Test Report 2025-053

Version A
Issued 21 July 2025

Project GCL-0801
Model Identifier: A04918
Primary Test Standard(s):
CFR 47, FCC Part 15.247
RSS-247 Issue 3

Garmin Compliance Lab
Garmin International
1200 E 151st Street
Olathe Kansas 66062 USA

Client-supplied Information

FCC ID: IPH-04918
IC ID: 1792A-04918

ACCREDITED
CERTIFICATE #6162.01

See section 6 of this report regarding the presence or absence of accreditation logos or marks on this cover page.

1. Summary

The equipment or product described in section 5 of this report was tested at the Garmin Compliance Lab according to standards listed in section 6. This report focuses on the 2.4 GHz Bluetooth transceiver and is tested under the FHSS provisions. The ANT, BLE, and IEEE 802.11 radios are treated as DTS devices and are reported separately. The results are as follows

Parameter	Description	Key Performance Values	Result	Data starts at page
Radio Modulation	Summary of the kinds of communication this radio can achieve, as stated by the client. [RSS-GEN at Annex A item 10b]	Digitally modulated frequency hopping spread spectrum at rates as high as 3 Mbps.	Reported	N/A
Hopping Channels	The radio manages it use of channels appropriately. [15.247(a)(1); RSS-247 at 5.1]	The system uses 79 hopping channels separated by at least 2/3 of the 20 dB Bandwidth. Channels are used on an appropriately equal time basis.	PASS	16
DTS Bandwidth	The nature of the radio signal is broadband, being at least 500 kHz wide. [15.247(a)(2); RSS-247 at 5.2(a)]	Only relevant for DTS systems.	N/A	N/A
Other Bandwidths	Regulatory agencies also require the reporting of signal bandwidths using alternate processes. [2.202; RSS-GEN at 6.7]	These values are reported but have no actual performance requirements.	Reported	20
Transmit Power	The peak transmit power presented to the antenna is no greater than 1 Watt or 30 dBm. The effective radiated power is limited to 4 Watts or 36 dBm EIRP. [15.247(b); RSS-247 at 5.4(d)]	The maximum transmit power is 13.2 dBm or 20.9 mW.	PASS	24
Antenna Gain	The radio should not focus too much energy in any direction. Unless additional rules are applied, the antenna gain is no greater than 6 dBi. [15.247(b)(4) and (c)]	NT. The client stated that the antenna gain was -5.77 dBi and will document antenna gain separately.	NT	NT

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Unwanted (Spurious) Emissions	The radio should not provide too much radio energy to the antenna at frequencies beyond its intended frequency band. [15.247(d); 15.209, RSS-247 at 5.5, RSS-Gen at 8.9]	Emissions outside the band must meet the 'Class B' limits of 15.209 or be reduced at least 30 dB from in-band levels. The margin to the 'Class B' limit was 4.1 dB or greater.	PASS	27
Adjacent Restricted Bands	The radio must not emit in certain designated restricted frequency bands to the transmission band above a set of limit values. This entry focuses on bands adjacent to the operating band. [15.247(d) and 15.205; RSS-247 at 3.3]	Emissions in the adjacent restricted bands were at least 14.6 dB below the applicable limits. Compliance for the remaining restricted bands is demonstrated by the spurious emission data.	PASS	48
Power Spectral Density	The radio must not focus too much radio energy in a narrow frequency band. [15.247(e); RSS-247 at 5.2(b)]	Not relevant to FHSS systems.	N/A	N/A
Hybrid Systems	A radio that is both frequency hopping and digitally modulated should satisfy a combination of system rules. [15.247(f); RSS-247 at 5.3]	N/A. The radios described in this report are not subjected to the Hybrid System rules.	N/A	N/A
Frequency Hopping Rules	Frequency hopping systems have additional functional requirements. [15.247(g) and (h); RSS-247 at 5.1]	These functional requirements are design parameters, but not testable requirements.	NT	NT
Radio Safety	The radio emissions must meet public health & safety guidelines related to human exposure. [15.247(i) and 1.1307; RSS-Gen at 3.4]	NT. Client will report radio energy safety results separately.	NT	NT
Frequency Stability	The radio tuning must be robust over a range of temperature and supply voltage conditions. [RSS-Gen at 6.11]	Radio emissions remained within the allowed radio band under all environmental conditions tested.	NT	NT
Unwanted Emissions (Mains Conducted)	While transmitting, the emissions conducted into the power mains must not be too strong. [15.207, RSS-Gen at 8.8]	Emissions other than the fundamental and harmonics must meet the 'Class B' limits. The measured emissions had at least 24 dB of margin.	PASS	52

NT (Not Tested) means the requirement may or may not be applicable, but the relevant measurement or test was not performed as part of this test project.

N/A (Not Applicable) means the lab judged that the test sample is exempt from the requirement.

Table 1: Summary of results

Report Organization

For convenience of the reader, this report is organized as follows:

1. Summary
2. Test Background
3. Report History and Approval
4. Test Sample Modifications and Special Conditions
5. Description of Equipment Tested
6. Test Standards Applied
7. Measurement Instrumentation Uncertainty
8. Selected Examples of Calculations
9. Environmental Conditions During Test
10. 3m RF Chamber Block Diagrams

Annex: Test records are provided for each type of test, following the order and page numbering stated in the summary table. Concluding notes appear on the final page of this report.

Due to confidentiality, certain material (such as test setup photographs) has been removed from this report and placed in GCL Test Report 2025-046. That report is treated as a part of this document by way of this reference.

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2. Test Background

2.1 The Test Lab

The testing reported here was performed at the Garmin Compliance Lab, an organization within Garmin International, located at 1200 E 151st St, Olathe Kansas, USA. The contact telephone number is +1.913.397.8200.

2.2 The Client

The testing was performed on behalf of the Garmin design group, a separate organization located at 1200 E 151st St, Olathe Kansas, USA. Witnesses from the business group included: None.

2.3 Other Information

Test Sample received: 15 Apr 2025
Test Start Date: 05 May 2025
Test End Date: 18 July 2025

The data in this test report apply only to the specific samples tested.

Upon receipt all test samples were believed to be properly assembled and ready for testing.

3. Report History and Approval

This report was written by Andy Heier and initially issued on 21 July 2025 as Version A.

Report Technical Review:

Majid Farah
Senior EMC Engineer

Report Approval:

Shruti Kohli
Senior Manager Operations

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4. Test Sample Modifications and Special Conditions

The following special conditions or usage attributes were judged during test to be necessary to achieve compliance with one or more of the standards listed in section 6 of this report:
None.

The following modifications to the test sample(s) were made, and are judged necessary to achieve compliance with one or more of the standards listed in section 6 of this report:

Modification 1
Detailed Description: Samples' E1 (s/n 510606624), E2 (s/n 510606683), E3 (510606648), E4 (s/n 510606682), and E5 (s/n 510606627) firmware was updated from version 9.28 to 9.4.
Date applied: 28 May 2025 @ 11:30am
Reason for this modification: Reduced FCC WiFi power tables: G - Ch 8, N - Ch's 8, 12; added Bluetooth receiver test mode.
The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: Occupied Bandwidth, Transmit Power, Radiated Emissions (FCC Restricted Bands) and Conducted Emissions.

Modification 2
Detailed Description: Samples' E2 (s/n 510606683) and E4 (s/n 510606682) firmware was updated from 9.4 to 9.41
Date applied: 10 Jun 2025 @ 10:30am
Reason for this modification: Added NFC reader test mode and corrected voltage settings on preamplifier for NFC card emulator mode.
The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: Change was for NFC testing only and has no impact on any tests in this report. Modification was included for consistency across reports.

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5. Description of the Equipment Tested

5.1 Unique Identification

Product Model	A04918
Serial Numbers Tested	510606624, 510606683, 510606648, 510606682

The product tested is a mobile device for collecting and sharing data with the user and nearby electronic devices.

The client affirmed that the test samples will be representative of production in all relevant aspects.

5.2 Key Parameters

EUT Input Power:	5 Vdc
I/O Ports:	USB
Radio Transceivers:	IEEE 802.11 b/g/n, Bluetooth, Bluetooth Low Energy, ANT, NFC
Radio Receivers:	GPS L1, GPS L5, Galileo E1, Galileo E5a/b, BeiDou, GLONASS
Primary Functions:	Data collection and communication
Typical use:	Portable Transceiver
Highest internal frequency:	2.484 GHz
Highest digital frequency:	250 MHz
Firmware Revision	9.41 (See section 4)

5.3 Operating modes

During test, the EUT was operated in one or more of the following modes.

Mode 1: M1 (BtTx). Bluetooth, sometimes called Bluetooth Classic, radio is transmitting consistently on a selected channel sending data using the BR (Basic Rate of 1 Mbps), EDR2 (Extended Data Rate of 2 Mbps) or EDR3 (Extended Data Rate of 3 Mbps) modulation types.

Mode 2: M2 (BtLnk). Bluetooth Classic radio is paired to a companion device, transmitting and receiving data on various channels in accordance with the protocol, and maintaining the paired relationship.

Mode 3: M3 (BleTx). Bluetooth Low Energy radio transmitting consistently on a selected channel at 1 Mbps or 2 Mbps

Mode 4: M4 (BleLnk). Bluetooth Low Energy radio is paired to a companion device, transmitting and receiving data on various channels in accordance with the protocol, and maintaining the paired relationship.

Mode 5: M5 (AntTx). ANT radio transmitting consistently on a selected channel.

Mode 6: M6 (AntLnk). ANT radio is paired to a companion device, transmitting and receiving data in accordance with the protocol, and maintaining the paired relationship.

Mode 7: M7 (WiFiTx). The IEEE 802.11 b/g/n radio was transmitting consistently on a selected channel, with a specified modulation type, and data rate.

Mode 8: M8 (WiFiLnk). The IEEE 802.11 b/g/n radio is paired to a companion device, transmitting and receiving data on a selected channel in accordance with the protocol, and maintaining the paired relationship.

Mode 9: M9 (RxBtBlA). The specified Bluetooth Classic, Bluetooth Low Energy, or ANT radio was set to receive, but not transmit, on a selected channel, with a specified modulation type, and data rate.

Mode 10: M10 (RxWiFi). The IEEE 802.11 b/g/n radio was set to receive, but not transmit, on a selected channel, with a specified modulation type, and data rate.

Mode 12: M12 (NfcLnk). The NFC 13.56 MHz transceiver is in Card Emulation mode, and is actively linked to a companion NFC Reader.

Mode 13: M13 (GNSS). The Global Navigation Satellite System receiver is monitoring the GNSS bands, attempting to detect a constellation and determine location. Unless otherwise noted, the EUT was provided simulated GNSS signals representing one of more constellation types. In addition, the EUT was reporting signal levels and satellite data to an attached computer to monitor link health.

Mode 14: M14 (NfcIdle). The NFC 13.56 MHz transceiver is powered, but not actively linked to a companion device.

Mode 15: M15 (GNSS). The Global Navigation Satellite System receiver is monitoring the GNSS bands, attempting to detect a constellation and determine location. Unless otherwise noted, the EUT was provided simulated GNSS signals representing one of more constellation types.

Mode 16: M16 (NfcTag). The NFC 13.56 MHz transceiver is in Card Reader mode, and is actively linked to a companion NFC Tag.

Mode 17: M17 (Display). The display test mode page is selected and actively running.

Mode 18: M18 (Accelerometer). The accelerometer test mode page is selected and actively running.

Mode 19: M19 (ML1). Multiple link, combining modes M2, M4, & M6. The EUT is actively paired to BT Classic, BLE and ANT companion devices, used for Immunity tests.

Mode 20: M20 (ML2). Multiple link, combining modes M4 & M6. The EUT is actively paired to BLE and ANT companion devices, used for Immunity tests.

5.4 EUT Arrangement

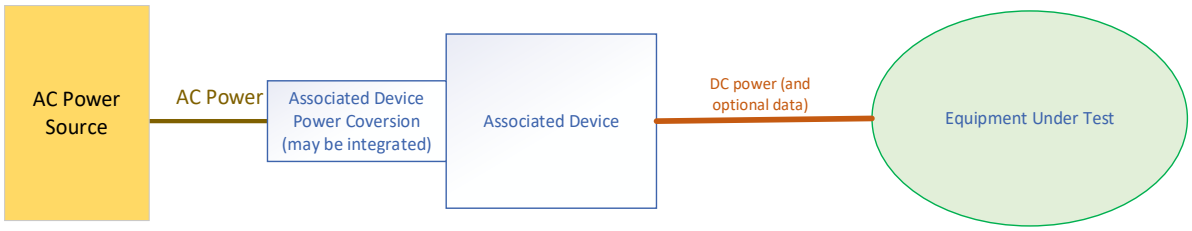
During test, the EUT components and associated support equipment were selected including the following arrangement sets.

Arrangement 1: A1 (Solo). The test sample operates from its battery and no external physical connections. No block diagram is needed for this arrangement.

Arrangement 2: A2 (Upwr). The test sample is attached to a Mains-powered device connected that provides dc power to the sample over a cable but no user data. See the block diagram in Figure 1.

Arrangement 3: A3 (Udata). The test sample is attached to a Mains-powered device connected that provides dc power to the sample and user data over a cable. See the block diagram in Figure 1.

Arrangement 4: A4 (Udc). The test sample is attached to a Mains-powered device connected that provides dc power to the sample and may or may not provide user data. This arrangement is specified in the test plan to provide staff flexibility when the presence or absence of data on the cable is not pertinent. See the block diagram in Figure 1.



This interconnect drawing is not to scale.
It does not indicate the placement of devices.

Figure 1: Block diagram of equipment arrangements A2, A3, A4

Arrangement 6: A6 (NFCu). The test sample is powered via internal battery and actively linked to a NFC card reader powered by a laptop PC.

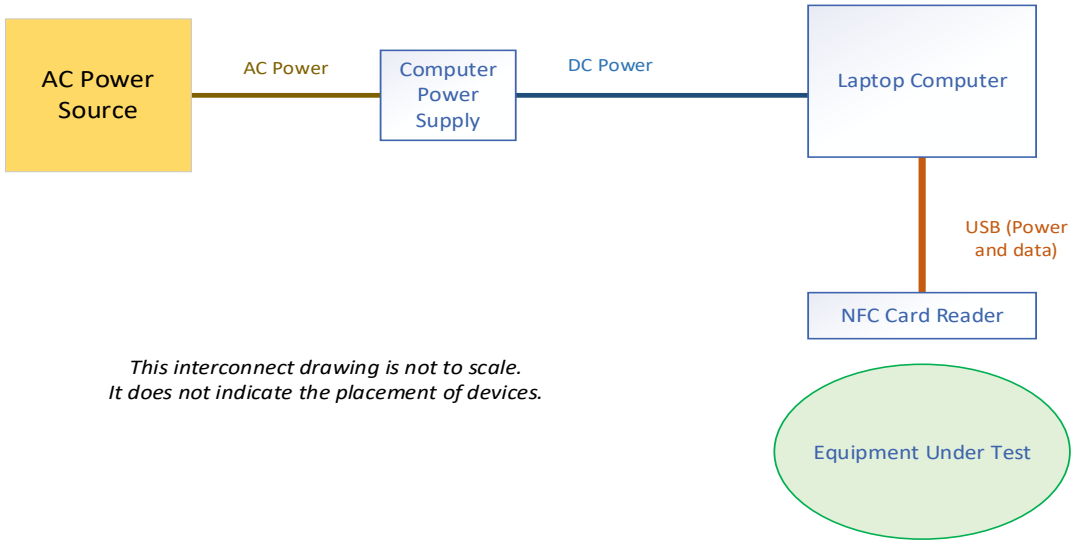


Figure 2: Block diagram of equipment arrangement A6

Arrangement 7: A7 (NFCu). The test sample is powered via internal battery and actively linked to a passive NFC tag.

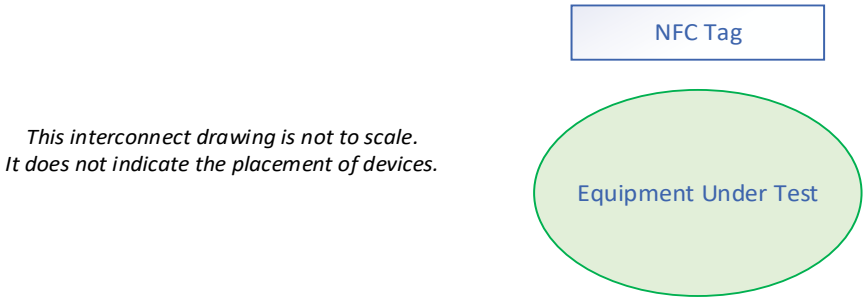


Figure 2: Block diagram of equipment arrangement A7

5.5 Associated Equipment (AE) used

Description	Manufacturer	Model	Serial/Part Number
USB C Power Adaptor	Phihong (Garmin)	AQ27A-59CFA	362-00118-00
Laptop	Dell	Latitude 5410	5VSPFB3
AC/DC Power Adapter	Dell	HA65NM191	0BD-7TC0-A02
Laptop	Dell	Latitude 5420	38SS2F3
AC/DC Power Adapter	bti	A12-TYPE-C	65WUSB-C-BTI
Laptop	Dell	Precision 5540	3JYG33
AC/DC Power Adapter	Dell	HA130PM130	0V363H-CH200-78G-0DC1-A01
Phone	Samsung	SM-G973U (S10)	RF8MC0W9XVR
NFC Card Reader	ACS	ACR1252U-M1	RR554-118449
NFC Tag	NXP	NTAG210μ	04:11:CC:AA:8F:51:81
Laptop	Dell	Inspiron	7DCR5R3
AC/DC Power Adapter	Dell	DA65NM191	0KPVMF-DES00-233-EE1V-A00
Wi-Fi Adaptor	Alpha network	AWUS036ACS	21BP036AC8259
Wi-Fi Adaptor	Alpha network	AWUS036ACS	21BP036ACS2718
BT Headphones	Garmin	DEZl Headset 200	16869214

Table 2: List of associated equipment that may have been used during test

5.6 Cables used

Description	From	To	Length	EMC Treatment
USB C to custom cable	Power and/or Data source	EUT	0.5 m	None

Table 3: List of cables that may have been used during test

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6. Test Standards Applied

6.1. Accredited Standards

The following test or measurement standards were applied and are within the scope of the lab's accreditation. All results in this report that cite these standards are presented as Accredited results consistent with ISO/IEC 17025.

CFR 47, FCC Part 15, Subpart C
ANSI C63.10: 2020 and ANSI C63.10: 2020 +Cor 1: 2023
AS/NZS 4268: 2017
RSS-GEN Issue 5 Amd 2
RSS-247 Issue 3

6.2 Non-accredited Standards

The following test or measurement standards were applied and are either outside the scope of the lab's accreditation, or were performed in such a way that results are not presented as being fully accredited.

FCC Part 2.202
TRC-43 Issue 3

6.3 Variances

The following variances were applied to standards cited in this section.

Where different test standards cover the same test parameter or phenomenon, and the standards have compatible differences, the stricter of the requirements is typically applied. For example, a consolidated limit may be applied to emission tests selecting the strictest of the limits at each frequency. Likewise, if one standard requires a vertical antenna sweep with boresighting and another does not, swept motion with boresighting will typically be used as it is the more stringent requirement.

Some standards that apply an Average detector provide a variety of methods to handle time-averaging, especially where the transmission is not continuous and the Duty Cycle (DC) is below a value such as 98%. The basic GCL process is to begin by applying an Average detector to the emission with the receiver in Max-Hold data mode. This Max Average method is worst-case compared to any of the methods of time-averaging provided. If the Max Average result complies with the limit, that result is provided in the test record and the emission judged to be compliant without additional detail. If the Max Average result is near or above the limit at one or more emission frequencies, then one of the appropriate time-averaging methods is applied to determine final compliance. When time-averaging is used, the test record will indicate which method of time-averaging was used.

Some standards ask for measurements made with a 'Time Domain Power' function, but that function is not defined in the standards. GCL addresses this gap as follows. Staff capture a zero-span Average detector data record of emission power, with a timespan covering a transmission burst. When the maximum power in the data record is clearly below the limit, this value will be reported. When the maximum power in the data record is near or above the limit, then the average of the power (in linear units) during a transmission burst is calculated and reported.

DISCLAIMER: In some test activities, the operation of a test or the result of a test depends on data provided by the client. The Garmin Compliance Lab disclaims responsibility for any error in the processes, results, or judgments in this report arising from incorrect client-provided data.

6.4 Laboratory Accreditation

The Garmin Compliance Lab, an organization within Garmin International, is registered with the US Federal Communication Commission as US1311. The lab is recognized by the Canada Department of Innovation, Science, and Economic Development (ISED) under CAB identifier US0233.

The Garmin Compliance Lab, an organization within Garmin International, is accredited by A2LA, Certificate No. 6162.01. The presence of the A2LA logo on the cover of this report indicates this is an accredited ISO/IEC 17025 test report. If the logo is absent, this report is not issued as an accredited report. Other marks and symbols adjacent to the A2LA logo are accreditation co-operations of which A2LA is a member under a mutual recognition agreement, and to which the Garmin Compliance Lab has been sublicensed.

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7. Measurement Instrumentation Uncertainty

The lab has analyzed the sources of measurement instrumentation uncertainty. The analysis concludes that the actual measurement values cited in this report are accurate within the U_{LAB} intervals shown below with approximately 95% statistical confidence. Where the report shows a judgment that a test sample passes a test against a published limit based on these measured values, that judgment has a statistical confidence of 97.5% or greater. Measurement Instrumentation Uncertainty is one component of over-all measurement uncertainty, and other uncertainty components are not considered as part of this analysis.

The primary benchmark for measurement instrumentation uncertainty (MIU) in an electromagnetic compatibility (EMC) test lab is the set of U_{CISPR} values published in CISPR 16-4-2. In all cases where a U_{CISPR} value is published by CISPR, the analysis shows that U_{LAB} – this lab's estimated MIU – is better than the U_{CISPR} benchmark.

The secondary benchmark for MIU in an EMC lab performing radio transceiver tests is a set of uncertainty limit values published in various ETSI standards. In this report, U_{ETSI} is the most restrictive of the values found in the ETSI EN standards listed in section 5 of this report. The analysis principles are described in the ETSI TR documents listed there. In most cases U_{LAB} is better than the U_{ETSI} benchmark. Where U_{LAB} exceeds the U_{ETSI} benchmark cited here, that entry is preceded by an asterisk. When required by the ETSI EN standards, excess uncertainty will be added to the measurand before comparison to a limit. In an individual test report, staff may re-evaluate that excess uncertainty based on the uncertainty of the method used and the uncertainty limits of the actual ETSI EN standard being applied, and the revised uncertainty values will be shown in the test report.

Some measurement uncertainties analyzed and reported here are not addressed in CISPR 16-4-2 or the ETSI standards, as indicated by the entry 'None.'

Test Type		**U_{LAB}**	**U_{CISPR}**	**U_{ETSI}**
Conducted DC voltage		0.09% + 2 x LSDPV	None	1%
Conducted AC voltage below 500 Hz		1.0% + 3 x LSDPV	None	2%
Conducted Emissions, Mains Voltage		0.10% + 10 mV	None	None
Conducted Emissions, Mains Current		0.10% + 3 mA	None	None
Conducted Emissions, Mains Power		0.15% + 100 mW	None	None
Conducted Emissions, Power Mains, 9 kHz to 150 kHz		1.70 dB	3.8 dB	None
Conducted Emissions, Power Mains, 150 kHz to 30 MHz		1.48 dB	3.4 dB	None
Conducted Emissions, Cat 6 LCL, 150 kHz to 30 MHz		1.57 dB	5 dB	None
Conducted Emissions, Cat 5 LCL, 150 kHz to 30 MHz		3.06 dB	5 dB	None
Conducted Emissions, Cat 3 LCL, 150 kHz to 30 MHz		4.27 dB	5 dB	None
Radiated Emissions, below 30 MHz		0.88 dB	None	6 dB
Radiated Emissions, 30 MHz to 1000 MHz		2.79 dB	6.3 dB	6 dB
Radiated Emissions, 1 GHz to 18 GHz		2.54 dB	5.2 & 5.5 dB	6 dB
Radiated Emissions, 18 GHz to 26.5 GHz		2.68 dB	None	6 dB
Radiated Emissions, 26.5 GHz to 40 GHz		3.17 dB	None	6 dB
*Radio Signal Frequency Accuracy		*1.55 x 10^-7	None	1.0 x 10^-7
Radio Signal Occupied Bandwidth		0.95%	None	5%
Radio Power or Power Spectral Density		0.98 dB	None	1 dB
Temperature		0.38 °C	None	1 °C
Barometric Pressure		0.38 kPA	None	None
Relative Humidity		2.85% RH	None	±5% RH
Signal Timing	The greater of these three...	0.63 µsec 0.01% of value 0.5 x LSDPV	None	None

Note: *LSDPV stands for the Least Significant Digit Place Value reported. In the value 1470 msec, the least significant digit is the 7. It has a 10 msec place value. The LSDPV is thus 10 msec and the maximum error due to roundoff would be 5 msec. If the time value were reported as 147<u>0</u> msec, the underscore indicates that the 0 is a significant figure and the error due to roundoff would be 0.5 msec. All digits provided to the right of a decimal point radix are significant.*

8. Selected Example Calculations

Certain regulators require samples of the calculations that lead from the raw measurement to the final result for AC Mains conducted and unintended radiated emissions. The assumption is that the lab performs raw measurements, then adds, subtracts, multiplies, or divides based on transducer factors, amplifier gains, and losses in the signal transmission path. In this lab, our CISPR 16 Receiver does not work that way. The calibration factors and losses and gains are provided to the receiver as detailed data files. These factors are applied in the RF measurement path prior to the detector. But as a step in the lab measurement process, staff frequently verify that these factors are applied correctly. They make a measurement with the factors applied inside the receiver, then they disable the factors and remeasure the result manually adding in the various relevant factors.

The transmission loss is measured including the combined losses and gains of preamplifiers, cables, and any band-selective filters. In many cases above 1 GHz it is a negative value, indicating that the preamplifier gain is greater than these other losses.

Here are examples of these calculations. The data in these examples was not taken as part of this project:

8.1 AC Mains conducted emissions at 22 MHz

(Raw measurement) + (AMN factor) + (transmission loss) = Result

(7.145 dBµV) + (9.812 dB) + (0.216 dB) = 17.173 dBµV

8.2 Radiated Emissions at 630 MHz

(Raw measurement) + (Antenna factor) + (transmission loss) = Result

(2.25 dBµV) + (27.80 dB/m) + (2.89 dB) = 32.94 dBµV/m

8.3 Radiated Emissions at 2.7 GHz

(Raw measurement) + (Antenna factor) + (transmission loss) = Result

(43.72 dBµV) + (32.22 dB/m) + (-36.09 dB) = 39.85 dBµV/m

9. Environmental Conditions During Test

Environmental conditions in the test lab were monitored during the test period. Temperature and humidity are controlled by an air handling system. As information to the reader, the conditions were observed at the values or within the ranges noted below. For any tests where environmental conditions are critical to test results and require further constraints or details, the test records in the annex may provide more specific information.

Temperature:	21.5 to 22.9 °C
Relative Humidity:	43% to 63% (non-condensing)
Barometric Pressure	95.8 to 98.4 kPa

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Barometer	Traceable	6453	240300703	9-Apr-2024	9-Apr-2027

Table 4: Environmental monitoring device

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10. 3m RF Chamber Block Diagrams

The 3m chamber has three basic configurations which are shown in the figures below. These figures are not to scale.

Figure 1 shows a semi anechoic setup which is typically used for frequencies below 1 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes. If a preamplifier or RF filter is used, they are located at or just below floor level. The receiver is outside the chamber, typically in an adjacent separate shielded room.

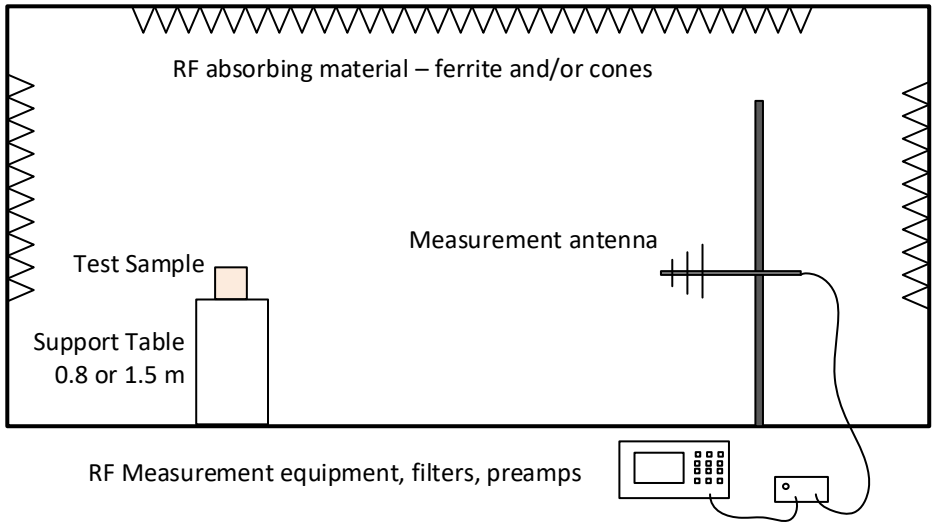

Figure 1: Typical configuration for measurements below 1 GHz

Figure 2 shows an FSOATS setup which is typically used for frequencies above 1 GHz but below an upper limit such as 14 or 18 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes and bore sighting. If a preamplifier or RF filter is used, they are located at or just below floor level. The receiver is outside the chamber, typically in an adjacent separate shielded room.

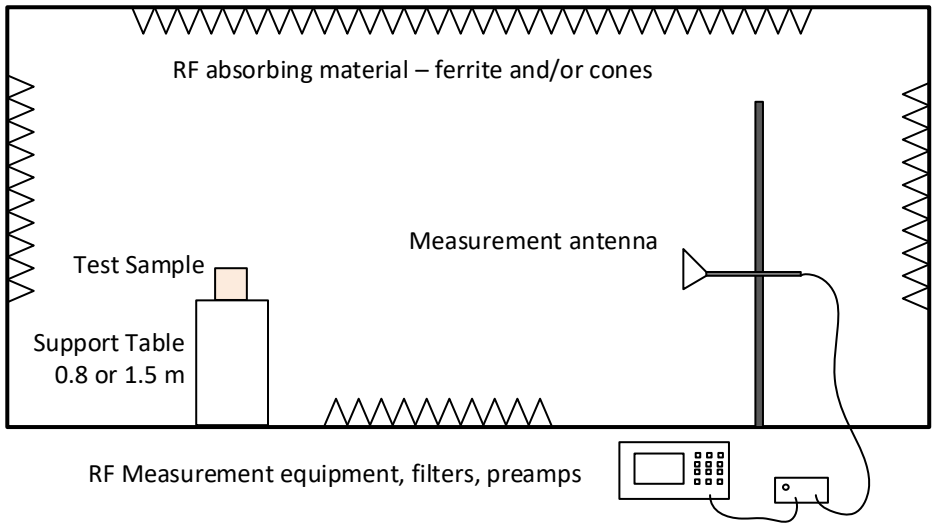

Figure 2: Typical configuration for measurements between 1 GHz and 14 GHz

Figure 3 shows an alternate FSOATS setup which is typically used for frequencies above 14 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes and bore sighting. A preamplifier is located on the mast just behind the antenna. The receiver is located in the chamber near floor level but outside the antenna beam. The receiver may be operated manually by an operator in the chamber and or remotely via an Ethernet connection.

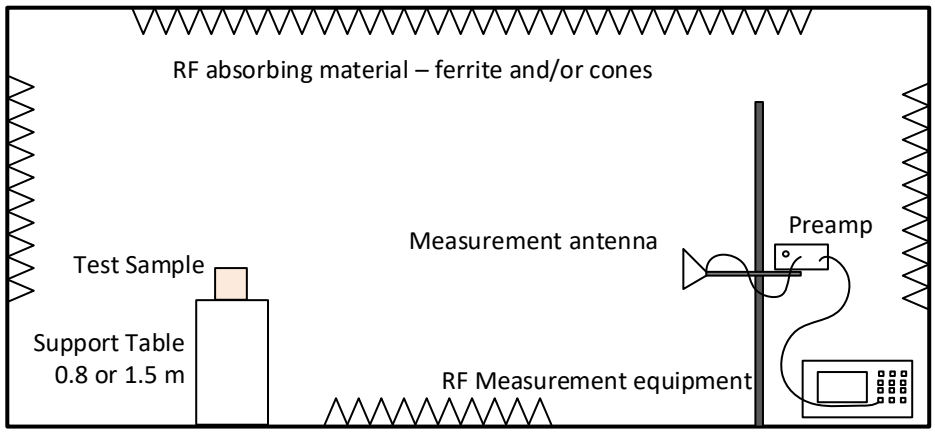

Figure 3: Typical configuration for measurements above 14 GHz

ANNEX

The remainder of this report is an Annex containing individual test data records. These records are the basis for the judgments summarized in section 1 of this report. The Annex ends with a set of concluding notes regarding use of the report.

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Test Record
FHSS ANSI Channel Separation & Occupation
Test IDs TR51, TR52
Project GCL-0801

Test Date(s)	10 Jun 2025
Test Personnel	Jim Solum supervised by Majid Farah
Product Model	A04918
Serial Number tested	510606624
Operating Mode	M1 (BtTx)
Arrangement	A4 (Udc)
Input Power	USB 5V dc
RF Output	Is not greater than 125 mW (21 dBm) conducted to the antenna
Test Standards:	FCC Part 15.247, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this test record:	10 Jun 2025

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	17-Mar-2025	17-Mar-2026

Table TR51.1: Test equipment used

Test software used: Keysight PXE software 37.02, FHSS ANSI Occupancy Template v2.xlsx

Test Data

This test looks at details specific to frequency hopping systems in the referenced standards: the number of hopping channels; the relationship between 20 dB Occupied bandwidth and channel separation; and channel occupancy time.

This measurement requires that a coaxial feed line from the transmitter is available as a connector exterior to the test sample. This feed line and connector may be a part of the shipping product, or it may be a special modification to the product for testing purposes. The connector is attached via laboratory cables to the measurement instrument. Since the absolute signal amplitude is not relevant to these tests, the results may not have been adjusted to account for the losses in the laboratory cables.

Test Data: Hopping Channels

The test sample was placed in a test mode where it transmits on its various frequency channels while hopping. The spectrum analyzer scanned a frequency range that included these frequencies in Max Hold condition. The resulting spectra are attached, showing that the sample uses each of the 79 hopping frequencies from 2402 MHz to 2480 MHz, also confirming a channel separation of 1 MHz.

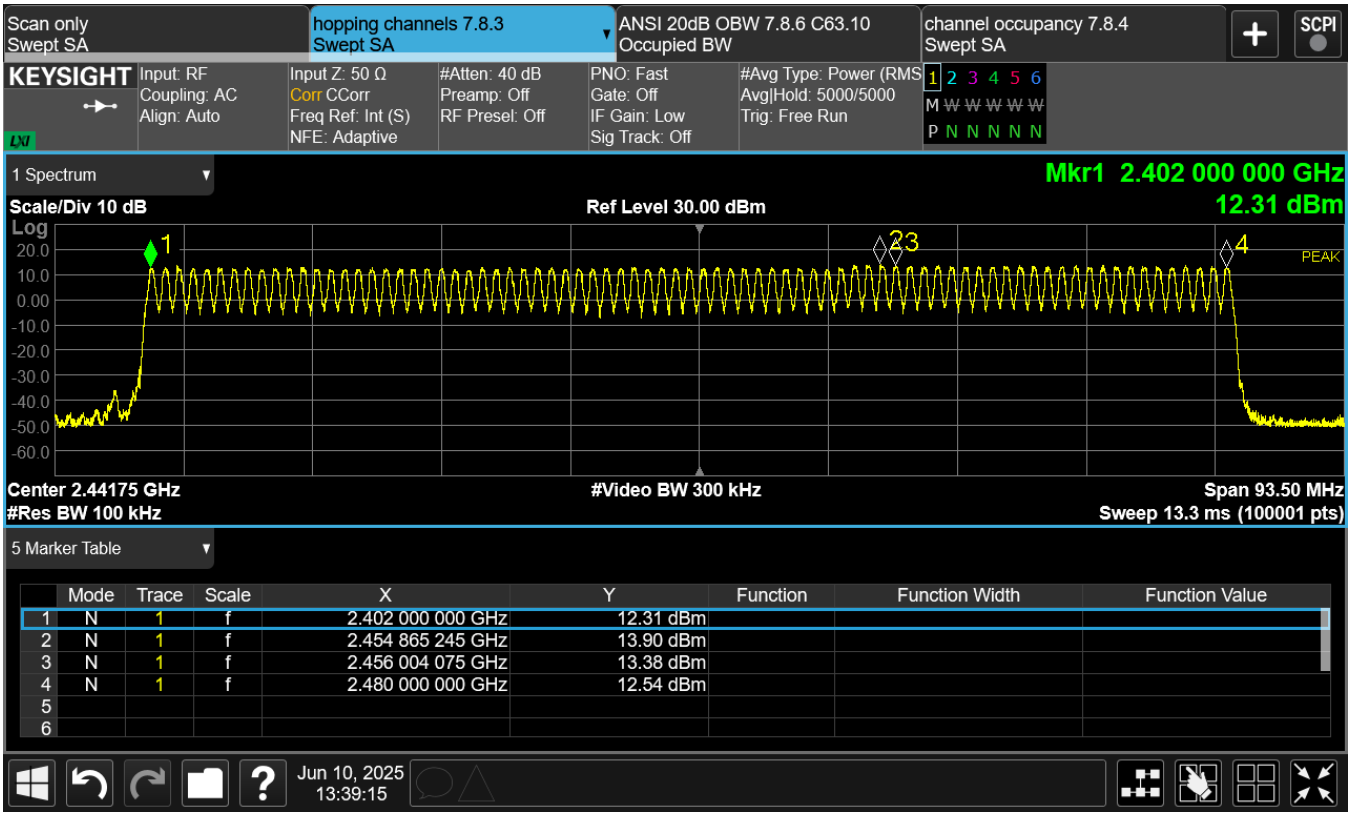

Figure TR51.1: Spectral data, Bluetooth Basic Rate transmission, showing channels used

Test Data: Bandwidth and Channel Separation

The 20 dB Occupied bandwidth (OBW20) was measured for each modulation type, with the transmission fixed on low, middle, and high channels. The maximum bandwidth observed is highlighted in yellow, and the spectrum image for that case is also provided.

The standards require that the hopping channel separation is no less than OBW20 if the transmitted power is above 125 mW. For lower power transmissions, the hopping channel separation must be no less than two-thirds of OBW20. This second case can also be expressed as limiting OBW20 to 1.5 times the channel separation. Based on the 1 MHz separation between hopping channel, and the output power of the transmitter, the 20 dB occupied bandwidth must be no greater than 1.5 MHz. The data below shows compliance with this limit.

Freq (MHz)	2425	2452	2455
Bluetooth BR	1.036	1.036	1.034
Bluetooth EDR2	1.338	1.338	1.340
Bluetooth EDR3	1.324	1.329	1.364

Table TR51.2: Summary of 20 dB Occupied Bandwidth results in MHz

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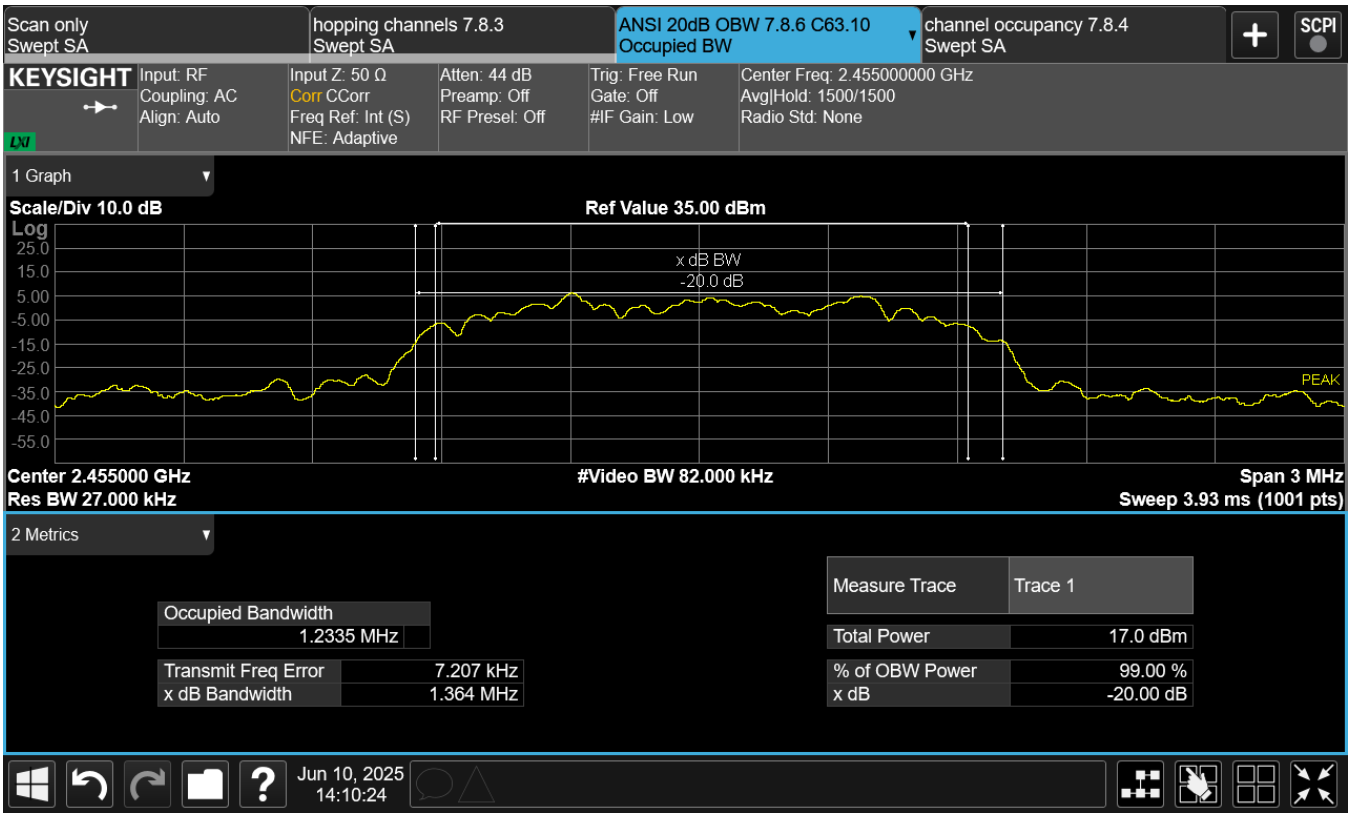

Figure TR51.2: Spectral data for Bluetooth EDR3 modulation at 2455 MHz

Test Data: Channel Occupancy

The channel occupancy requirement ensures that the transmissions are distributed consistently across the hopping channels. The measurement is made on each of the three randomly selected channels for a period of 0.4 seconds multiplied by the number of hopping channels. For this product, that is a measurement period of 31.6 seconds. During that time, the sum of the transmission times on the selected channel cannot exceed the limit of 0.4 seconds.

This testing is performed at three test channel frequencies, randomly selected within a range. The first range is 2402 to 2427 MHz. The second test frequency range is 2428 to 2454 MHz. The final range is 2455 to 2480 MHz.

The test sample was placed in a test mode where it transmits on its various frequency channels while hopping. The transmissions were measured while the test equipment was tuned to each one of the three test channels using a detector more narrow than the OBW20 value. This provides a record of transmissions only on the selected channel over time. A spreadsheet analyzed the data to determine channel occupancy -- the total sum of time that the transmitter was on the selected channel. The maximum channel occupancy values is highlighted in yellow, and a zero-span time plot image for that case is also provided.

Freq (MHz)	2425	2452	2455
Bluetooth BR	0.345	0.296	0.339
Bluetooth EDR2	0.340	0.347	0.354
Bluetooth EDR3	0.373	0.335	0.332

Table TR51.3: Summary of Channel Occupancy results in seconds

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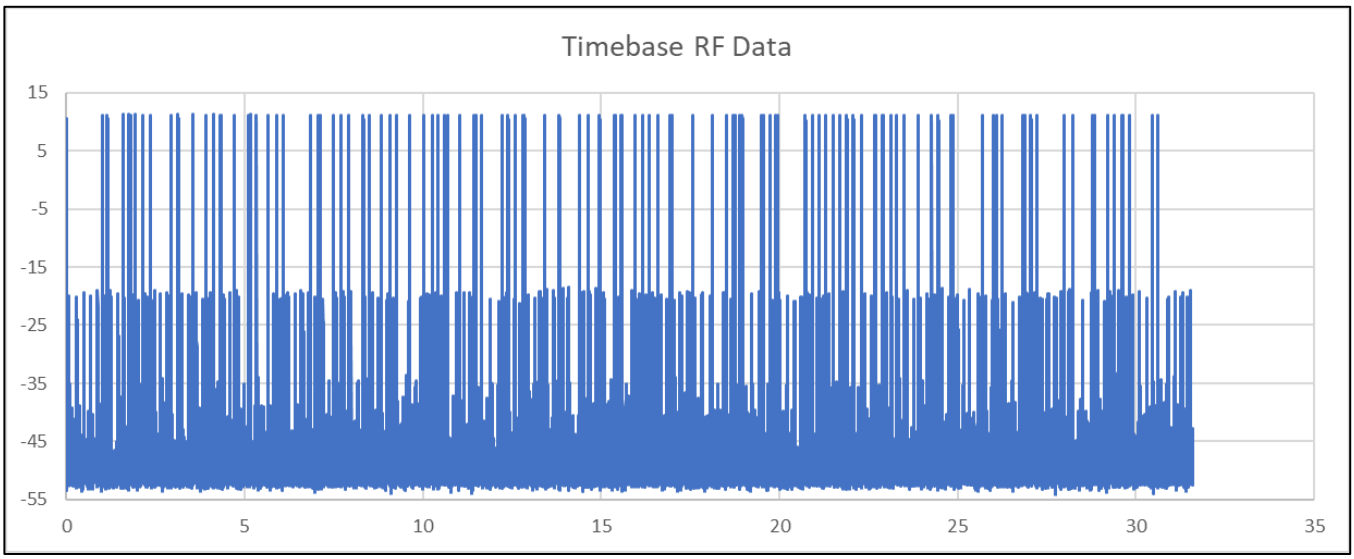

Figure TR51.3: Channel Occupancy time data for Bluetooth EDR3 modulation at 2425 MHz

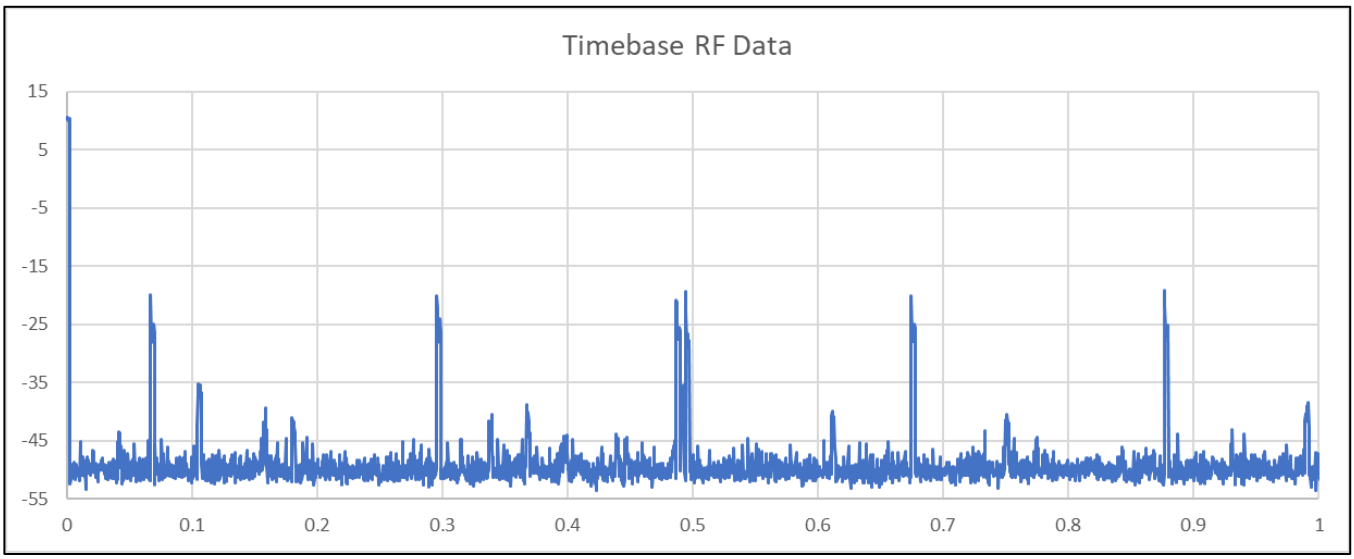

Figure TR51.4: First second of the Channel Occupancy time data for improved clarity

This line is the end of the test record.

Test Record
Transmitter Bandwidth Tests
Test IDs TR09
Project GCL0801

Test Date(s)	12, 13 May 2025
Test Personnel	Jim Solum
Product Model	A04918
Serial Number tested	510606624
Operating Mode	M1 (BtTx)
Arrangement	A4 (Udc)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 2.202, ANSI C63.10, TRC-43, RSS-GEN (as noted in Section 6 of the report).
Radio Protocol	Bluetooth Classic (Including EDR2 and EDR3)
Radio Band	2480 to 2483.5 MHz
Pass/Fail Judgment:	**Reported**
Test record created by:	Jim Solum
Date of this record:	16 May 2025

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	17-Mar-2025	17-Mar-2026

Table TR09.1 Equipment Used

Software used: Keysight PXE software A.37.02

Background
There are regulatory requirements to present two additional types of bandwidth analyses: 99% Occupied Bandwidth and Necessary Bandwidth. There are no limits or functional requirements around these data, beyond a reporting requirement. The contents of this test record are for information, and do not affect compliance of the devices that are the subject of this report.

For BLE operating at 2 Mbps, the lowest operating frequency was 2404 MHz, and the highest operating frequency was 2478 MHz. For all other Bluetooth, BLE, and ANT radios reported here, the lowest operating frequency was 2402 MHz, and the highest operating frequency was 2480 MHz.

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Test Setup

This block diagram shows the test equipment setup.

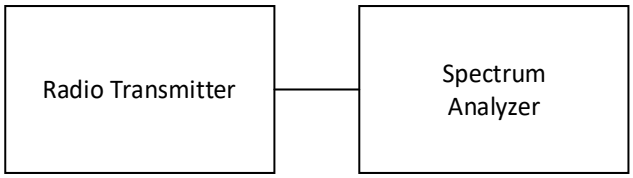

Figure TR09.1: Test setup

Occupied Bandwidth, 99% Test Method

During this test the transmitter output is fed directly, or through RF attenuators, to the spectrum analyzer. The analyzer has a built-in capability to identify the minimum bandwidth that contains a specified percentage of the total power observed. The spectrum is scanned hundreds of times so that the varied effects of modulation are appropriately assessed. Since the focus is on the relative distribution of energy across a range of frequencies, the absolute amplitudes recorded during this test are not relevant and may not include cable losses or attenuation factors.

Occupied Bandwidth, 99% Test Data

The data for each type of bandwidth is summarized below, followed by the spectral data for the cases highlighted in yellow. The analysis threshold for this test was the bandwidth containing 99% of the observed power using the ANSI C63.10 method. The standards require testing a frequency near the bottom, middle, and top of the band. The measured bandwidth data are in bold font and have MHz as their units of measure.

	2402 (04)	2440	2480 (78)
Bluetooth BR	**0.9303**	**0.9310**	**0.9321**
Bluetooth EDR2	**1.1035**	**1.1009**	**1.1049**
Bluetooth EDR3	**1.1048**	**1.1001**	**1.1054**

Table TR09.2: Summary of 99% Occupied Bandwidth Data for Bluetooth mode

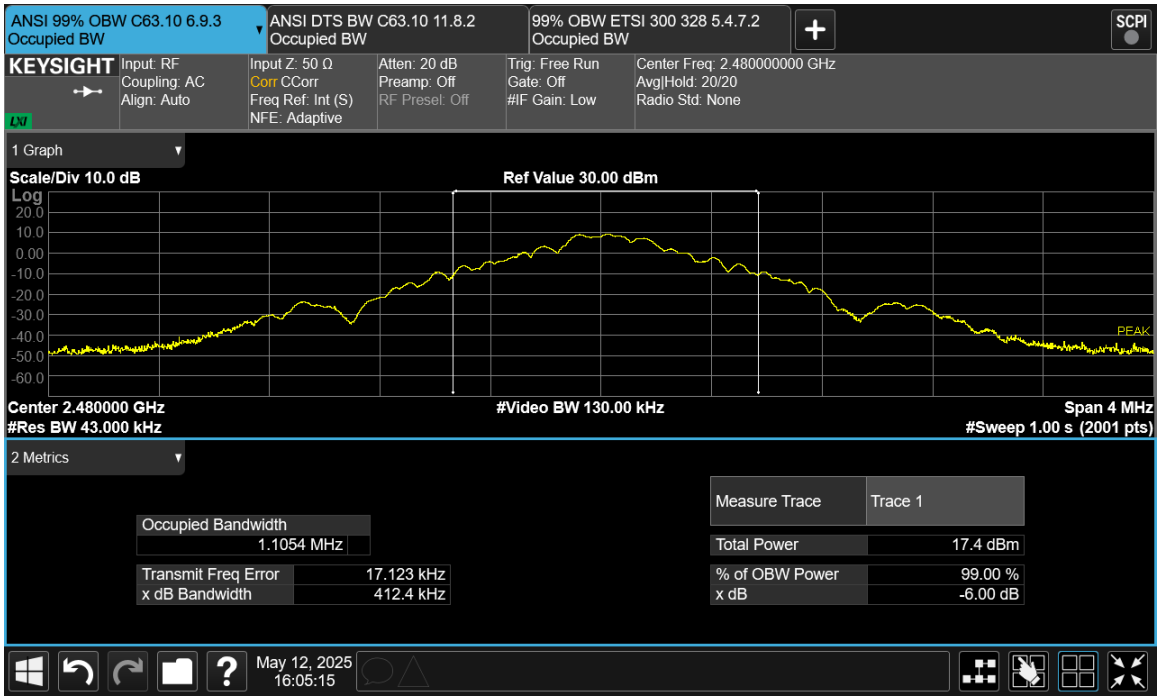

Figure TR09.2: Occupied bandwidth data for Bluetooth EDR 3 at high channel (2480 MHz)

Necessary Bandwidth Calculations

The Necessary Bandwidth is a theoretical value based on the specifications for a communication protocol, rather than the hardware implementation and a subsequent lab measurement. The analysis methods in FCC Part 2.202 and TRC-43 are the same for NFC, Bluetooth, ANT, and IEEE 802.11b WiFi. However, they differ for IEEE 802.11g and 11n systems because the Canadian TRC-43 standard provides different analysis methods for Orthogonal Frequency Division Multiplexing systems (OFDM). The tables below will show the analysis for most of the radios signals as a combined approach, then separately analyze the results for IEEE 802.11g and n systems. The tables below may include radio protocols that are not part of the product being evaluated.

NFC (Near Field Communication) at 13.56 MHz uses continuous wave telegraphy without tone modulation. The bit rate 'B' in the FCC and TRC equations is split into two parts here. B is the baud rate. C is a coding factor. C=1 for Miller encoding where the transition speed is as high as the bit rate, or C=2 for Manchester encoding where the transition speed is as high as twice the bit rate). K is a factor set to 3 for non-fading circuits under the standards. The Necessary Bandwidth, B_N is then:

$B_N = BCK$

Radio Type	B (kbaud)	C	K	B_N (kHz)
NFC A	106	1	3	318.0
NFC B	212	2	3	1272.0
NFC B	424	2	3	2544.0

Table TR09.100: Necessary Bandwidth for NFC

The radio modulation schemes for Ant, for the various Bluetooth protocols, and for IEEE 802.11 b WiFi are a mix of Phase Shift Key (PSK) and Quadrature Amplitude Modulation (QAM) techniques. The Necessary Bandwidth calculations use the equations from 47CFR Part 2.202(g) table section 6. We have set the variable K=1, which leaves the equation for both PSK and QAM as:

$B_N = 2R / Log_2(S)$

where B_N is the Necessary Bandwidth, R is the bit rate, and S is the number of signaling states.

Radio Type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
ANT / ANT+	1	1	2	1	2

Table TR09.101: Necessary Bandwidth for ANT and ANT+ Radio Protocols (FCC and TRC-43)

Radio Type	Sub-type	Method	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
Bluetooth	BR	GFSK	1	1	2	1	2
	EDR2	Pi/4 DPSK	2	1	4	2	2
	EDR3	8DPSK	3	1	8	3	2
BLE	1Mbps	GFSK	1	1	2	1	2
	2Mbps	DQPSK	2	1	4	2	2

Table TR09.102: Necessary Bandwidth for Bluetooth Radio Protocols (FCC and TRC-43)

Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 b	1	1	1	2	1	2
	2	2	1	4	2	2
	5.5	5.5	1	4	2	5.5
	11	11	1	4	2	11

Table TR09.103: Necessary Bandwidth for IEEE 802.11 b Radio Protocol (FCC and TRC-43)

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Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 a/g	6	6	1	2	1	12
	9	9	1	2	1	18
	12	12	1	4	2	12
	18	18	1	4	2	18
	24	24	1	16	4	12
	36	36	1	16	4	18
	48	48	1	64	6	16
	54	54	1	64	6	18
802.11 n/ac	MCS0	7.2	1	2	1	14.4
	MCS1	14.4	1	4	2	14.4
	MCS2	21.7	1	4	2	21.7
	MCS3	28.9	1	16	4	14.5
	MCS4	43.3	1	16	4	21.7
	MCS5	57.8	1	64	6	19.3
	MCS6	65	1	64	6	21.7
	MCS7	72.2	1	64	6	24.1
	MCS8	86.7	1	256	8	21.7

Table TR09.104: Necessary Bandwidth for IEEE 802.11 a, g, n, and ac 20 MHz Radio Protocols (FCC)

Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 n/ac	MCS0	15	1	2	1	30.0
	MCS1	30	1	4	2	30.0
	MCS2	45	1	4	2	45.0
	MCS3	60	1	16	4	30.0
	MCS4	90	1	16	4	45.0
	MCS5	120	1	64	6	40.0
	MCS6	135	1	64	6	45.0
	MCS7	150	1	64	6	50.0
	MCS8	180	1	256	8	45.0
	MCS9	200	1	256	8	50.0

Table TR09.105: Necessary Bandwidth for IEEE 802.11 n and ac 40 MHz Radio Protocols (FCC)

As a note, the bit rate for IEEE 802.11 n or ac WiFi is calculated based on the IEEE standard's short guard interval of 400 nsec. If only the long guard interval of 800 nsec were implemented, the bit rates would decrease by a small amount.

The TRC-43 method for OFDM signals simply multiplies the number of subcarriers, K, and the subcarrier spacing, N_S. In both cases, Ns is 312.5 kHz. The count of subcarriers includes nulls. So for example, 802.11 n uses 4 pilot subcarriers, 52 data subcarriers, and one null suppressed subcarrier in the middle for 57 total subcarrier channels.

$$B_N = N_S * K$$

Radio Type	Mode	Ns (MHz)	K	B_N (MHz)
802.11a/g	20 MHz	0.3125	53	16.6
802.11n/ac	20 MHz	0.3125	57	17.8
802.11n/ac	40 MHz	0.3125	117	36.6

Table TR09.106: Necessary Bandwidth for IEEE 802.11 a, g, n, and ac Radio Protocols (TRC-43)

This line is the end of the test record.

Test Record
Transmitter Power, Duty Cycle
Test IDs TR01
Project GCL0801

Test Date(s)	05, 14 May 2025
Test Personnel	Jim Solum, Vladimir Tolstik supervised by M Farah
Product Model	A04918
Serial Number	510606624
Operating Mode	M1 (BtTx)
Arrangement	A4 (Udc)
Input Power	USB 5Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-210, (as noted in Section 6 of the report).
Antenna Gain	-5.77 dBi, as reported by the client
Radio Protocol	Bluetooth, Bluetooth Low Energy, ANT
Hopping Frequencies	79 for Bluetooth, 40 for BLE
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum, Vladimir Tolstik
Date of this record:	06 Jun 2025

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
RF Power Sensor	Rohde&Schwarz	NRP8S	109927	18-Jul-2024	18-Jul-2026
Thermometer	Thermco	ACCD370P	210607316	21-Sep-2023	15-Sep-2025
Thermal Chamber	Tenney	T2RC	31244	Calibration	Not Required

Table TR01.1: List of test equipment used

Software used: Rohde & Schwarz Power Viewer V11.3; TimePowerAnalysisSpreadsheetv12d.xls

Test Method
The basic test standards provide options for the time evaluation test method. The following test methods were applied.

ANSI C63.10: 11.9.2.3.2 (Gated average power with broadband power meter)

Duty Cycle data will be included if it is relevant to test methods used for other standards such as Average Detector methods in the ANSI standards that apply duty cycle correction or certain kinds of analysis under the RF exposure standards.

Transmit Power and Timing Data
Each measurement is made conducted from the antenna port with the transmitter on a specified channel and in a selected transmission protocol. Where standards cited here apply harmonized test methods and different limits, the more strict limit has applied.

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This test record will show results based on one or more of the following methods of analyzing the same set of raw power data vs. time. The ANSI peak power method looks for the highest power in the data record, with results in dBm units. The ANSI gated average power method determines the average power in the data record but only during times when the transmitter is keyed on, with results in dBm units. Under the US and Canadian rules a limit of 30 dBm is applied independent of which ANSI method is used. The RF exposure analysis asks for the average power observed over the entire data record time, with results in linear power units such as milliwatts. RF exposure limits are not addressed in this test record. Many of the these standards also care about duty cycle, the portion of the time when the transmitter was actually transmitting. That is presented as a percentage, and no limit applies. All of these results are drawn from the same trace of Tx power data. The results are shown below.

ANSI Power

Frequency	(MHz)	2402	2404	2406	2440	2474	2476	2478	2480
Bluetooth	Basic	**12.90**	**NT**	**NT**	**12.86**	**NT**	**NT**	**NT**	**13.19**
Bluetooth	EDR2	**12.51**	**NT**	**NT**	**13.02**	**NT**	**NT**	**NT**	**13.24**
Bluetooth	EDR3	**11.65**	**NT**	**NT**	**11.74**	**NT**	**NT**	**NT**	**12.09**

Table TR01.2: Transmit Power, ANSI method, in dBm

Other Power Analyses

Frequency	(MHz)	2402	2404	2406	2440	2474	2476	2478	2480
Bluetooth	Basic	**19.48**	**NT**	**NT**	**19.34**	**NT**	**NT**	**NT**	**20.84**
Bluetooth	EDR2	**17.84**	**NT**	**NT**	**20.02**	**NT**	**NT**	**NT**	**21.09**
Bluetooth	EDR3	**14.61**	**NT**	**NT**	**14.92**	**NT**	**NT**	**NT**	**16.18**

Table TR01.3: Transmit Power, RF exposure method, in mW

Frequency	(MHz)	2402	2404	2406	2440	2474	2476	2478	2480
Bluetooth	Basic	**100.0%**	**NT**	**NT**	**100.0%**	**NT**	**NT**	**NT**	**100.0%**
Bluetooth	EDR2	**100.0%**	**NT**	**NT**	**100.0%**	**NT**	**NT**	**NT**	**100.0%**
Bluetooth	EDR3	**100.0%**	**NT**	**NT**	**100.0%**	**NT**	**NT**	**NT**	**100.0%**

Table TR01.4: Duty cycle for each radio mode

Setup Diagram

The following block diagrams show how the EUT and test equipment is arranged for test.

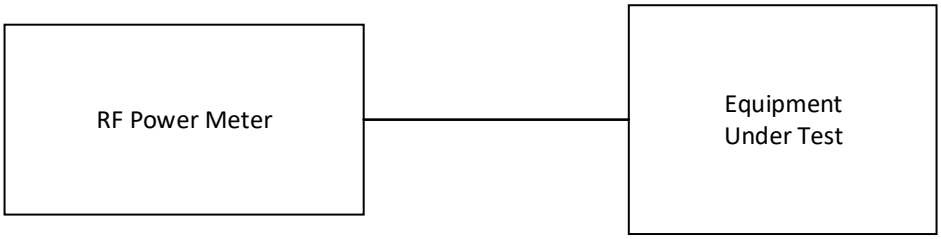

Figure TR01.1: Test equipment setup

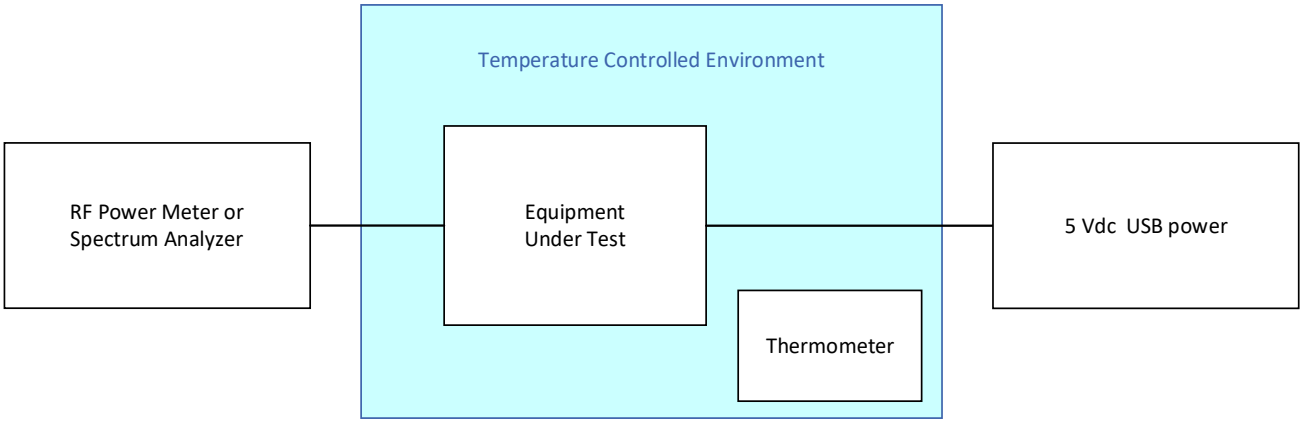

Figure TR01.2: Test equipment setup transmit power over temperature

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Test Record
Radiated Emission Test RE33
Project GCL0801

Test Date(s)	14,15 Jul 2025
Test Personnel	Vladimir Tolstik, Jim Solum
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).
Frequency Range:	1 GHz to 14 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Vladimir Tolstik, Jim Solum
Date of this record:	15 Jul 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	13-Dec-2024	13-Dec-2027
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required
3 GHz High Pass filter	Anatech Electronics	0K0R2	01	Calibration	Not Required

Table RE33.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, EPX test software Version 2025.01.000

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

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In the 1 GHz to 3.2 GHz frequency range, a Chebyshev 'Wifi' notch filter covering the 2.4 GHz ISM band was placed in series just before the preamplifier to ensure it operated in its linear range. This filter is accounted for in the system loss, so it appears in the prescan plots as high noise floor levels from 2400 – 2483 MHz. These are not failing emissions. A 3 GHz high pass filter was applied during testing between 3.2 GHz and 14 GHz to similarly protect the preamplifier.

In the 1 GHz to 14 GHz frequency range, pre-scan spectral data was taken at 1 meter and extrapolated to a 3 meter distance. Final measurements were made at 3 meters.

At azimuth angle 180° the 'front' reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The tables show the selected final measurement data between 1 GHz and 14 GHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the Bluetooth radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2321.950	H	39.7	49.7	-4.3	35.4	45.4	54.0	74.0	18.6	28.6	124.5	0.0
2362.006	H	44.5	52.0	-4.2	40.3	47.8	54.0	74.0	13.7	26.2	106.6	0.0
4803.938	V	42.2	52.2	0.1	42.3	52.3	54.0	74.0	11.7	21.7	227.4	316.0
7206.419	V	37.5	47.9	4.3	41.8	52.2	54.0	74.0	12.2	21.8	100.0	317.0
9187.371	H	31.9	45.2	10.3	42.2	55.5	54.0	74.0	11.8	18.5	222.9	73.0
11811.432	H	34.2	46.3	11.5	45.7	57.8	54.0	74.0	8.3	16.2	306.0	334.0

Table RE33.2: Emission summary (BT, BR, 2402 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2360.105	H	39.1	49.0	-4.2	34.9	44.8	54.0	74.0	19.1	29.2	106.6	0.0
2519.947	H	40.7	50.0	-3.3	37.4	46.7	54.0	74.0	16.6	27.3	400.0	305.0
3253.274	H	38.7	49.2	-2.8	35.9	46.4	54.0	74.0	18.1	27.6	276.0	11.0
4880.005	V	40.9	51.0	-0.1	40.8	50.9	54.0	74.0	13.2	23.1	237.1	316.0
7319.922	V	37.6	48.6	4.5	42.1	53.1	54.0	74.0	11.9	20.9	100.0	318.0
12929.620	H	32.0	46.4	12.4	44.4	58.8	54.0	74.0	9.6	15.2	148.0	0.0

Table RE33.3: Emission summary (BT, BR, 2440 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2319.896	H	37.2	47.8	-4.3	32.9	43.5	54.0	74.0	21.1	30.5	157.8	328.0
2520.035	H	41.2	50.2	-3.3	37.9	46.9	54.0	74.0	16.1	27.1	400.0	304.0
3306.655	H	41.8	50.6	-2.9	38.9	47.7	54.0	74.0	15.1	26.3	100.0	14.0
4960.078	V	42.8	52.3	0.1	42.9	52.4	54.0	74.0	11.1	21.6	219.3	320.0
5977.636	H	34.0	46.7	2.8	36.8	49.5	54.0	74.0	17.2	24.5	400.0	31.0
7439.756	V	39.0	49.3	4.8	43.8	54.1	54.0	74.0	10.2	19.9	110.6	318.0
10282.418	H	32.3	46.2	10.2	42.5	56.4	54.0	74.0	11.5	17.6	335.2	276.0
13275.374	V	31.8	45.8	13.0	44.8	58.8	54.0	74.0	9.2	15.2	288.7	133.0

Table RE33.4: Emission summary (BT, BR, 2480 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2321.877	H	38.4	49.3	-4.3	34.1	45.0	54.0	74.0	19.9	29.0	124.5	0.0
2362.013	H	42.7	51.1	-4.2	38.5	46.9	54.0	74.0	15.5	27.1	106.6	0.0
3202.784	H	37.9	49.2	-2.6	35.3	46.6	54.0	74.0	18.7	27.4	284.1	13.0
4803.962	V	43.1	54.4	0.1	43.2	54.5	54.0	74.0	10.8	19.5	106.6	325.0
6390.591	H	33.8	46.9	3.7	37.5	50.6	54.0	74.0	16.5	23.4	248.2	59.0
7206.014	V	37.6	48.8	4.3	41.9	53.1	54.0	74.0	12.1	20.9	100.0	315.0
9189.153	V	32.8	45.3	10.3	43.1	55.6	54.0	74.0	10.9	18.4	128.4	208.0
13952.350	H	33.4	48.1	13.3	46.7	61.4	54.0	74.0	7.3	12.6	100.0	36.0

Table RE33.5: Emission summary (BT, EDR2, 2402 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2359.987	H	37.9	49.1	-4.2	33.7	44.9	54.0	74.0	20.3	29.1	198.6	330.0
2520.039	H	38.8	49.1	-3.3	35.5	45.8	54.0	74.0	18.5	28.2	379.5	309.0
3253.367	H	39.5	49.6	-2.8	36.7	46.8	54.0	74.0	17.3	27.2	308.3	8.0
4879.964	V	41.3	52.4	-0.1	41.2	52.3	54.0	74.0	12.8	21.7	100.0	326.0
7319.930	V	37.5	49.6	4.5	42.0	54.1	54.0	74.0	12.0	19.9	100.0	318.0
9204.375	V	32.2	45.6	10.3	42.5	55.9	54.0	74.0	11.5	18.1	321.2	297.0
13256.439	V	32.1	45.7	13.1	45.2	58.8	54.0	74.0	8.8	15.2	100.0	144.0
13984.965	V	33.8	48.0	13.3	47.1	61.3	54.0	74.0	6.9	12.7	379.0	47.0

Table RE33.6: Emission summary (BT, EDR2, 2440 MHz)

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Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
2520.042	H	38.9	49.8	-3.3	35.6	46.5	54.0	74.0	18.4	27.5	377.4	311.0
3306.640	H	40.5	49.8	-2.9	37.6	46.9	54.0	74.0	16.4	27.1	279.5	8.0
4959.974	V	42.5	54.2	0.1	42.6	54.3	54.0	74.0	11.4	19.7	120.4	324.0
6626.708	H	33.8	47.3	4.0	37.8	51.3	54.0	74.0	16.2	22.7	138.6	287.0
7439.994	V	38.8	50.1	4.8	43.6	54.9	54.0	74.0	10.4	19.1	110.6	319.0
9147.461	H	32.2	45.4	10.1	42.3	55.5	54.0	74.0	11.7	18.5	343.8	26.0
11867.933	V	32.5	46.9	11.7	44.2	58.6	54.0	74.0	9.8	15.4	247.1	13.0

Table RE33.7: Emission summary (BT, EDR2, 2480 MHz)

The graphs below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

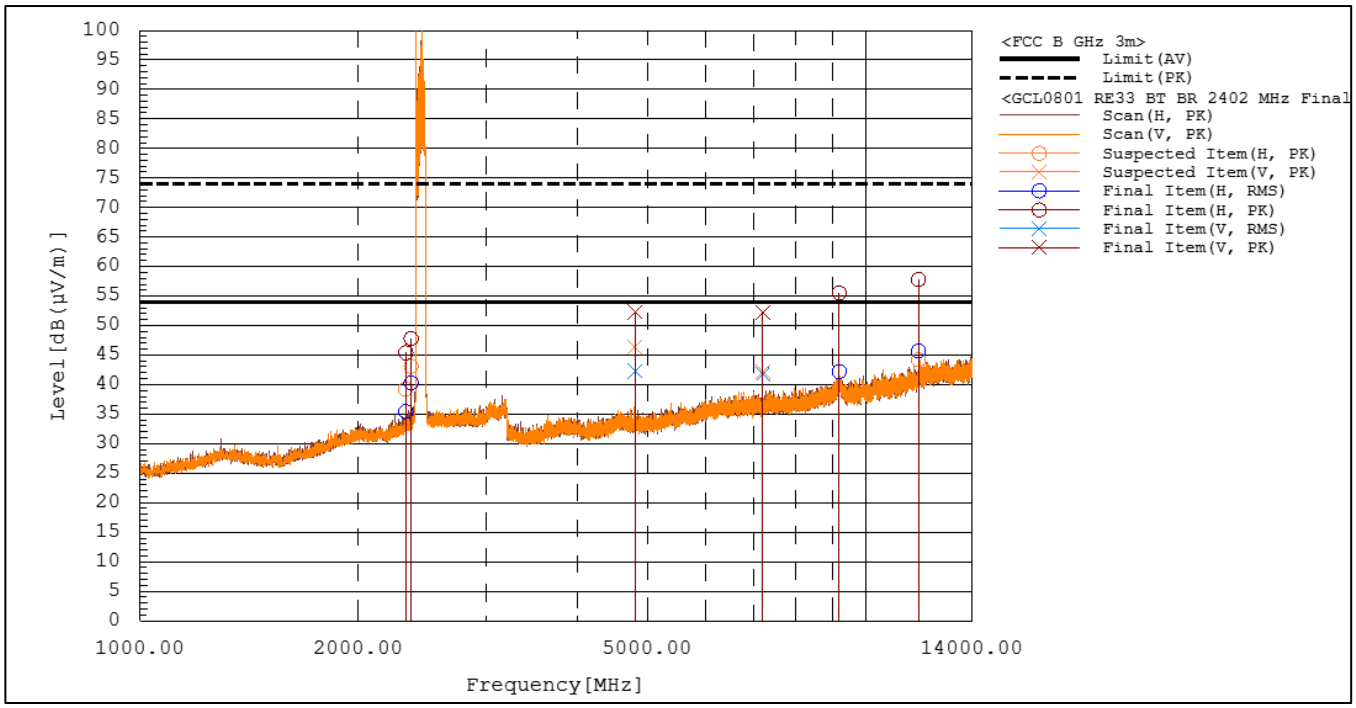

Figure RE33.1: Spectral data (BT, BR, 2402 MHz)

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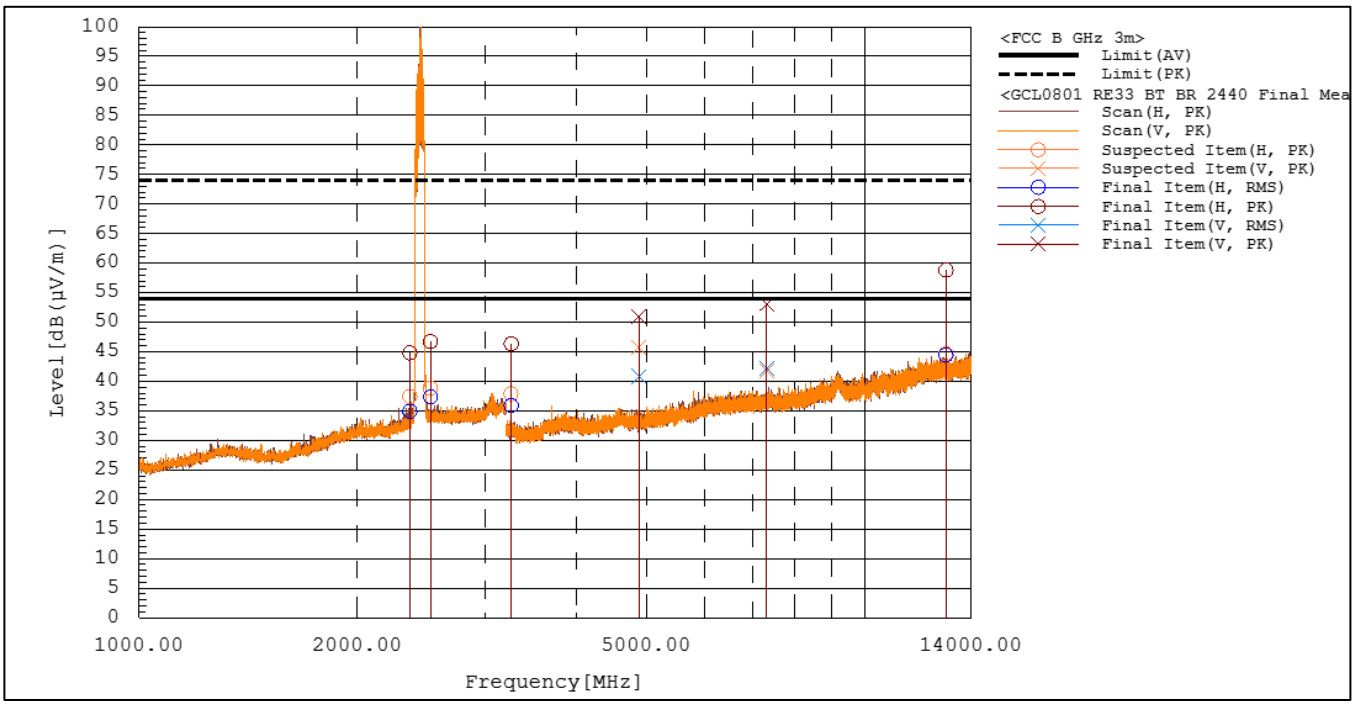

Figure RE33.2: Spectral data (BT, BR, 2440 MHz)

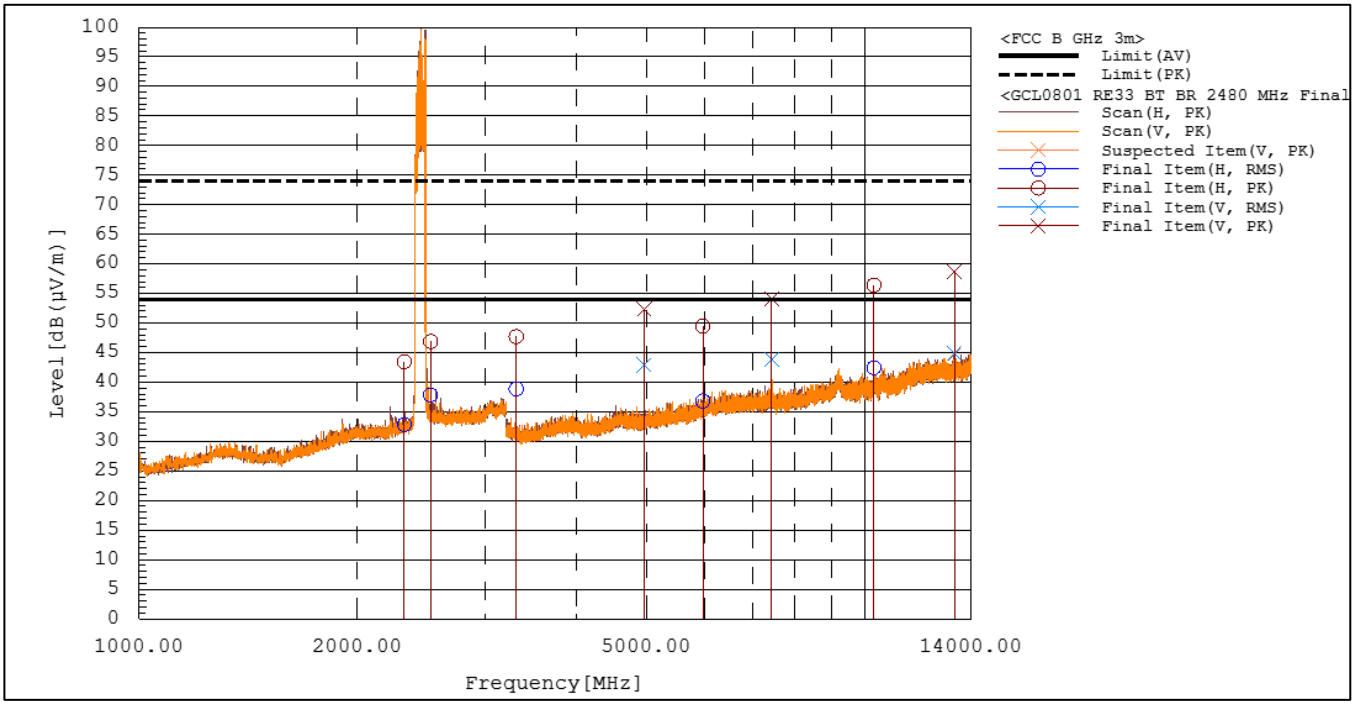

Figure RE33.3: Spectral data (BT, BR, 2480 MHz)

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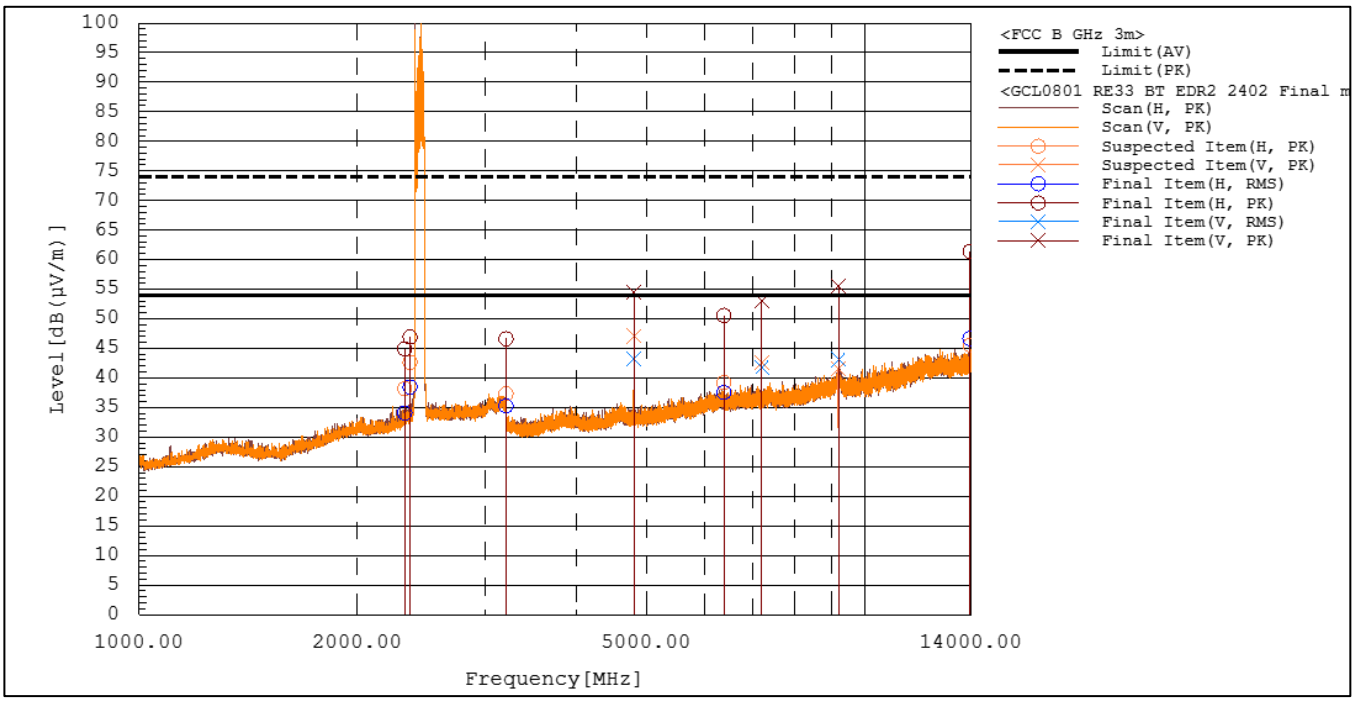

Figure RE33.4: Spectral data (BT, EDR2, 2402 MHz)

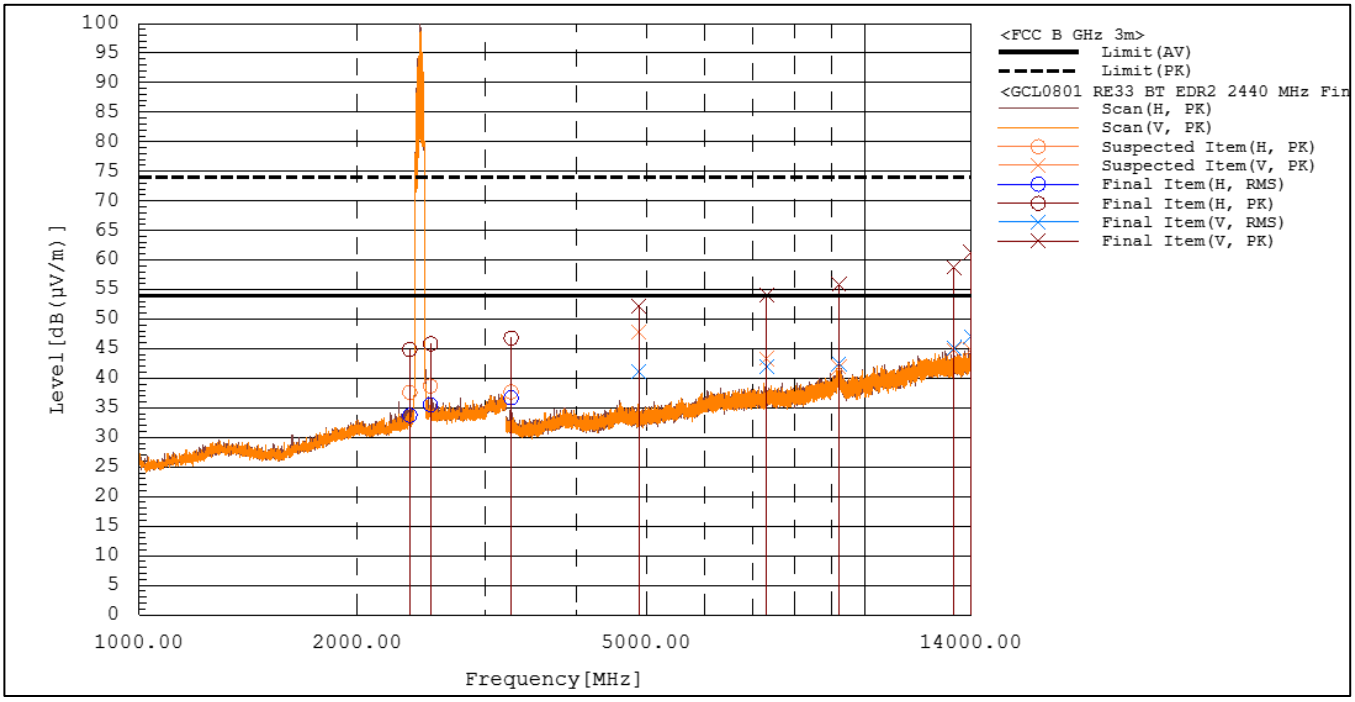

Figure RE33.5: Spectral data (BT, EDR2, 2440 MHz)

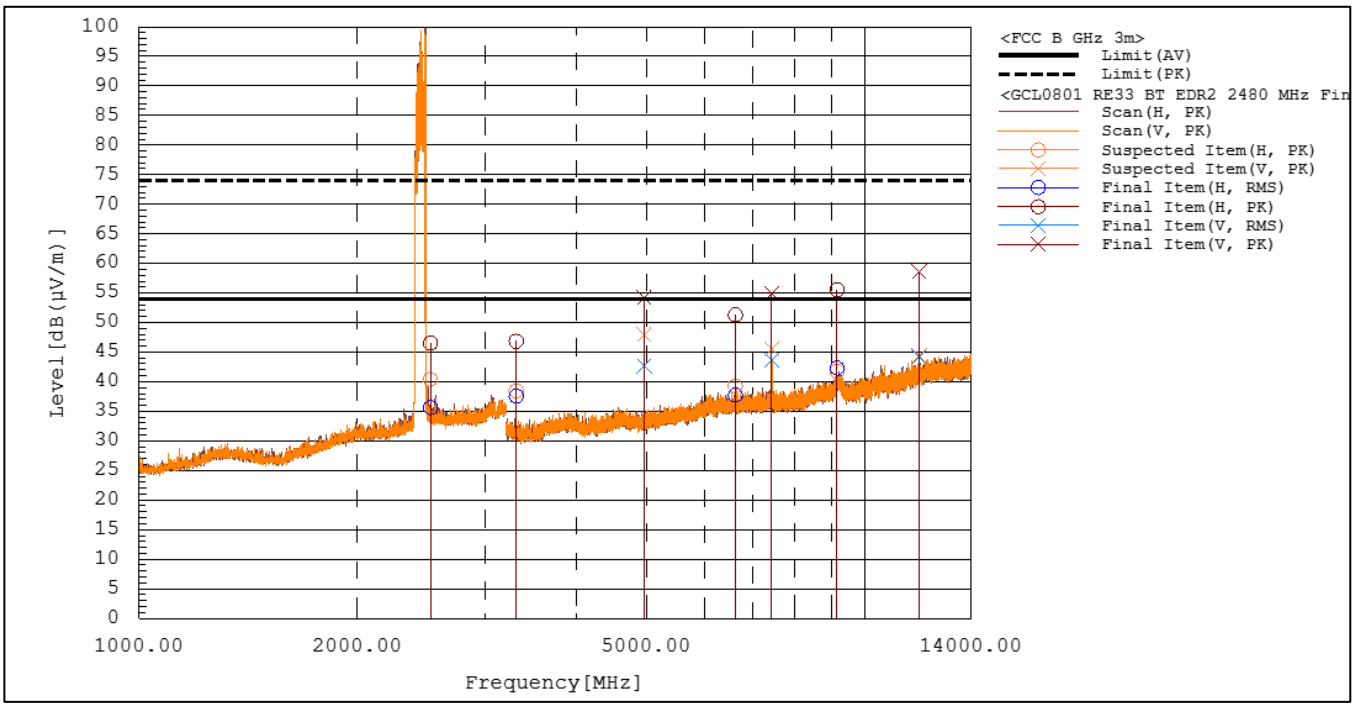

Figure RE33.6: Spectral data (BT, EDR2, 2480 MHz)

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure RE33.7: EUT test setup, first view

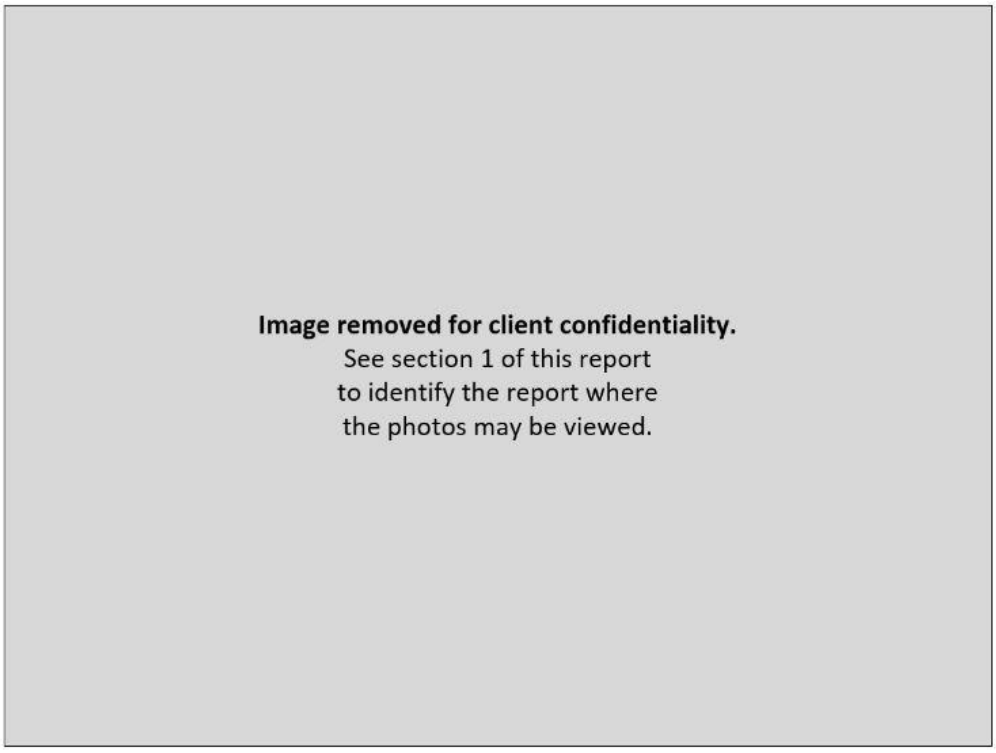

Figure RE33.8: EUT test setup, second view

This line is the end of the test record.

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Test Record
Radiated Emission Test RE31
Project GCL0801

Test Date(s)	17, 18 Jul 2025
Test Personnel	Jim Solum, Vladimir Tolstik
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).
Frequency Range:	9 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Vladimir Tolstik
Date of this record:	18 Jul 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Loop antenna, amplified	Schwarzbeck	FMZB 1519B	00174	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	11-Dec-2024	11-Dec-2027
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026

Table RE31.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, RE 150k to 30M Signal Maximization Tool V1 2021Mar17.xlsx, RE 9k30m FccCanada Analysis3.xlsx, RE 9k to 30M XYZ_orientations_TemplateV7.xlsx

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, and in the three loop antenna polarizations. The loop antenna was positioned at a 1.5 m height. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the loop was set to the worst case orientation for that frequency and the turntable angle was explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

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At azimuth angle 0° the 'front' reference mark of the turntable is pointed Southward. At 90° the reference mark points West. At -90° it points East. At -7° the turntable reference mark is pointed directly at the antenna mast for tests that involve changes in antenna elevation. At 0° the turntable reference mark is pointed directly at the loop antenna location. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 9 kHz and 30 MHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
0.009	46.35	Avg	128.38	82.03	57.40	148.38	90.98	Z	100
0.0384	34.43	Avg	115.93	81.50	45.19	135.93	90.74	X	89
0.0489	47.68	Avg	113.82	66.13	54.01	133.82	79.81	X	-149
0.0626	37.02	Avg	111.67	74.66	44.52	131.67	87.15	X	102
0.067	41.89	Avg	111.08	69.19	48.22	131.08	82.87	Y	-162
0.069	37.43	Avg	110.83	73.40	43.38	130.83	87.45	Y	104
0.1252	31.62	Avg	105.65	74.03	37.15	125.65	88.50	Z	-17
0.134	33.20	Avg	105.07	71.86	39.11	125.07	85.95	Z	180
0.15	22.05	Avg	104.08	82.03	31.74	124.08	92.34	Z	180

Table RE31.2: Emission summary (BT, BR, 2402 MHz)

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
0.009	46.82	Avg	128.52	81.70	55.88	148.52	92.64	Z	94
0.049	51.45	Avg	113.81	62.36	57.46	133.81	76.35	Z	180
0.0626	36.78	Avg	111.67	74.90	43.07	131.67	88.60	Y	180
0.067	41.66	Avg	111.08	69.42	48.18	131.08	82.90	Z	54
0.069	37.39	Avg	110.83	73.45	44.03	130.83	86.80	Z	-129
0.0885	28.71	Avg	108.67	79.96	38.67	128.67	90.00	Z	-168
0.1252	31.75	Avg	105.66	73.90	37.48	125.66	88.18	X	116
0.134	33.19	Avg	105.06	71.87	38.71	125.06	86.35	Y	-68
0.15	21.80	Avg	104.08	82.28	32.05	124.08	92.04	Z	180

Table RE31.3: Emission summary (BT, EDR2, 2402 MHz)

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The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

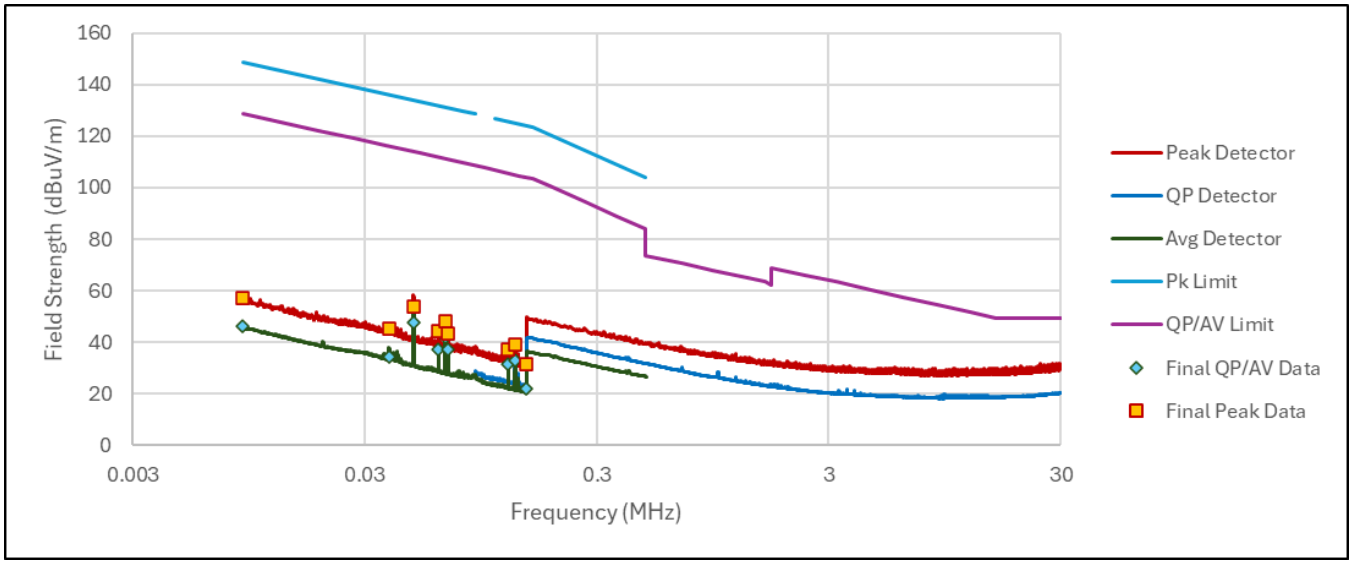

Figure RE31.1: Spectral data (BT, BR, 2402 MHz)

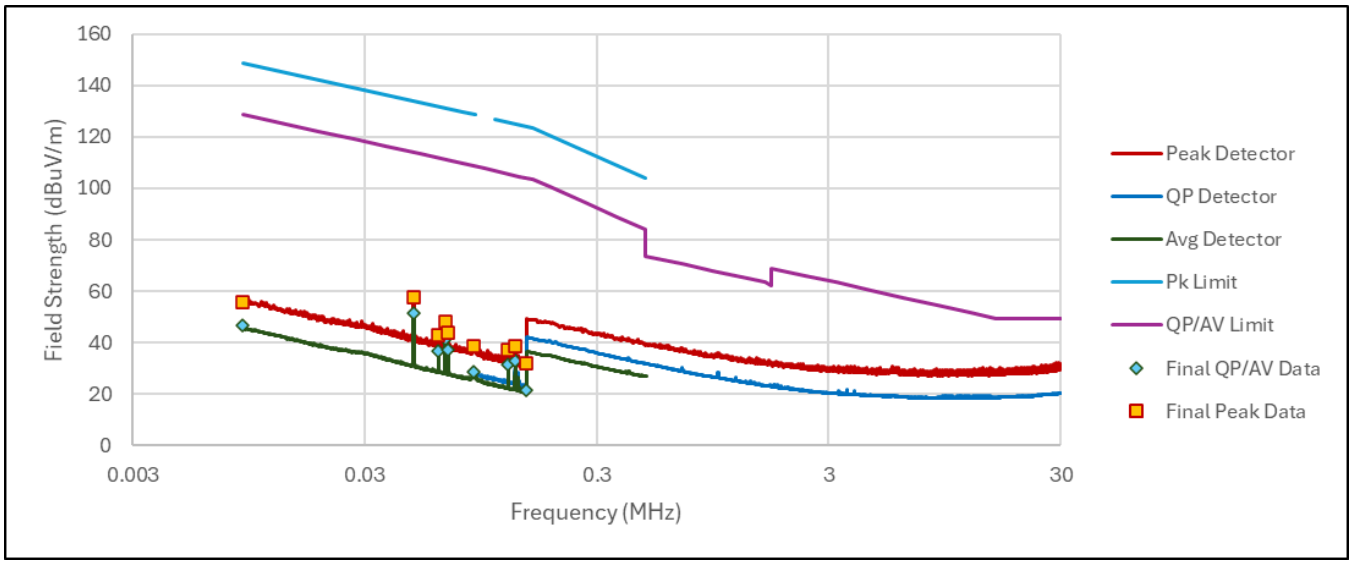

Figure RE31.2: Spectral data (BT, EDR2, 2402 MHz)

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Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

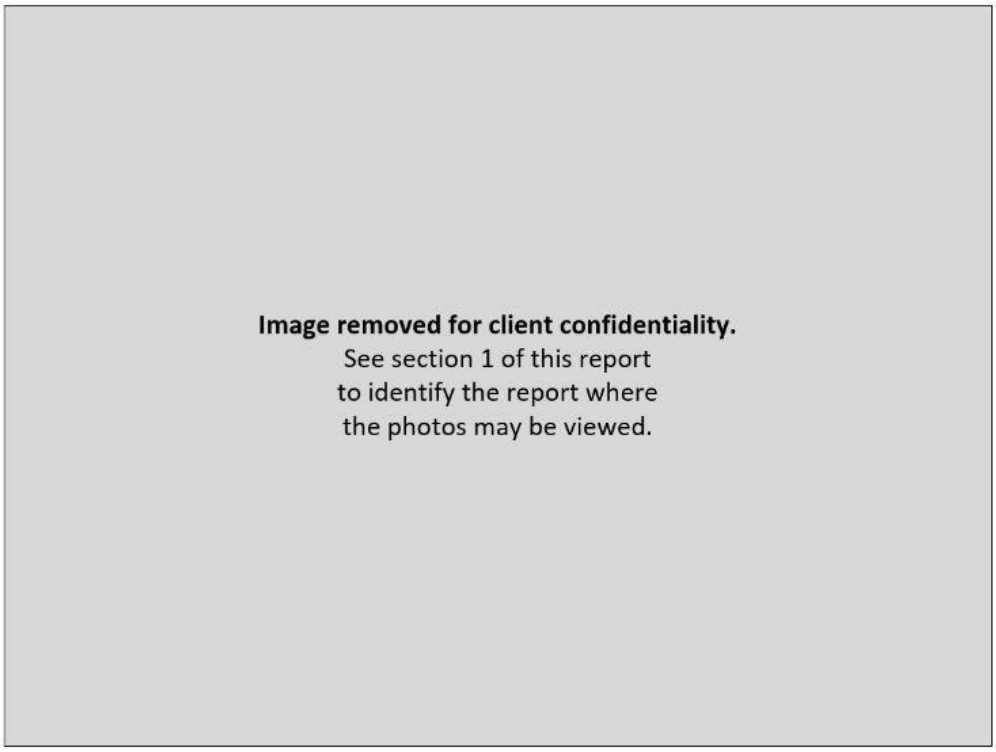

Figure RE31.3: EUT test setup, first view

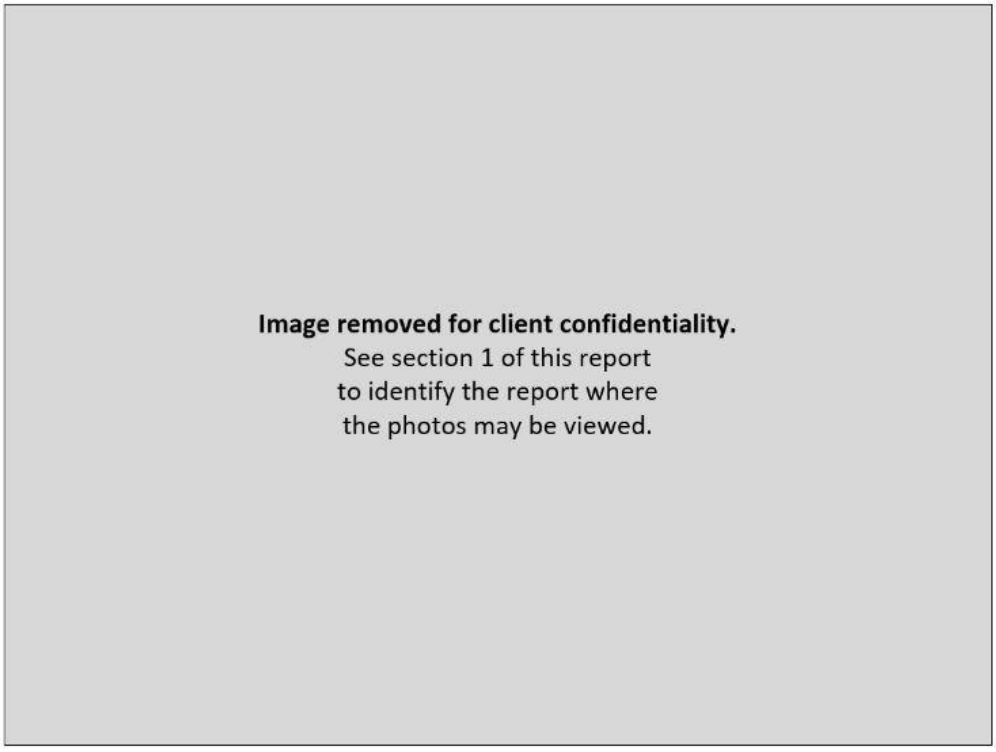

Figure RE31.4: EUT test setup, Antenna X Polarization

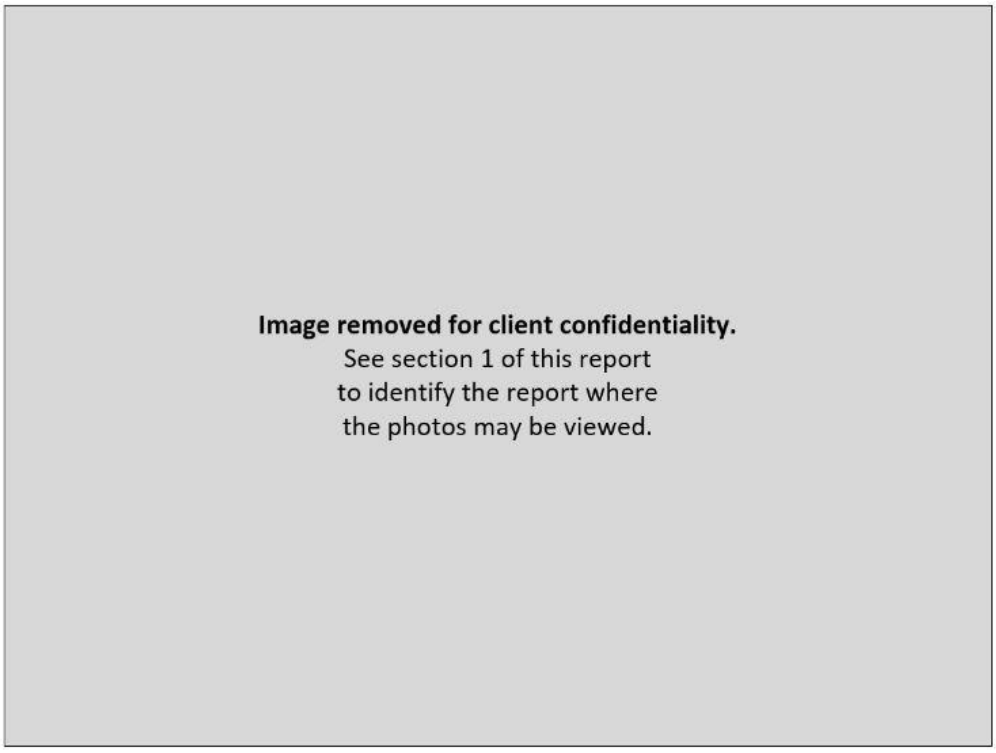

Figure RE31.5: EUT test setup, Antenna Y Polarization

Figure RE31.6: EUT test setup, Antenna Z Polarization

This line is the end of the test record.

Test Record
Radiated Emission Test RE32
Project GCL0801

Test Date(s)	17 July 2025
Test Personnel	Jim Solum
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247, RSS-GEN (as noted in Section 6 of the report).
Frequency Range:	30 MHz to 1000 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	17 July 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Biconilog, 30M-6 GHz	ETS Lindgren	3142E	00233201	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	11-Dec-2024	11-Dec-2027
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026

Table RE32.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06 EPX test software Version 2025.01.00

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

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At azimuth angle 180° the 'front' reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 30 MHz and 1 GHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB(μV)	dB(1/m)	dB(μV/m)	dB(μV/m)	dB	cm	deg
		QP		QP	QP	QP		
33.120	V	9.3	20.5	29.8	40.0	10.2	100.0	14.0
44.490	V	15.2	14.8	30.0	40.0	10.0	100.0	140.0
52.560	V	12.9	13.3	26.2	40.0	13.8	100.0	146.0
74.910	V	11.8	13.8	25.6	40.0	14.4	100.0	331.0
204.750	H	4.3	18.0	22.3	43.5	21.2	144.9	79.0
778.230	V	1.0	31.9	32.9	46.0	13.1	369.6	121.0
786.300	V	1.0	31.9	32.9	46.0	13.1	335.7	135.0
941.280	V	0.5	34.1	34.6	46.0	11.4	195.7	333.0

Table RE32.2: Emission summary (BT, BR, 2402 MHz)

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB(μV)	dB(1/m)	dB(μV/m)	dB(μV/m)	dB	cm	deg
		QP		QP	QP	QP		
33.180	V	10.1	20.5	30.6	40.0	9.4	100.0	359.0
43.920	V	14.2	15.0	29.2	40.0	10.8	100.0	122.0
52.380	V	13.0	13.3	26.3	40.0	13.7	100.0	105.0
74.760	V	12.3	13.8	26.1	40.0	13.9	114.0	0.0
204.540	H	4.0	18.0	22.0	43.5	21.5	151.3	268.0
778.380	H	0.6	31.9	32.5	46.0	13.5	253.2	331.0
786.210	V	0.9	31.8	32.7	46.0	13.3	327.0	153.0

Table RE32.3: Emission summary (BT, EDR2, 2402 MHz)

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The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

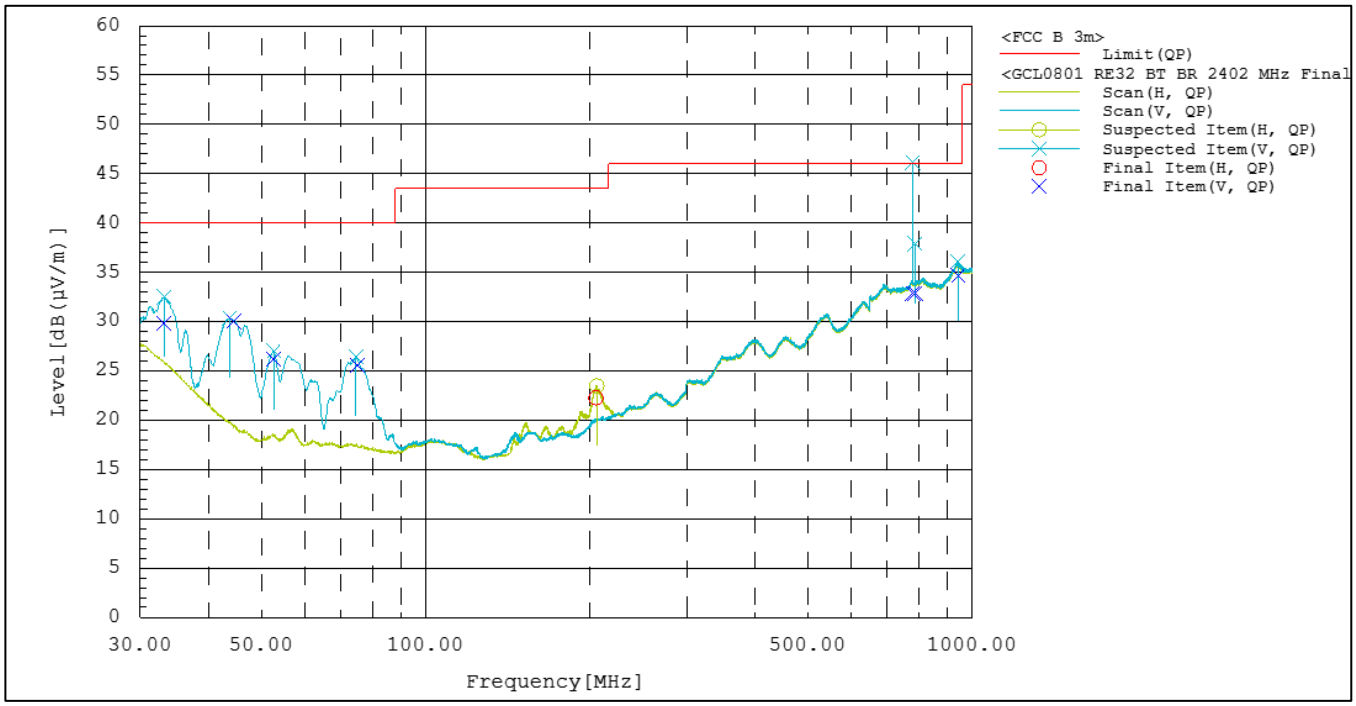

Figure RE32.1: Spectral data (BT, BR, 2402 MHz)

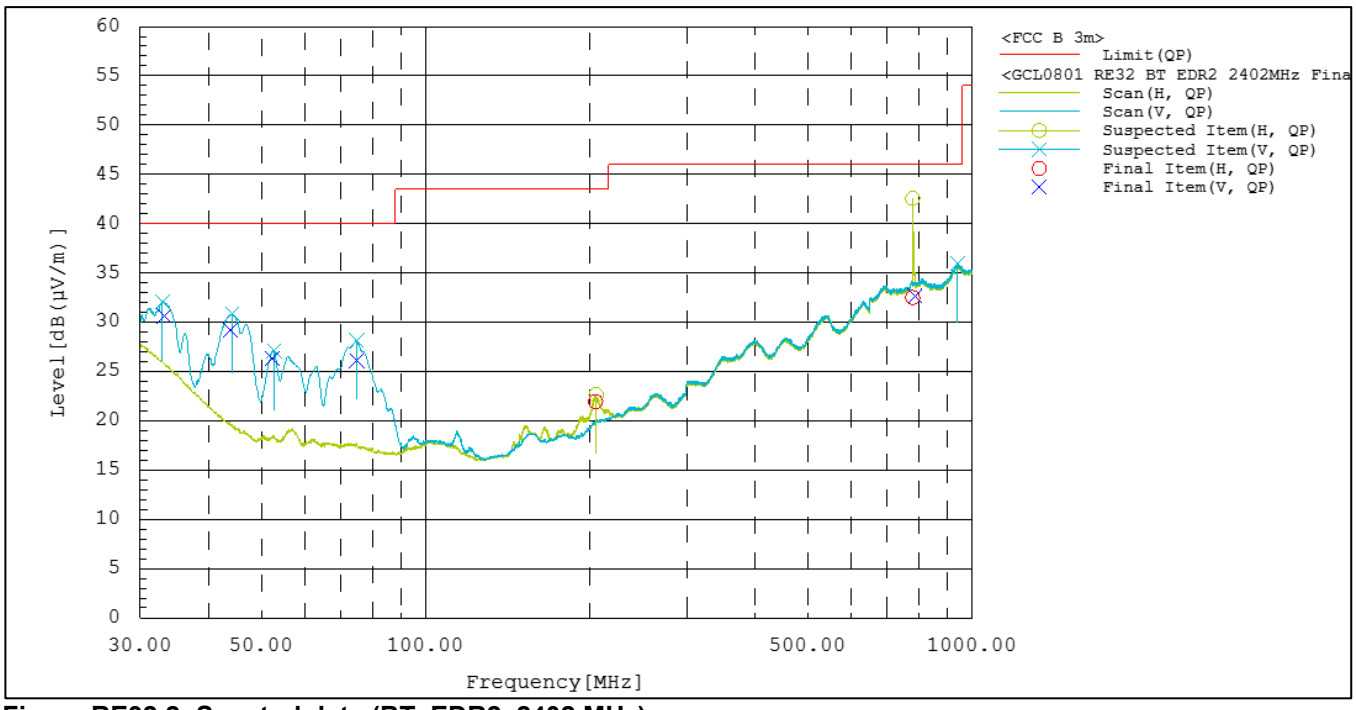

Figure RE32.2: Spectral data (BT, EDR2, 2402 MHz)

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Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure RE32.3: EUT test setup, first view

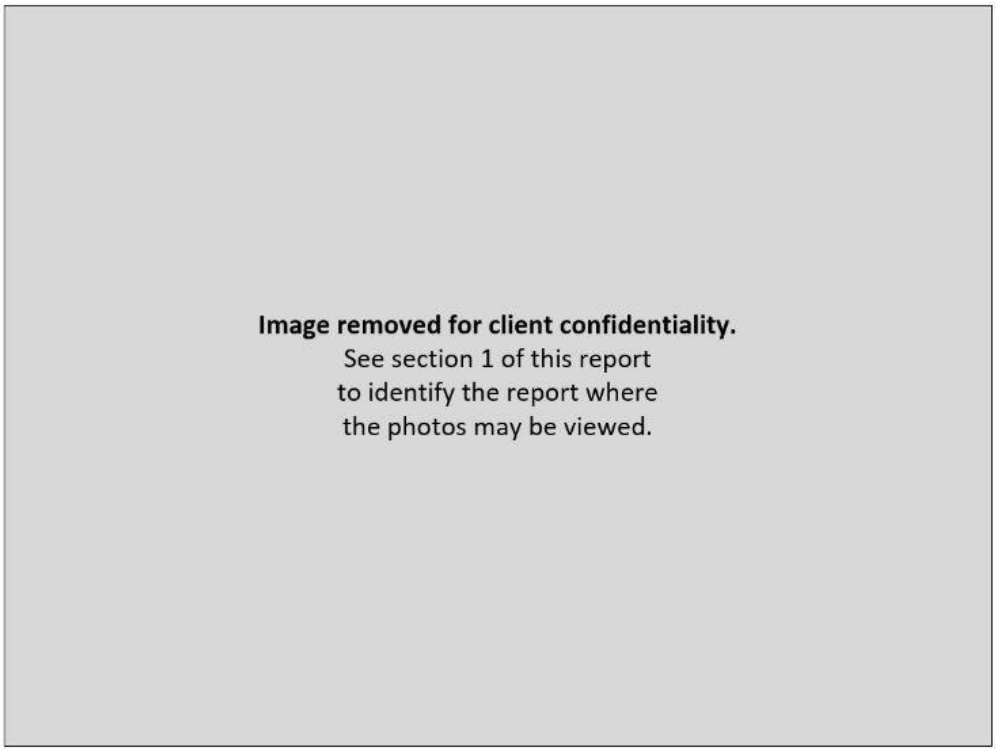

Figure RE32.4: EUT test setup, second view

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Test Record
Radiated Emission Test RE34
Project GCL0801

Test Date(s)	16 July 2025
Test Personnel	Jim Solum
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247, RSS-GEN (as noted in Section 6 of the report).
Frequency Range:	14 GHz to 25 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	17 July 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Antenna, Horn, 10-40 GHz	ETS Lindgren	3116C	00227673	14-Sep-2023	15-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	13-Dec-2024	13-Dec-2027
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
Preamplifier, 14 GHz to 40 GHz	Com-Power	PAM-840A	461364	Calibration	Not Required

Table RE34.1: Test Equipment Used

Software Used: Keysight PXE software A.33.03, EPX test software Version 2025.01.00

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

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In the 14 GHz to 26.5 GHz frequency range, pre-scan spectral data was taken at 1 meter and extrapolated to a 3 meter distance. Final measurements were made at 3 meters.

At azimuth angle 180° the 'front' reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 14 GHz and 25 GHz. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the Bluetooth radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

In this test, fewer than six emissions were observed within 20 dB of the limit. The relevant emissions were measured, including one or more noise floor signals as judged appropriate to the spectrum.

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
19215.511	H	26.0	37.7	19.7	45.7	57.4	54.0	74.0	8.3	16.6	364.8	92.0
23050.699	V	28.1	31.7	21.8	49.9	53.5	54.0	74.0	4.1	20.5	308.3	0.0

Table RE34.2: Emission summary (BT, BR, 2402 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		RMS	PK		RMS	PK	AV	PK	RMS	PK		
18736.408	H	28.4	26.0	19.8	48.2	45.8	54.0	74.0	5.8	28.2	317.5	212.0
23020.457	V	25.0	36.6	21.8	46.8	58.4	54.0	74.0	7.2	15.6	373.4	339.0

Table RE34.3: Emission summary (BT, EDR2, 2402 MHz)

The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

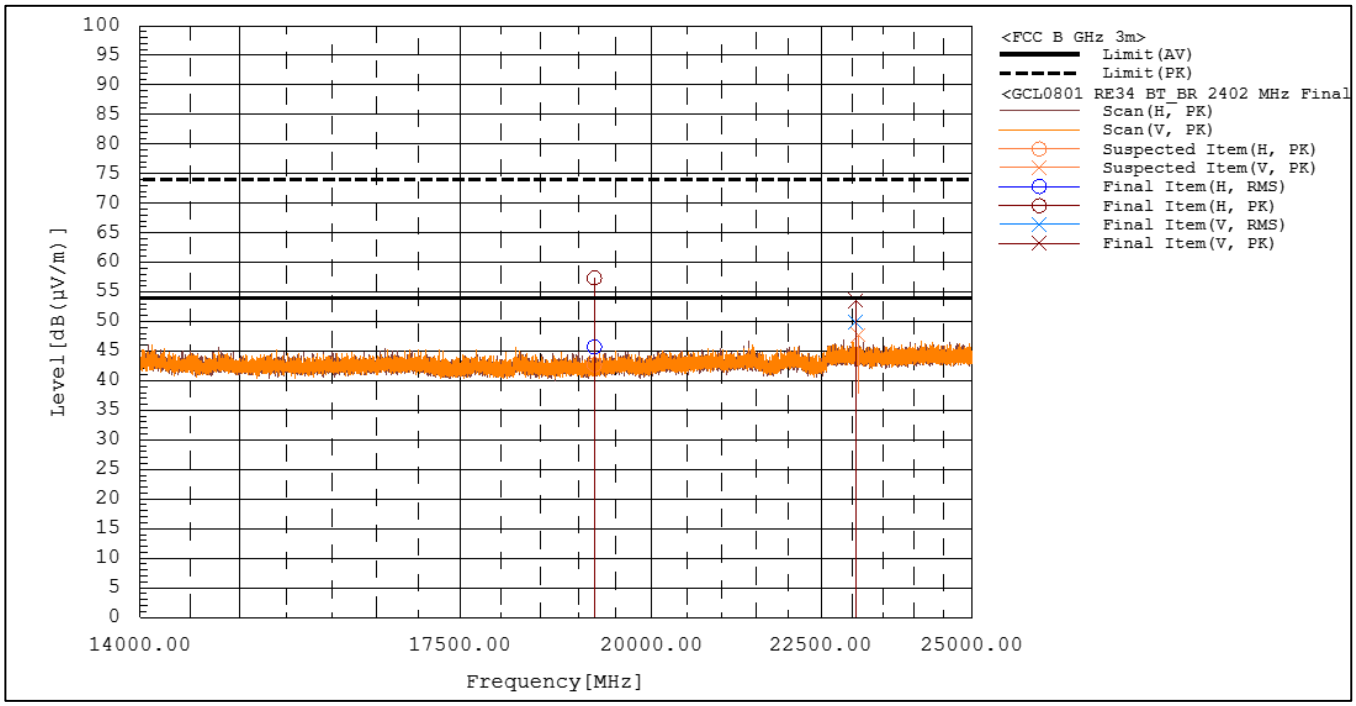

Figure RE34.1: Spectral data (Bluetooth Basic Rate 2402 MHz)

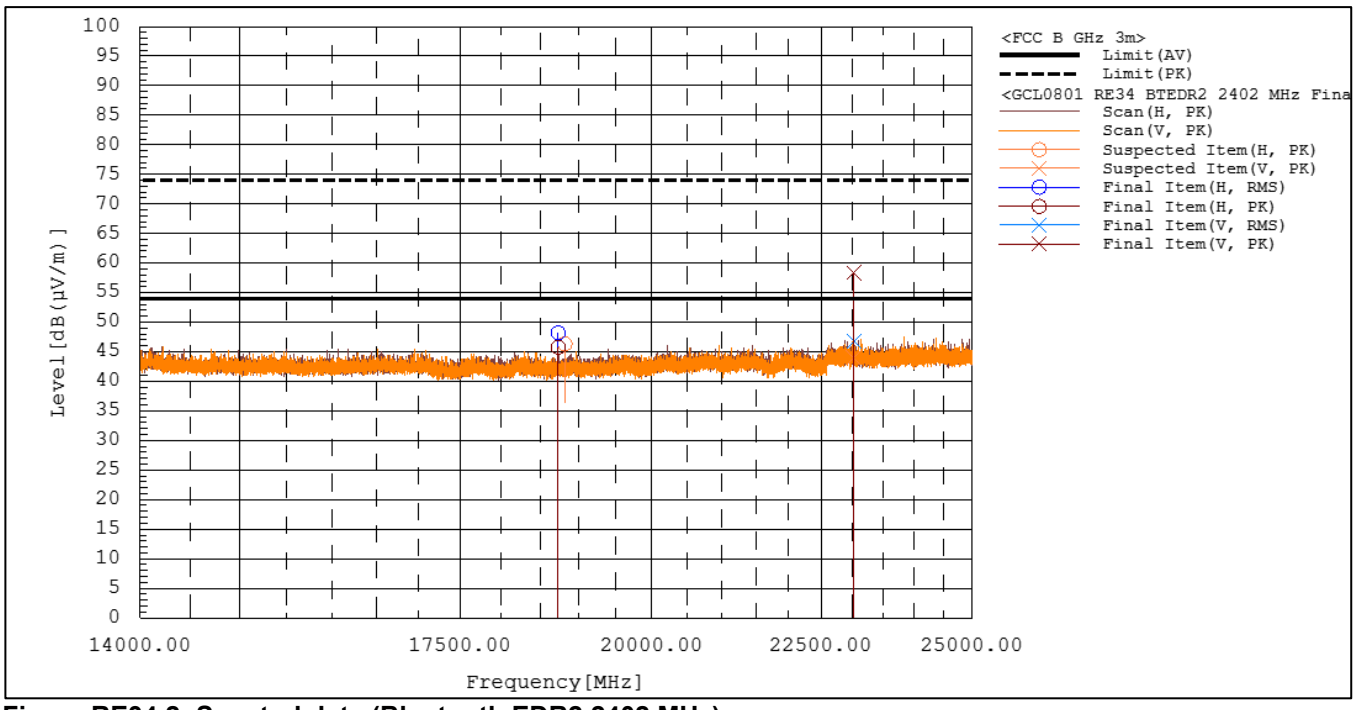

Figure RE34.2: Spectral data (Bluetooth EDR2 2402 MHz)

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Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure RE34.3: EUT test setup, first view

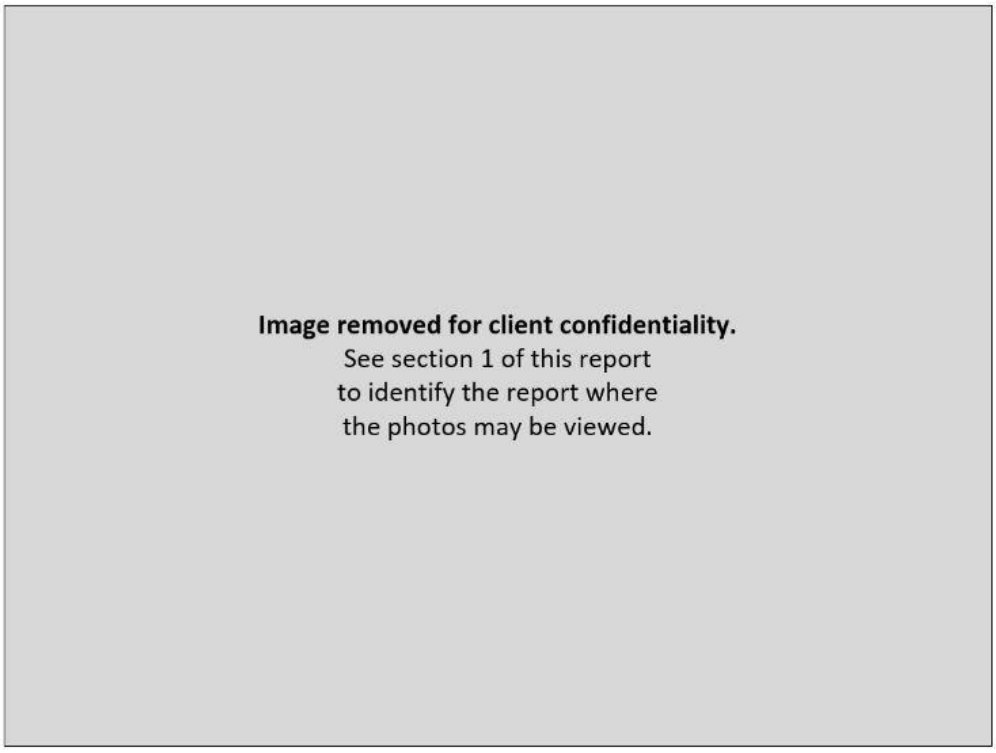

Figure RE34.4: EUT test setup, second view

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Test Record
Radiated Emission Test RE02
Project GCL0801

Test Date(s)	12 May 2025
Test Personnel	David Kerr Jim Solum Vladimir Tolstik
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report)
Frequency Range:	Restricted Bands (2200-2300 MHz, 2310-2390 MHz, 2483.5-2500 MHz)
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	02 June 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required

Table RE02.1: Test Equipment Used

Software Used
Keysight PXE receiver software A.32.06, RE Signal Maximization Tool v2021Feb25.xlsx,

Test Data

US and Canadian laws contain dozens of bands where radio operation is restricted. Compliance with most of those band restrictions is typically demonstrated by a series of spurious emission tests covering a very wide span of frequencies from kilohertz to Gigahertz. This test record focuses on restricted bands that are immediately adjacent to the authorized band in which the test sample radio operate. It shows whether the modulation products are sufficiently suppressed to meet the restricted band requirements.

The radiated emission test began with a preliminary scan in each restricted band at multiple turntable angles, antenna heights, and both antenna polarizations. For test standards that require reorienting the test sample, further preliminary scans were taken in those alternate orientations typically described as X, Y, and Z. Subsequent testing was done using on the orientation(s) producing the highest result relative to the test limit. Final field strength measurements were taken in that set of positions.

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Restricted band measurements in the lower band were made while the transmitter was tuned to its lowest frequency of 2402 MHz. Measurements in the upper band were made while the transmitter was tuned to its highest frequency of 2480 MHz.

At azimuth angle 0° the 'front' reference mark of the turntable is pointed Southward. At 90° the reference mark points West. At -90° it points East. At -7° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The tables show the selected final measurement data between the FCC restricted bands. It includes a the strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC restricted band 'Class B' Limit at 3 m listed at 15.209 and RSS-Gen clause 8.9.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report. The duty cycle for the BT radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2362.3	54	74	38.97	48.16	15.03	25.84	170	3130	VERT	RMS	0.00
2362	54	74	39.37	48.54	14.63	25.46	170	3130	VERT	RMS	0.00

Table RE02.2: FCC restricted bands from 2200 to 2390 MHz (BT, EDR3, 2402 MHz)

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2483.5	54	74	35.28	50.46	18.72	23.54	160	3480	VERT	RMS	0.00

Table RE02.3: FCC restricted band from 2483.5 to 2500 MHz (BT, EDR3, 2480 MHz)

The graphs below show the background spectrum observed during pre-scan, as well as the final data points from the table above.

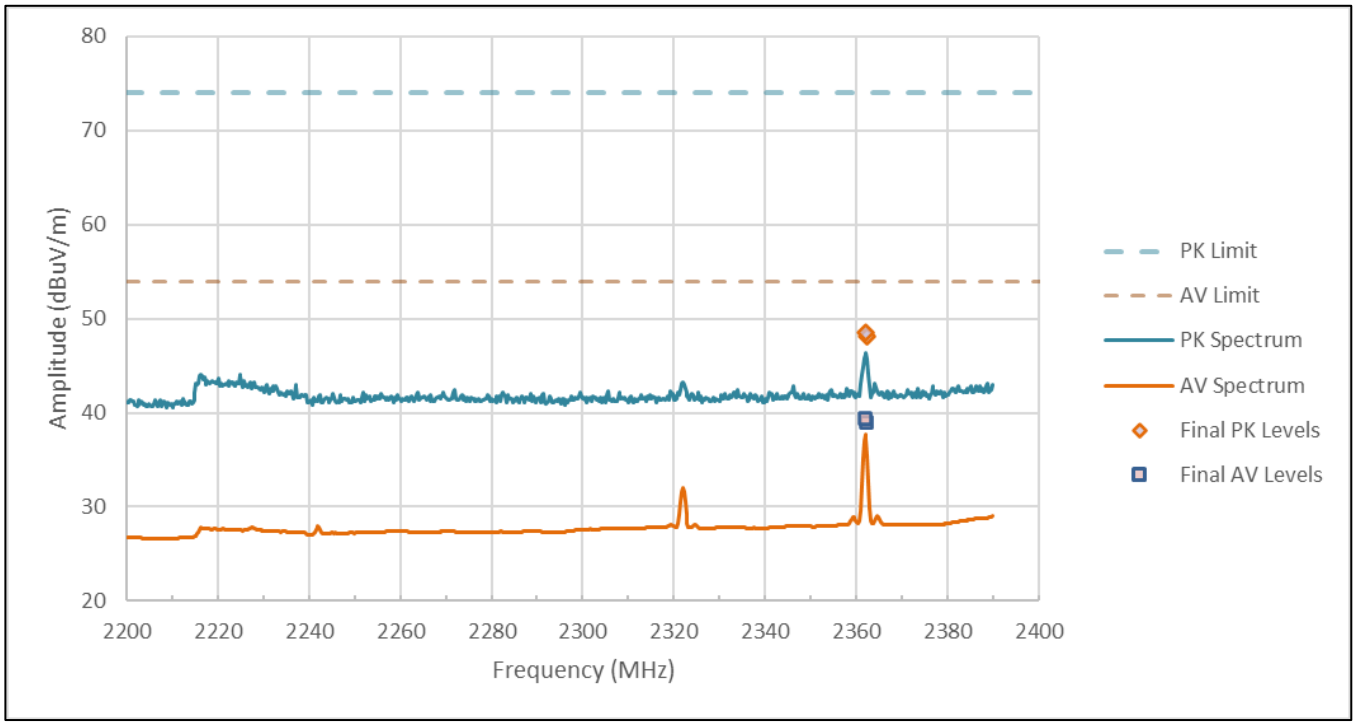

Figure RE02.1: FCC restricted band spectral data from 2200 to 2390 MHz (BT, EDR3, 2402 MHz)

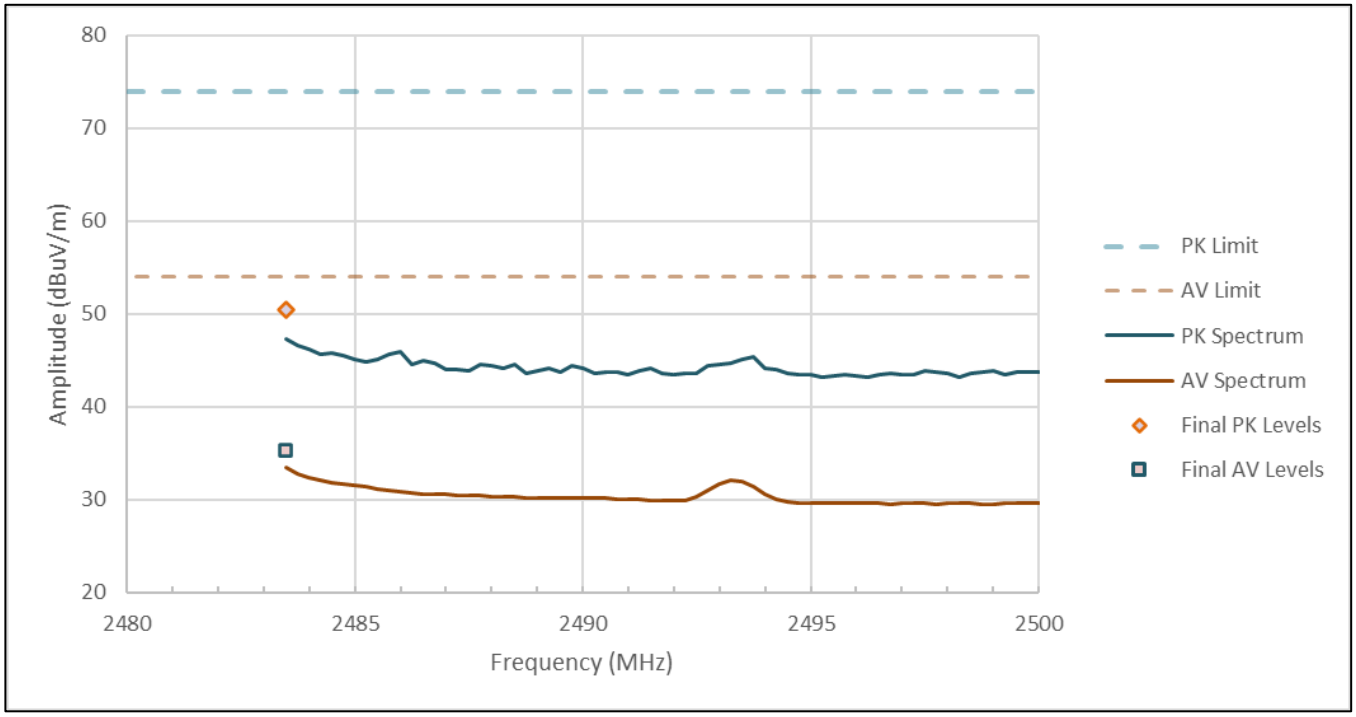

Figure RE02.2: FCC restricted band spectral data from 2483.5 to 2500 MHz (BT, EDR3,2480 MHz)

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure RE02.3: EUT test setup, primary view

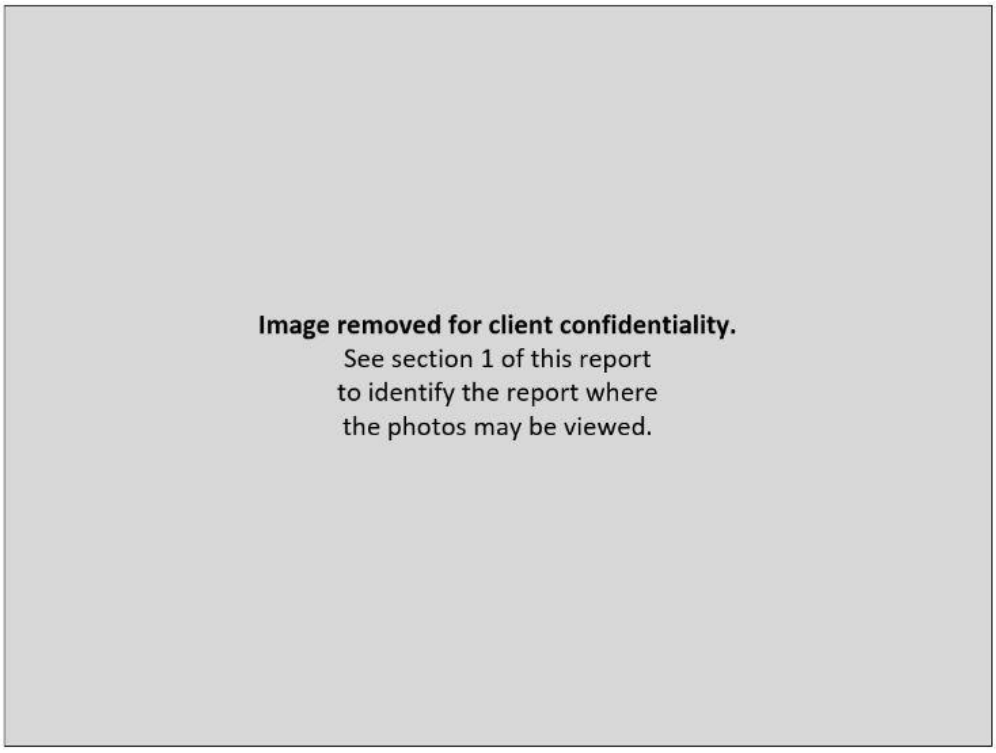

Figure RE02.4: EUT test setup, reverse view

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Test Record

Conducted Emissions Mains Test CE01
Project GCL0801

Test Date(s)	09 May 2025
Test Personnel	Majid Farah
Product Model	A04918
Serial Number tested	510606683
Operating Mode	M1 (BtTx)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC part 15; RSS-247; ANSI C63.10 (as noted in Section 6 of the report).
Frequency Range:	150 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Majid Farah
Date of this record:	12 May 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013784	26-Jun-2024	26-Jun-2027
LISN multiline; 20A 50uH	Com-Power	LIN-120C	20160005	3-Apr-2024	1-Apr-2027
Coaxial Power Cable	Com-Power	RG214/U	20230124-01	3-Apr-2024	1-Apr-2027

Table CE01.1: Test Equipment Used

Software Used
Keysight PXE software A33.03; CE Mains 150k to 30M Data Analysis V3a 2025Jan08.xlsx

Test Data

The conducted emission test process began with a set of preliminary scans on both power conductors using both Quasi-Peak and Average detectors across the frequency range. Where the test standard requires cable manipulation, one or more likely worst case frequencies selected by the test personnel. Cables were manipulated to find the maximal signal strength while observing the receiver levels at those selected frequencies. At each of the frequencies selected for final measurements, Quasi-peak and Average detector readings were taken on each conductor. Any emissions from an intentional transmission are not subject to the limits.

The table shows the selected final measurement data. It includes at least the six strongest emissions observed relative to the limit lines, along with other data points of interest. The yellow highlight indicate the data points with the least margin to the quasi-peak detector limit and the average detector limit. A positive margin value indicates that the emission was below the test limit. The test limit is the CISPR Class B Limit.

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Frequency	QP Limit	AV Limit	L1 QP	L2 QP	L1 AV	L2 AV	QP Margin	AV Margin
(kHz)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)
150	66.00	56.00	28.62	27.90	22.73	21.62	37.38	33.27
463	56.64	46.64	27.23	20.53	22.38	16.69	29.42	24.26
715	56.00	46.00	25.33	17.52	18.20	12.98	30.67	27.80
1676	56.00	46.00	25.54	18.51	18.91	14.43	30.46	27.09
8601	60.00	50.00	27.48	20.52	19.63	16.47	32.52	30.37
10012	60.00	50.00	25.60	19.83	18.33	15.26	34.40	31.67

Table CE01.2: Emission summary (BT, EDR2, 2440 MHz)

The graph below shows preliminary scan data as continuous curves. Superimposed are the final measurement data points reported in the table above.

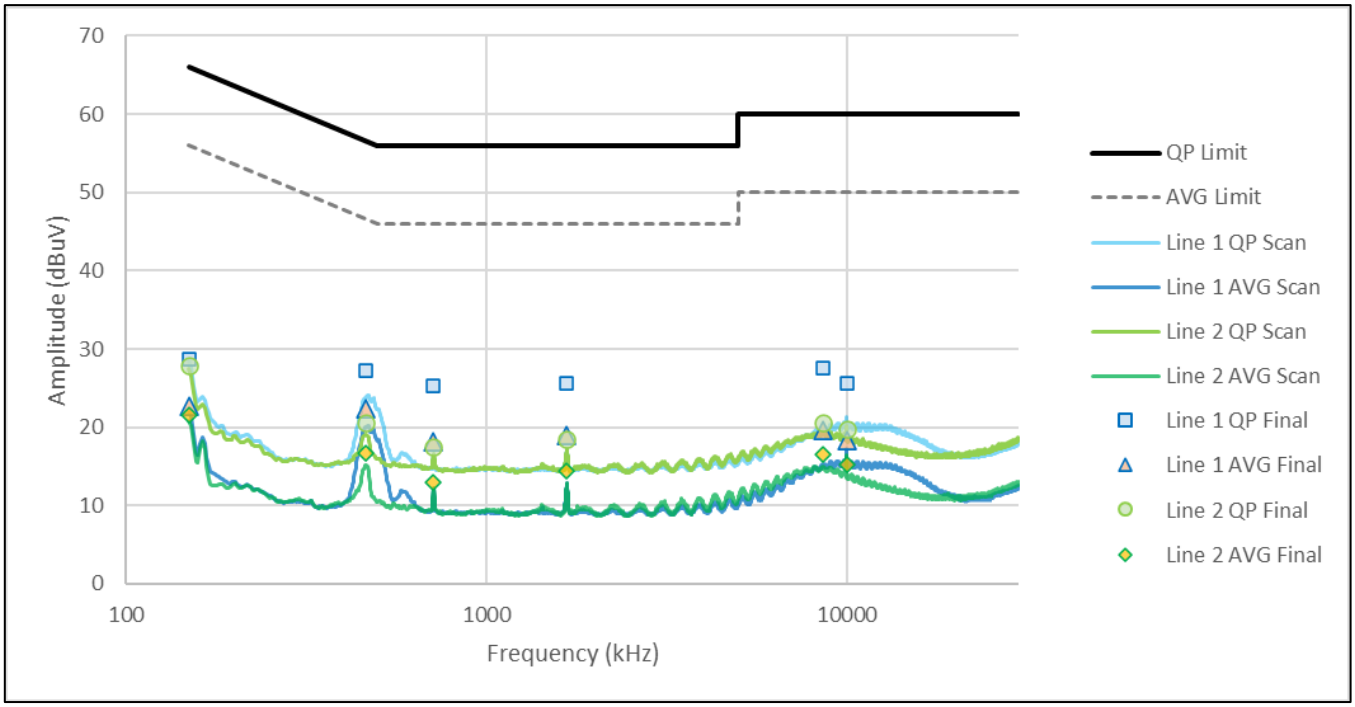

Figure CE01.1: Spectral data (BT, EDR2, 2440 MHz)

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Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure CE01.2: Test setup, first view

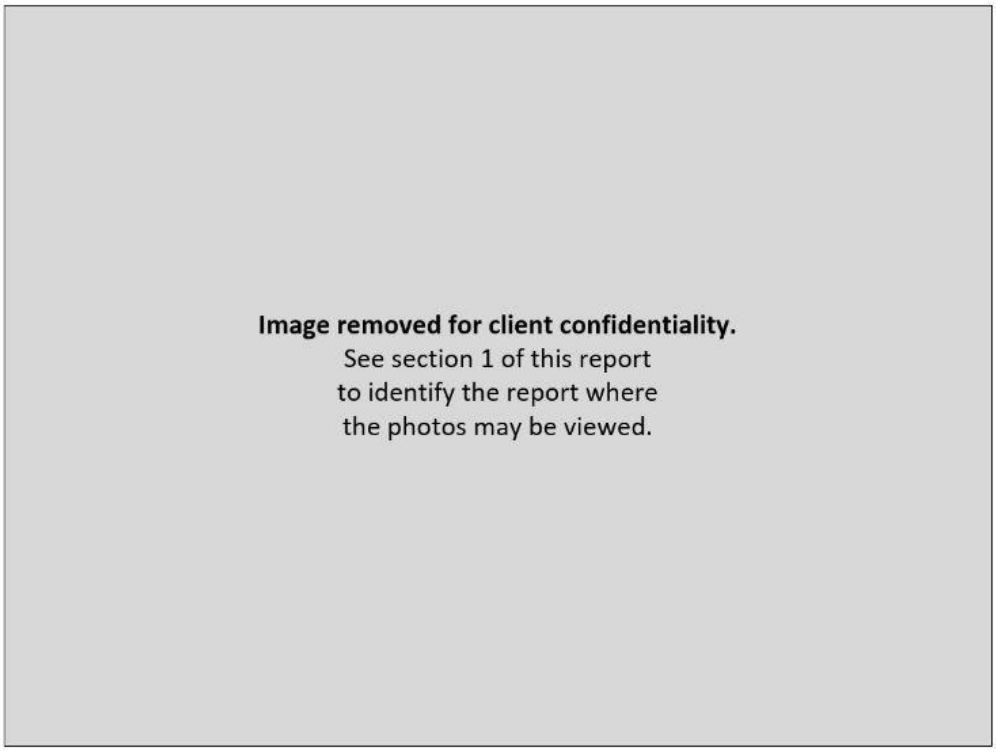

Figure CE01.3: Test setup, second view

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Concluding Notes

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