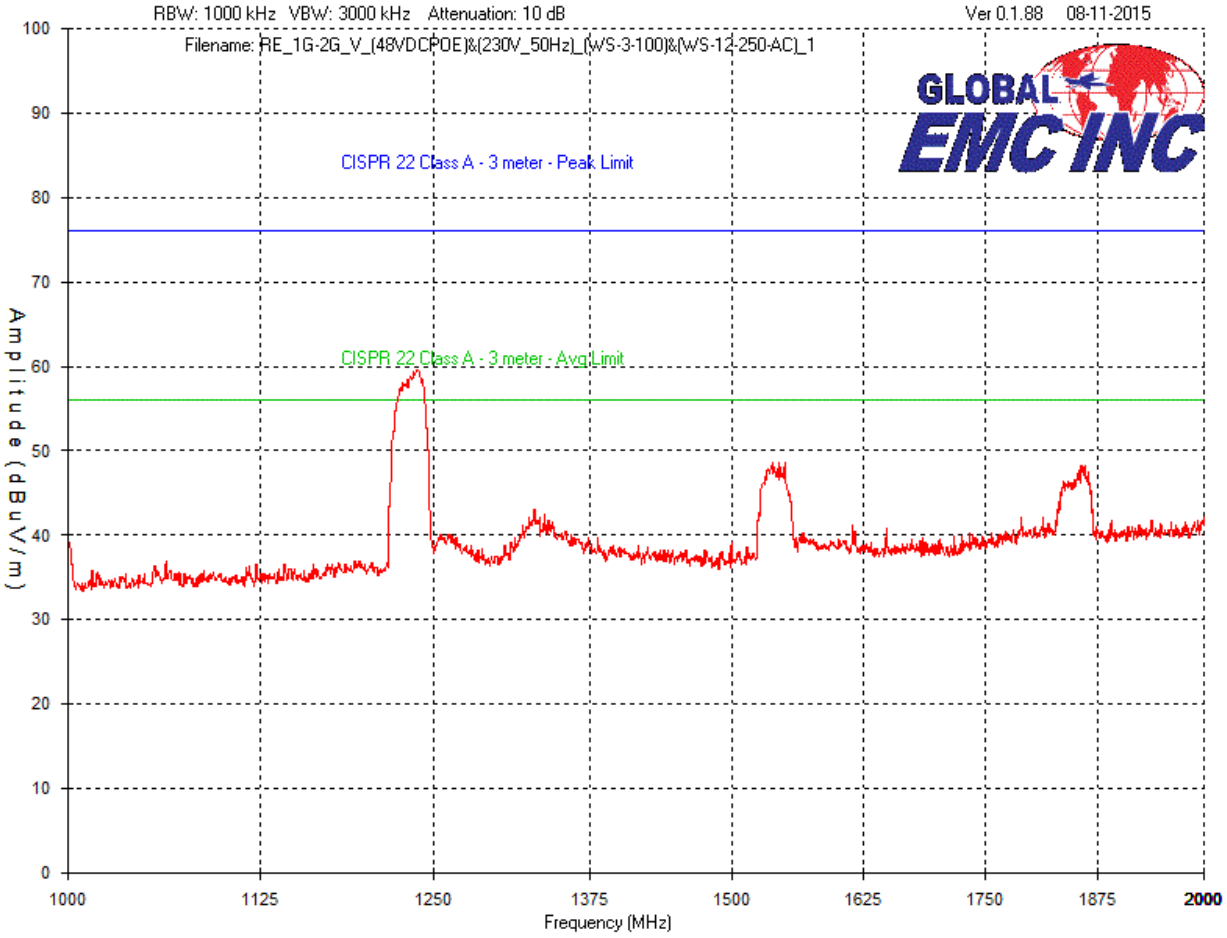
Vertical – Peak Emissions Graph
WS-6-100: 48V_{DC} (PoE)
30MHz – 1GHz



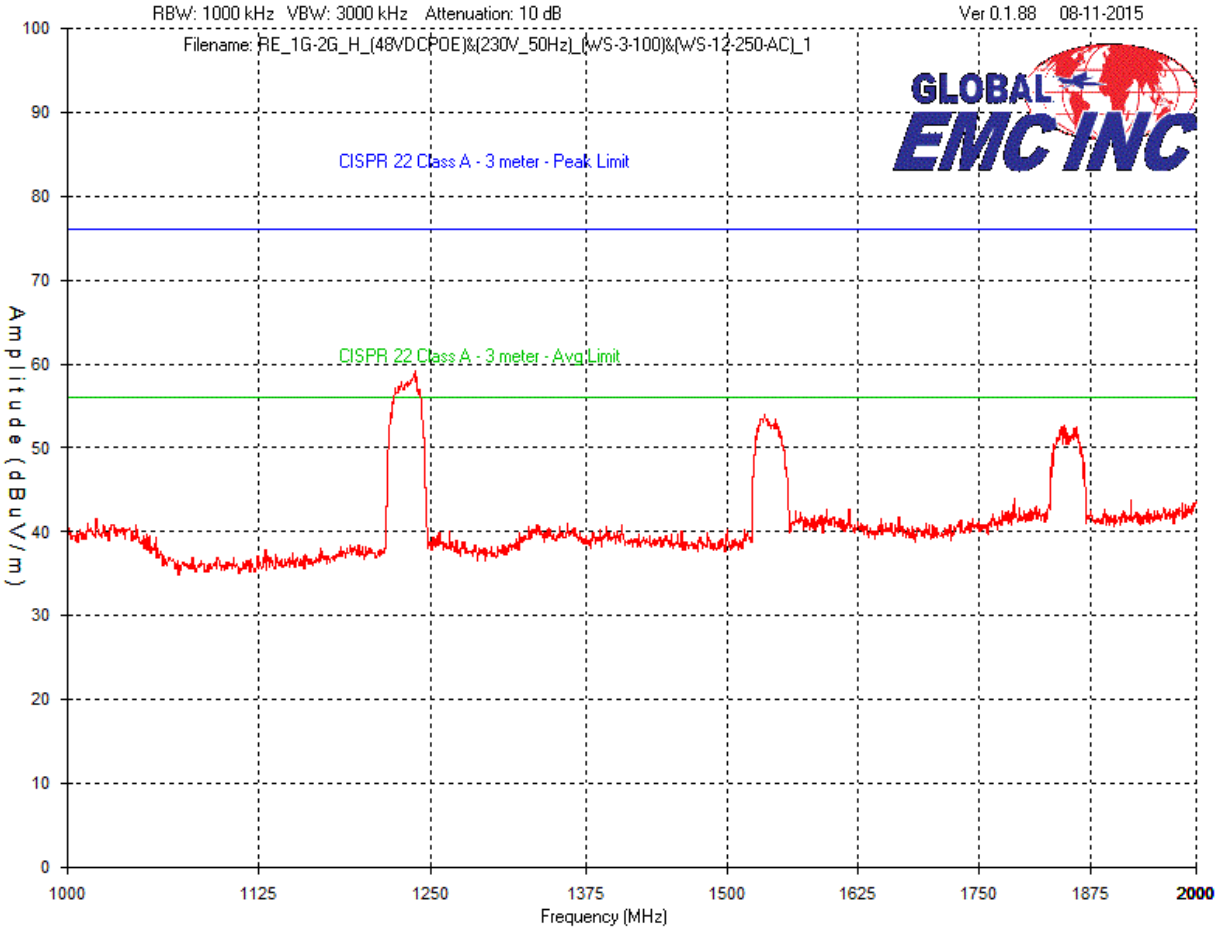
Horizontal – Peak Emissions Graph
WS-6-100: 48V_{DC} (PoE)
30MHz – 1GHz



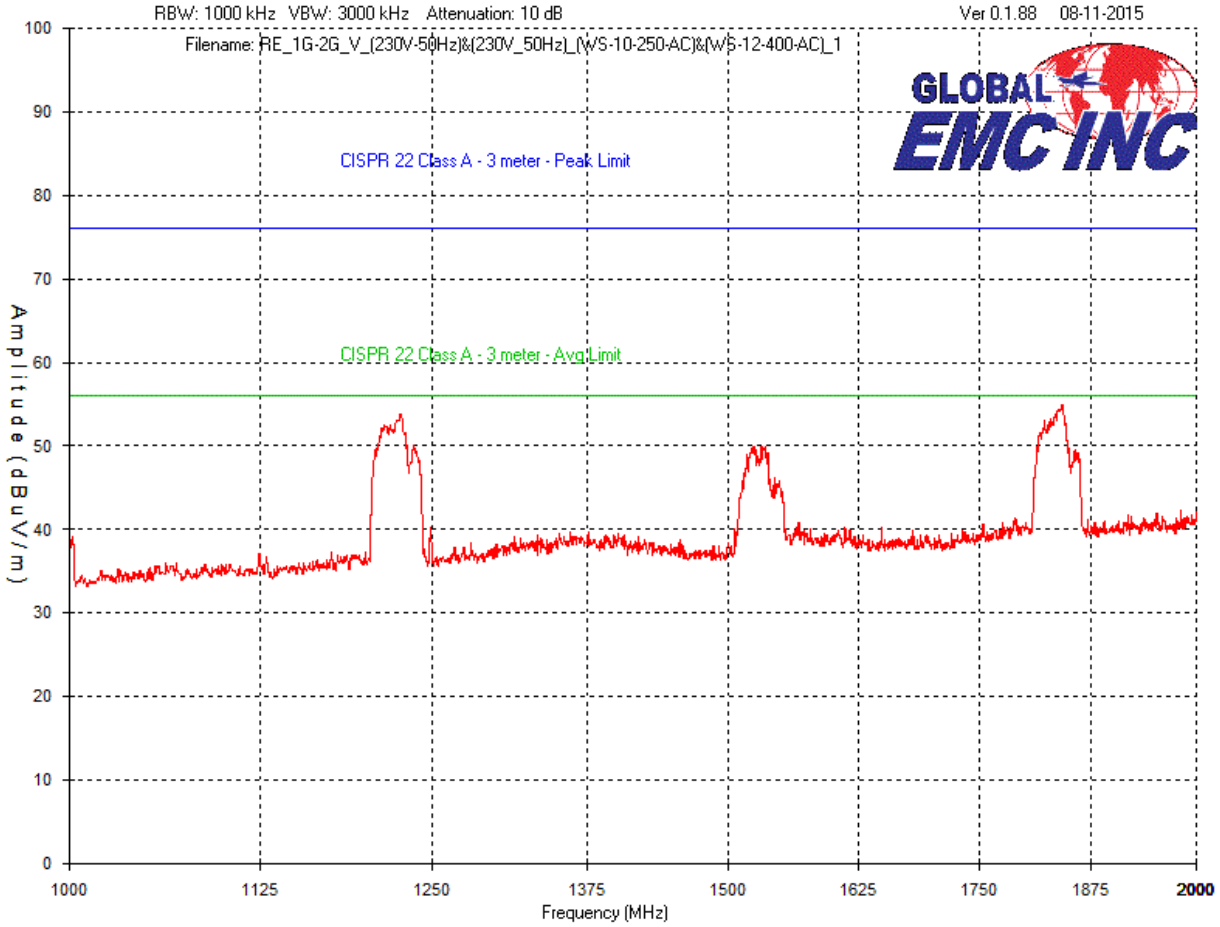
Vertical – Peak Emissions Graph
WS-12-250-AC: 230V_{AC}, 50Hz
& WS-6-100: 48V_{DC} (PoE)
1GHz – 2GHz



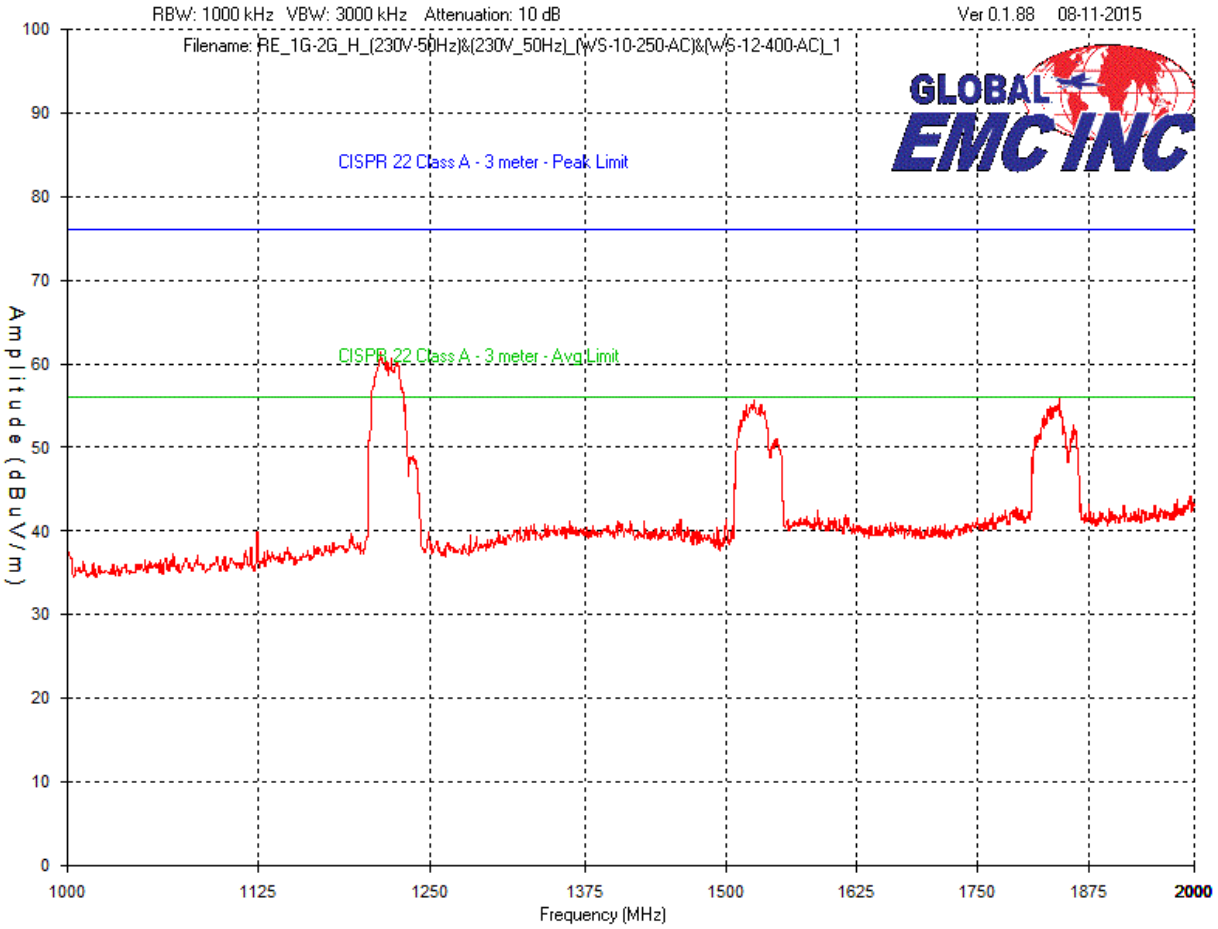
Horizontal – Peak Emissions Graph
WS-12-250-AC: 230$V_{AC,}$ 50Hz
WS-6-100: 48V_{DC} (PoE)
1GHz – 2GHz



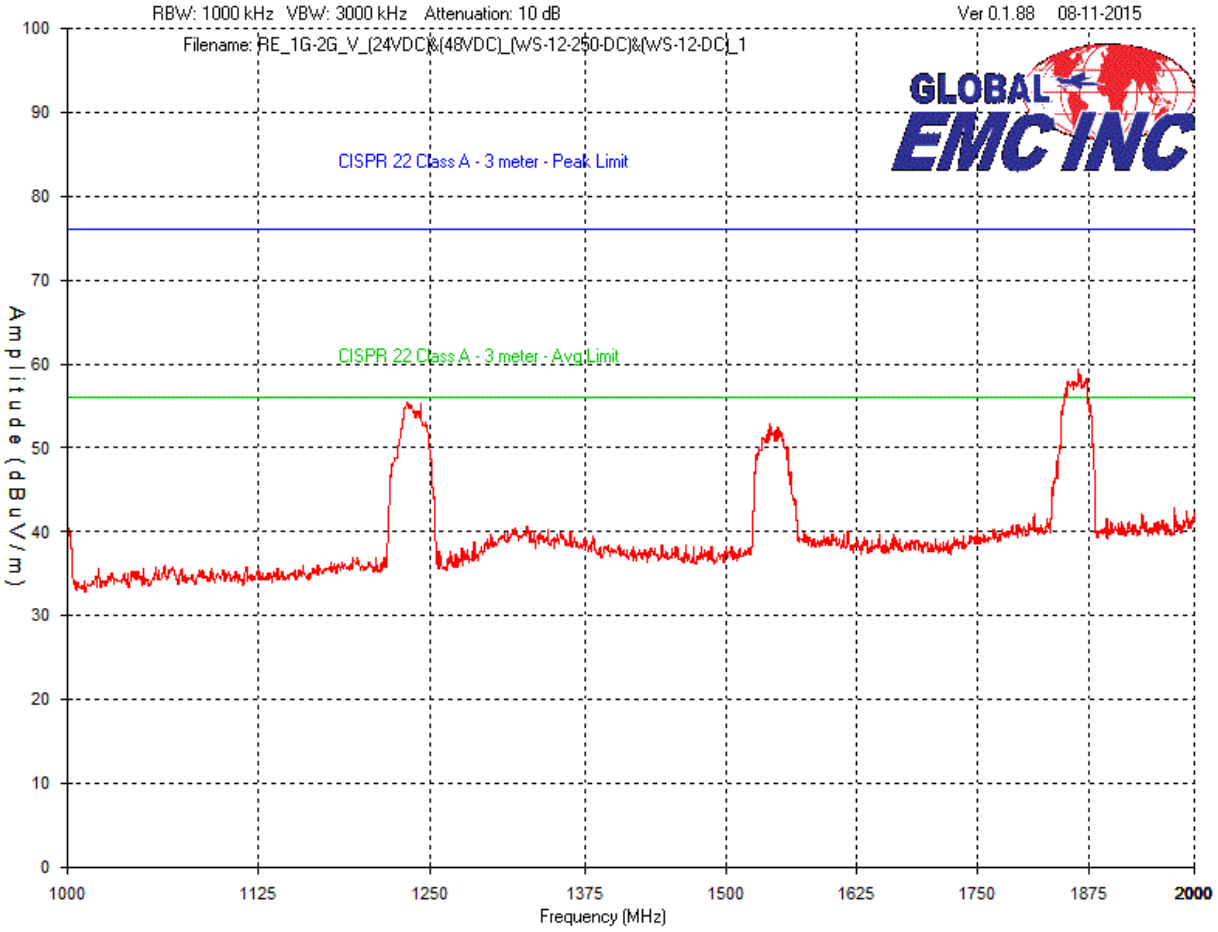
Vertical – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz
WS-12-400-AC: 230V_{AC}, 50Hz
1GHz – 2GHz



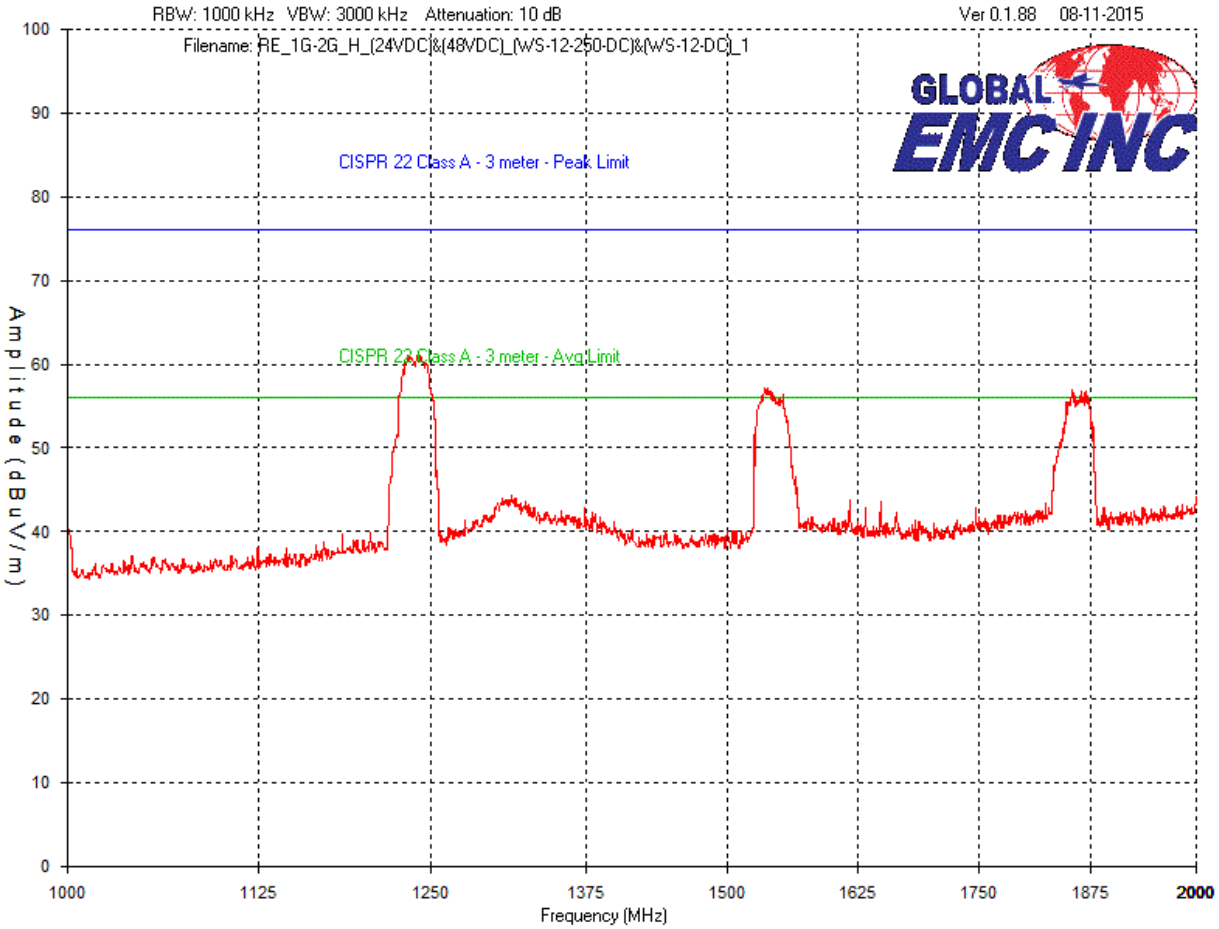
Horizontal – Peak Emissions Graph
WS-10-250-AC: 230V_{AC}, 50Hz
WS-12-400-AC: 230V_{AC}, 50Hz
1GHz – 2GHz



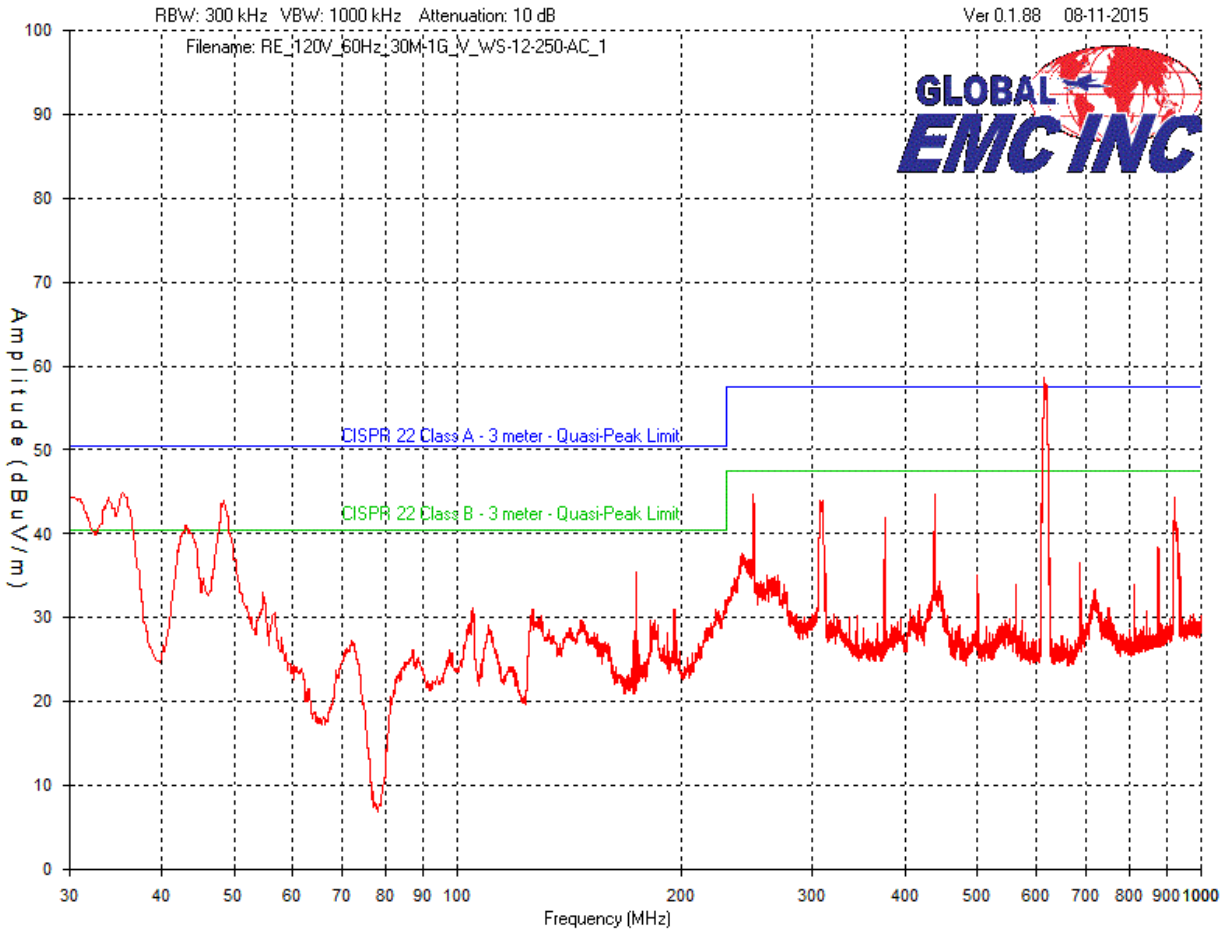
Vertical – Peak Emissions Graph
WS-12-250-DC: $24V_{DC}$
WS-12-DC: $48V_{DC}$
1GHz – 2GHz



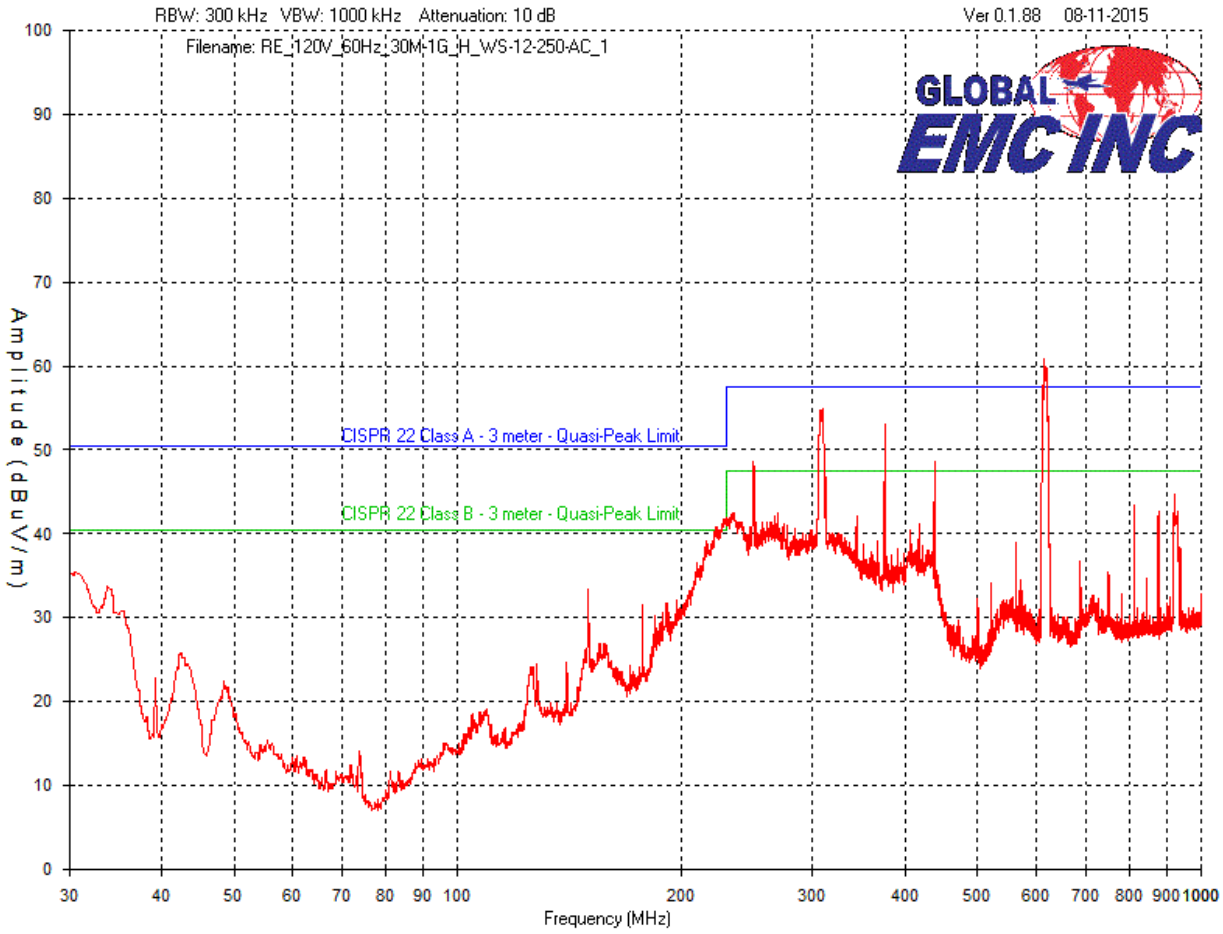
Horizontal – Peak Emissions Graph
WS-12-250-DC: $24V_{DC}$
WS-12-DC: $48V_{DC}$
1GHz – 2GHz



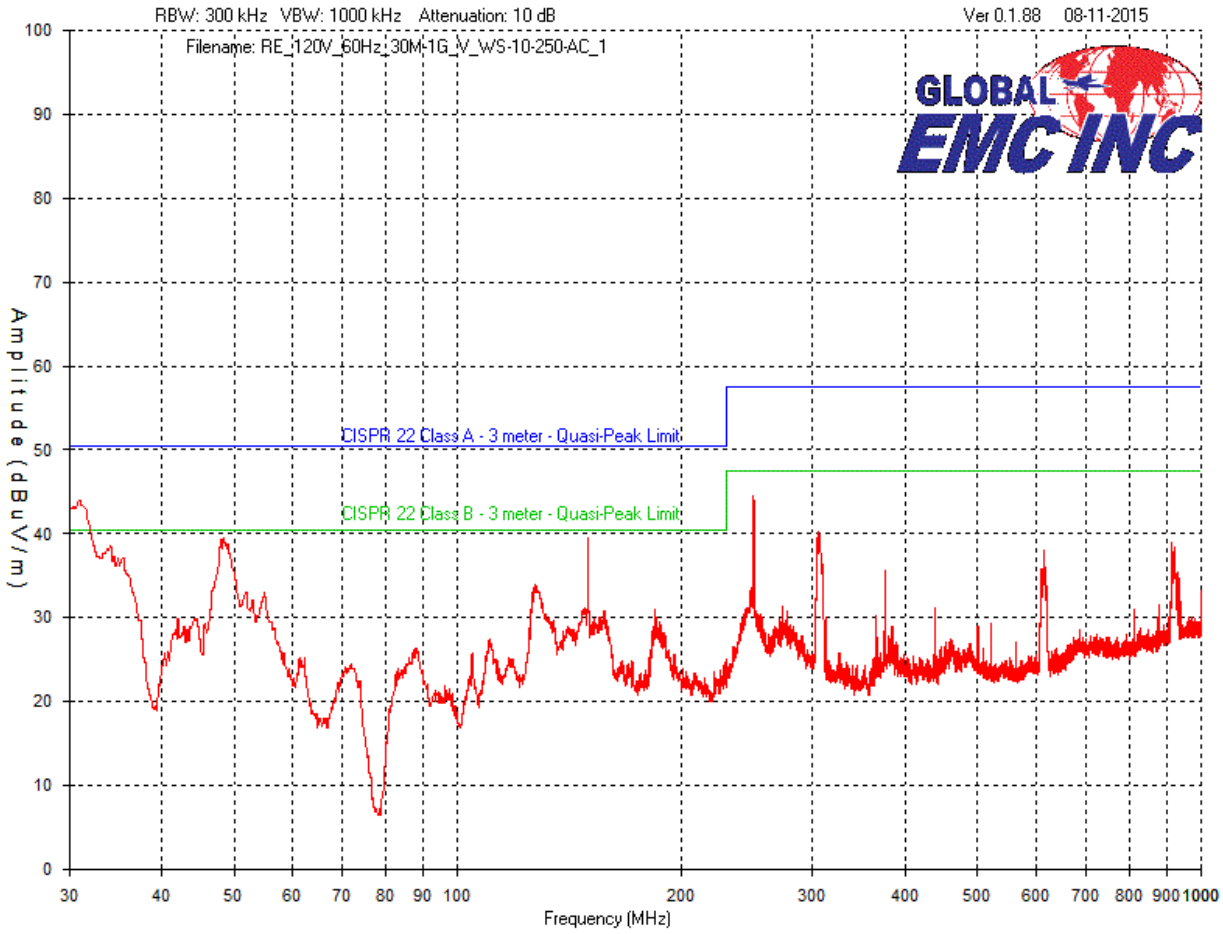
Vertical – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



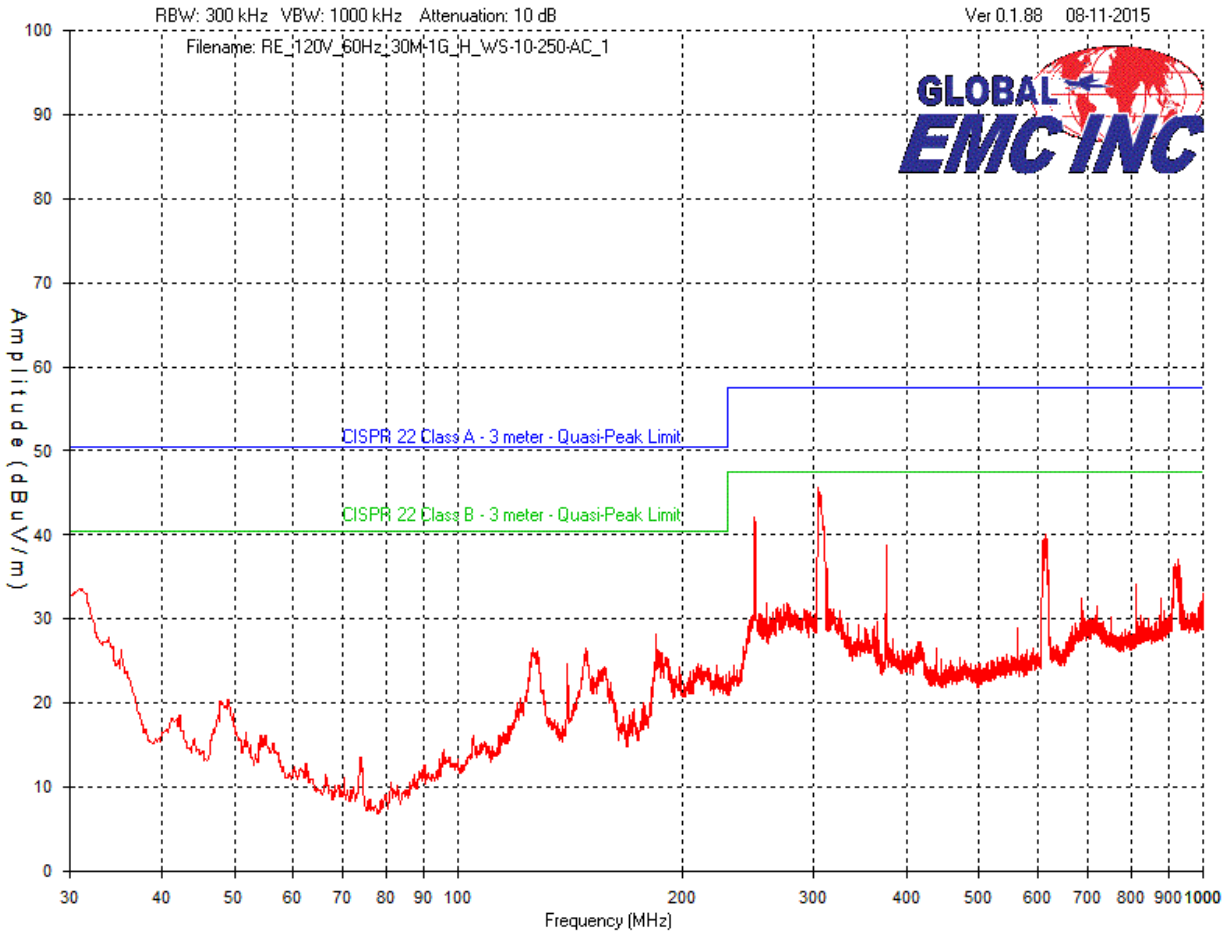
Horizontal – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



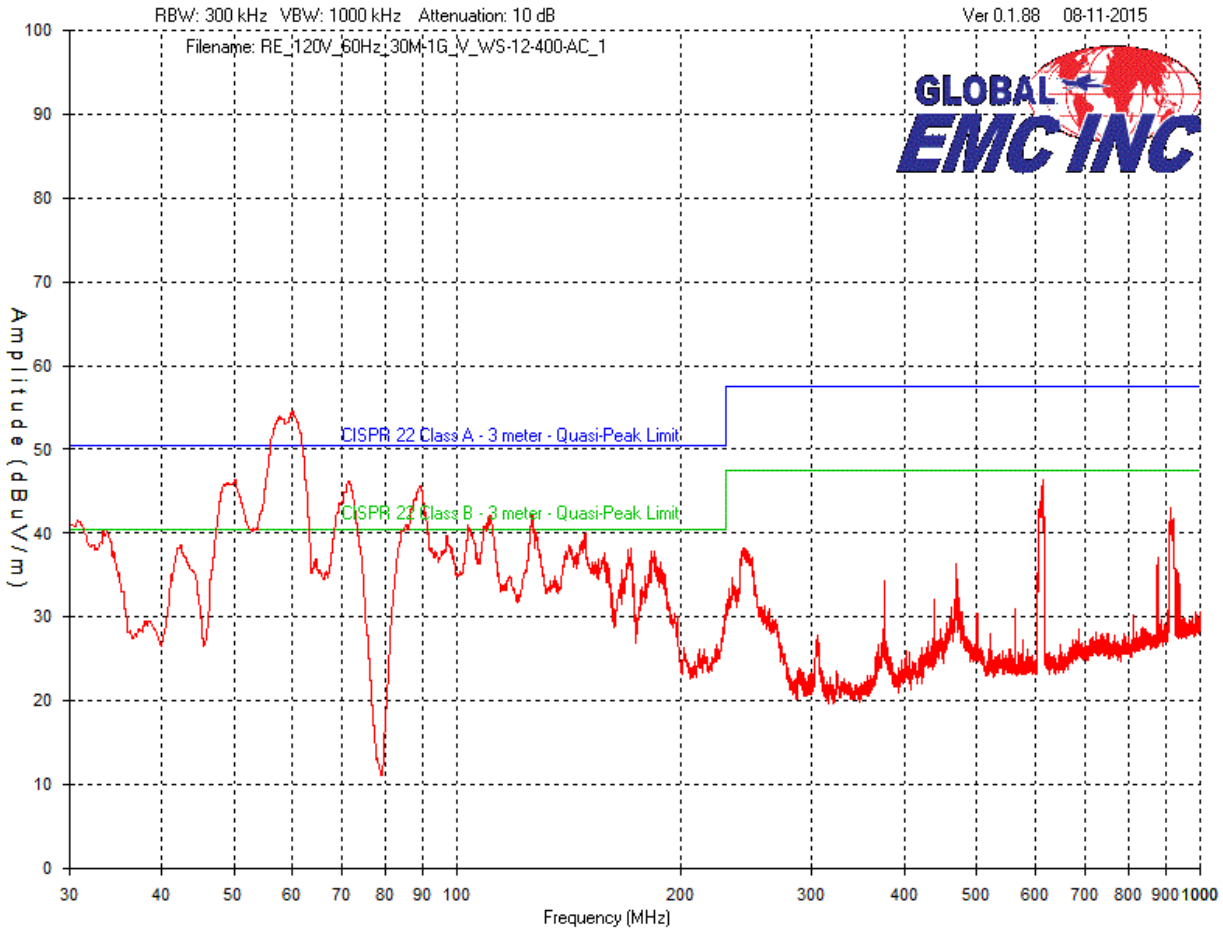
Vertical – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



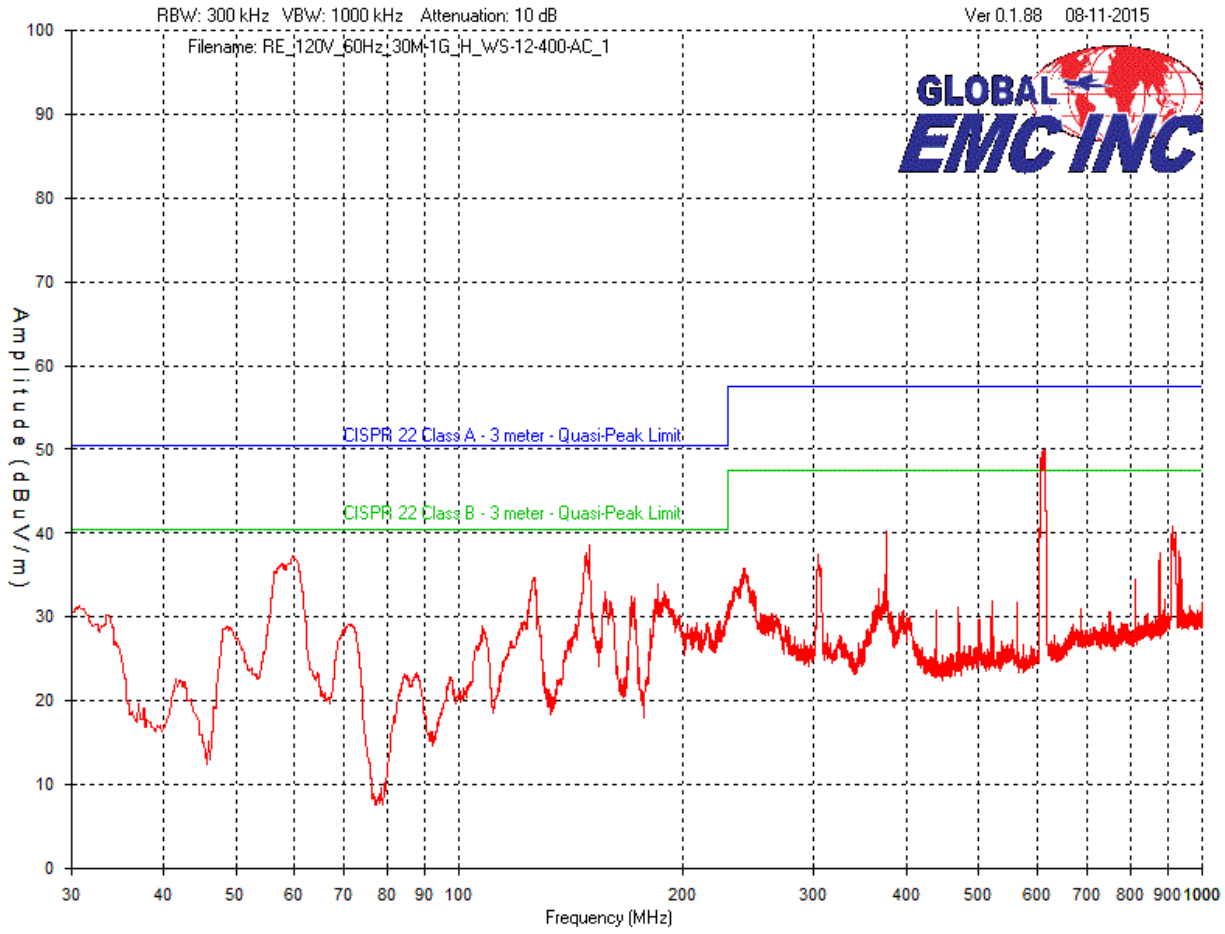
Horizontal – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



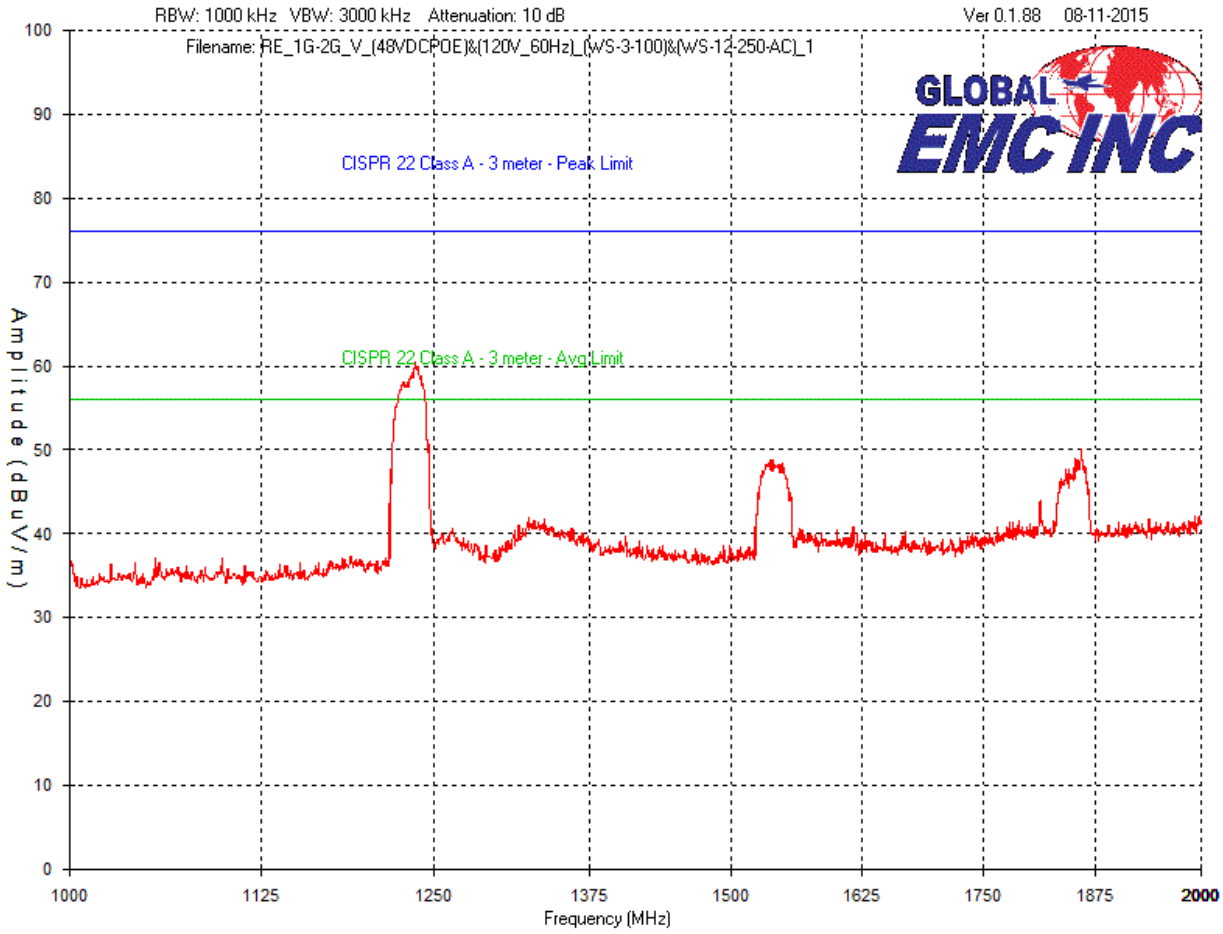
Vertical – Peak Emissions Graph
WS-12-400-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



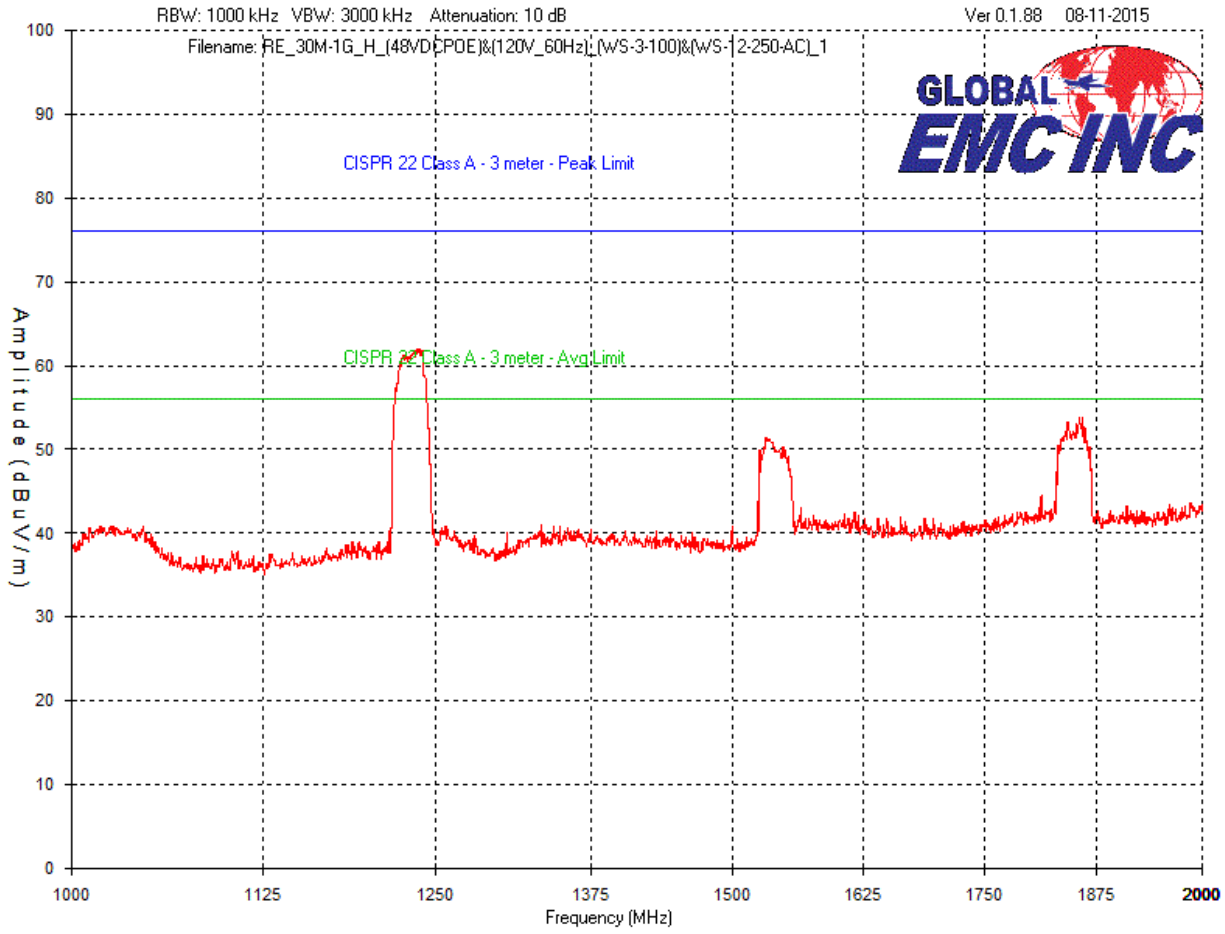
Horizontal – Peak Emissions Graph
WS-12-400-AC: 120V_{AC}, 60Hz
30MHz – 1GHz



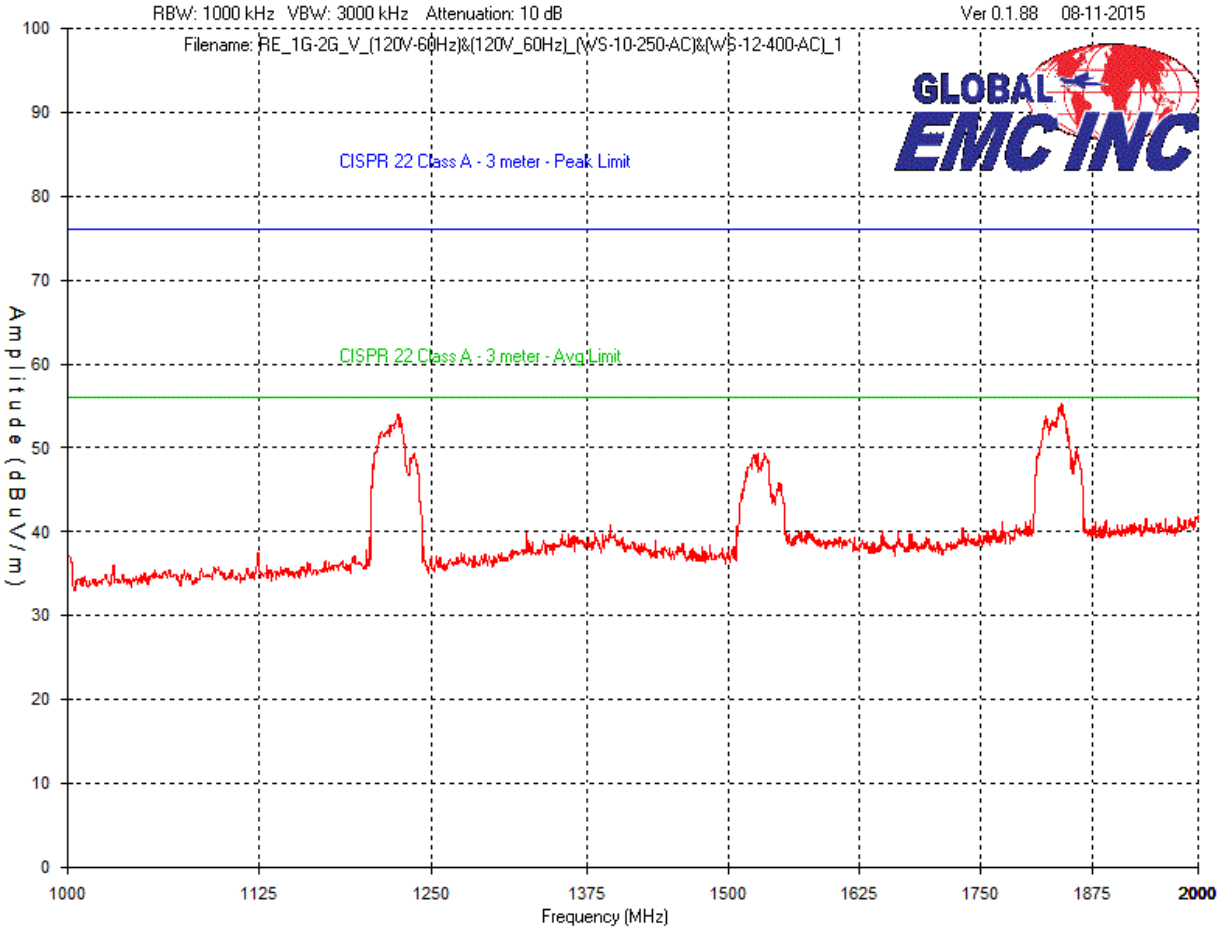
Vertical – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz
1GHz – 2GHz



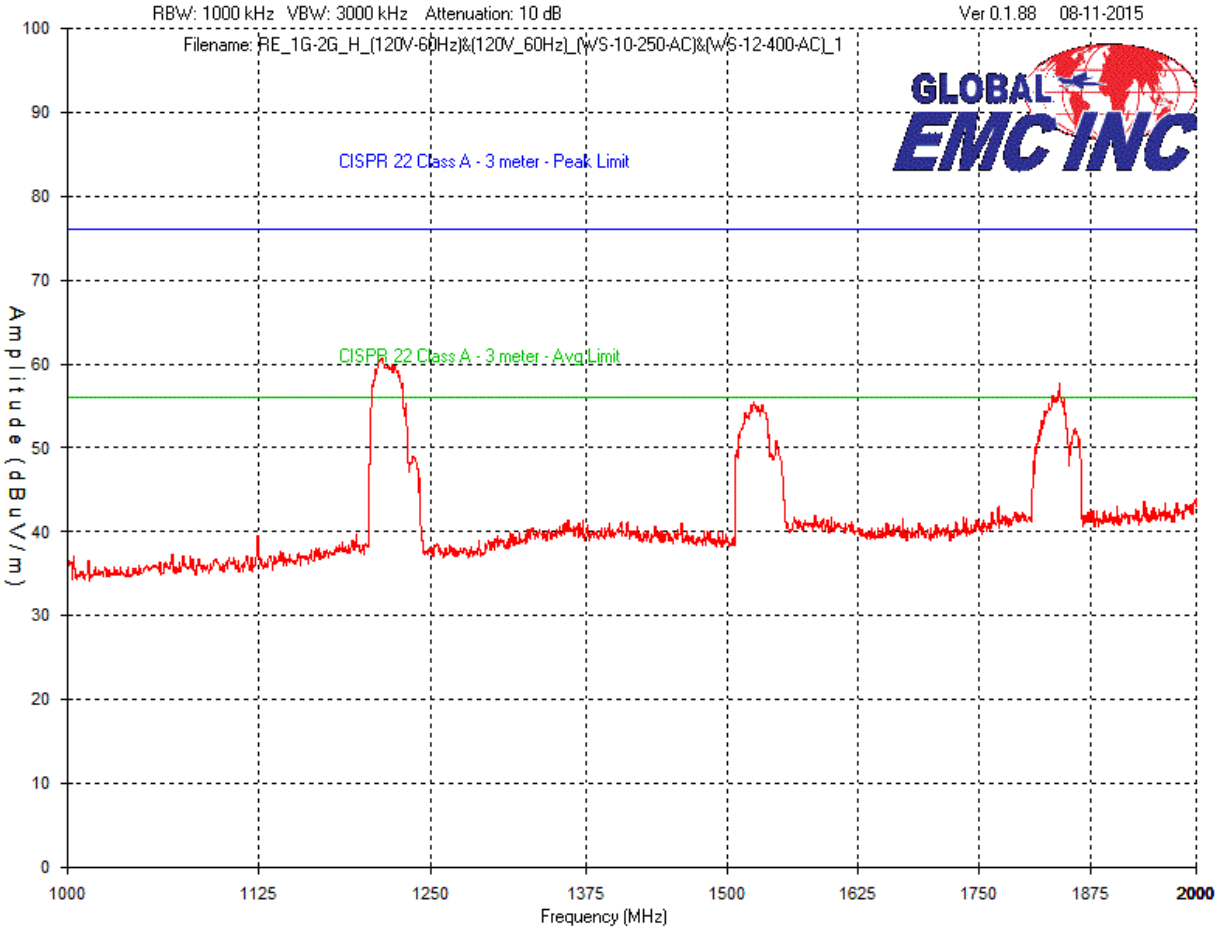
Horizontal – Peak Emissions Graph
WS-12-250-AC: 120V_{AC}, 60Hz
1GHz – 2GHz



Vertical – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz
WS-12-400-AC: 120V_{AC}, 60Hz
1GHz – 2GHz



Horizontal – Peak Emissions Graph
WS-10-250-AC: 120V_{AC}, 60Hz
WS-12-400-AC: 120V_{AC}, 60Hz
1GHz – 2GHz



Final Measurements

WS-12-250-AC Emissions Table
Class A; 230V_{AC}, 50Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
31.2	QP	59.94	15	0.5	-33.1	42.34	50.5	8.16	Pass
615.3	QP	63.73	19.7	1.9	-33.7	51.63	57.5	5.87	Pass
42.8	Peak	71	9.5	0.6	-33.1	48	50.5	2.5	Pass
249.8	Peak	66.8	12.4	1.2	-33.6	46.8	57.5	10.7	Pass
437.5	Peak	61.9	16	1.6	-33.9	45.6	57.5	11.9	Pass
309.4	Peak	63	13.9	1.3	-33.7	44.5	57.5	13	Pass
Horizontal Antenna Polarity									
615.1	Peak	66.9	20.7	1.9	-33.7	55.8	57.5	1.7	Pass
307.1	Peak	68.2	14.4	1.3	-33.7	50.2	57.5	7.3	Pass
437.5	Peak	65.6	16.9	1.6	-33.9	50.2	57.5	7.3	Pass
249.9	Peak	70.2	12.3	1.2	-33.6	50.1	57.5	7.4	Pass
375.0	Peak	65.2	16.1	1.5	-33.8	49	57.5	8.5	Pass
312.5	Peak	64.3	14.3	1.3	-33.7	46.2	57.5	11.3	Pass

WS-10-250-AC Emissions Table
Class A; 230V_{AC}, 50Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
31.2	Peak	65.2	15	0.5	-33.1	47.6	50.5	2.9	Pass
48.8	Peak	70.8	8.1	0.6	-33.2	46.3	50.5	4.2	Pass
126.8	Peak	66.6	8	0.9	-33.2	42.3	50.5	8.2	Pass
249.8	Peak	64.1	12.4	1.2	-33.6	44.1	57.5	13.4	Pass
42.2	Peak	58.5	9.7	0.6	-33.1	35.7	50.5	14.8	Pass
305.1	Peak	58.1	14.2	1.3	-33.7	39.9	57.5	17.6	Pass
Horizontal Antenna Polarity									
305.3	Peak	63.1	14.5	1.3	-33.7	45.2	57.5	12.3	Pass
31.0	Peak	53.1	17.4	0.5	-33.1	37.9	50.5	12.6	Pass
249.9	Peak	63	12.3	1.2	-33.6	42.9	57.5	14.6	Pass
127.2	Peak	58.5	7.3	0.9	-33.2	33.5	50.5	17	Pass
613.5	Peak	51.4	20.6	1.9	-33.7	40.2	57.5	17.3	Pass
920.4	Peak	43.8	23.9	2.3	-31.8	38.2	57.5	19.3	Pass

WS-12-400-AC Emissions Table
Class A; 230V_{AC}, 50Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
59.7	QP	71.32	7.4	0.6	-33.1	46.22	50.5	4.28	Pass
88.7	QP	66	8.3	0.8	-33.2	41.9	50.5	8.6	Pass
49.4	QP	62.58	8.1	0.6	-33.2	38.08	50.5	12.42	Pass
71.4	QP	69.69	5.5	0.7	-33.2	42.69	50.5	7.81	Pass
125.4	Peak	71.9	8	0.9	-33.2	47.6	50.5	2.9	Pass
103.7	Peak	70.9	9.1	0.8	-33.2	47.6	50.5	2.9	Pass
Horizontal Antenna Polarity									
612.0	Peak	61.3	20.5	1.9	-33.7	50	57.5	7.5	Pass
58.1	Peak	66.4	7.8	0.6	-33.1	41.7	50.5	8.8	Pass
149.6	Peak	64	8.9	0.9	-33.2	40.6	50.5	9.9	Pass
125.6	Peak	65.4	7.3	0.9	-33.2	40.4	50.5	10.1	Pass
31.2	Peak	52	17.3	0.5	-33.1	36.7	50.5	13.8	Pass
107.8	Peak	58.7	8.6	0.8	-33.2	34.9	50.5	15.6	Pass

WS-12-250-DC Emissions Table
Class A; 24V_{DC}
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
614.8	Peak	68.5	19.7	1.9	-33.7	56.4	57.5	1.1	Pass
49.6	Peak	66.1	8	0.6	-33.2	41.5	50.5	9	Pass
920.4	Peak	50	22.6	2.3	-31.8	43.1	57.5	14.4	Pass
80.3	Peak	61.1	6.4	0.7	-33.2	35	50.5	15.5	Pass
875.2	Peak	47.6	21.7	2.3	-32.1	39.5	57.5	18	Pass
192.3	Peak	54.4	10.3	1.1	-33.4	32.4	50.5	18.1	Pass
Horizontal Antenna Polarity									
614.8	QP	66.2	20.7	1.9	-33.7	55.1	57.5	2.4	Pass
310.4	QP	63.89	14.3	1.3	-33.7	45.79	57.5	11.71	Pass
312.5	QP	60.24	14.3	1.3	-33.7	42.14	57.5	15.36	Pass
375.0	Peak	69	16.1	1.5	-33.8	52.8	57.5	4.7	Pass
147.1	Peak	67.1	8.6	0.9	-33.3	43.3	50.5	7.2	Pass
249.9	Peak	70.3	12.3	1.2	-33.6	50.2	57.5	7.3	Pass

WS-12-DC Emissions Table
Class A; 48V_{DC}
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
137.3	QP	74.2	7.5	0.9	-33.2	49.4	50.5	1.1	Pass
127.2	QP	74.3	8	0.9	-33.2	50	50.5	0.5	Pass
122.8	QP	72.5	8	0.9	-33.2	48.2	50.5	2.3	Pass
163.8	QP	65.1	9.9	1	-33.3	42.7	50.5	7.8	Pass
153.4	QP	71.93	9.5	0.9	-33.3	49.03	50.5	1.47	Pass
142.3	QP	72.13	8	0.9	-33.3	47.73	50.5	2.77	Pass
49.4	QP	71.7	8.1	0.6	-33.2	47.2	50.5	3.3	Pass
55.6	QP	65.56	7.8	0.6	-33.1	40.86	50.5	9.64	Pass
Horizontal Antenna Polarity									
623.0	QP	64.85	20.7	1.9	-33.7	53.75	57.5	3.75	Pass
925.9	Peak	54.4	24	2.3	-31.7	49	57.5	8.5	Pass
309.2	Peak	64.8	14.3	1.3	-33.7	46.7	57.5	10.8	Pass
153.1	Peak	62.5	9.2	0.9	-33.3	39.3	50.5	11.2	Pass
119.2	Peak	59.4	7.8	0.9	-33.3	34.8	50.5	15.7	Pass
875.1	Peak	46.5	22.9	2.3	-32.1	39.6	57.5	17.9	Pass

WS-6-100 Emissions Table
Class A; 48V_{DC} (PoE)
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
34.9	Peak	68.7	12.6	0.5	-33.1	48.7	50.5	1.8	Pass
921.5	Peak	62.1	22.6	2.3	-31.7	55.3	57.5	2.2	Pass
615.1	Peak	64.2	19.7	1.9	-33.7	52.1	57.5	5.4	Pass
48.2	Peak	65.2	8.3	0.6	-33.2	40.9	50.5	9.6	Pass
153.2	Peak	63.2	9.5	0.9	-33.3	40.3	50.5	10.2	Pass
91.2	Peak	63.6	8.7	0.8	-33.2	39.9	50.5	10.6	Pass
Horizontal Antenna Polarity									
921.5	Peak	58.1	23.9	2.3	-31.7	52.6	57.5	4.9	Pass
149.8	Peak	68	8.9	0.9	-33.2	44.6	50.5	5.9	Pass
375.1	Peak	67.5	16.1	1.5	-33.8	51.3	57.5	6.2	Pass
615.2	Peak	61.6	20.7	1.9	-33.7	50.5	57.5	7	Pass
274.9	Peak	69.7	13.1	1.3	-33.6	50.5	57.5	7	Pass
30.6	Peak	57	17.6	0.5	-33.1	42	50.5	8.5	Pass

WS-12-250-AC Emissions Table
Class A; 120V_{AC}, 60Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
615.3	QP	63.23	19.7	1.9	-33.7	51.13	57.5	6.37	Pass
35.4	Peak	65.1	12.3	0.5	-33.1	44.8	50.5	5.7	Pass
48.4	Peak	68.3	8.2	0.6	-33.2	43.9	50.5	6.6	Pass
43.0	Peak	64	9.5	0.6	-33.1	41	50.5	9.5	Pass
437.4	Peak	61	16	1.6	-33.9	44.7	57.5	12.8	Pass
249.8	Peak	64.6	12.4	1.2	-33.6	44.6	57.5	12.9	Pass
Horizontal Antenna Polarity									
614.4	QP	64.42	20.7	1.9	-33.7	53.32	57.5	4.18	Pass
309.6	Peak	73	14.3	1.3	-33.7	54.9	57.5	2.6	Pass
375.0	Peak	69.3	16.1	1.5	-33.8	53.1	57.5	4.4	Pass
249.8	Peak	68.7	12.3	1.2	-33.6	48.6	57.5	8.9	Pass
437.4	Peak	63.9	16.9	1.6	-33.9	48.5	57.5	9	Pass
920.6	Peak	50.2	23.9	2.3	-31.8	44.6	57.5	12.9	Pass

WS-10-250-AC Emissions Table
Class A; 120V_{AC}, 60Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
31.0	Peak	61.5	15.1	0.5	-33.1	44	50.5	6.5	Pass
149.6	Peak	62.9	9	0.9	-33.2	39.6	50.5	10.9	Pass
48.4	Peak	63.9	8.2	0.6	-33.2	39.5	50.5	11	Pass
249.9	Peak	64.5	12.4	1.2	-33.6	44.5	57.5	13	Pass
126.8	Peak	58.3	8	0.9	-33.2	34	50.5	16.5	Pass
305.3	Peak	58.5	14.2	1.3	-33.7	40.3	57.5	17.2	Pass
Horizontal Antenna Polarity									
304.4	Peak	63.5	14.4	1.3	-33.7	45.5	57.5	12	Pass
249.9	Peak	62.2	12.3	1.2	-33.6	42.1	57.5	15.4	Pass
31.2	Peak	48.9	17.3	0.5	-33.1	33.6	50.5	16.9	Pass
614.4	Peak	51.3	20.7	1.9	-33.7	40.2	57.5	17.3	Pass
375.1	Peak	55.1	16.1	1.5	-33.8	38.9	57.5	18.6	Pass
925.1	Peak	42.4	24	2.3	-31.7	37	57.5	20.5	Pass

WS-12-400-AC Emissions Table
Class A; 120V_{AC}, 60Hz
30 MHz – 1 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	QP Emission limit dB(µV/m	QP Margin (dB)	Result
Vertical Antenna Polarity									
59.9	QP	68.46	7.3	0.6	-33.1	43.26	50.5	7.24	Pass
57.4	QP	69.59	8.3	0.6	-33.1	45.39	50.5	5.11	Pass
50.2	Peak	71	8	0.6	-33.2	46.4	50.5	4.1	Pass
71.6	Peak	73.2	5.6	0.7	-33.2	46.3	50.5	4.2	Pass
89.3	Peak	69.6	8.4	0.8	-33.2	45.6	50.5	4.9	Pass
110.7	Peak	65.9	8.7	0.8	-33.2	42.2	50.5	8.3	Pass
Horizontal Antenna Polarity									
612.7	Peak	61.1	20.6	1.9	-33.7	49.9	57.5	7.6	Pass
149.7	Peak	62.1	8.9	0.9	-33.2	38.7	50.5	11.8	Pass
59.8	Peak	62.3	7.5	0.6	-33.1	37.3	50.5	13.2	Pass
125.6	Peak	59.7	7.3	0.9	-33.2	34.7	50.5	15.8	Pass
184.7	Peak	55.9	10.3	1	-33.4	33.8	50.5	16.7	Pass
910.7	Peak	46.5	23.8	2.3	-31.8	40.8	57.5	16.7	Pass

Emissions Table - Class A
WS-12-250-AC: 230V_{AC}, 50Hz
& WS-6-100: 48V_{DC} (PoE)
1 GHz – 2 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	Avg. Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Avg. Margin (dB)	Peak Margin (dB)	Result
Vertical Antenna Polarity											
1236.0	Peak	69.7	24.6	2.7	-36.5	60.5	---	76	---	15.5	Pass
1236.0	Avg.	54.9	24.6	2.7	-36.5	45.7	56	---	10.3	---	Pass
Horizontal Antenna Polarity											
1238.3	Peak	67.1	25.8	2.7	-36.5	59.1	---	76	---	16.9	Pass
1238.3	Avg.	34.3	25.8	2.7	-36.5	26.3	56	---	29.7	---	Pass

Emissions Table - Class A
WS-10-250-AC: 230V_{AC}, 50Hz
& WS-12-400-AC: 230V_{AC}, 50Hz
1 GHz – 2 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	Avg. Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Avg. Margin (dB)	Peak Margin (dB)	Result
Horizontal Antenna Polarity											
1212.7	Peak	68.9	26.4	2.7	-36.6	61.4	---	76	---	14.6	Pass
1212.7	Avg.	42.6	26.4	2.7	-36.6	35.1	56	---	20.9	---	Pass
1840.0	Peak	58.5	30	3.4	-36	55.9	---	76	---	20.1	Pass
1840.0	Avg.	35.7	30	3.4	-36	33.1	56	---	22.9	---	Pass

Emissions Table - Class A
WS-12-250-DC: $24V_{DC}$
& WS-12-DC: $48V_{DC}$
1 GHz – 2 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	Avg. Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Avg. Margin (dB)	Peak Margin (dB)	Result
Vertical Antenna Polarity											
1861.7	Peak	64	28	3.4	-36	59.4	---	76	---	16.6	Pass
1861.7	Avg.	50.7	28	3.4	-36	46.1	56	---	9.9	---	Pass
1233.0	Peak	64.7	24.6	2.7	-36.5	55.5	---	76	---	20.5	Pass
1233.0	Avg.	58.2	24.6	2.7	-36.5	49	56	---	7	---	Pass
Horizontal Antenna Polarity											
1232.7	Peak	69	25.9	2.7	-36.5	61.1	---	76	---	14.9	Pass
1232.7	Avg.	55.4	25.9	2.7	-36.5	47.5	56	---	8.5	---	Pass
1537.0	Peak	62.2	28.1	3.1	-36.2	57.2	---	76	---	18.8	Pass
1537.0	Avg.	48.8	28.1	3.1	-36.2	43.8	56	---	12.2	---	Pass
1853.3	Peak	59.7	29.8	3.4	-36	56.9	---	76	---	19.1	Pass
1853.3	Avg.	41.9	29.8	3.4	-36	39.1	56	---	16.9	---	Pass

Emissions Table - Class A
WS-12-250-AC: $120V_{AC}$, 60Hz
1 GHz – 2 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	Avg. Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Avg. Margin (dB)	Peak Margin (dB)	Result
Vertical Antenna Polarity											
1236.0	Peak	69.7	24.6	2.7	-36.5	60.5	---	76	---	15.5	Pass
1236.0	Avg.	54.9	24.6	2.7	-36.5	45.7	56	---	10.3	---	Pass
Horizontal Antenna Polarity											
1239.0	Peak	70	25.8	2.7	-36.5	62	---	76	---	14	Pass
1239.0	Avg.	52.4	25.8	2.7	-36.5	44.4	56	---	11.6	---	Pass

Emissions Table - Class A
WS-10-250-AC, 120V_{AC}, 60Hz
& WS-12-400-AC, 120V_{AC}, 60Hz
1 GHz – 2 GHz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Antenna factor (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBµV/m)	Avg. Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Avg. Margin (dB)	Peak Margin (dB)	Result
Horizontal Antenna Polarity											
1212.7	Peak	68.1	26.4	2.7	-36.6	60.6	---	76	---	15.4	Pass
1212.7	Avg.	55.5	26.4	2.7	-36.6	48	56	---	8	---	Pass
1838.7	Peak	60.3	30	3.4	-36	57.7	---	76	---	18.3	Pass
1838.7	Avg.	42	30	3.4	-36	39.4	56	---	16.6	---	Pass

Notes:

Peak = Peak readings
QP = Quasi-Peak readings
Avg. = Average readings

Where peak readings are under quasi-peak or average limits, the EUT is deemed to have passed the requirement and no quasi-peak or average readings are necessary.

For frequencies >1 GHz, scans may be made with more than 1 unit of the EUT. Passing results from scanning more than 1 unit indicates that the units will pass individually.

See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up for the highest radiated emissions.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	Oct. 9, 2014	Oct. 9, 2016	GEMC 193
Quasi-Peak Detector	85650A	HP	May. 22, 2014	May. 22, 2016	GEMC 194
BiLog Antenna	3142-C	ETS	Feb 10, 2015	Feb 10, 2017	GEMC 137
Preamp (30MHz – 1GHz)	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
Preamp 1GHz – 2GHz)	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31
Orbit Emissions Software	0.1.88	Global EMC	NCR	NCR	GEMC 58

Appendix A – Client Provided Details

General EUT Description

Client Details	
Organization / Address	Netonix LLC
Contact	David Olive
Phone	647-989-2365
Email	dave@netonix.com
Manufacturer Details	
Organization / Address	6B East Main Street, Leola, PA 17540
Contact	David Olive
Phone	647-989-2365
Email	dave@netonix.com
EUT (Equipment Under Test) Details	
EUT Name / Model	WS-12-250-AC WS-10-250-AC WS-12-400-AC WS-12-250-DC WS-12-DC WS-6-100
EUT revision	1.0
Software version	1.0
Equipment category	IT
Input voltage range(s) (V)	WS-12-250-AC, WS-10-250-AC, WS-12-400-AC: 110-220 AC WS-12-250-DC: < 60 volts DC, 24 VDC nominal. (DC power is from battery banks, not telecom or DC mains). WS-12-DC: 48 volts DC (DC power is from battery banks, not telecom or DC mains). WS-6-100: < 50 volts DC (PoE)
Frequency range(s) (Hz)	WS-12-250-AC, WS-10-250-AC, WS-12-400-AC: 50-60 Hz
Rated input current (A)	Depends on supply voltage. WS-12-250-AC, WS-10-250-AC: 2-3A WS-12-400-AC: 2-4A WS-12-250-DC, WS-12-DC: Up to 5A DC. WS-6-100: Up to 2A DC
Nominal power consumption (W)	WS-12-250-AC, WS-10-250-AC: Up to 250 Watts WS-12-400-AC: Up to 400 Watts WS-12-250-DC, WS-12-DC: Up to 150 Watts WS-6-100: Up to 50 Watts
Number of power supplies in EUT	All except WS-12-DC & WS-6-100: 1 WS-12-DC & WS-6-100: none

Basic EUT functionality description	Passive POE Ethernet switch
Modes of operation	One
Frequency of all clocks present in EUT	WS-12-250-AC, WS-10-250-AC, WS-12-400-AC, WS-12-250-DC, WS-12-DC, WS-6-100: 200MHz
I/O cable description	Shielded Cate5 cable
Available connectors on EUT	All except WS-6-100: SFP & RJ45 ports & serial console port. Serial port is for maintenance use only. WS-6-100: RJ45
Peripherals required to exercise EUT Ex. Signal generator	Rocket M5T radio (to test PoE output). D-Link DIR-850L router. Laptop PC with web browser.
Dimensions of product	WS-12-250-AC, WS-12-250-AC, WS-10-250-AC: L: 180 mm, W: 220 mm, H: 43 mm WS-12-250-DC, WS-12-DC: L: 180 mm, W: 200 mm, H: 43 mm WS-6-100: L: 120 mm, W: 130 mm, H: 30 mm
Method of monitoring EUT and description of failure for immunity.	PC interface screen monitored for updates.

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For close-up pictures of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

EUT Configuration

Please see *Appendix B* for pictures of the unit during testing.

- The EUT is tested as submitted and demonstrated for set up by the manufacturer/client.
- Cables and earthing were connected as per the manufacturer's specification.
- As per the client's specification, the EUT will be using shielded cables during its application in the field.
- Except for the WS-6-100, I/O ports of all units were tested with RJ45 port 1 set to run Ethernet communication data, and RJ45 port 3 was set to provide 48Vdc output. These configurations are considered representative of the functions of the ports, as each RJ45 port is identical in functions and configurability.
- Testing of the WS-6-100 is powered by RJ45 port 3 of the WS-12-DC configured to provide 48Vdc through PoE, as demonstrated by the client. Port 6 is set to provide 48Vdc output.
- As per the manufacturer, the DC units are not to be connected to a DC mains system.

Operational Setup

These devices are required to be attached to the EUT to test its normal operation. They are not tested in the scope of this report:

- Rocket Titanium M5T: Load to exercise 48Vdc PoE port.
- D-Link DIR-850L router: Switch for Ethernet communication.
- Laptop PC with web browser.

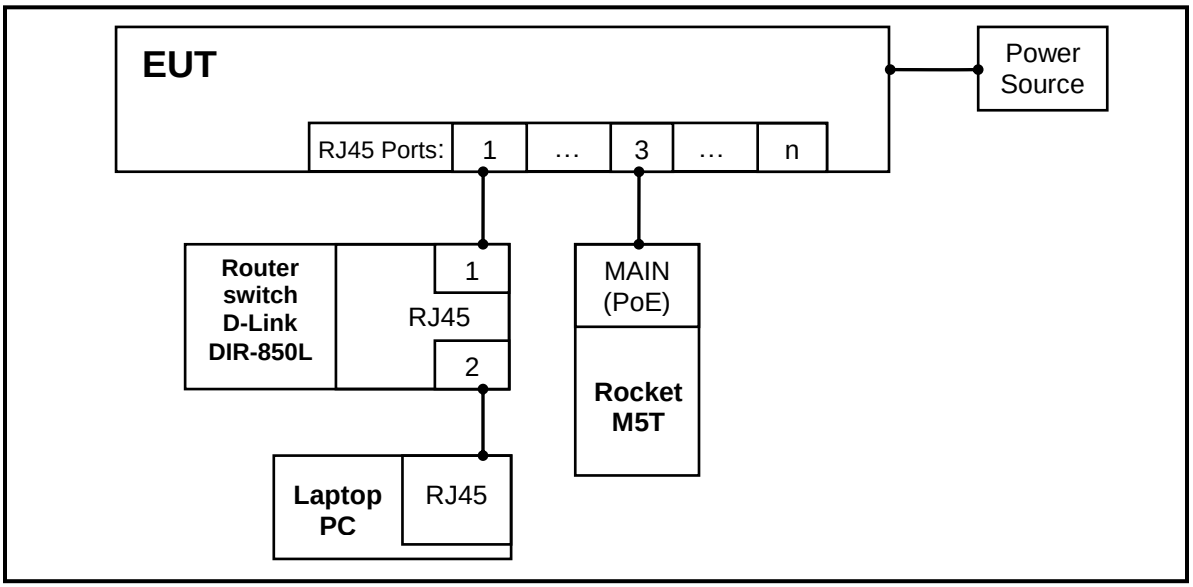
To set up the EUT:

- EUT has been preprogrammed by the manufacturer for Ethernet communication on RJ45 port 1, and 48Vdc PoE on port 3 for all units except the WS-6-100. The WS-6-100 is programmed for PoE output on port 6.
- Connect the EUT to the peripheral test equipment as shown in the *EUT Connection Block Diagrams* below.
- Connect all equipment to the appropriate mains power and boot equipment.
- Load web browser in PC.
- Access EUT interface using IP: 192.1681.20 (192.1681.21 for WS-6-100) in browser.
- Click “Advanced” > “Proceed to 192.1681.20 (unsafe)” > Enter username and password. > Click “Login.”
- Monitor “Total Throughput” plot on interface for updates, and “PoE” indicates correct voltage is supplied at the respective port.

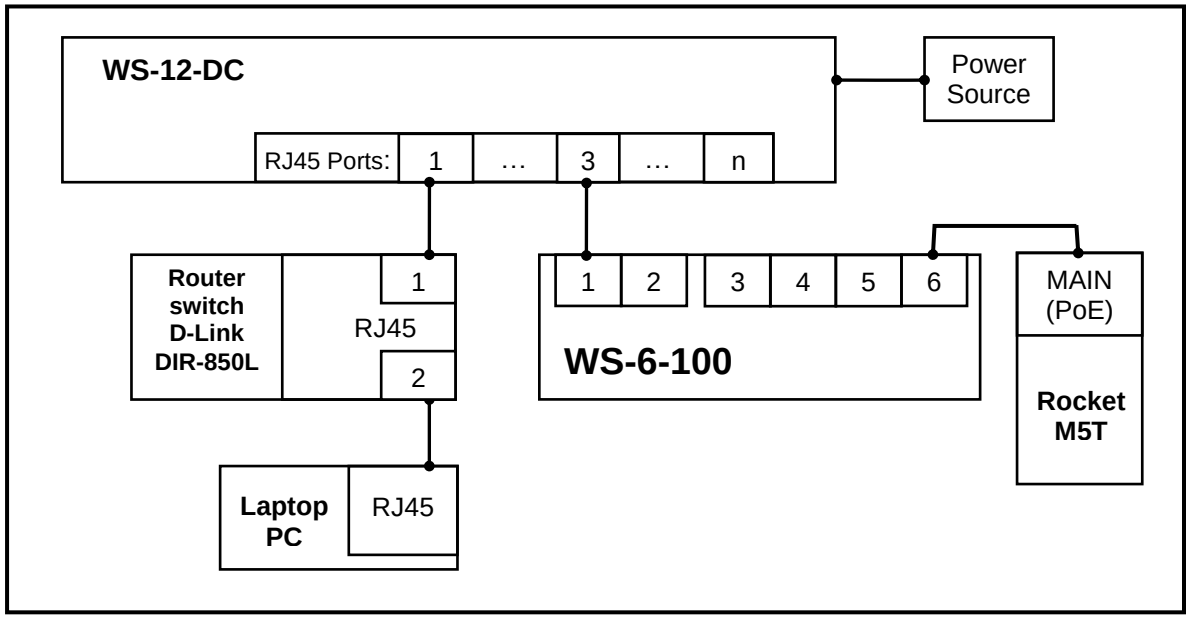
See *Appendix B* for photos showing individual test setups.

EUT Connection Block Diagrams

All except WS-6-100:



WS-6-100:



EUT Description

The EUT are PoE (Power over Ethernet) switches.
The following is a comparison of the units as indicated by the manufacturer.

- The WS-12-250-AC, WS-10-250-AC, WS-12-400-AC, WS-12-250-DC, and WS-12-DC uses the same main board.
- WS-12-250-AC includes all the hardware and functionality of the WS-10-250-AC (i.e. the WS-10-250-AC is a depopulated version of the WS-12-250-AC). Therefore, the WS-10-250-AC is a subset of the WS-12-250-AC.
- The WS-12-400-AC is the same as the WS-12-250-AC, but has a 400W power supply.
- The WS-12-250-DC is the same as the WS-12-250-AC, but has a different power supply, to accept 24 VDC instead of AC mains.
- The WS-12-DC is the same as the WS-12-250-DC, but has no power supply, and operated from 48VDC directly.
- The WS-6-100 uses a different main board, and is powered through 48VDC from PoE (Power over Ethernet).

Modifications Required for Compliance

The following modifications were made by the manufacturer during testing for the sample to achieve compliance with the test requirements. See individual parts in the *Detailed Test Result Section* for more details.

- None. EUT is tested as provided by manufacturer.

Criteria Description

Performance criterion A: During testing, normal performance as specified by the manufacturer.

Performance criterion B: During testing, temporary degradation, or loss of function or performance which is self-recovering.

Performance criterion C: During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.

Appendix B – EUT & Test Setup Photos

Test setups are similar for all units. Selected photos are shown as representative of the test setup.

Figure 1 – EUT
From left to right: WS-12-250-DC, WS-12-DC, WS-6-100

Figure 2 – EUT
WS-12-400-AC

Figure 3 – EUT
From left to right: WS-10-250-AC, WS-12-250-AC

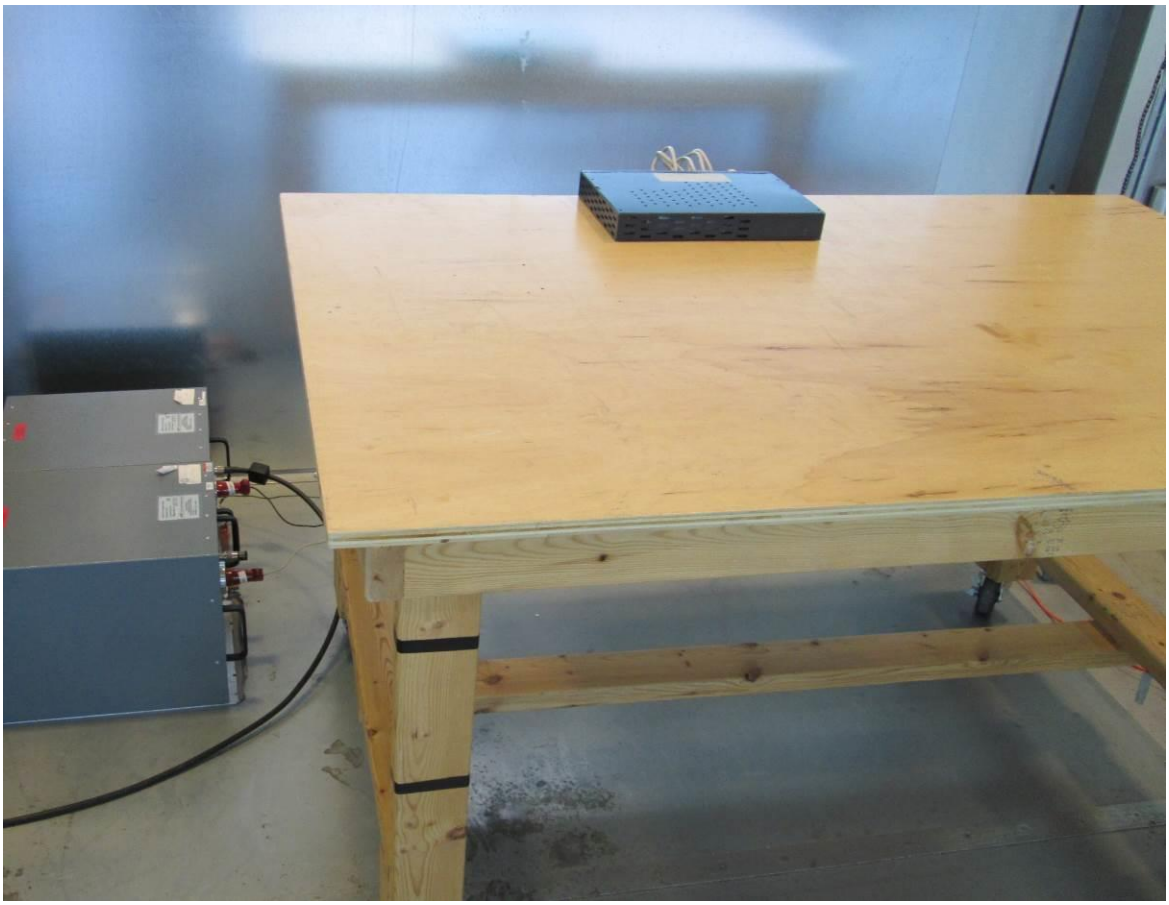


Figure 4 – Power Line Conducted Emissions Test Setup

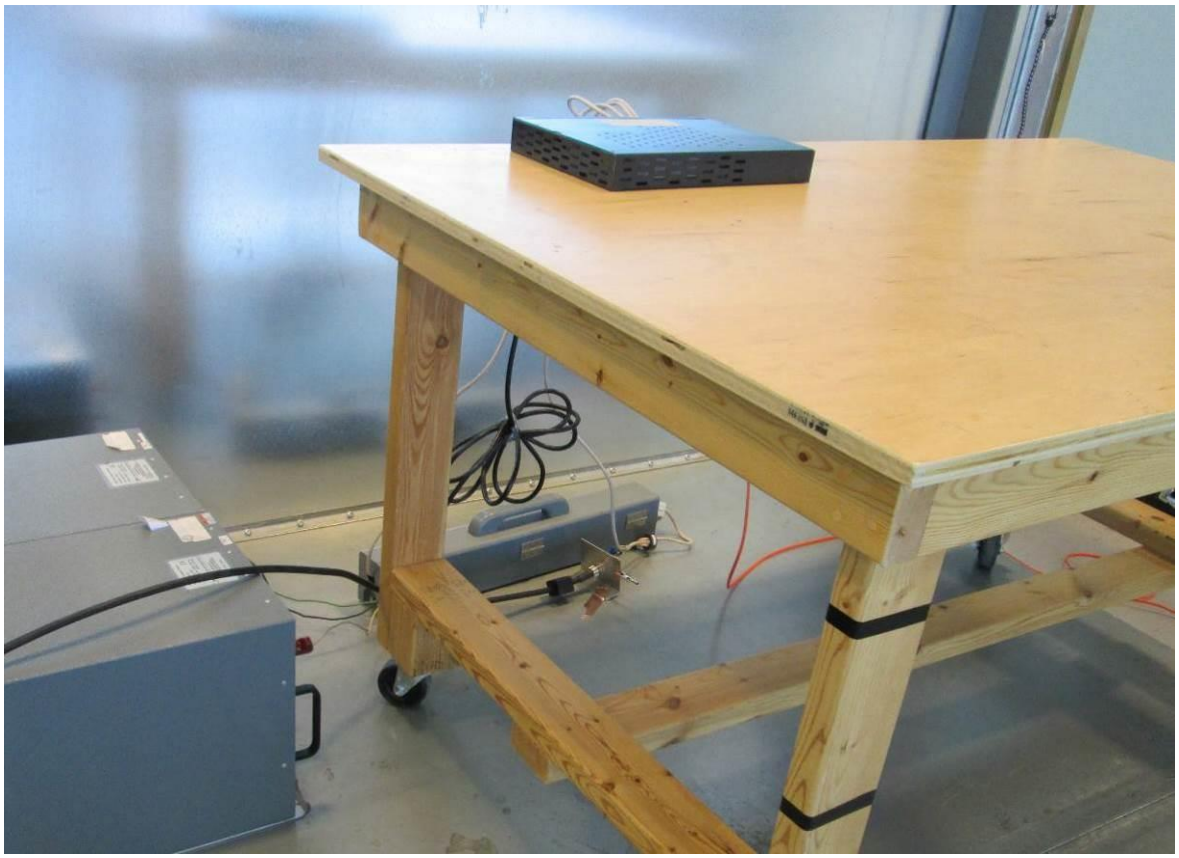


Figure 5 – Telecom Line Conducted Emissions Test Setup (Voltage)

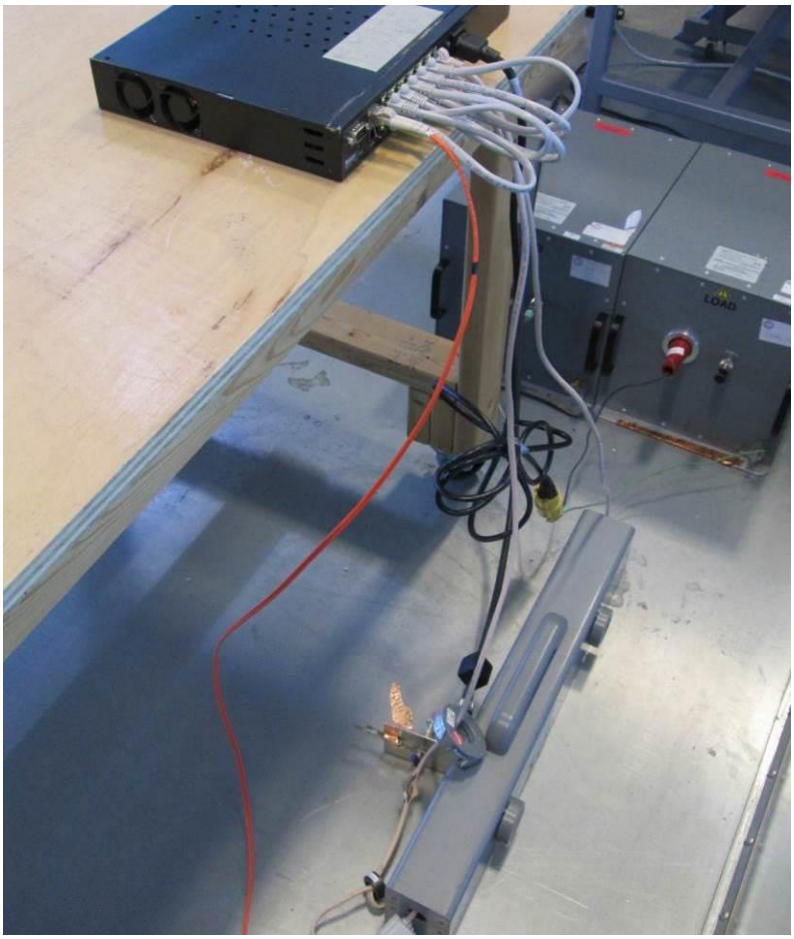


Figure 6 – Telecom Line Conducted Emissions Test Setup (Current)

Figure 7 - Radiated Emissions Test Setup

Figure 8 – Harmonics and Flicker Emissions Test Setup

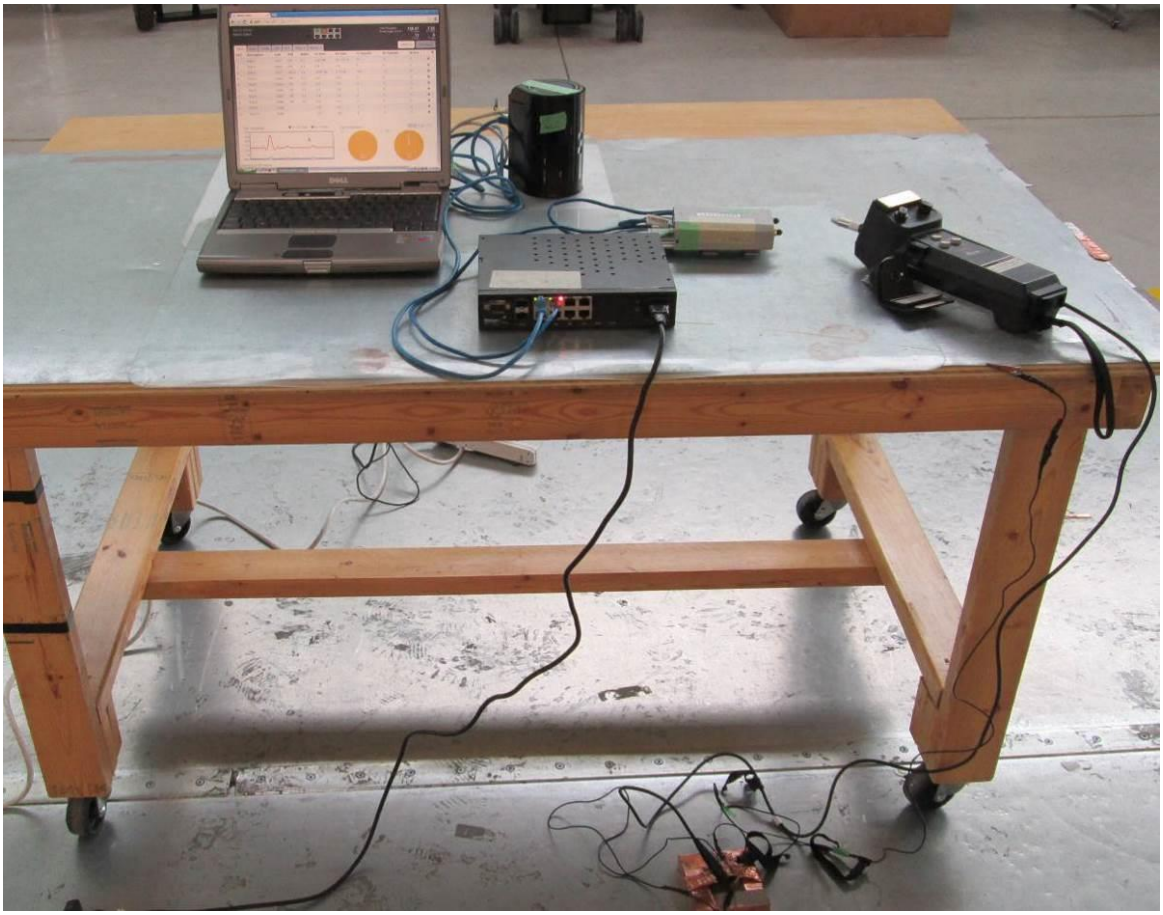


Figure 9 - ESD Test Setup

Figure 10 - Radiated Susceptibility Test Setup

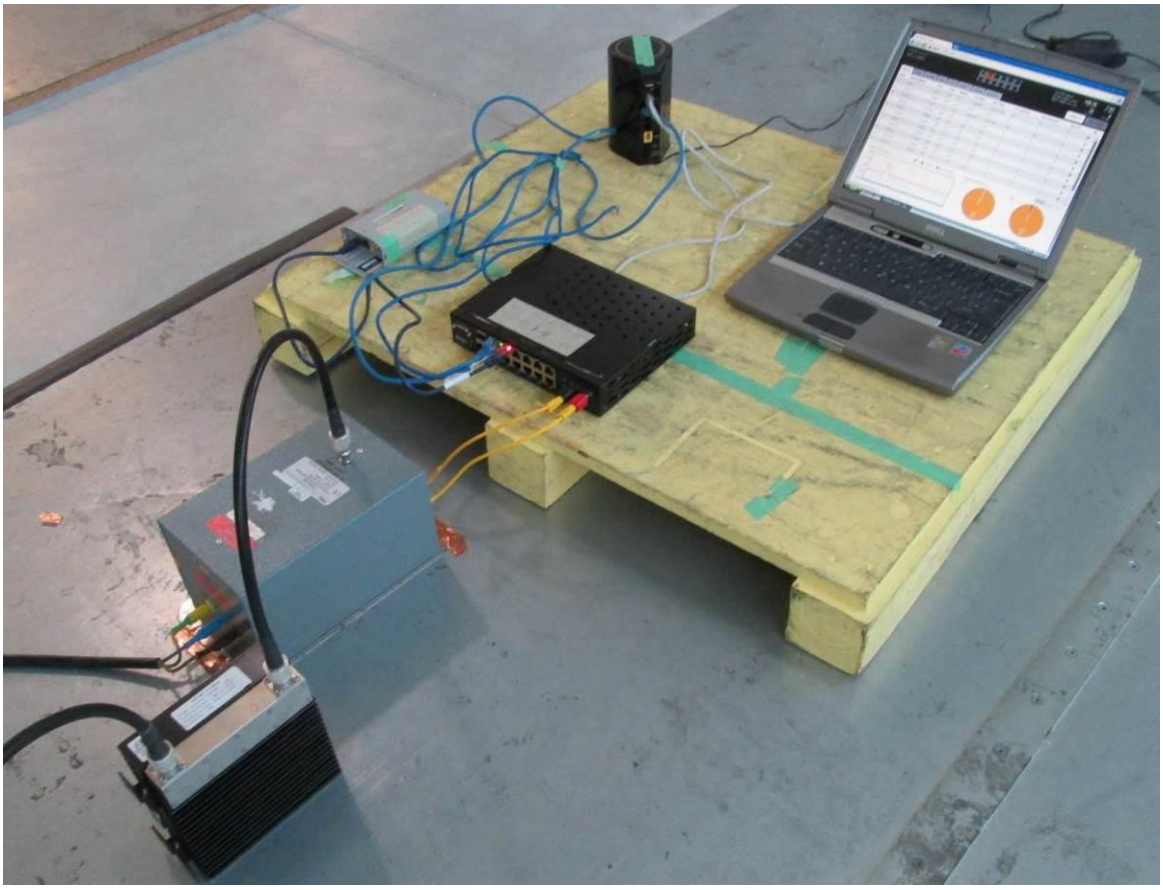


Figure 11 - Conducted RF Susceptibility Test Setup (power input)

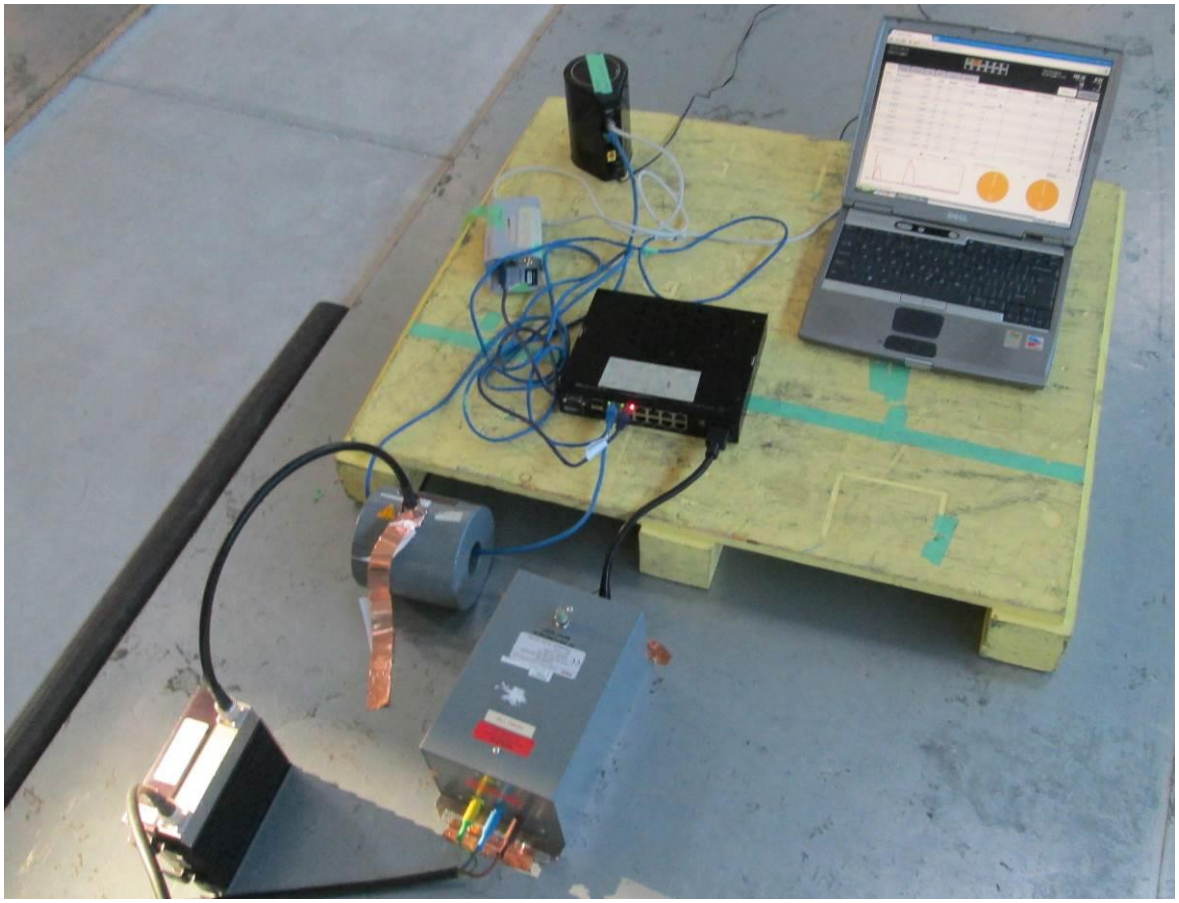


Figure 12 - Conducted RF Susceptibility Test Setup (I/O)

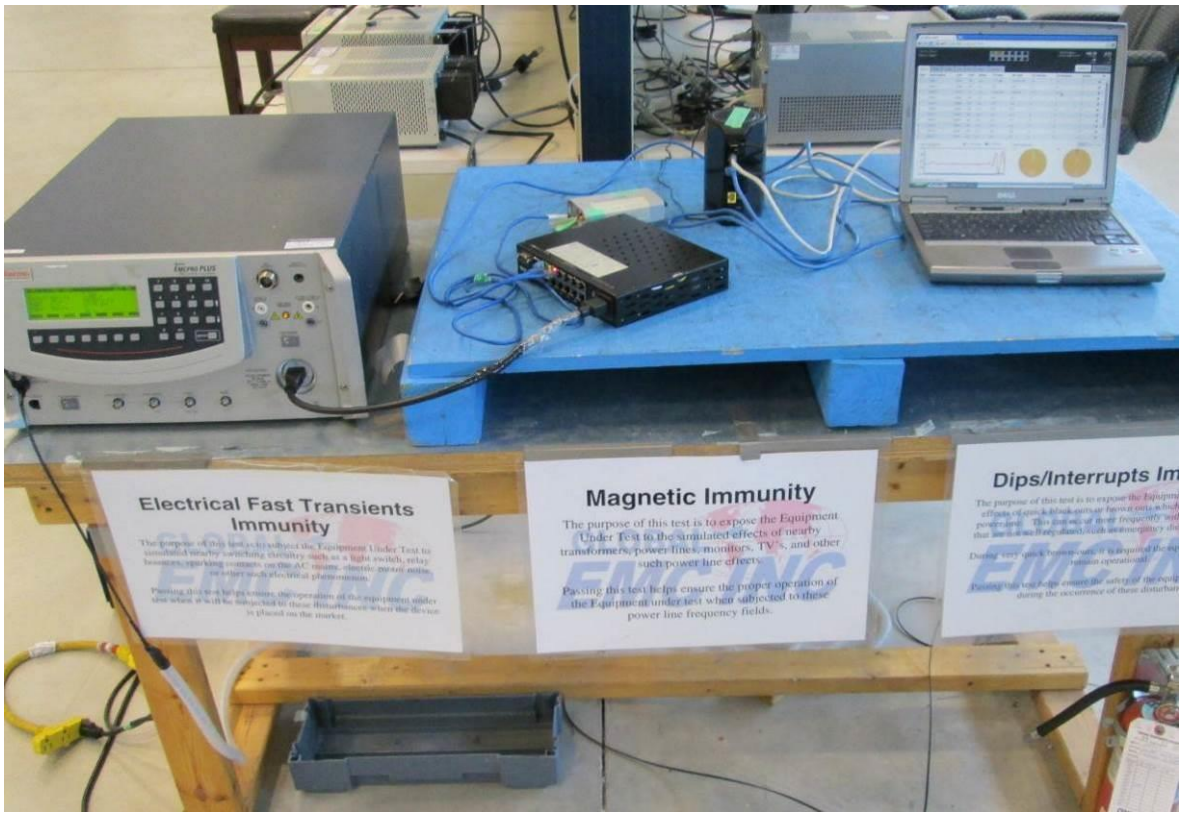


Figure 13 – EFT (AC & DC), Surge (AC only), and Voltage Dips/Interrupts (AC only) Test Setup

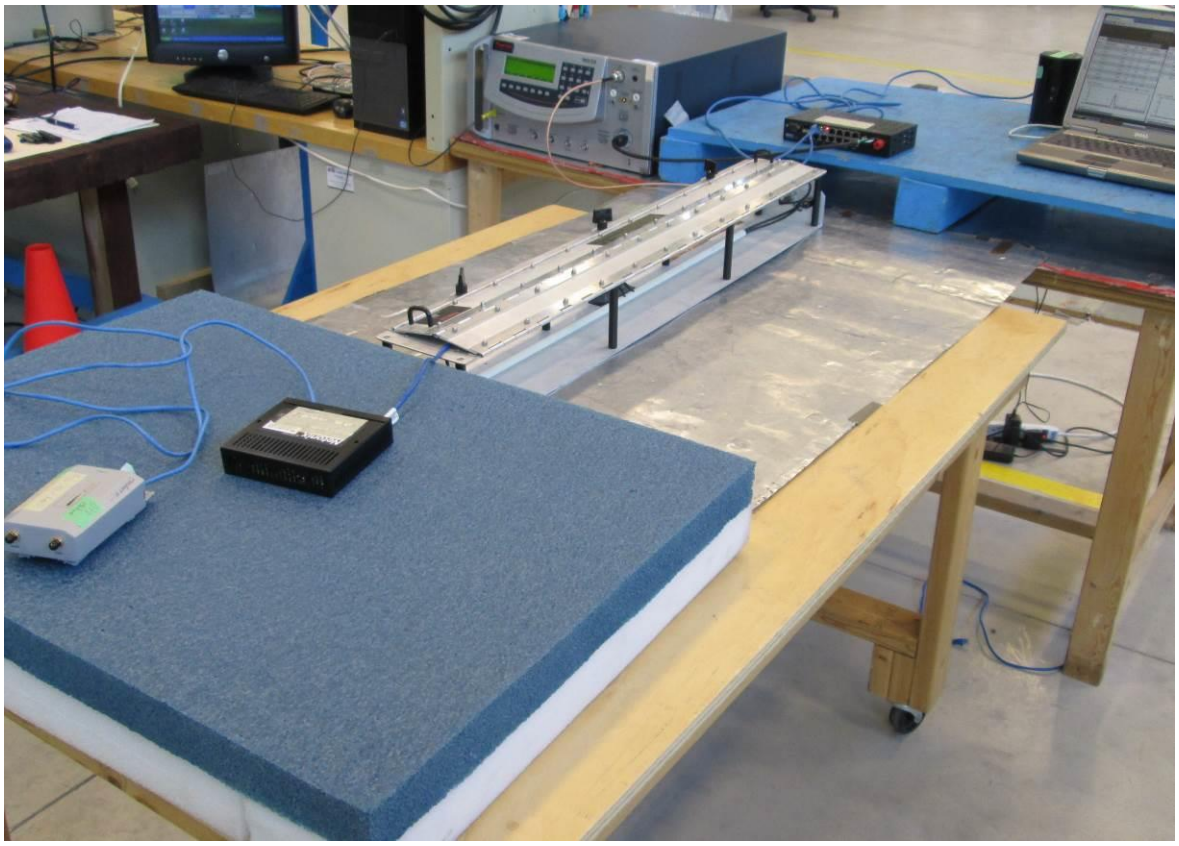


Figure 14 – EFT (I/O) Test Setup

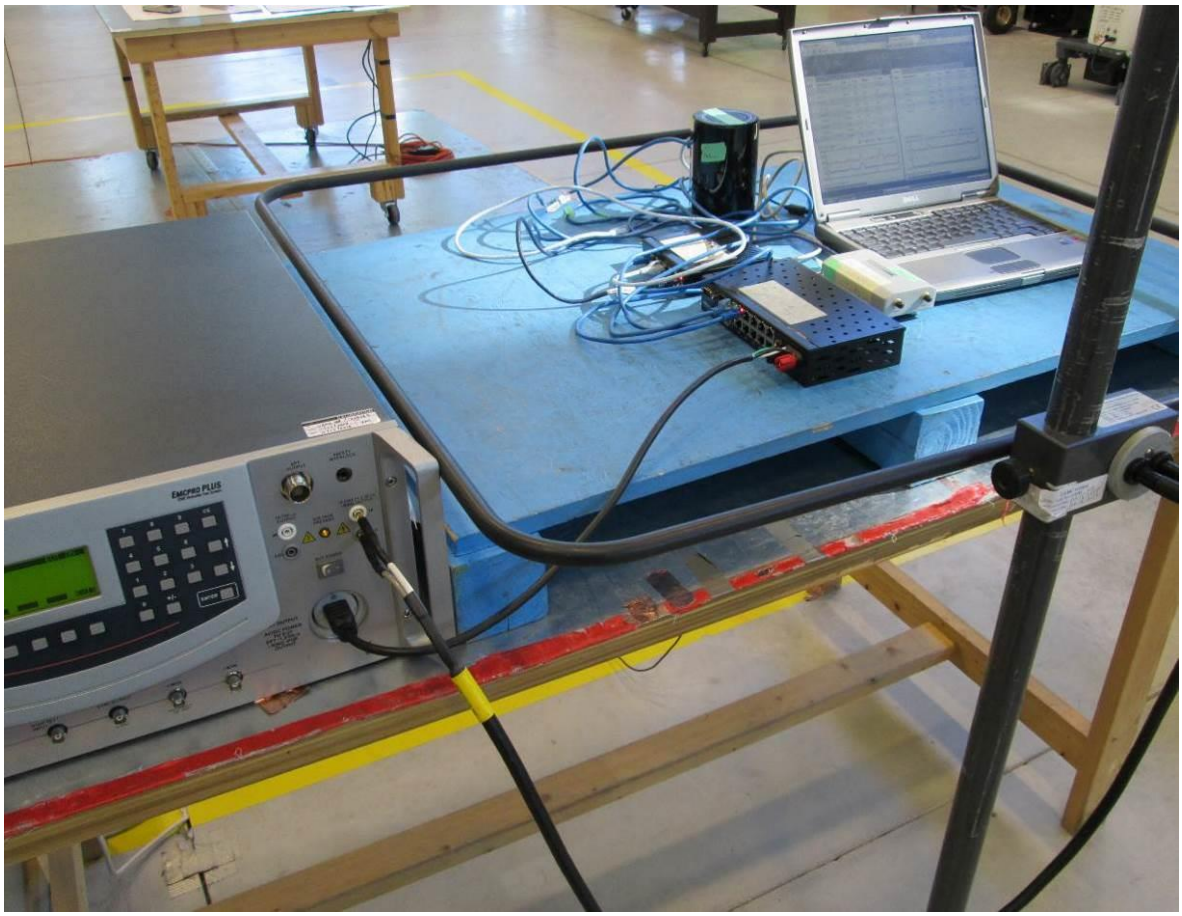


Figure 15 – Magnetic Field Susceptibility Test Setup