FCC Test Report

FOR:

Gemalto M2M GmbH

Model Number: ELS31-V

Product Description: LTE Module

FCC ID: QIPELS31-V

IC ID: 7830A-ELS31V

47 CFR Part 15B
ICES-003, issue 5

TEST REPORT #: EMC_CETEC_139_15001_15B_v1.0
DATE: 12/03/2015

FCC Recognized
A2LA Accredited
IC recognized # 3462E-1

***CETECOM* Inc.**
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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Part 15B of the Code of Federal Regulations and ICES-003, issue 5. No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Gemalto M2M GmbH	Cinterion® CAT 1 LTE Module	ELS31-V

Responsible for Testing Laboratory:

Date	Section	Name	Signature
12-03-2015	Compliance	Milton Ponce Deleon (Manager Compliance)	Milton Ponce de Leon Digitally signed by Milton Ponce de Leon DN: cn=Milton Ponce de Leon, c=US, o=Cetecom Inc., ou=OTA, email=milton.deleon@cetecom.com Date: 2015.12.03 12:27:00 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
12-03-2015	Compliance	Anthony Planinac (EMC Engineer)	Anthony Planinac Digitally signed by Anthony Planinac DN: cn=Anthony Planinac, c=US, o=CETECOM, ou=EMC SD, email=anthony.planinac@cetecom.com Reason: release Date: 2015.12.03 12:46:48 -08'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

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Department:	Compliance
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Telephone:	+1 (858) 362-2400
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Test Lab Manager:	Milton Deleon
Responsible Project Leader:	Anthony Planinac

2.2 Identification of the Client

Applicant's Name:	Gemalto M2M GmbH
Street Address:	Siemensdamm 50
City/Zip Code	Berlin 13629
Country	Germany
Contact Person:	Dr. Joerg Rook
Phone No.	+49 30 31102 8230
Fax No.	+49 30 31102 8305
e-mail:	Joerg.rook@gemalto.com

2.3 Identification of the Manufacturer

Applicant's Name:	Gemalto M2M GmbH
Street Address:	Siemensdamm 50
City/Zip Code	Berlin 13629
Country	Germany
Contact Person:	Thorsten Liebig
Phone No.	+49 30 31102 8241
Fax No.	+49 30 31102 8305
e-mail:	Thorsten.liebig@gemalto.com

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	Cinterion®/ ELS31-V
HW Revision :	1.0
FCC-ID	QIPELS31-V
IC-ID	7830A-ELS31V
Product Description:	CAT 1 LTE Module
Power supply	Vmin: 3.4V/ **Vnom: 3.8V** / Vmax: 4.2V
Antenna / highest declared gain:	LTE Band 4 (1700): Antenna gain = 2 dBi LTE Band 13 (700MHz): Antenna gain = -8 dBi
operating temperature range	–10°C ~ +55°C
Prototype / Production unit	Prototype
Radios included in the device:	LTE Band 13 (700MHz Band) LTE Band 4 (1700 MHz Band
Measurement Frequency Range	- 150kHz ~ 30MHz (Conducted Power Measurement) - 30MHz ~ 18GHz (Radiated Power Measurement)

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	Sample	HW/SW Version
1	EVR15082100122	Radiated/Conducted	1.0/LR4.3.1.0

3.3 Identification of Accessory equipment

AE #	Type	Model	HW Version	SW Version	Freq.
1	External Antenna	OmniLOG 90200	NA	NA	700MHz – 2.4GHz
2	Power Supply	Protek 3003B	NA	NA	NA

3.4 Environmental Conditions during test:

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

Ambient Temperature: 20-25^{o}C
Relative Humidity: 40-60%

3.5 Dates of testing:

09/20/2015 – 11/22/2015

4 Subject of Investigation

Testing was performed on the ELS31-V model 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.

All the above configurations have been evaluated against the applicable criteria of 47 CFR Part 15B And ICES-003, issue 5.

5 Summary of Measurement Results

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

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

6 Radiated Emissions

6.1 Reference:

FCC §15.109

Radiated emission limits- Unintentional Radiators quasi-peak power limits (or average-peak power limits) for a class B (residential) device:

Frequency of emission (MHz)	Field strength (µV/m) / (dB µV/m)
30–88	100 / 40
88–216	150 / 43.5
216–960	200 / 46
Above 960	500 / 54

For measurements below 1000MHz, the limits are based on using the quasi-peak or peak detector function in the measurement instrumentation. Above 1000MHz, the limits are based on using the average detector function.

6.2 Radiated Emissions Measurement Procedure

The radiated measurement is performed according to:
ANSI C63.4 (2009)
ANSI C63.10 (2009)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 16 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 3 frequency ranges due to antenna bandwidth restrictions. A Biconlog antenna is used from 30MHz to 1GHz and 1GHz to 3GHz, and a horn antenna is used to cover frequencies up to 18 GHz.

Radiated Emissions Measurement Uncertainty: ±3dB

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 dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

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

Example:

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

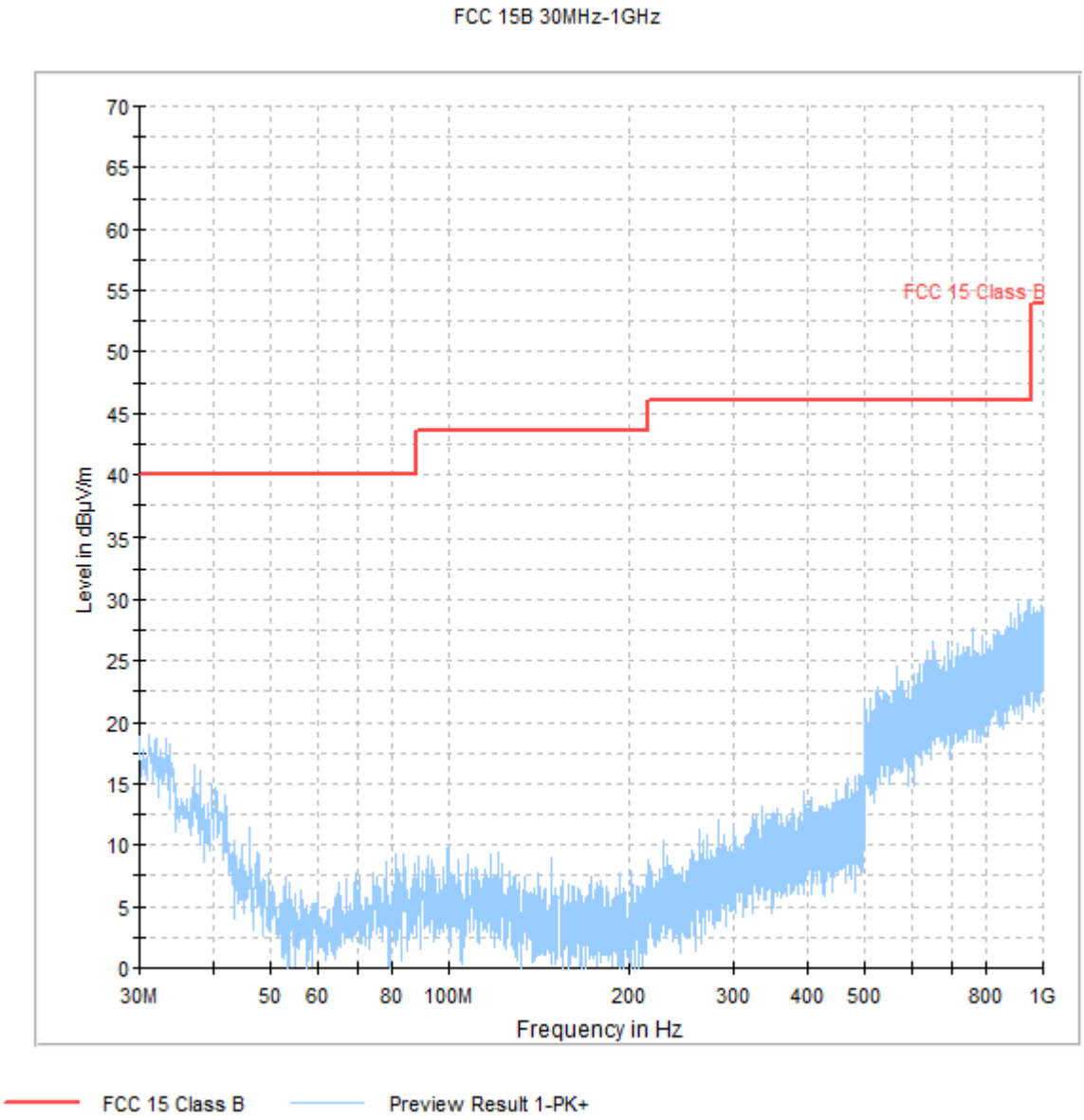
All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

6.4 Testing Notes:

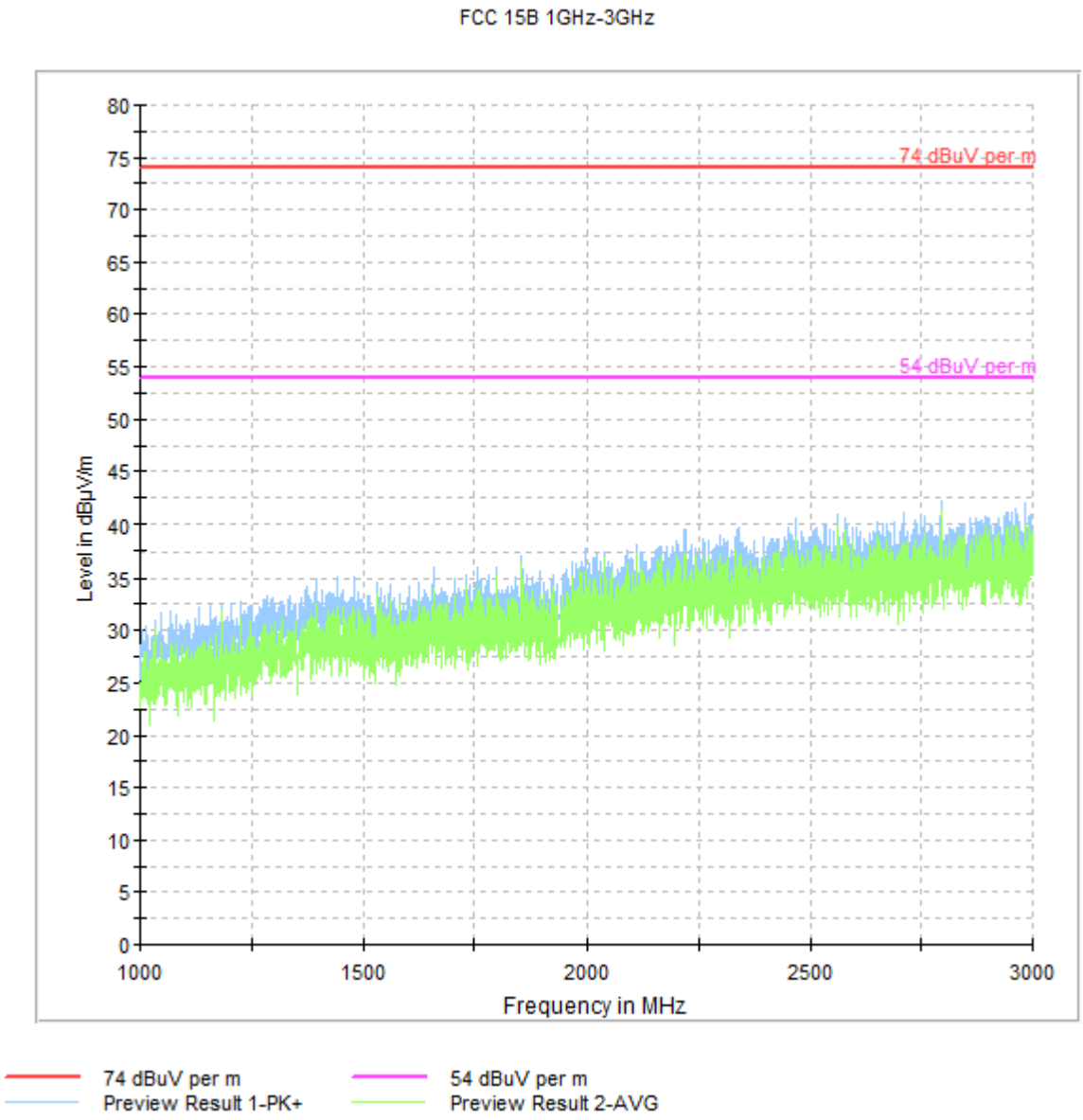
The relevant procedures of ANSI C63.4: 2009 have been followed.
All radiated test data in this report shows the worst case emissions for H/V measurement antenna polarizations and for all three orthogonal orientations of the EUT.

6.5 Results

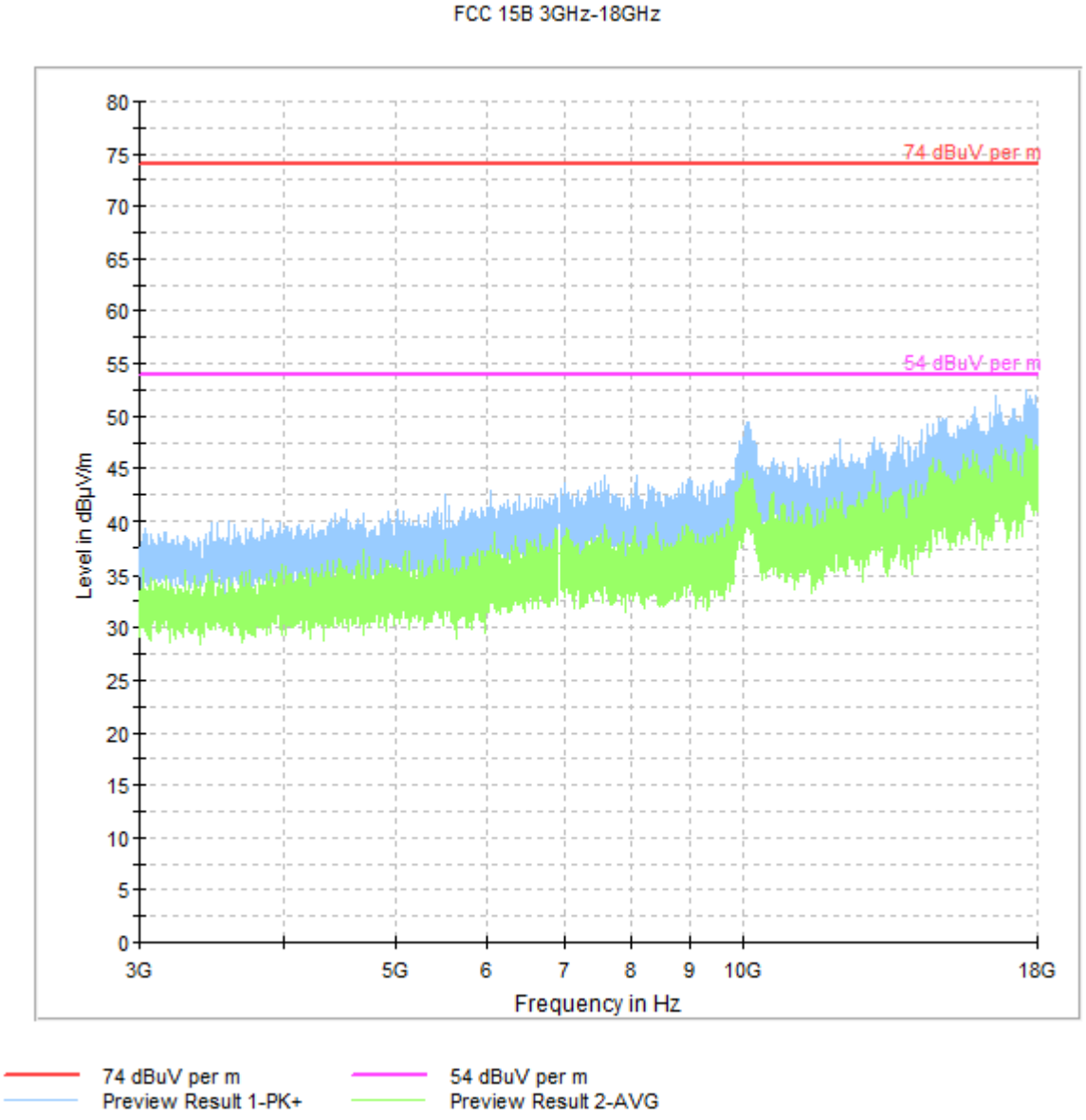
Radiated Emissions: 30M- 1GHz



Radiated Emissions: 1 GHz- 3 GHz



Radiated Emissions: 3 GHz- 18 GHz



7 AC Power Line Conducted Emissions

7.1 Conducted limits- Unintentional Radiators

§ 15.107 (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 floorstanding 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

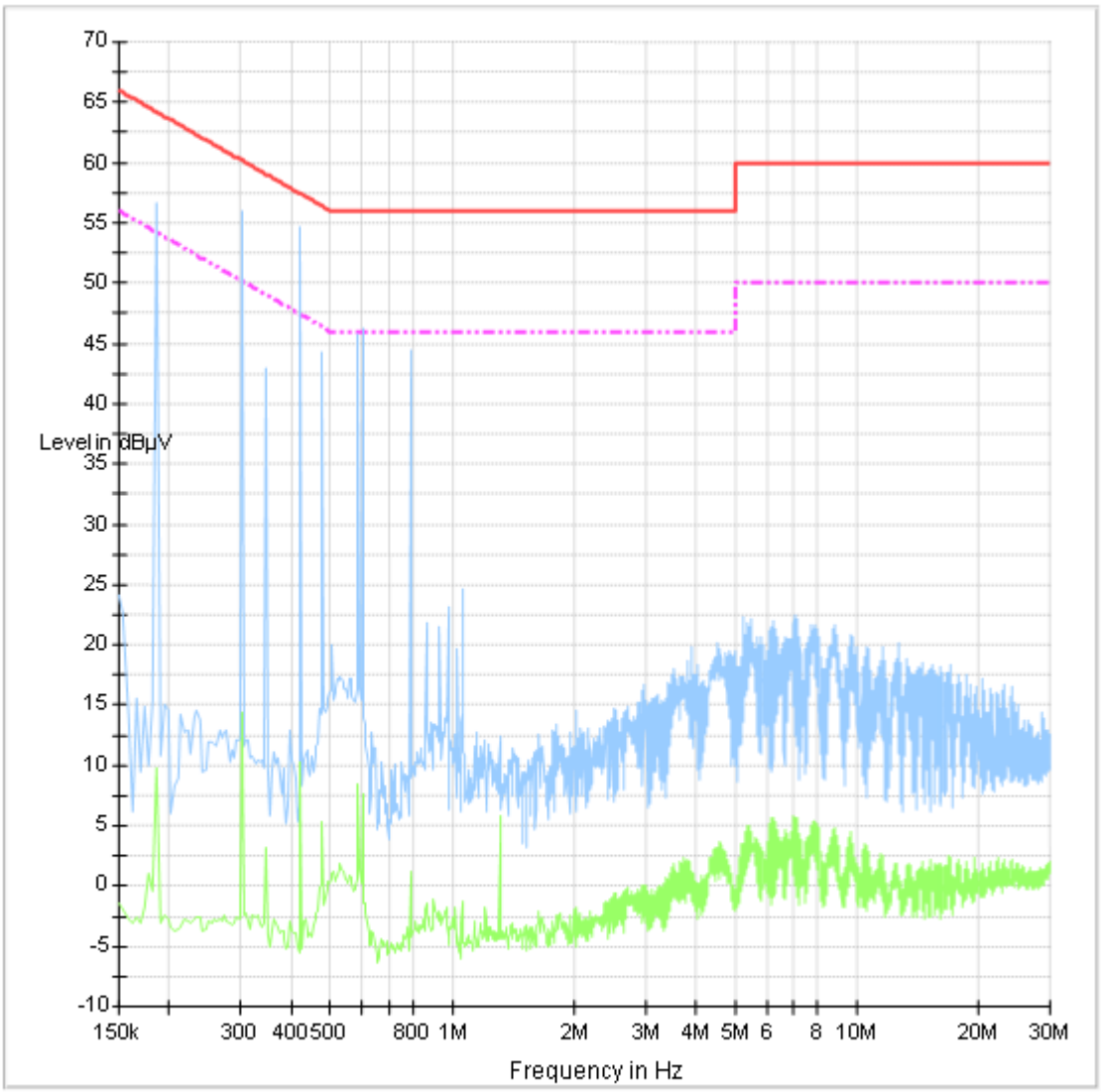
Exploratory measurements shall be used to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation 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 remaximized 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.

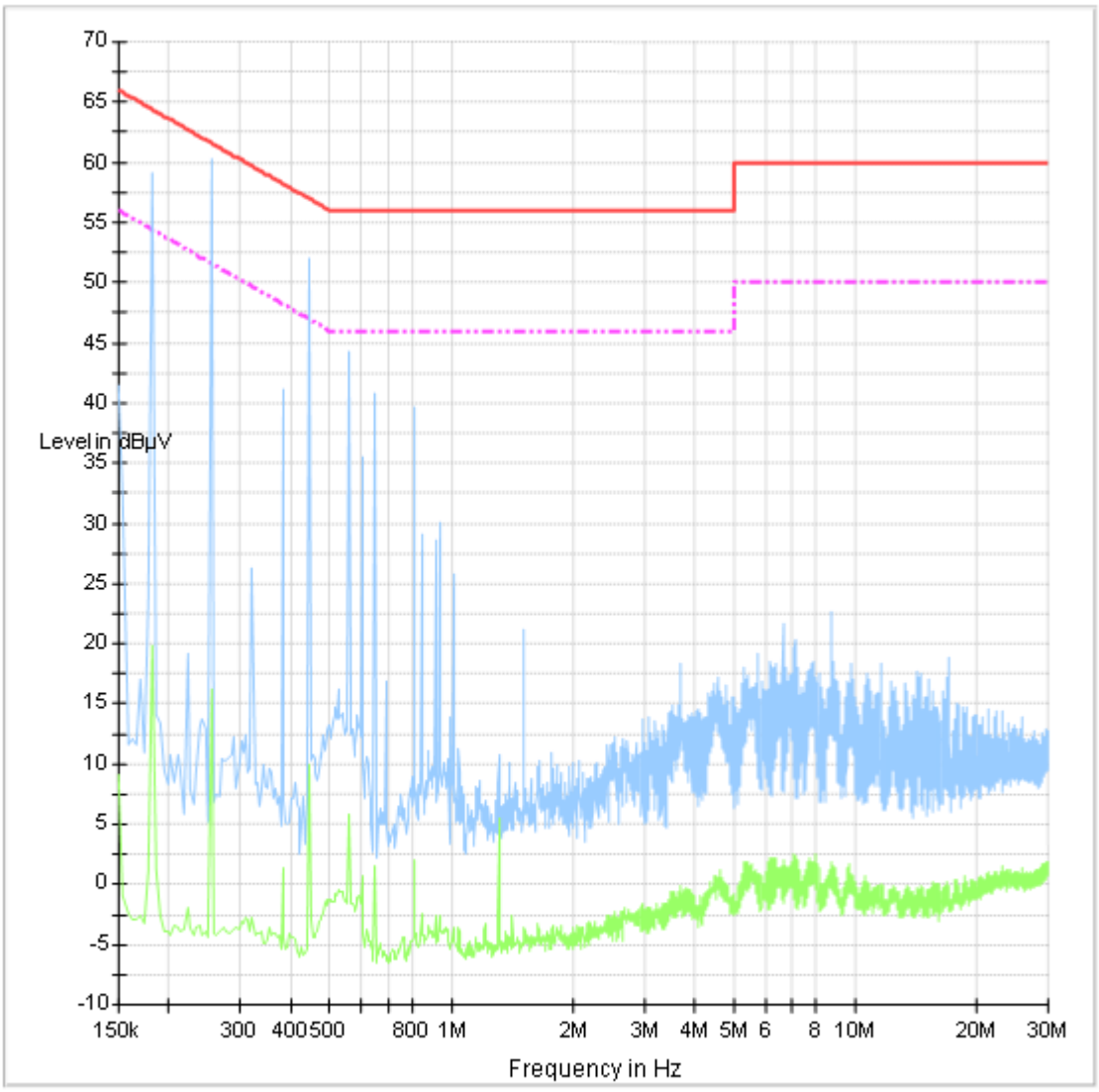
Conducted Emissions Measurement Uncertainty: ±3dB

7.3 Results:

7.3.1 Plots below show the worst case representation of emissions LINE.



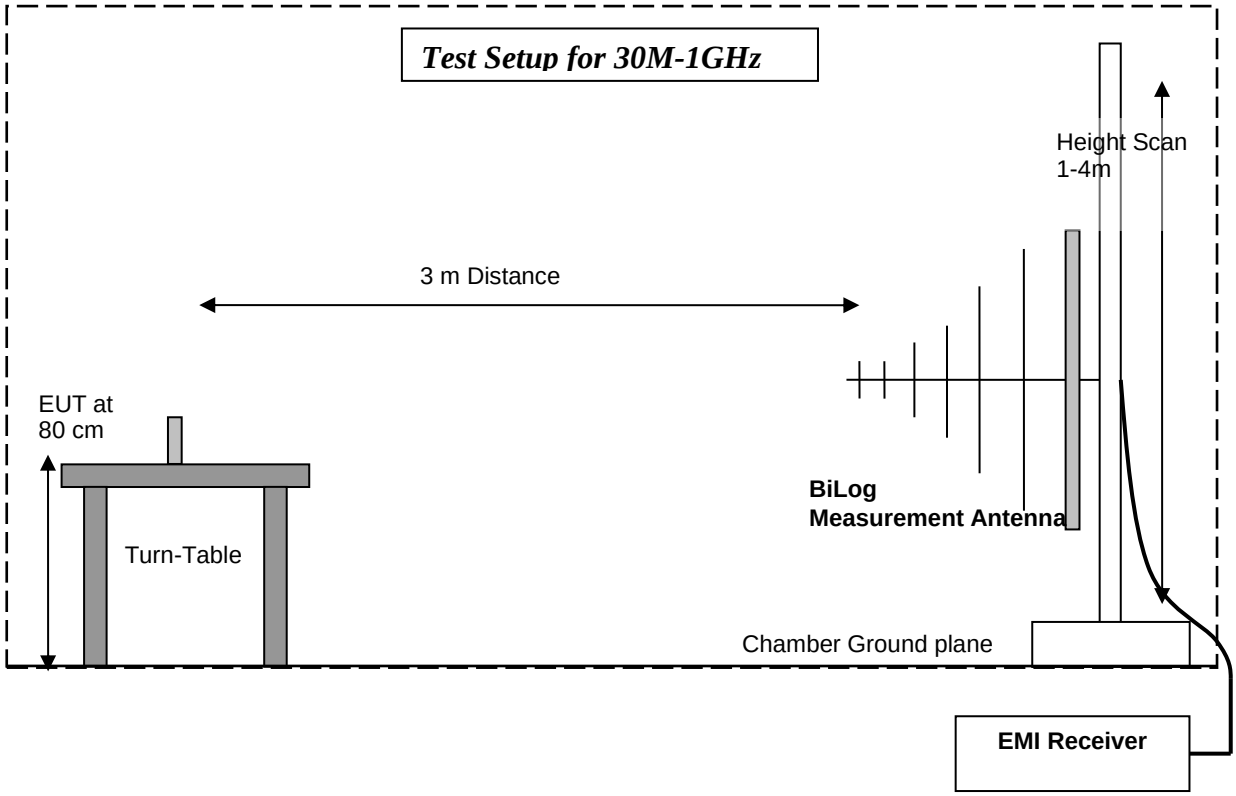
Plots below show the worst case representation of emissions NEUTRAL

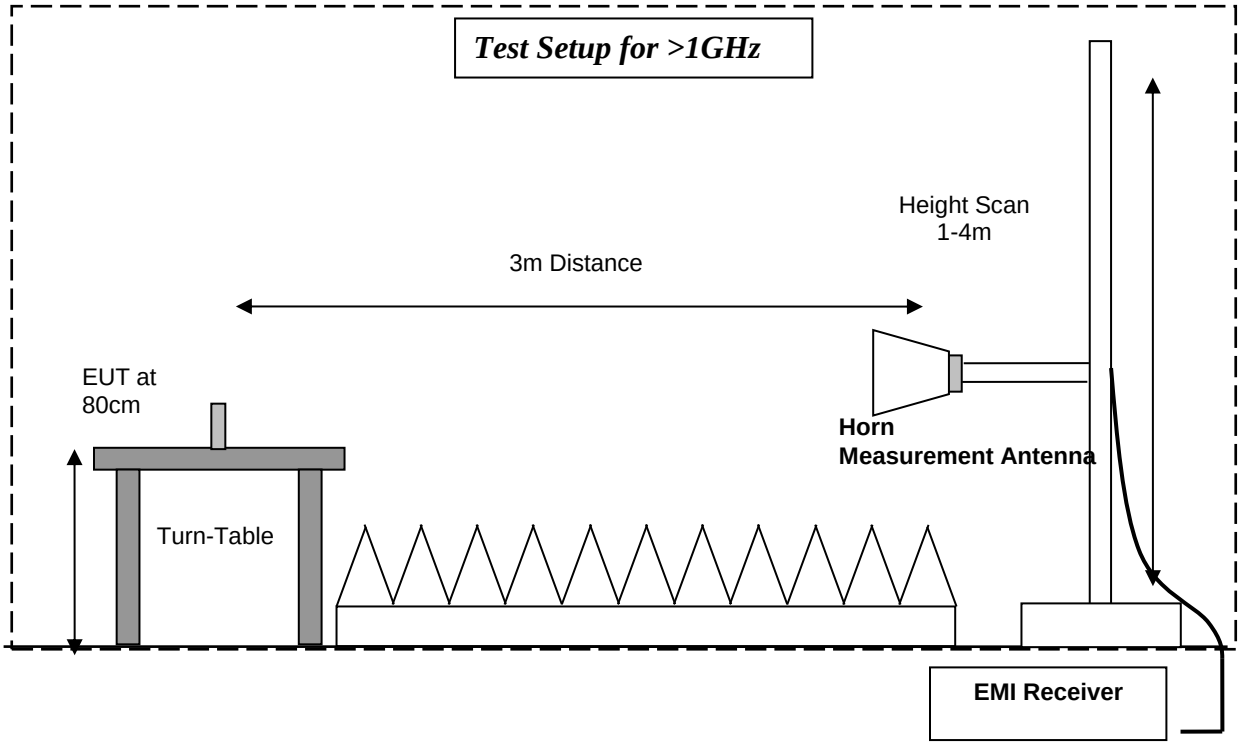


Test Equipment and ancillaries used for tests

Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber and Ground Plane:						
Spectrum Analyzer	Rohde und Schwarz	FSV 40	101022	7/2014	3 years	7/2017
Receiver	Rohde und Schwarz	ESR3	101663	7/2015	3 years	7/2018
LISN	Rohde und Schwarz	ESV 216	101129	7/2015	3 years	7/2018
Radio Communications Tester	Rohde and Schwarz	CMU 200	121672	7/2015	3 years	7/2018
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	5/2015	3 year	5/2018
Double-ridge Horn Antenna (1G-18G)	ETS-Lindgren	3117-PA	00167061	7/2014	3 year	7/2017
Double-ridge Horn Antenna (18G-40G)	ETS-Lindgren	3116C-PA	00166821	7/2014	3 year	7/2017
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extention Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/ 6070910	n/a		
Compact antenna Mast	Maturo	BAM 4.0-P	BAM4.0-P/078/165 50515	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Multiple control Unit	Maturo	NCD	NCD/169/ 16550515			
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		

8 Test Setup Diagrams




Test Setup for >1GHz
Height Scan
1-4m
3m Distance
EUT at
80cm
Horn
Measurement Antenna
Turn-Table
EMI Receiver

9 Revision History

Date	Report Name	Changes to report	Report prepared by
12/03/2015	EMC_CETEC-139-15001_15B_v1.0	First Release	Anthony Planinac