



FCC Test Report

FOR:

Company: Trimble Navigation Limited

Model Name: 88161

EUT Description: Industrial Handheld Computer

FCC ID: JUP88161

IC ID: 1756A-88161

FCC Part 15B

TEST REPORT #: EMC_TRIM2-017-13001_15B

DATE: 2013-10-09



**FCC:
Accredited**

**IC recognized #
3462B-1**

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2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Tunji Yusuf
Responsible Project Leader:	Yadvinder Garcha

2.2 Identification of the Client

Applicant's Name:	Trimble Navigation Limited
Street Address:	935 Stewart Drive, Sunnyvale
City/Zip Code	CA94088-3642
Country	USA
Contact Person:	Bruce Maule
Phone No.	+6439635628
e-mail:	bruce_maule@trimble.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	



3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	GeoExplorer® 7 Series handheld, Geo 7X
Model No:	88161
Product Description:	Industrial Handheld Computer
Radios included:	<ol style="list-style-type: none"> 1. Cinterion PXS8 Radio Module <ul style="list-style-type: none"> • 850/900/1800/1900Mhz GSM power class 4/1 GPRS Class B, Multislot 12 operation EDGE Multislot class 12 operation • 850/900/1900/2100 MHz WCDMA / HSPA+ HSDPA Category 10 data rate - 14.4 Mbps HSUPA Category 6 data rate - 5.76 Mbps • 800/1900 MHz CDMA 1xRTT / EV-D0 CDMA EVDO Rev A data rate - 3.1 Mbps 2. WLAN 802.11 b/g 3. BT 2.1+EDR 4. GPS 1575.42 MHz
FCC ID:	JUP88161
IC ID:	1756A-88161
Rated Operating Voltage Range:	9V DC (Low) / 11.1V DC (Nom) / 15.75V DC (High)
Rated Operating Temperature Range:	-20°C ~ +60°C
Prototype / Production unit:	Identical Prototype

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version
1	99000218997907109	Rev A	6.7.0
2	5315414839	Rev A	6.7.0

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	S/N
1	Laser Accessory	Trimble	Geo 7 Laser Rangefinder - 88185	N/A

3.4 Environmental Conditions during test:

The following environmental conditions were maintained during the course of testing:

Ambient Temperature: 20-25°C

Relative humidity: 40-60%

3.5 Dates of testing:

May 23, 2013; September 30, 2013



4 Subject of Investigation

Testing was performed to evaluate compliance against the applicable criteria specified in FCC CFR 47 Part 15 Subpart B.

Radiated Emission tests are carried out to show that the EUT complies with FCC15.109 (a) radiated emissions limit for Class B device.

Conducted Emission tests are carried out to show that the EUT complies with FCC15.107 (a) conducted emissions limit for Class B device.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.109	RX Spurious Emissions Radiated	Nominal	RX Mode	■	□	□	□	Complies
§15.107(a)	Conducted Emissions <30MHz	Nominal	RX Mode	■	□	□	□	Complies

Note: NA= Not Applicable; NP= Not Performed.



6 Radiated Emissions

6.1 §15.109 Radiated emission limits- Unintentional Radiators:

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)
30–88	100
88–216	150
216–960	200
Above 960	500

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)
30–88	90
88–216	150
216–960	210
Above 960	300

6.2 Measurement Procedure:

ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beam width, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be re-maximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the “cone of radiation” from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT’s size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

NOTES

- 1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
- 2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
- 3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.



6.3 Sample Calculations for Radiated Measurements

6.3.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dB μ V/m) = Measured Value on SA (dB μ V)+ Cable Loss (dB)+ Antenna Factor (dB/m)

Eg:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

6.4 Testing Notes:

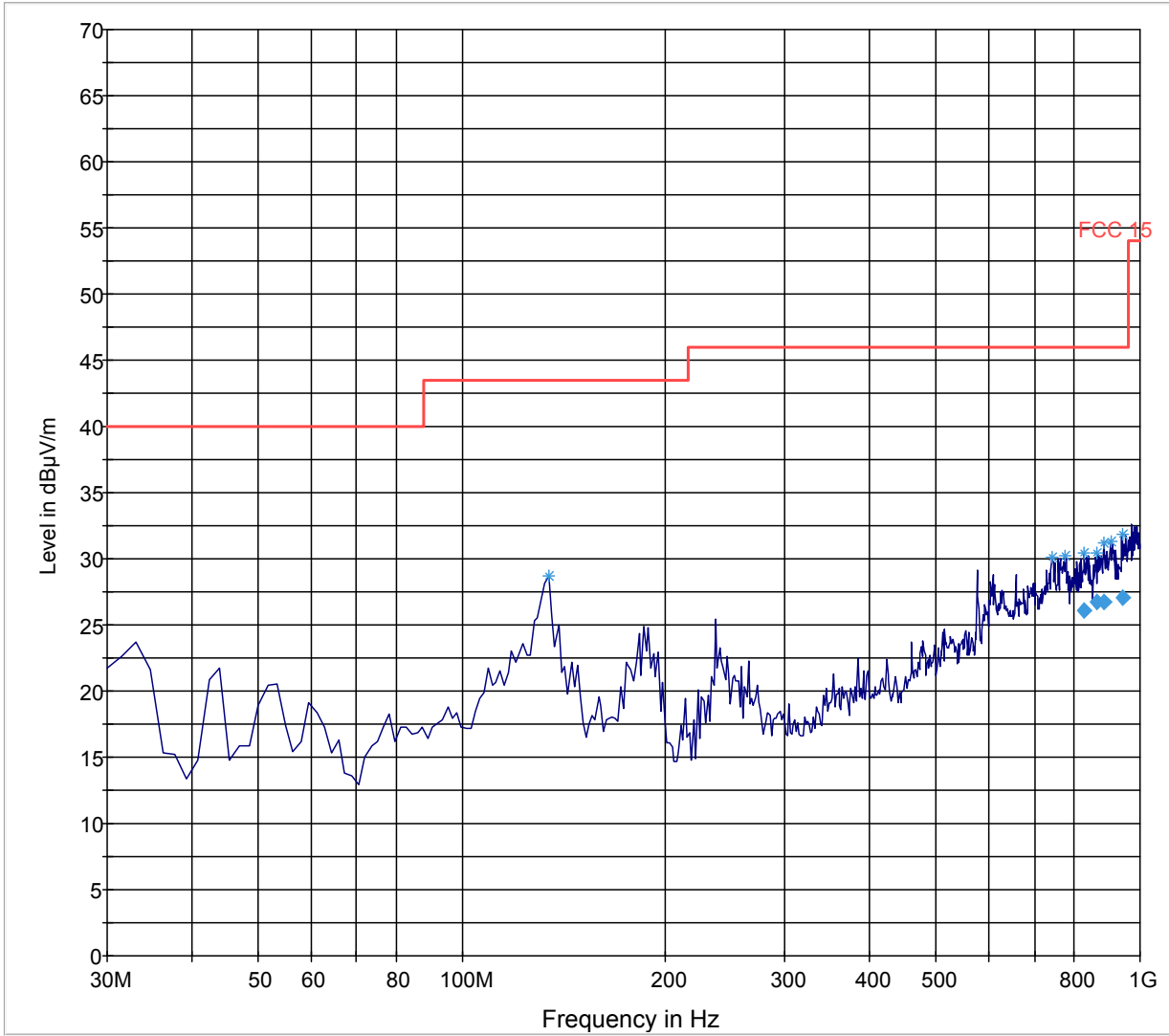
The relevant procedures of ANSI C63.4: 2009 have been followed.

All radiated test data in this report shows the worst case emissions for H/V measurement antenna polarizations and for all three orthogonal orientations of the EUT.



6.5 Results

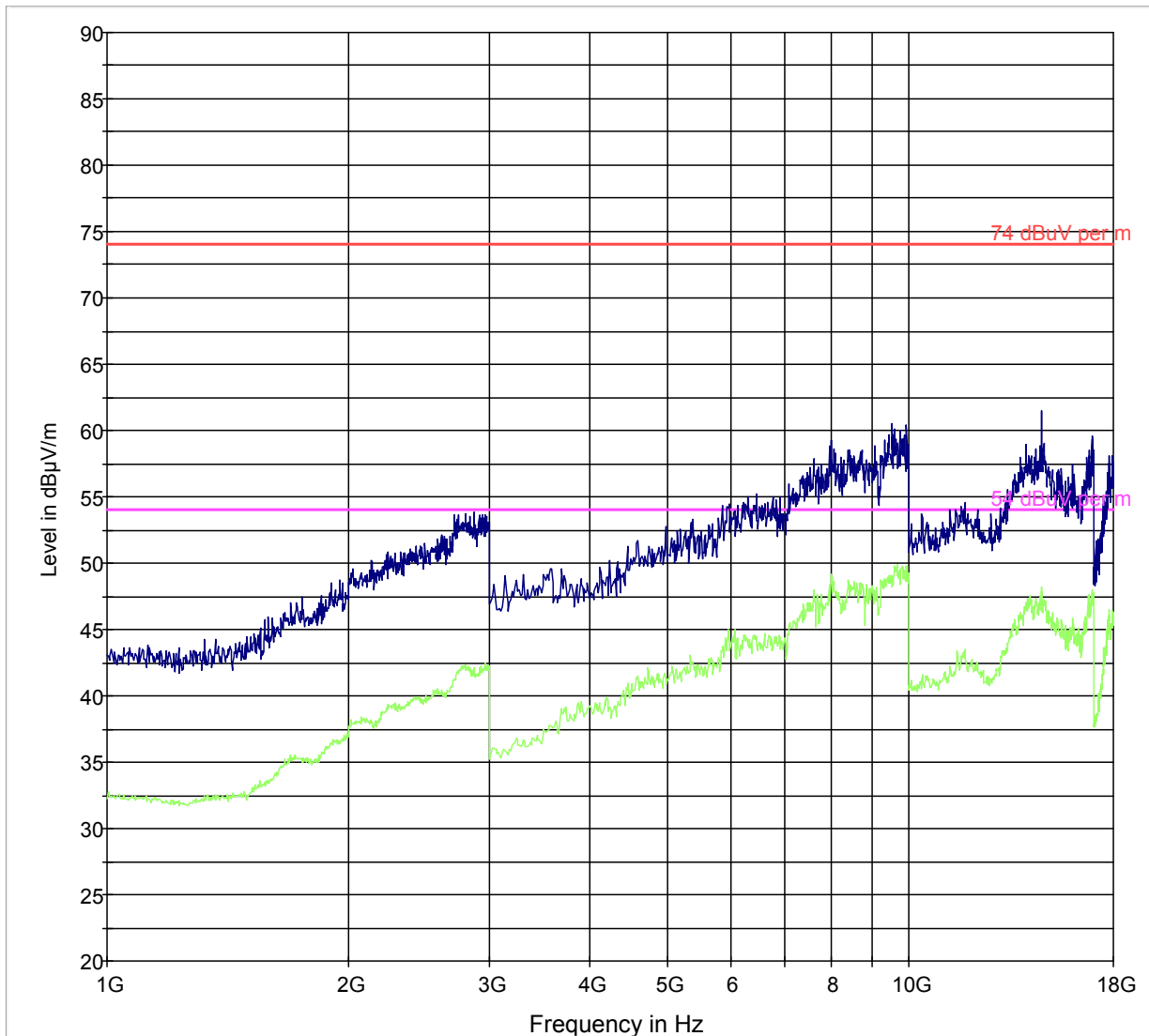
Radiated Emissions: 30M- 1GHz



— FCC 15
* Data Reduction Result 1 [3]-PK+ — Preview Result 1-PK+
◆ Final Measurement Result 1-QPK



Radiated Emissions: 1 GHz- 18 GHz



— 74 dBuV per m — 54 dBuV per m — Preview Result 1-PK+ — Preview Result 2-AVG



7 AC Power Line Conducted Emissions

7.1 § 15.107 Conducted limits- Unintentional Radiators

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	79	66
0.5–5	73	60

7.2 Measurement Procedure:

ANSI C63.4 (2009) Section 7.3.1: Measurements at a test site

Tabletop devices shall be placed on a nonconducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane, when used, or wall of a screened room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground plane or on insulating material. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs. AC power-line adapters that are used with EUTs, such as notebook computers, should be placed as typically used (i.e., on the tabletop) if the adapter-to-EUT cord is too short to allow the power adapter to reach the floor. Each current-carrying conductor of the EUT power cord(s), except the ground (safety) conductor(s), shall be individually connected through a LISN to the input power source. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument. When the test configuration consists of multiple units (EUT and associated/peripheral equipment, or EUT consisting of multiple equipment) that have their own power cords, ac power-line conducted emissions measurements shall be performed with the ac power-line cord of the particular unit under test connected to one LISN that is connected to the measuring instrument. Those power cords for the units in the remainder of the configuration not under measurement shall be connected to a separate LISN or LISNs. This connection may be made using a multiple-receptacle device. Emissions from each current-carrying conductor of the EUT shall be individually measured. Where multiple portions of the EUT receive ac power from a common power strip, which is furnished by the manufacturer as part of the EUT, measurements need only be made on the current-carrying conductors of the common power strip. Adapters or extension cords connected between the EUT power cord plug and the LISN power receptacle shall be included in the LISN setup, such that the calibration of the combined adapter or extension cord with an adapter and the LISN meets the requirements of 5.2.3. If the EUT consists of a number of devices that have their own separate ac power connections, e.g., a floor standing frame with independent power cords for each shelf, that are able to connect directly to the ac power network, each current-carrying conductor of one device is measured while the other devices are connected to a second (or more) LISN(s). All devices shall be separately measured. If the manufacturer provides a power strip to supply power to all of the devices making up the EUT, only the conductors in the common power cord to the power strip shall be measured.

If the EUT is normally operated with a ground (safety) connection, the EUT shall be connected to the ground at the LISN through a conductor provided in the lead from the ac power to the LISN. The excess length of the power cord between the EUT and the LISN receptacle (or ac power receptacle where a LISN cannot be used), or an adapter or extension cord connected to and measured with the LISN, shall be folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length. If the EUT does not have a flexible power lead, the EUT shall be placed at a distance of 80 cm from the LISN (or power receptacle where a LISN cannot be used) and connected thereto by a power lead or appropriate connection no more than 1 m long. The measurement shall be made at the LISN end of this power lead or connection.

The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

ANSI C63.4 (2009) Section 7.3.3: Exploratory ac power-line conducted emission measurements

Exploratory measurements shall be used to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation and for each ac power current-carrying conductor, cable manipulation may be performed within the range of likely configurations. For this measurement or series of measurements, the frequency spectrum of interest shall be monitored looking for the emission that has the highest amplitude relative to the limit. Once that emission is found for each current-carrying conductor of each power cord associated with the EUT (but not the cords associated with non-EUT equipment in the overall system), the one configuration and arrangement and mode of operation that produces the emission closest to the limit across all the measured conductors is recorded.

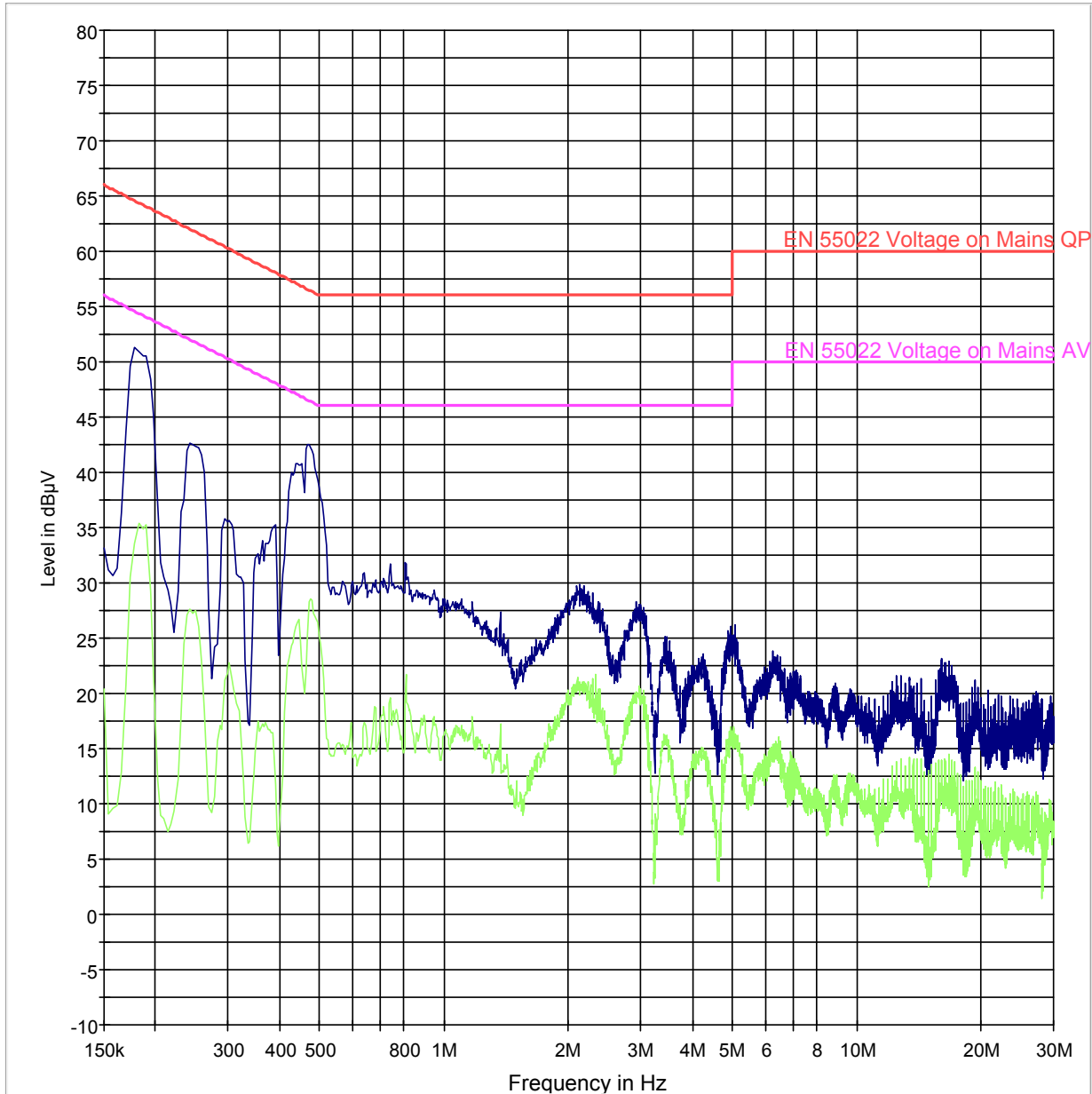
ANSI C63.4 (2009) Section 7.3.4: Final ac power-line conducted emission measurements

Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be re-maximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without additional variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT consists of equipment units that have their own separate ac power connections (e.g., a floor-standing frame with independent power cords for each shelf that are able to connect directly to the ac power network), then each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be measured separately. If the manufacturer provides a power strip to supply all the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.



7.3 Results:

Plots below show the worst case representation of emissions into LINE and NEUTRAL.



- EN 55022 Voltage on Mains QP
- EN 55022 Voltage on Mains AV
- Preview Result 1-PK+
- Preview Result 2-AVG



8 Test Equipment and ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Feb 2013	1 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	May 2011	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHz HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	FCC	50-25-2-08	08014	Jul 2012	3 Year
Ancillary equipment						
	Multimeter	Klein Tools	MM200	001	Apr 2011	3 Years
	Humidity Temperature Logger	Dickson	TM320	03280063	Mar 2012	2 Year
	Digital Barometer	VWR	35519-055	91119547	Nov 2011	2 Years
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

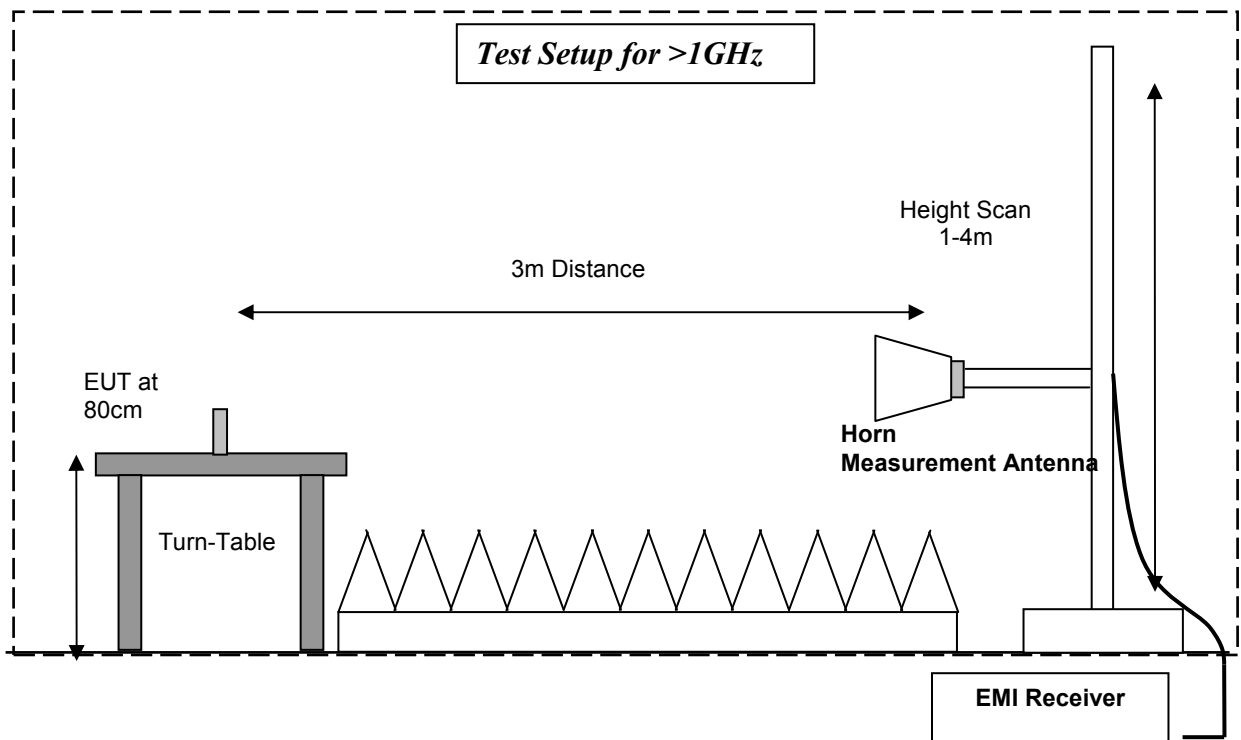
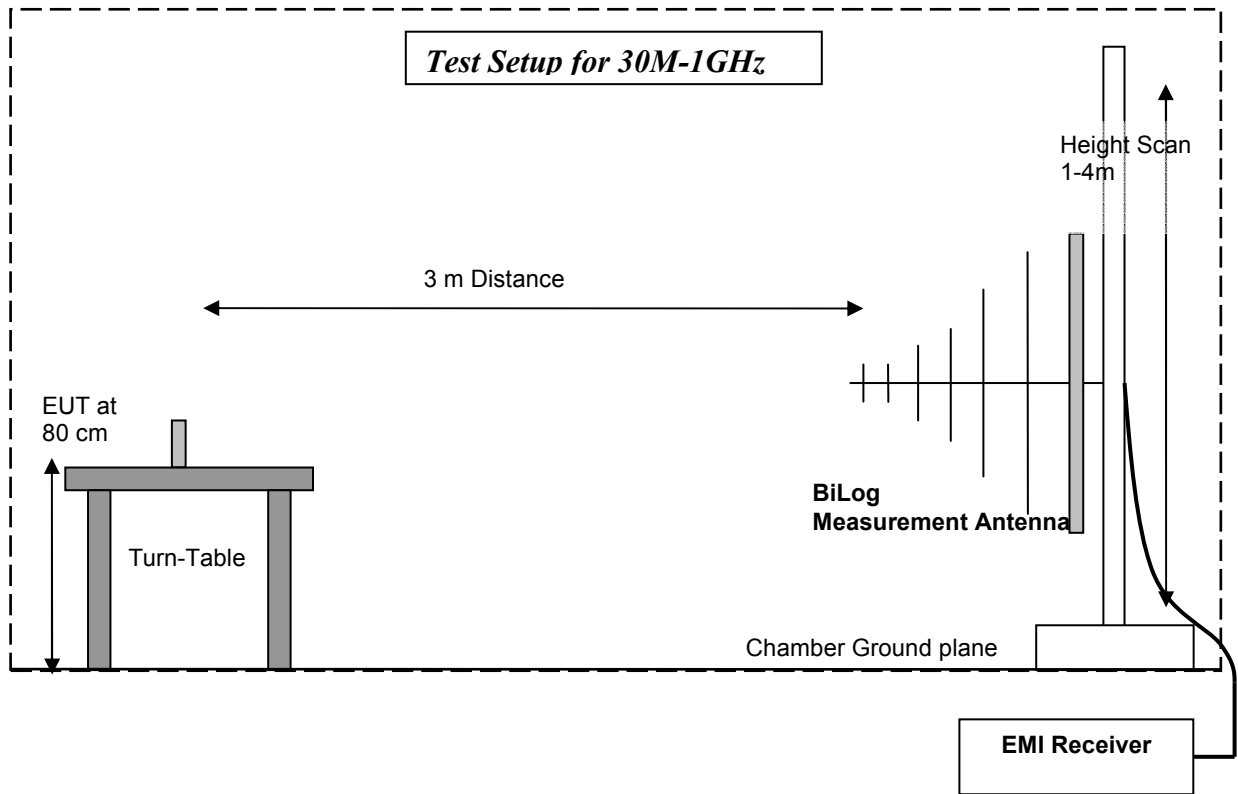
Calibration details valid at the time of testing.

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month.

Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

9 Test Setup Diagrams





10 Revision History

Date	Report Name	Changes to report	Report prepared by
2013-10-09	EMC_TRIM2-017-13001_15B	First Version	Josie Sabado