Limited Test report

460990-9TRFWL

Date of issue: September 30, 2022

Applicant:
Cubic Transportation Systems

Product:
Bus Validator

Model:
Validator 3.0

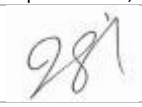
FCC ID: LVCVAL3 IC ID: 4387A-VAL3

Specifications:

- FCC 47 CFR Part 15, Subpart C – §15.247
  Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5727 – 5850 MHz
- Industry Canada RSS-247, Issue 2
  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943 Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Lan Sayasane, EMC Test Engineer
Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	September 30, 2022
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Applicant

Company name	Cubic Transportation Systems
Address	9233 Balboa Ave.
City	San Diego
State	CA
Postal/Zip code	92123
Country	USA

1.2 Manufacturer

Company name	Cubic Transportation Systems
Address	9233 Balboa Ave.
City	San Diego
State	CA
Postal/Zip code	92123
Country	USA

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C – §15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
IC RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.4 Test methods

ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Measurement Guidance v03r02 (June 5, 2014)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.5 Exclusions

Testing only includes Radiated Spurious and Restricted Band Edge measurements and limited maximum peak conducted power calculations.

1.6 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.5 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.7 Test report revision history

Table 1.7-1: *Test report revision history*

Revision #	Details of changes made to test report
460990-9TRFWL	Original report issued

Notes: None

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C, general requirements

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not tested
§15.31(e)	Variation of power source	Not tested
§15.203	Antenna requirement	Not tested

Notes: EUT is AC powered
The antenna is located within the protective cover of EUT on PCB

2.2 FCC Part 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not tested
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not tested
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Pass [1]
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicble [1]
§15.247(b)(4)	Transmitting antennas of directional gain greater than 6 dBi	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not tested
§15.247(f)	Time of occupancy for hybrid systems	Not tested

[1] Limited calculations only

2.3 IC RSS-247, Issue 2

Part	Test description	Verdict
5.1 (a)	Bandwidth of a frequency hopping channel	Not tested
5.1 (b)	Minimum channel spacing for frequency hopping systems	Not tested
5.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not tested
5.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2 (a)	Minimum 6 dB bandwidth	Not tested
5.2 (b)	Maximum power spectral density	Not tested
5.3 (a)	Digital modulation turned off	Not tested
5.3 (b)	Frequency hopping turned off	Not tested
5.4 (a)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass [1]
5.4 (c)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (d)	Systems employing digital modulation techniques	Not applicable
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not tested
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not tested
5.5	Out-of-band emissions	Pass

[1] Limited calculations only

2.4 IC RSS-GEN, Issue 5

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for License-Exempt Radio Apparatus	Not tested

2.5 Scope of limited testing

The EUT supports the following wireless technologies:

- Bluetooth (BT) + Enhanced Data Rate (EDR) operation

The following table summarizes the scope of the limited assessments performed:

Clause	Tests
§15.247(b)(1) Maximum peak output power	GFSK modulation, LOW, MID and HIGH channels π/4-DQPSK modulation, LOW, MID and HIGH channels 8-DPSK modulation, LOW, MID and HIGH channels
§15.247(d) Restricted band edges	GFSK, LOW and HIGH channel GFSK, Hopping
§15.247(d) Radiated spurious emissions, 30 MHz – 26 GHz	GFSK modulation, HIGH channel

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	14-Mar-2022
Nemko sample ID number	460990

3.2 EUT information

Product name	Bus Validator
Model	Validator 3.0
Serial number	N/A
Part number	N/A

3.3 Technical information

Frequency band	2400 – 2483.5 MHz
Minimum frequency (MHz)	2402
Maximum frequency (MHz)	2480
Type of modulation	Bluetooth + EDR: - GFSK - π/4-DQPSK - 8-DPSK
Power requirements	24 V DC powered via AC/DC adaptor
Antenna information	1.8 dBi gain, Pulse Chip antenna PN: W3006

3.4 EUT exercise and monitoring details

The EUT was controlled by support laptop running scripts to configure the EUT to transmit BT+EDR signals at max power while on the Low, Middle, and High channels or Hopping—as applicable per test.

Table 3.4-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
Bus Validator	Cubic Transportation Systems	Validator 3	n/a	n/a

Table 3.4-2: *EUT interface ports*

Description	Qty.
Serial cable	1
Ethernet cable	1
DC input	1

Table 3.4-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	143306	n/a
AC/DC adaptor	XP Power	VER36US240-JA	n/a	n/a
PC	Dell	Latitude 7480	ID IT2381	n/a

Table 3.4-4: *Inter-connection cables*

Cable description	From	To	Length (m)
DC power	EUT (Equipment Under Test)	Power source	2.0 m
Serial cable	EUT (Equipment Under Test)	PC	1.5 m

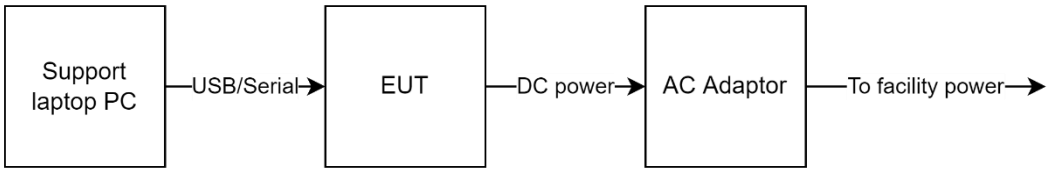


Figure 3.4-1: Test setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15-30 °C
Relative humidity	20-75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78
Powerline conducted emissions	1.38
All antenna port measurements	0.55
Conducted spurious emissions	1.13

Section 7 Test Equipment

Table 6.1-1: *Test Equipment List*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESU40	E1131	1 year	02-Mar-2023
System Controller	Sunol Sciences	SC 104V	E1191	NCR	NCR
Antenna, Bilog	Schaffner-Chase	CBL 6111D	1763	2 years	18-May-2022
Antenna, DRG Horn	ETS-Lindgren	3117-PA	E1139	2 years	19-Apr-2023
Filter, 2.4GHz	N/A	N/A	--	NCR	NCR
High pass filter	Wainwright Instruments	WHKX10-5850-6500	E1208	NCR	NCR

Notes: NCR - no calibration required

Table 6.1-2: *Test Software*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15 (radiated emissions)

Notes: None

Section 8 Testing data

8.1 FCC 15.247(b) and RSS-247 5.4 (b) Transmitter output power and e.i.r.p. requirements

8.1.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(b)(2) / (3)

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(4) The conducted output power limit specified in paragraph (b) of this Section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this Section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this Section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 → §5.4(b)

(b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

8.1.2 Test summary

Verdict	Pass

8.1.3 Notes

No testing was performed. The EIRP was calculated on the basis of test data from the original test report on the “Test-Report-3863433”. EIRP was re-calculated from the original test data using the new manufacturer declared antenna gain.

Manufacturer declared antenna gain: 1.8 dBi.

8.1.4 Test data

Table 8.1-1: *Output power*

Operating Mode	Test Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Limit (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
GFSK	2402	7.27	30.0	1.8	9.07	36.0
GFSK	2440	6.62	30.0	1.8	8.42	36.0
GFSK	2480	5.44	30.0	1.8	7.24	36.0
π/4-DQPSK	2402	8.28	30.0	1.8	10.08	36.0
π/4-DQPSK	2440	7.61	30.0	1.8	9.41	36.0
π/4-DQPSK	2480	6.42	30.0	1.8	8.22	36.0
8-DPSK	**2402**	**8.43**	**30.0**	**1.8**	**10.23**	**36.0**
8-DPSK	2440	7.87	30.0	1.8	9.67	36.0
8-DPSK	2480	6.72	30.0	1.8	8.52	36.0

8.2 FCC 15.247(d) and RSS-247 5.5 Radiated restricted band-edges and spurious emission

8.2.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(d)

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 → §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.2-1: *FCC §15.209– Radiated emission limits*

Frequency, MHz	Field strength of emissions µV/m	Field strength of emissions dBµV/m	Measurement distance, m
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Table 8.2-2: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.2.2 Test summary

Verdict	Pass		
Test date	March 18, 2022 March 24, 2022	Temperature	22 °C 22 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1008 mbar 1004 mbar
Test location	3m semi-anechoic chamber (Radiated)	Relative humidity	54 % 44 %

8.2.3 Notes

The EUT was configured to transmit continuously on the lowest, middle and highest channels.

The spectrum was search from 30 MHz to 26 GHz (above the 10th harmonic of the highest transmit frequency).

Radiated measurements were performed at a 3 m measurement distance.

8.2.4 Setup details

EUT setup configuration	Tabletop
Test facility	Nemko San Diego
Measurement details	Radiated spurious emissions measurement performed as per C63.10 §11.12

Receiver settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (preview measurements) Quasi-Peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

Receiver settings for radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average and peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

8.2.5 Test data

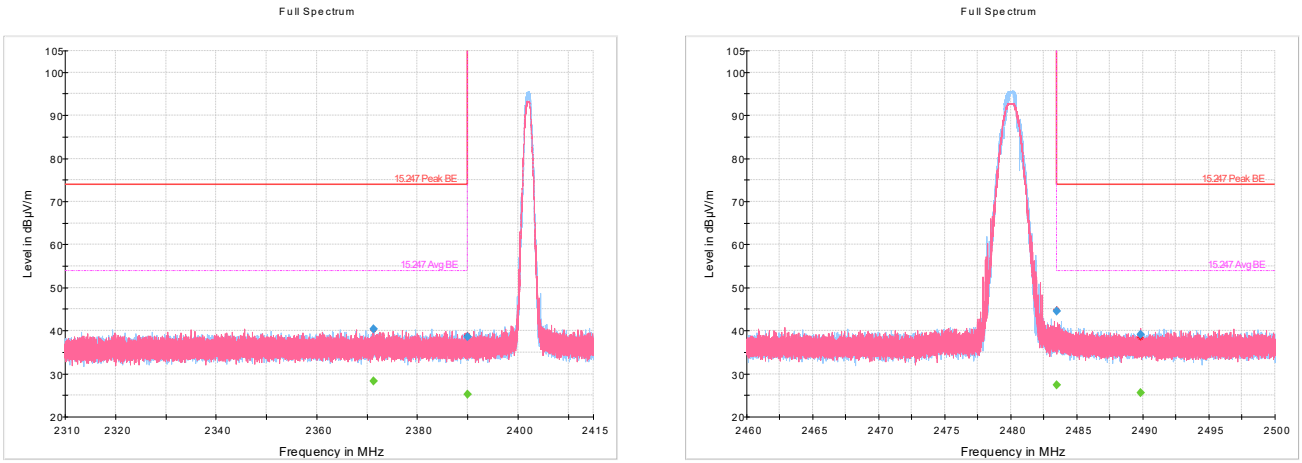


Figure 8.2-1: *Radiated emissions, restricted band edge, GFSK, LOW and HIGH channels respective*

Table 8.2-2: *Radiated emissions, restricted band edge, GFSK (Low Channel)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2371.348000	---	28.27	53.90	25.63	5000.0	1000.000	341.0	H	11.0	-10.1
2371.348000	40.40	---	73.90	33.50	5000.0	1000.000	341.0	H	11.0	-10.1
2390.000000	---	25.31	53.90	28.59	5000.0	1000.000	344.0	V	236.0	-10.0
2390.000000	38.64	---	73.90	35.26	5000.0	1000.000	344.0	V	236.0	-10.0

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

Table 8.2-3: *Radiated emissions, restricted band edge, GFSK (High Channel)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	---	27.47	53.90	26.43	5000.0	1000.000	108.0	V	192.0	-9.7
2483.500000	44.53	---	73.90	29.37	5000.0	1000.000	108.0	V	192.0	-9.7
2489.829333	---	25.57	53.90	28.33	5000.0	1000.000	110.0	V	197.0	-9.6
2489.829333	39.12	---	73.90	34.78	5000.0	1000.000	110.0	V	197.0	-9.6

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

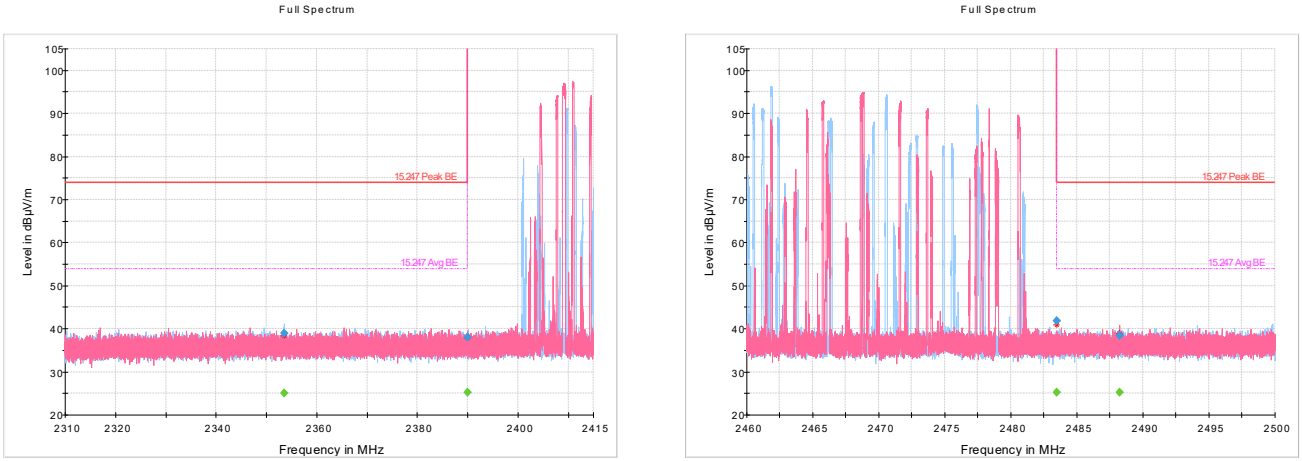


Figure 8.2-2: *Radiated emissions, restricted band edge, GFSK, Hopping*

Table 8.2-4: *Radiated emissions, restricted band edge, GFSK (Hopping, Low band edge)*

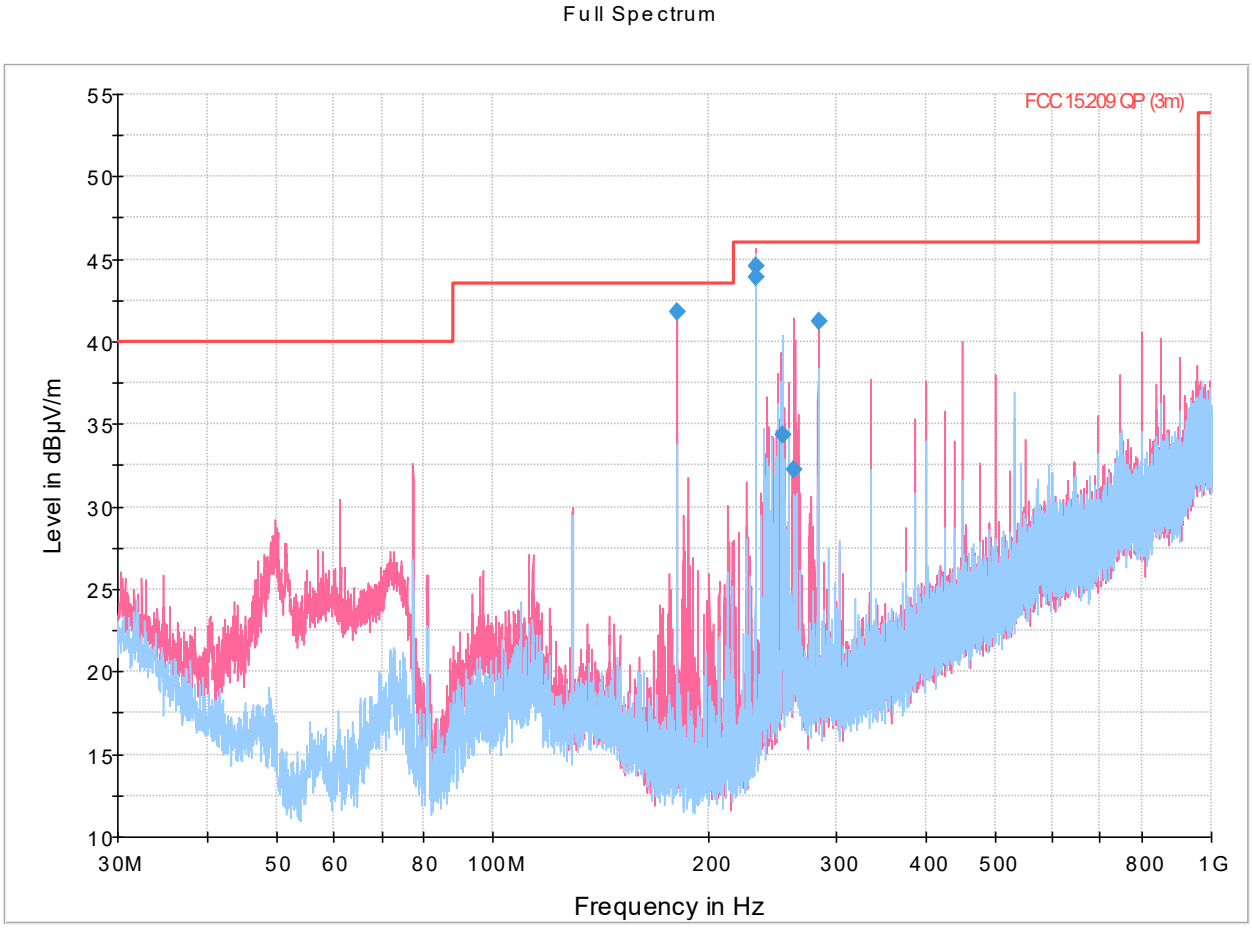
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2353.491000	---	25.03	53.90	28.87	5000.0	1000.000	152.0	H	107.0	-10.1
2353.491000	39.00	---	73.90	34.90	5000.0	1000.000	152.0	H	107.0	-10.1
2390.000000	---	25.24	53.90	28.66	5000.0	1000.000	266.0	H	152.0	-10.0
2390.000000	37.99	---	73.90	35.91	5000.0	1000.000	266.0	H	152.0	-10.0

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

Table 8.2-5: *Radiated emissions, restricted band edge, GFSK (Hopping, High band edge)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	---	25.30	53.90	28.60	5000.0	1000.000	164.0	V	0.0	-9.7
2483.500000	41.76	---	73.90	32.14	5000.0	1000.000	164.0	V	0.0	-9.7
2488.229333	---	25.23	53.90	28.67	5000.0	1000.000	222.0	V	218.0	-9.6
2488.229333	38.41	---	73.90	35.49	5000.0	1000.000	222.0	V	218.0	-9.6

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)



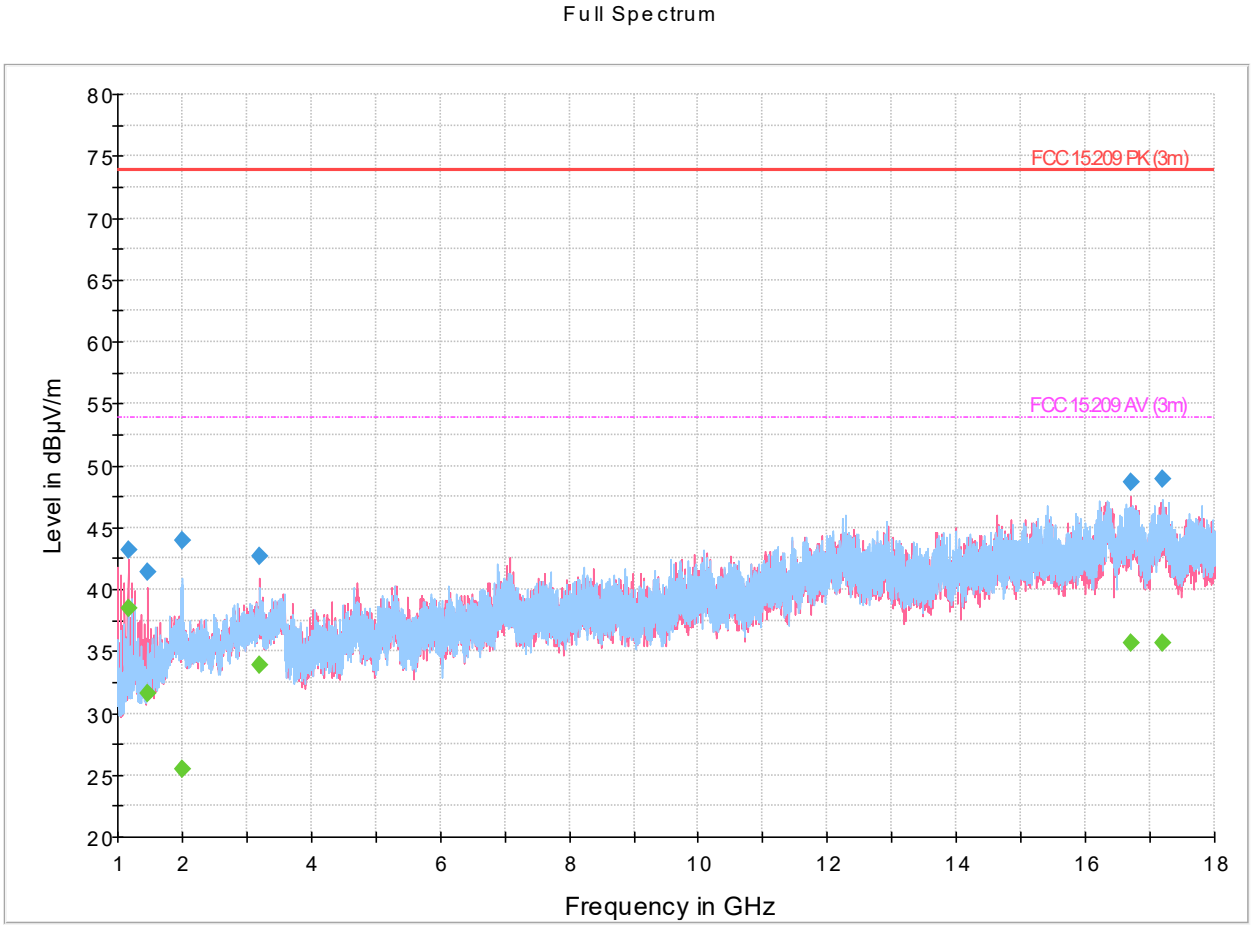
The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 8.2-3: *Radiated spurious emissions, GFSK, 30-1000 MHz spectral plot (2480 MHz)*

Table 8.2-6: *Radiated spurious emissions, GFSK, 30-1000 MHz (2480 MHz) (Quasi-Peak) results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
180.467000	41.80	43.50	1.70	5000.0	120.000	100.0	V	356.0	16.3
232.006333	44.58	46.00	1.42	5000.0	120.000	132.0	V	80.0	17.9
232.031000	43.91	46.00	2.09	5000.0	120.000	100.0	H	108.0	17.9
252.754000	34.37	46.00	11.63	5000.0	120.000	120.0	H	118.0	20.6
262.449000	32.25	46.00	13.75	5000.0	120.000	154.0	V	11.0	22.1
283.578000	41.24	46.00	4.76	5000.0	120.000	154.0	V	44.0	20.9

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] Limits converted to dBµV/m and an inverse proportionality factor of 20 dB per decade has been used to normalize the specification limit to a measurement distance of 3 meters to determine compliance.



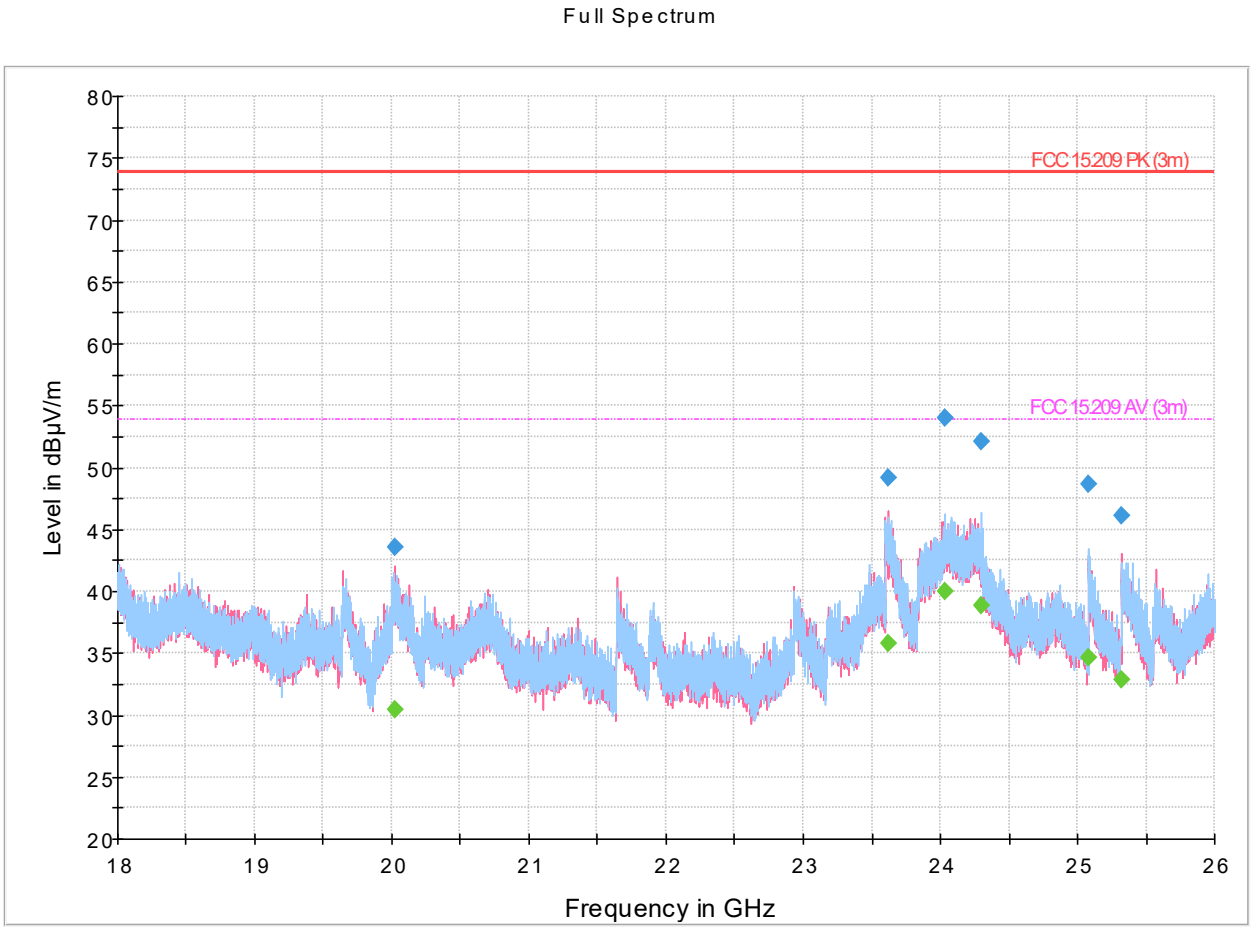
The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

***Figure 8.2-4**: Radiated spurious emissions, BLE, 1-18 GHz spectral plot* (2462 MHz)

***Table 8.2-7:** Radiated spurious emissions, BLE, 1-18 GHz results (2462 MHz)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1160.200000	43.20	---	73.90	30.70	5000.0	1000.000	171.0	V	32.0	-14.5
1160.200000	---	38.47	53.90	15.43	5000.0	1000.000	171.0	V	32.0	-14.5
1469.033333	41.43	---	73.90	32.47	5000.0	1000.000	196.0	V	355.0	-15.0
1469.033333	---	31.55	53.90	22.35	5000.0	1000.000	196.0	V	355.0	-15.0
2004.933333	---	25.48	53.90	28.42	5000.0	1000.000	179.0	H	264.0	-10.8
2004.933333	43.97	---	73.90	29.93	5000.0	1000.000	179.0	H	264.0	-10.8
3197.933333	---	33.94	53.90	19.96	5000.0	1000.000	287.0	V	42.0	-7.1
3197.933333	42.68	---	73.90	31.22	5000.0	1000.000	287.0	V	42.0	-7.1
16701.933333	48.70	---	73.90	25.20	5000.0	1000.000	143.0	V	244.0	14.7
16701.933333	---	35.62	53.90	18.28	5000.0	1000.000	143.0	V	244.0	14.7
17202.333333	48.89	---	73.90	25.01	5000.0	1000.000	375.0	H	0.0	15.0
17202.333333	---	35.72	53.90	18.18	5000.0	1000.000	375.0	H	0.0	15.0

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)
A 2.4 GHz notch filter was used to remove the fundamental carrier frequency



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

***Figure 8.2-5**: Radiated spurious emissions, GFSK, 18-26 GHz (2480 MHz) spectral plot*

***Table 8.2-8:** Radiated spurious emissions, GFSK, 18-26 GHz results (2480 MHz)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20020.500000	---	30.39	53.90	23.51	5000.0	1000.000	368.0	V	266.0	18.5
20020.500000	43.58	---	73.90	30.32	5000.0	1000.000	368.0	V	266.0	18.5
23626.100000	---	35.81	53.90	18.09	5000.0	1000.000	311.0	V	285.0	25.7
23626.100000	49.13	---	73.90	24.77	5000.0	1000.000	311.0	V	285.0	25.7
24036.500000	---	39.97	53.90	13.93	5000.0	1000.000	353.0	H	228.0	29.7
24036.500000	54.00	---	73.90	19.90	5000.0	1000.000	353.0	H	228.0	29.7
24302.900000	52.08	---	73.90	21.82	5000.0	1000.000	207.0	H	92.0	28.2
24302.900000	---	38.88	53.90	15.02	5000.0	1000.000	207.0	H	92.0	28.2
25084.900000	---	34.69	53.90	19.21	5000.0	1000.000	410.0	H	331.0	24.4
25084.900000	48.63	---	73.90	25.27	5000.0	1000.000	410.0	H	331.0	24.4
25326.900000	46.12	---	73.90	27.78	5000.0	1000.000	225.0	V	174.0	23.4
25326.900000	---	32.89	53.90	21.01	5000.0	1000.000	225.0	V	174.0	23.4

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up

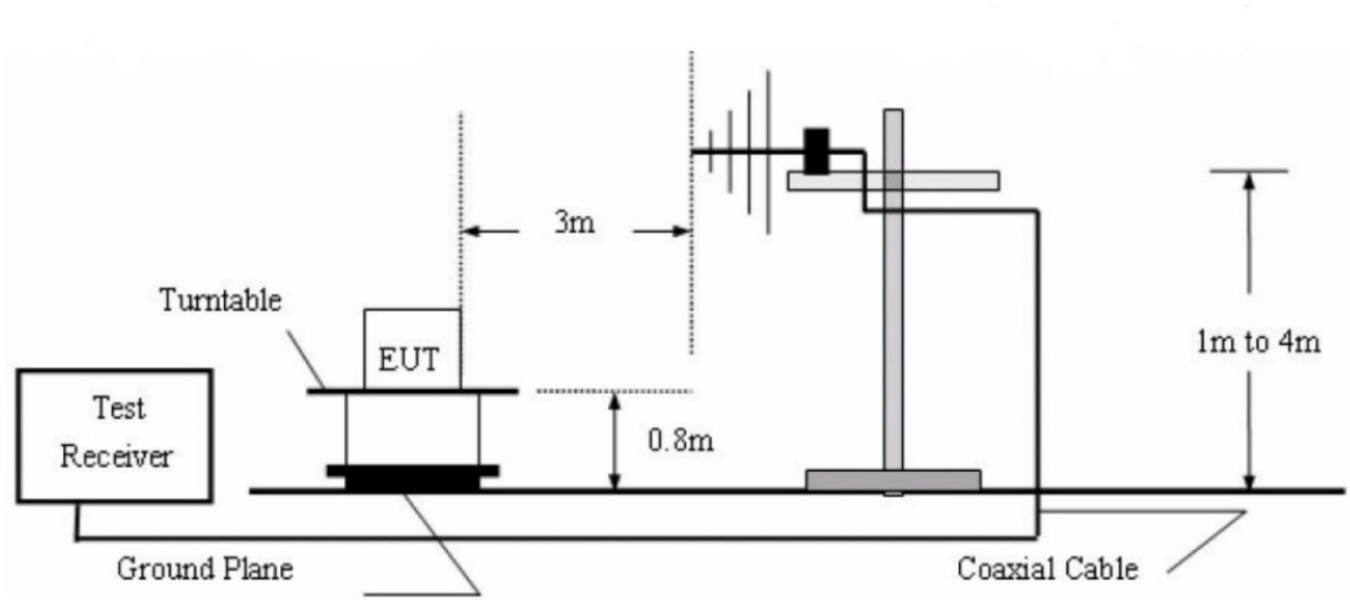


Figure 9.1-1: *30 MHz - 1000 MHz Setup*

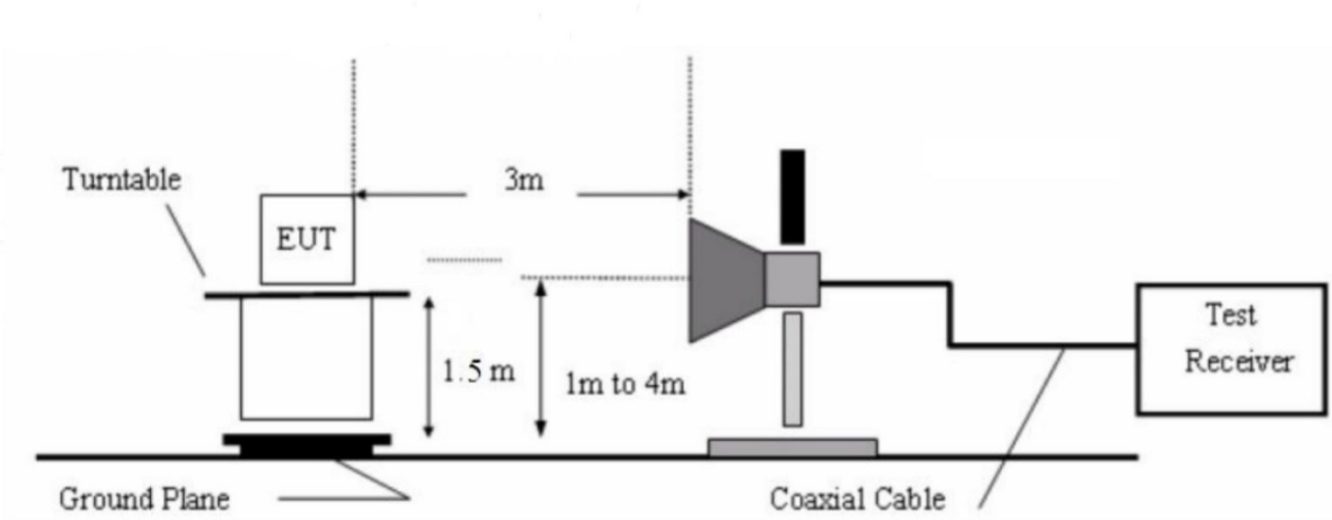


Figure 9.1-2: *1 GHz - 26 GHz Setup*