Element Materials Technology
(formerly PCTEST)
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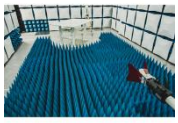


PART 25 MEASUREMENT REPORT

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
01/17/2025 - 08/03/2025
Test Report Issue Date:
8/3/2025
Test Site/Location:
Element Materials Technology Morgan Hill, CA, USA
Test Report Serial No.:
1C2503270029-03.BCG

FCC ID:	**BCG-A3281**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A3281, A3282
EUT Type:	Watch
FCC Classification:	Licensed Non-Broadcast Transmitter Worn on Body (TNT)
FCC Rule Part:	25
Test Procedure(s):	ANSI C63.26-2015, KDB 971168 D01 v03r01

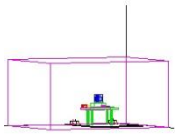
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

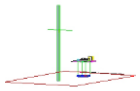
RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.02

TABLE OF CONTENTS



PART 25 MEASUREMENT REPORT



Bandwidth	Tx Frequency [MHz]	OBW [MHz]	EIRP		Emission Designator
			Max. Power [mW]	Max. Power [dBm]	
200kHz	1610.2	0.2093	57.810	17.62	209KG1D
	1618.0	0.2080	58.749	17.69	208KG1D
	1626.0	0.2034	58.345	17.66	203KG1D

EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

1.2 Element Test Location

These measurement tests were conducted at the Element Materials Technology facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology.

- Element Materials Technology is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Materials Technology facility is a registered (22831) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutal Recognition Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A3281**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 25.

Test Device Serial No.: FN6HG1000GN0000VL1, FN6HG1000DF0000VL1, W7Y9YP320W, YMHWMV7H7D, T262Q5T4CQ

2.2 Device Capabilities

This device contains the following capabilities:

Multi-band LTE, 5G NR (FR1), 802.11b/g/n WLAN, 802.11a/n UNII, 802.15.4ab-NB, Bluetooth (1x, EDR, HDR4, HDR8, LE1M, LE2M), NFC, UWB, 60.5GHz Transmitter, Mobile Satellite Service (MSS).

This device supports only 15kHz subcarrier spacings with BPSK modulation.

This device supports simultaneous transmission operations, which allows multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Simultaneous Tx Config	Antenna FCM					
	WLAN	Bluetooth	802.15.4ab - NB	LTE/FR1	UNII	UWB
	802.11b/g/n	BDR, EDR, HDR4/8, LE1/2M	O-QPSK	Mid/High Band	802.11a/n	Ch.5/Ch.9
Config 1	✓	×	×	✓	×	✓
Config 2	×	✓	×	✓	×	✓
Config 3	×	✓	✓	✓	×	×
Config 4	✓	×	✓	✓	×	×
Config 5	×	✓	×	✓	✓	×
Config 6	×	✓	×	✓	×	✓
Config 7	✓	×	×	✓	×	×
Config 8	✓	×	✓	×	×	×
Config 9	✓	×	×	×	×	✓
Config 10	×	✓	×	×	✓	×
Config 11	×	✓	×	✓	×	×
Config 12	×	✓	✓	×	×	×
Config 13	×	✓	×	×	×	✓
Config 14	×	×	✓	✓	×	×
Config 15	×	×	×	✓	✓	×
Config 16	×	×	×	✓	×	✓

Table 2-1. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All the above simultaneous transmission configurations have been tested, and the worst-case configuration was found to be Config 5 and reported in RF Bluetooth, RF UNII, and RF FCC Part 27b test reports.

2.3 Antenna Description

The following antenna gain provided by the manufacturer were used for testing.

Band	Antenna Gain [dBi]
	Antenna FCM
1610MHz – 1626.5MHz	-9.40

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	FVFDHG8TP3XY
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB-C cable	Model:	N/A	S/N:	N/A
	w/ Charging Dock	Model:	A2921	S/N:	DQ8137601MY08V22F
	w/ Cradle	Model:	N/A	S/N:	CYV142700BEE1EN01MP1P
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC313306ZQ1NR1A7
	Apple Magnetic Charger	Model:	A2879	S/N:	DLCH5T0012A00000WB
4	Pathfinder Davenport	Model:	920-15901-01	S/N:	DLCH640006H0000QA0
	SiP Socket	Model:	P2 N230 PF 238	S/N:	DLCHB60007Q0000Q45
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-3. Test Support Equipment

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

The worst case configuration was investigated for the various types of wristbands, metal and non-metal wristbands. The EUT was also investigated with and without wireless charger. The worst case configuration found was used for all testing.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

2.6 Software and Firmware

Testing was performed on device(s) using firmware version watchOS 26 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the documents titled “American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services” (ANSI C63.26-2015) and “Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems” (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..……..None

3.2 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;\ \text{where D is the measurement distance in meters.}$$

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012.All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	2.07
Radiated Disturbance (<30MHz)	4.12
Radiated Disturbance (30MHz-1GHz)	4.85
Radiated Disturbance (1-18GHz)	5.08
Radiated Disturbance (>18GHz)	5.22

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance with the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	3Hz-26.5GHz PXA Signal Analyzer	10/31/2024	Annual	10/31/2025	MY55330128
ATM	180-442-KF	20dB Nominal Gain Horn Antenna	3/24/2025	Annual	3/24/2026	T058601-02
ESPEC	SU-241	Tabletop Temperature Chamber	10/24/2024	Annual	10/24/2025	92009574
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	9/25/2024	Annual	9/25/2025	240109
Fairview Microwave	FMCA1975-36	30MHz-40GHz Conducted Cable *	6/17/2025	Annual	6/17/2026	-
Fairview Microwave	M2CP1122-10	30MHz-40GHz Conducted Coupler *	6/17/2025	Annual	6/17/2026	1946
Keysight Technology	N9040B	UXA Signal Analyzer	6/9/2025	Annual	6/9/2026	MY57212015
MCL	BW-K10-2W44+	Attenuator *	6/17/2025	Annual	6/17/2026	-
Rohde & Schwarz	ESW44	EMI Test Receiver	10/17/2024	Annual	10/17/2025	101668
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/20/2025	Annual	5/20/2026	101619
Rohde & Schwarz	FSW67	Signal and Spectrum Analyzer (2Hz-67GHz)	1/7/2025	Annual	1/7/2026	101366
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/14/2024	Annual	8/14/2025	101648
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	12/10/2024	Annual	12/10/2025	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	3/4/2025	Annual	3/4/2026	164715
Rohde & Schwarz	HFH2-Z2	Loop Antenna	5/12/2025	Annual	5/12/2026	100546
Rohde & Schwarz	HFH2-Z2	Loop Antenna	6/26/2025	Annual	6/26/2026	100519
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/3/2025	Annual	6/3/2026	100052
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	11/15/2024	Annual	11/15/2025	102326
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	9/18/2024	Annual	9/18/2025	358

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. * Denotes passive equipment that has been internally verified/calibrated.

6.0 SAMPLE CALCULATIONS

Emission Designator

BPSK Modulation

Emission Designator = 8M62G7W
BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination of Any

Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A3281

FCC Classification: Licensed Non-Broadcast Transmitter Worn on Body (TNT)

Mode(s): MSS

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
	Occupied Bandwidth	2.1049	N/A	**N/A**	Section 7.2
	Conducted Emission Mask	2.1051, 25.202(f)	Must meet the limits specified in 25.202(f)	**PASS**	Section 7.3
	Conducted Spurious Emissions			**PASS**	Section 7.4
	Transmitter Conducted Output Power	2.1046, 25.204(a)	Must meet the limits specified in 25.204(a)	**PASS**	Section 7.5
	Frequency Stability	25.202(d)	< 0.001% of reference frequency	**PASS**	Section 7.8
RADIATED	Radiated Spurious Emissions	25.202(f)	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions	**PASS**	Section 7.6
	Radiated Spurious Emissions (1559 - 1610MHz)	25.216(c), (g)	< -70dBW/MHz for emissions in the band 1559 - 1605MHz < -10dBW/MHz at 1610MHz	**PASS**	Section 7.7
	Carrier-Off State Emissions (1559 - 1610MHz)	25.216(i)	< -80dBW/MHz for emissions in the band 1559 - 1610MHz	**PASS**	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4. For radiated emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 3.4.2.

7.2 Occupied Bandwidth

§2.1049

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

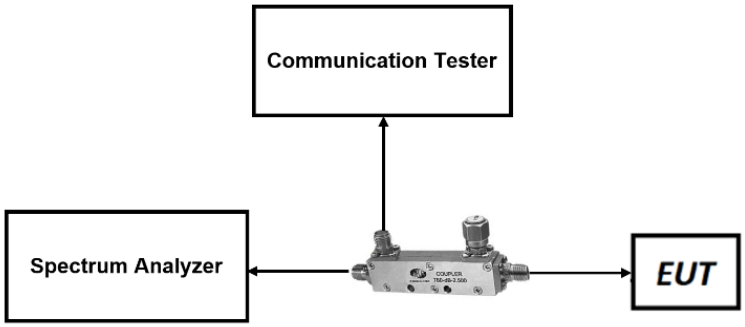


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

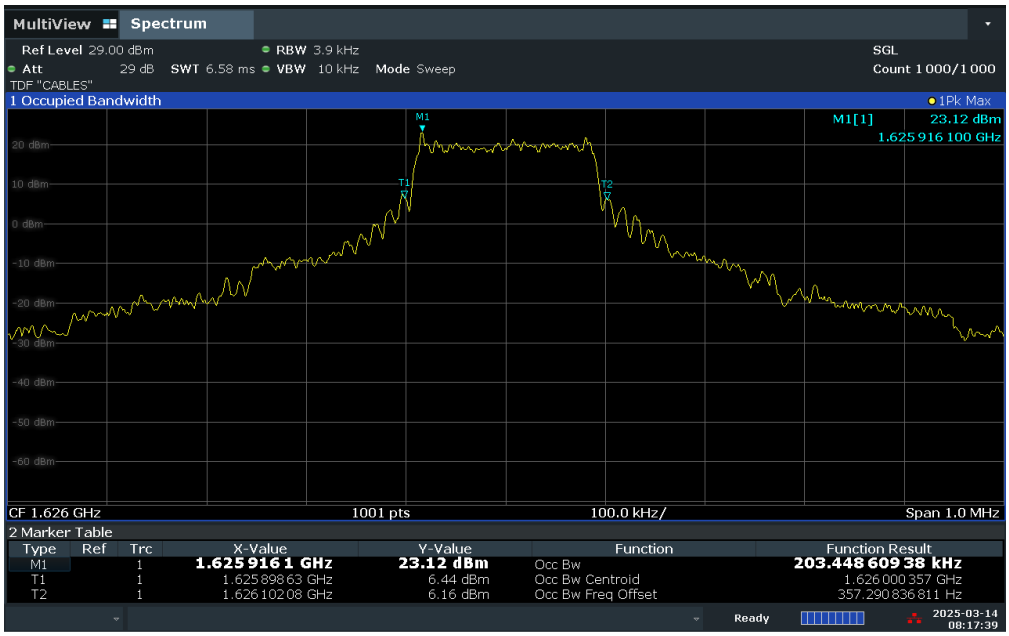
None.

08:04:55 AM 03/14/2025

Plot 7-1. Occupied Bandwidth Plot (Low Channel)

08:11:22 AM 03/14/2025

Plot 7-2. Occupied Bandwidth Plot (Mid Channel)



Plot 7-3. Occupied Bandwidth Plot (High Channel)

7.3 Conducted Emissions Mask

§2.1051; §25.202(f)

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Per FCC Part 25.202(f):

Emission limitations.

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

Test Procedure Used

ANSI C63.26-2015 – Section 5.7

Test Settings

1. EUT is connected to the spectrum analyzer.
2. Highest Power within the transmitting signal is measured.
3. Worst Case Emissions are identified and measured
4. RBW ≥ 4kHz
5. VBW ≥ 3 x RBW
6. Detector = RMS
7. Trace mode = trace average
8. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

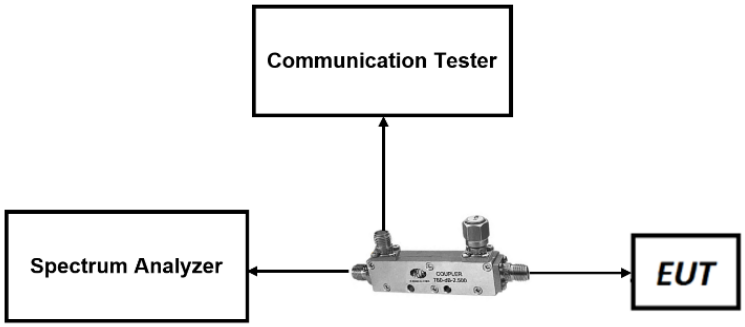
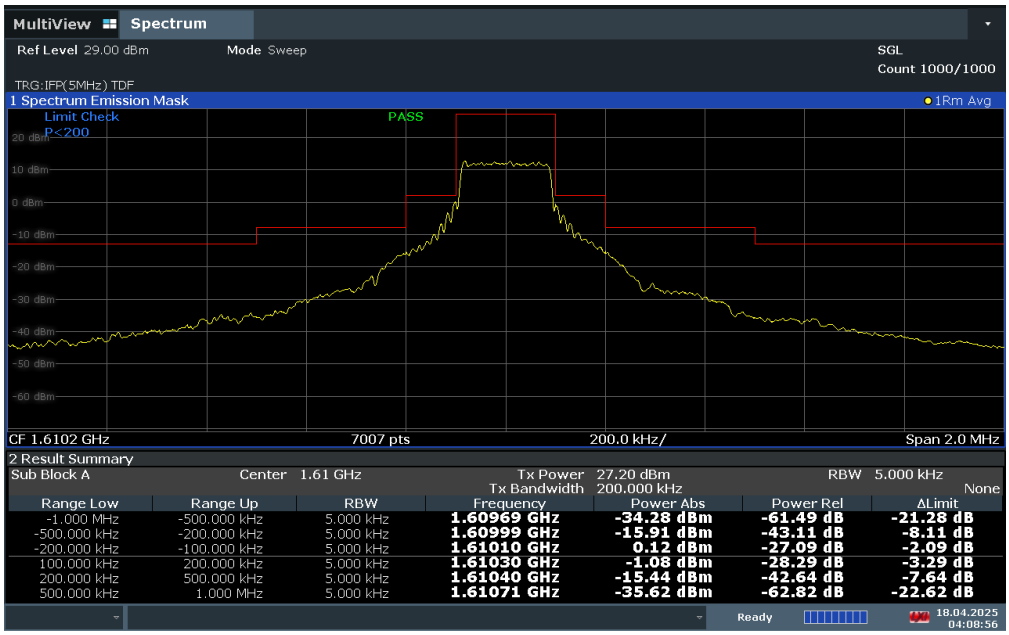


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

1. For the purposes of the emission mask testing in this section, the manufacturer has declared an authorized bandwidth of 200kHz.

2. Due to measurement equipment limitations, an RBW of 4KHz is not available. To ensure worst-case results an RBW = 5kHz was utilized for conducted emission mask measurements.



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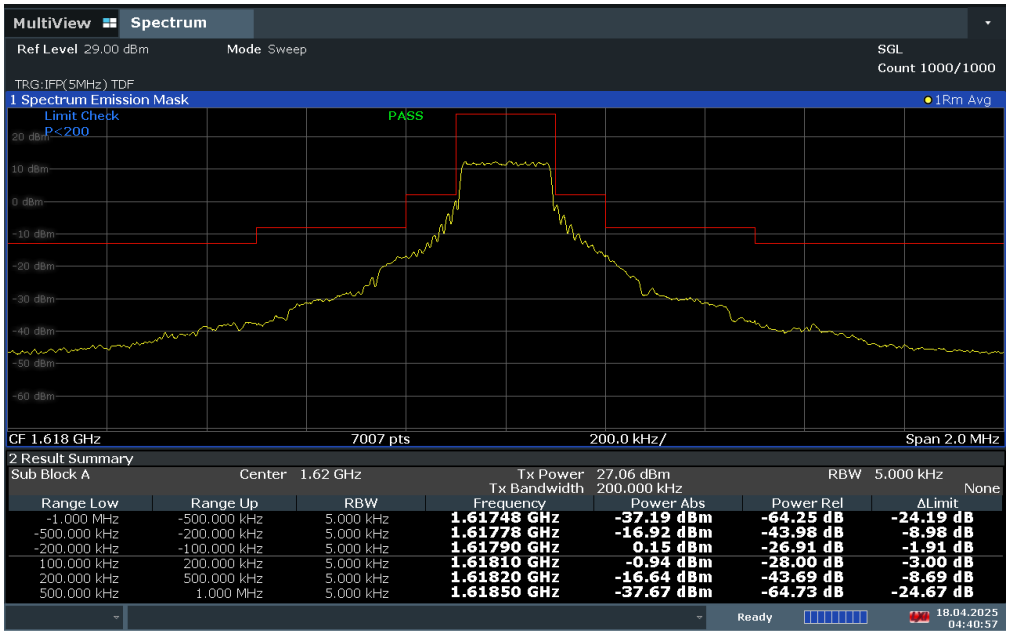
Plot 7-4. Low Channel Conducted Emission Mask



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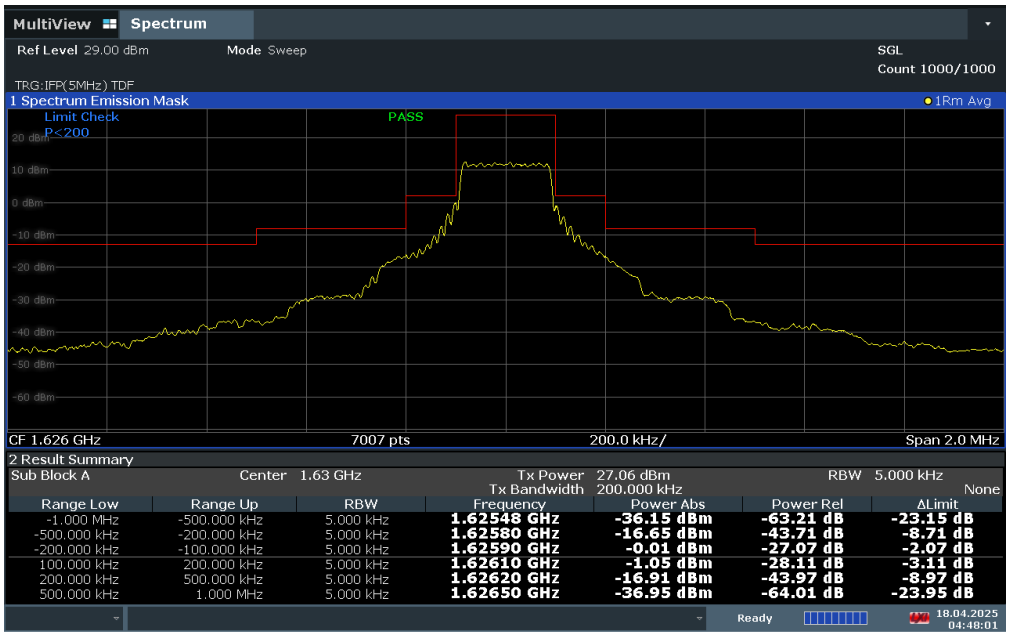
Plot 7-5. Mid Channel Conducted Emission Mask



04:48:02 18.04.2025

Plot 7-6. High Channel Conducted Emission Mask

7.4 Conducted Spurious Emission

§2.1051; §25.202(f)

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

Per FCC Part 25.202(f):

Emission limitations.

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts

Test Procedure Used

ANSI C63.26-2015 – Section 5.7

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 20GHz
2. RBW ≥ 100kHz
3. VBW = 3 x RBW
4. Detector = RMS
5. Number of sweep points ≥ 2 x Span/RBW
6. Trace mode = max hold
7. Sweep time = auto couple
8. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

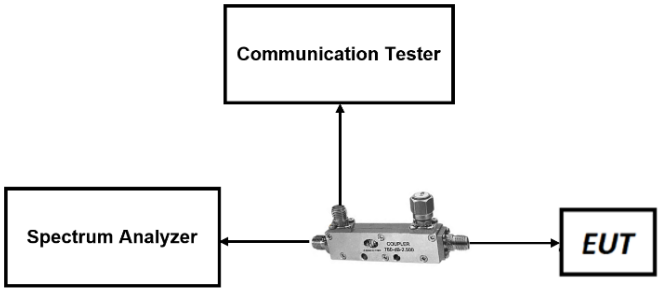
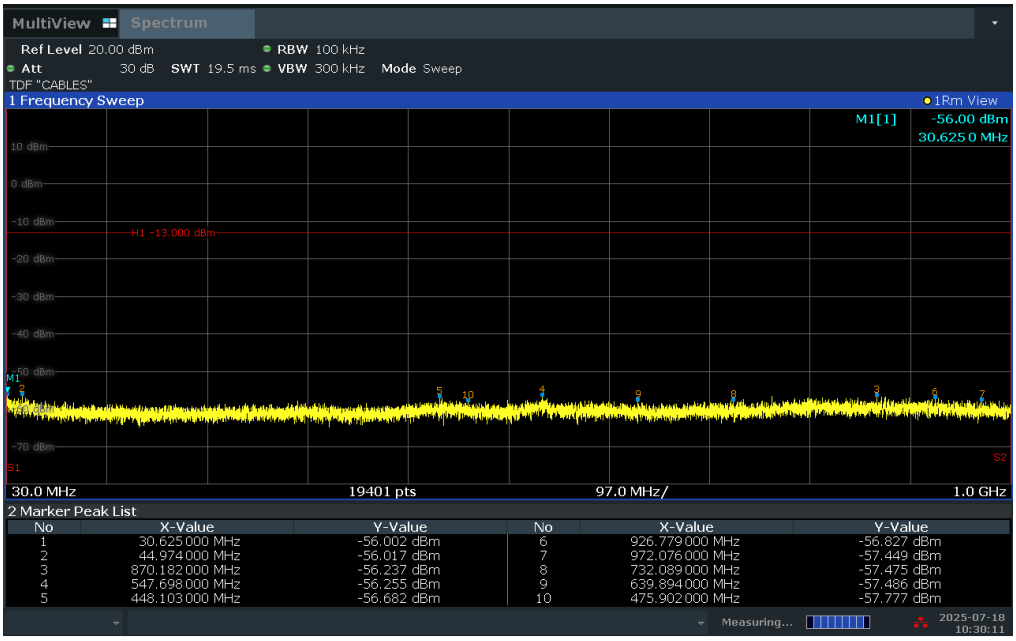


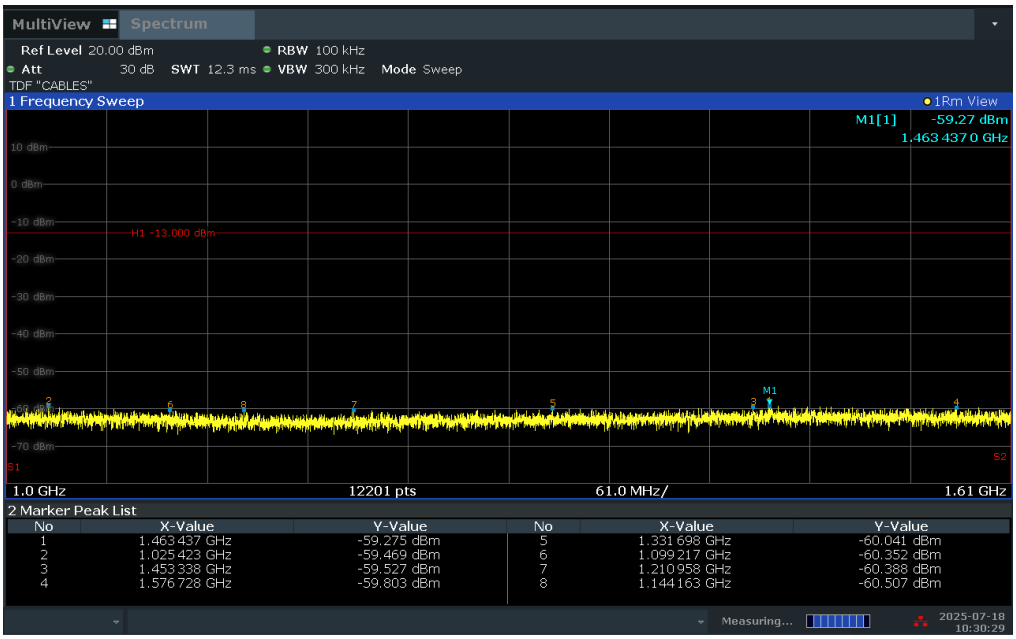
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

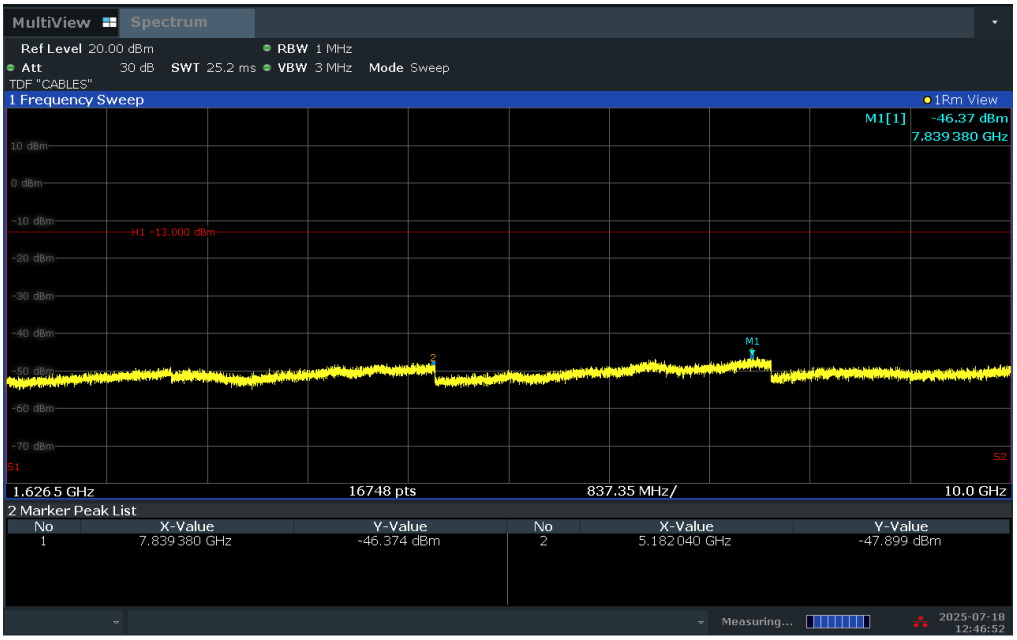
None.



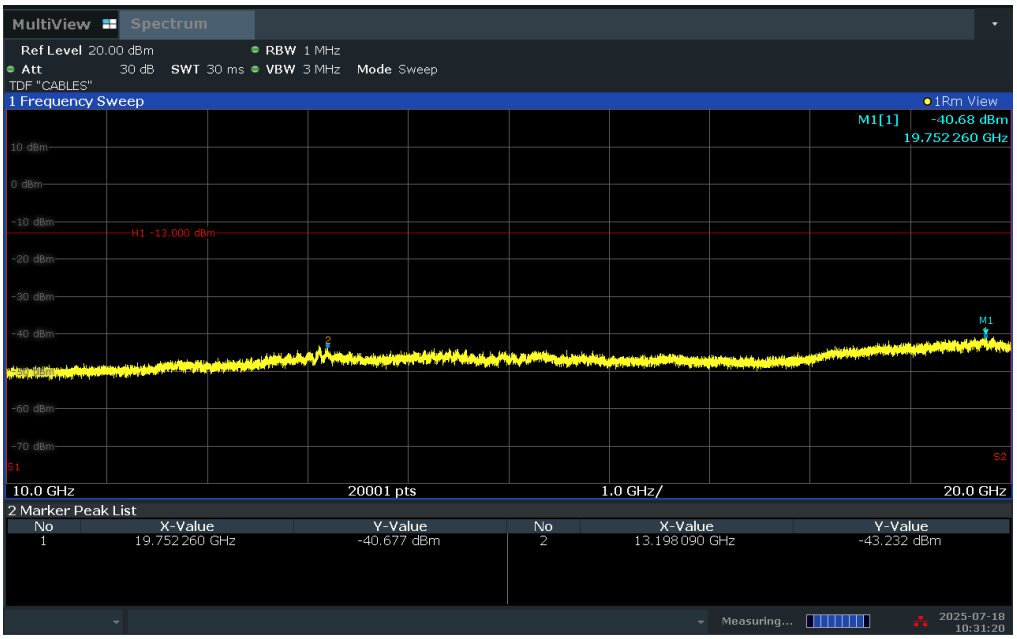
Plot 7-7. Conducted Spurious Emission (Low Channel)



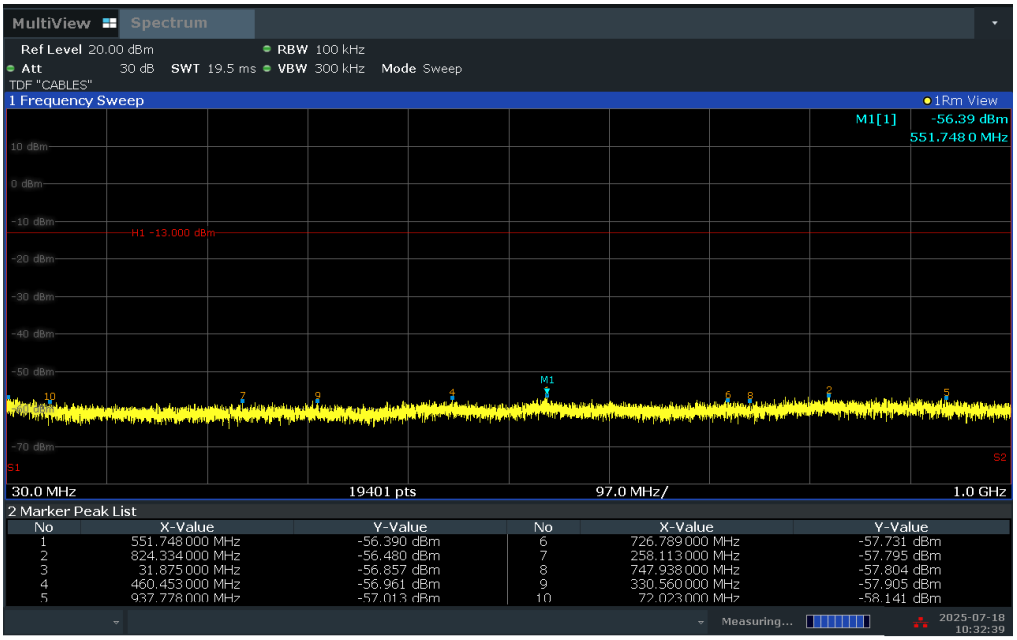
Plot 7-8. Conducted Spurious Emission (Low Channel)



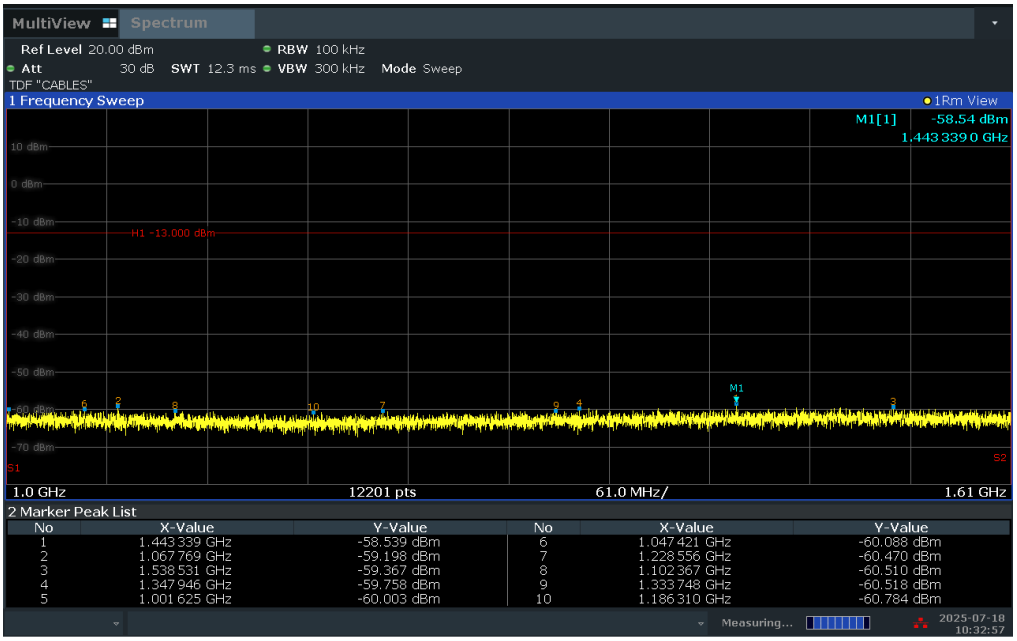
Plot 7-9. Conducted Spurious Emission (Low Channel)



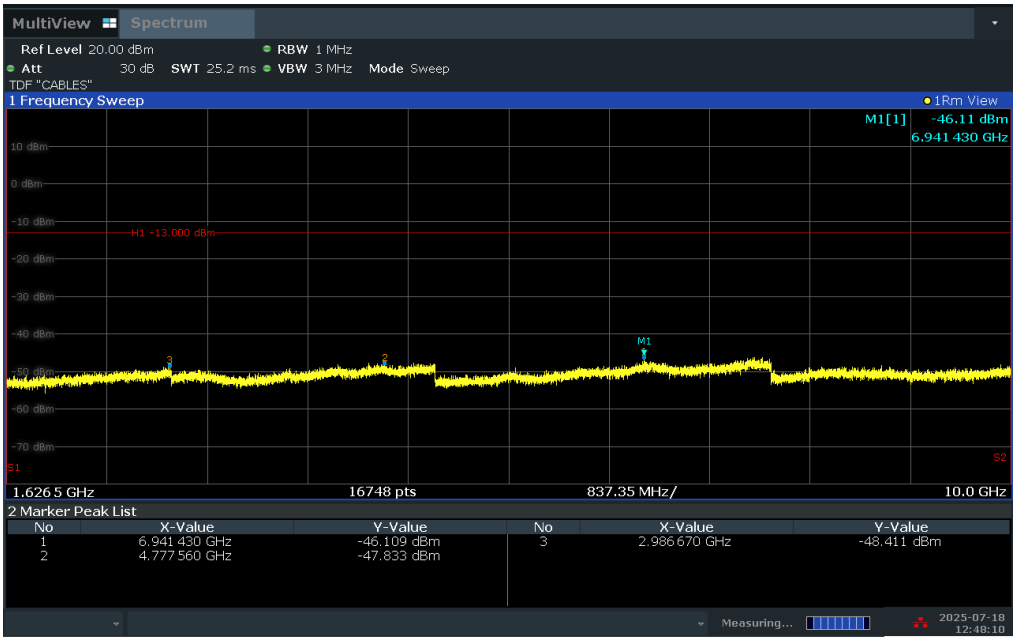
Plot 7-10. Conducted Spurious Emission (Low Channel)



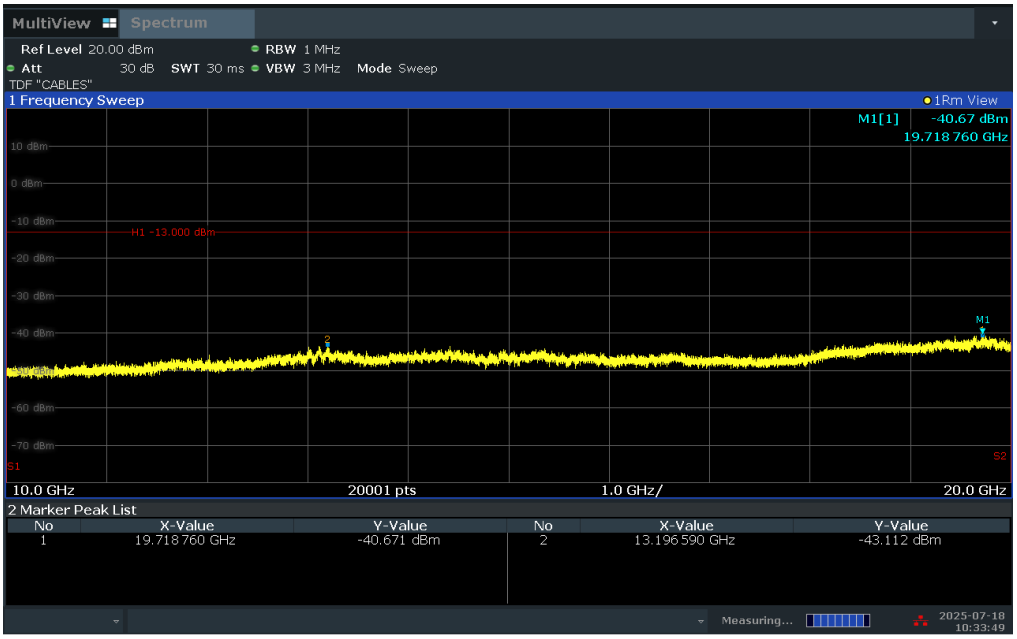
Plot 7-11. Conducted Spurious Emission (Mid Channel)



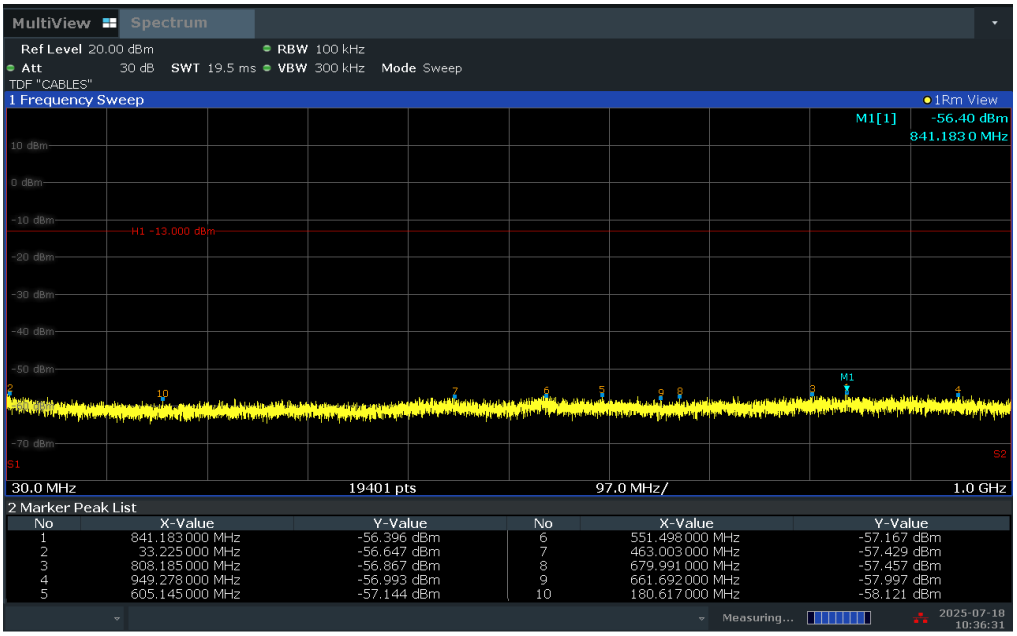
Plot 7-12. Conducted Spurious Emission (Mid Channel)



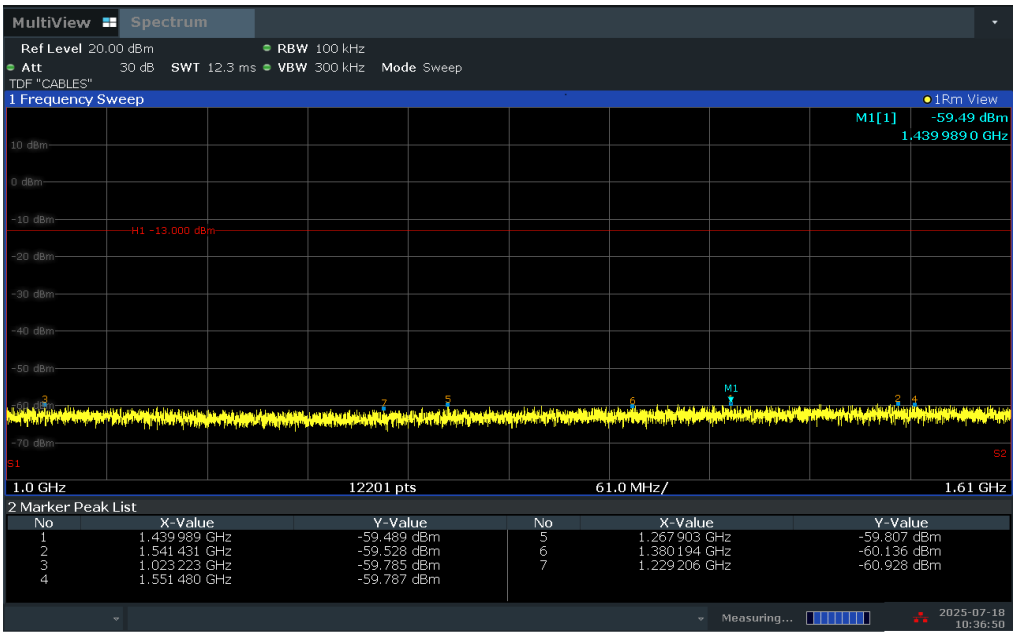
Plot 7-13. Conducted Spurious Emission (Mid Channel)



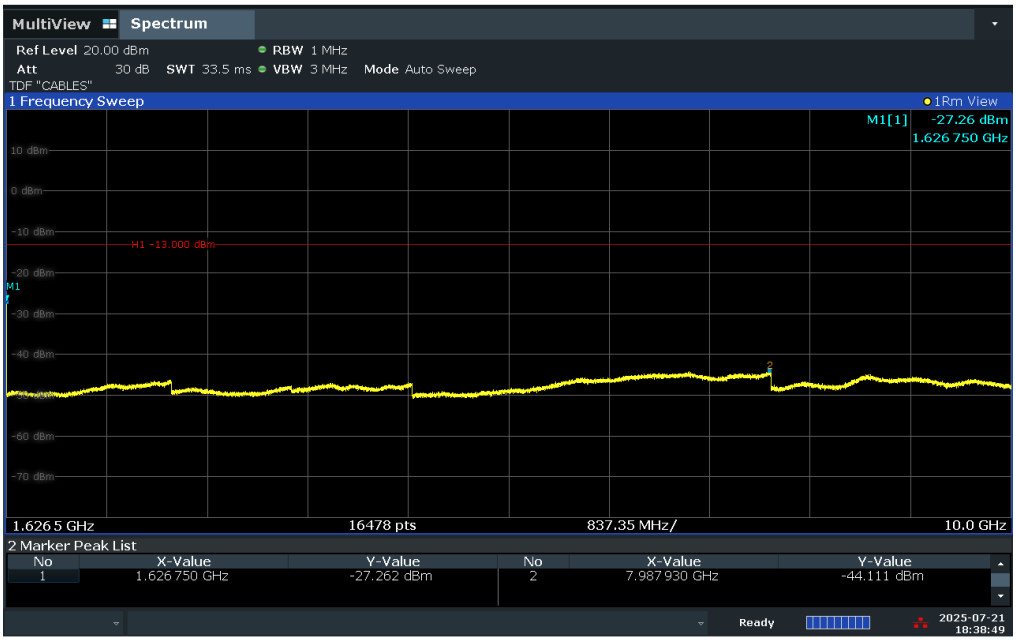
Plot 7-14. Conducted Spurious Emission (Mid Channel)



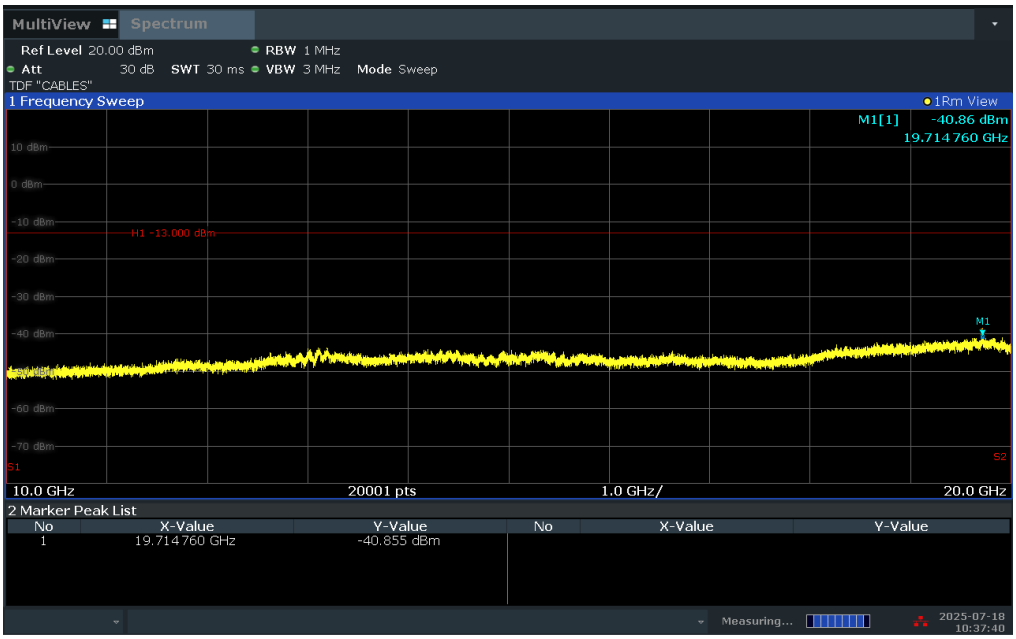
Plot 7-15. Conducted Spurious Emission (High Channel)



Plot 7-16. Conducted Spurious Emission (High Channel)



Plot 7-17. Conducted Spurious Emission (High Channel)



Plot 7-18. Conducted Spurious Emission (High Channel)

7.5 Conducted Output Power

§2.1046; §25.204(a)

Test Overview and Limit

Equivalent Isotropic Radiated Power (EIRP) measurements are calculated by adding the highest antenna gain to maximum measured conducted output power. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

40 dBW in any 4 kHz band for θ ≤ 0°

40 dBW + 3θ dBW in any 4 kHz band for 0° < θ ≤ 5°

where θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1
ANSI C63.26-2015 – Section 5.2.5.5

Test Settings

The relevant equation for determining the EIRP from the conducted RF output power measured is:

EIRP = PMeas – LC + GT

Where:

EIRP = Equivalent Isotropic Radiated Power (expressed in the same units as PMeas, typically dBW or dBm)

PMeas = measured transmitter output power or PSD, in dBW or dBm

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

GT = gain of the transmitting antenna, in dBi (EIRP)

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

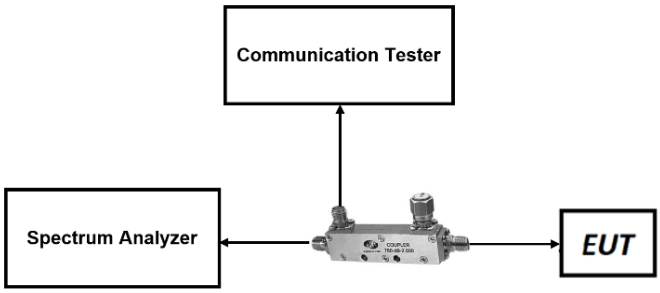


Figure 7-4. Test Instrument & Measurement Setup

Test Notes:

1. This unit was tested with its standard battery.
2. The power output was measured on the EUT antenna port using SMA cable with directional coupler connected to a spectrum analyzer and utilizing the Channel Power function.
3. The Ant. Gains (GT) are listed in dBi.

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
200 kHz	BPSK	1610.2	-9.40	27.02	17.62	57.810	70.00	-52.38
		1618.0	-9.40	27.09	**17.69**	58.749	70.00	-52.31
		1626.0	-9.40	27.06	17.66	58.345	70.00	-52.34

Table 7-2. Antenna FCM EIRP Data

7.6 Radiated Spurious Emissions

§25.202(f)

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

ANSI C63.26-2015 – Section 5.5.4

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

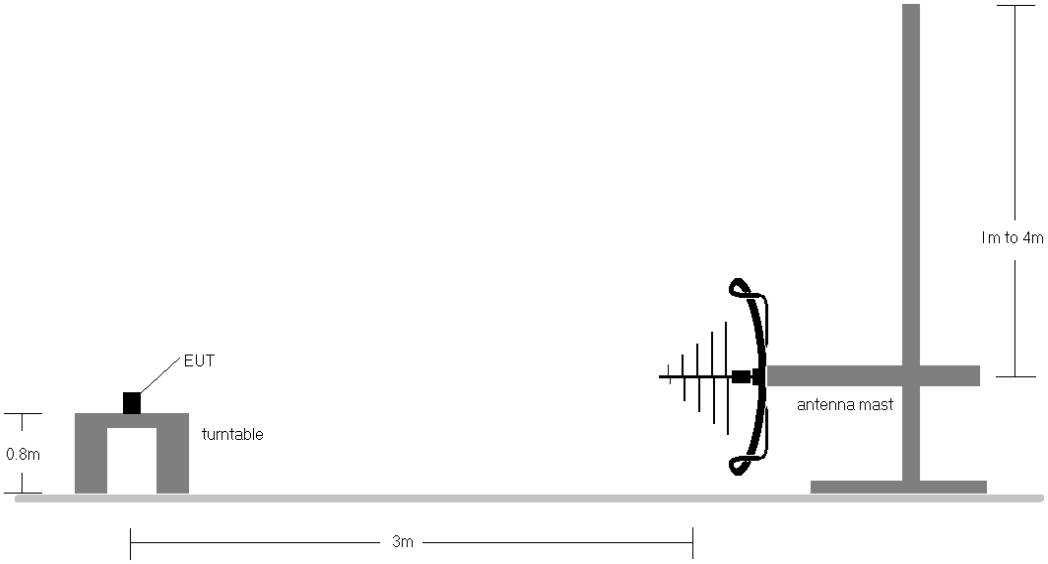


Figure 7-5. Test Instrument & Measurement Setup < 1GHz

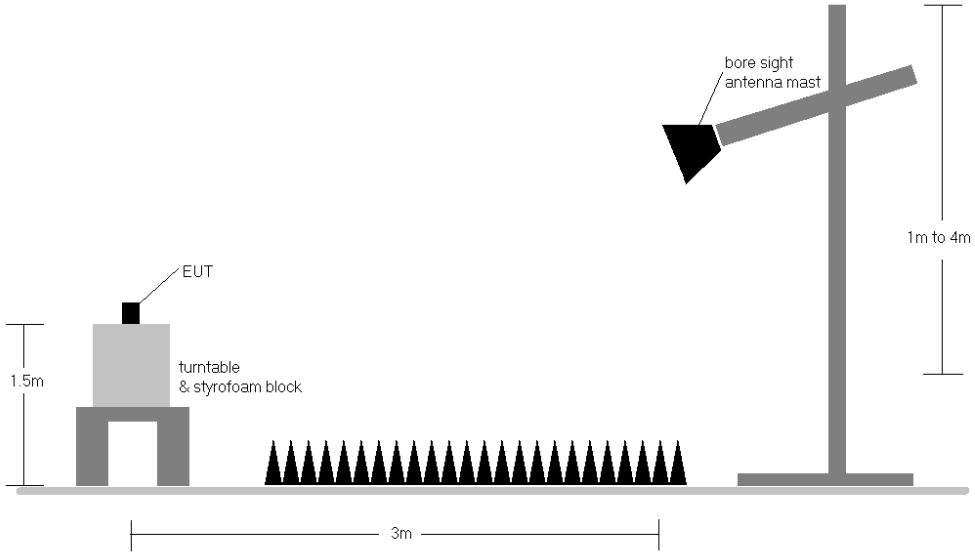


Figure 7-6. Test Instrument & Measurement Setup >1 GHz

Test Notes

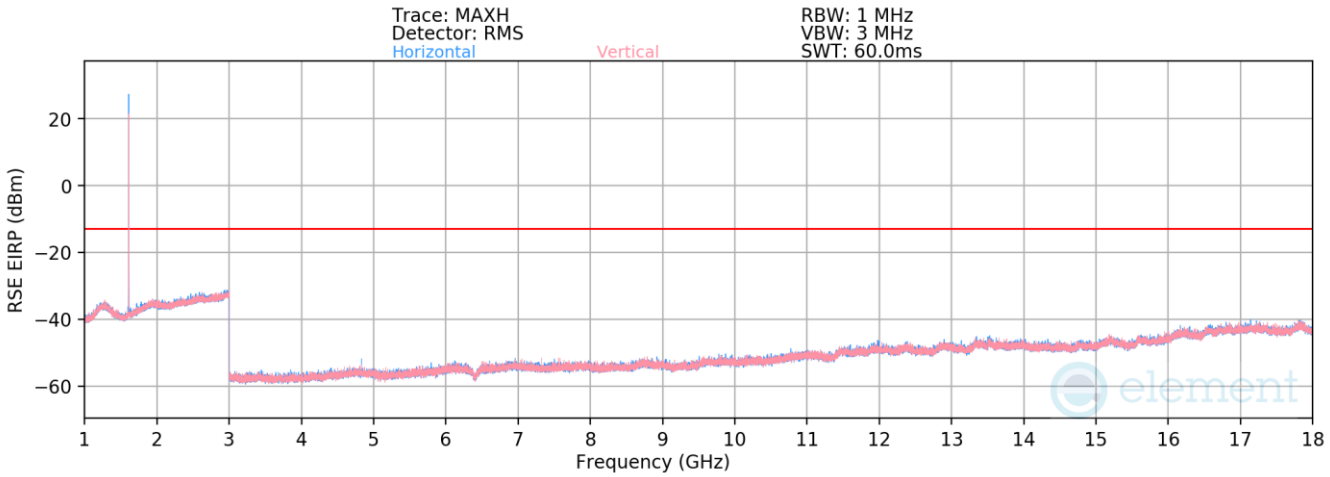
1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 D01 v03r01 Section 5.8.4.
    a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
    b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2. The EUT was tested in three orthogonal planes and in all possible test positions. The worst-case emissions are reported with the EUT positioning shown in the tables below.

3. This unit was tested with its standard battery.

4. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

5. The "-" shown in the following RSE tables are used to denote a noise floor measurement.



Plot 7-19. Radiated Spurious Plot 1 - 18GHz (Low Channel)

Bandwidth (kHz):	200
Frequency (MHz):	1610.2
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3220.4	V	251	189	-75.21	2.48	34.27	-60.99	-13.00	-47.99
4830.6	V	381	316	-76.70	5.92	36.22	-59.04	-13.00	-46.04
6440.8	V	-	-	-82.30	8.89	33.59	-61.66	-13.00	-48.66
8051.0	V	-	-	-81.08	8.73	34.65	-60.61	-13.00	-47.61
9661.2	V	-	-	-81.69	10.96	36.27	-58.99	-13.00	-45.99

Table 7-3. Radiated Spurious Data (Low Channel)

Bandwidth (kHz):	200
Frequency (MHz):	1618.0
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3236.0	V	-	-	-78.31	2.50	31.19	-64.06	-13.00	-51.06
4854.0	H	382	118	-69.20	6.12	43.92	-51.34	-13.00	-38.34
6472.0	V	-	-	-81.98	8.97	33.99	-61.27	-13.00	-48.27
8090.0	V	-	-	-81.06	8.69	34.63	-60.63	-13.00	-47.63
9708.0	V	-	-	-81.26	10.69	36.43	-58.83	-13.00	-45.83

Table 7-4. Radiated Spurious Data (Mid Channel)

Bandwidth (kHz):	200
Frequency (MHz):	1626.0
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3252.0	V	-	-	-78.38	2.56	31.18	-64.07	-13.00	-51.07
4878.0	H	341	102	-63.72	6.26	49.54	-45.72	-13.00	-32.72
6504.0	H	-	-	-81.72	8.47	33.75	-61.51	-13.00	-48.51
8130.0	H	-	-	-81.69	9.10	34.41	-60.84	-13.00	-47.84
9756.0	H	-	-	-81.03	10.07	36.04	-59.21	-13.00	-46.21

Table 7-5. Radiated Spurious Data (High Channel)

7.7 Additional Unwanted Emission Measurements (1559 – 1610MHz)

§25.216(c), §25.216(g)

Test Overview and Limit

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Per FCC Part 25.216:

(c) The e.i.r.p. density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed −70 dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed −80 dBW, averaged over any 2 millisecond active transmission interval, in the 1559-1605 MHz band

(g) Mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies in the 1610-1626.5 MHz band shall suppress the power density of emissions in the 1605-1610 MHz band-segment to an extent determined by linear interpolation from −70 dBW/MHz at 1605 MHz to −10 dBW/MHz at 1610 MHz averaged over any 2 millisecond active transmission interval. The e.i.r.p of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from −80 dBW at 1605 MHz to −20 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval.

Test Procedures Used

ANSI C63.26-2015 – Section 5.5.4

Test Settings

1. RBW = 1MHz
2. VBW ≥ 3 x RBW
3. Span = 1559 – 1610MHz
4. No. of sweep points = 1001
5. Detector = RMS
6. Trace mode = Max-hold
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

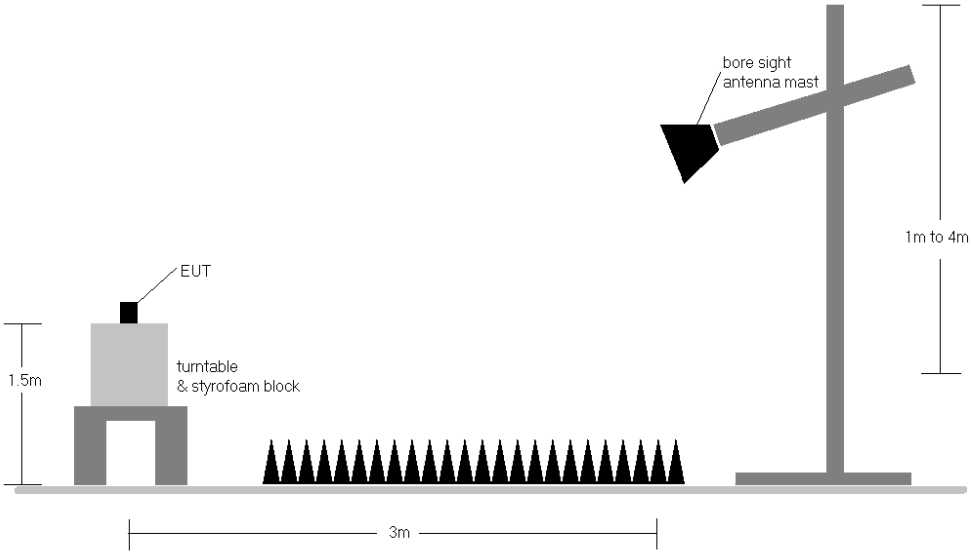


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

Test Notes

1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 D01 v03r01 Section 5.8.4.
    a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
    b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2. The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst-case emissions are reported with the EUT positioning, modulations, and channel bandwidth configurations shown in the tables below.

3. This unit was tested with its standard battery.

4. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

5. Both horizontal / vertical polarizations and low/mid/high channels were investigated. Low channel was found to be worst case.

6. Only channels with 200kHz bandwidth are enabled on the EUT. Thus, all channels have been evaluated to be passing linear interpolation from −70 dBW/MHz at 1605 MHz to −10 dBW/MHz at 1610 MHz.

7. Two plots have been included to evaluate e.i.r.p. of discrete emissions of less than 700Hz for each polarity. One plot evaluates the limit of −80 dBW in the 1559-1605 MHz band. One plot evaluates the limit determined by linear interpolation from −80 dBW at 1605 MHz to −20 dBW at 1610 MHz.

(1559 – 1610MHz – Low Channel)

Plot 7-20. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Horizontal

Plot 7-21. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Horizontal (Zoom-In)

Plot 7-22. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Horizontal

Plot 7-23. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Horizontal

Plot 7-24. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Vertical

Plot 7-25. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Vertical (Zoom-In)

Plot 7-26. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Vertical

Plot 7-27. Radiated Spurious Plot – (1559 – 1610MHz) – Low Channel – Vertical

7.8 Frequency Stability / Temperature Variation

§25.202(d)

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Per FCC Part 25.202(d) Frequency tolerance, Earth stations. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

Test Procedure Used

ANSI C63.26-2015 – Section 5.6

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber. In addition, the EUT was connected to a communication tester via an attenuated RF coupler.

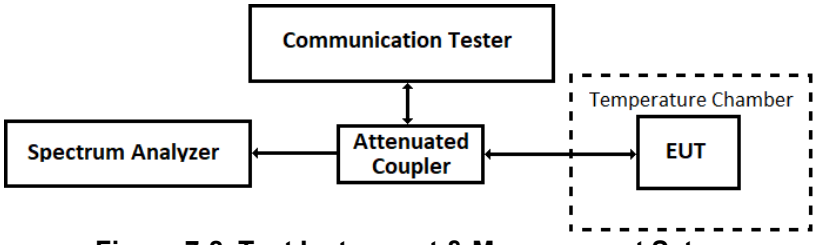


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

None

Frequency Stability / Temperature Variation

Operating Frequency (GHz):	1.6180
Ref. Voltage (VDC):	3.80
Deviation Limit:	± 0.001%

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (GHz)	Freq. Dev. (GHz)	Deviation (%)
100 %	3.80	- 30	1.618000640	0.000000456	0.000018317
		- 20	1.618000296	0.000000112	0.000004499
		- 10	1.618000049	-0.000000135	-0.000005423
		0	1.617999980	-0.000000204	-0.000008194
		+ 10	1.618000435	0.000000251	0.000010082
		+ 20 (Ref)	1.618000184	0.000000000	0.000000000
		+ 30	1.617999858	-0.000000326	-0.000013095
		+ 40	1.617999958	-0.000000226	-0.000009078
		+ 50	1.617999824	-0.000000360	-0.000014461
Battery Endpoint	3.40	+ 20	1.618000340	0.000000156	0.000006266

Table 7-6. Frequency Tolerance Data

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Watch FCC ID: BCG-A3281** complies with the requirements of Part 25 of the FCC rules.