

## Mode Data Rate: 500 Kbps

### Low Channel



## Mid Channel



## High Channel



## 2.7.6 Conducted Emissions Data: Port 2 Data Rate: 125 Kbps

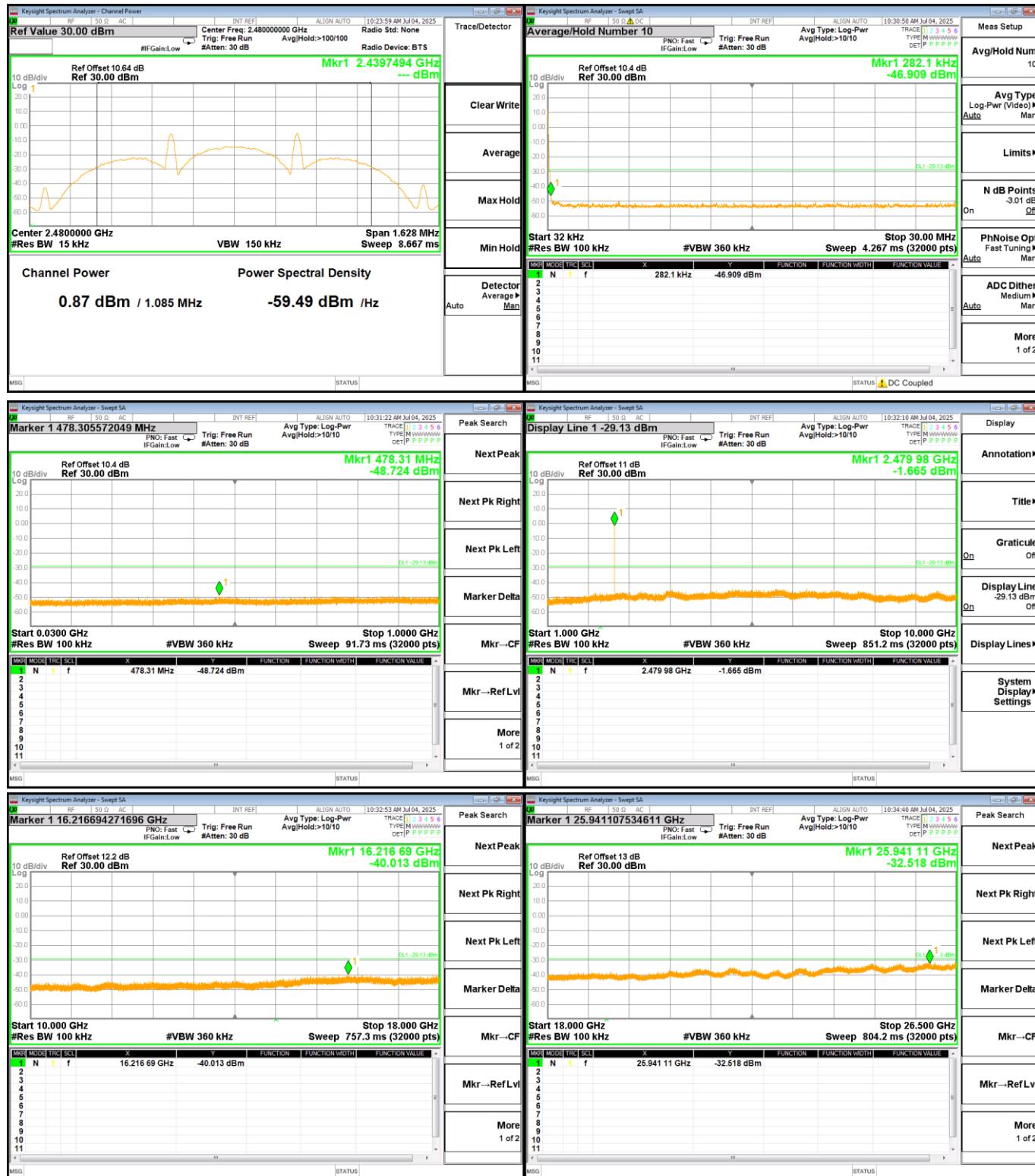
### Low Channel



## Mid Channel



## High Channel



## Data Rate: 500 Kbps Low Channel



## Mid Channel



## High Channel

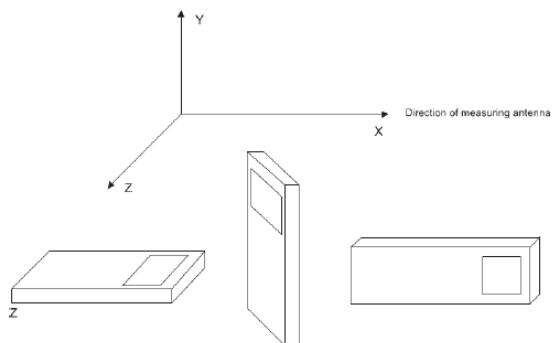
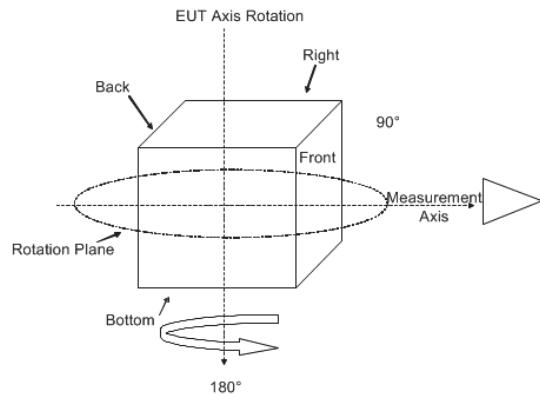


## 2.8 EUT Positioning Assessment

<b>Test Lab:</b> Electronics Test Centre, Airdrie	<b>EUT:</b> Torque Monitoring Sub
<b>Test Personnel:</b>	<b>Standard:</b> FCC PART 15.247
<b>Date:</b>	<b>Basic Standard:</b> ANSI C63.4-2014
<b>Comments:</b> Fix position at final installation	

### Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.



## 2.9 Radiated Spurious Emissions (within restricted band)

Test Lab: Electronics Test Centre, Airdrie	EUT: Torque Monitoring Sub
Test Personnel: Brendan Van Hee	Standard: FCC PART 15.247/15.209
Date: 2025-05-15/16 (20.4°C, 27.5% RH)	Basic Standard: ANSI C63.10-2013
<b>EUT status: Compliant</b>	

### Specification: FCC PART 15.247(d)

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

### Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 ■	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 – 0.5050000 ■	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 ■	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 – 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 – 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 – 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 ■	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 – 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 **	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 – 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 **	960.00000 – 1240.00000 ***	3260.0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 – 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 ■	1300.0000 – 1427.0000 ***	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 – 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 – 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 ***		

■ US only

\*\* Canada 108 – 138 MHz

\*\*\* Canada 960 – 1427 MHz

\*\*\*\* Canada only

### 2.9.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

### 2.9.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.9.3 Test Equipment

Testing was performed with the following equipment:

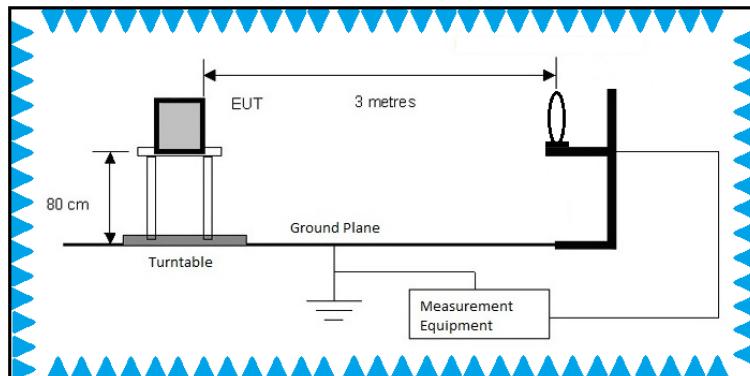
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMC Software	UL	Ver. 9.5	SWC 021		N/A
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2024-08-15	2025-08-15
Loop Antenna (9KHz – 30MHz)	EMCO	6502	10868	2023-06-21	2025-06-21
Biconilog Antenna (30 – 1000 MHz)	AR	JB1	6905	2023-11-29	2025-11-29
DRG Horn (1 – 18 GHz)	EMCO	3115	19357	2022-10-05	2025-10-05
STD Horn (18-26 GHz)	Quinstar	QWH-KRPS00	6163	2022-10-10	2025-10-10
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2025-05-01	2026-05-01
Pre-Amplifier (30 – 1400 MHz)	HP	8447D	9291	2025-01-21	2026-01-21
L.N. Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	2025-01-21	2026-01-21
L.N. Amplifier (18 – 26 GHz)	MITEQ	JS44-01002650-33-3P	6163	2025-01-21	2026-01-21
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A-3600-KPA-01102006	4419	2025-01-21	2026-01-21
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2025-01-21	2026-01-21
2.4GHz Notch Filter	Microtronics	BRM50702	6953	2025-01-09	2026-01-09

#### 2.9.4 Test Sample Verification, Configuration & Modifications

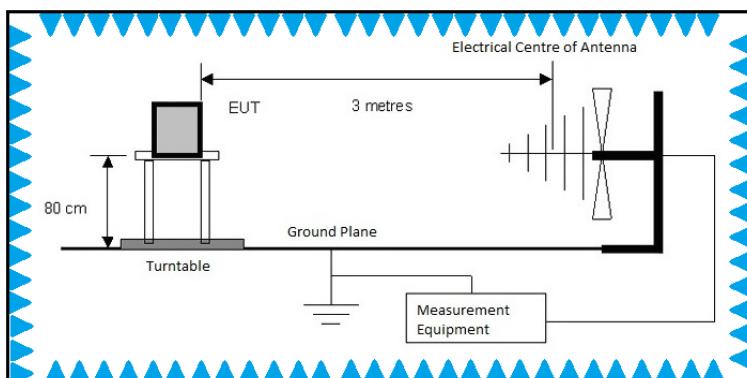
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

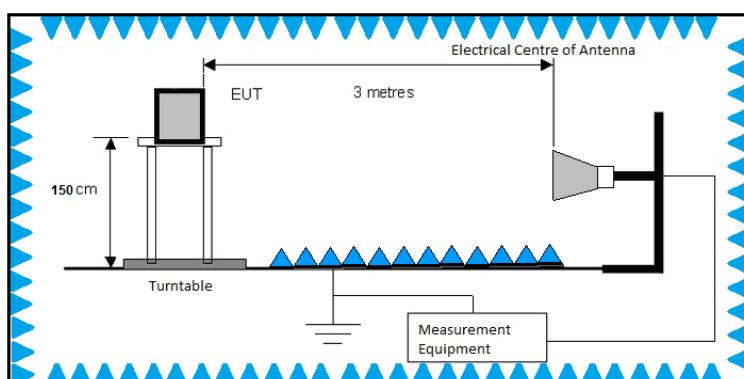
#### Test setup diagram for Radiated Spurious Emissions testing (below 30 MHz):



#### Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):



#### Test setup diagram for Radiated Spurious Emissions testing (above 1GHz):



### 2.9.5 Radiated Emissions Data:

Freq. Marker	Freq. [MHz]	Raw reading [dB $\mu$ V]	Det	Antenna Factor [dB/m]	Pre amp Gain [dB]	Corrected Reading [dB $\mu$ V/m]	FCC 15.209 Limit [dB $\mu$ V/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	158	30.79	PK	16.3	-23.3	23.79	< 20dBc		220	100	Vertical
2	839	47.68	PK	25.8	-19.2	54.28	< 20dBc		60	100	Vertical
1	1799.5	11.55	AV	46.6	-17.5	40.65	54		333	396	Horizontal
		24.93	PK			54.03	74				
2	1799.5	11.17	AV	46.6	-17.5	40.27	54		46	369	Vertical
		23.36	PK			52.46	74				

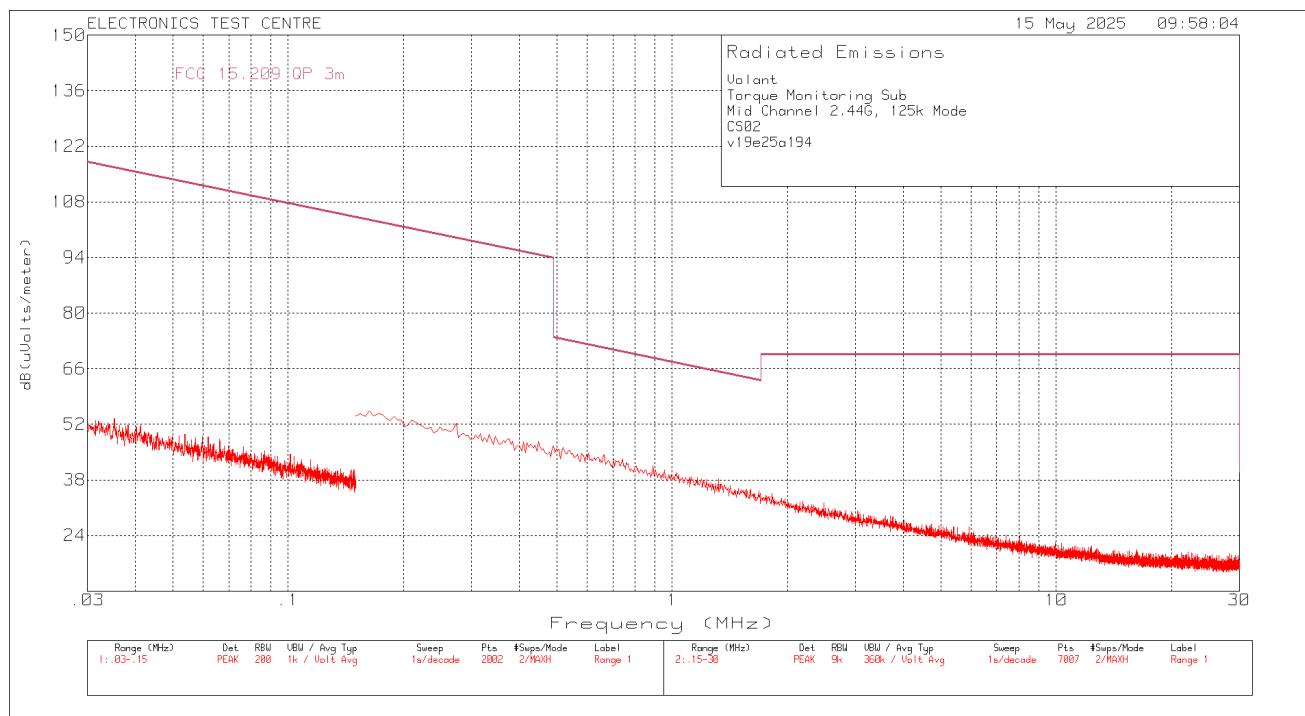
Meter Reading in dB $\mu$ V + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dB $\mu$ V/m.

#### Notes:

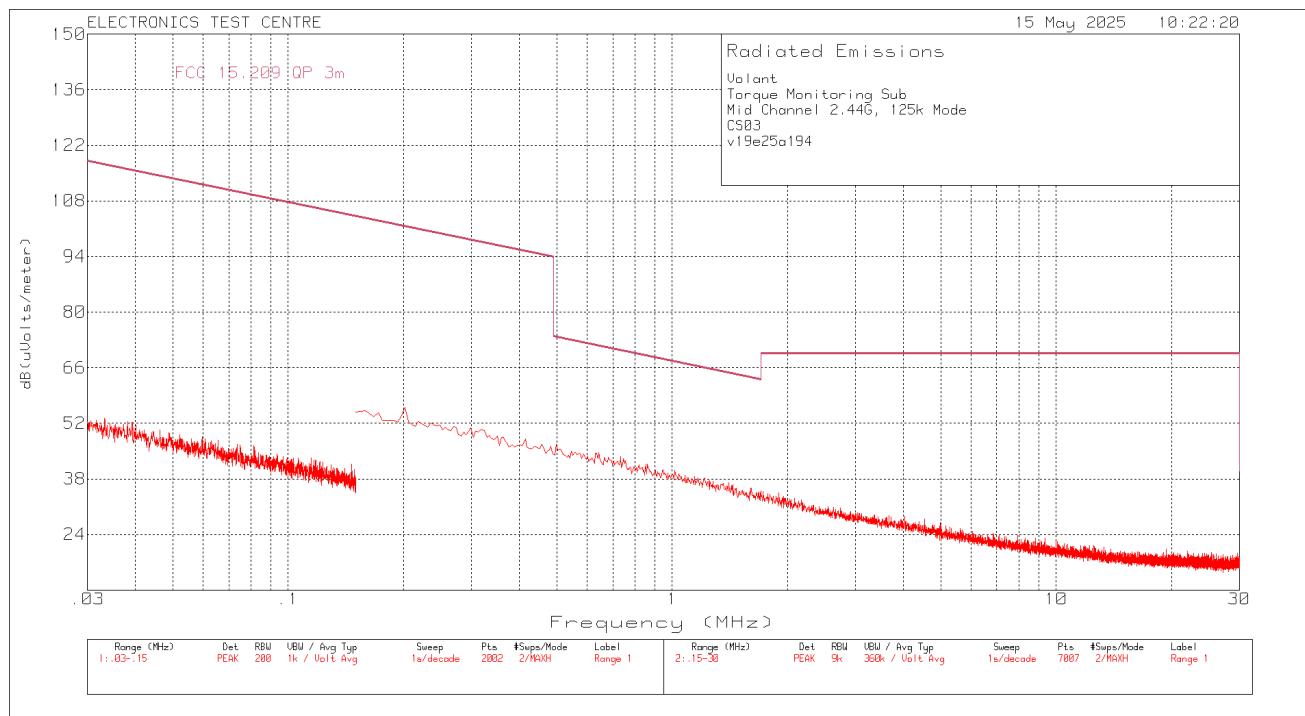
- In Transmit mode, the EUT was assessed up to 26.0 GHz.

## 125Kbps Mode:

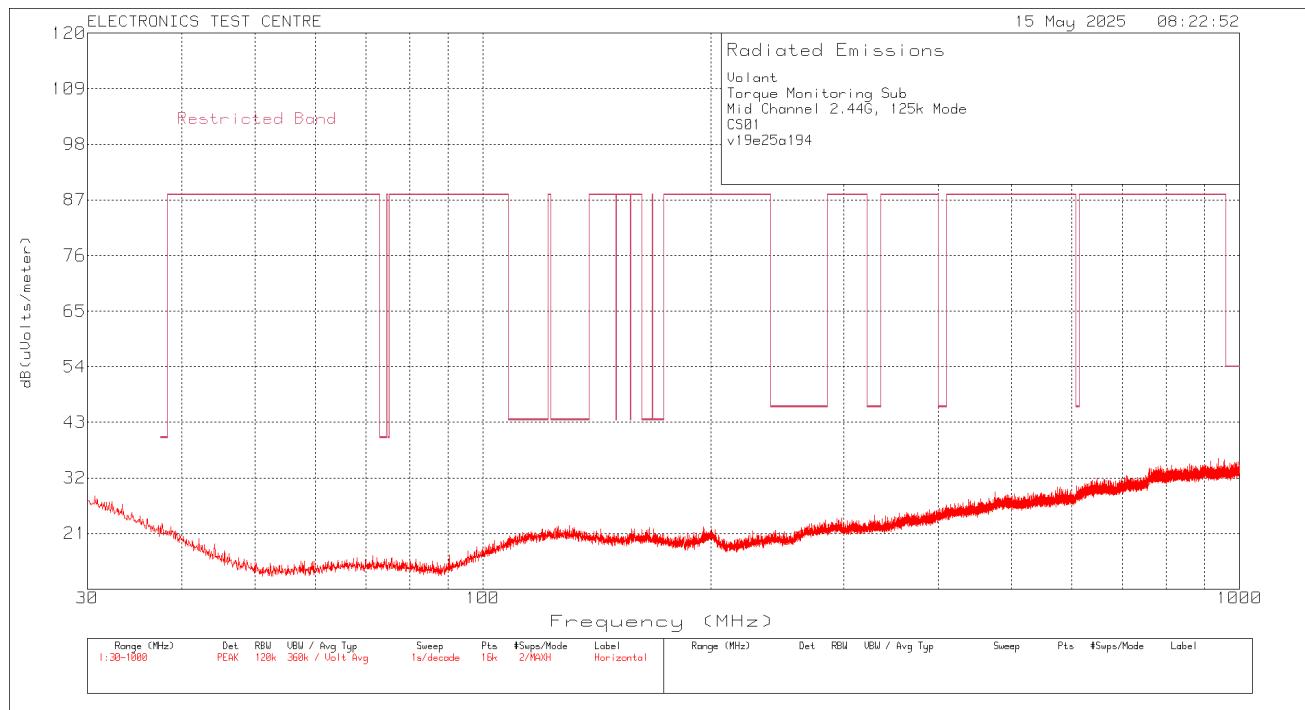
### Plot of Radiated Emissions: Parallel



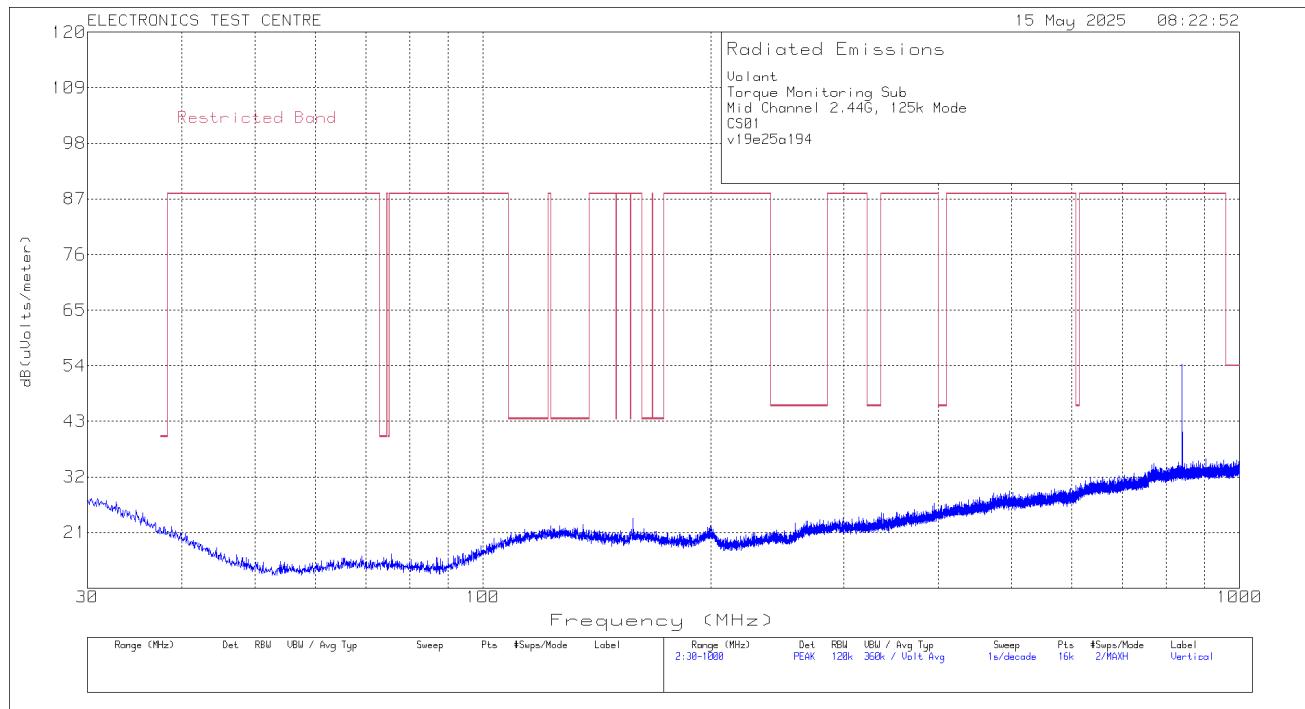
### Plot of Radiated Emissions: Perpendicular



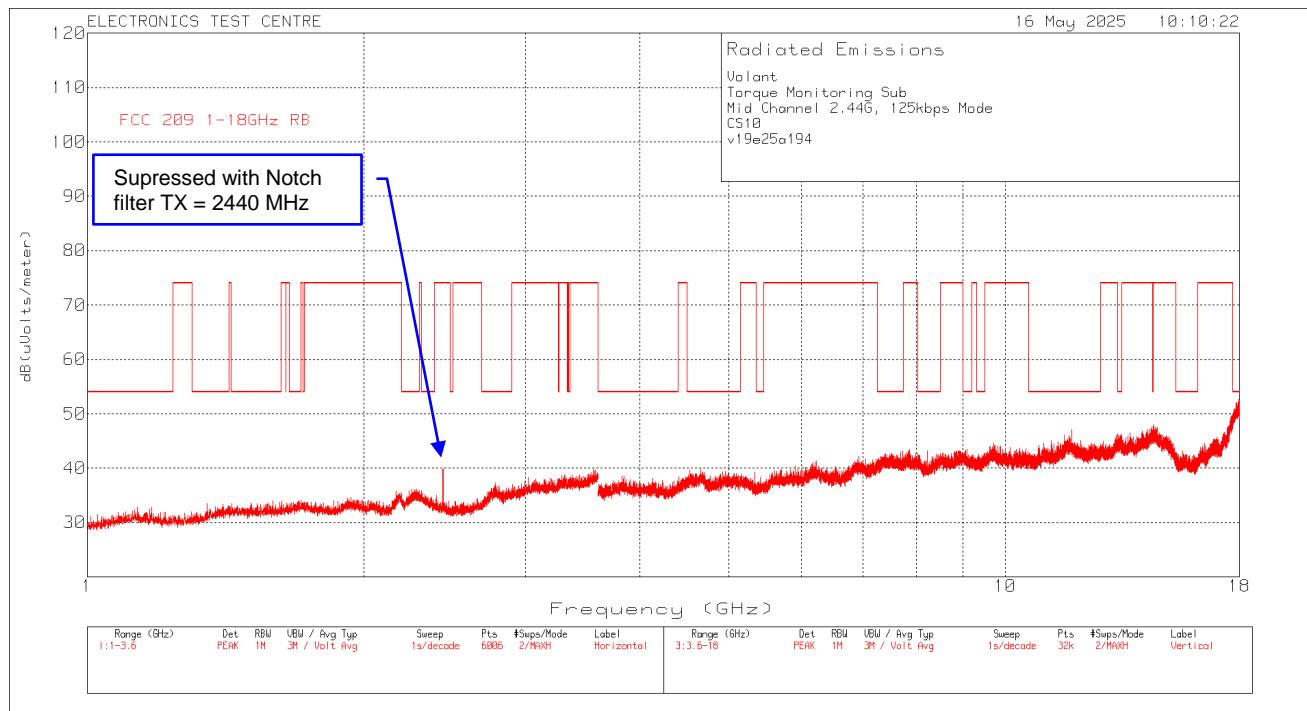
## Plot of Radiated Emissions: Horizontal polarization



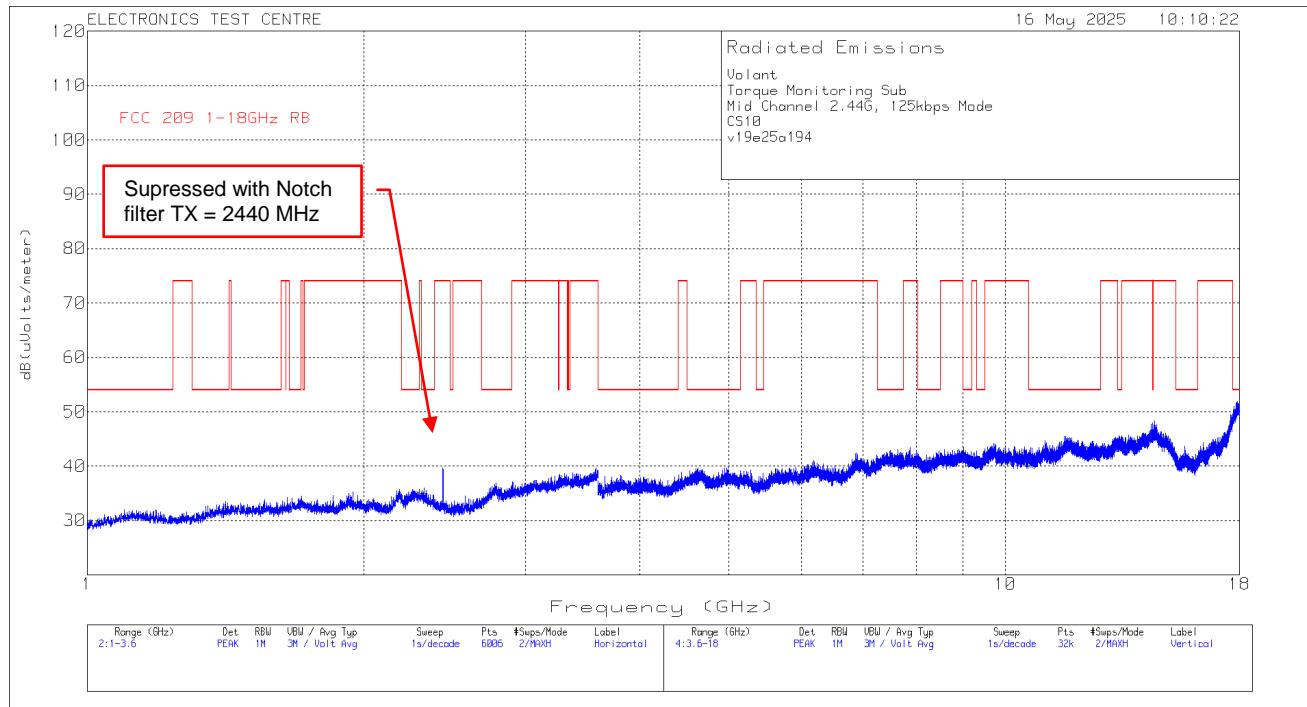
## Plot of Radiated Emissions: Vertical polarization



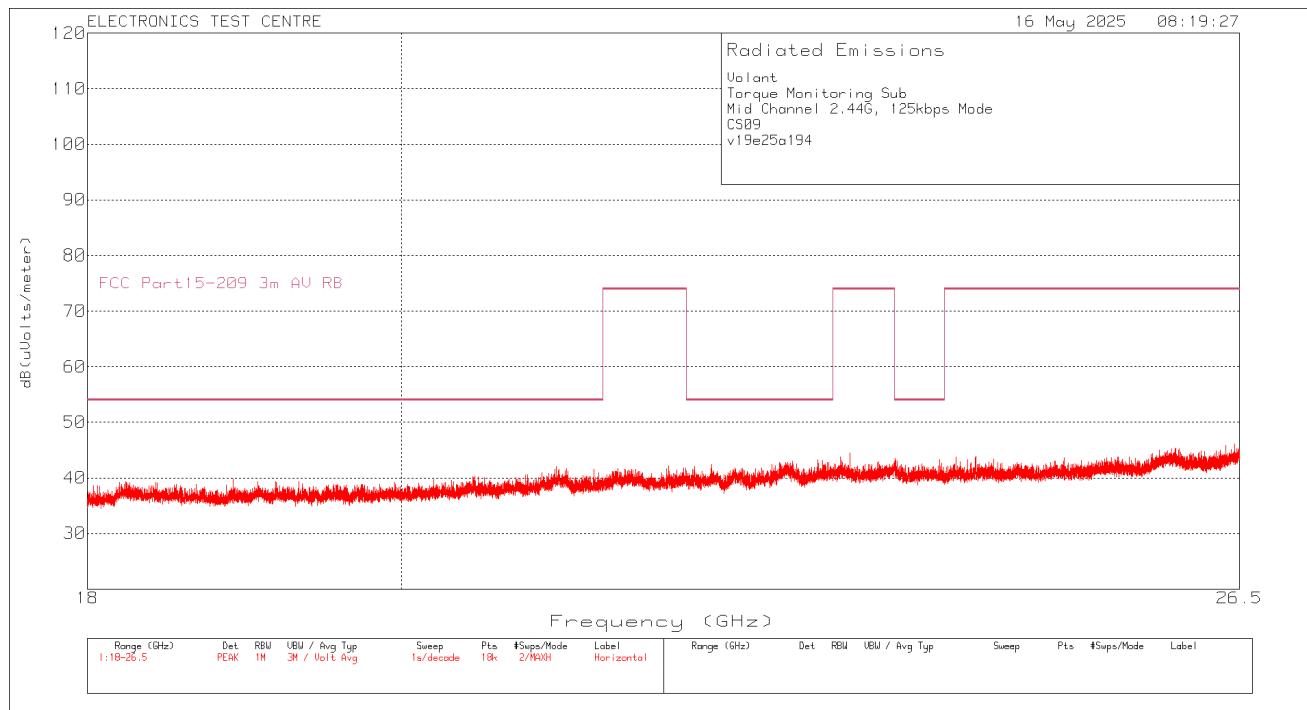
## Plot of Radiated Emissions: Horizontal polarization



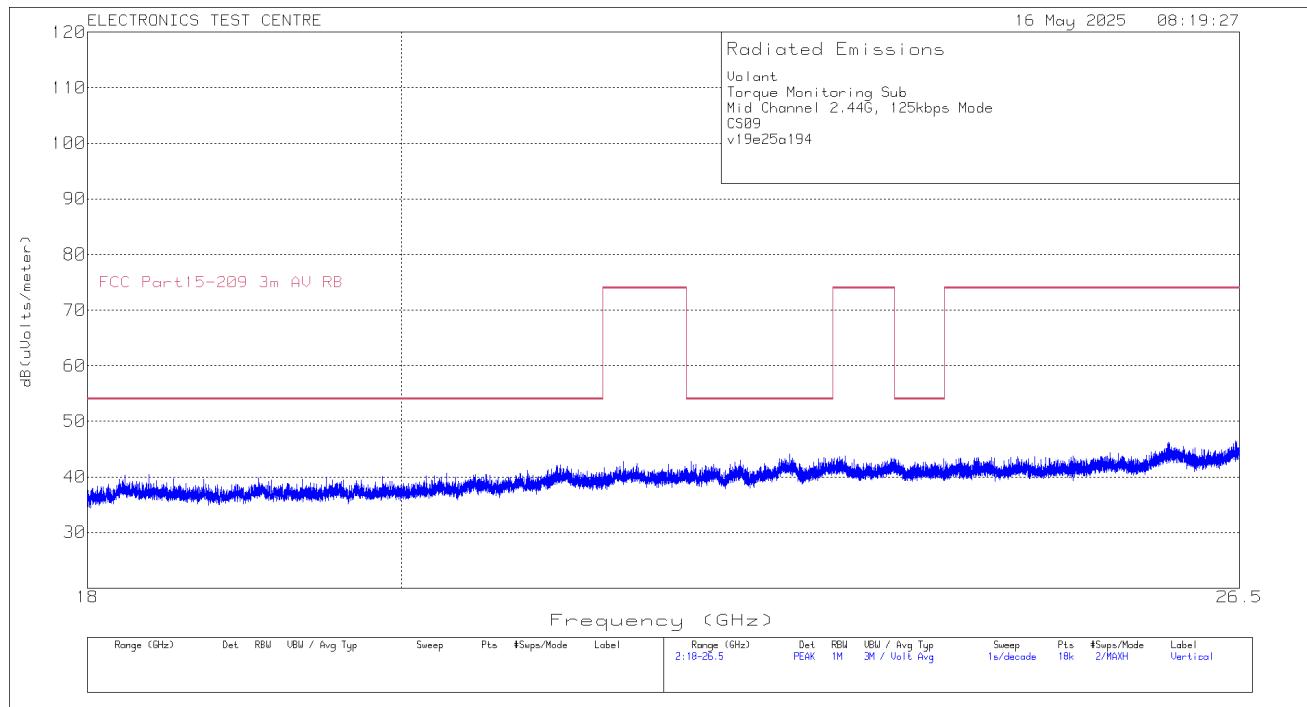
## Plot of Radiated Emissions: Vertical polarization



## Plot of Radiated Emissions: Horizontal polarization

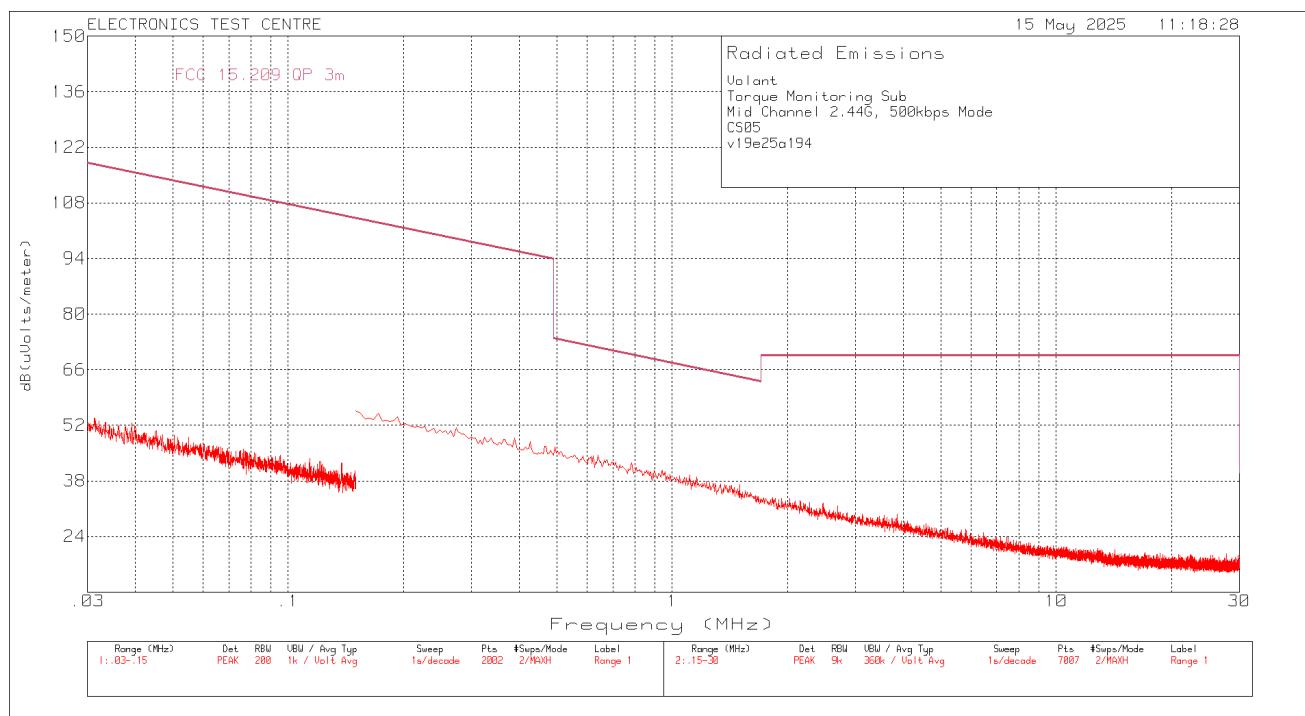


## Plot of Radiated Emissions: Vertical polarization

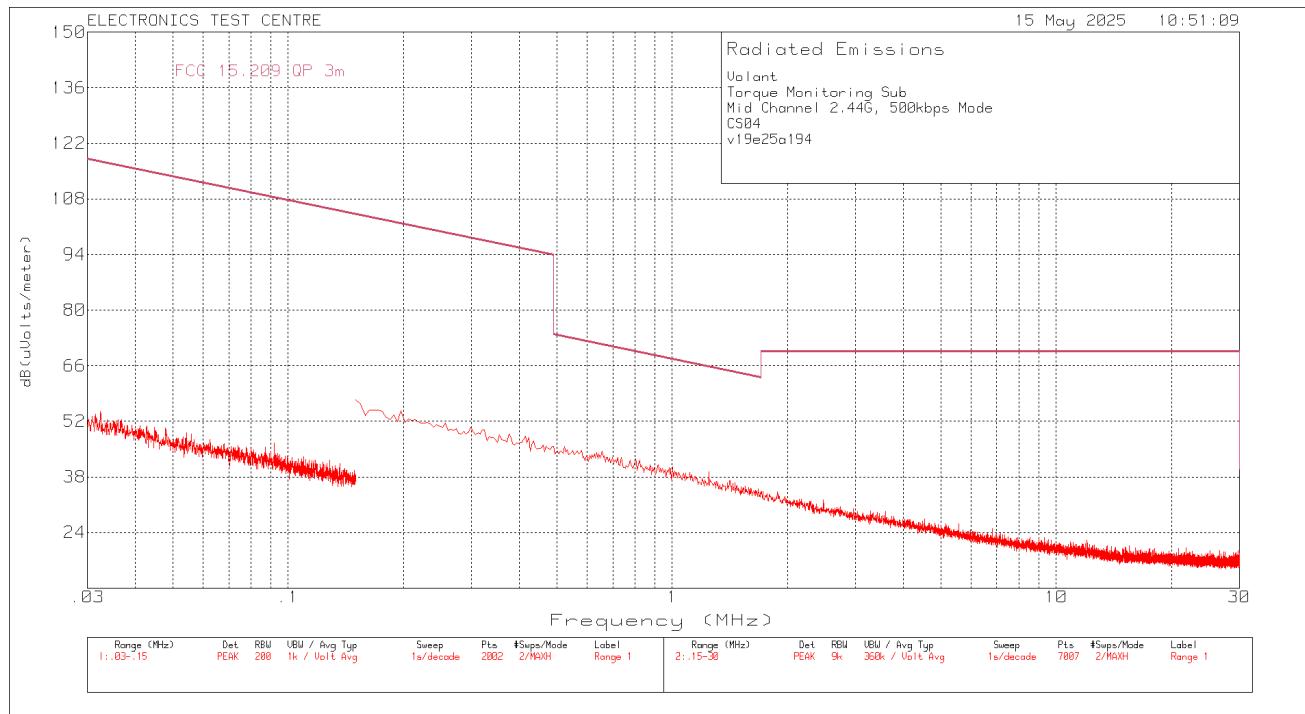


## 500 Kbps Mode:

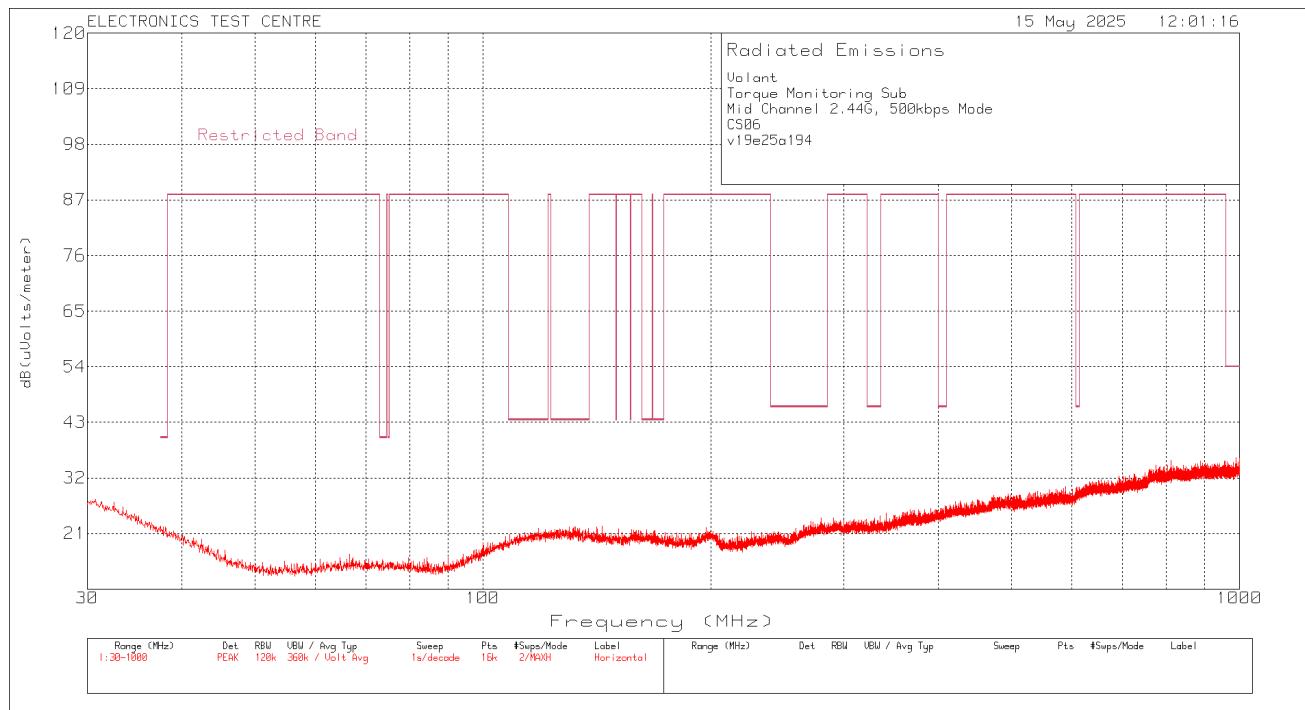
### Plot of Radiated Emissions: Parallel



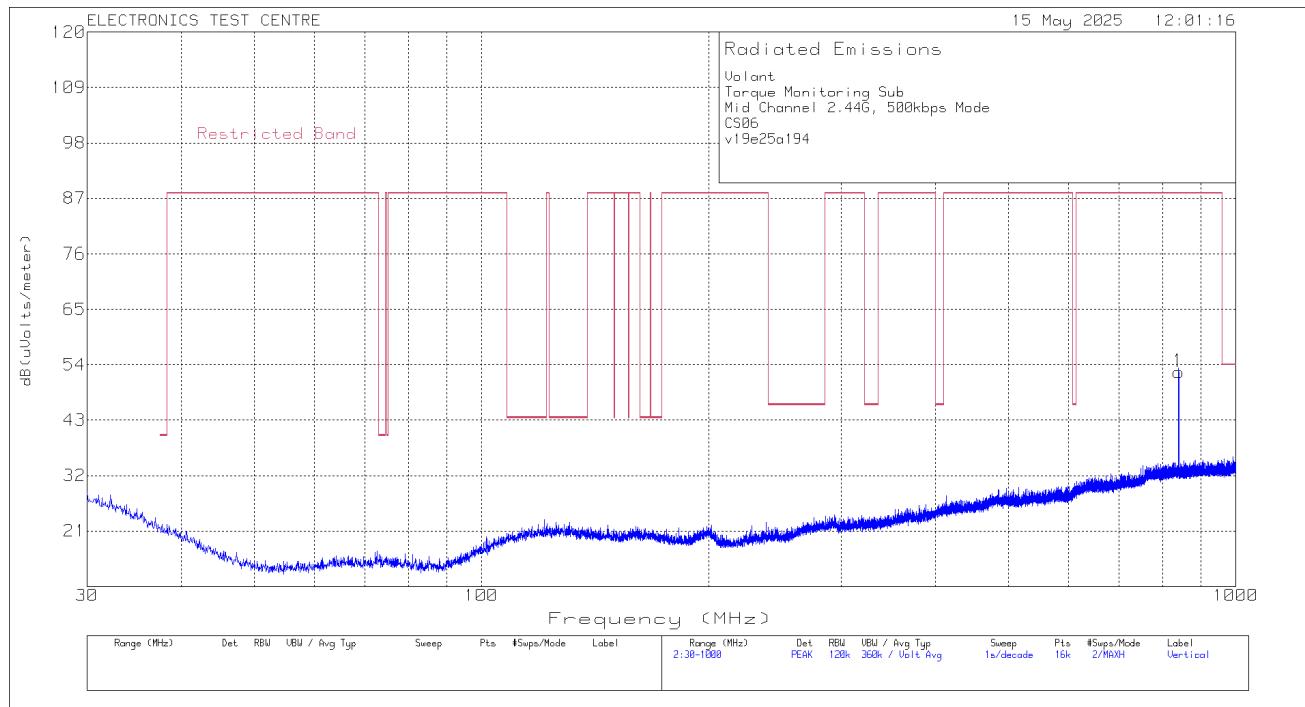
### Plot of Radiated Emissions: Perpendicular



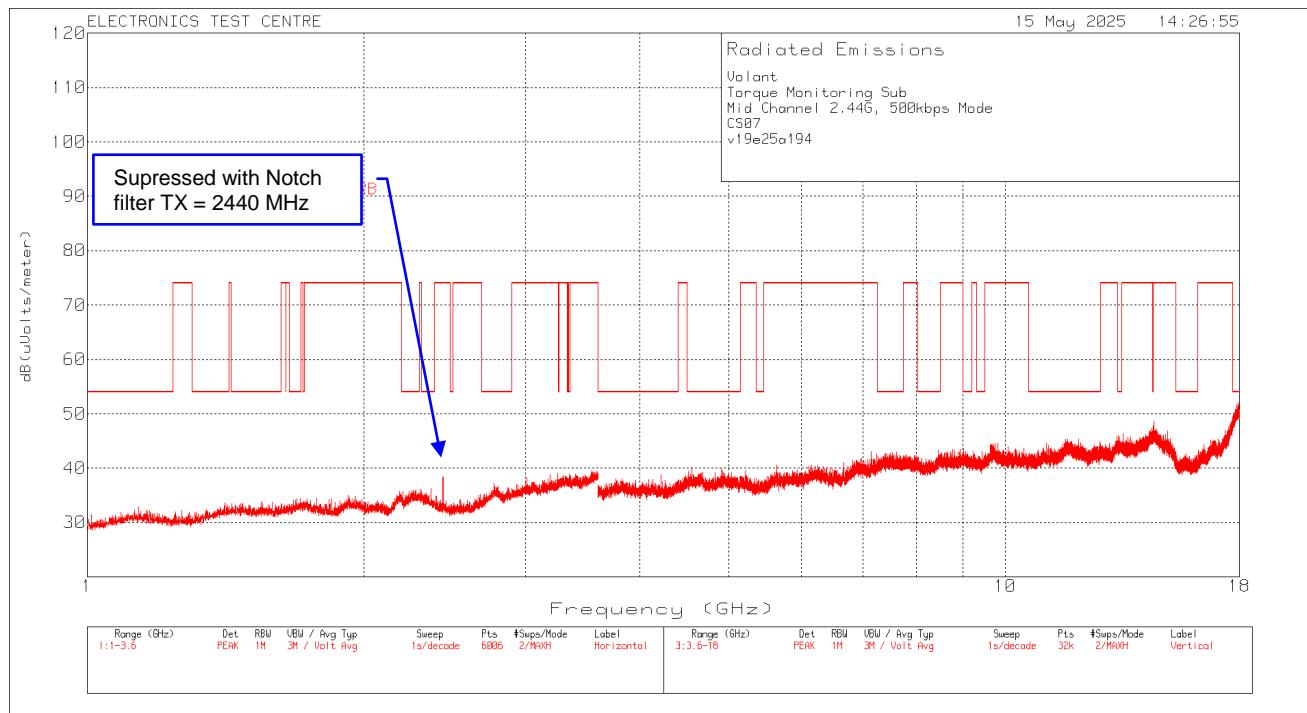
## Plot of Radiated Emissions: Horizontal polarization



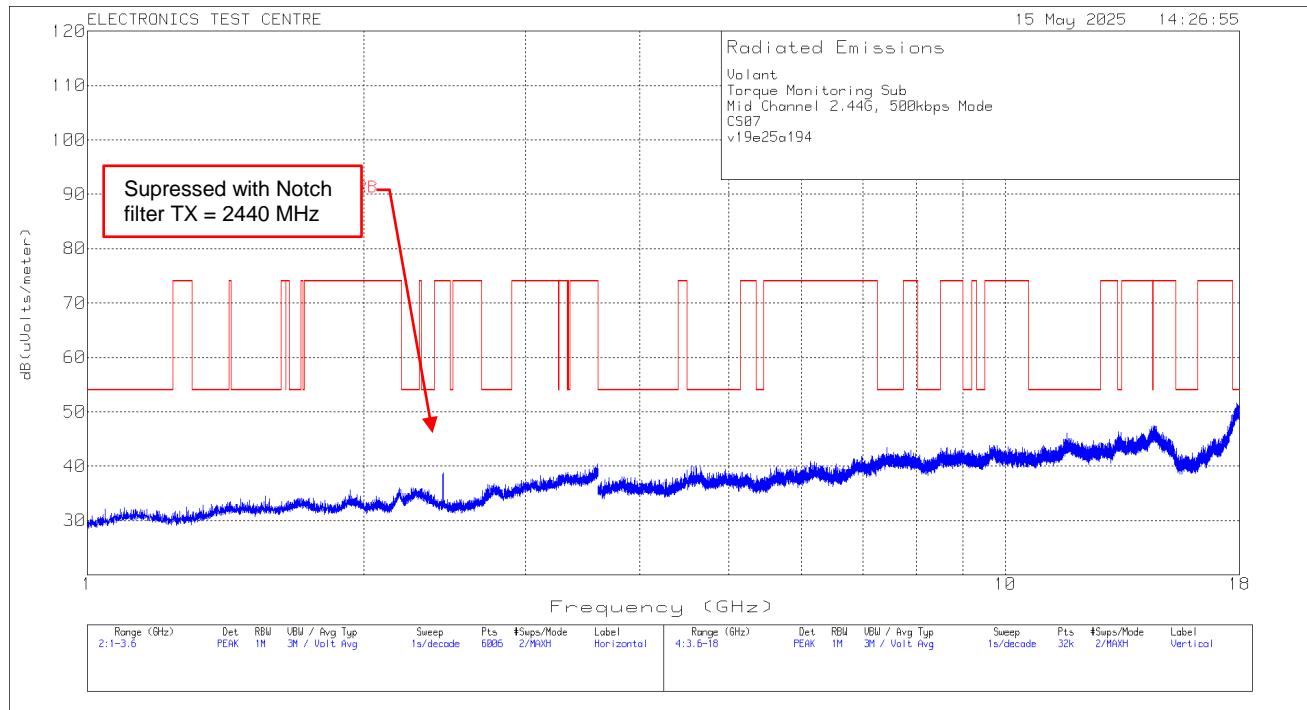
## Plot of Radiated Emissions: Vertical polarization



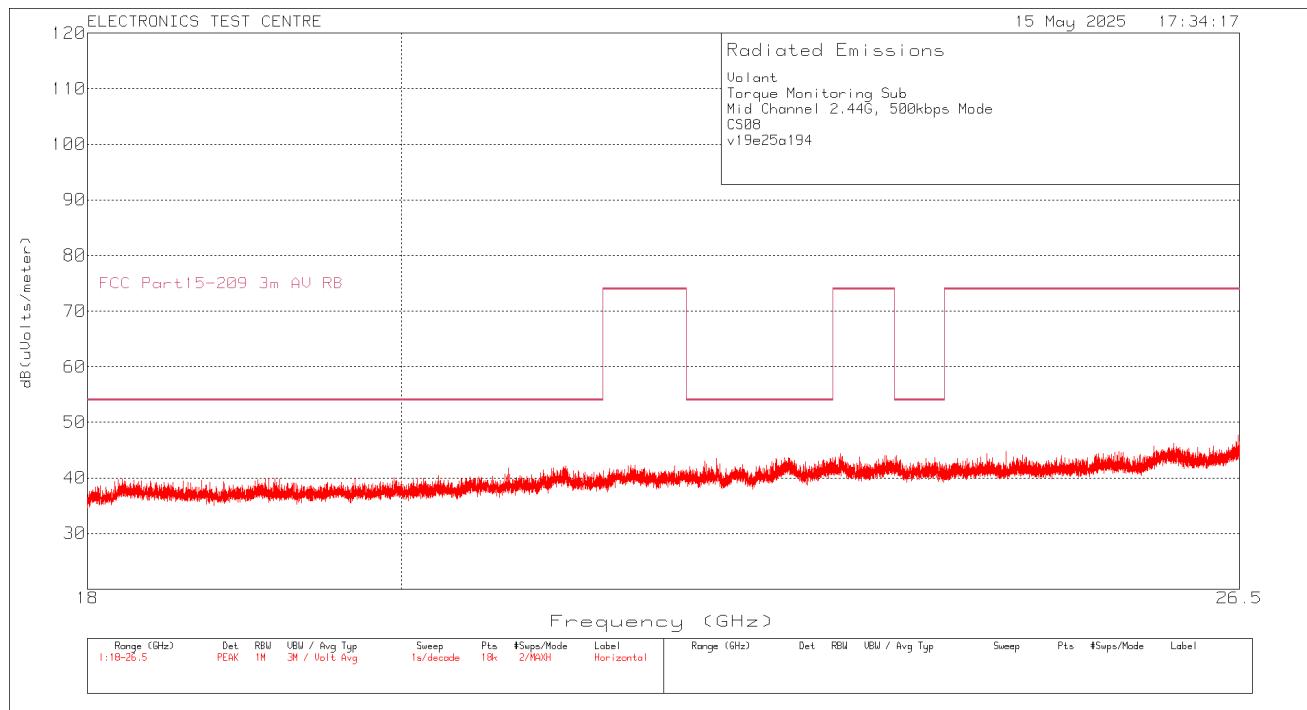
## Plot of Radiated Emissions: Horizontal polarization



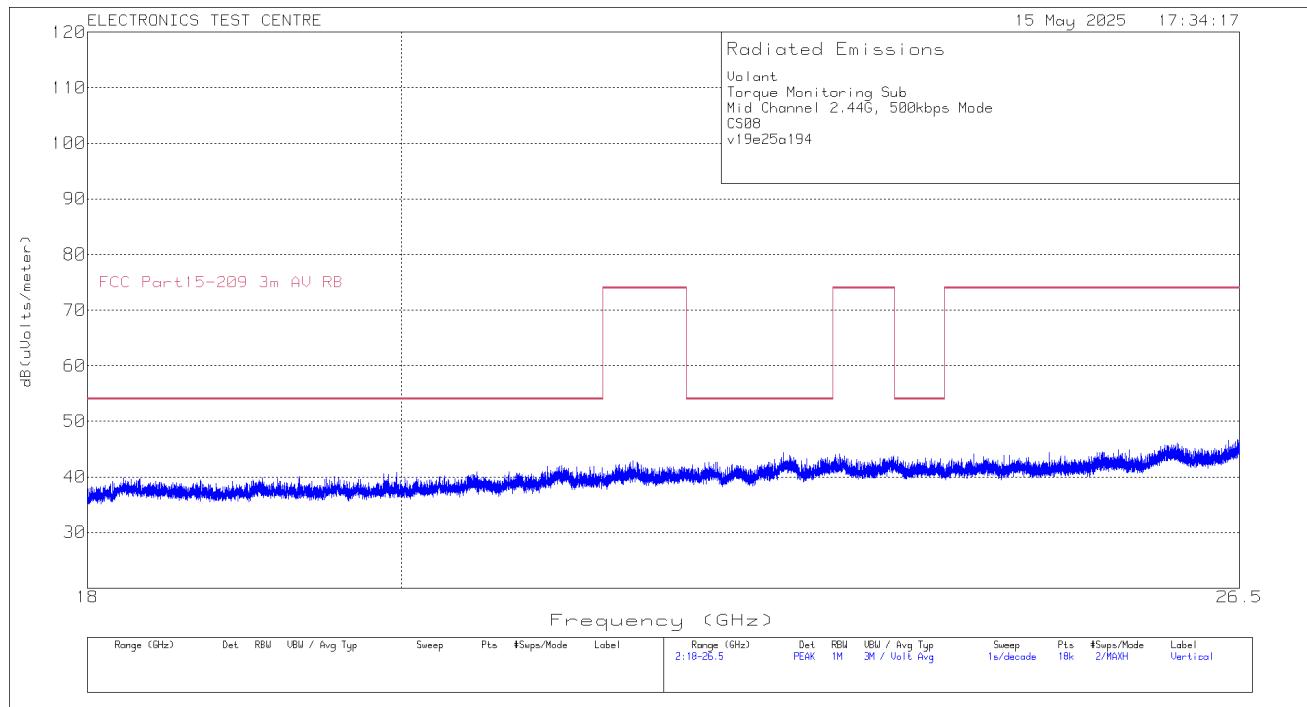
## Plot of Radiated Emissions: Vertical polarization



## Plot of Radiated Emissions: Horizontal polarization



## Plot of Radiated Emissions: Vertical polarization



## 2.10 Radiated Emissions (RX Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Torque Monitoring Sub
Test Personnel: Brendan Van Hee	Standard: FCC Part 15.109
Date: 2025-05-16 (20.0°C, 28.3% RH)	Basic Standard: ANSI C63.4: 2014
	Class: B

**EUT status: Compliant**

Frequency (MHz)	FCC Part 15.109 Class B Limit (3m)
30 – 88	40 (dB $\mu$ V/m)
88 – 216	43.52 (dB $\mu$ V/m)
216 – 960	46.02 (dB $\mu$ V/m)
Above 960	53.98 (dB $\mu$ V/m)

**Criteria:** The radiated emissions produced by a device, measured at a distance of 3 meters, shall not exceed the limits as specified.

### 2.10.1 Test Guidance:

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz.

The scan is performed at discreet increments of turntable azimuth and stepped antenna height, with peak detector and Max Hold function which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

After the pre-scan is completed, the frequencies of interest are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. This may produce a different reading than the pre scan trace. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

### 2.10.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.10.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMC Software	UL	Ver. 9.5	SWC 021		N/A
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2024-08-15	2025-08-15
Biconilog Antenna (30 – 1000 MHz)	AR	JB1	6905	2023-11-29	2025-11-29
DRG Horn (1000 – 18000 MHz)	EMCO	3115	19357	2022-10-05	2025-10-05
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2025-05-01	2026-05-01
Pre-Amplifier (30 – 1400 MHz)	HP	8447D	9291	2025-01-21	2026-01-21
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	2025-01-21	2026-01-21
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A-3600-KPA-01102006	4419	2025-01-21	2026-01-21
RE Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2025-01-21	2026-01-21

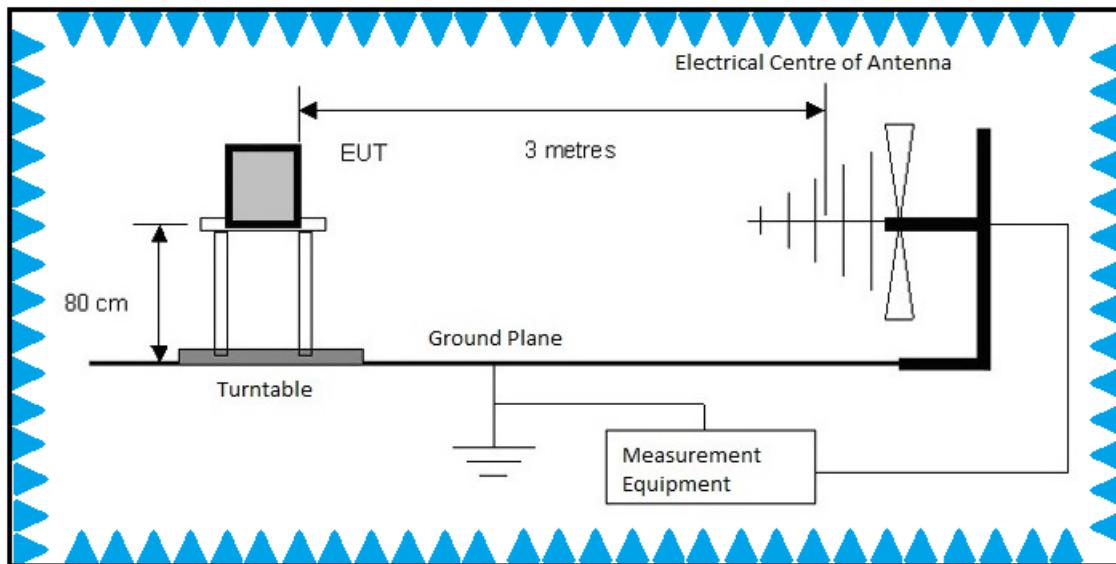
\* In-house verification.

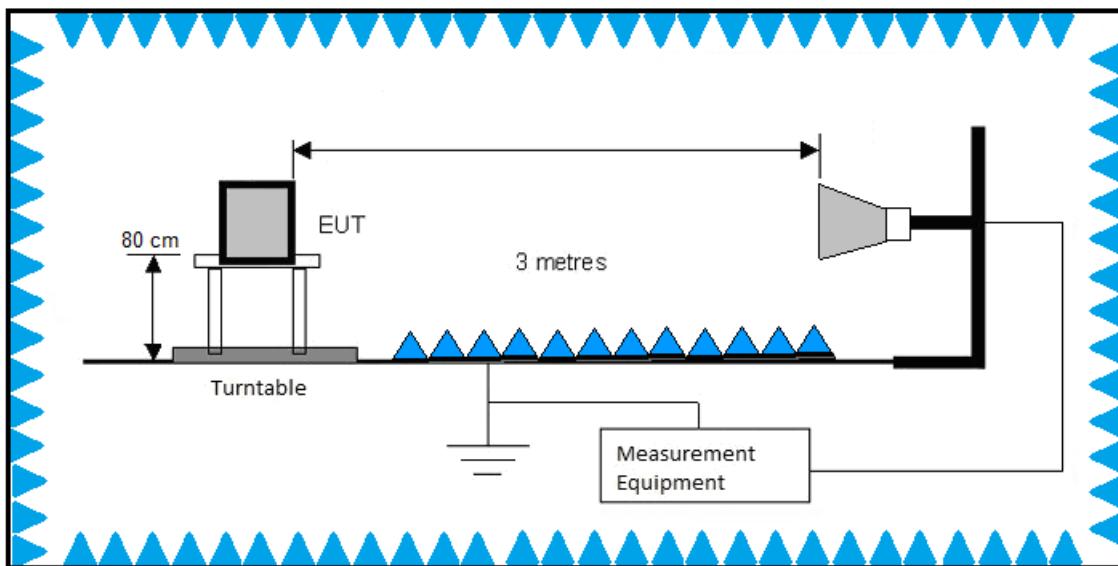
### 2.10.4 Test Sample Verification, Configuration & Modifications

To cover the unintentional radiated emission. The EUT was configured in receive mode. Unit was placed at the center of turntable in semi-anechoic chamber 80cm above the ground plane and at a distance of 3m from the test receive antenna.

The EUT met the requirements without modification.

#### EUT RX configuration Block Diagram for Radiated Emissions testing:



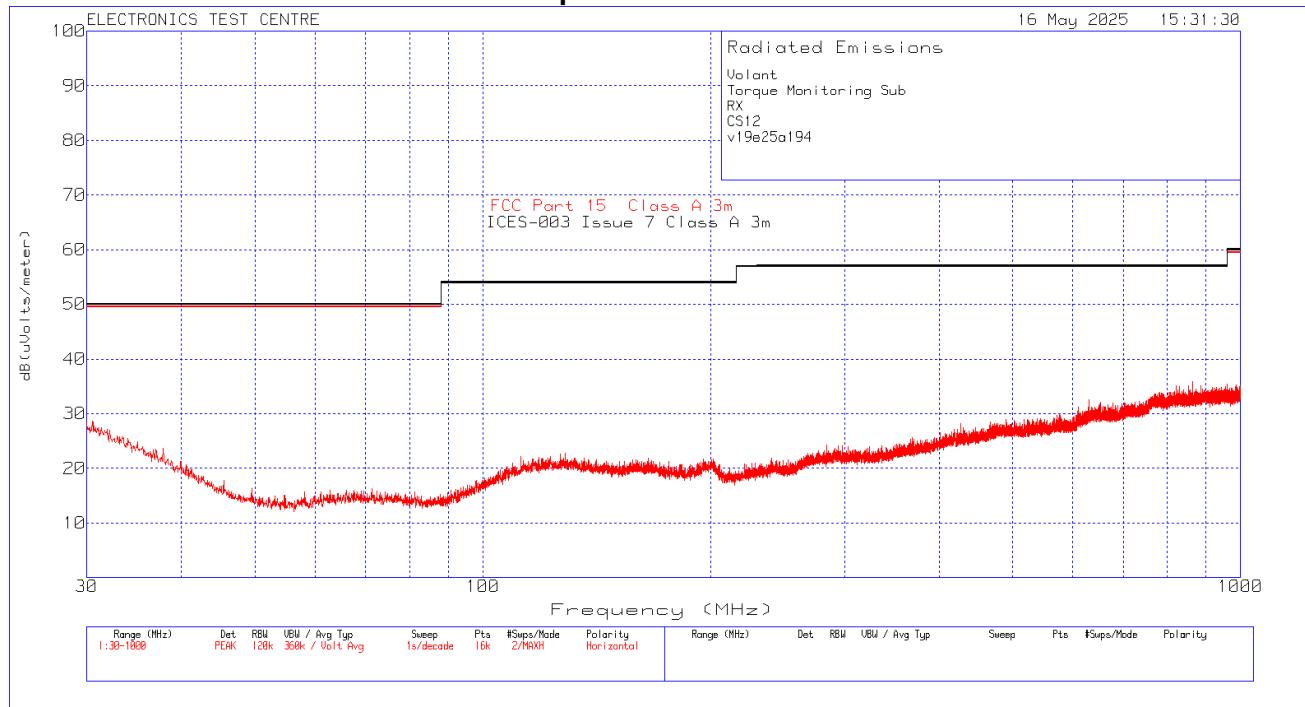


#### 2.10.5 Radiated Emissions Data:

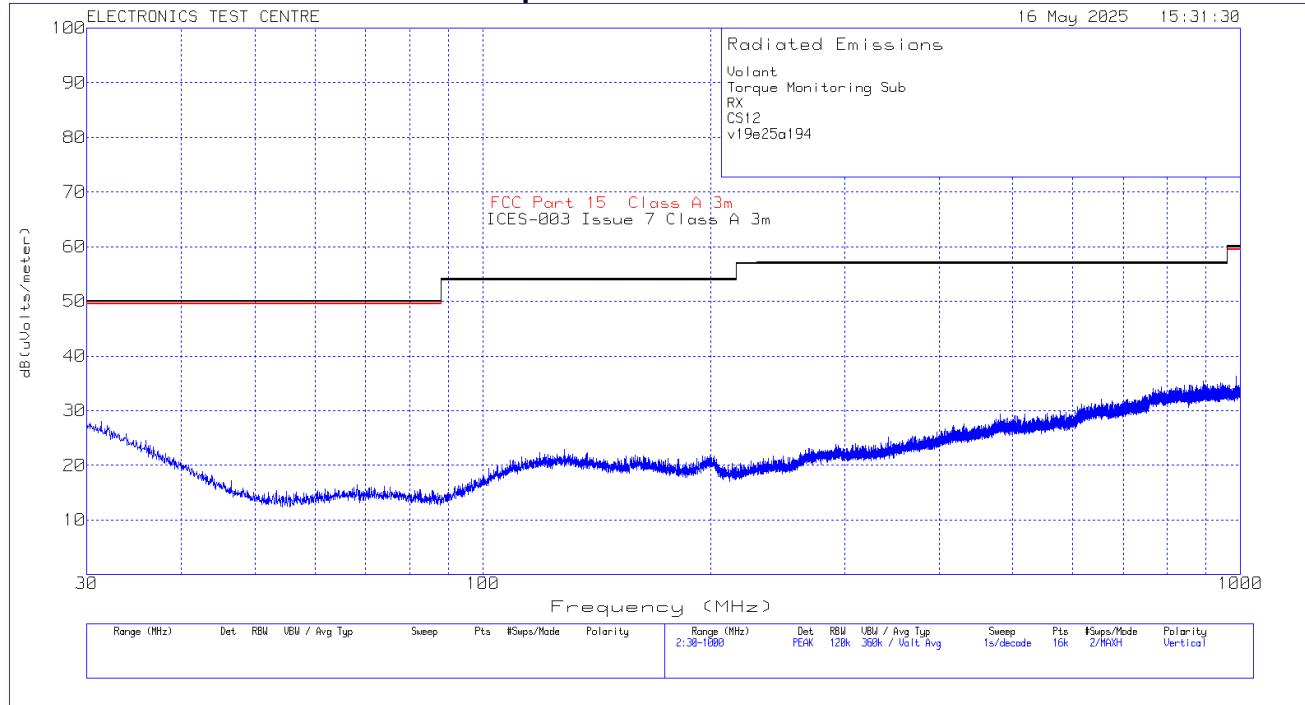
Emission is more than 20 dB below the limit

Meter Reading in  $\text{dB}\mu\text{V}$  + Antenna Factor in  $\text{dB}/\text{m}$  + Gain/Loss Factor in  $\text{dB}$  = Corrected Field Strength in  $\text{dB}\mu\text{V}/\text{m}$ .

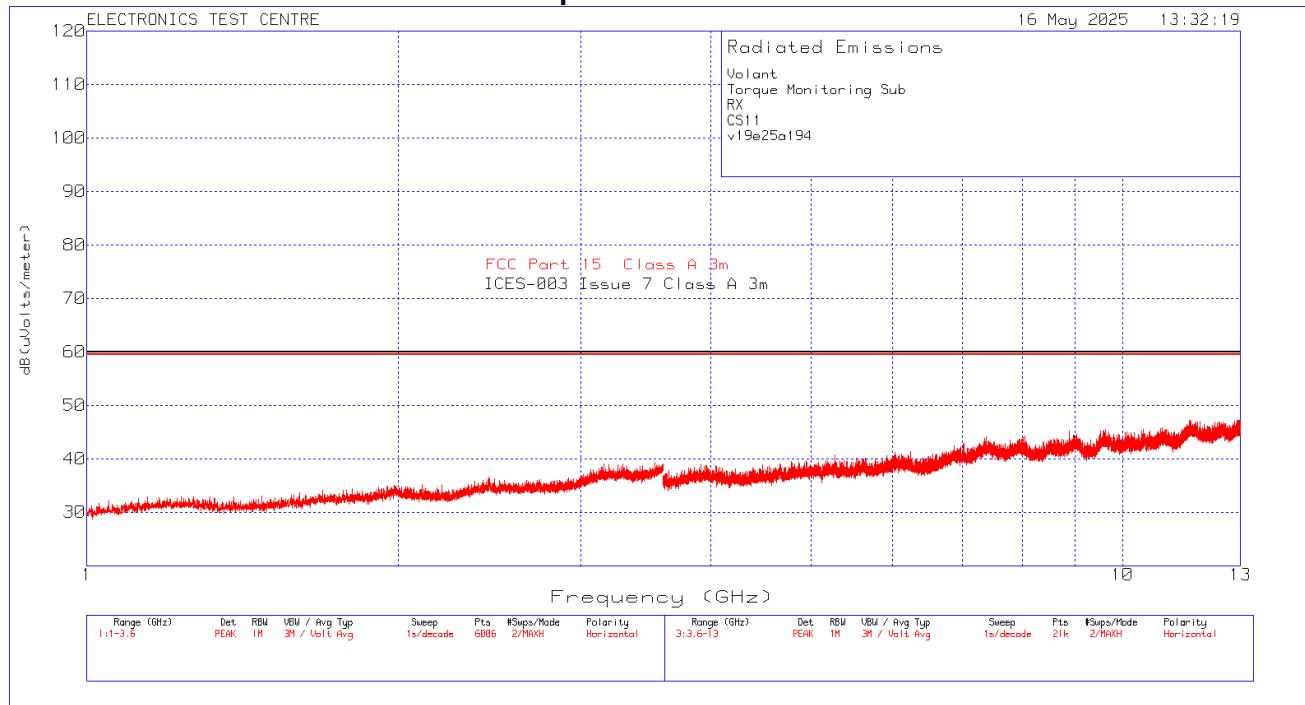
## Plot of Radiated Emissions: Horizontal polarization



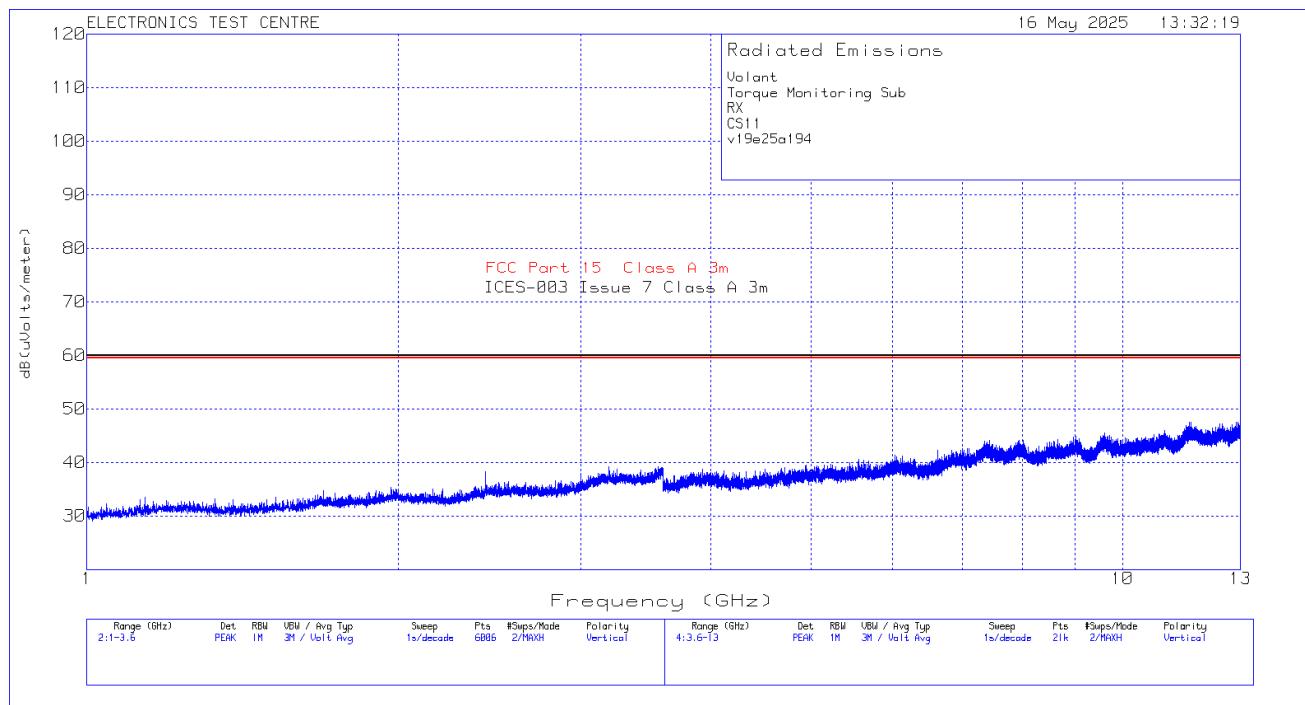
## Plot of Radiated Emissions: Vertical polarization



## Plot of Radiated Emissions: Horizontal polarization



## Plot of Radiated Emissions: Vertical polarization



## 2.11 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	EUT: Torque Monitoring Sub
Test Personnel:	Standard: FCC PART 15.247
Date:	

**EUT status: Exempt from SAR Evaluation**

**Compliant:** RF exposure assessment to be provided in a separate Exhibit.

## **3.0 TEST FACILITY**

### **3.1 Location**

The Torque Monitoring Sub was tested at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

The test site is listed with Industry Canada as per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

### **3.2 Grounding Plan**

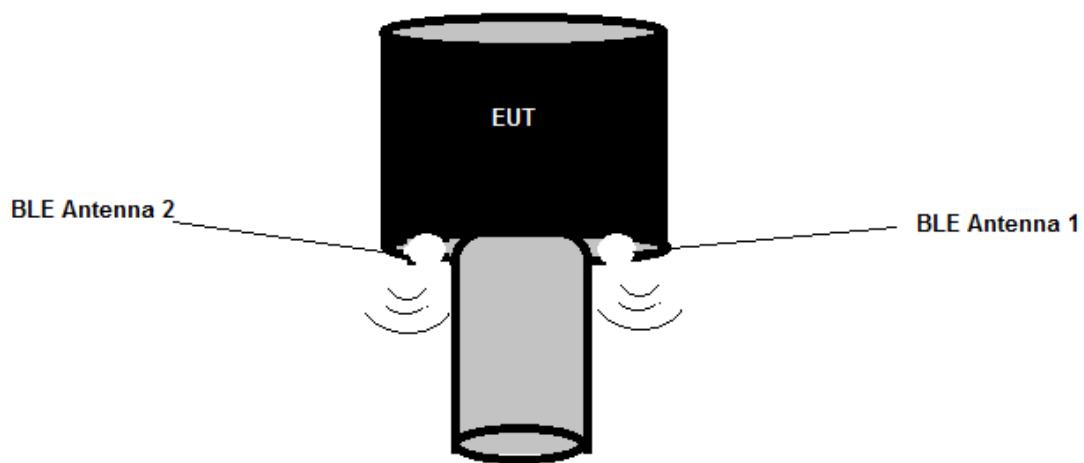
The Torque Monitoring Sub was placed at the center of the test chamber turntable 80-cm high below 1GHz and at 1.5m high above 1 GHz for transmits mode and 80cm high for RX mode from ground reference plane. The Torque Monitoring Sub enclosure ground is connected to GRP.

### **3.3 Power Supply**

Power supplied fully charged internal battery packs.

## Appendix A – Test Setup Block Diagram

### TX MODE with External Antenna



## End of Document