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ETC Report #: v19e26a168_DTS Release 2

Report date: September 3, 2026

EMC testing of the Volant Oil Tools, Inc. Torque Monitoring Sub in accordance with

FCC Part 15 Subpart C (15.247(d), 15.209, 15.205)

ANSI C63.10: 2020

ANSI C63.4: 2014

FCC ID: 2BOMO-VOLANT001

Test Dates: March 23, 2026

Test Personnel: Brendan Van Hee

Prepared for: Volant Oil Tools, Inc.

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REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2026/03/23	B. Van Hee	Initial draft submitted for review.
Release 1	2026/07/06	I. Akram	Sign Off
Release 2	2026/09/03	I. Akram	Clarify the C2PC applicability and addition of new variant in section 1.1. Sign Off

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1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247 and ANSI C63.10 to gain FCC Class II permissive change Authorization for Low-Power License-Exempt transmitters TMS60.

The Volant Oil Tools Inc. has two TMS variants named TMS60 and TMS100 (new variant). The original filing was done with TMS60 variant. Since original filing the PCB was modified so the TMS60 was selected to analyze the PCB modification impact on the TMS emission profile. Along with C2PC for TMS60 the Volant Oil Tools Inc. likes to add the new variant TMS100 under same ID. The electronics/PCB is common to both TMS variant. The difference between the two variants is given in the family exhibit in detail.

The TMS was utilized with a specialized mandrel that was thinned to remove weight for testing purposes only, as the tool can weight > 450 lbs.

All test procedures, limits, criteria, and results described in this report apply only to the Volant Oil Tools, Inc. Torque Monitoring Sub test sample TMS60, referred to herein as the EUT (Equipment Under Test).

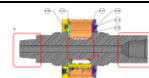
This report does not imply product endorsement by the Electronics Test Centre, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for Volant Oil Tools, Inc., located in Edmonton, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by Volant Oil Tools, Inc.:

Product Name:		Torque Monitoring Sub
Radio		BT
Frequency Band		2400 – 2483.5 MHz
Frequency Range		2402– 2480 MHz
Operating Mode		BLE
Max Transmit Power (Conducted)		5.61 dBm (0.00364W)
BLE	Associated External Antennas (Max. Gain)	WiFi / Bluetooth Ceramic Patch Antenna, APAKN2504-S2448-T, Max Antenna Gain: 7 dBi, Number of Antenna = 2
	Detachable/Non Detachable	Detachable (professional Installation)
Tested Model#		TMS60
Serial#		Proto2
Power supply:		VDC (Internal Battery)
Note: The units use 1 BLE radio, and its power is split into two antenna ports via a splitter. For radiated spurious emissions' analysis, the MID channel and 125kHz Mbps were selected from the original filing test report as the worst case scenario for any impact of PCB modification on the emission profile. The original filing was done for only one variant named TMS60. Now adding a 2nd new variant TMS100. The only significant difference between the two is the amount of metal material in the center portion (mandrel) of the units. The TMS100 has more metal material compared to the TMS60 to handle more weight.		
Mandrel (Grey area).		

1.4 General Test Conditions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated. In order to meet the operational requirements during testing as per KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 the device was programmed with a special firmware to transmit at a maximum achievable duty cycle. Special firmware is strictly for testing purpose only and not available to end user. This special test case represents the worst-case duty cycle. The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

1.5 Reference Standards

Standards	Description
FCC, title 47 CFR § 15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC, title 47 CFR § 15.207	Conducted limits for an intentional radiator that is designed to be connected to the public utility (AC) power line.
FCC, title 47 CFR § 15.107	Conducted limits for equipment that is designed to be connected to the public utility (AC) power line.
FCC, title 47 CFR § 15.209	Radiated emission limits; general requirements
FCC, title 47 CFR § 15.109	Radiated emission limits; from unintentional radiators digital devices.
ANSI C63.10: 2020 W/ Cor1-2023, Amd1-2024	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio – Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 KHz to 40 GHz
558074 D01 15.247 Meas Guidance v05r02	Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The FCC Rules
662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

1.6 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case.

1.6.1 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.6.2 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

1.6.3 Uncertainty of Measurement:

The factors contributing to measurement uncertainty are identified and calculated in accordance with CISPR 16-4-2: 2011.

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Uncertainty
Radiated Emissions Level (9 KHz – 1 GHz)	±5.8 dB
Radiated Emissions Level (1 GHz – 18 GHz)	±4.9 dB
Radiated Emissions Level (18 GHz – 26.5 GHz)	±5.0 dB
Uncertainty Conducted Power level	±0.5 dB
Uncertainty Conducted Spurious emission level	±0.6 dB
Uncertainty for Bandwidth test	±1.5 %

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

The measurement uncertainty is not accounted for determination of the statement of compliance. The statement of compliance is based only on the measurement value recorded.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Modifications	Config.	Result
2.1	AC Main Conducted Emissions	15.207 / 15.109	Torque Monitoring Sub	none	see § 2.1	N/A
2.2	EUT Position	ANSI C63.4	Torque Monitoring Sub	none	see § 2.2	Fix Position
2.3	Radiated Spurious Emission (Restricted Band)	15.205, 15.209 15.247(d)	Torque Monitoring Sub	none	see § 2.3	Compliant
2.4	RF Exposure	15.247(i)	Torque Monitoring Sub	none	see § 2.4	Exempt

Refer to the test data for applicable test conditions.

2.1 AC Main Power Line Conducted Emissions: N/A

Test Lab: Electronics Test Centre, Airdrie	EUT: Torque Monitoring Sub Standard: FCC Part 15.207, FCC Part 15.107 Basic Standard: ANSI C63.10: 2020 Basic Standard: ANSI C63.4: 2014
EUT status: N/A	
Comments: EUT is internal rechargeable battery powered. No Direct/indirect connection to AC main.	

2.2 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie

EUT: Torque Monitoring Sub

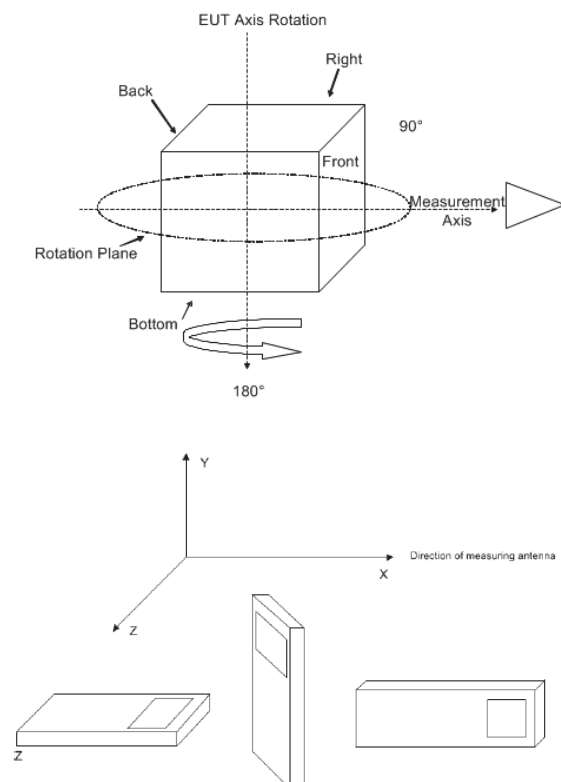
Standard: FCC PART 15.247

Basic Standard: ANSI C63.4-2014

Comments: 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.



2.3 Radiated Spurious Emissions (within restricted band)

Test Lab: Electronics Test Centre, Airdrie	EUT: Torque Monitoring Sub
Test Personnel: Brendan Van Hee	Model#: TMS60
Date: 2025/03/23 (20.4°C, 15.4% RH)	Standard: FCC PART 15.247/15.209
	Basic Standard: ANSI C63.10
EUT status: Compliant	

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	12.2900000 - 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 – 1240.0000	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

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 discrete 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.

2.3.2 Deviations From The Standard:

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

2.3.3 Test Equipment

Testing was performed with the following equipment:

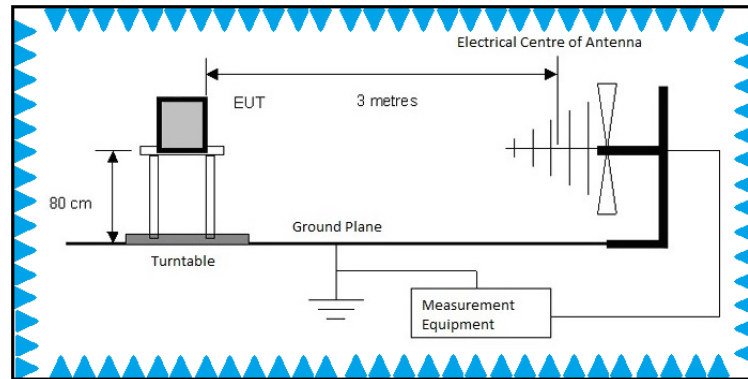
Equipment	Manufacturer	Model #	Asset #	Calibration Date YYYY/MM/DD	Calibration Due YYYY/MM/DD
EMC Software	UL	V 9.5	SWE021	N/A	
EMI Receiver	Agilent	N9038A FW v A.22.08	6906	2026/02/17	2027/02/17
Biconilog Antenna	SunAR	JB1	6905	2026/01/09	2028/01/09
DRG Horn	EMCO (Tensor)	3115	19357	2025/11/18	2027/11/18
Standard Horn	Quinstar	QWH-KPRS00	6163	2025/11/20	2027/11/20
Pre-Amplifier 30-1000 MHz	HP	8447D	9291	2026/01/05	2027/01/05
Low Noise Amplifier 1-18 GHz	MITEQ	JS43-01001800-21-5P	4354	2026/01/05	2027/01/05
Low Noise Amplifier 18-26.5 GHz	MITEQ	JS44-01002650-33-3P	6163	2026/01/05	2027/01/05
Measurement Cable (all ranges)	AH Systems	SAG-26G-8.23	6187	2026/01/05	2027/01/05
Measurement Cable (30M-1GHz, underground portion)	Insulated Wire	KS-1501A-3600-KPS	4419	2026/01/05	2027/01/05
2.4 GHz Notch Filter	Micro-Tronics	BRM50702	6953	2026/01/05	2027/01/05
T/H Logger	Extech	42270	5892	2025/05/01	2026/05/01

2.3.4 Test Sample Verification, Configuration & Modifications

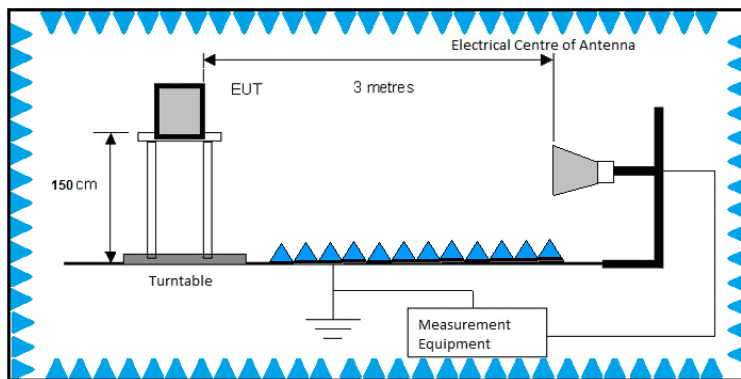
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

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



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



2.3.5 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dBμV/m.

Delta = Field Strength – Limit

Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

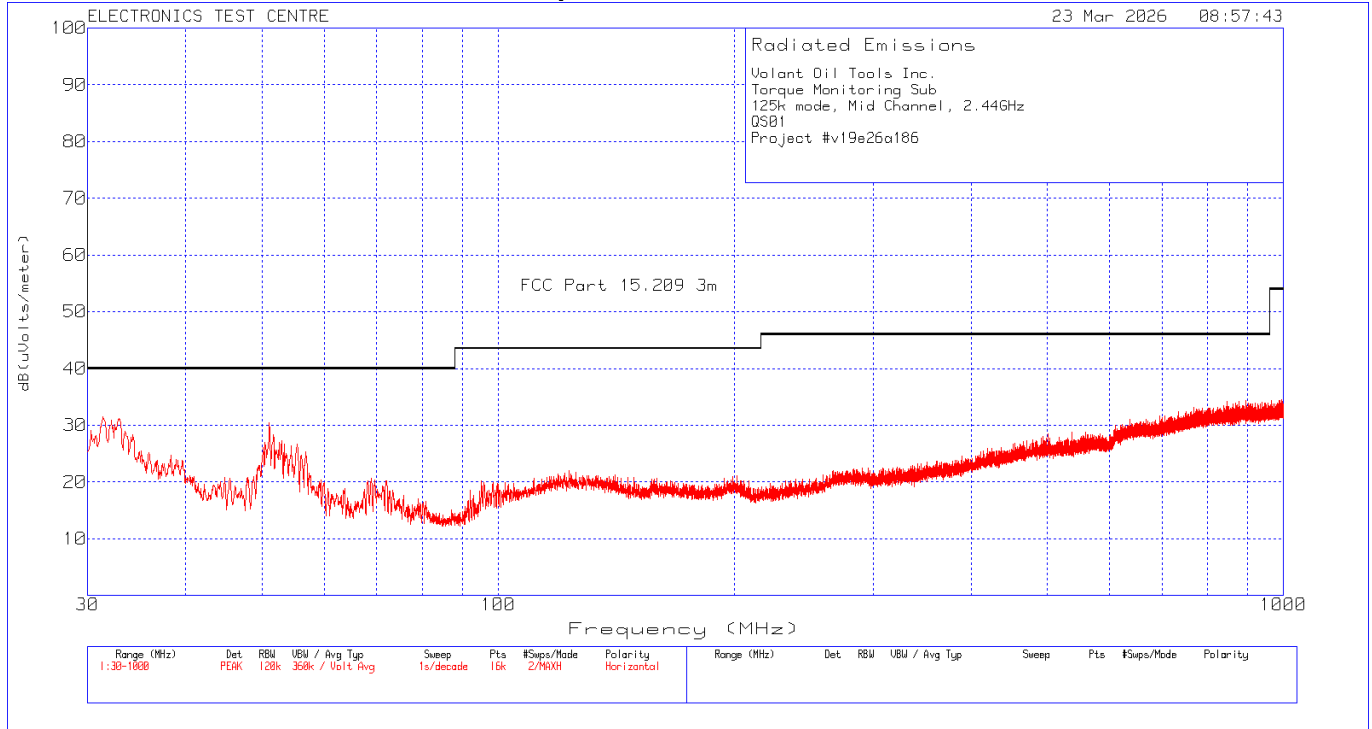
Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission

Freq. Marker	Freq. [GHz]	Raw reading [dBμv]	Det	Antenna Factor [dB/m]	Cable Loss [dB]	Corrected Reading [dBμv/m]	Emission Limit [dBμv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	7.33	40.18	PK	36.5	-26.0	50.68	73.98	-23.30	189	101	Vertical
		30.69	AV			41.19	53.98	-12.79			
2	18.00	23.22	PK	45.2	-16.7	51.72	73.98	-22.26	240	207	Vertical
		11.41	AV			39.91	53.98	-14.07			

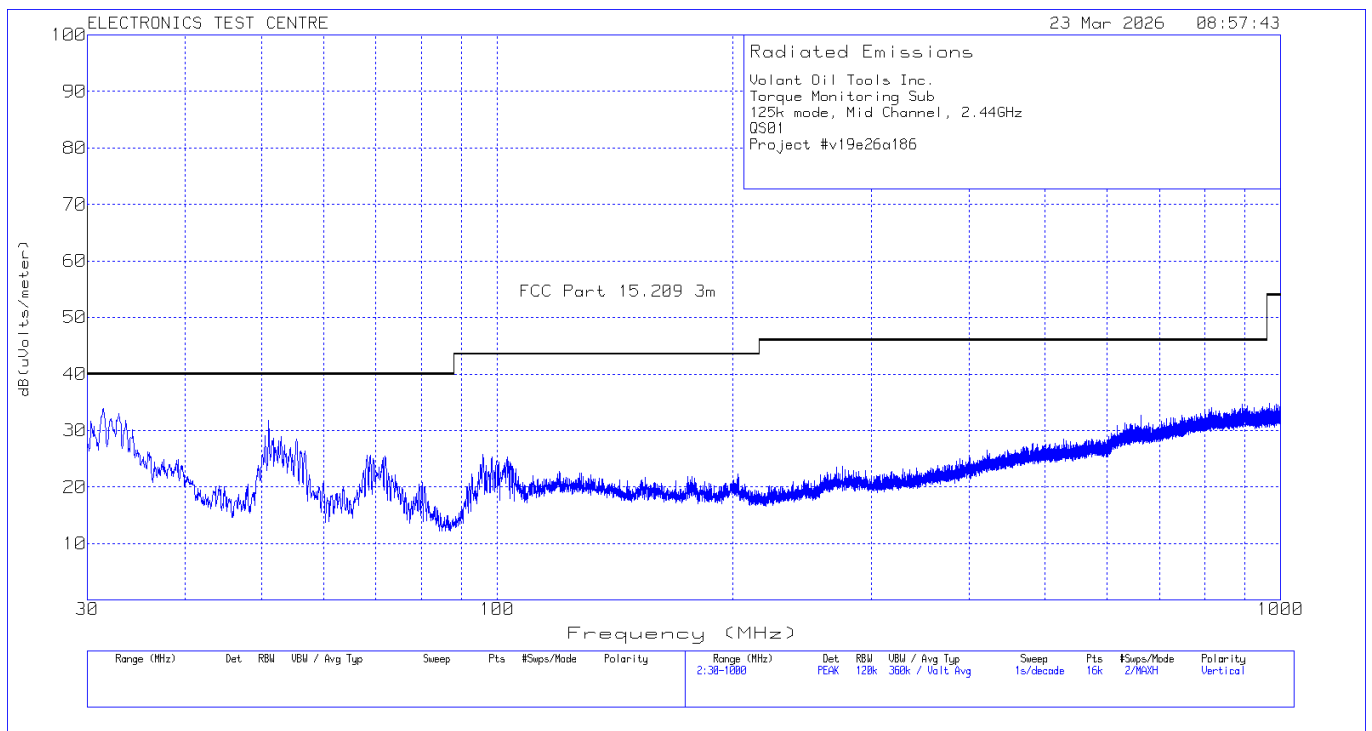
Notes:

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

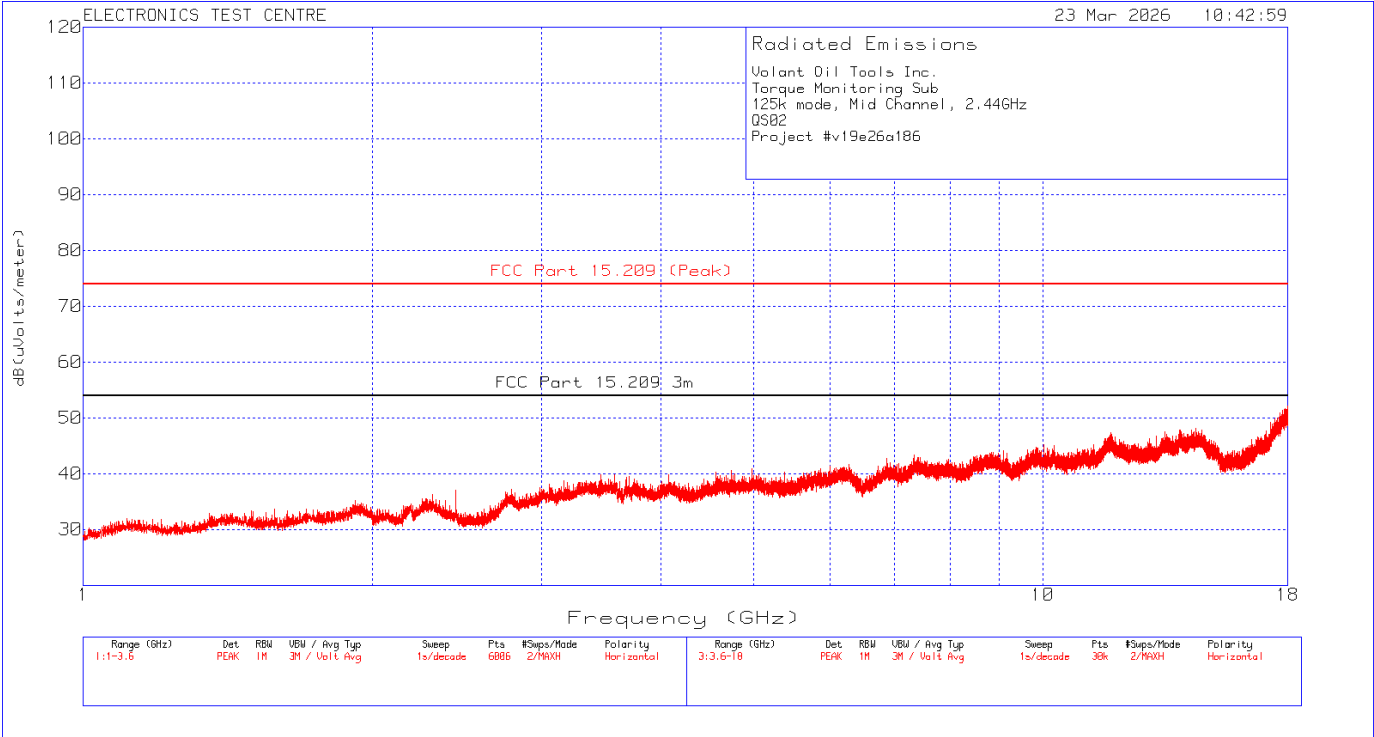
Plot of Radiated Emissions: Horizontal polarization



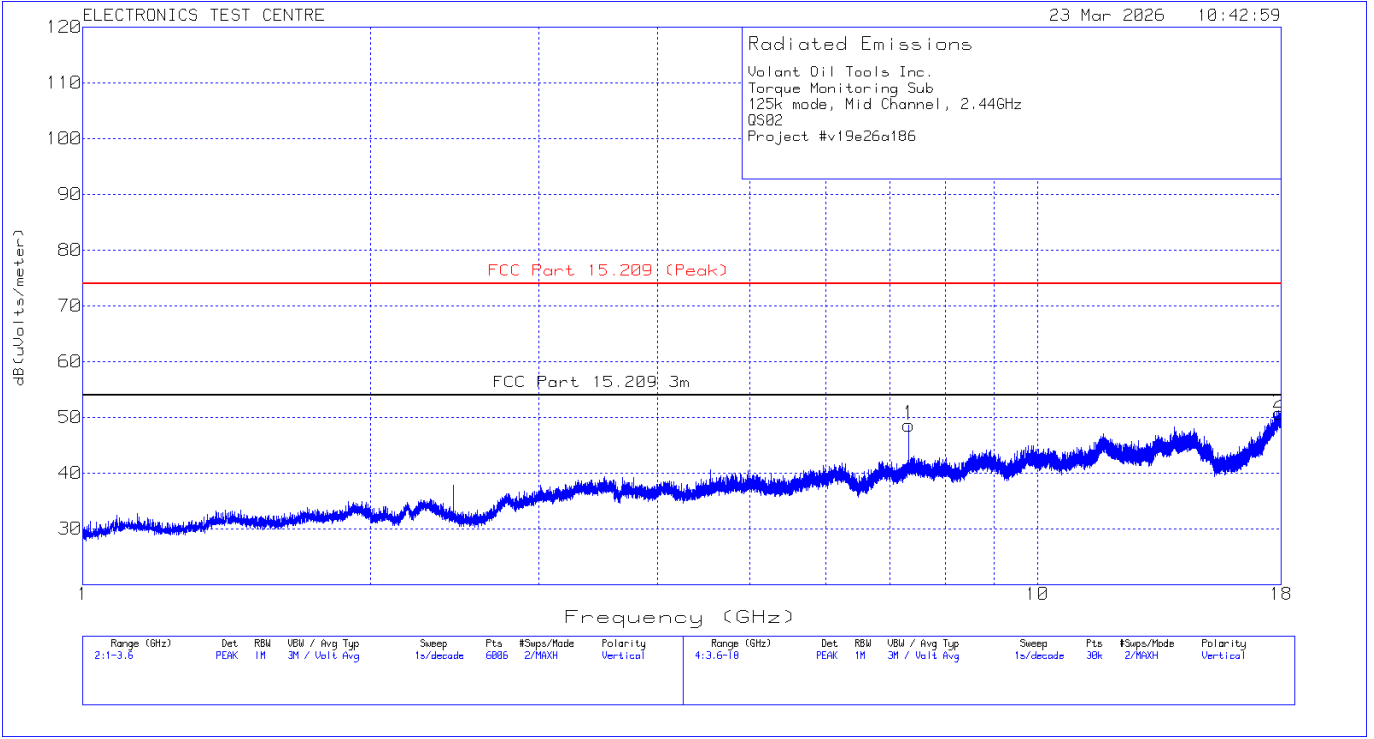
Plot of Radiated Emissions: Vertical polarization



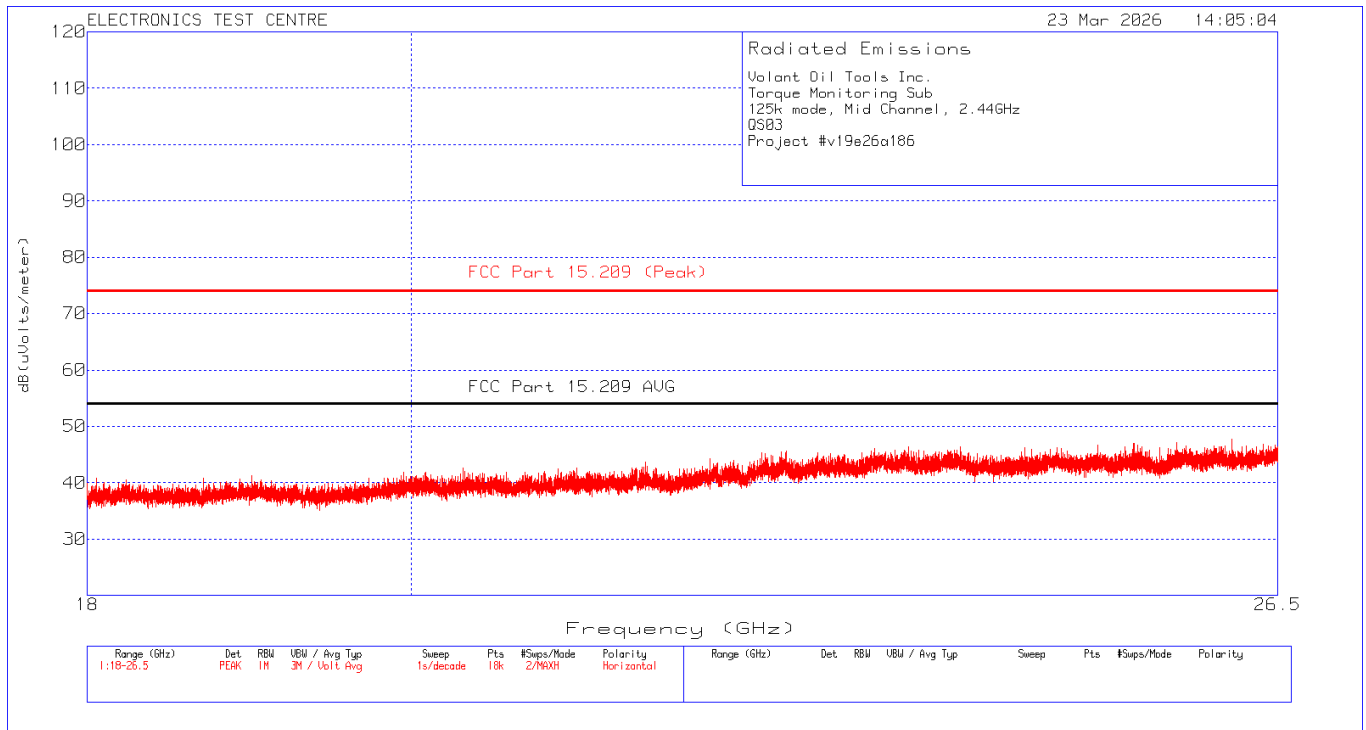
Plot of Radiated Emissions: Horizontal polarization



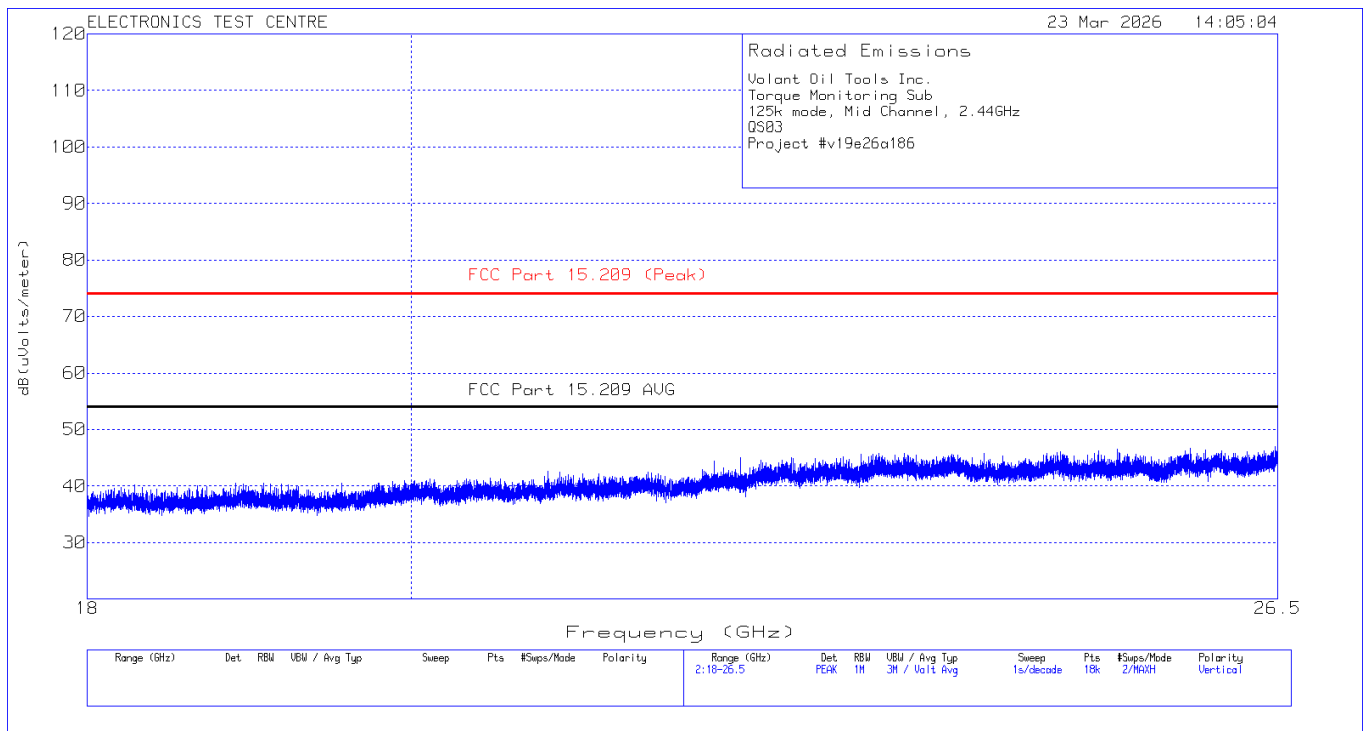
Plot of Radiated Emissions: Vertical polarization



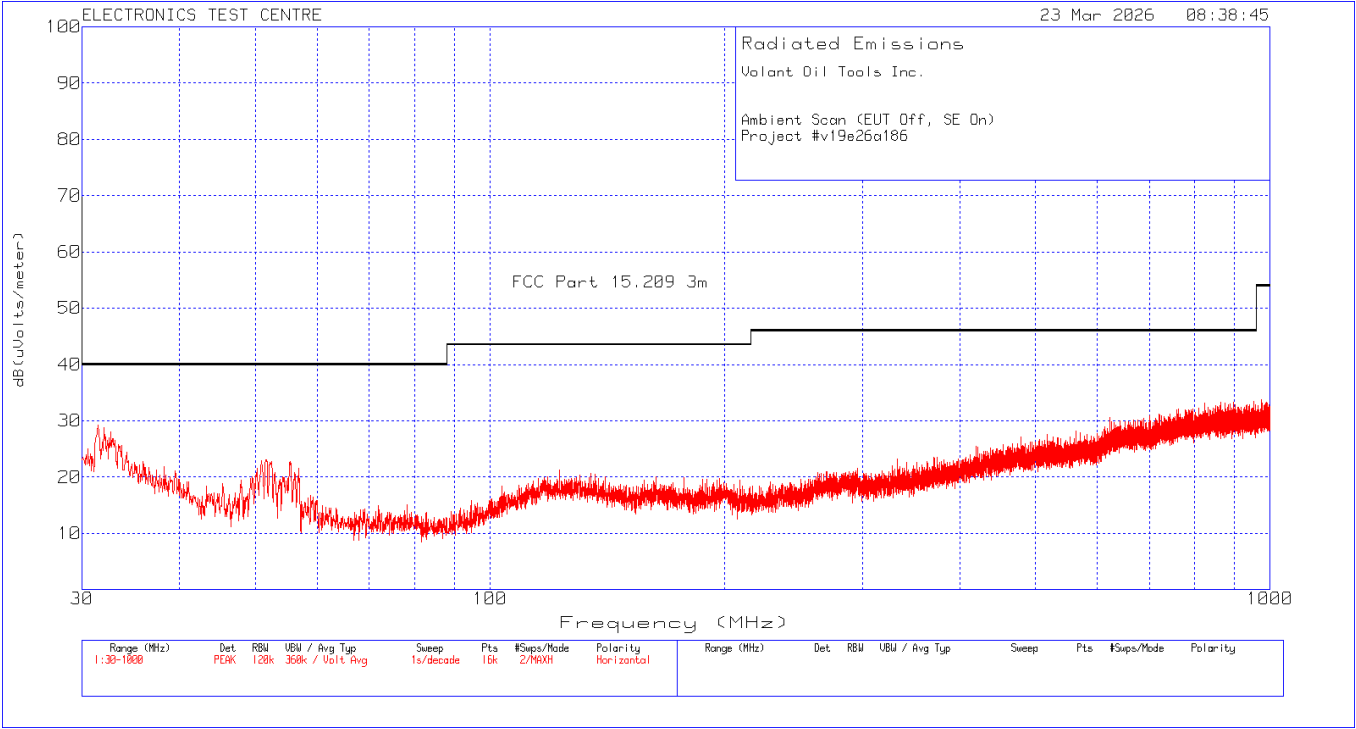
Plot of Radiated Emissions: Horizontal polarization



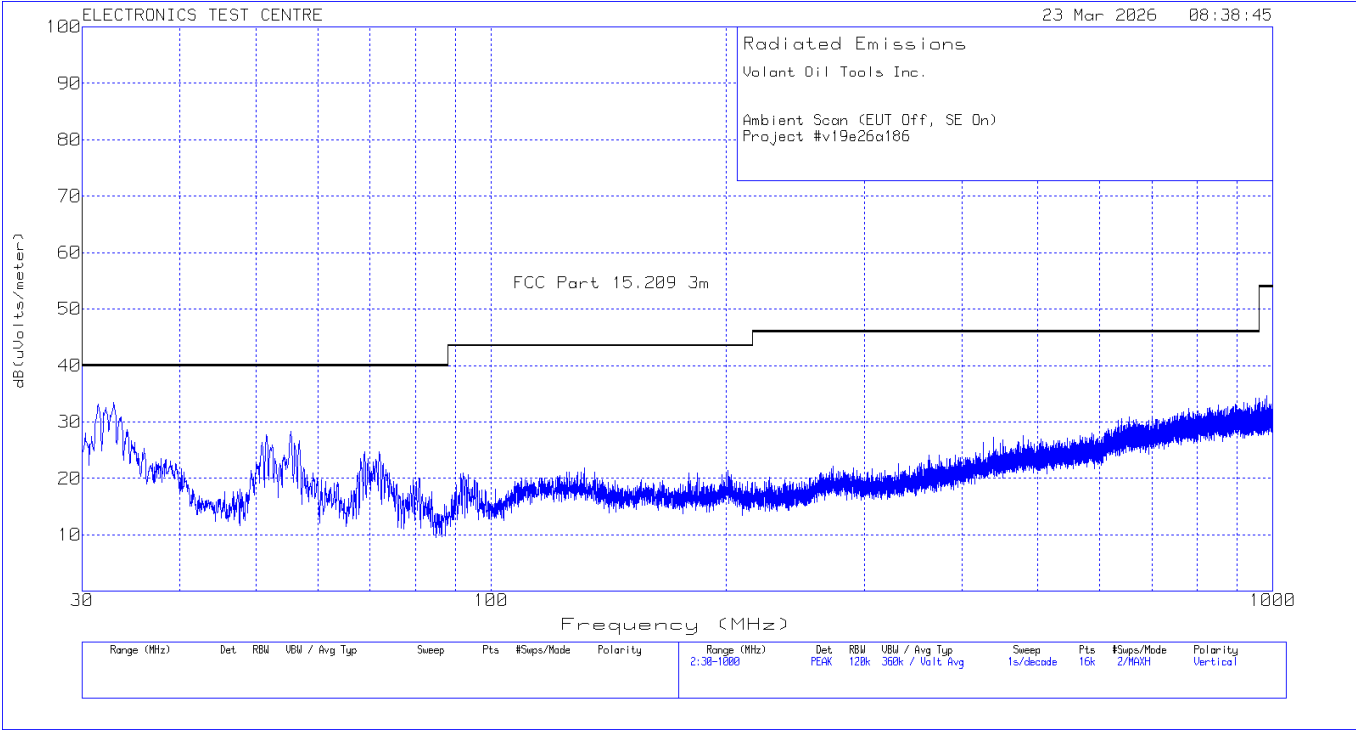
Plot of Radiated Emissions: Vertical polarization



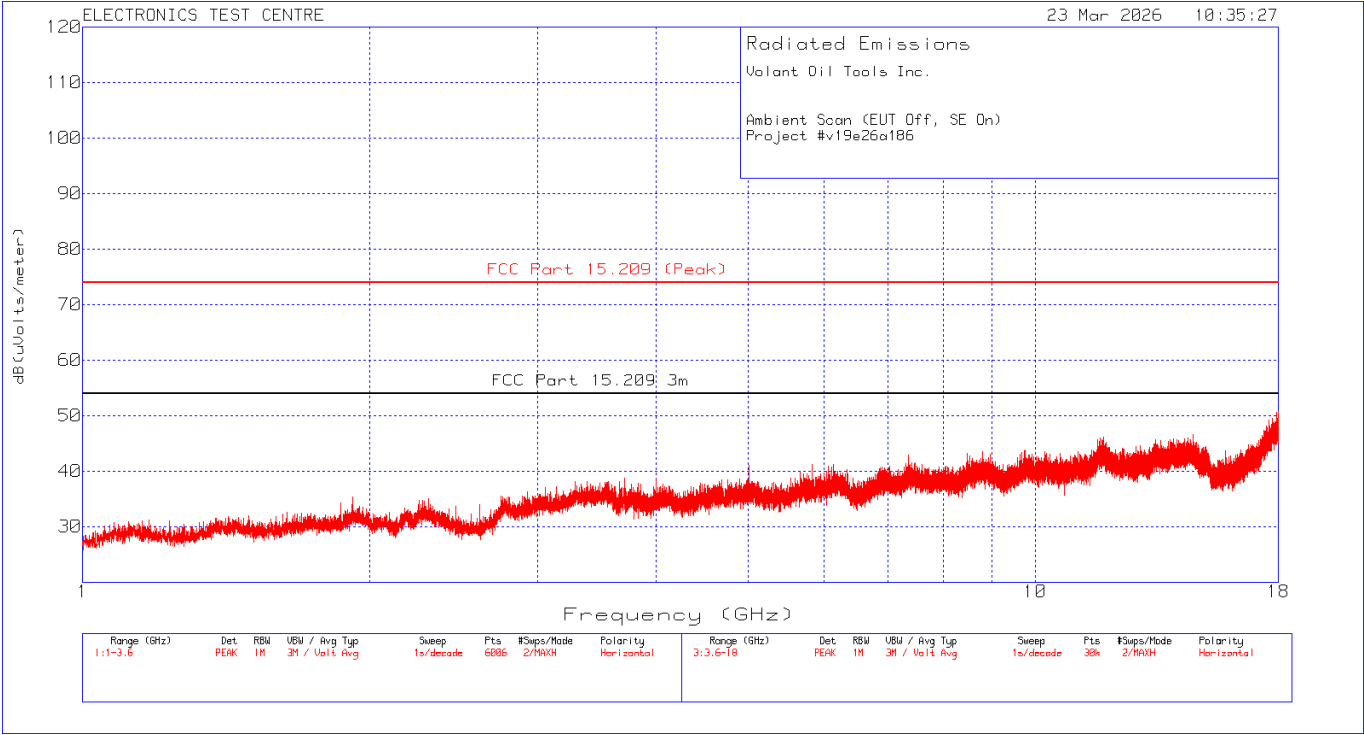
Plot of Test Chamber Ambient: (measurement noise floor):



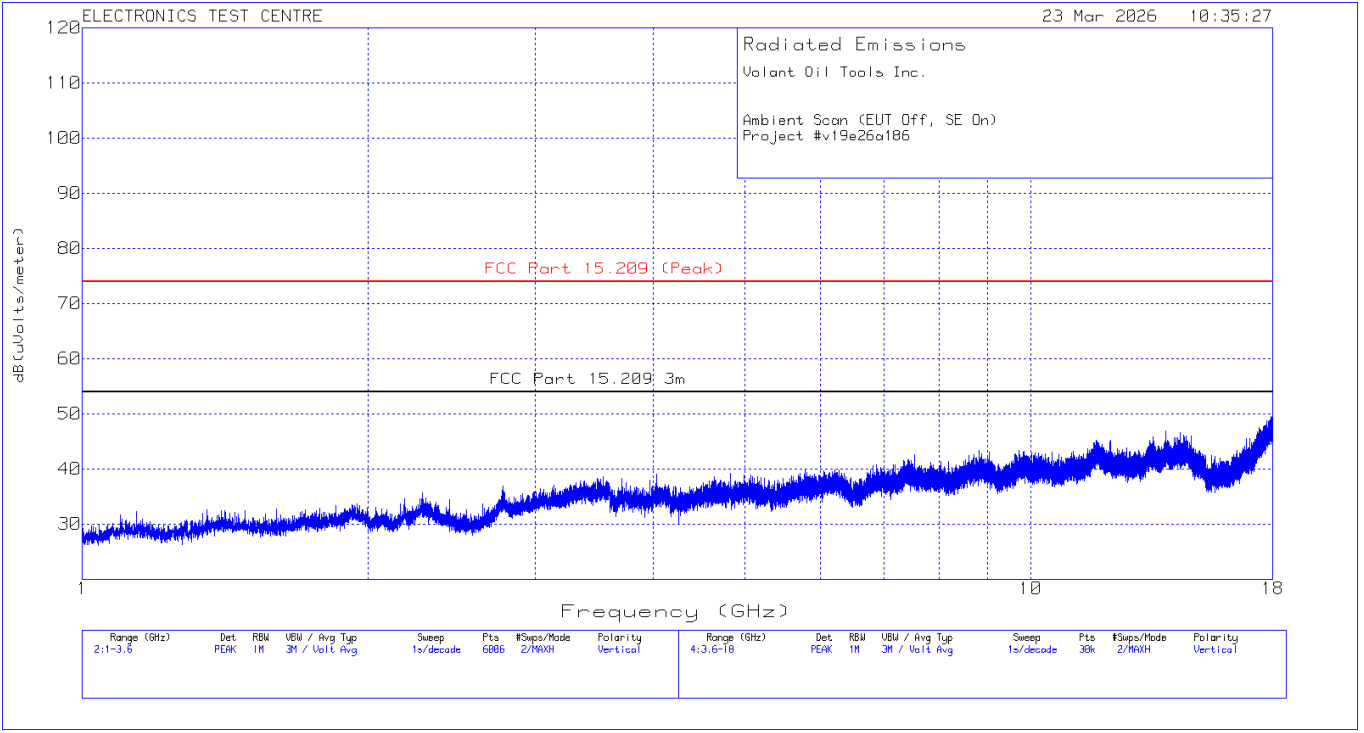
Plot of Test Chamber Ambient: (measurement noise floor):



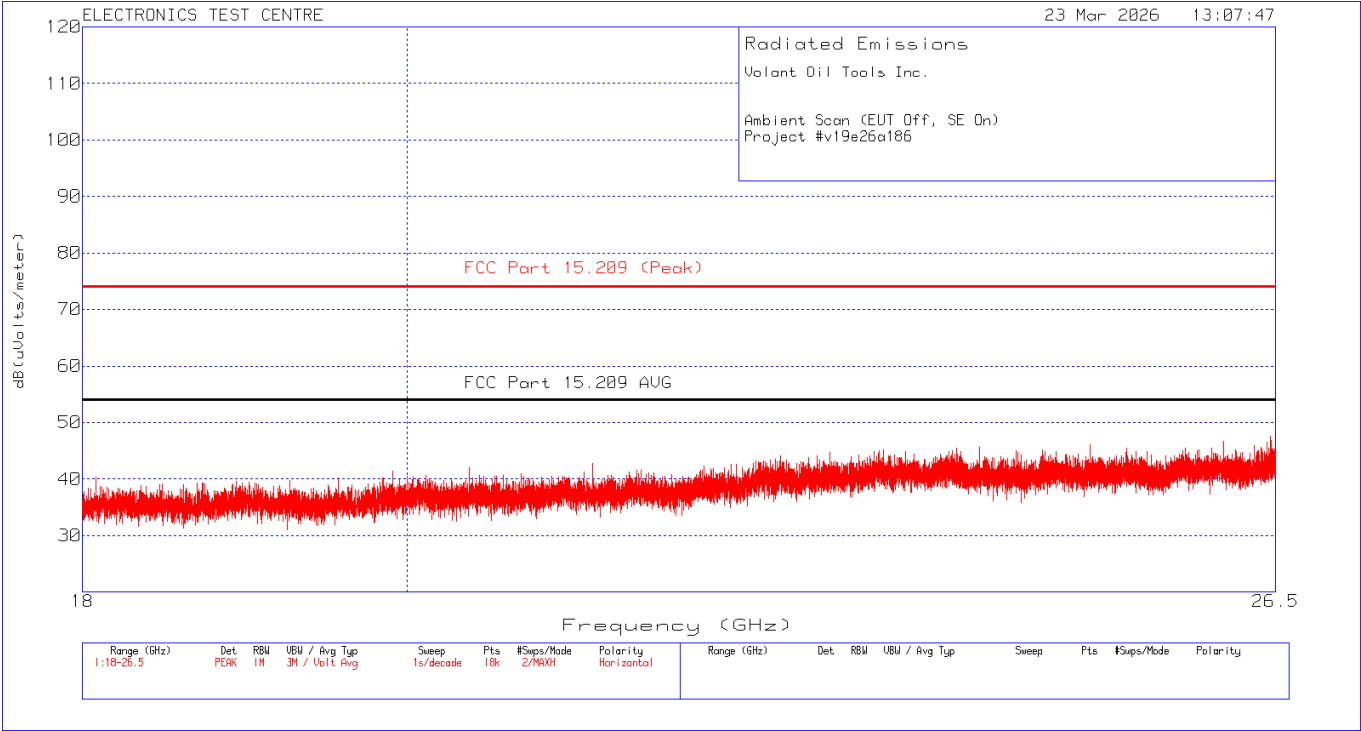
Plot of Test Chamber Ambient: (measurement noise floor):



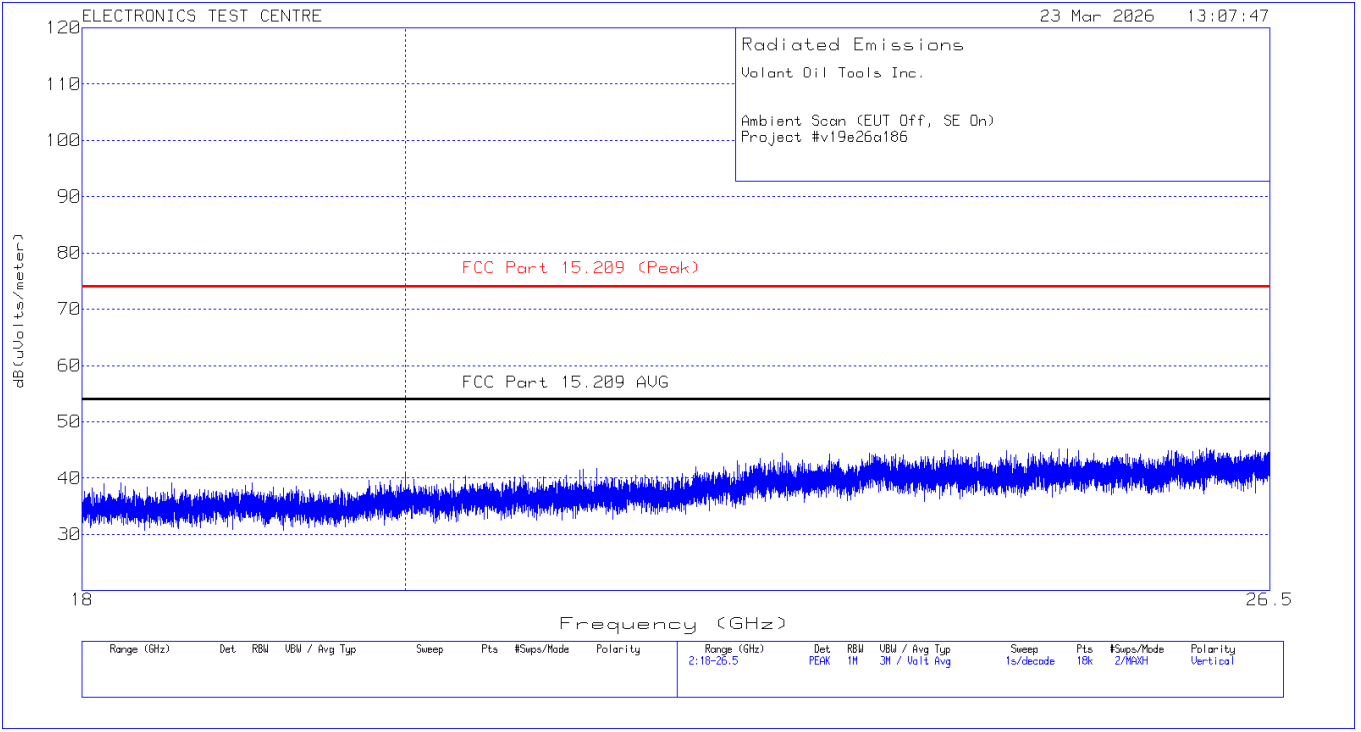
Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



2.4 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.

This test site is registered with Industry Canada as per registration # 2046A and its CAB Identifier number is CA2046. It is also listed with the FCC under Registration Number 175004 and the MRA designation number is 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

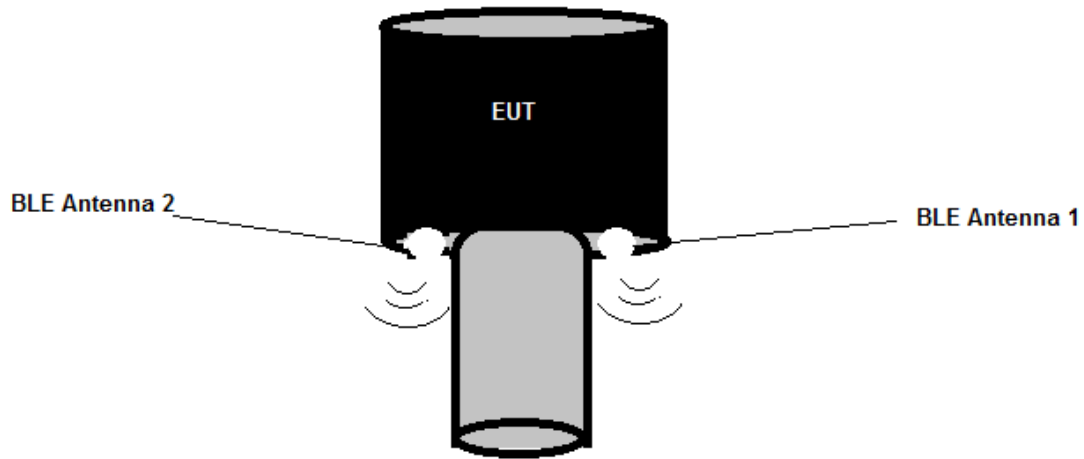
The Torque Monitoring Sub was placed at the center of the test chamber turntable 80-cm high below 1GHz and at 1.5m high above 1 GHz for transmit mode from ground reference plane. No external ground is connected to the EUT enclosure.

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