EMC / EMI Test Report

As per

CISPR 32:2015 / EN 55032:2015 / AS/NZS CISPR 32:2015, CISPR 24:2010/EN 55024:2010, FCC Part 15 Subpart B:2017 & ICES-003:2016

Emissions & Immunity for

Multimedia Class A Equipment

on the

Vega 3000G & Vega 3050G

Issued by:

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Testing produced for

Sangoma Technologies

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

Industry Canada
Registration # 6844A-3

Testing Laboratory
Certificate #2955.02

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

Registration # CA6844

Table of Contents

Report Scope

This report addresses the EMC verification testing and test results of the **Vega 3000G**, and **Vega 3050G**, from Sangoma Technologies. These units are herein referred to collectively as EUT (Equipment Under Test), except where indicated individually or as otherwise. The EUT was tested for emissions and immunity compliance against the following standards:

EN 55032:2015 / CISPR 32:2015 / AS/NZS CISPR 32:2015

EN 55024:2010/CISPR 24:2010

FCC Part 15 Subpart B:2017

ICES-003:2016

Power line conducted emissions, radiated emissions, harmonics emissions, flicker emissions, and immunity testing was evaluated on the EUT. Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

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

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.

Summary

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

Equipment Under Test (EUT)	Vega 3000G Vega 3050G
EUT passed all tests performed	Yes
Testing conducted by	Raymond Lee Au

For testing dates, see 'Testing Environmental Conditions and Dates'.

Test Results Summary

Standard/ Method	Description	Criteria	Class / Level	Result
CISPR 32 FCC 15 - ICES 003	Power Line Conducted Emissions	N/A	Class A	Pass
CISPR 32	Asymmetric Mode Conducted Emissions	N/A	Class A	Pass
CISPR 32 FCC 15 - ICES 003	Radiated Emissions	N/A	Class A	Pass
IEC 61000-3-2	Power Line Harmonic Emissions	N/A	Class A	Pass
IEC 61000-3-3	Flicker Emissions	N/A	--	Pass
IEC 61000-4-2	Electro-Static Discharge	B	±4kV Contact ±8kV Air	Pass
IEC 61000-4-3	Radiated Field Immunity	A	3 V/m, 80 MHz – 1 GHz	Pass
IEC 61000-4-4	Electrical Fast Transients (Bursts)	B	±1kV - Mains ±0.5kV - I/O	Pass
IEC 61000-4-5	Surge Immunity	B	±1kV Line - Line ±2kV Line - Ground	Pass
IEC 61000-4-6	Conducted RF Immunity	A	3 Vrms, 150 kHz – 80 MHz	Pass
IEC 61000-4-8	Power Frequency Magnetic Field	A	1 A/m (3 A/m Tested)	Pass
IEC 61000-4-11	Voltage Dips and Interrupts	B/C	Various	Pass
Overall Result				**Pass**

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 is issued.

Notes, Justifications, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

Results in this report apply to both the Vega 3000G and Vega 3050G, except where they are referred to individually, or otherwise indicated.

EUT are tested with shielded CAT 5e RJ45 cable connected to the LAN port, as supplied by the manufacturer.

The Vega 3000G and Vega 3050G are tested in sequence. They were tested together for Radiated Emissions, Flicker Emissions, and Radiated Immunity testing, as this will either produce the worst case, or equivalent results, to testing them individually. Passing results from being tested together in these cases indicates that they will pass individually.

Testing for ESD was performed using Telnet communication with the auxiliary equipment (laptop PC) instead of serial. As per the manufacturer, this provides the method of monitoring the EUT's performance, and is not part of the EUT's functionality. This connection is used for communication with the auxiliary PC to monitor the EUT's functionality only. As the serial communication is affected by this test, the Telnet communication is used to interface with the auxiliary PC to monitor EUT functionality during this test. See *Electro-Static Discharge* in the *Detailed Test Result Section* for more details.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used is 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.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)
Margin = 50dBµV/m – (50dBµV + 10dB + 2.5dB – 20dB)
Margin = 7.5 dB (pass)

Power Line Conducted Emission Test

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)
Margin = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)
Margin = 10.0 dB (pass)

Milligauss to A/m Conversion (Magnetic Immunity)

1A/m = 12.57 mG
3A/m = 3*12.57 = 37.7 mG

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
AS/NZS CISPR 32:2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
CFR47 FCC Part 15 Subpart B:2017	Code of Federal Regulations - Radio Frequency Devices
CISPR 11:2015	Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement
ICES-003, Issue 6 2016	Information Technology Equipment (ITE) - Limits and Methods of Measurement
EN55032:2015/ CISPR32:2015/	Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements
EN55024:2010/ CISPR24:2010	Information Technology Equipment - Immunity Characteristics - Limits and Methods of Measurement
CISPR 16-2-3:2010/A2:2014	Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 2-3: Methods of Measurement of Disturbances and Immunity - Radiated Disturbance Measurements
IEC/EN 61000-3-2:2014	Limits for Harmonic Current Emissions (equipment input current ≤ 16A per phase)
IEC/EN 61000-3-3:2013	Limitation of Voltage Changes, Voltage Fluctuations and Flicker in Public Low-Voltage Supply Systems, for equipment with rated current ≤ 16A per phase and not subject to conditional connection.
IEC 61000-4-2:2008 EN 61000-4-2:2009	Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
IEC/EN 61000-4-3:2006/ A2:2010	Testing and Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field Immunity Test
IEC/EN 61000-4-4:2004	Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test
IEC 61000-4-5:2005 EN 61000-4-5:2006	Testing and Measurement Techniques - Surge Immunity Test
IEC 61000-4-6:2008 EN 61000-4-6:2009	Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields
IEC 61000-4-8:2009 EN 61000-4-8:2010	Testing and Measurement Techniques - Power Frequency Magnetic Field Immunity Test

IEC/EN 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 March 21, 2017

- Initial report release.

Definitions and Acronyms

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

AE – Associated Equipment. Equipment needed to exercise and/or monitor the operation of the EUT.

AM – Amplitude Modulation

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**: Operation of this equipment in a residential environment could cause radio interference."

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. NOTE: A residential environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10m of the device concerned.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

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

LISN – Line Impedance Stabilization Network

NA – Not Applicable

NCR – No Calibration Required

NSA – Normalized Site Attenuation

Signal/Control Port – Port intended for the interconnection of components of an EUT, or between an EUT and local AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it).
(Examples include: RS-232, USB, HDMI, Fire Wire)

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.

Optical Fiber Port – Port at which an optical fiber is connected to an equipment.

Broadcast Receiver Tuner Port – Port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services.

Wired Network Port – Point of connection for voice, data and signaling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network.
(Examples include: CATV, PSTN, ISDN, xDSL, LAN and similar networks)

RF – Radio Frequency

EMC Test Plan – An EMC test plan established prior to testing. See 'Appendix A – EUT & Client Provided Details'.

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on an EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, 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 TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's 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	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Feb. 21, 2017	Power Line Conducted Emissions	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 6, 2017	Asymmetric Mode Conducted Emissions	RA	21 – 24	40 – 51	98.0 – 102.0
Feb. 7, 2017	Radiated Emissions	RA	21 – 24	40 – 51	98.0 – 102.0
Feb. 24, 2017	Harmonic Emissions	RA	21 – 24	40 – 51	98.0 – 102.0
Feb. 24, 2017	Flicker Emissions	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 3, 2017	Electro-Static Discharge	RA	21 – 24	40 – 51	98.0 – 102.0
Feb. 17, 2017	Radiated Field Immunity	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 2, 2017	Electrical Fast Transients	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 2, 2017	Surge Immunity	RA	21 – 24	40 – 51	98.0 – 102.0
Feb. 28, 2017	Conducted RF Immunity	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 3, 2017	Power Frequency Magnetic Field	RA	21 – 24	40 – 51	98.0 – 102.0
Mar. 3, 2017	Dips and Interrupts	RA	21 – 24	40 – 51	98.0 – 102.0

Detailed Test Result Section

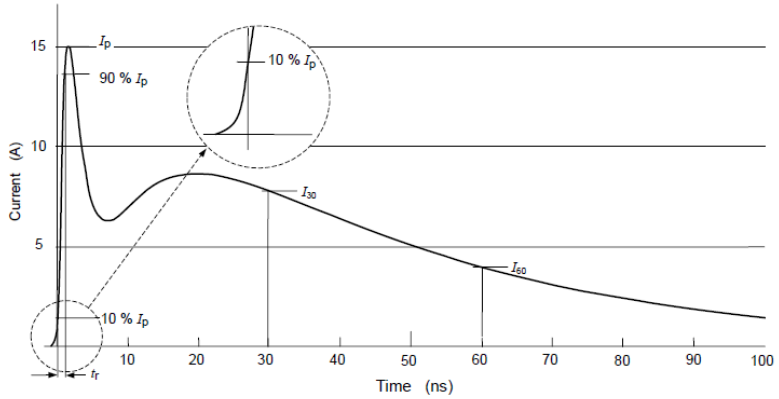
Electro-Static Discharge

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 discharge can be seen in low humidity conditions when a person touches an object and creates a small spark. This spark could potentially be harmful to the operation of the EUT. The contact method, with related reduced voltages, has been shown to be roughly equivalent to air discharges in severity and due to its reproducibility, contact is the preferred test method. Air discharge is used where contact discharge cannot be applied since 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 in a normal usage environment. This test does not guarantee that the EUT will not be exposed to higher discharge levels which could cause it to fail.

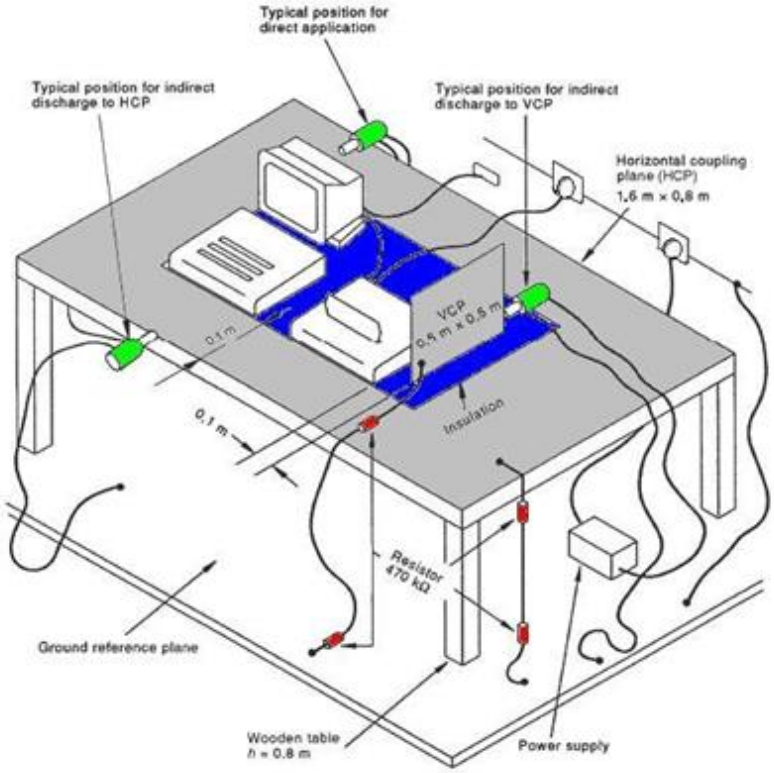
Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-2. Ten hits in the positive and negative polarity are applied at each defined discharge point on the EUT. These are called direct discharges, regardless of contact or air being applied. Horizontal Coupling Plane (HCP) and Vertical Coupling Plane (VCP) discharges are also applied and these are called indirect discharges. A typical test setup representation is shown on the following page. A photograph of the actual test setup is shown in Appendix B. See the results table under Test Results for the actual EUT discharge points.



A level of ±4kV contact or ±8kV air, where applicable, is applied to each defined discharge point. For air discharge testing, the test is applied at the lower test levels first. Performance Criteria level B as defined in "Appendix A – EUT & Client Provided Details" is applied to this test. However, all anomalies, if any, are noted.

Typical ESD Setup



Application Level Accuracy

Contact discharge: ±15% for the first peak current, ±5% for the output voltage and ±25% for the rise time as measured at the discharge electrode tip of ESD generator.

Test Results

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

Behavior of the EUT from this test is obtained by monitoring the EUT through the Telnet connection (using the "LAN" RJ45 port) instead of the serial port ("Console"). As per the manufacturer, the communication between these ports and the auxiliary PC is to provide a means to monitor the EUT's operation. If the serial connection is used to monitor the EUT, ESD discharges will disrupt their communication, and prevent the PC from receiving updates, until the cable is disconnected and reconnected to the port, in which case the updates will resume displaying on the PC. The EUT does not require adjustment. The Telnet connection is more robust, and allows monitoring of the EUT throughout the test, unaffected by ESD. Using this connection, the EUT shows normal operation through the test. Results from each discharge location is shown below.

Location	Test Voltage	Discharge Type	Pass / Fail
Vega 3000G			
1. Front overlay & "Status" LED	±8kV	Air	Pass. Criteria A No Discharge
2. Enclosure, sides, top	±4kV	Contact	Pass. Criteria A
3. Enclosure, vents	±4kV	Contact	Pass. Criteria A (Air discharge arcs to enclosure)
4. Enclosure, fan grille.	±4kV	Contact	Pass. Criteria A (Air discharge arcs to enclosure)
5. Back overlay	±8kV	Air	Pass. Criteria A No Discharge
6. "RJ-21 Interface – FXS 1-24" connector, plastic parts	±8kV	Air	Pass. Criteria A No Discharge
7. "RJ-21 Interface – FXS 1-24" connector, screws	±4kV	Contact	Pass. Criteria A
8. "RJ-21 Interface – FXS 1-24" connector, cable	±8kV	Air	Pass. Criteria A No Discharge
9. "Console" RJ45 shell	±4kV	Contact	Pass. Criteria A
10. "LAN" RJ45 shell	±4kV	Contact	Pass. Criteria A
11. USB shell	±4kV	Contact	Pass. Criteria A
12. DC power input barrel connector shell	±4kV	Contact	Pass. Criteria A

13. Ground screw	±4kV	Contact	Pass. Criteria A
14. AC/DC power supply enclosure + LED	±8kV	Air	Pass. Criteria A No Discharge
15. AC/DC power supply plastic connector & cable	±8kV	Air	Pass. Criteria A No Discharge
16. HCP & VCP	±4kV	Contact	Pass. Criteria A
Vega 3050G			
17. Enclosure, front sides, top	±4kV	Contact	Pass. Criteria A
18. Enclosure, vents	±4kV	Contact	Pass. Criteria A (Air discharge arcs to enclosure)
19. Fan grilles	±4kV	Contact	Pass. Criteria A (Air discharge arcs to enclosure)
20. USB shell	±4kV	Contact	Pass. Criteria A
21. “LAN” RJ45 shell	±4kV	Contact	Pass. Criteria A
22. “Console” RJ45 shell	±4kV	Contact	Pass. Criteria A
23. Metal plate around “FX01” & “FX02” ports	±4kV	Contact	Pass. Criteria A
24. “RJ21 Interface FXS 1-25” connector screws	±4kV	Contact	Pass. Criteria A
25. “RJ21 Interface FXS 1-25” connector plastic	±8kV	Air	Pass. Criteria A No Discharge
26. “RJ21 Interface FXS 1-25” cable	±8kV	Air	Pass. Criteria A No Discharge
27. “RJ21 Interface FXS 26-50” connector screws	±4kV	Contact	Pass. Criteria A
28. “RJ21 Interface FXS 26-50” connector plastic	±8kV	Air	Pass. Criteria A No Discharge
29. “RJ21 Interface FXS 26-50” cable	±8kV	Air	Pass. Criteria A No Discharge
30. Ground screw	±4kV	Contact	Pass. Criteria A
31. Overlay around connectors	±8kV	Air	Pass. Criteria A No Discharge
32. Mains inlet	±8kV	Air	Pass. Criteria A No Discharge
33. HCP & VCP	±4kV	Contact	Pass. Criteria A

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
ESD Generator	NSG 437	Teseq	Nov. 6, 2015	Nov. 6, 2017	GEMC 130
ESD HCP	80CM x 160CM	Global EMC	NCR	NCR	GEMC 50
ESD VCP	50CM x 50CM	Global EMC	NCR	NCR	GEMC 51
ESD 470K A	2x470kΩ 100CM	Global EMC	NCR	NCR	GEMC 52
ESD 470K B	2x470kΩ 100CM	Global EMC	NCR	NCR	GEMC 53

IEC61000-4-2_ESD_Rev4

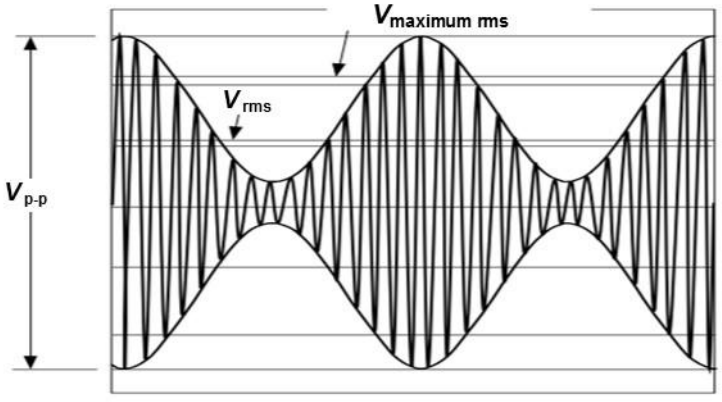
Radiated Field Immunity

Purpose

The EUT will likely be exposed to intentional sources of electromagnetic radiation during its regular application. Sources of such radiation can be cellular phones, FM radio, television, remote car alarms, garage door openers, and other broadcast transmissions. These sources of radiation are licensed or certified for broadcast and therefore, the EUT should be immune to their RF energy. This test assesses the immunity of the EUT to the applicable field strength test level. This test, however, does not guarantee that the EUT will not be exposed to higher level fields during its operation, which may cause it to fail.

Application Level Requirement

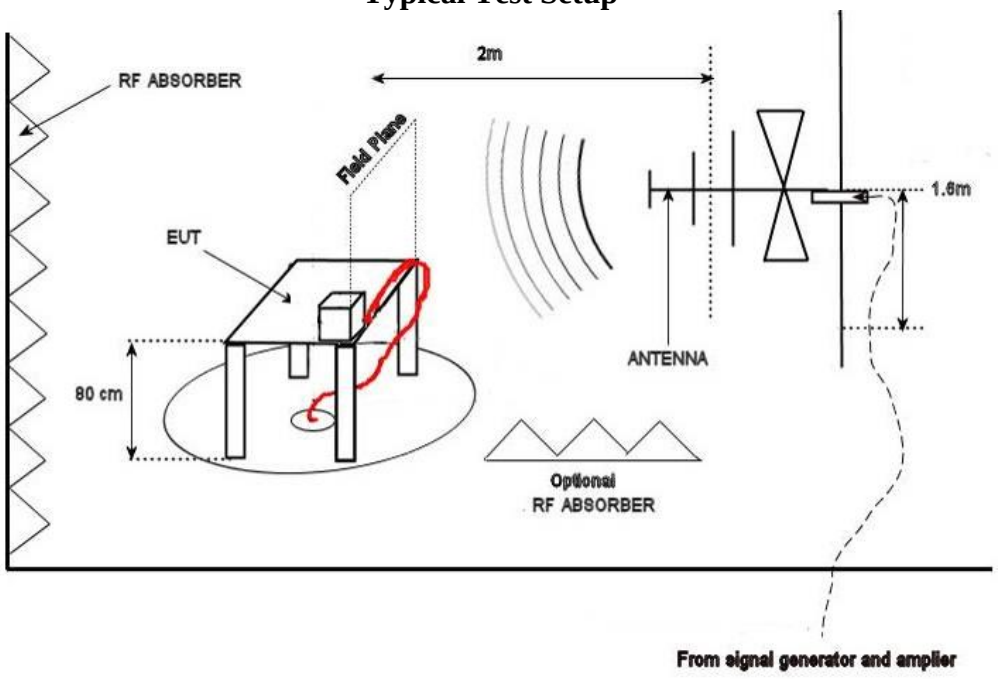
This test is performed in accordance with the methodology defined in IEC 61000-4-3. This immunity test is performed over the frequency range of 80MHz to 1.0GHz. As the frequency range is swept incrementally, the step size used is 1% of the preceding frequency value, rounded down to the nearest kHz. Known clock frequencies, local oscillators, etc. are analyzed separately, where applicable, and these are defined in "Appendix A – EUT & Client Provided Details". The field uniformity is calibrated at 3V/m and a modulation of 80% AM 1 kHz sine wave is applied during the application of the RF energy at each frequency.



Modulated RF signal 80% AM

The RF field is applied in both horizontal and vertical antenna polarization and four sides of the EUT are subjected to this RF field. The dwell time used for each frequency is 3 seconds. Forward power is monitored and records are kept on file at TÜV SÜD Canada. An isotropic field probe is also placed in near proximity of the EUT to verify the application of the RF field. Performance Criteria level A as defined in "Appendix A – EUT & Client Provided Details" is applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC 61000-4-3, the RF field is specified as 0dB to +6dB 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. The EUT met Criteria A as defined in "Appendix A – EUT & Client Provided Details". No anomalies were observed.

Input Voltage and Frequency	230Vac, 50Hz	
Frequency Range and Field Strength	80MHz – 1GHz, 3V/m (80% AM)	
Sweep Step	1% of Fundamental	
Dwell Time	3 sec.	
Clock Frequencies Analyzed Separately		
Clock	**Frequency Inspected**	**Dwell Time**
1.	125 MHz	60 sec.
2.	666 MHz	60 sec.
Result	**Pass**	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Generator	SMHU	Rohde & Schwarz	Feb. 1, 2017	Feb. 1, 2019	GEMC 155
BiLog Antenna	CBL6111	Chase	Dec. 17, 2015	Dec 17, 2017	GEMC 201
Field Probe	FL 7018	AR	Sept. 21, 2016	Sept. 21, 2018	GEMC 164
Power Head	PH 2000	AR	Feb. 1, 2017	Feb. 1, 2019	GEMC 15
Power Meter	PM 2002	AR	Feb. 1, 2017	Feb. 1, 2019	GEMC 16
Power Amplifier	250W1000B	AR	NCR	NCR	GEMC 192
Field Monitor	FM 7004	AR	NCR	NCR	GEMC 13
Immunity Software	V221	Global EMC	NCR	NCR	GEMC 57

IEC61000-4-3_RadiatedImmunity_Rev4

Electrical Fast Transients / Bursts

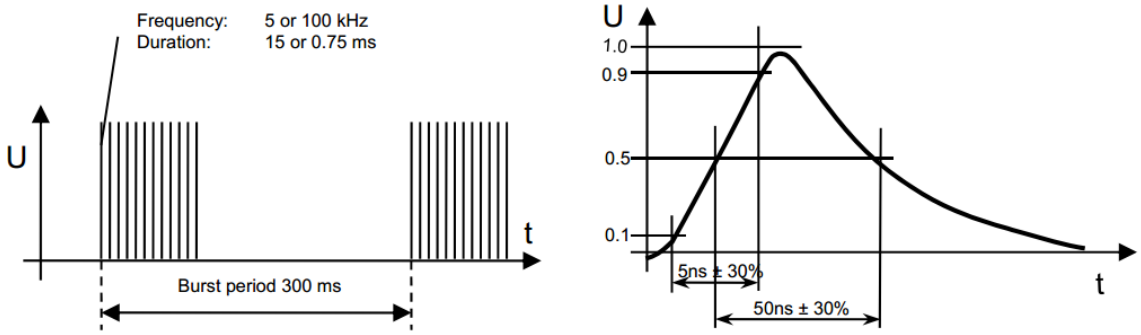
Purpose

Electrical Fast Transients is a series of bursts consisting of a number of fast transients, which in a typical application environment, can be coupled into the supply and onto the I/O lines of the EUT. These transient signals usually arise from nearby switching circuitry such as a light switch, relay bounces, electric motor noise, interruption of inductive loads, etc. This test is to verify that the EUT is immune to such transient disturbances based on the applicable test levels. This test, however, does not guarantee that the EUT will not experience higher level burst impulses 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: 5ns ± 30%
- Pulse duration (to 50% value): 50ns ± 30%
- Pulse repetition frequency 5kHz (75 pulses per 15ms burst train)
- Burst duration should be 15ms ± 20%
- Burst period should be 300ms ± 20%



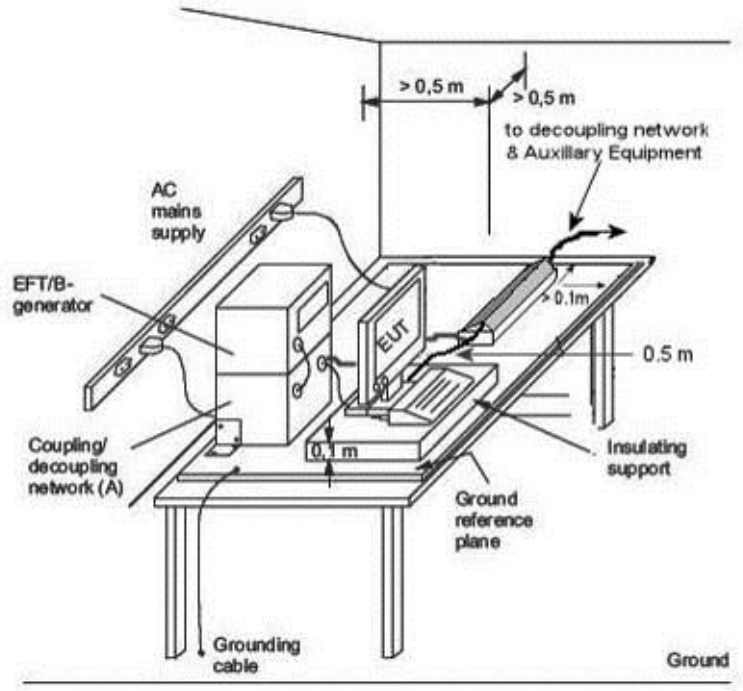
Open-circuit voltage Voltage in a 50Ω-Load

Bursts are applied for 1 minute each at the positive and the negative polarity to the mains power input (common mode) and to each applicable I/O line.

A test level of ±0.5kV is applied to I/O lines via a capacitive coupling clamp and ±1kV is applied to the power supply port(s) via a coupling and decoupling network. Performance

Criteria level B as defined in "Appendix A – EUT & Client Provided Details" is applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC 61000-4-4, the test level is specified as being within ±10% into a 50Ω load and ±20% into a 1000Ω load.

Test Results

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

Test Voltage	Repetition Rate	Coupling Lines	Result
±1kV	5kHz	Mains: L – N – PE	Pass. Criteria A
±0.5kV	5kHz	I/O Lines	Pass. Criteria A

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Immunity Generator	EMC Pro Plus	Keytek Thermo Corp.	Dec. 19, 2016	Dec. 19, 2018	GEMC 4
Capacitive Coupling Clamp	CDN 126	Schaffner	Dec. 20, 2016	Dec. 20, 2018	GEMC 195
Immunity Software	CEWare 32 V4.1	Thermo Fisher Scientific	NCR	NCR	GEMC 182

IEC61000-4-4_EFTB_Rev4

Surge Immunity

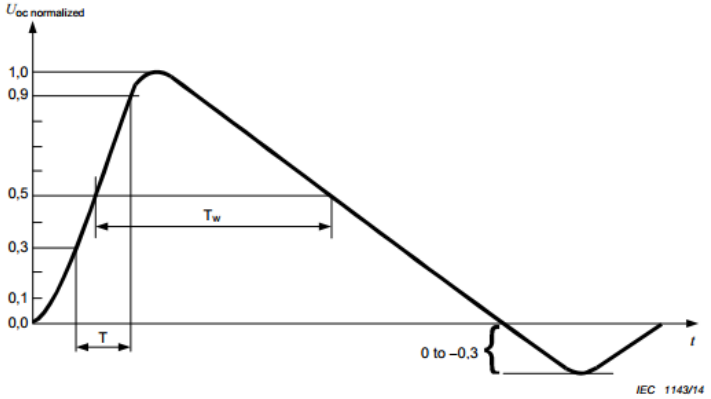
Purpose

Surge occurs when a high energy disturbance takes place on the power lines, or less frequently, I/O lines and can cause significant temporary increase in current and/or voltage. These disturbances can arise during a nearby lightning strike, circuit trips, short-circuits on the same power line that the equipment is connected to, etc. The sudden rise in voltage over a very short period of time could cause damage to the components of the EUT and this test assesses the immunity of the EUT to such transient waves. This test differs from Electrical Fast Transients / Bursts in that this waveform, characterized by the rapid increase of current and/or voltage followed by a slower decrease, has a longer wave duration that could allow damage to the EUT. This test does not guarantee that the EUT will not be exposed to a higher level of surge energy during its operation, which may cause the EUT to fail. This test also does not ensure operation of the EUT in the presence of direct lightning effects.

Application Level Requirement

This test is performed in accordance with the methodology defined in IEC 61000-4-5. Surges are simulated using a waveform generator and the characteristics of the waveform generated are as follows:

- Rise time of 1.2µs and wave duration of 50µs (to 50% value) into an open circuit.
- Rise time of 8µs and wave duration of 20µs (to 50% value) into a short circuit.
- Dwell time of 60 seconds between each surge.
- 5 surges in the positive and 5 surges in the negative polarity.
- For AC systems, the surge pulses are applied at 0º, 90º, and 270º.
- For AC systems, Line to Ground is performed at 2 times the Line to Line voltage.

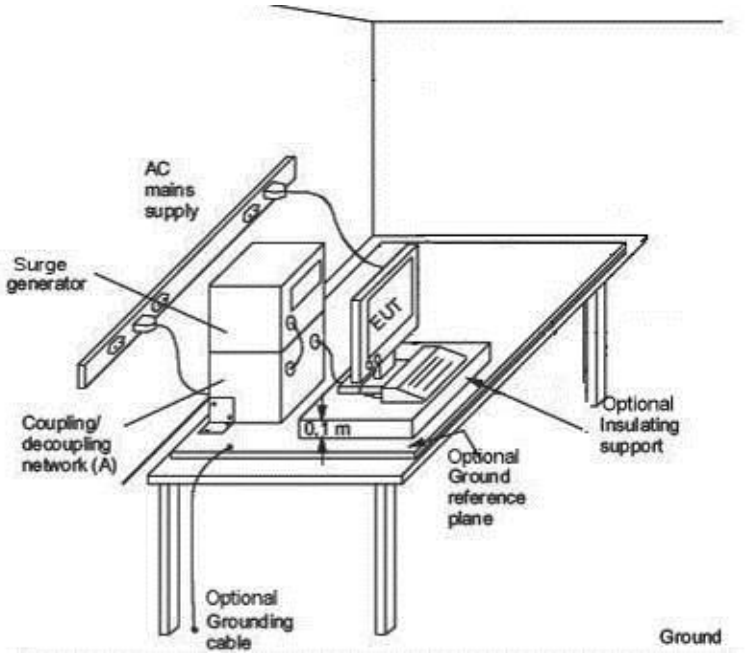


Front time: $T_f = 1{,}67 \times T = 1{,}2\ \mu s \pm 30\ \%$
Duration: $T_d = T_w = 50\ \mu s \pm 20\ \%$

NOTE The value 1,67 is the reciprocal of the difference between the 0,9 and 0,3 thresholds.

For AC mains supply, a test level of ±1kV Line to Line and ±2kV Line to Ground is applied to the power supply port(s) via a coupling and decoupling network. Lower test levels are evaluated first before applying the required test level. Performance Criteria level B as defined in "Appendix A – EUT & Client Provided Details" is applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC 61000-4-5, the level is specified as being within ±10% for open circuit voltage calibration or ±10% for 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

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

Test Voltages	Phase Angles	Number of Surges	Coupling Lines	Result
±0.5kV, ±1kV, ±2kV	0°, 90°, 270°	5 per polarity	L – PE	Pass Criteria A
±0.5kV, ±1kV, ±2kV	0°, 90°, 270°	5 per polarity	N – PE	Pass Criteria A
±0.5kV, ±1kV	0°, 90°, 270°	5 per polarity	L – N	Pass Criteria A

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Immunity Generator	EMC Pro Plus	Keytek Thermo Corp.	Dec. 19, 2016	Dec. 19, 2018	GEMC 4
Immunity Software	CEWare 32 V4.1	Thermo Fisher Scientific	NCR	NCR	GEMC 182

IEC61000-4-5_Surge_Rev4

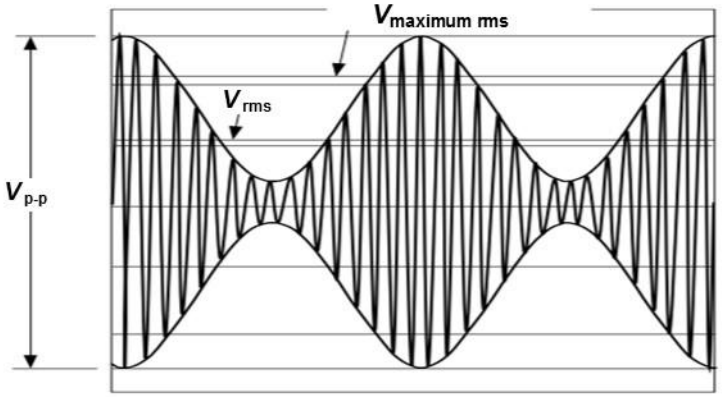
Conducted RF Immunity

Purpose

The EUT will likely be exposed, in some way, to low frequency intentional sources of RF energy during its regular 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 and therefore, 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 than subjecting the EUT to an equivalent RF field.

Application Level Requirement

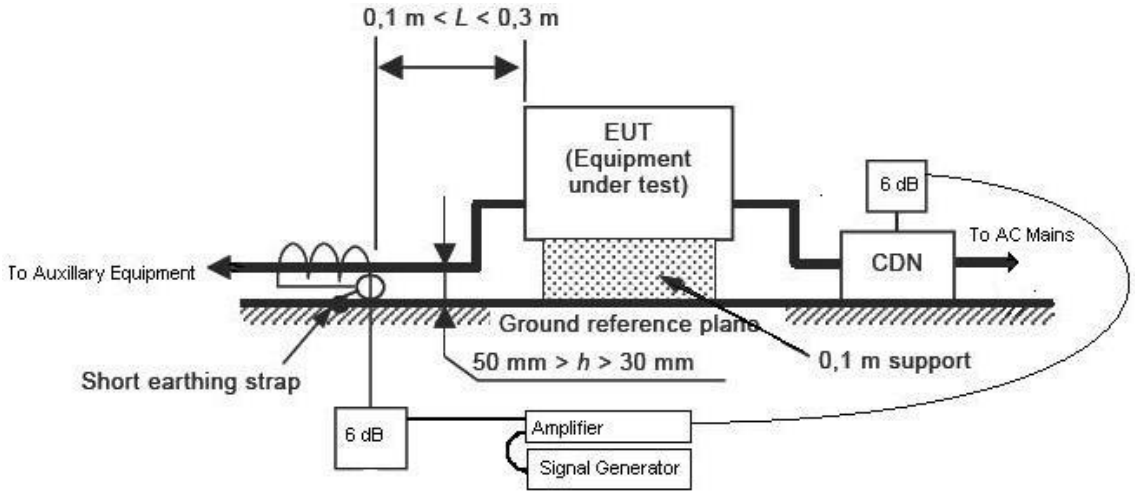
This test is performed in accordance with the methodology defined in IEC 61000-4-6. I/O cables are tested using a bulk current injection probe and power lines are tested using a coupling and decoupling network. The immunity test is performed over the frequency range of 150 kHz to 80 MHz. As the frequency range is swept incrementally, the step size used is calculated at 1% of the preceding frequency value, rounded down to the nearest kHz. Known clock frequencies, local oscillators, etc. are analyzed separately, where applicable, and these are defined in "Appendix A – EUT & Client Provided Details". The test level is calibrated at 3Vrms and a modulation of 80% AM 1kHz sine wave is applied during the application of the RF energy at each frequency.



Modulated RF signal 80% AM

The dwell time used for each frequency is 3 seconds. A current probe is placed between the coupling device and the EUT to verify the application of the RF energy. Performance Criteria level A as defined in "Appendix A – EUT & Client Provided Details" is applied to this test.

Typical Test Setup



Application Level Accuracy

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

Test Results

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

Input Voltage and Frequency	230Vac, 50Hz	
Frequency Range and Signal Strength	150kHz - 80MHz 3 Vrms (80% AM)	
Sweep Step	1% of Fundamental	
Dwell Time	3 sec.	
AC Mains	Pass	
I/O Lines:	Pass	
Clock Frequencies Analyzed Separately		
Clock	**Frequency Inspected**	**Dwell Time**
1.	25 MHz	60 sec
2.	8.192 MHz	60 sec
3.	2.048 MHz	60 sec
Result	**Pass**	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Signal Generator	SMHU	Rohde & Schwarz	Feb. 1, 2017	Feb. 1, 2019	GEMC 155
Power Line CDN	FCC-801-M3-16A	FCC	Feb. 10, 2016	Feb. 10, 2018	GEMC 138
Bulk Current Injection Probe	F-120-9A	FCC	Jan. 27, 2017	Jan. 27, 2019	GEMC 20
RF Current Probe	F-33-2	FCC	Jan. 27, 2017	Jan. 27, 2019	GEMC 19
Power Amplifier	75A250A	AR	NCR	NCR	GEMC 14
Power Attenuator 6dB	100-A-FFN-06	Bird	NCR	NCR	GEMC 48
Immunity Software	V219	Global EMC	NCR	NCR	GEMC 57

IEC61000-4-6_ConductedImmunity_Rev4

Power Frequency Magnetic Field

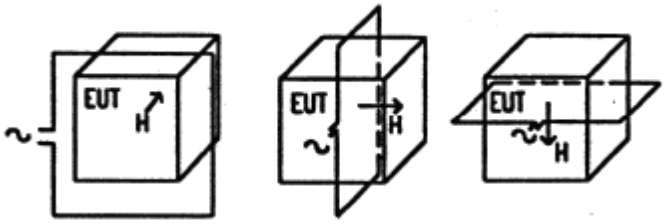
Purpose

A magnetic field with the 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 normal operating conditions. These fields have 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. The transient magnetic field, if applicable, is tested for 1 minute while the steady state magnetic field is tested for 15 minutes. The frequencies applied are 50 Hz and 60 Hz. A magnetic field strength of 3 A/m is applied to the EUT in each orthogonal axis. Performance Criteria level A as defined in "Appendix A – EUT & Client Provided Details" is applied to this test.

Typical Setup Diagram



Application Level Accuracy

As per IEC 61000-4-8, the field over the area that the EUT occupies within the loop must be calibrated to be within ±3dB. For a field strength of 3 A/m, this means that the empty calibrated field strength can be between 2.1 A/m and 4.2 A/m over the area that the EUT occupies.

Test Results

The EUT passed the requirements. The EUT met Criteria A as defined in "Appendix A – EUT & Client Provided Details," when tested at both 50Hz and 60Hz. No anomalies were observed.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Immunity Generator	EMC Pro Plus	Keytek Thermo Corp.	Dec. 19, 2016	Dec. 19, 2018	GEMC 4
Milligauss Meter	4180	F W Bell	Sept. 21, 2016	Sept. 21, 2018	GEMC 74
Magnetic Loop	F-1000-4-8/9/10-L-1M	FCC	NCR	NCR	GEMC 22
Immunity Software	CEWare 32 V4.1	Thermo Fisher Scientific	NCR	NCR	GEMC 182

IEC61000-4-8_MagneticImmunity_Rev3

Voltage Dips, Interruptions and Variations

Purpose

An AC powered device may be subjected to voltage dips, short interruptions or other voltage variations in the power line. Such conditions are mainly caused by faults or changes in the network due to sudden large changes in load, or when a brown out or a black out condition occurs. These voltage dips 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 Requirements

This test is performed in accordance with the methodology defined in IEC 61000-4-11. As per CISPR 24 Table 4, the following dip and interruption levels apply:

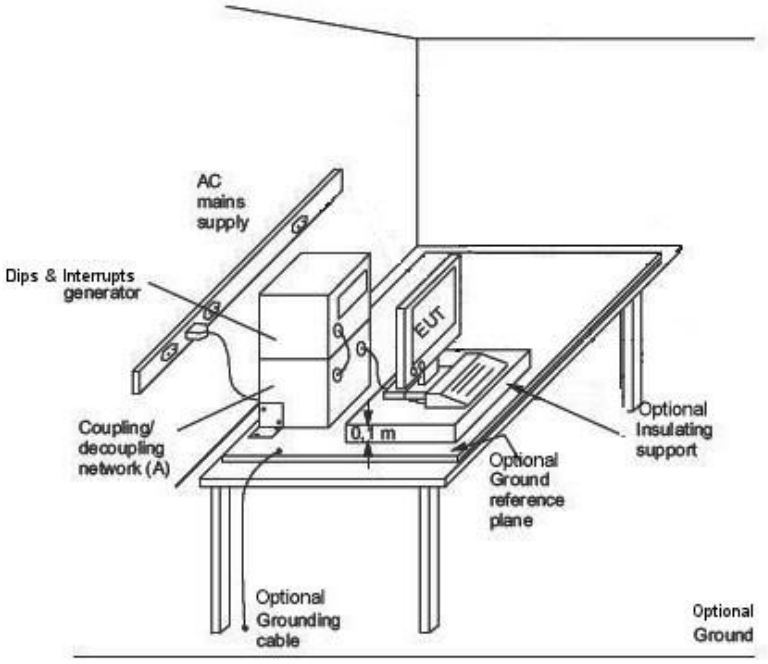
Voltage Dip Level	Duration [s]	Duration @ 50Hz [Cycles]	Criteria Level Applied
0% (0 Vac)	0.01	0.5	B
70% (161 Vac)	0.5	25	C
0% (0 Vac)	5	250	C

The voltage level in brackets is the residual voltage of the voltage dip applied and presumes a normal operating voltage of 230 Vac. This should be scaled appropriately for other values of operating voltage.

The test is carried out at phase angles of 0º, 90º, and 270º of the AC with 5 repetitions applied at each of the dips and interrupts listed in the table above.

Performance Criteria levels B and C as listed in the table above and defined in "Appendix A – Client Provided Details" are applied to this test.

Typical Test Setup



Application Level Accuracy

As per IEC 61000-4-11, 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

The EUT passed the requirements. The EUT met the criteria listed above in the application level requirements. During the 5 second interruption (0% for 250 cycles), the EUT powered off, rebooted, and the use required to reset the unit to restore normal operation. For the other test levels, the EUT operated normally and no anomalies were observed.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Immunity Generator	EMC Pro Plus	Keytek Thermo Corp.	Dec. 19, 2016	Dec. 19, 2018	GEMC 4
Immunity Software	CEWare 32 V4.1	Thermo Fisher Scientific	NCR	NCR	GEMC 182

IEC61000-4-11_DipsImmunity-C24_Rev3

Power Line Harmonics Emissions

Purpose

The purpose of this test is to ensure that the 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. These current limits reduce the chances of that overheating from occurring.

Limits

The limits listed below are as per IEC 61000-3-2 and apply to equipment which are 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)	0.40
11 (550 Hz)	0.33
13 (650 Hz)	0.21
15 ≤ n ≤ 39 (750 Hz – 1950 Hz)	0.15 x (15 / n)
Even Harmonics	
2 (100 Hz)	1.08
4 (200 Hz)	0.43
6 (300 Hz)	0.30
8 ≤ n ≤ 40	0.23 x (8 / n)

Measurement Accuracy

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

Measurement Results

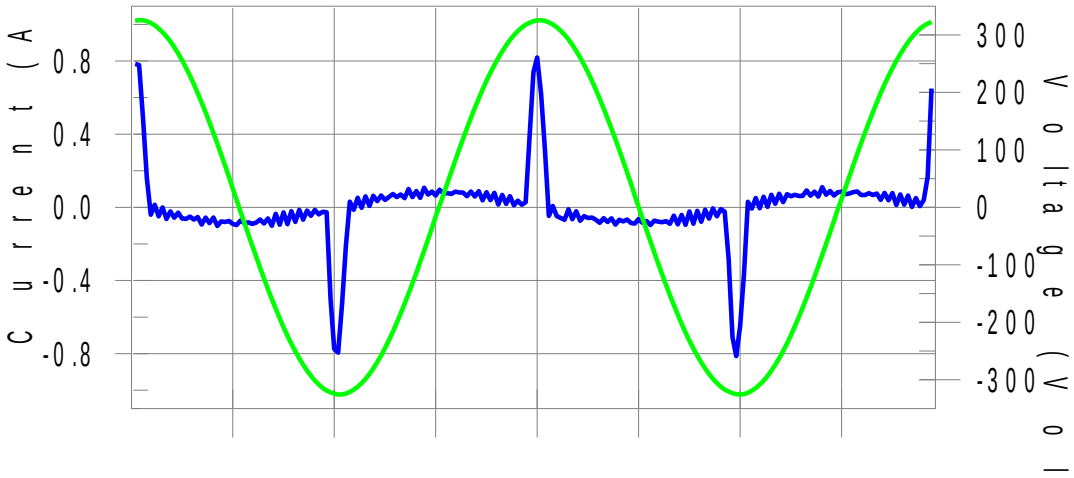
The graphs shown below are for graphical illustration of the final tabular results. For final measurements in text form, please refer to the tables.

Harmonics – Class-A per Ed. 4.0 (2014) (Run time) incl. inter-harmonics
Vega 3000G

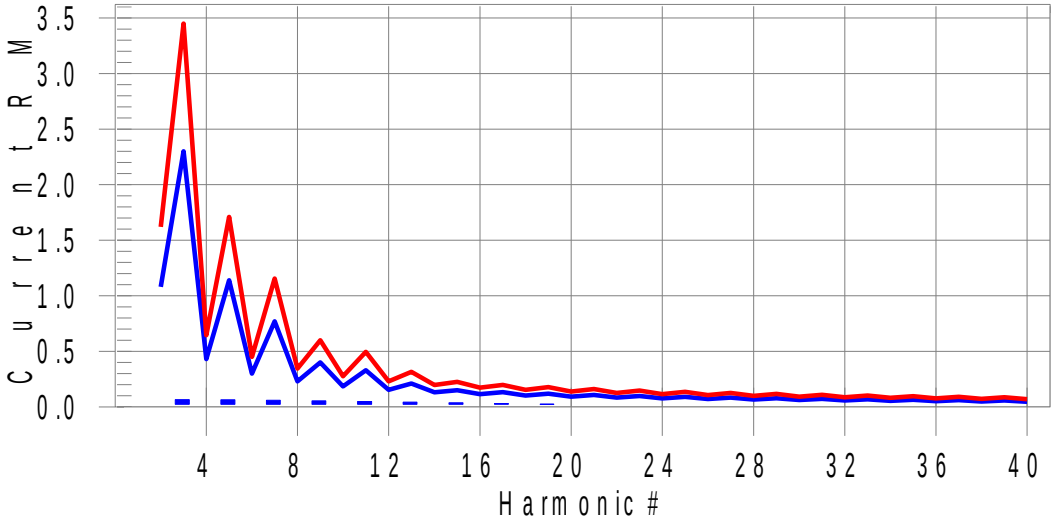
EUT: 3000 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

Current & voltage waveforms



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



Test result: Pass Worst harmonics H15-17.8% of 150% limit, H15-24.8% of 100% limit

Current Test Result Summary (Run time)
Vega 3000G

EUT: 3000 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

THC(A): 0.151 **I-THD(%): 154.8** **POHC(A): 0.027** **POHC Limit(A): 0.251**

Highest parameter values during test:

V_RMS (Volts):	**230.11**	**Frequency(Hz):**	**50.00**
I_Peak (Amps):	**0.857**	**I_RMS (Amps):**	**0.199**
I_Fund (Amps):	**0.098**	**Crest Factor:**	**4.630**
Power (Watts):	**17.7**	**Power Factor:**	**0.395**

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	N/A	0.002	1.620	N/A	Pass
3	0.066	2.300	2.9	0.076	3.450	2.2	Pass
4	0.001	0.430	N/A	0.001	0.645	N/A	Pass
5	0.063	1.140	5.6	0.072	1.710	4.2	Pass
6	0.001	0.300	N/A	0.001	0.450	N/A	Pass
7	0.060	0.770	7.8	0.068	1.155	5.8	Pass
8	0.001	0.230	N/A	0.001	0.345	N/A	Pass
9	0.055	0.400	13.7	0.061	0.600	10.2	Pass
10	0.001	0.184	N/A	0.001	0.276	N/A	Pass
11	0.050	0.330	15.0	0.055	0.495	11.0	Pass
12	0.001	0.153	N/A	0.001	0.230	N/A	Pass
13	0.043	0.210	20.7	0.047	0.315	15.0	Pass
14	0.001	0.131	N/A	0.001	0.197	N/A	Pass
15	0.037	0.150	24.8	0.040	0.225	17.8	Pass
16	0.001	0.115	N/A	0.001	0.173	N/A	Pass
17	0.031	0.132	23.2	0.033	0.198	16.5	Pass
18	0.001	0.102	N/A	0.001	0.153	N/A	Pass
19	0.024	0.118	20.6	0.026	0.178	14.4	Pass
20	0.001	0.092	N/A	0.001	0.138	N/A	Pass
21	0.018	0.107	17.1	0.019	0.161	11.8	Pass
22	0.001	0.084	N/A	0.001	0.125	N/A	Pass
23	0.013	0.098	13.3	0.014	0.147	9.6	Pass
24	0.000	0.077	N/A	0.000	0.115	N/A	Pass
25	0.008	0.090	9.0	0.009	0.135	7.0	Pass
26	0.000	0.071	N/A	0.001	0.107	N/A	Pass
27	0.005	0.083	N/A	0.006	0.125	N/A	Pass
28	0.001	0.066	N/A	0.001	0.099	N/A	Pass
29	0.003	0.078	N/A	0.004	0.116	N/A	Pass
30	0.001	0.061	N/A	0.001	0.092	N/A	Pass
31	0.003	0.073	N/A	0.005	0.109	N/A	Pass
32	0.001	0.058	N/A	0.001	0.086	N/A	Pass
33	0.004	0.068	N/A	0.006	0.102	N/A	Pass
34	0.000	0.054	N/A	0.001	0.081	N/A	Pass
35	0.005	0.064	7.9	0.006	0.096	6.7	Pass
36	0.001	0.051	N/A	0.001	0.077	N/A	Pass

37	0.005	0.061	8.9	0.006	0.091	6.7	Pass
38	0.000	0.048	N/A	0.001	0.073	N/A	Pass
39	0.005	0.058	8.8	0.005	0.087	6.3	Pass
40	0.001	0.046	N/A	0.001	0.069	N/A	Pass

Voltage Source Verification Data (Run time)
Vega 3000G

EUT: 3000 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

Highest parameter values during test:

Voltage (Vrms):	**230.11**	**Frequency(Hz):**	**50.00**
I_Peak (Amps):	**0.857**	**I_RMS (Amps):**	**0.199**
I_Fund (Amps):	**0.098**	**Crest Factor:**	**4.630**
Power (Watts):	**17.7**	**Power Factor:**	**0.395**

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.311	0.460	67.63	OK
3	0.415	2.071	20.05	OK
4	0.110	0.460	23.98	OK
5	0.100	0.920	10.84	OK
6	0.074	0.460	16.10	OK
7	0.074	0.690	10.68	OK
8	0.057	0.460	12.48	OK
9	0.042	0.460	9.12	OK
10	0.048	0.460	10.46	OK
11	0.068	0.230	29.36	OK
12	0.044	0.230	19.10	OK
13	0.022	0.230	9.44	OK
14	0.032	0.230	13.74	OK
15	0.045	0.230	19.70	OK
16	0.030	0.230	12.95	OK
17	0.030	0.230	12.83	OK
18	0.033	0.230	14.28	OK
19	0.037	0.230	16.17	OK
20	0.025	0.230	10.75	OK
21	0.025	0.230	10.70	OK
22	0.020	0.230	8.63	OK
23	0.031	0.230	13.34	OK
24	0.020	0.230	8.56	OK
25	0.013	0.230	5.58	OK
26	0.013	0.230	5.78	OK
27	0.018	0.230	8.04	OK
28	0.014	0.230	5.97	OK
29	0.010	0.230	4.36	OK
30	0.014	0.230	5.90	OK
31	0.016	0.230	6.93	OK
32	0.010	0.230	4.28	OK

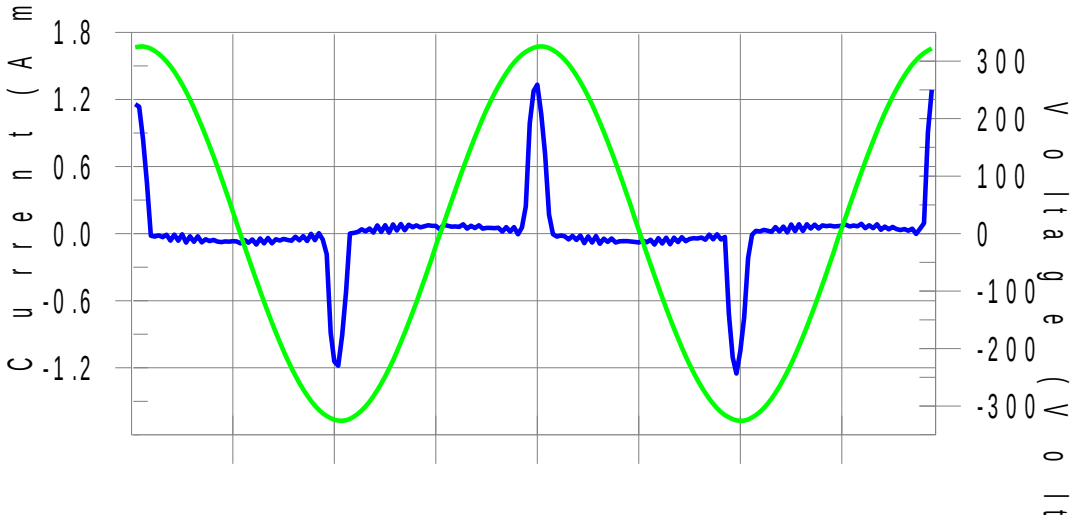
33	**0.015**	**0.230**	**6.31**	**OK**
34	**0.011**	**0.230**	**4.58**	**OK**
35	**0.009**	**0.230**	**3.73**	**OK**
36	**0.011**	**0.230**	**4.86**	**OK**
37	**0.017**	**0.230**	**7.33**	**OK**
38	**0.008**	**0.230**	**3.28**	**OK**
39	**0.010**	**0.230**	**4.21**	**OK**
40	**0.007**	**0.230**	**3.15**	**OK**

Harmonics – Class-A per Ed. 4.0 (2014) (Run time) incl. inter-harmonics Vega 3050G

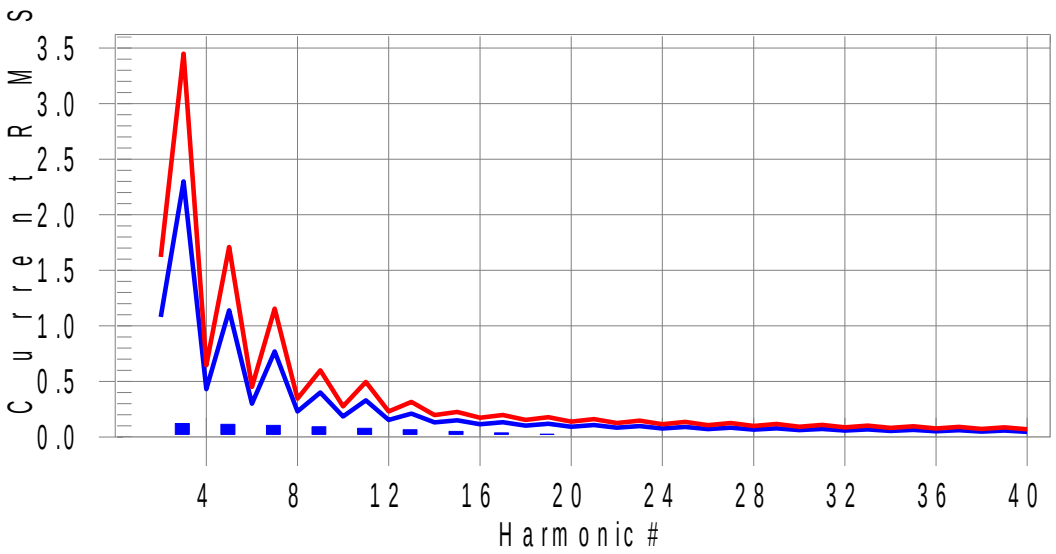
EUT: 3050 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

Current & voltage waveforms



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



Test result: Pass Worst harmonic was #15 with 24.0% of the limit.

Current Test Result Summary (Run time)
Vega 3050G

EUT: 3050 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

THC(A): 0.250 **I-THD(%): 184.2** **POHC(A): 0.027** **POHC Limit(A): 0.251**

Highest parameter values during test:

V_RMS (Volts):	230.12	Frequency(Hz):	50.00
I_Peak (Amps):	1.449	I_RMS (Amps):	0.342
I_Fund (Amps):	0.163	Crest Factor:	4.824
Power (Watts):	34.9	Power Factor:	0.454

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.004	1.080	N/A	0.010	1.620	N/A	Pass
3	0.121	2.300	5.2	0.147	3.450	4.3	Pass
4	0.004	0.430	N/A	0.009	0.645	N/A	Pass
5	0.114	1.140	10.0	0.138	1.710	8.0	Pass
6	0.003	0.300	N/A	0.008	0.450	N/A	Pass
7	0.104	0.770	13.5	0.124	1.155	10.7	Pass
8	0.003	0.230	N/A	0.008	0.345	N/A	Pass
9	0.092	0.400	23.0	0.107	0.600	17.9	Pass
10	0.003	0.184	N/A	0.007	0.276	N/A	Pass

11	0.079	0.330	23.9	0.089	0.495	18.0	Pass
12	0.002	0.153	N/A	0.006	0.230	N/A	Pass
13	0.065	0.210	30.8	0.071	0.315	22.5	Pass
14	0.002	0.131	N/A	0.005	0.197	N/A	Pass
15	0.051	0.150	33.7	0.054	0.225	24.0	Pass
16	0.002	0.115	N/A	0.004	0.173	N/A	Pass
17	0.037	0.132	27.9	0.038	0.198	19.2	Pass
18	0.002	0.102	N/A	0.003	0.153	N/A	Pass
19	0.025	0.118	20.9	0.027	0.178	15.2	Pass
20	0.001	0.092	N/A	0.003	0.138	N/A	Pass
21	0.014	0.107	13.5	0.017	0.161	10.9	Pass
22	0.001	0.084	N/A	0.003	0.125	N/A	Pass
23	0.008	0.098	8.1	0.010	0.147	6.9	Pass
24	0.001	0.077	N/A	0.003	0.115	N/A	Pass
25	0.006	0.090	6.9	0.010	0.135	7.5	Pass
26	0.001	0.071	N/A	0.002	0.107	N/A	Pass
27	0.008	0.083	9.0	0.012	0.125	9.8	Pass
28	0.001	0.066	N/A	0.003	0.099	N/A	Pass
29	0.009	0.078	12.1	0.013	0.116	11.1	Pass
30	0.001	0.061	N/A	0.002	0.092	N/A	Pass
31	0.010	0.073	13.4	0.011	0.109	10.4	Pass
32	0.001	0.058	N/A	0.002	0.086	N/A	Pass
33	0.009	0.068	13.3	0.010	0.102	9.6	Pass
34	0.001	0.054	N/A	0.002	0.081	N/A	Pass
35	0.007	0.064	11.4	0.008	0.096	8.3	Pass
36	0.001	0.051	N/A	0.002	0.077	N/A	Pass
37	0.005	0.061	8.8	0.007	0.091	7.4	Pass
38	0.001	0.048	N/A	0.002	0.073	N/A	Pass
39	0.003	0.058	N/A	0.005	0.087	N/A	Pass
40	0.001	0.046	N/A	0.002	0.069	N/A	Pass

Voltage Source Verification Data (Run time)
Vega 3050G

EUT: 3050 **Tested by: RA**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test duration (min): 10
Customer: Sangoma

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

Highest parameter values during test:

Voltage (Vrms):	**230.12**	**Frequency(Hz):**	**50.00**
I_Peak (Amps):	**1.449**	**I_RMS (Amps):**	**0.342**
I_Fund (Amps):	**0.163**	**Crest Factor:**	**4.824**
Power (Watts):	**34.9**	**Power Factor:**	**0.454**

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.315	0.460	68.49	OK
3	0.434	2.071	20.94	OK
4	0.110	0.460	23.87	OK
5	0.100	0.920	10.90	OK
6	0.077	0.460	16.65	OK

7	**0.092**	**0.690**	**13.29**	**OK**
8	**0.059**	**0.460**	**12.86**	**OK**
9	**0.029**	**0.460**	**6.40**	**OK**
10	**0.049**	**0.460**	**10.74**	**OK**
11	**0.086**	**0.230**	**37.17**	**OK**
12	**0.045**	**0.230**	**19.50**	**OK**
13	**0.030**	**0.230**	**12.95**	**OK**
14	**0.033**	**0.230**	**14.24**	**OK**
15	**0.059**	**0.230**	**25.57**	**OK**
16	**0.031**	**0.230**	**13.44**	**OK**
17	**0.030**	**0.230**	**13.21**	**OK**
18	**0.035**	**0.230**	**15.07**	**OK**
19	**0.039**	**0.230**	**17.13**	**OK**
20	**0.027**	**0.230**	**11.83**	**OK**
21	**0.019**	**0.230**	**8.45**	**OK**
22	**0.022**	**0.230**	**9.36**	**OK**
23	**0.030**	**0.230**	**12.98**	**OK**
24	**0.022**	**0.230**	**9.47**	**OK**
25	**0.021**	**0.230**	**9.01**	**OK**
26	**0.014**	**0.230**	**6.16**	**OK**
27	**0.015**	**0.230**	**6.47**	**OK**
28	**0.014**	**0.230**	**6.16**	**OK**
29	**0.025**	**0.230**	**10.82**	**OK**
30	**0.014**	**0.230**	**5.92**	**OK**
31	**0.014**	**0.230**	**6.28**	**OK**
32	**0.011**	**0.230**	**4.89**	**OK**
33	**0.022**	**0.230**	**9.43**	**OK**
34	**0.012**	**0.230**	**5.26**	**OK**
35	**0.010**	**0.230**	**4.50**	**OK**
36	**0.012**	**0.230**	**5.35**	**OK**
37	**0.018**	**0.230**	**7.89**	**OK**
38	**0.009**	**0.230**	**4.05**	**OK**
39	**0.008**	**0.230**	**3.31**	**OK**
40	**0.008**	**0.230**	**3.52**	**OK**

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Flicker Meter	PACS-1	California Instruments	Jan. 27, 2017	Jan. 27, 2019	GEMC 46
AC Power Source	5000 iX	California Instruments	Jan. 27, 2017	Jan. 27, 2019	GEMC 47
California Instruments CTS SW2	CTS 4.0 V4.9	Ametek Programmable Power Division	NCR	NCR	GEMC 184

IEC61000-3-2_Harmonics_Rev3

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 from time to time.

Limits

The limits listed below apply as per IEC 61000-3-3. 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 the 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 500ms,
- 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 Results

The graphs shown below are for graphical illustration of the final tabular results. For final measurements in text form please refer to the table.

Flicker Test Summary per EN/IEC61000-3-3 Ed. 3.0 (2013) (Run time) Vega 3000G & Vega 3050G

EUT: 3000, 3050
Test category: All parameters (European limits)
Test duration (min): 121
Customer: Sangoma

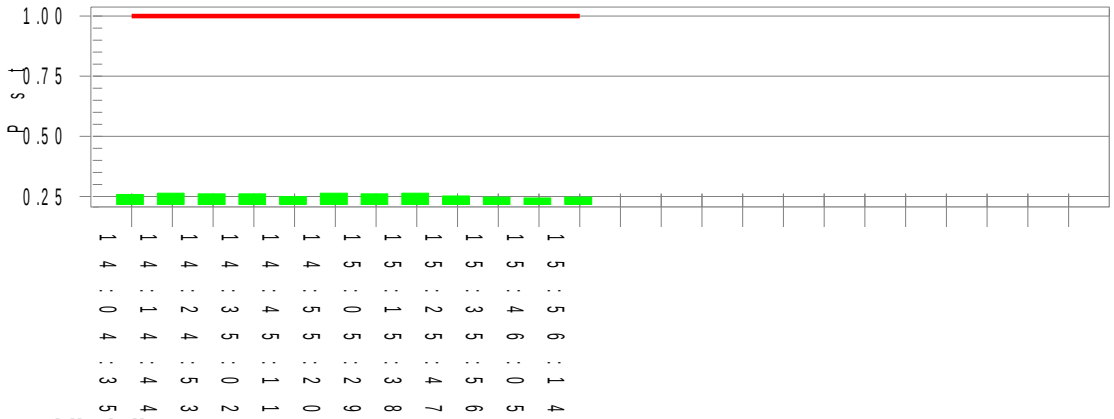
Tested by: RA
Test Margin: 100

Test Result: Pass

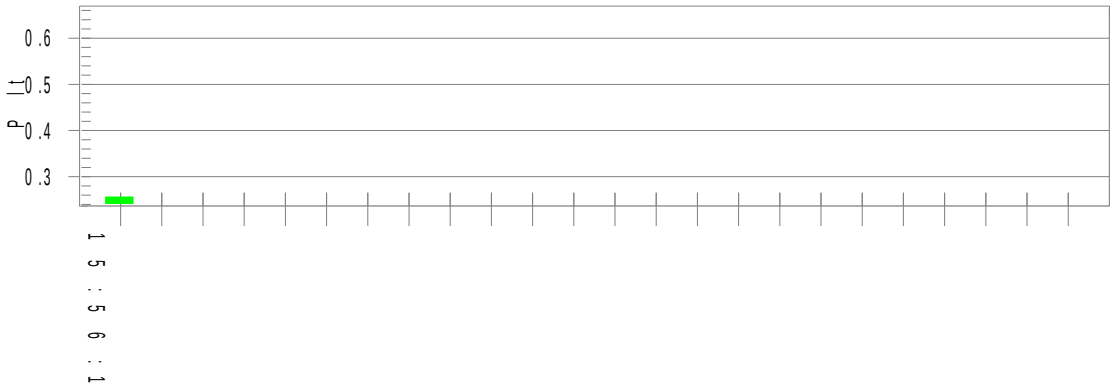
Status: Test Completed

Pst_i and limit line

European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	**230.07**			
Highest dt (%):	**0.00**	**Test limit (%):**	**N/A**	**N/A**
T-max (mS):	**0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.03**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.263**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.256**	**Test limit:**	**0.650**	**Pass**

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Flicker Meter	PACS-1	California Instruments	Jan. 27, 2017	Jan. 27, 2019	GEMC 46
AC Power Source	5000 iX	California Instruments	Jan. 27, 2017	Jan. 27, 2019	GEMC 47
California Instruments CTS SW2	CTS 4.0 V4.9	Ametek Programmable Power Division	NCR	NCR	GEMC 184

IEC61000-3-3_Flicker_Rev3

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 and measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits and method are as defined in CISPR 32, EN55032, 47 CFR FCC Part 15 Section 15.107, and ICES-003 Issue 6 Section 6.1. Note these limits are identical to those of CISPR 11.

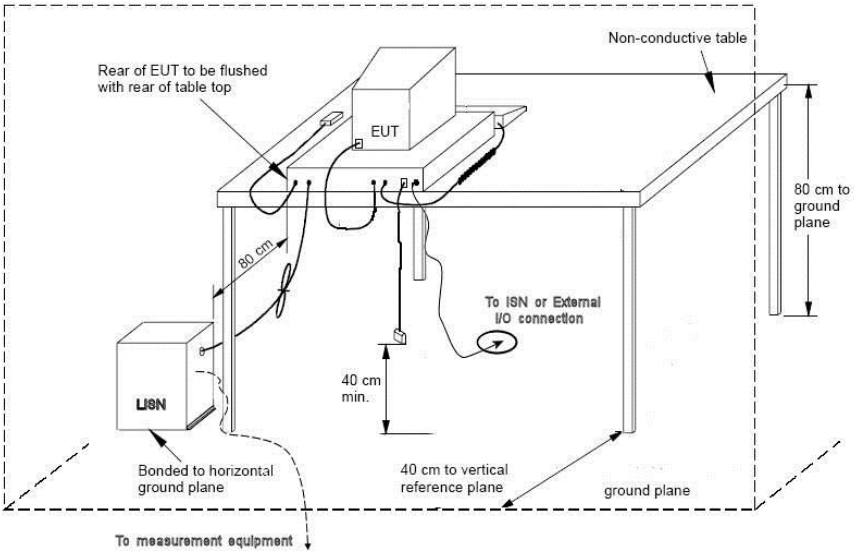
Limits For CLASS A Products

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

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

Based on ANSI C63.4 Section 4.2 and CISPR 32 Annex C.3, if the Peak or Quasi-Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Typical Setup Diagram



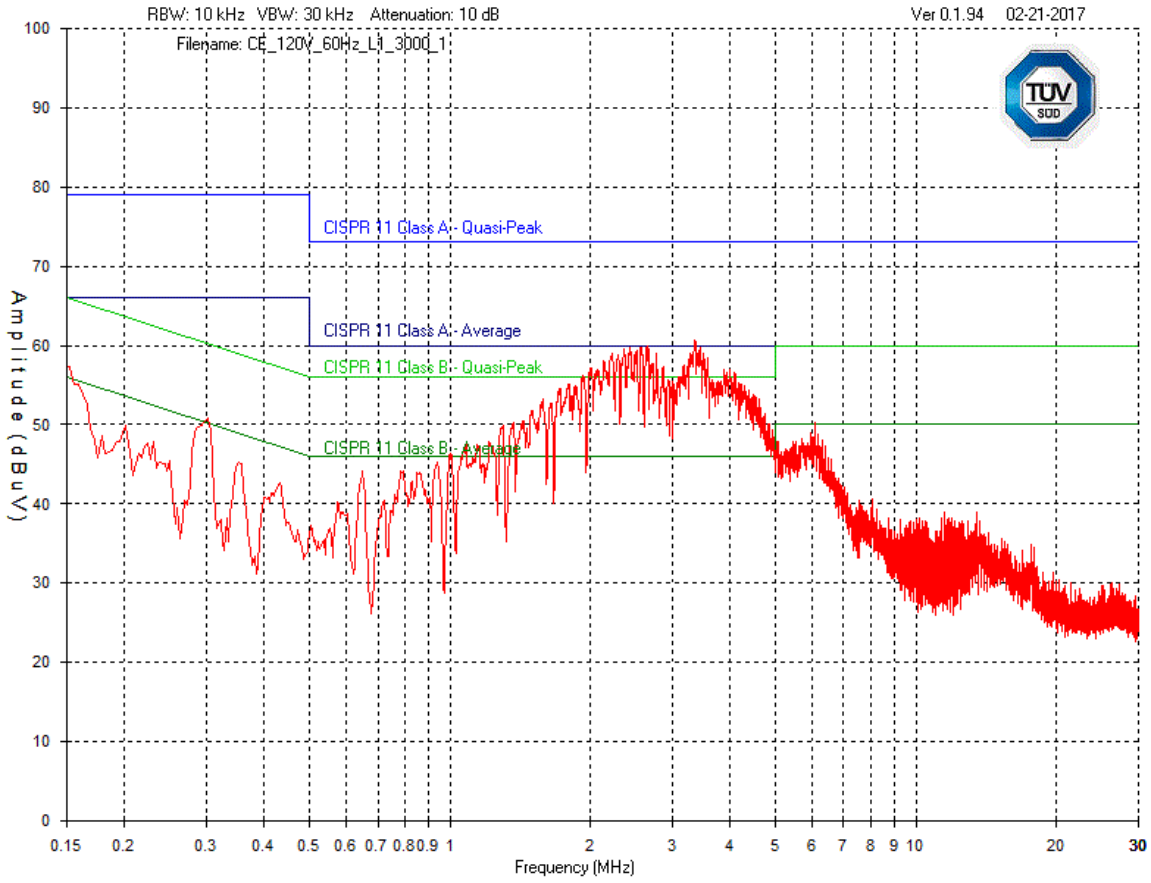
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.91dB with a 'k=2' coverage factor and a 95% confidence level.

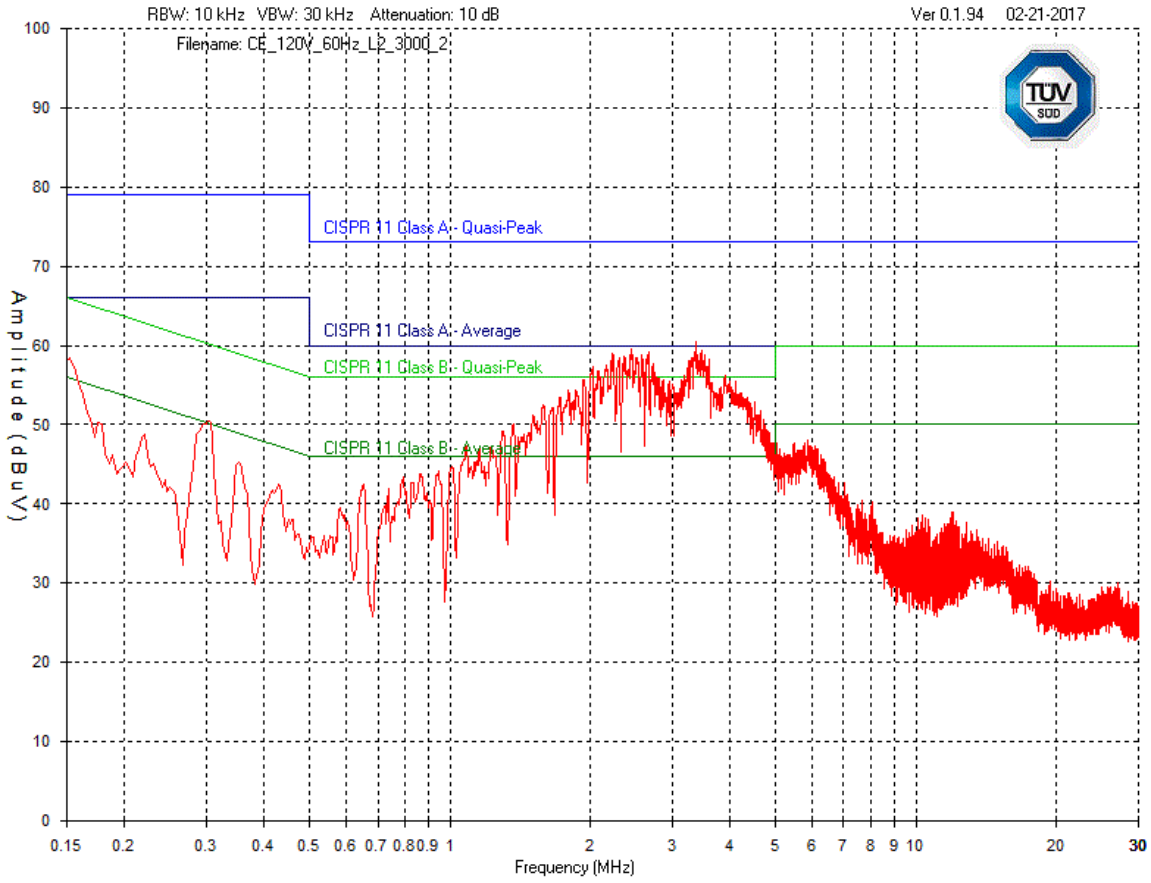
Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under *Final Measurements*.

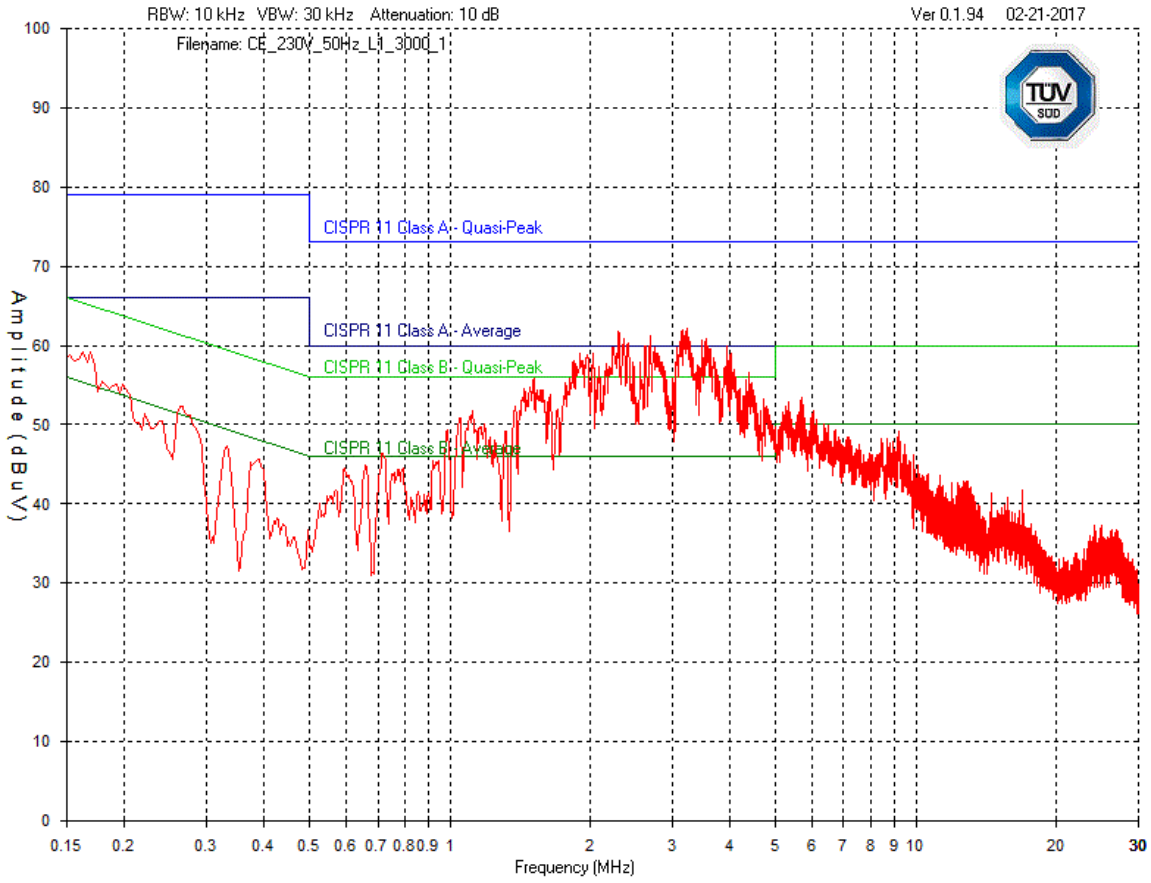
Vega 3000G
Phase Line (L1)
120Vac, 60Hz



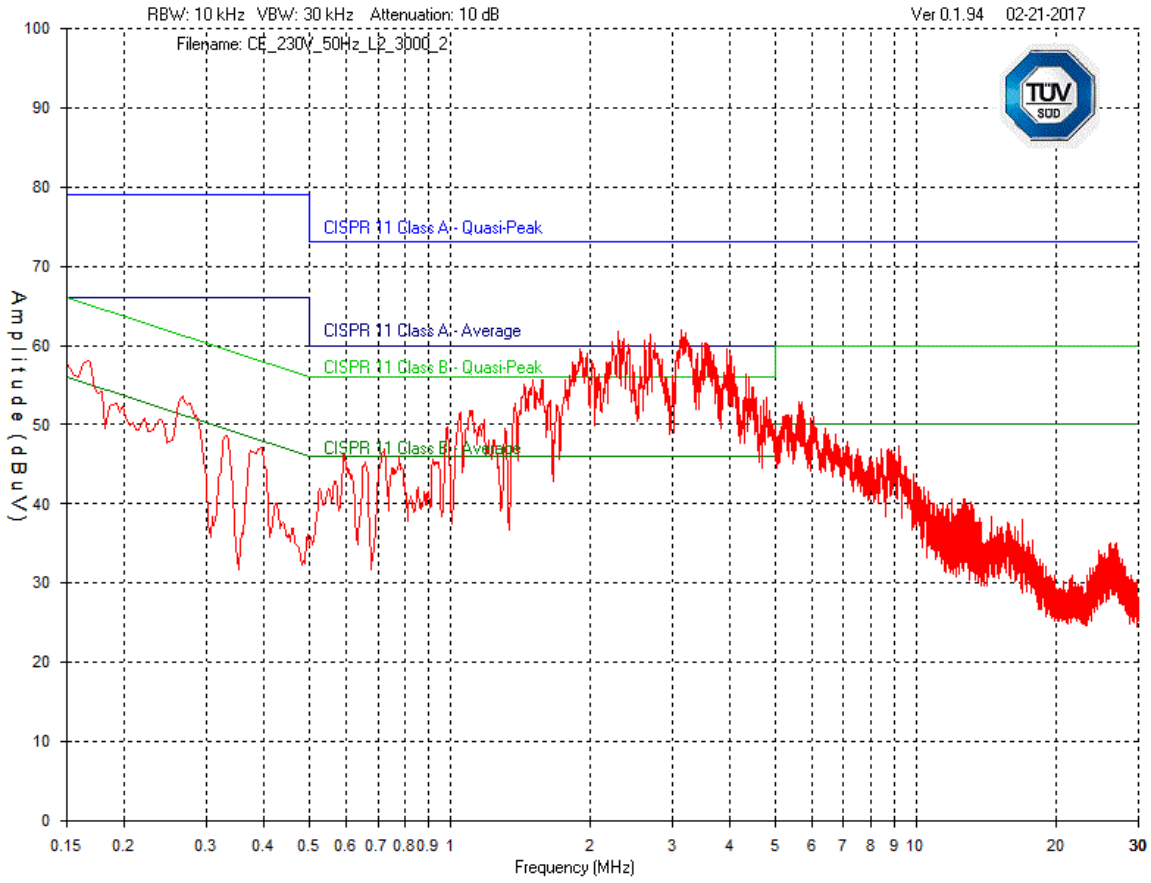
Vega 3000G
Neutral Line (L2)
120Vac, 60Hz



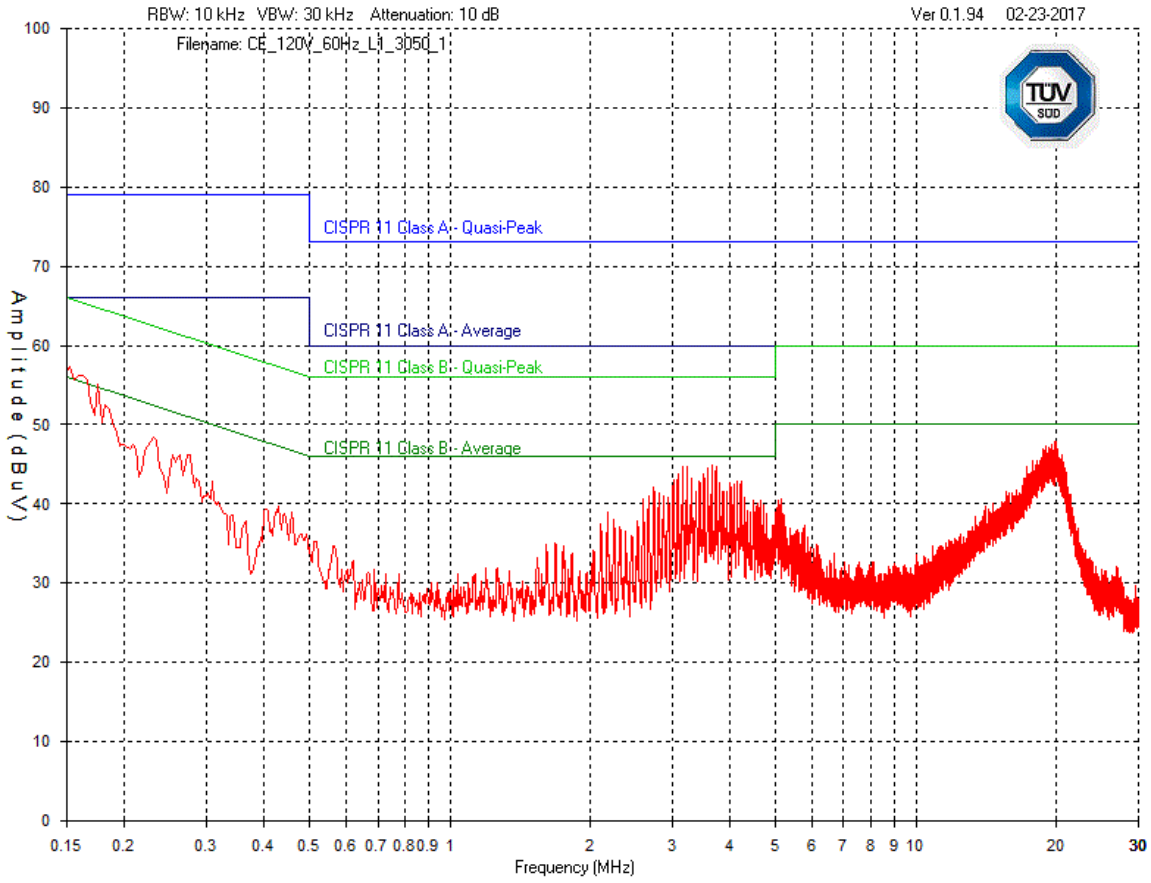
Vega 3000G
Phase Line (L1)
230Vac, 50Hz



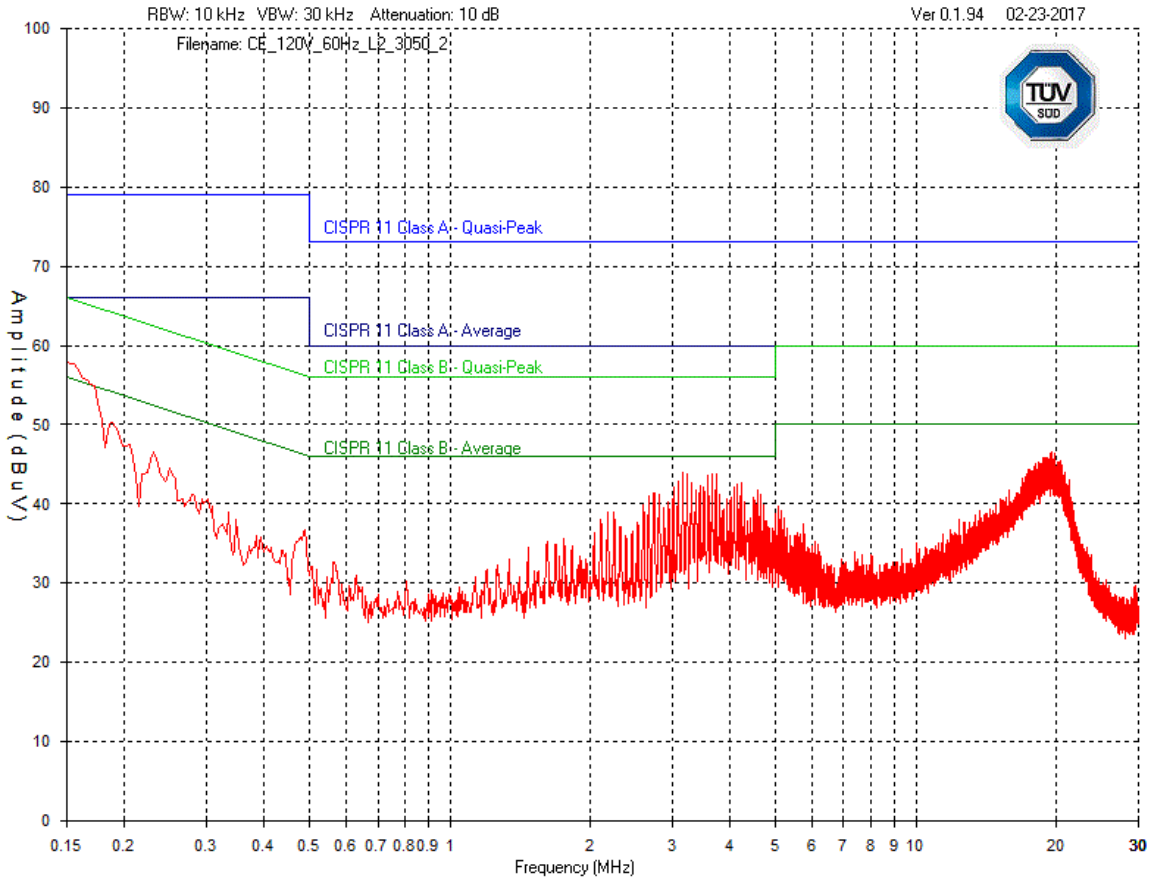
Vega 3000G
Neutral Line (L2)
230Vac, 50Hz



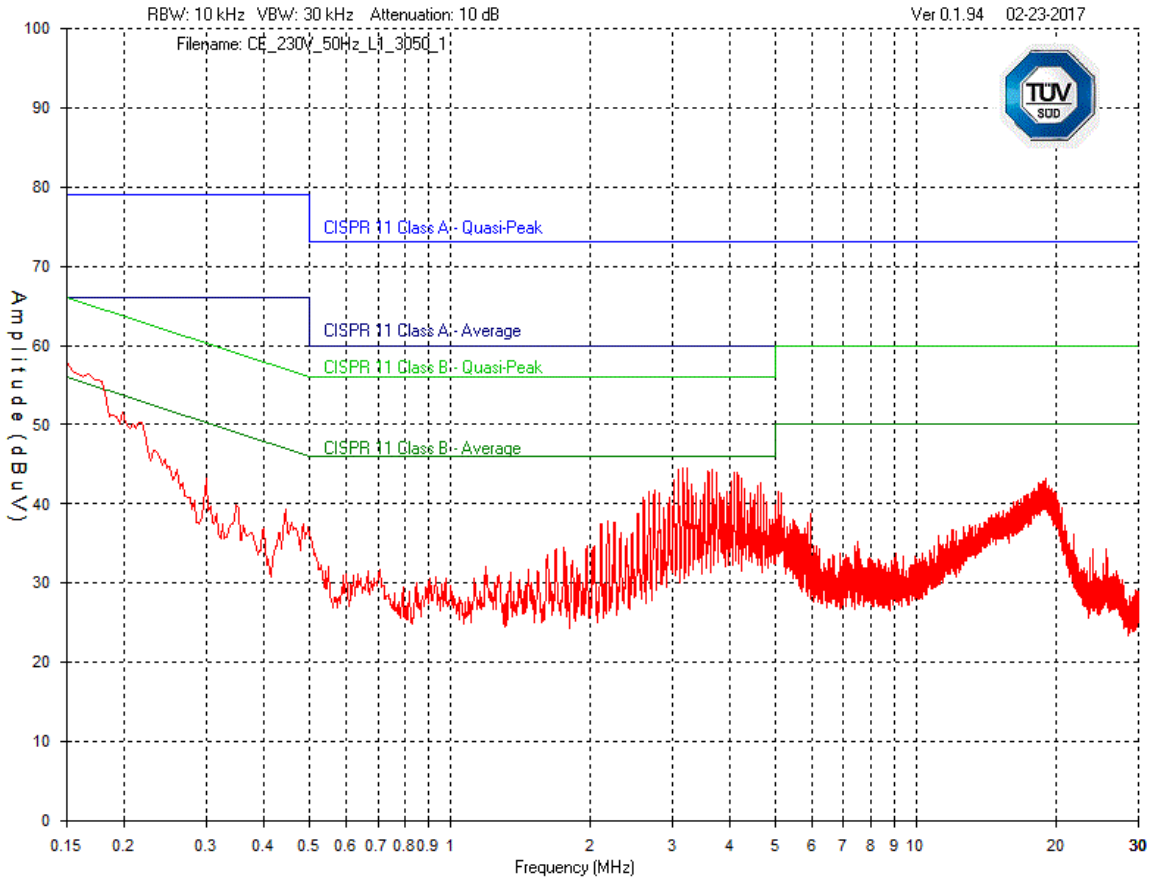
Vega 3050G
Phase Line (L1)
120Vac, 60Hz



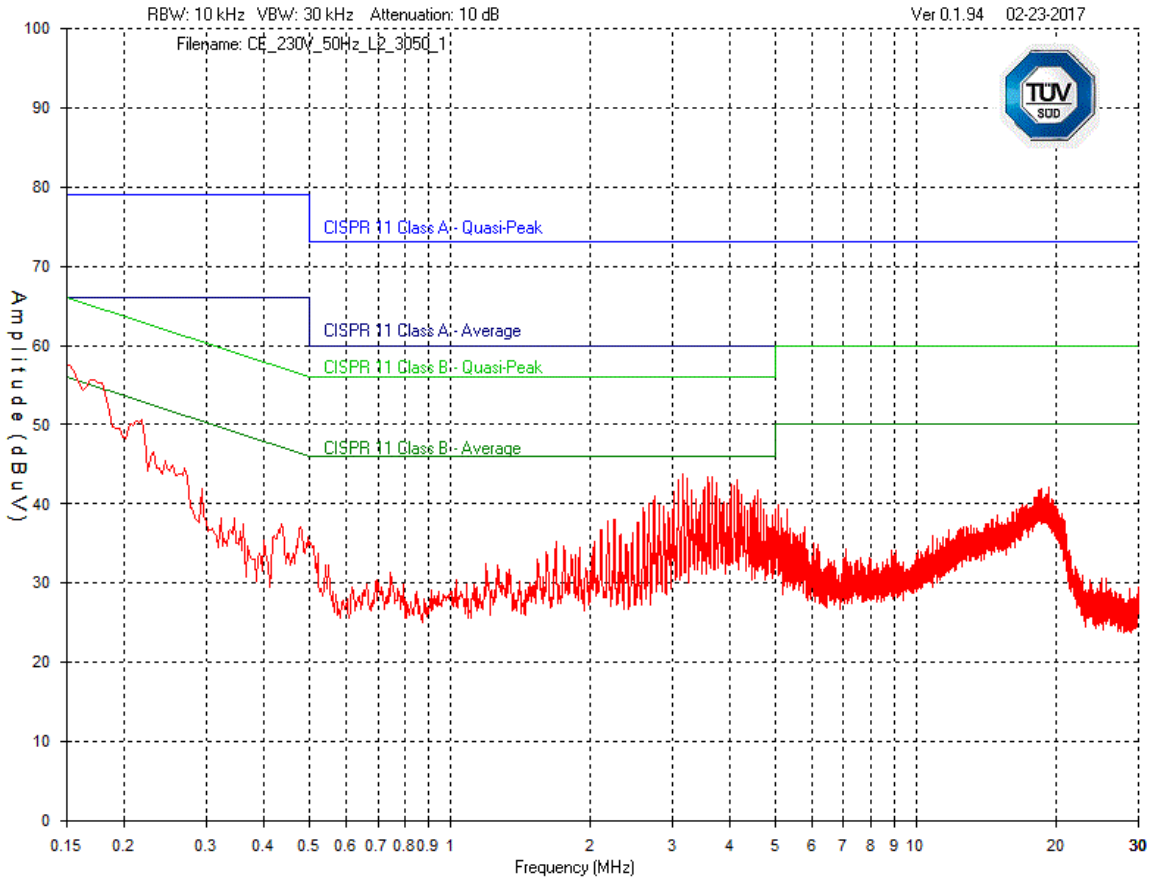
Vega 3050G
Neutral Line (L2)
120Vac, 60Hz



Vega 3050G
Phase Line (L1)
230Vac, 50Hz



Vega 3050G
Neutral Line (L2)
230Vac, 50Hz



Final Measurements

Vega 3000G
Emissions Table
120V, 60Hz

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											
3.36	Peak	50.5	10	0.1	0.1	60.7	73	---	12.3	---	Pass
3.36	Average	40.42	10	0.1	0.1	50.62	---	60	---	9.38	Pass
2.65	Peak	49.7	10	0.1	0.1	59.9	73	---	13.1	---	Pass
2.65	Average	43.64	10	0.1	0.1	53.84	---	60	---	6.16	Pass
2.44	Peak	49.6	10	0.1	0.1	59.8	73	---	13.2	---	Pass
2.44	Average	43.43	10	0.1	0.1	53.63	---	60	---	6.37	Pass
2.57	Peak	49.5	10	0.1	0.1	59.7	73	---	13.3	---	Pass
2.57	Average	42.87	10	0.1	0.1	53.07	---	60	---	6.93	Pass
2.23	Peak	48.8	10	0.1	0.1	59	73	60	14	1	Pass
2.78	Peak	48.8	10	0.1	0.1	59	73	60	14	1	Pass
Neutral Line											
3.37	Peak	50.4	10	0.1	0.1	60.6	73	---	12.4	---	Pass
3.37	Average	41.96	10	0.1	0.1	52.16	---	60	---	7.84	Pass
2.45	Peak	49.4	10	0.1	0.1	59.6	73	---	13.4	---	Pass
2.45	Average	43.75	10	0.1	0.1	53.95	---	60	---	6.05	Pass
2.67	Peak	48.9	10	0.1	0.1	59.1	73	60	13.9	0.9	Pass
2.24	Peak	48.7	10	0.1	0.1	58.9	73	60	14.1	1.1	Pass
2.58	Peak	48.7	10	0.1	0.1	58.9	73	60	14.1	1.1	Pass
2.31	Peak	48.3	10	0.1	0.1	58.5	73	60	14.5	1.5	Pass

Vega 3000G
Emissions Table
230V, 50Hz

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											
3.22	Peak	52	10	0.1	0.1	62.2	73	---	10.8	---	Pass
3.22	Average	48.56	10	0.1	0.1	58.76	---	60	---	1.24	Pass
2.30	Peak	51.5	10	0.1	0.1	61.7	73	---	11.3	---	Pass
2.30	Average	47.95	10	0.1	0.1	58.15	---	60	14.85	1.85	Pass
2.70	Peak	51.1	10	0.1	0.1	61.3	73	---	11.7	---	Pass
2.70	Average	47.59	10	0.1	0.1	57.79	---	60	---	2.21	Pass
3.55	Peak	50.7	10	0.1	0.1	60.9	73	---	12.1	---	Pass
3.55	Average	47.52	10	0.1	0.1	57.72	---	60	---	2.28	Pass
3.94	Peak	49.8	10	0.1	0.1	60	73	---	13	---	Pass
3.94	Average	44.69	10	0.1	0.1	54.89	---	60	---	5.11	Pass
1.90	Peak	48.8	10	0.1	0.1	59	73	---	14	---	Pass
1.90	Average	45.82	10	0.1	0.1	56.02	---	60	---	3.98	Pass
Neutral Line											
3.14	Peak	51.7	10	0.1	0.1	61.9	73	---	11.1	---	Pass
3.14	Average	46.84	10	0.1	0.1	57.04	---	60	---	2.96	Pass
2.29	Peak	51.5	10	0.1	0.1	61.7	73	---	11.3	---	Pass
2.29	Average	48.68	10	0.1	0.1	58.88	---	60	---	1.12	Pass
2.70	Peak	51.3	10	0.1	0.1	61.5	73	---	11.5	---	Pass
2.70	Average	46.45	10	0.1	0.1	56.65	---	60	---	3.35	Pass
3.48	Peak	50.1	10	0.1	0.1	60.3	73	---	12.7	---	Pass
3.48	Average	46.2	10	0.1	0.1	56.4	---	60	---	3.6	Pass
1.91	Peak	49.4	10	0.1	0.1	59.6	73	---	13.4	---	Pass
1.91	Average	45.75	10	0.1	0.1	55.95	---	60	---	4.05	Pass
3.93	Peak	49.3	10	0.1	0.1	59.5	73	---	13.5	---	Pass
3.93	Average	44.44	10	0.1	0.1	54.64	---	60	---	5.36	Pass

Vega 3050G
Emissions Table
120V, 60Hz

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	47.1	10	0	0.2	57.3	79	66	21.7	8.7	Pass
19.8	Peak	37.7	10	0.1	0.1	47.9	73	60	25.1	12.1	Pass
3.65	Peak	34.8	10	0.1	0.1	45	73	60	28	15	Pass
3.16	Peak	34.5	10	0.1	0.1	44.7	73	60	28.3	15.3	Pass
3.23	Peak	34.5	10	0.1	0.1	44.7	73	60	28.3	15.3	Pass
3.73	Peak	34.5	10	0.1	0.1	44.7	73	60	28.3	15.3	Pass
Neutral Line											
0.153	Peak	47.5	10	0	0.2	57.7	79	66	21.3	8.3	Pass
19.5	Peak	36.4	10	0.1	0.1	46.6	73	60	26.4	13.4	Pass
3.16	Peak	33.9	10	0.1	0.1	44.1	73	60	28.9	15.9	Pass
3.23	Peak	33.7	10	0.1	0.1	43.9	73	60	29.1	16.1	Pass
3.66	Peak	33.6	10	0.1	0.1	43.8	73	60	29.2	16.2	Pass
3.73	Peak	33.6	10	0.1	0.1	43.8	73	60	29.2	16.2	Pass

Vega 3050G
Emissions Table
230V, 50Hz

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	47.2	10	0	0.2	57.4	79	66	21.6	8.6	Pass
3.17	Peak	34.4	10	0.1	0.1	44.6	73	60	28.4	15.4	Pass
3.24	Peak	34.3	10	0.1	0.1	44.5	73	60	28.5	15.5	Pass
3.66	Peak	34.2	10	0.1	0.1	44.4	73	60	28.6	15.6	Pass
3.10	Peak	34.2	10	0.1	0.1	44.4	73	60	28.6	15.6	Pass
3.59	Peak	33.9	10	0.1	0.1	44.1	73	60	28.9	15.9	Pass
Neutral Line											
0.153	Peak	47.2	10	0	0.2	57.4	79	66	21.6	8.6	Pass
3.16	Peak	33.7	10	0.1	0.1	43.9	73	60	29.1	16.1	Pass
3.66	Peak	33.3	10	0.1	0.1	43.5	73	60	29.5	16.5	Pass
3.59	Peak	33.2	10	0.1	0.1	43.4	73	60	29.6	16.6	Pass
3.24	Peak	33	10	0.1	0.1	43.2	73	60	29.8	16.8	Pass
4.15	Peak	32.9	10	0.1	0.1	43.1	73	60	29.9	16.9	Pass

Notes:

Peak = Peak measurement
Average = Average measurement

See 'Appendix B – EUT, Peripherals and Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Nov. 25, 2015	Nov. 25, 2017	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 1, 2017	Feb. 1, 2019	GEMC 65
RF Cable 7m	LMR-400-7M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	612-10-1	Meca Electronics, Inc	NCR	NCR	GEMC 223
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

CISPR32-FCC_PLCE_Rev1

Asymmetric Mode 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 and measured from a Telecom LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio, 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 limits and method are as defined in CISPR 32 and EN55032:

Limits For CLASS A Products

Frequency Range	Voltage Limits dBµV		Current Limits dBµA	
	Quasi-Peak	Average	Quasi-Peak	Average
150 kHz – 500 kHz	97 to 87*	84 to 74*	53 to 43*	40 to 30*
500 kHz – 30 MHz	87	74	43	30

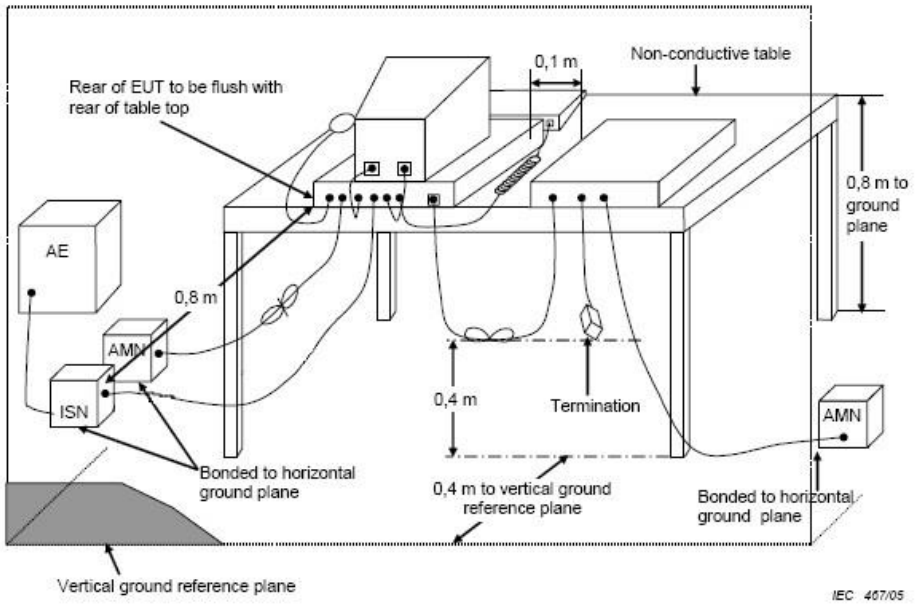
*Decreases linearly with the logarithm of the frequency.

The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode impedance of 150Ω to the telecommunication port under test.

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

Based on CISPR 32 Annex C.3, if the Peak or Quasi-Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements. Current measurements are not required as this measurement is performed with a T-LISN offering 150Ω impedance (offering a worst case for screened cables).

Typical Setup Diagram



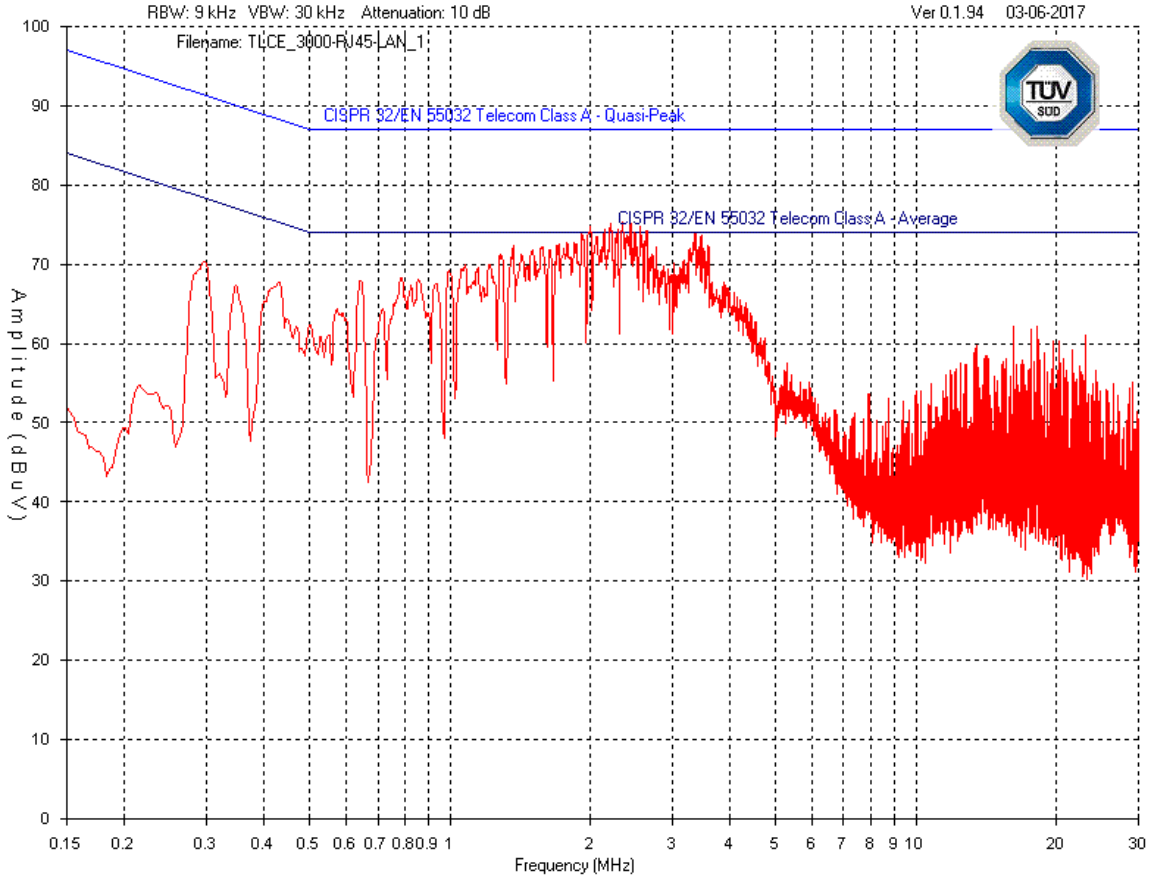
Measurement Uncertainty

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.

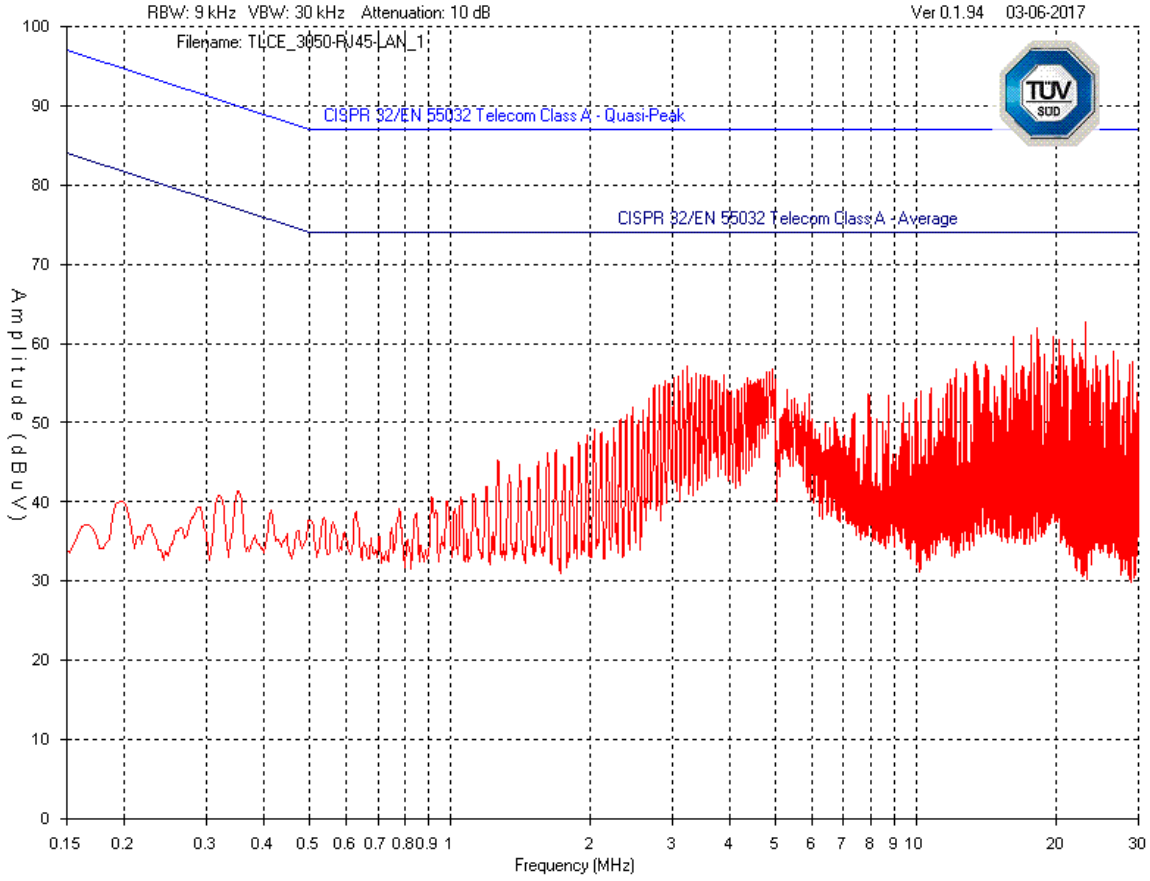
Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under *Final Measurements*.

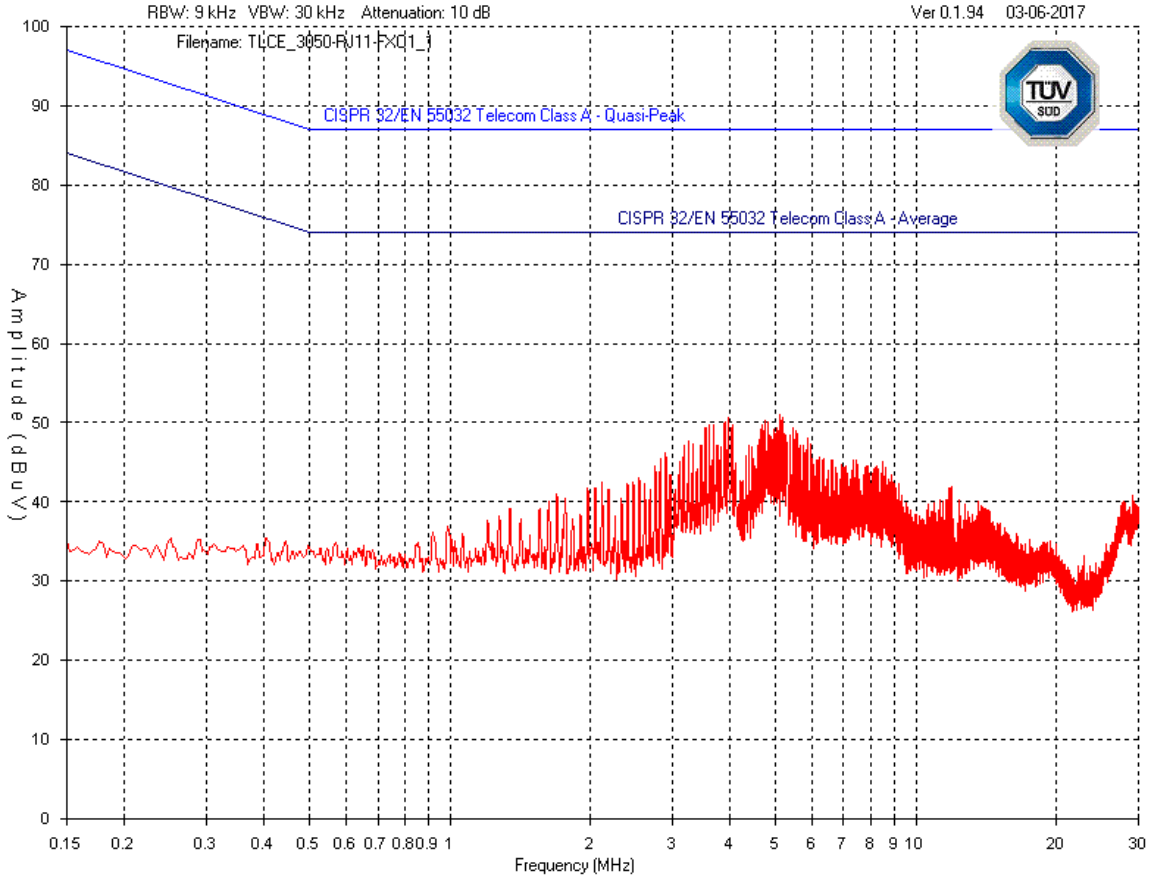
Vega 3000G
Telecom Line LAN



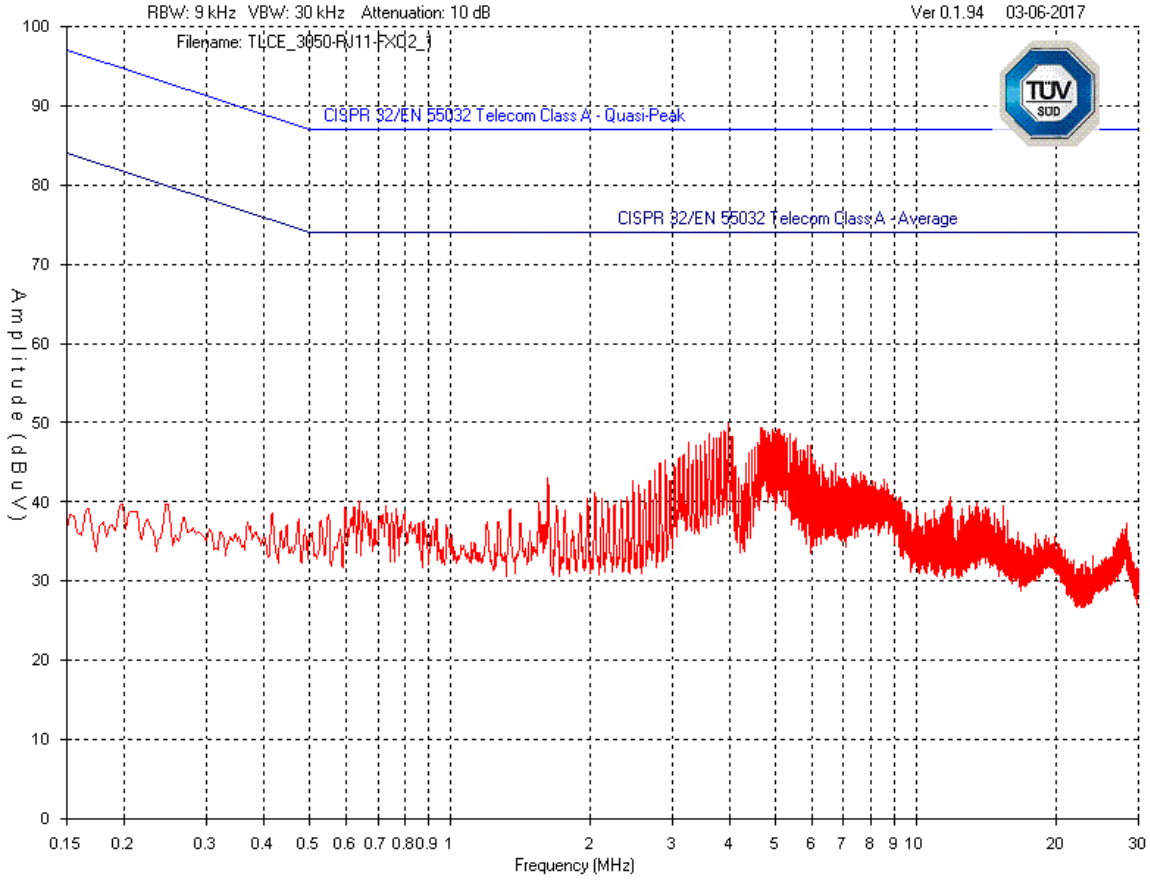
Vega 3050G
Telecom Line LAN



Vega 3050G
Telecom Line FXO1



Vega 3050G
Telecom Line FXO2



Final Measurements

Vega 3000G
Emissions Table
Telecom Line LAN

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	T-LISN Factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
2.44	Peak	55	10	0.1	10.2	75.3	87	---	11.7	---	Pass
2.44	Average	51.24	10	0.1	10.2	71.54	---	74	---	2.46	Pass
2.21	Peak	54.7	10	0.1	10.2	75	87	---	12	---	Pass
2.21	Average	51.15	10	0.1	10.2	71.45	---	74	---	2.55	Pass
2.56	Peak	54.4	10	0.1	10.2	74.7	87	---	12.3	---	Pass
2.56	Average	50.35	10	0.1	10.2	70.65	---	74	---	3.35	Pass
2.00	Peak	54.4	10	0.1	10.2	74.7	87	---	12.3	---	Pass
2.00	Average	50.3	10	0.1	10.2	70.6	---	74	---	3.4	Pass
2.30	Peak	54	10	0.1	10.2	74.3	87	---	12.7	---	Pass
2.30	Average	50.07	10	0.1	10.2	70.37	---	74	---	3.63	Pass
2.64	Peak	53.9	10	0.1	10.2	74.2	87	---	12.8	---	Pass
2.64	Average	49.64	10	0.1	10.2	69.94	---	74	---	4.06	Pass
3.37	Peak	53.6	10	0.1	10.2	73.9	87	---	13.1	---	Pass
3.37	Average	49.58	10	0.1	10.2	69.88	---	74	---	4.12	Pass
1.92	Peak	53.4	10	0.1	10.2	73.7	87	---	13.3	---	Pass
1.92	Average	48.98	10	0.1	10.2	69.28	---	74	---	4.72	Pass
3.48	Peak	53.3	10	0.1	10.2	73.6	87	---	13.4	---	Pass
3.48	Average	48.83	10	0.1	10.2	69.13	---	74	---	4.87	Pass

Vega 3050G
Emissions Table
Telecom Line LAN

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	T-LISN Factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
23.1	Peak	42	10	0.1	10.5	62.6	87	74	24.4	11.4	Pass
18.2	Peak	41.4	10	0.1	10.5	62	87	74	25	12	Pass
17.7	Peak	40.6	10	0.1	10.5	61.2	87	74	25.8	12.8	Pass
19.7	Peak	40.2	10	0.1	10.5	60.8	87	74	26.2	13.2	Pass
16.2	Peak	40.3	10	0.1	10.4	60.8	87	74	26.2	13.2	Pass
21.7	Peak	39.9	10	0.1	10.5	60.5	87	74	26.5	13.5	Pass

Vega 3050G
Emissions Table
Telecom Line FXO1

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	T-LISN Factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
5.09	Peak	30.7	10	0.1	10.3	51.1	87	74	35.9	22.9	Pass
3.96	Peak	30.3	10	0.1	10.3	50.7	87	74	36.3	23.3	Pass
5.16	Peak	30.2	10	0.1	10.3	50.6	87	74	36.4	23.4	Pass
4.74	Peak	29.9	10	0.1	10.3	50.3	87	74	36.7	23.7	Pass
4.81	Peak	29.7	10	0.1	10.3	50.1	87	74	36.9	23.9	Pass
3.89	Peak	29.7	10	0.1	10.3	50.1	87	74	36.9	23.9	Pass

Vega 3050G
Emissions Table
Telecom Line FXO2

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	T-LISN Factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
3.96	Peak	29.6	10	0.1	10.3	50	87	74	37	24	Pass
4.66	Peak	29.1	10	0.1	10.3	49.5	87	74	37.5	24.5	Pass
5.09	Peak	28.9	10	0.1	10.3	49.3	87	74	37.7	24.7	Pass
4.94	Peak	28.8	10	0.1	10.3	49.2	87	74	37.8	24.8	Pass
5.02	Peak	28.7	10	0.1	10.3	49.1	87	74	37.9	24.9	Pass
4.73	Peak	28.6	10	0.1	10.3	49	87	74	38	25	Pass

Notes:

Peak = Peak measurement
Average = Average measurement

See 'Appendix B – EUT, Peripherals, and Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Nov. 25, 2015	Nov. 25, 2017	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 1, 2017	Feb. 1, 2019	GEMC 65
TLISN	ISN T8	Com-Power Corporation	Jan. 30, 2017	Jan. 30, 2019	GEMC 251
RF Cable 7m	LMR-400-7M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	612-10-1	Meca Electronics, Inc	NCR	NCR	GEMC 223
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

C32_AMCE_Rev1

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 and 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.

Limits & Method

The limits and method are as defined in ANSI C63.4 and CISPR 32, EN55032, 47 CFR FCC Part 15 Section 15.109(g), and ICES-003 Issue 6 Section 6.2:

Limits For CLASS A Products

CISPR 32 / EN 55032 Limits 30 MHz – 1 GHz

Frequency Range[a]	Quasi-Peak Limits - 10m[b]	Quasi-Peak Limits - 3m[b]
30 MHz – 230 MHz	40 dBµV/m	50 dBµV/m
230 MHz – 1 GHz	47 dBµV/m	57 dBµV/m

FCC Part 15, Subpart B / ICES-003 Limits 30 MHz – 1 GHz

Frequency Range[a]	Quasi-Peak Limits - 10m[b]	Quasi-Peak Limits - 3m[b]
30 MHz – 88 MHz	39.1 dBµV/m	49.5 dBµV/m
88 MHz – 216 MHz	43.5 dBµV/m	54 dBµV/m
216 MHz – 960 GHz	46.4 dBµV/m	57 dBµV/m
960 MHz – 1 GHz	49.5 dBµV/m	60 dBµV/m

CISPR 32 / EN 55032 Limits > 1 GHz

Frequency Range[a]	Average Limit - 3m[c]	Peak Limit - 3m[d]
1 GHz – 3 GHz	56 dBµV/m	76 dBµV/m
3 GHz – 6 GHz	60 dBµV/m	80 dBµV/m

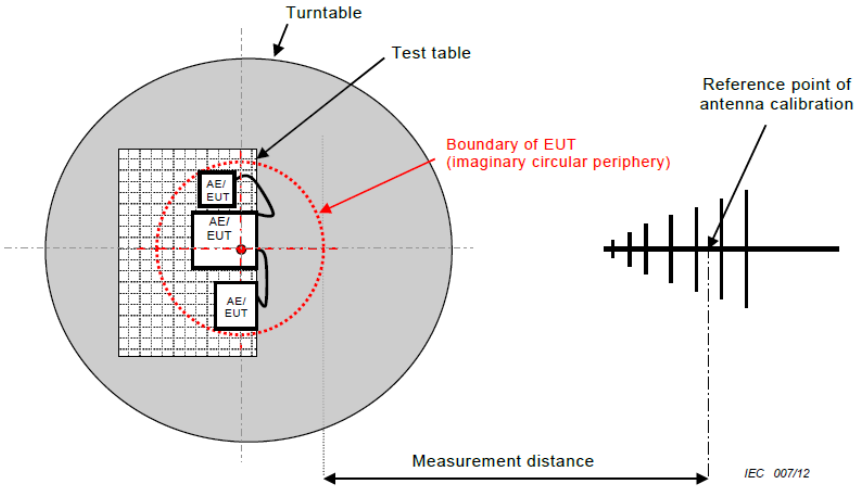
FCC Part 15 Subpart B / ICES-003 Limits > 1 GHz

Frequency Range[a]	Average Limit - 3m[c]	Peak Limit - 3m[d]
1 GHz and Up	60 dBµV/m	80 dBµV/m

[a]The frequency range scanned is in accordance to CISPR 32 Table 1 and FCC Part 15 Section 15.33(b).
[b]Limit is with a resolution bandwidth of 120 kHz, a video bandwidth at least three times greater than the resolution bandwidth, and using a Quasi-Peak detector.
[c]Limit is with a resolution bandwidth of 1 MHz and using an Average detector.
[d]Limit is with a resolution bandwidth of 1 MHz, a video bandwidth at least three times greater than the resolution bandwidth, and using a Peak detector.

Based on ANSI C63.4 Section 4.2 and CISPR 32 Annex C.3, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

Typical Radiated Emissions Setup



Note: In accordance with CISPR 32 Annex C, testing was performed at a 3 meter test distance.

Measurement Uncertainty

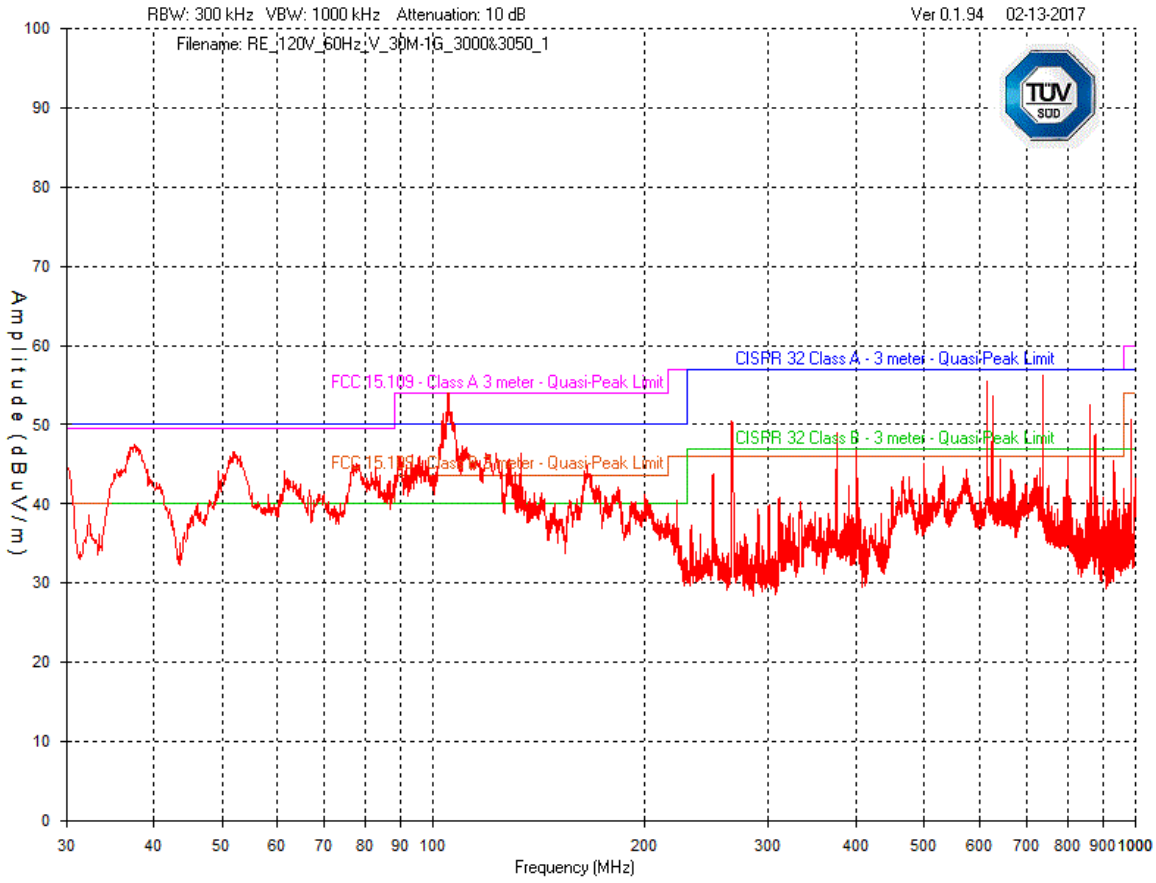
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.25dB for 30MHz – 1GHz and ±4.93dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

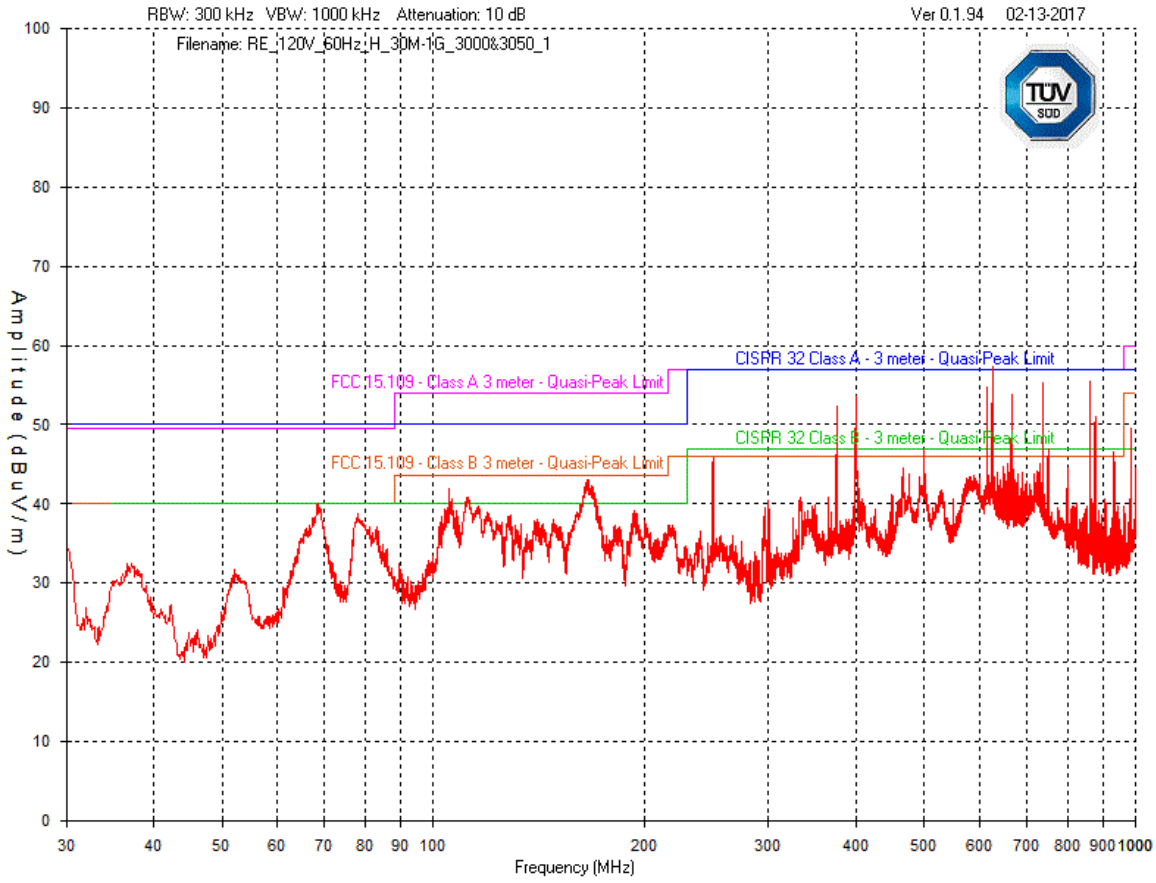
The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under *Final Measurements*.

In accordance with FCC Part 15, Subpart A, Section 15.33 and CISPR 32 Table 1, the EUT was scanned to a minimum of a 1 GHz. For devices containing clocks higher than 108 MHz, they were scanned above 1 GHz to meet the requirements of FCC Part 15 Section 15.33 and CISPR 32.

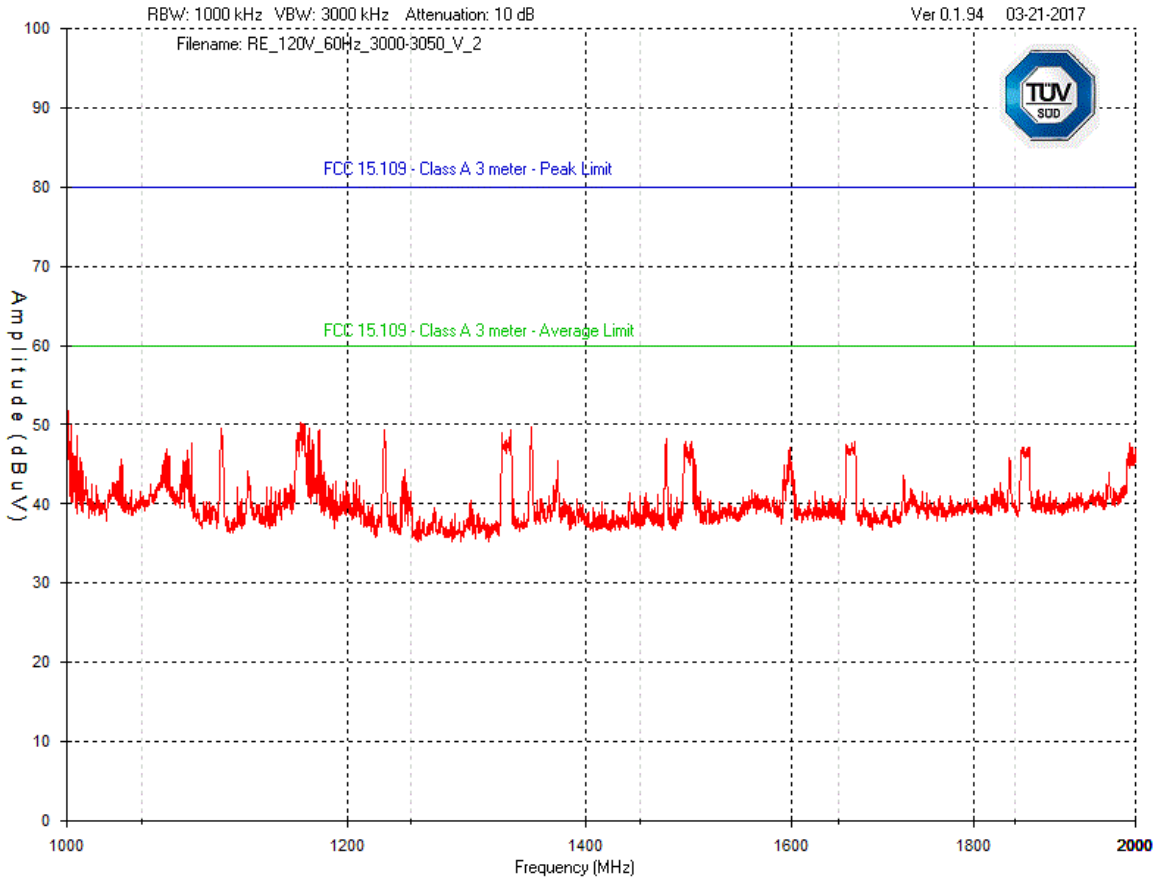
Vega 3000G & Vega 3050G
30 MHz – 1 GHz
Peak Emissions Graph
Vertical Antenna Polarity
120Vac, 60Hz



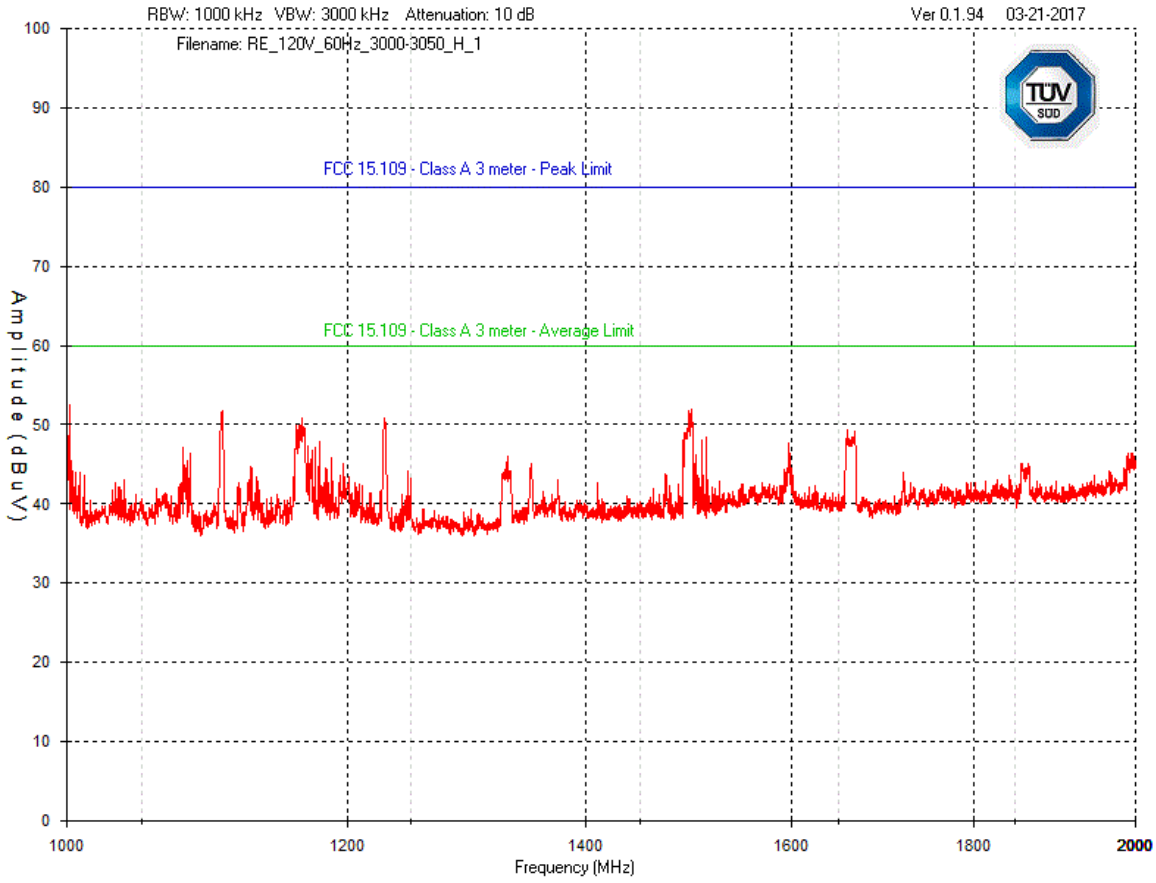
Vega 3000G & Vega 3050G
30 MHz – 1 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
120Vac, 60Hz



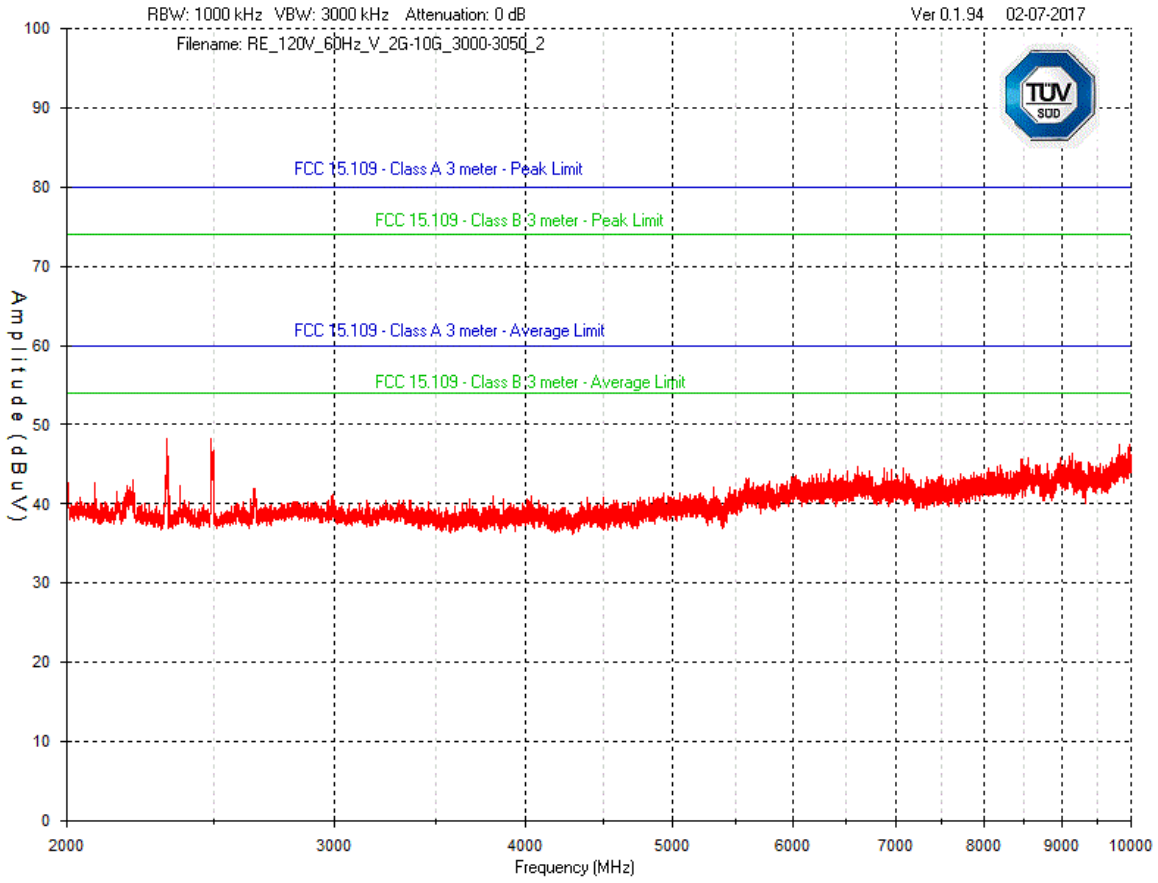
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Peak Emissions Graph
Vertical Antenna Polarity
120Vac, 60Hz



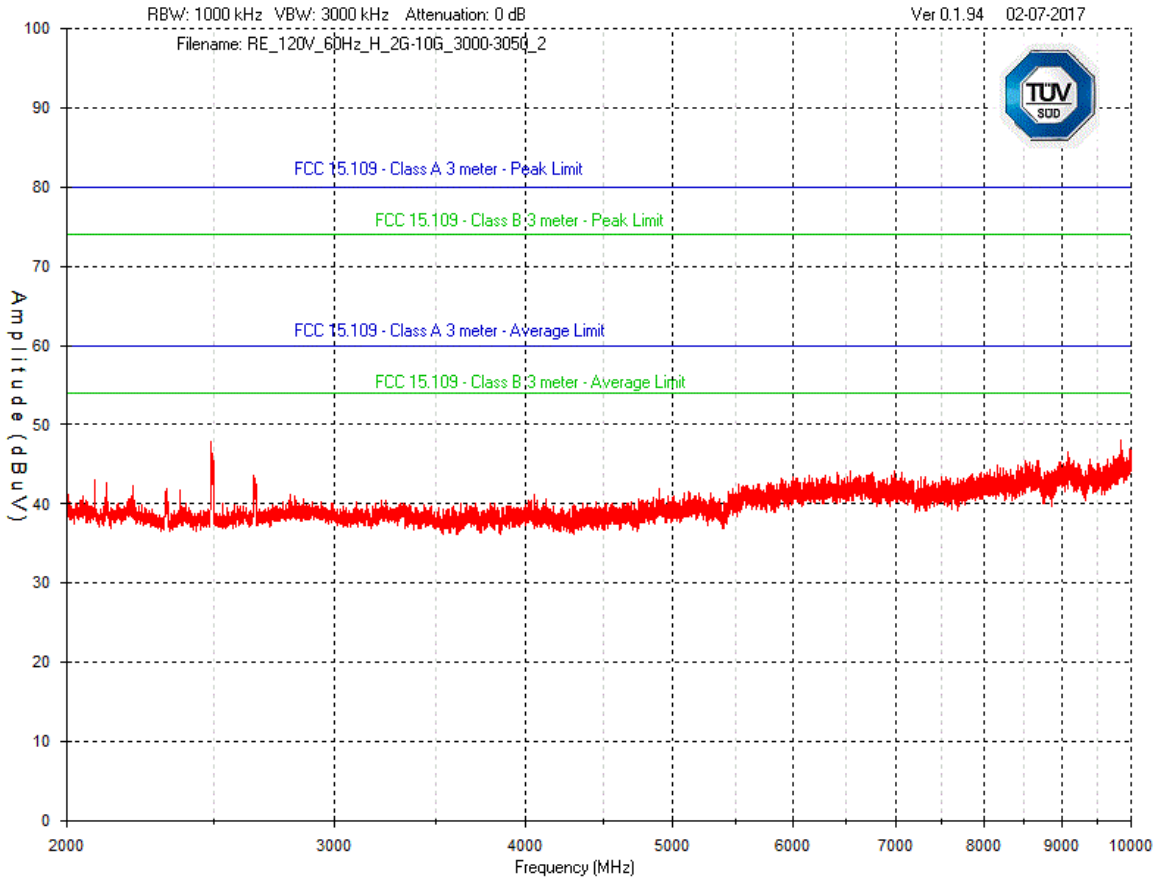
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
120Vac, 60Hz



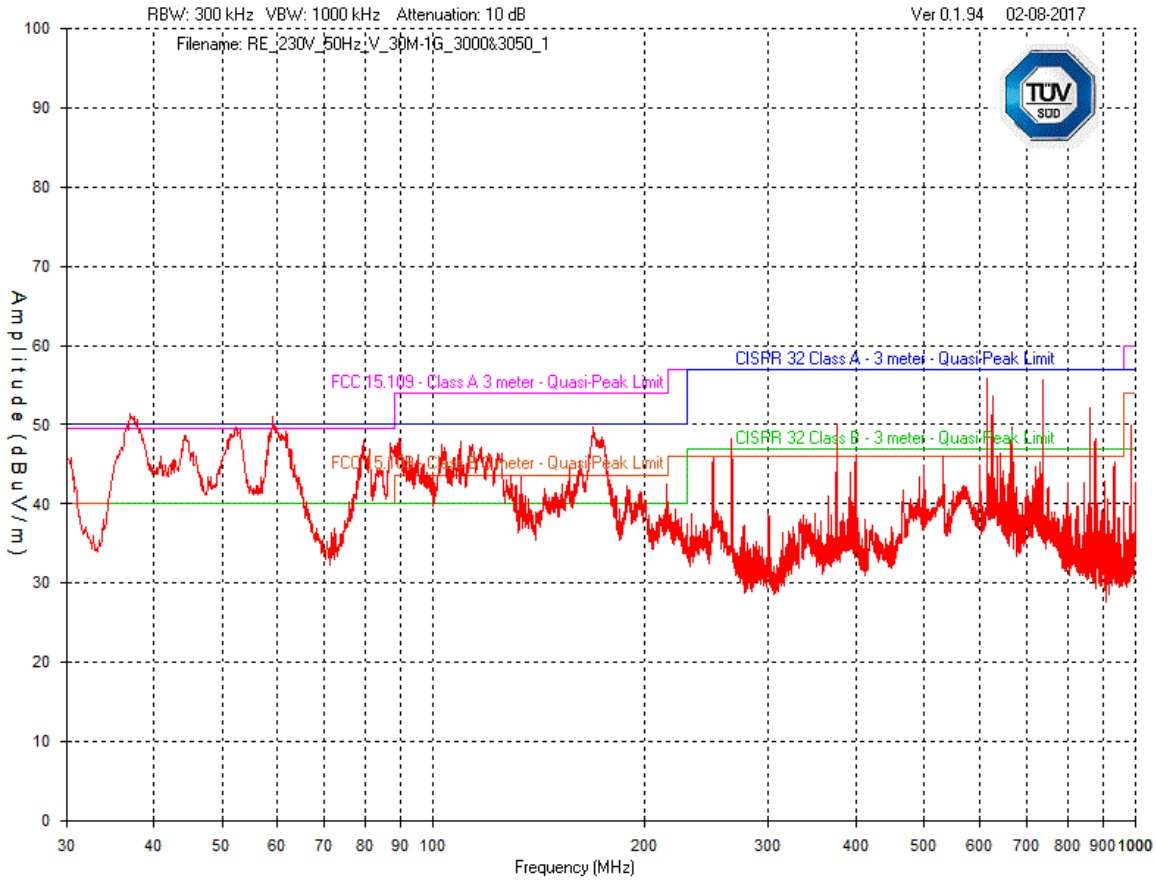
Vega 3000G & Vega 3050G
2 GHz – 10 GHz
Peak Emissions Graph
Vertical Antenna Polarity
120Vac, 60Hz



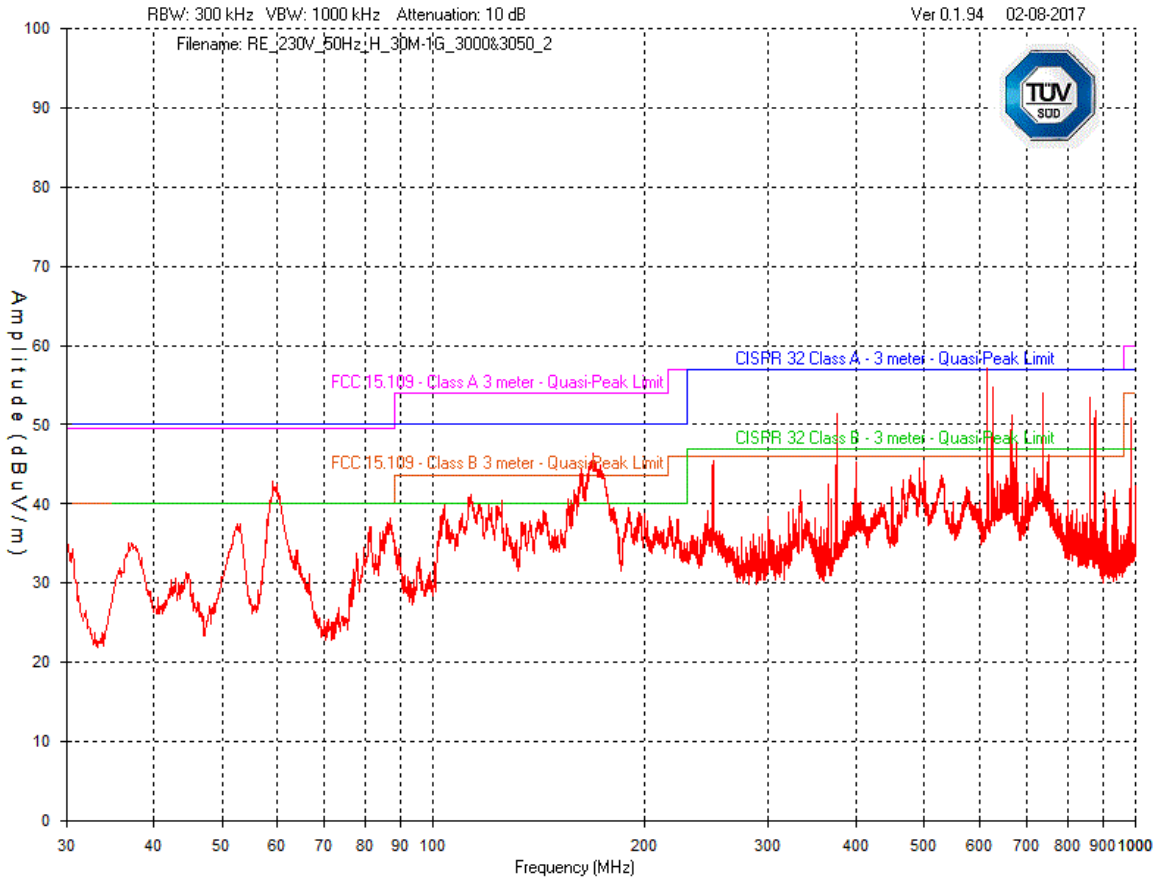
Vega 3000G & Vega 3050G
2 GHz – 10 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
120Vac, 60Hz



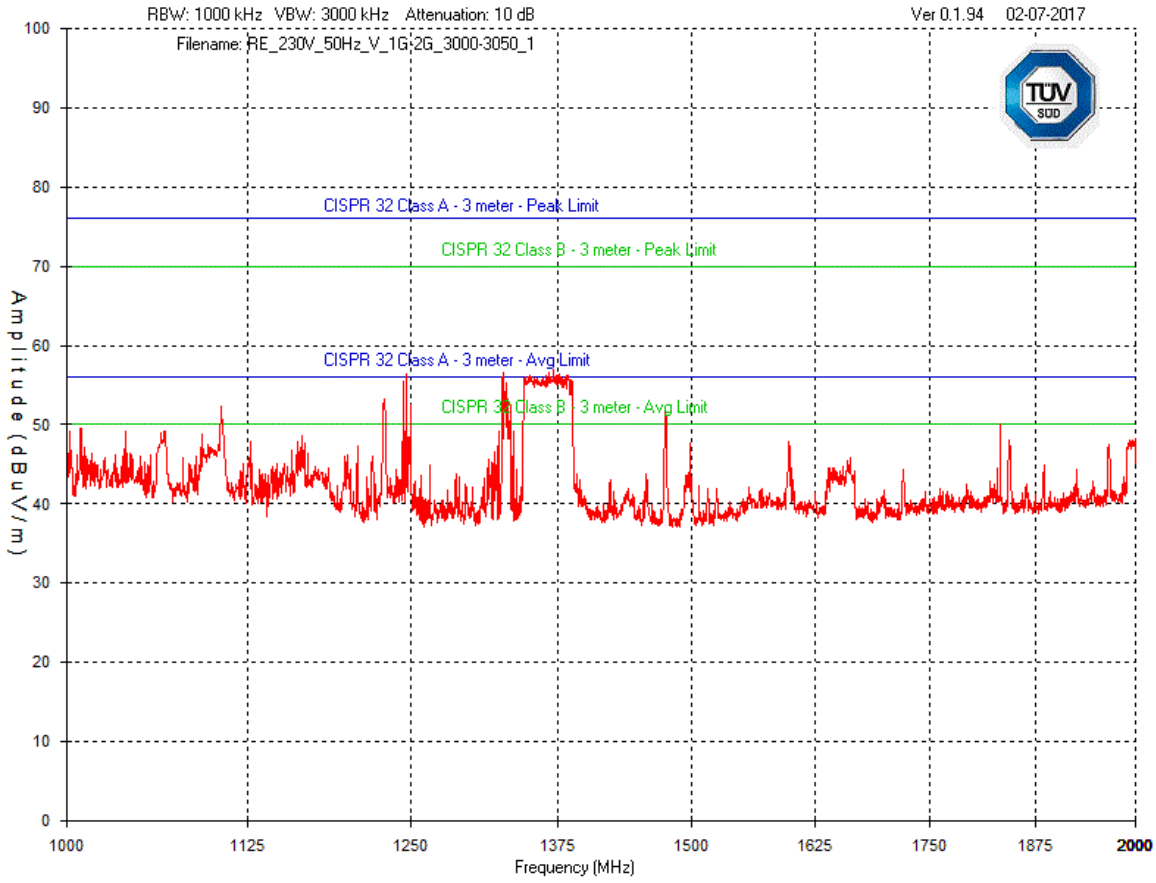
Vega 3000G & Vega 3050G
30 MHz – 1 GHz
Peak Emissions Graph
Vertical Antenna Polarity
230Vac, 50Hz



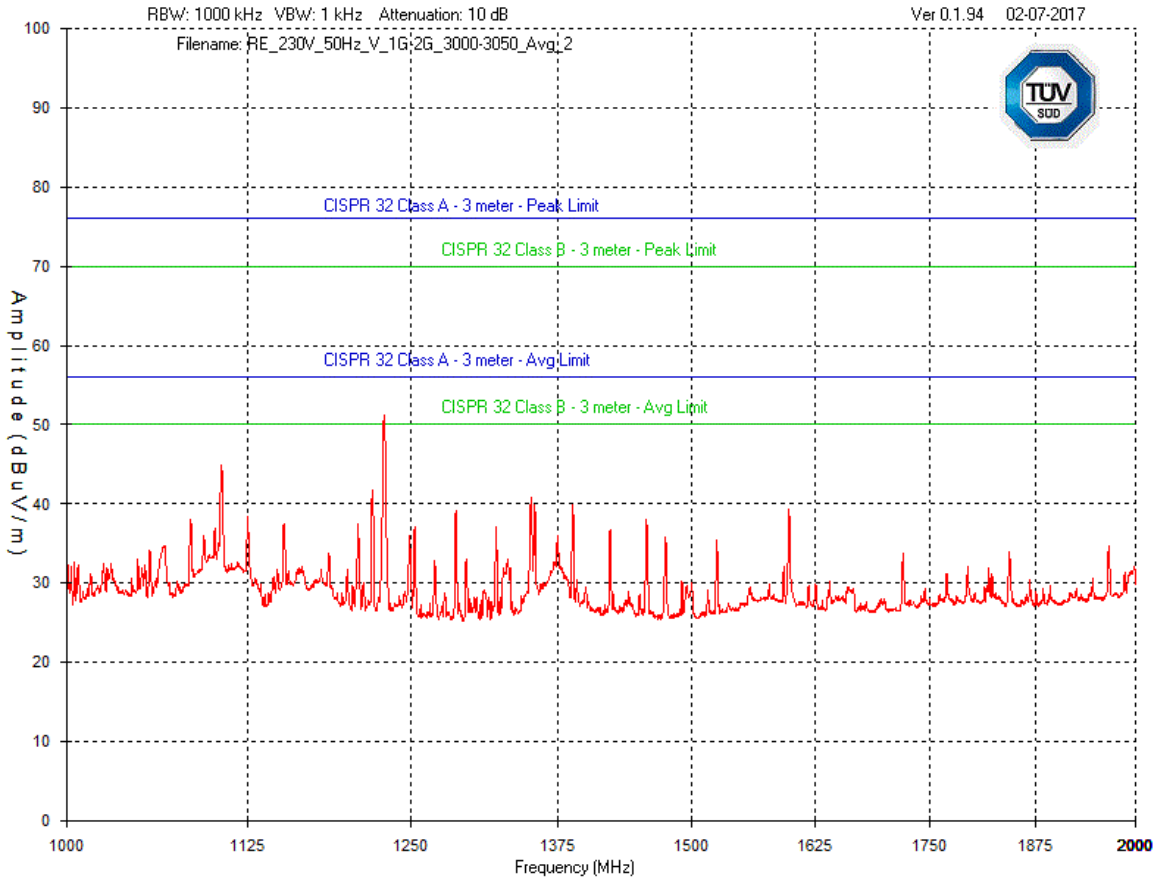
Vega 3000G & Vega 3050G
30 MHz – 1 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
230Vac, 50Hz



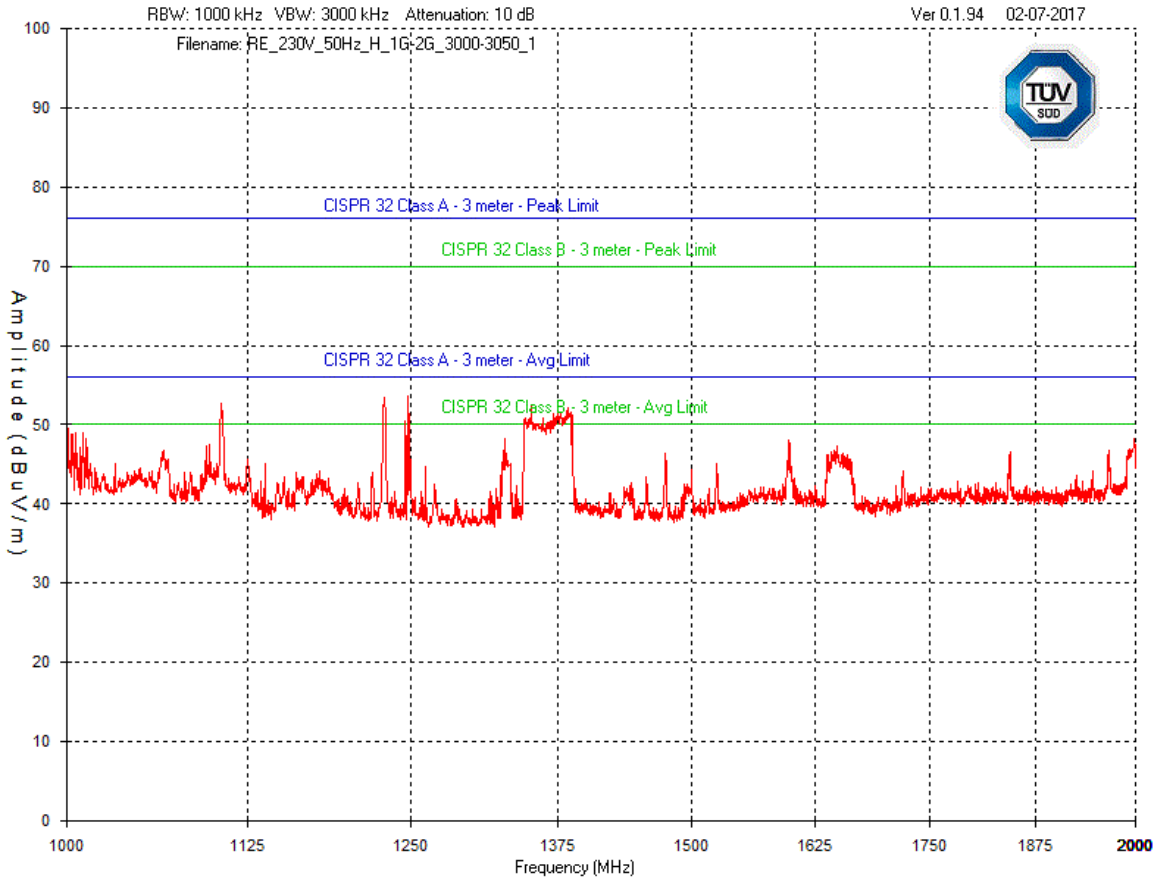
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Peak Emissions Graph
Vertical Antenna Polarity
230Vac, 50Hz



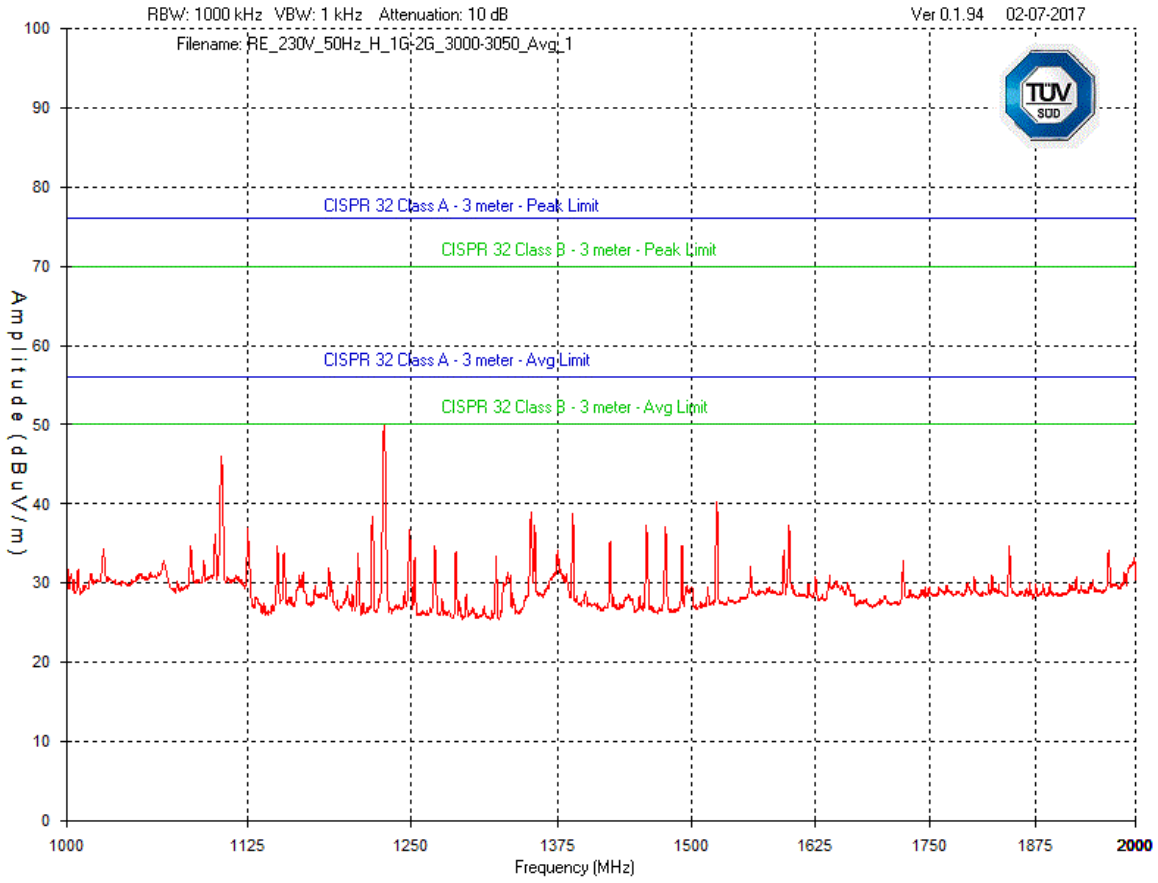
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Average Emissions Graph
Vertical Antenna Polarity
230Vac, 50Hz



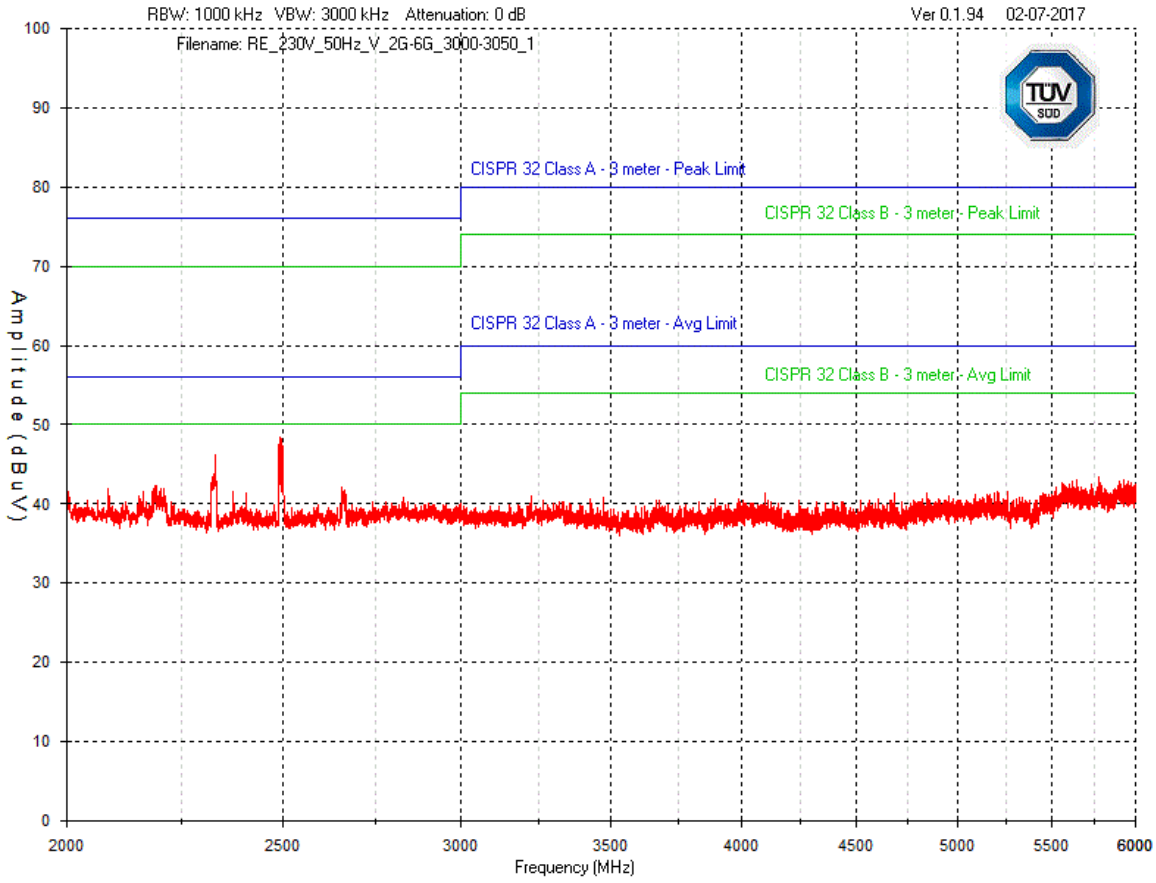
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
230Vac, 50Hz



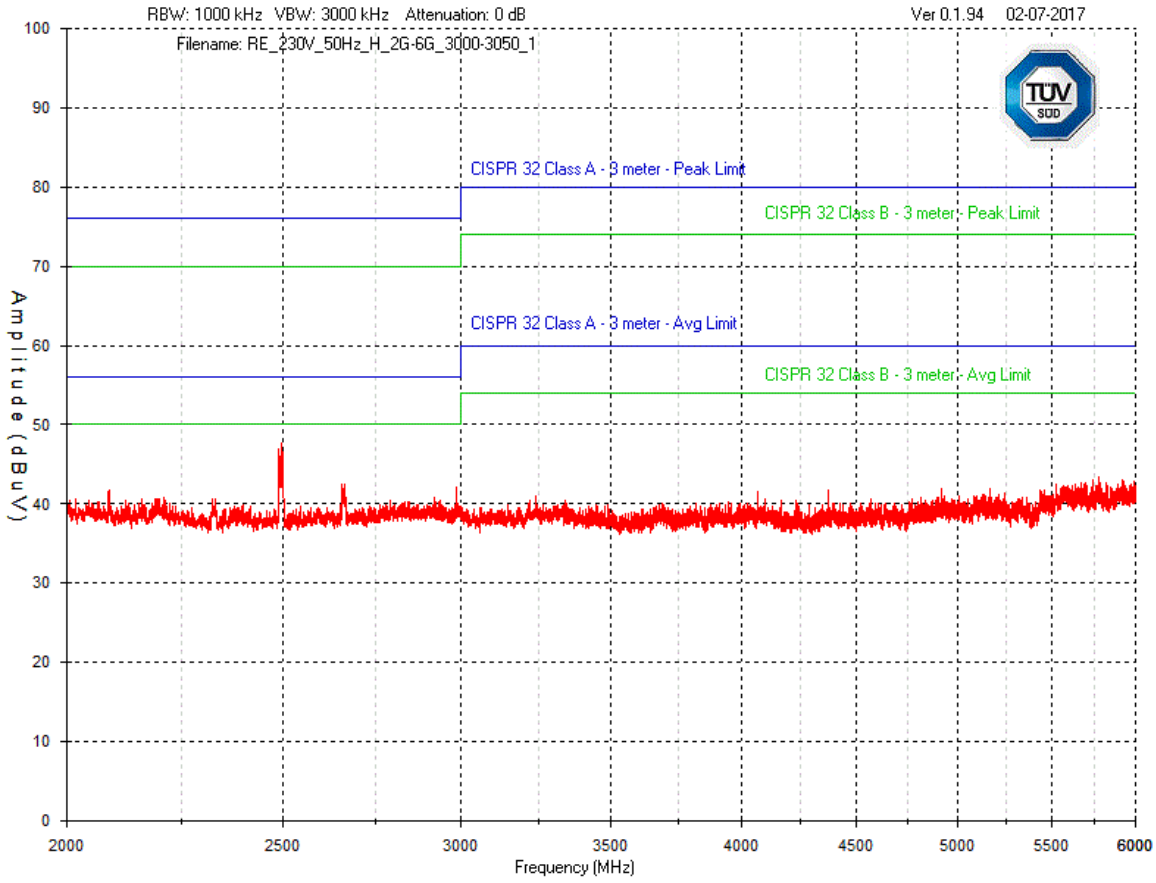
Vega 3000G & Vega 3050G
1 GHz – 2 GHz
Average Emissions Graph
Horizontal Antenna Polarity
230Vac, 50Hz



Vega 3000G & Vega 3050G
2 GHz – 6 GHz
Peak Emissions Graph
Vertical Antenna Polarity
230Vac, 50Hz



Vega 3000G & Vega 3050G
2 GHz – 6 GHz
Peak Emissions Graph
Horizontal Antenna Polarity
230Vac, 50Hz



Final Measurements

The worst case measurement (QP) as listed in the table below appeared at a horizontal antenna height of 100 cm and a table azimuth of 90 degrees, at 120V, 60Hz, and a horizontal antenna height of 100 cm, table azimuth of 141 degrees, at 230V, 50Hz.

Vega 3000G & Vega 3050G
Emissions Table
120V, 60Hz

Frequency (MHz)	Detector Peak/ QP	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	QP Limit (dB)	QP Margin (dB)	Pass/ Fail
Vertical Antenna Polarization									
105.4	QP	64.1	9.3	0.8	-34.6	39.6	54	14.4	Pass
737.3	QP	62.92	21.4	2.3	-32	54.62	56.9	2.28	Pass
614.4	QP	64.58	20	2	-33.7	52.88	56.9	4.02	Pass
37.5	Peak	69.5	12	0.5	-34.5	47.5	49.6	2.1	Pass
52.0	Peak	73	7.7	0.5	-34.5	46.7	49.6	2.9	Pass
624.9	Peak	65.2	19.9	2	-33.5	53.6	56.9	3.3	Pass
Horizontal Antenna Polarization									
625.1	QP	63.86	21.2	2.1	-33.5	53.66	56.9	3.24	Pass
860.2	Peak	60.8	22.8	2.5	-30.6	55.5	56.9	1.4	Pass
737.2	Peak	62.9	22	2.3	-32	55.2	56.9	1.7	Pass
614.3	Peak	65.6	20.8	2	-33.7	54.7	56.9	2.2	Pass
667.4	Peak	63.4	21.4	2.2	-33.1	53.9	56.9	3	Pass
400.5	Peak	69.8	17.2	1.6	-34.9	53.7	56.9	3.2	Pass

Vega 3000G & Vega 3050G
Emissions Table
230V, 50Hz

Frequency (MHz)	Detector Peak/ QP	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	QP Limit (dB)	QP Margin (dB)	Pass/ Fail
Vertical Antenna Polarization									
37.1	QP	59.38	11.9	0.5	-34.5	37.28	50	12.72	Pass
59.0	QP	61.61	8	0.6	-34.5	35.71	50	14.29	Pass
52.3	QP	64.82	7.8	0.5	-34.5	38.62	50	11.38	Pass
168.6	QP	67.27	10.3	0.9	-34.6	43.87	50	6.13	Pass
614.4	QP	64.9	20	2	-33.7	53.2	57	3.8	Pass
737.3	QP	61.51	21.4	2.3	-32	53.21	57	3.79	Pass
Horizontal Antenna Polarization									
614.4	QP	66.5	20.8	2	-33.7	55.6	57	1.4	Pass
625.0	Peak	65	21.2	2.1	-33.5	54.8	57	2.2	Pass
737.3	Peak	61.8	22	2.3	-32	54.1	57	2.9	Pass
860.2	Peak	58.7	22.8	2.5	-30.6	53.4	57	3.6	Pass
875.1	Peak	56.9	23	2.5	-30.5	51.9	57	5.1	Pass
375.0	Peak	68.7	15.9	1.6	-34.8	51.4	57	5.6	Pass

Notes:

Peak = Peak measurement
QP = Quasi-Peak measurement

See 'Appendix B – EUT, Peripherals, and Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 6, 2016	Jan. 6, 2018	GEMC 233
BiLog Antenna	3142-C	ETS	Oct. 5, 2016	Oct. 5, 2018	GEMC 8
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 12, 2016	Feb. 12, 2018	GEMC 6375
Pre-Amp 9 kHz – 1 GHz	CPA9231A	Chase	Oct 12, 2016	Oct 12, 2018	GEMC 6403
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Nov. 27, 2015	Nov. 27, 2017	GEMC 189
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 27
RF Cable 0.5m	LMR-400-0.5M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 31
Emissions Software	0.1.91	Global EMC	NCR	NCR	GEMC 58

CISPR32-FCC_RE-A_Rev1

Appendix A – EUT & Client Provided Details

Test setups for the Vega 3000G and Vega 3050G are similar.
A photo showing testing on one of them is shown as representative of both for each test.

General EUT Description

Client / Manufacturer Details	
Organization / Address	Sangoma Technologies 100 Renfrew Drive, suite 100
Contact	Bruno Fagundes
Phone	905 474 1990 x125
Email	bfagundes@sangoma.com
EUT (Equipment Under Test) Details	
EUT Name(s) / Model(s)	Vega 3000G Vega 3050G
Equipment category	Information Technology
EUT is powered using	Vega 3000G: Mean Well GST40A12 AC/DC adapter Vega 3050G: Mains inlet
Input voltage range(s) (V)	Vega 3000G: 12VDC Mean Well GST40A12 AC/DC adapter: 100-240 VAC Vega 3050G: 100-240 VAC
Frequency range(s) (Hz)	50-60 Hz
Rated input current (A)	Vega 3000G: 5 ADC Vega 3050G: 1-0.5 AAC
Nominal power consumption (W)	Vega 3000G: 20W Vega 3050G: 35W
Basic EUT functionality description	VOIP Gateway
Step by step instructions for setup and operation	*Monitoring via serial connection:* - Connect Amphenol cable - Connect Laptop to unit - USB to RJ45 blue cable - connect to console - Ethernet to LAN/Switch - Log into unit via CLI - Open Putty - Configure for Serial : 115200 baud CLI - user: admin pass: admin - Run certification script - CLI> shell /rw/cert start - Stop certification script - CLI> shell /rw/cert stop *Monitoring via Telnet connection:* - Determine the IP of Vega via console cable - Connect Console Cable - Run: Putty -> configure for COM Serial (115200,N,8,1) - Login: - User: admin

	- Pass: admin - Run command: - show banner - You will see the IP address - From Laptop run telnet - telnet <Vega IP address> - Login: - User: admin - Pass: admin - Certification script - shell /rw/cert start - shell /rw/cert stop
Frequency of all clocks present in EUT	25MHz, 8.192MHz, 2.048MHz, 8kHz, 32.768kHz, 666MHz (DDR3), 125MHz (Eth)
I/O cable description	The unit ships with 1 x shielded CAT5e cables, 2M, yellow booted for Ethernet port 1 x blue DB9 to RJ45 flat console cable, 6ft
Available connectors on EUT	Vega 3000G 1 x Amphenol RJ21 connector, 1 x eth port, 1 x serial console port, 1x DC 3.5mm jack Vega 3050G 2 x Amphenol RJ21 connector, 2x RJ11 connectors, 1 x eth port, 1 x serial console port, 1 x AC plug
Peripherals required to exercise EUT	laptop/computer with serial and/or Ethernert port
Dimensions of product	Vega 3000G: L 270mm x W 155mm x H 45mm Vega 3050G: L 440mm x W 250mm x H 45mm
Method of monitoring EUT and description of failure for immunity.	Status updates on laptop/computer screen.

EUT Functional Description

The EUT are VOIP analog gateway. Vega 3000G supports 24 port. Vega 3050G supports 50.

EUT Configuration

Please see *Appendix B* for a picture of the unit running in normal conditions.

- Cables and earthing were connected as per manufacturer's specification.
- Ground screw on EUT is connected to protective earth ground.
- The Vega 3000G is powered by an AC/DC adapter provided by the manufacturer, and is tested using this power supply. The Vega 3050G is powered using a mains cord set and mains inlet.
- See *Step by step instructions for setup and operation* in the *General EUT Description* chart to see operation of EUT during testing.

Operational Setup

Peripheral devices were attached to the EUT for its test operation. However, this report does not represent compliance of these peripheral device(s) in any way.

- PC with USB (for serial access) and/or Ethernet port.

Modifications for Compliance

The following modifications were made by the manufacturer during testing for the sample to achieve compliance with the testing requirements:

- None. EUT was tested as supplied by the manufacturer.

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Criteria Description

Performance Criterion A: During and after the test, the equipment shall continue to operate as intended as specified by the manufacturer.

Performance Criterion B: After the test, the equipment shall continue to operate as intended as specified by the manufacturer. During testing, temporary degradation, or loss of function or performance which is self-recovering is allowed.

Performance Criterion C: During testing, temporary degradation, or loss of function or performance which is self-recoverable or restorable by the operation of controls.

Appendix B – EUT, Peripherals, and Test Setup Photos

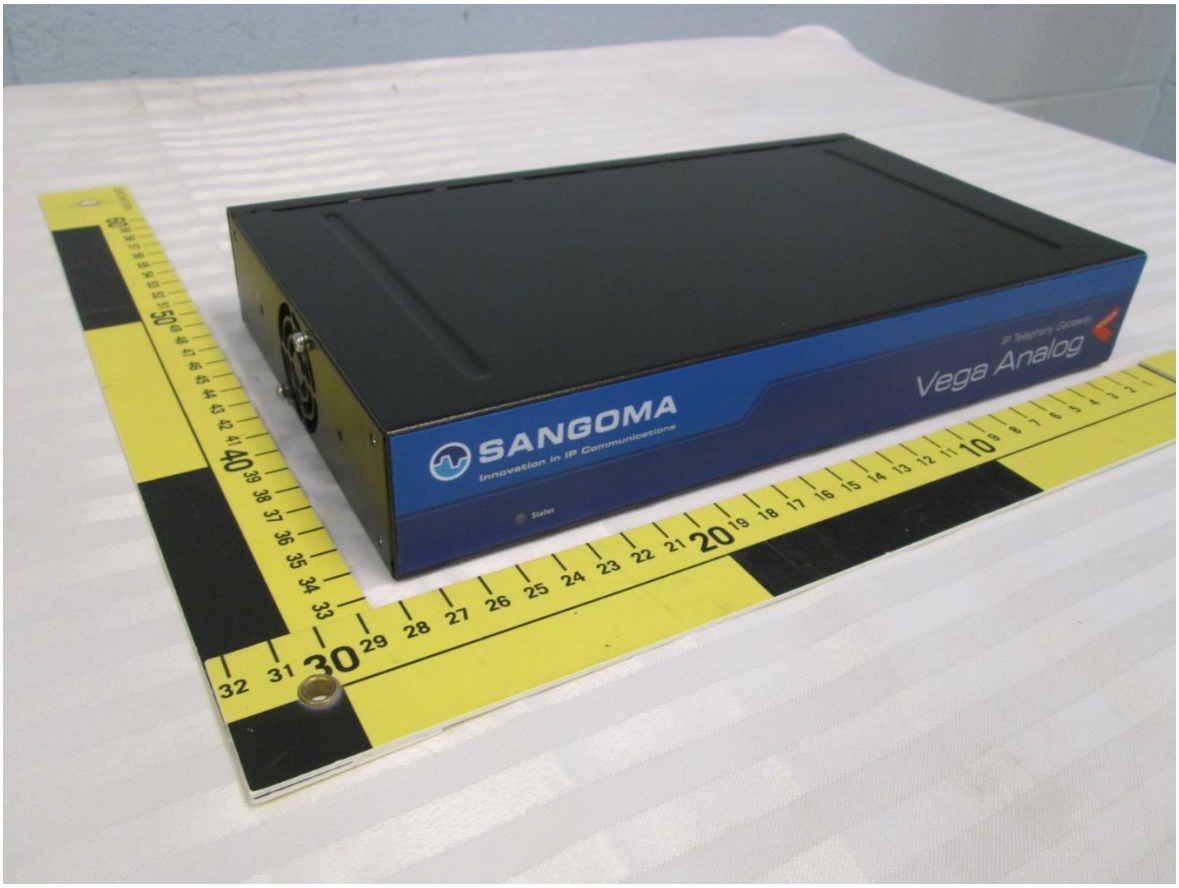

Figure 1 – EUT, Vega 3000G, View 1

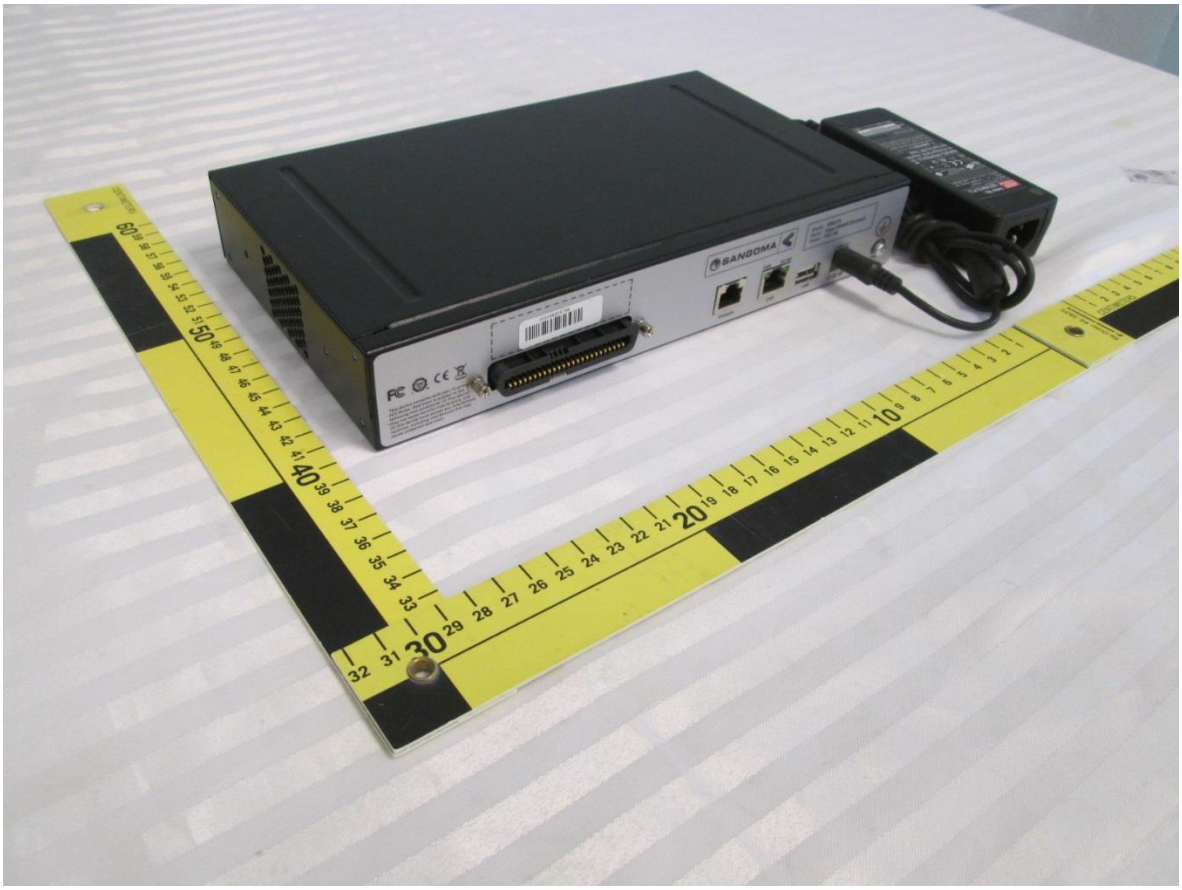

Figure 2 – EUT, Vega 3000G, View 2, with power supply attached

Figure 3 – EUT, Vega 3000G power adapter, close-up of label

Figure 4 – EUT, Vega 3050G, View 1

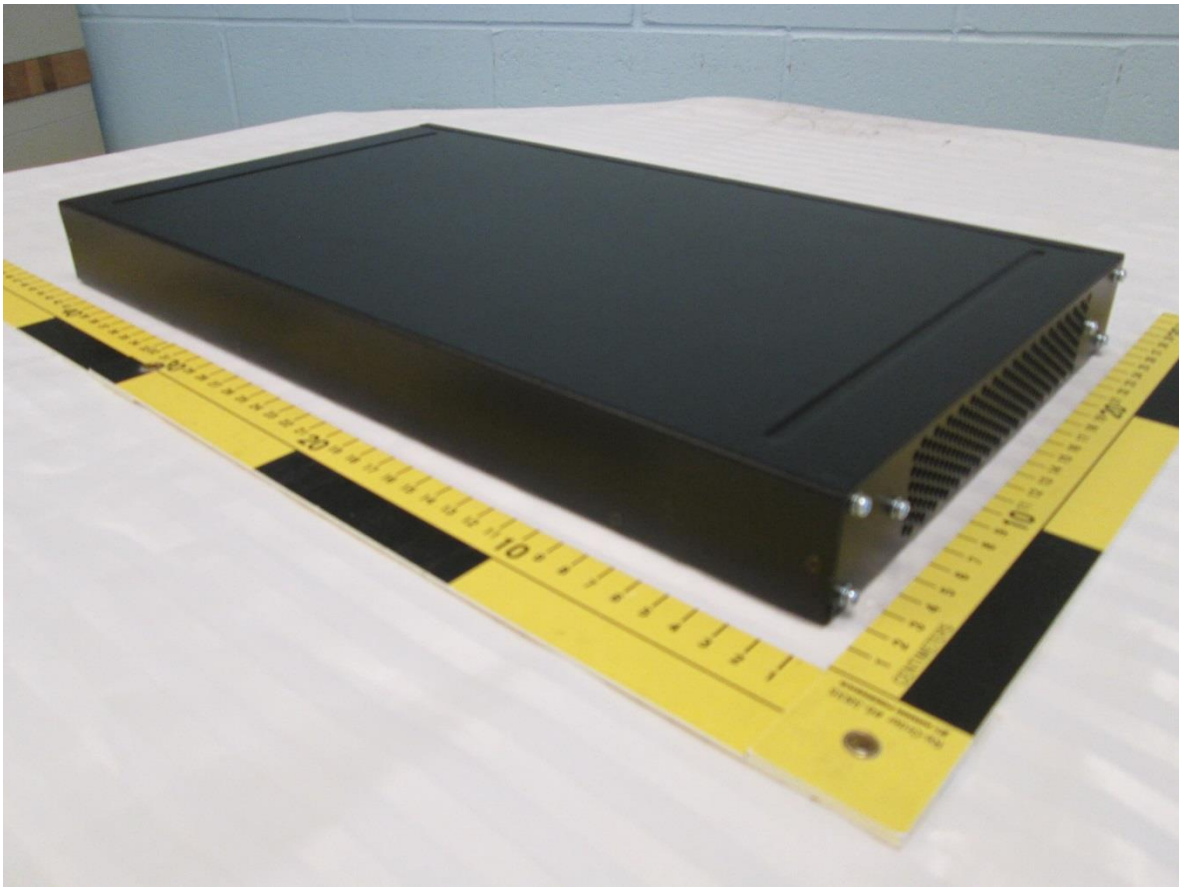

Figure 5 – EUT, Vega 3050G, View 2

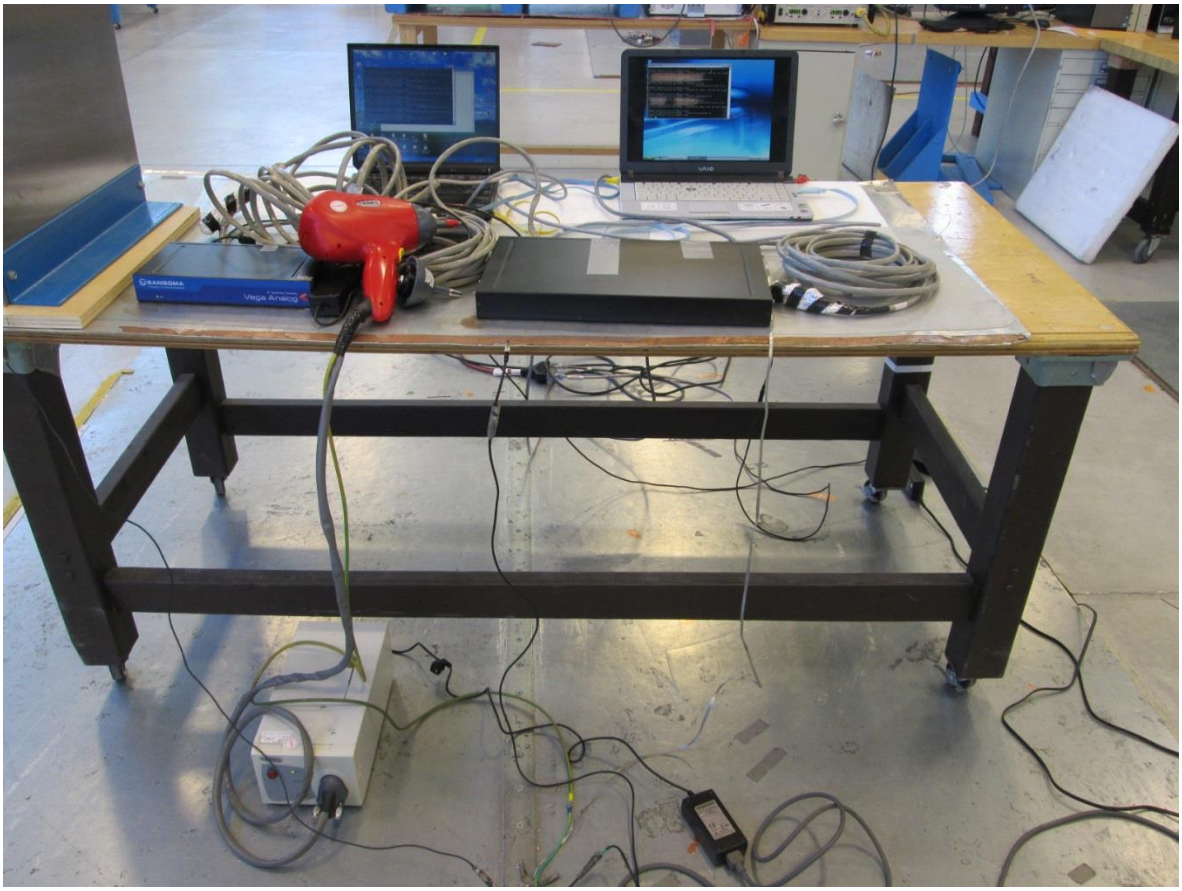

Figure 6 – Electro-Static Discharge Setup

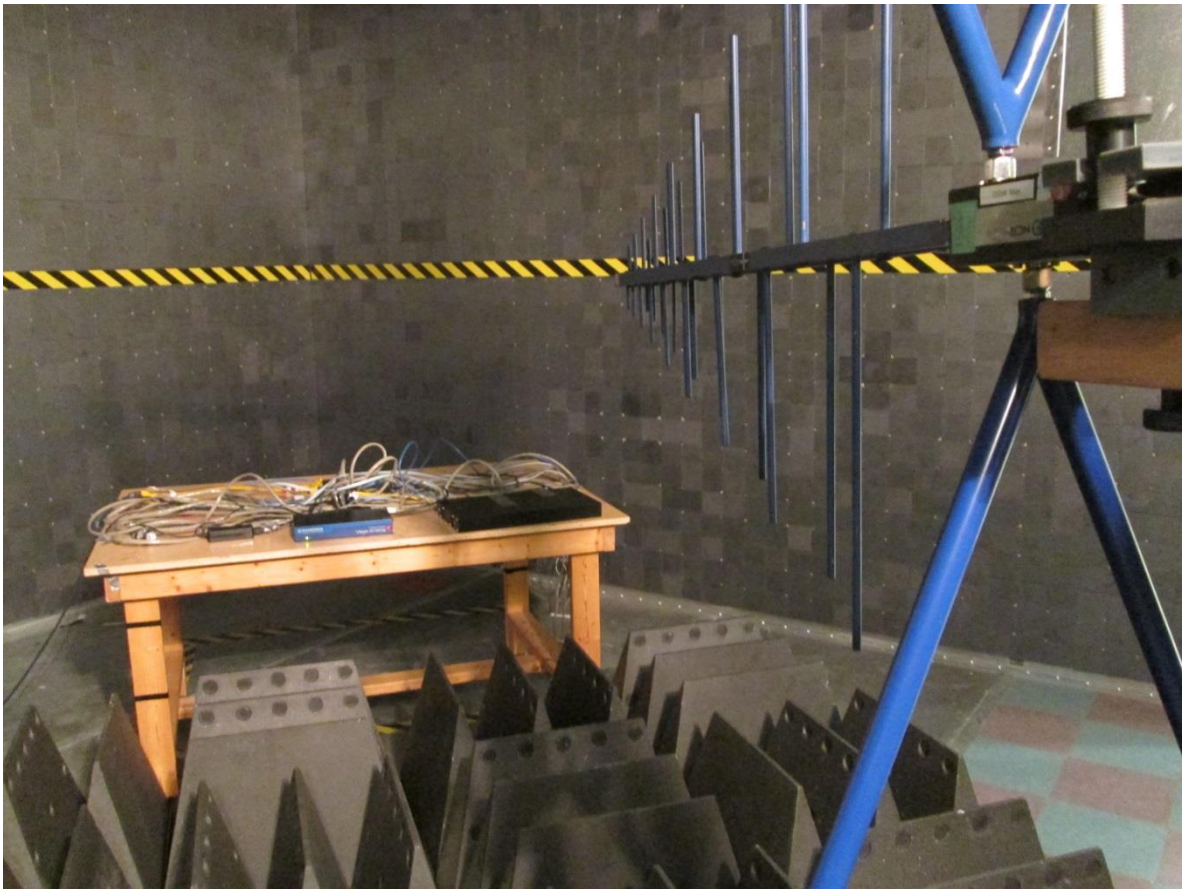

Figure 7 – Radiated Immunity Setup

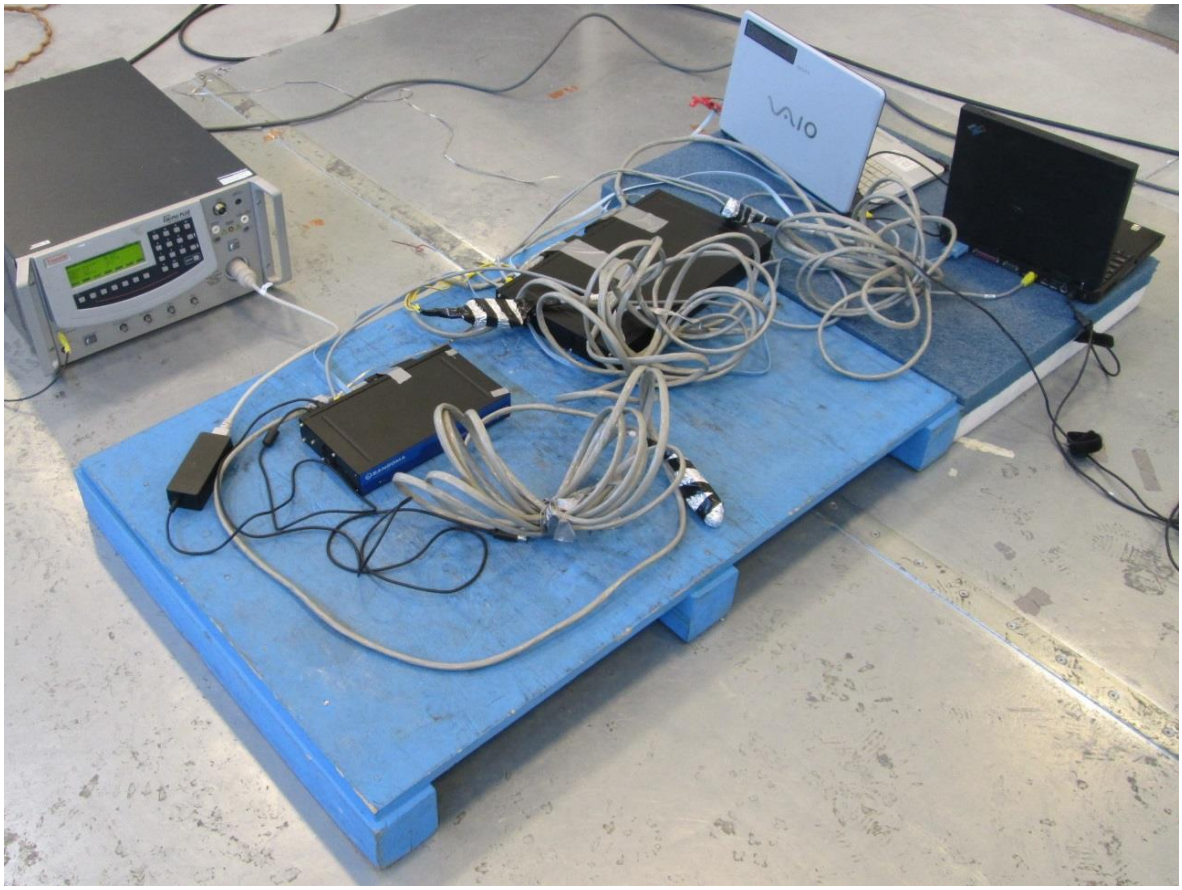

Figure 8 – EFT/B (mains), Surge and Voltage Dips & Interrupts Setup

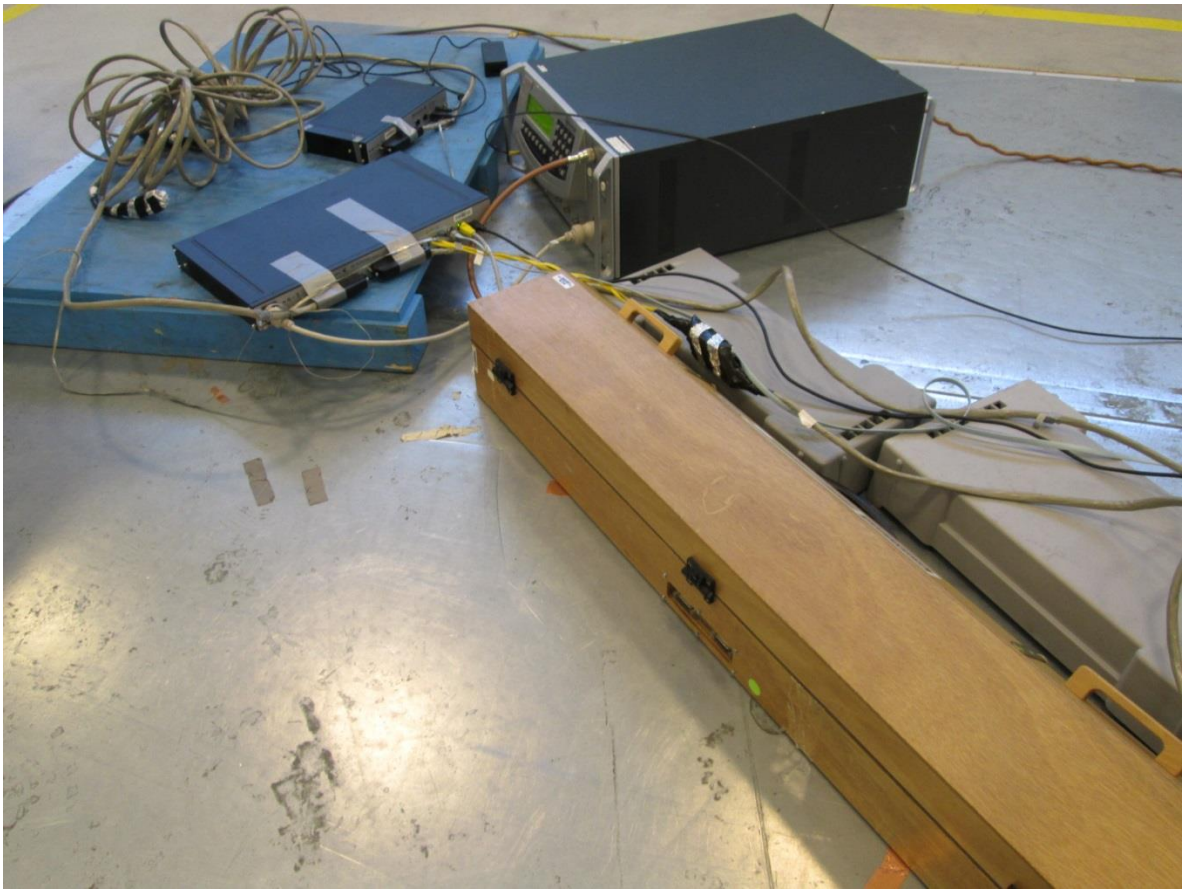

Figure 9 – EFT (I/O lines) Setup

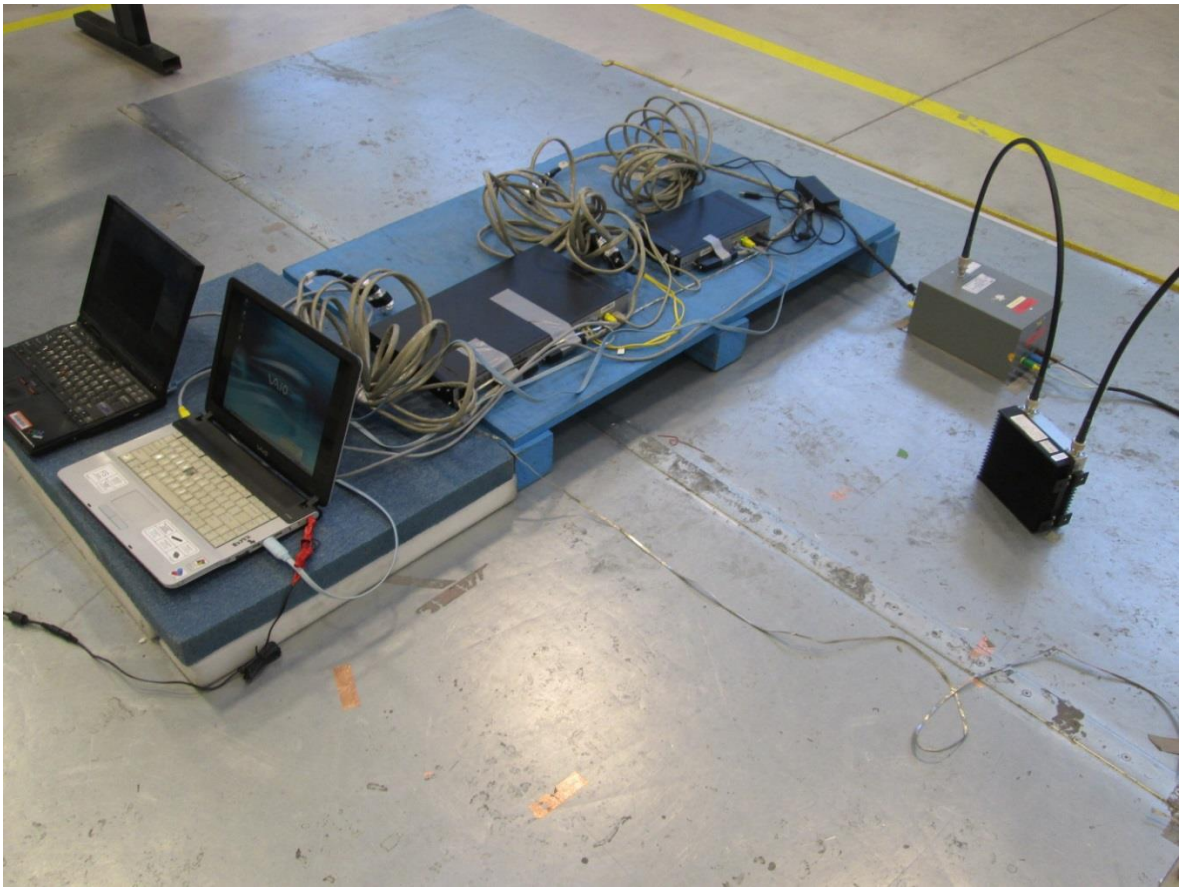

Figure 10 – Conducted Immunity (mains) Setup

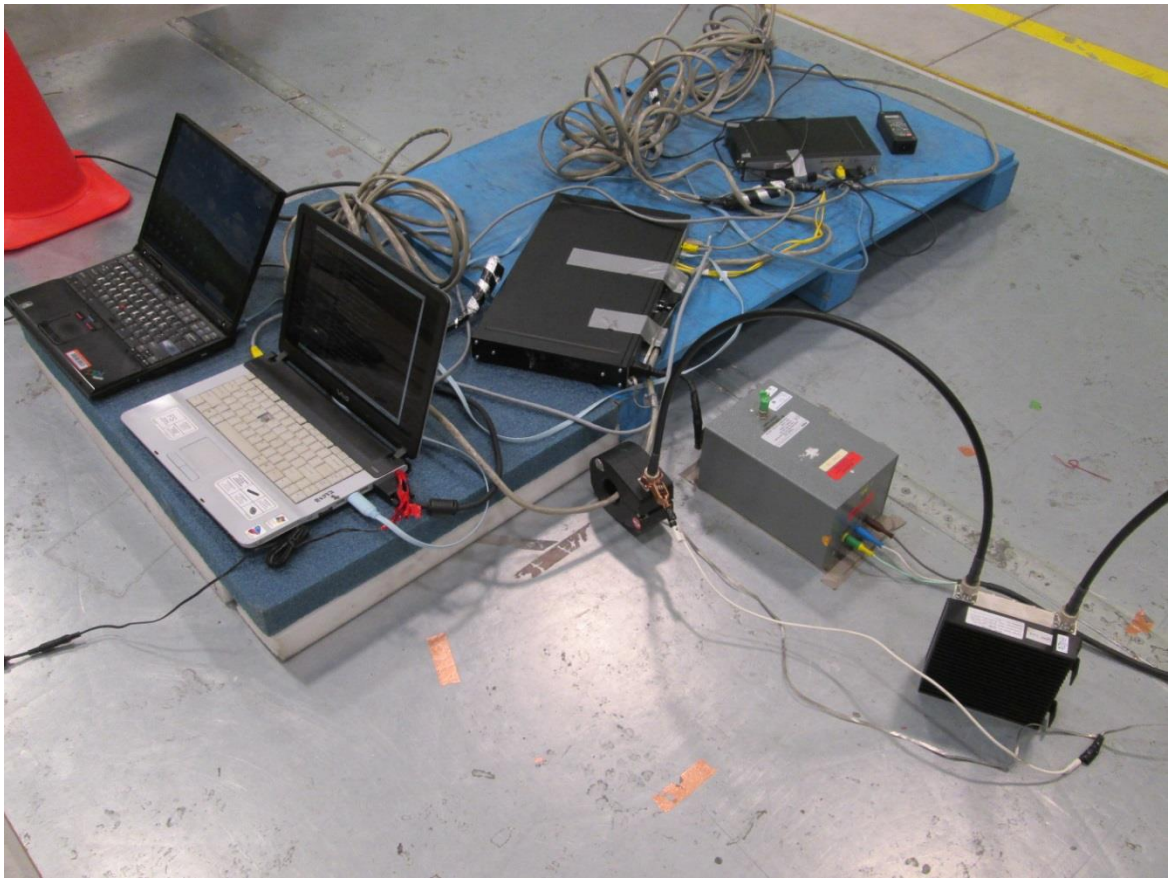

Figure 11 – Conducted Immunity (I/O lines) Setup

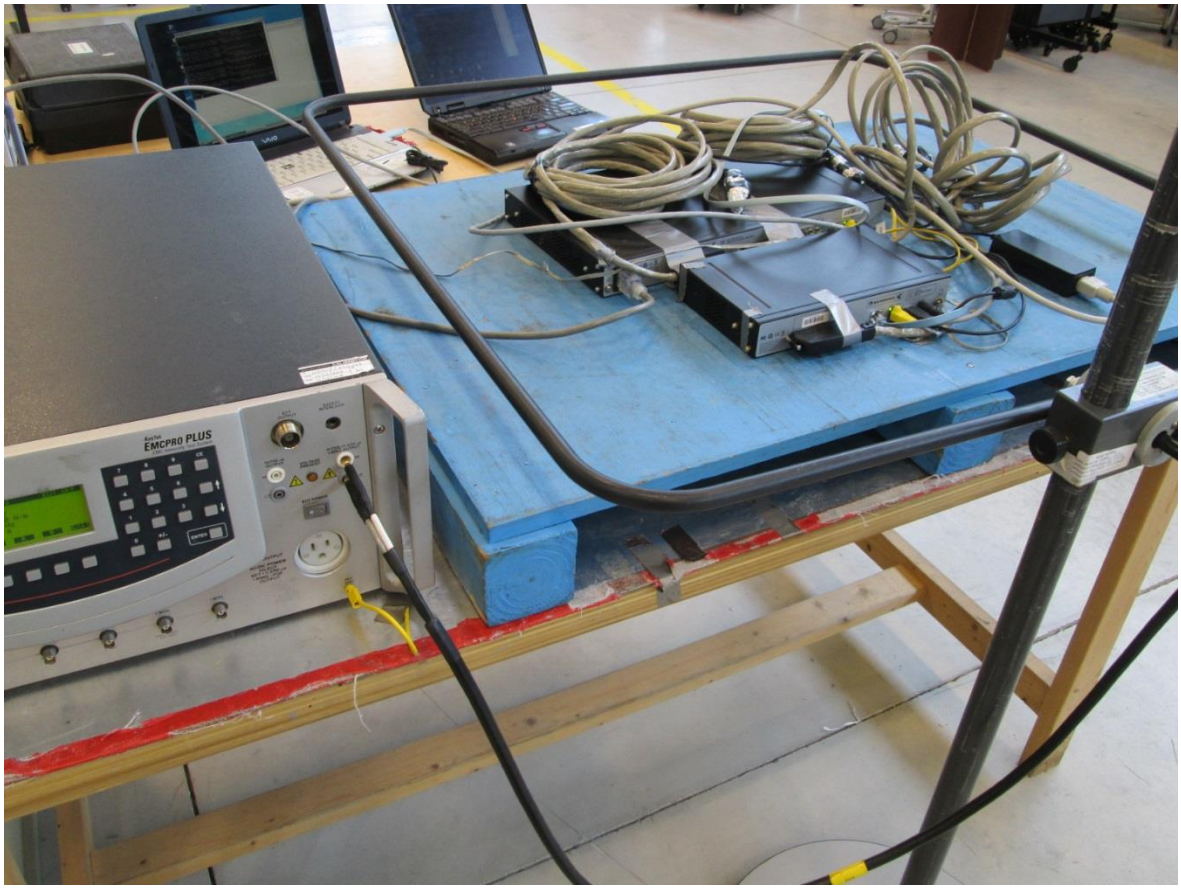

Figure 12 – Power Frequency Magnetic Field Setup

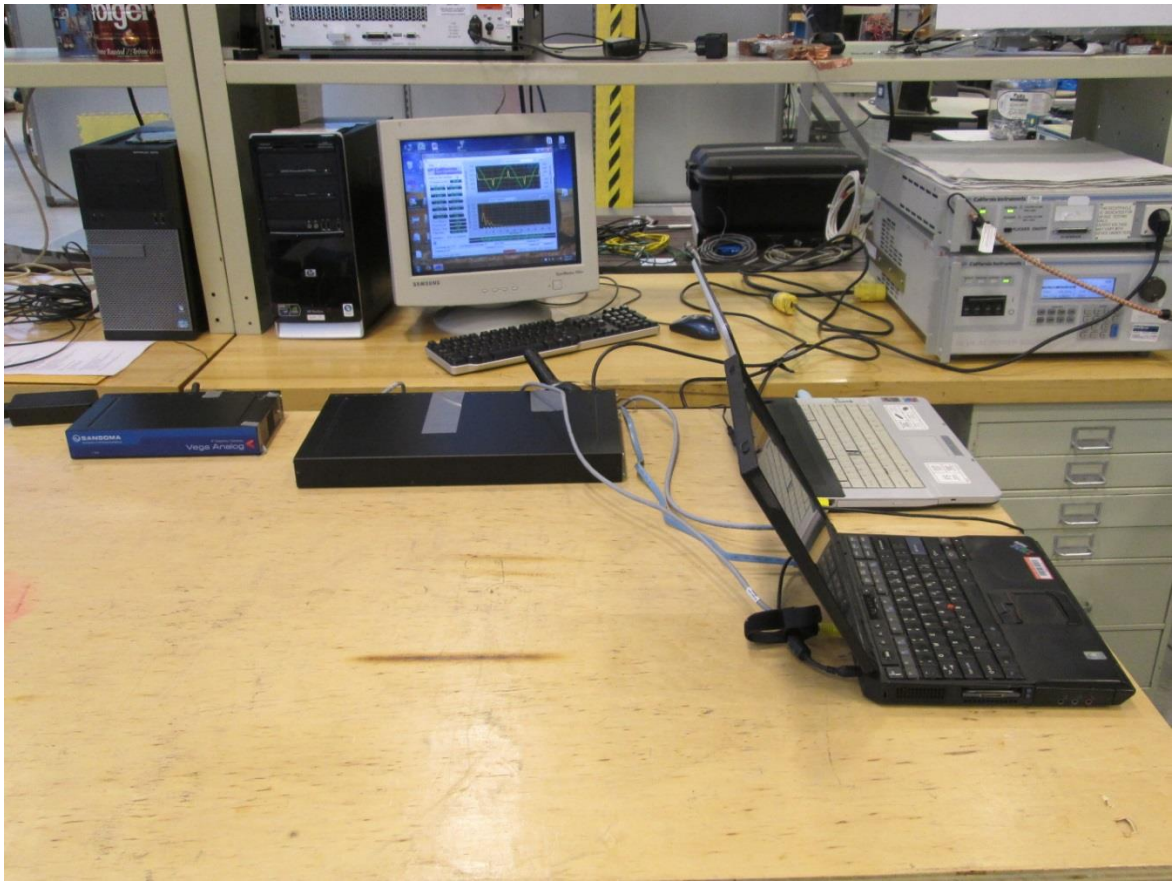

Figure 13 – Harmonics and Flicker Setup

Figure 14 – Power Line Conducted Emissions Setup

Figure 15 – Asymmetric Mode Conducted Emission Setup

Figure 16 – Radiated Emissions Setup, 30 MHz – 2 GHz

Figure 17 – Radiated Emissions Setup, > 2 GHz