



Test Report Serial Number:

45461761 R2.0

Test Report Date:

31 August 2022

Project Number:

1595

EMC Test Report - New Filing

Applicant:



The Detection Group
440 N. Wolfe Rd. E126
Sunnyvale, CA, 94085
USA

The Detection Group
440 N. Wolfe Rd. E211
Sunnyvale, CA, 94085
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FCC ID:

2AK4V-DT-553

Product Model Number / HVIN

DT-553

IC Registration Number

22517-DT553

Product Name / PMN

DT-553 Valve Controller

In Accordance With:

FCC 47 CFR §15.247, Part 15 Subpart B

Intentional Radiators - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, Unintentional Radiators

RSS-GEN, RSS-247, ICES-003

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Approved By:

Ben Hewson, President

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Canada



Test Lab Certificate: 2470.01



**Industry
Canada**

IC Registration 3874A



FCC Registration: CA3874

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Art Voss, P.Eng.	Date(s) of Evaluation:		17 May - 3 June, 2022
Report Prepared By:		Art Voss, P.Eng.	Report Reviewed By:		Ben Hewson
Report Revision	Description of Revision	Revised Section	Revised By	Revision Date	
1.0	Initial Release	n/a	Art Voss	18 July 2022	
2.0	Revised Device Description	2.0	Art Voss	31 August 2022	

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name (FCC)	The Detection Group
Applicant Address (FCC)	440 Wolfe Rd. E126
	Sunnyvale, CA, 94085
	USA
Applicant Name (ISED)	The Detection Group
Applicant Address (ISED)	440 Wolfe Rd. E211
	Sunnyvale, CA, 94085
	USA
DUT Information	
Device Identifier(s):	FCC ID: 2AK4V-DT-553
	IC ID: 22517-DT553
Device Type:	Industrial Digital Transceiver
Device Model(s) / HVIN:	DT-533
Device Marketing Name / PMN:	DT-533 Valve Controller
Firmware Version ID Number / FVIN:	-
Host Marketing Name / HMN:	-
Test Sample Serial No.:	T/A Sample - Identical Prototype
Equipment Class (FCC):	Digital Transmission System (DTS)
Equipment Class (ISED):	Other
Transmit Frequency Range:	906 - 92MHz
Test Channels:	1 Channel
Manuf. Max. Rated Output Power:	24dBm
Manuf. Max. Rated BW/Data Rate:	n/a
Antenna Make and Model:	Chip
Antenna Type and Gain:	1.59
Modulation:	FSK
Mode:	Simplex
Emission Designator:	See Section 8.0
DUT Power Source:	12VDC
DUT Dimensions [LxWxD]	140mm x 100mm x 40mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

The Detection Group

, (the '*Applicant*'), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and, unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device Description:

The HVIN: DT-553, PMN: DT-553 Valve Controller is a Class A Industrial remote water sensing/water valve controller with a low power 912MHz Transceiver. It is made available to the general public and requires professional installation.

Application:

This is an application for a New Certification, Single.

Regulatory Requirement:

As per FCC 47 CFR 2 Subpart I and the Radiocommunication Regulations of Canada, Equipment Authorization is required for this *Equipment* by means of Certification in accordance with FCC 47 CFR §15.249 and ISED RSS-210.

Scope of Work:

The scope of this investigation is limited only to the evaluation of the DT-553 to determine compliance to the *Rules* identified herein.

RF Exposure:


As per FCC 47 CFR §2.1091 and Canada Health Safety Code 6, an RF Exposure (MPE) evaluation is required for this *Equipment* and the results of the RF Exposure (MPE) evaluation appear in a separate report.

4.0 TEST SUMMARY

TEST SUMMARY						
Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Applicable Rule Part(s) ISED	Test Date	Result
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	RSS-Gen (6.7)	17 May 2022	Pass
8.0	DTS Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(2)	RSS-Gen (6.7) RSS-247 (5.2)(a)	17 May 2022	Pass
9.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	RSS-Gen (6.12) RSS-247 (5.4)(d)	17 May 2022	Pass
10.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	RSS-247 (5.2)(b)	24 May 2022	Pass
11.0	Conducted Tx Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	27 May 2022	Pass
12.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	27 May 2022	Pass
13.0	Radiated Tx Spurious Emissions And Restricted Band	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	RSS-Gen (6.13)	1 June 2022	Pass
14.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	RSS-Gen (7.4) ICES-003(6.2)	1 June 2022	Pass
15.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	ICES-003(6.1)	3 June 2022	Pass

Test Station Day Log					
Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
17 May 2022	25.3	18	102.1	EMC	7, 8, 9
24 May 2022	26.5	17	101.8	EMC	10
27 May 2022	24.8	17	100.7	EMC	11, 12
1 June 2022	24.2	43	101.7	OATS	13, 14
3 June 2022	25.3	75	100.7	LISN	15

EMC - EMC Test Bench **SAC** - Semi-Anechoic Chamber
OATS - Open Area Test Site **TC** - Temperature Chamber
LISN - LISN Test Area **ESD** - ESD Test Bench
IMM - Immunity Test Area **RI** - Radiated Immunity Chamber

<p>I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.</p>	 <hr/> Art Voss, P.Eng. Technical Manager Celltech Labs Inc. <hr/> 18 July 2022 <hr/> Date
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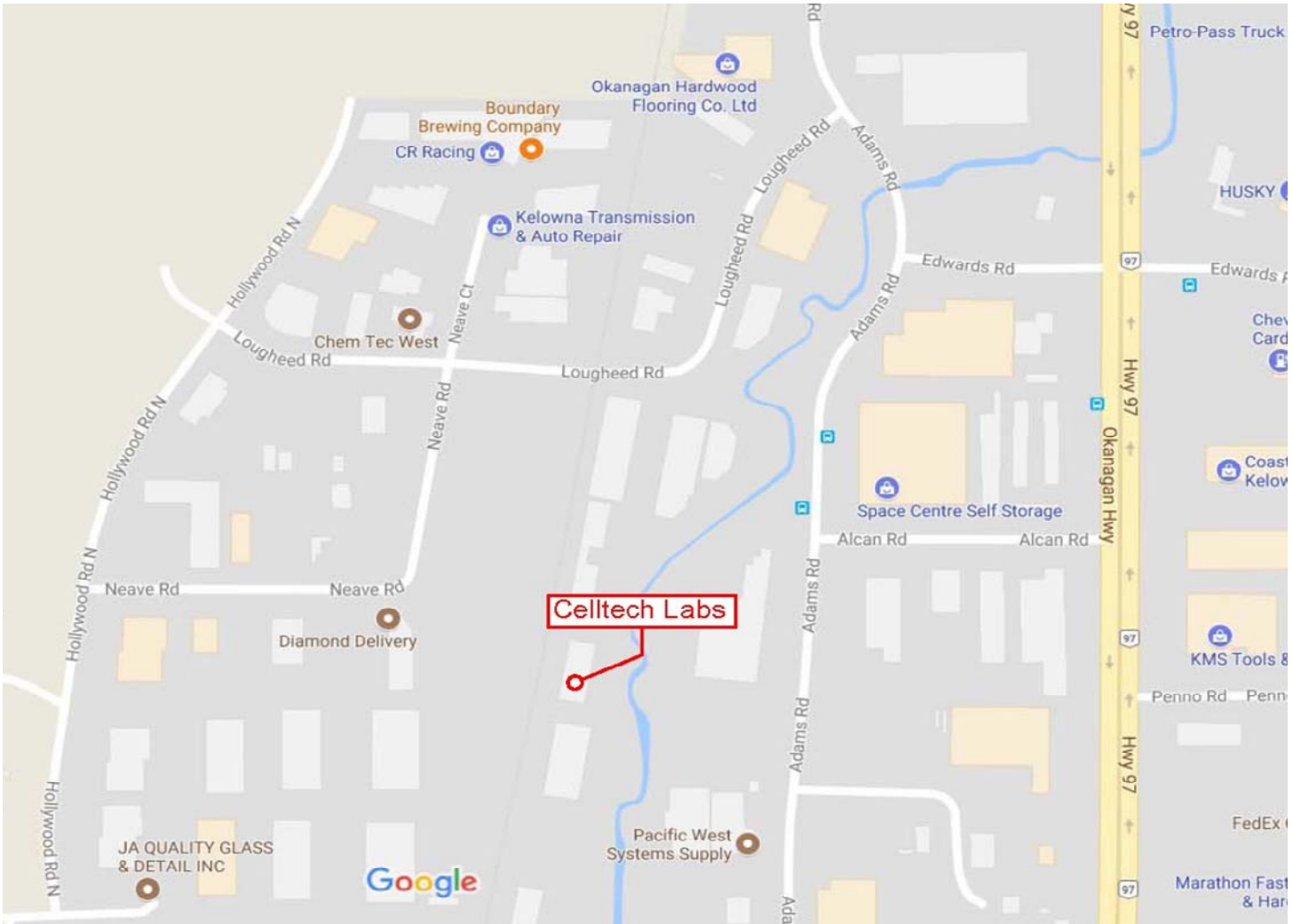
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.4-2014	American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR	Code of Federal Regulations Title 47: Telecommunication Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart B: Unintentional Radiators
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Sub Part C (15.247) Intentional Radiators
ISED	Innovation, Science and Economic Development Canada RSS-Gen Issue 5A1: Spectrum Management and Telecommunications Radio Standards Specification March 2019 General Requirements and Information for the Certification of Radiocommunication Equipment
ISED	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification ICES-003 Issue 6: Information Technology Equipment (Including Digital Apparatus) — Jan 2016 Limits and Methods of Measurement
ISED	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification RSS-247 Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) February 2017 and Licensed-Exempt Local Area Network (LE_LAN) Devices
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Loughheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 OCCUPIED BANDWIDTH

Test Procedure

Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)
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General Procedure

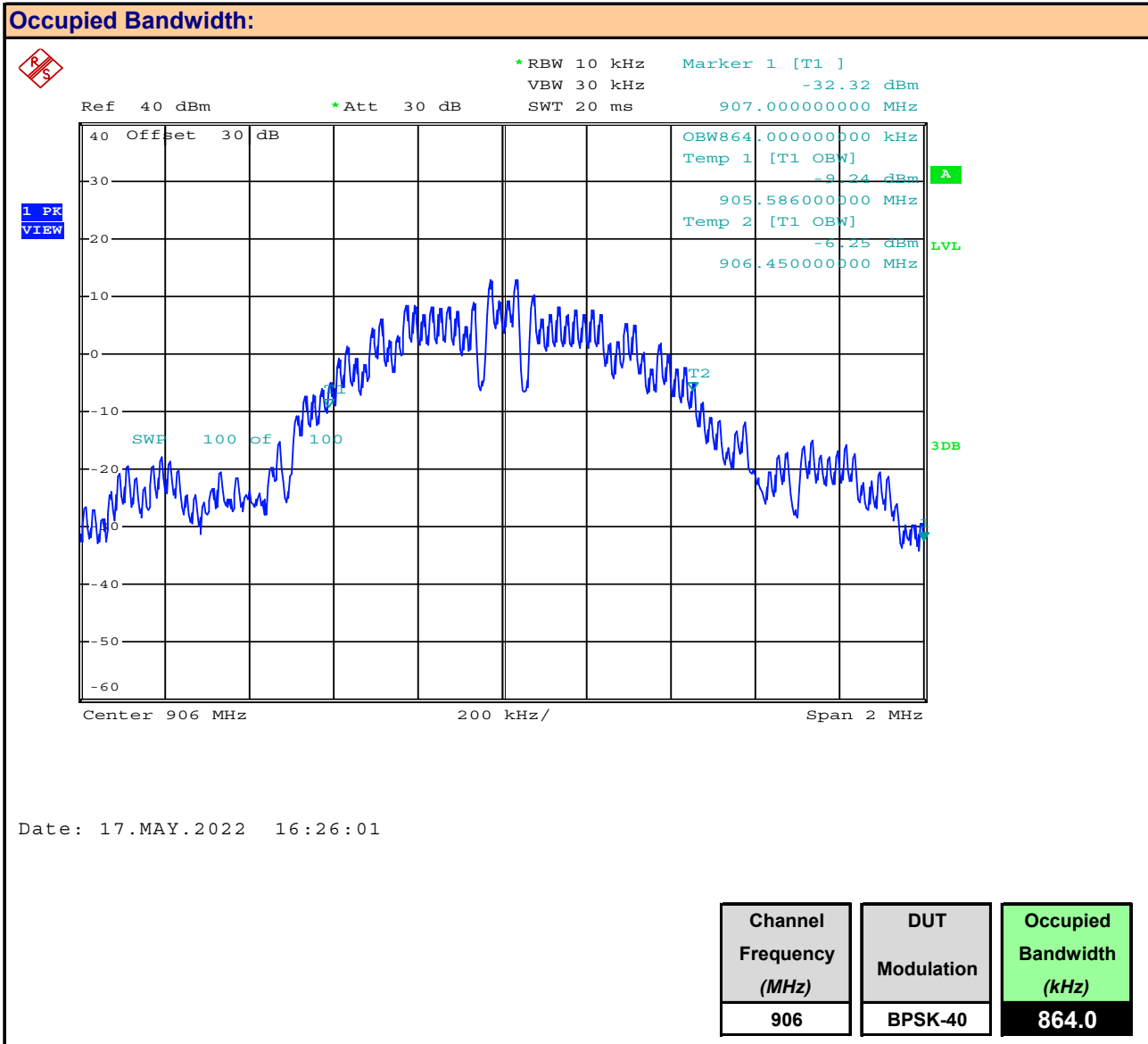
KDB 558074 (8.3.2.1)	<p>8.3.2.1 General</p> <p>Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.</p>
C63.10 (6.9.3)	<p>6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure</p> <p>The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:</p> <ol style="list-style-type: none"> The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement. Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2. Step a) through step c) might require iteration to adjust within the specified range. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

Test Setup	Appendix A - Figure A.1
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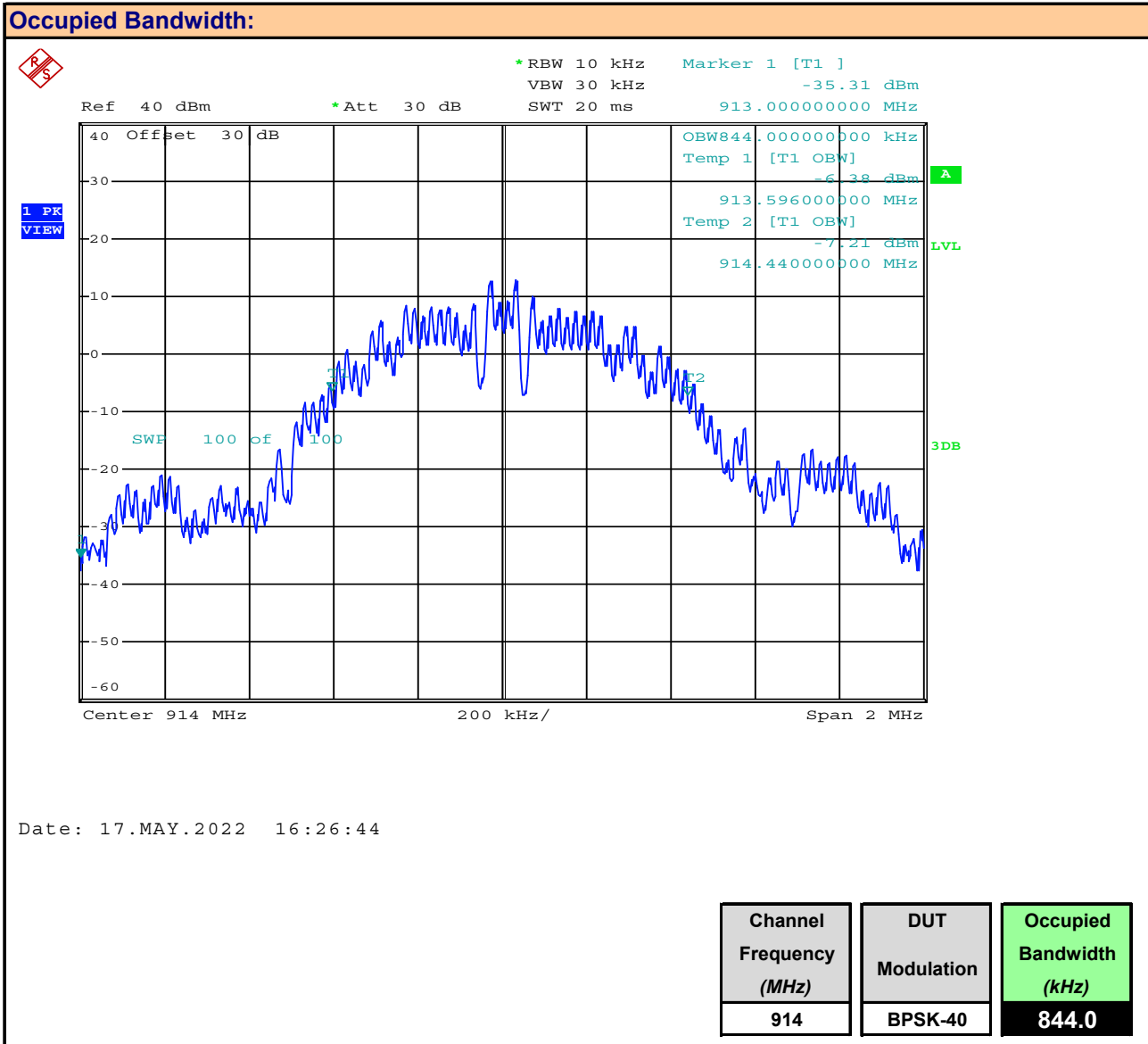
Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded and used for the basis for measuring the Conducted Output Power.

Plot 7.1 – Occupied Bandwidth, 906MHz



Plot 7.2 – Occupied Bandwidth, 914MHz



Plot 7.3 – Occupied Bandwidth, 924MHz

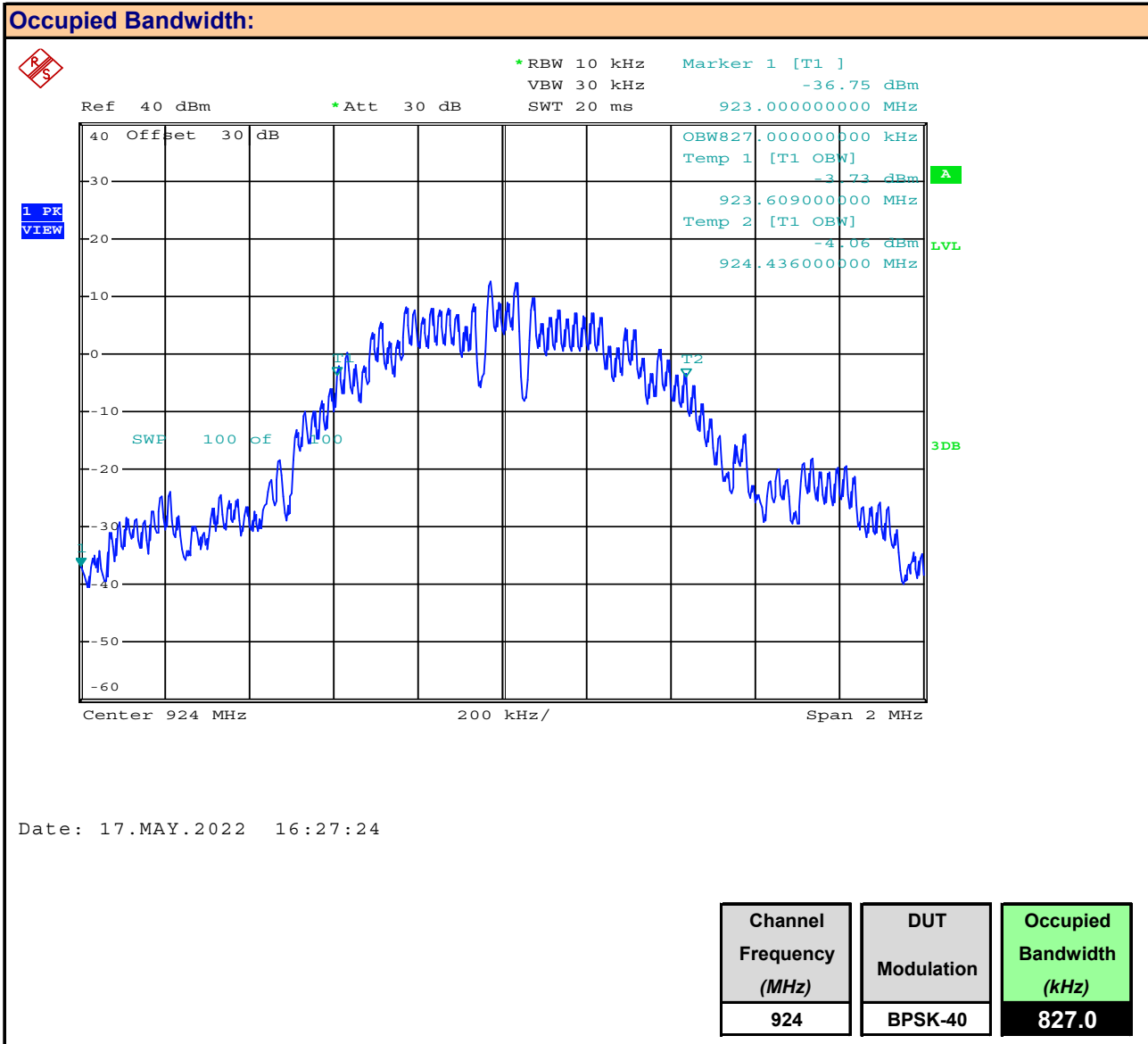


Table 7.1 – Summary of Occupied Bandwidth Measurements

Occupied Bandwidth Results:			
Channel Frequency (MHz)	Modulation	Measured Occupied Bandwidth (kHz)	Emission Designator
906.0	BPSK-40	864.0	864KG1D
914.0		844.0	844KG1D
924.0		827.0	827KG1D
			Complies

8.0 DTS BANDWIDTH

Test Procedure

Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a), KDB 558074 (8.2), ANSI C63.10 (11.8.2)
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Limits

47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
RSS-247 (5.2)(a)	5.2 Digital transmission systems DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz: a) The minimum 6 dB bandwidth shall be 500 kHz.

General Procedure

KDB 558074 (8.2) C63.10 (11.8.2)	11.8.2 Option 2 The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
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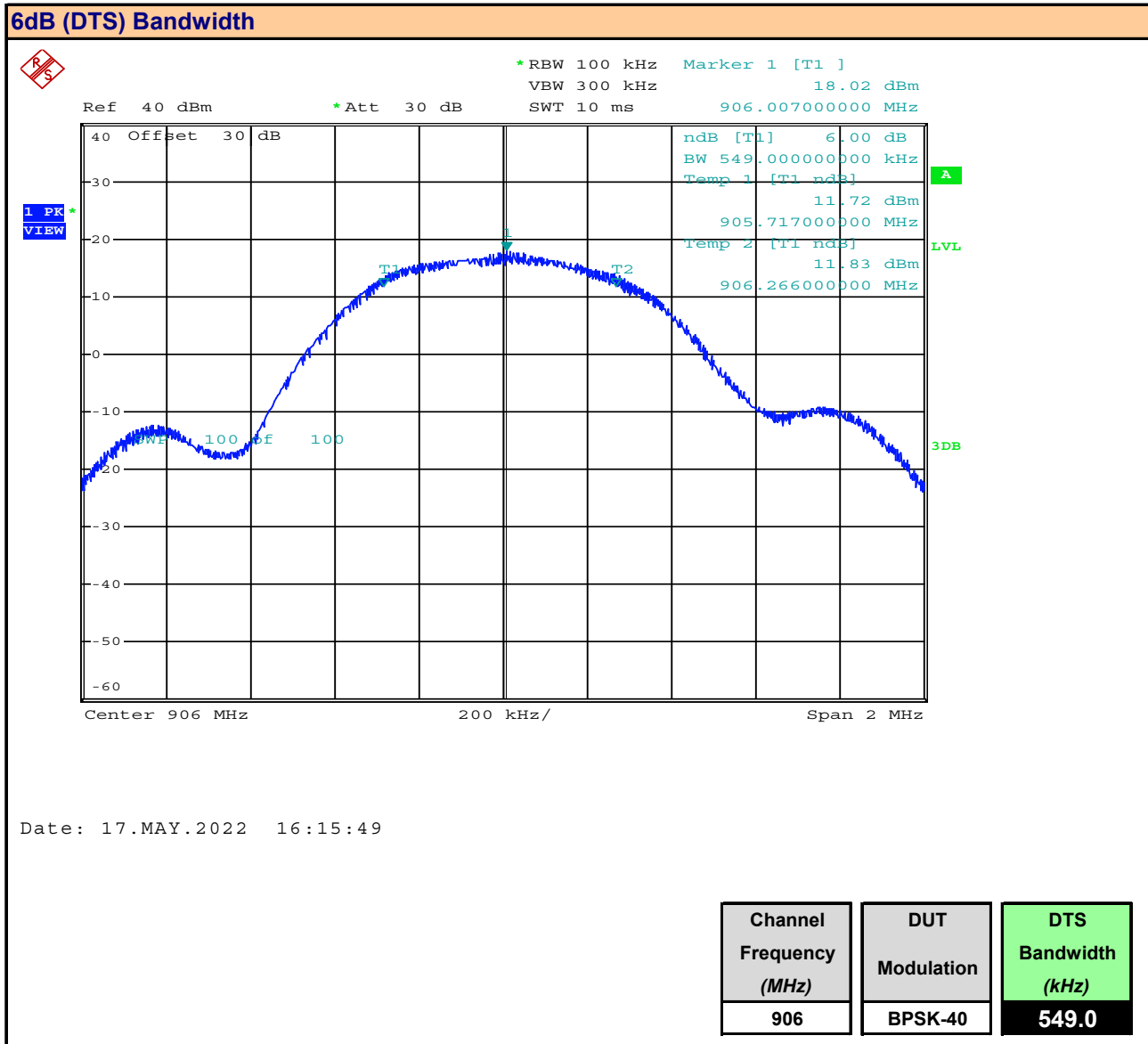
Test Setup

Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as above using the Automatic 6dB Cursor Bandwidth measurement. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle.

Plot 8.1 – DTS Bandwidth, 906MHz



Plot 8.3 – DTS Bandwidth, 924MHz

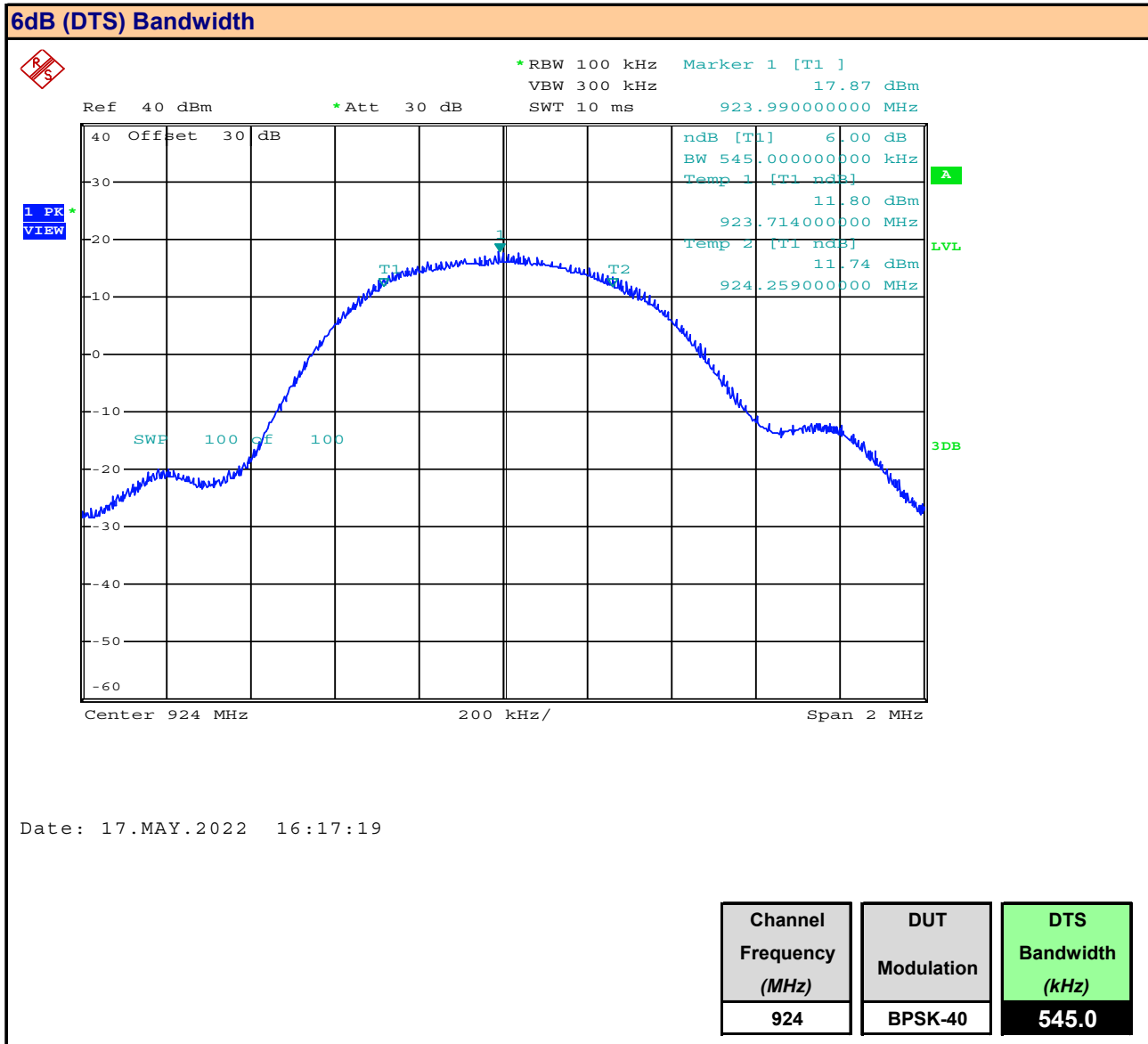


Table 8.1 – Summary of DTS Bandwidth Measurements

DTS Bandwidth Results:				
Channel Frequency (MHz)	Modulation	Measured DTS Bandwidth (kHz)	Minimum Limit (kHz)	Margin (Hz)
906.0	BPSK-40	549.0	500.0	49.0
914.0		542.0		42.0
924.0		545.0		45.0
				Complies

9.0 CONDUCTED CHANNEL POWER

Test Procedure

Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)
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Limits

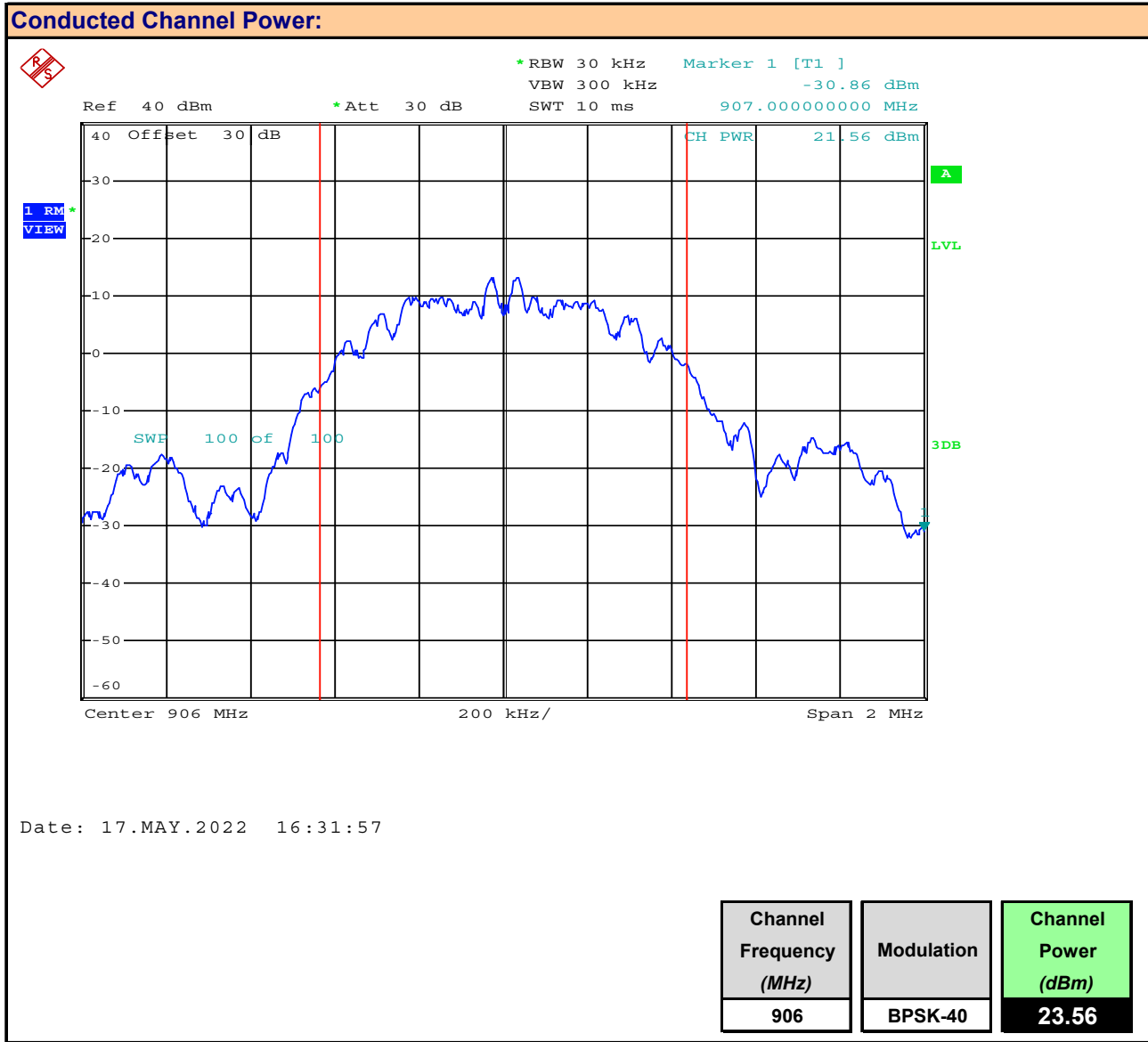
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) Devices shall comply with the following requirements, where applicable: d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

General Procedure	
KDB 558074 (8.3.2.1)	<p>8.3.2.1 General</p> <p>Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.</p>
C63.10 (11.9.2.2.2)	<p>Method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each</p> <ul style="list-style-type: none"> a) Set span to at least 1.5 X OBW. b) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz. c) Set VBW \geq 3 X RBW. d) Number of points in sweep \geq 2 X span / RBW. e) Sweep time = auto. f) Detector = RMS g) If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle \geq 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”. h) Trace average at least 100 traces in power averaging i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges.

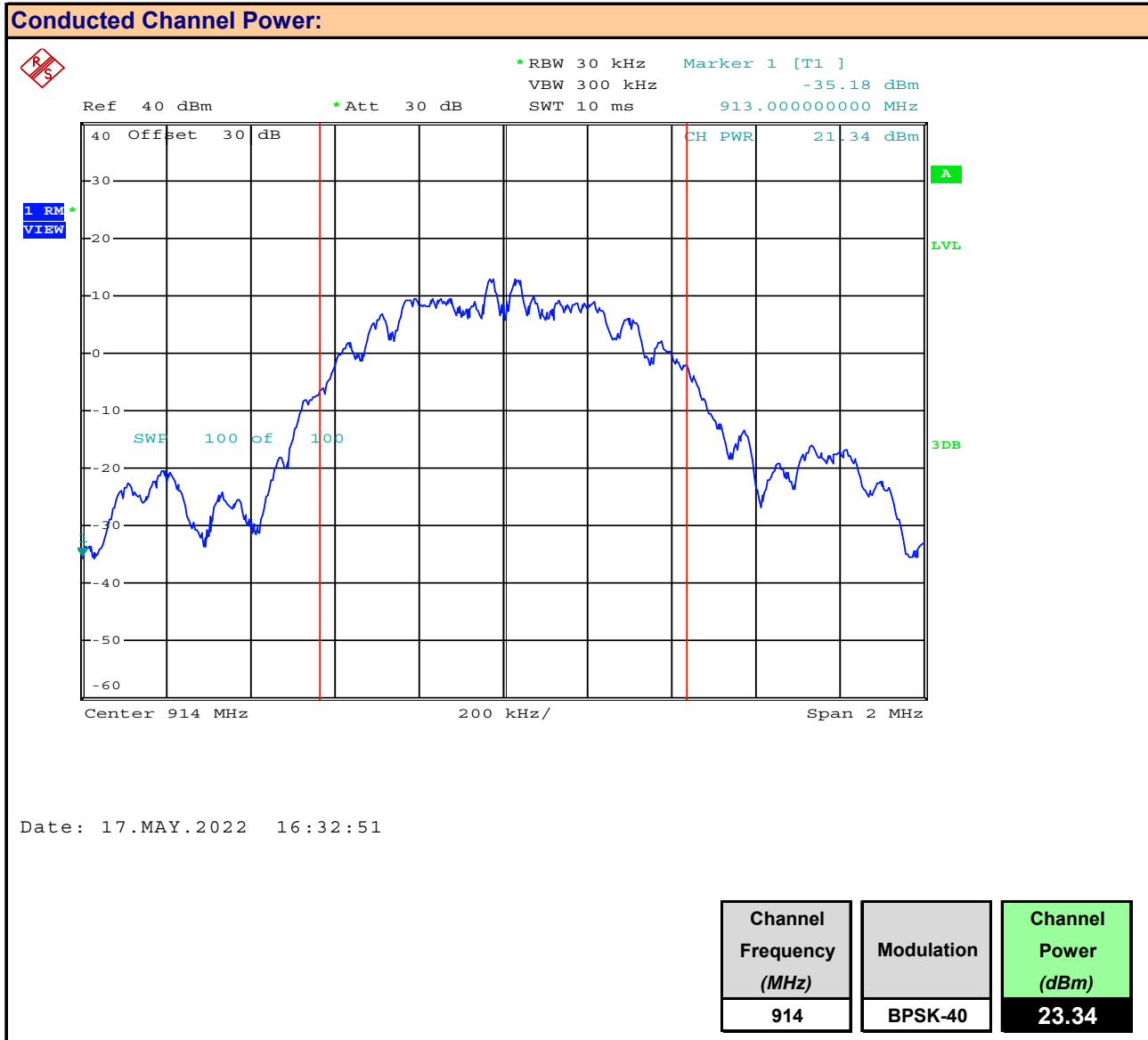
Test Setup	Appendix A - Figure A.1
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Measurement Procedure
<p>The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT’s antenna port. The SA was configured as described above. Number of Sweep Points \geq 2 X Span / RBW = 2 X (1.2MHz / 3kHz) = 800, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer’s highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Channel Bandwidth was set to the measured 99% Occupied Bandwidth (See Section 9.0). The Band Channel Power was measured and recorded.</p>

Plot 9.1 – Conducted Channel Power, 906 MHz



Plot 9.2 – Conducted Channel Power, 914 MHz



Plot 9.3 – Conducted Channel Power, 924 MHz

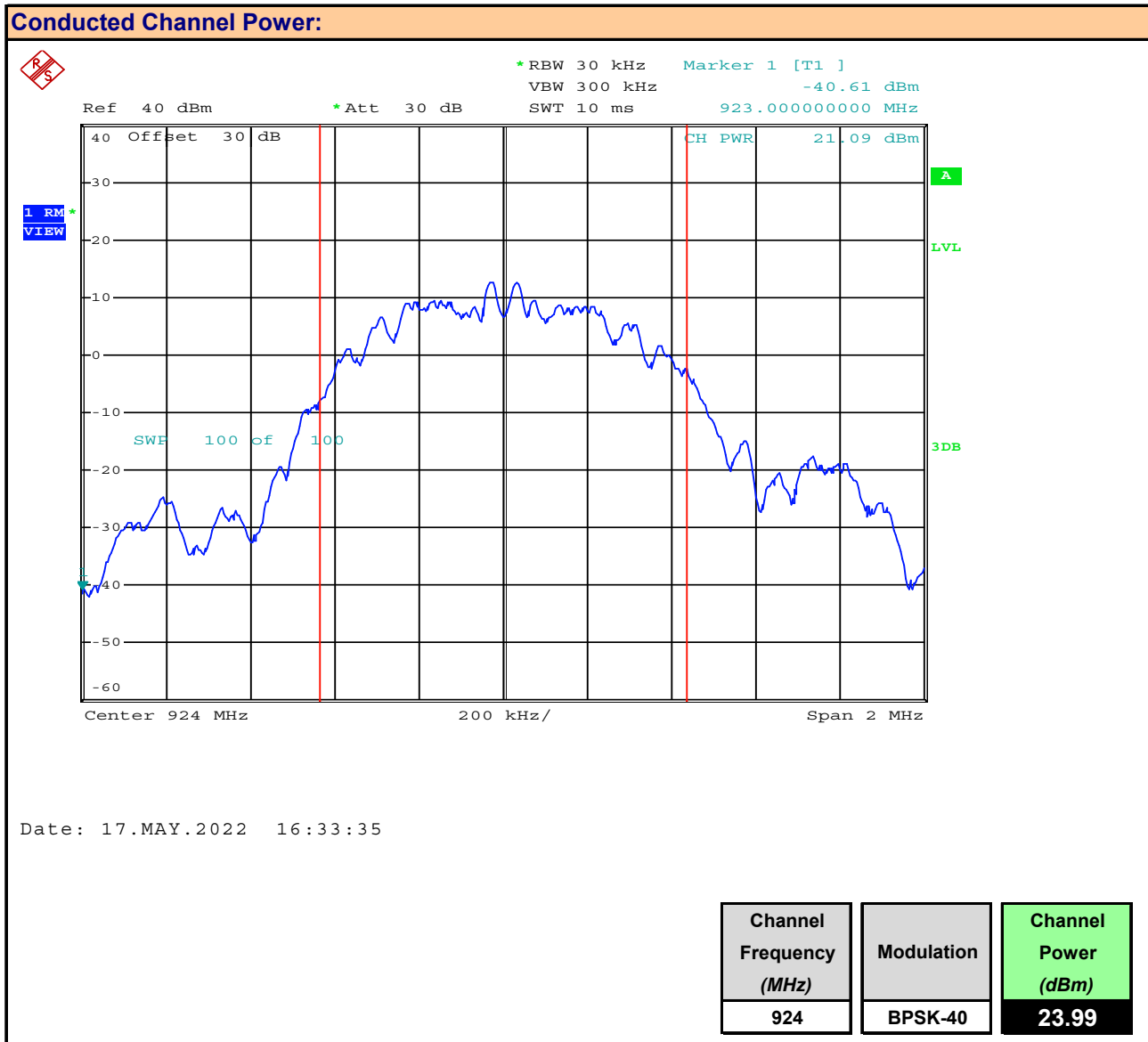


Table 9.1 – Summary of Conducted Channel Power Measurements

§15.247(b)(3), RSS-247 (5.4)(d) Channel Output Power (RMS)							
Frequency (MHz)	BW (kHz)	Modulation	Power Setting ⁽¹⁾ (dBm)	Measured Power [E _{Meas}] (dBm)	Measured Power [E _{Meas}] (W)	Limit (W)	Margin (dB)
906.0	549	BPSK-40	Max	23.56	0.23	1.0	6.4
914.0				23.44	0.22		6.6
924.0				23.99	0.25		6.0
Results:						Complies	

(1) The output power is factory set to maximum
 Margin = 10*Log(Limit / E_{meas})

RSS-247 (5.4)(d) Channel EIRP (RMS)										
Frequency (MHz)	BW (kHz)	Modulation	Power Setting ⁽¹⁾ (dBm)	Measured Power [E _{Meas}] (dBm)	Antenna Gain ⁽²⁾ [G _T] (dBi)	Cable Loss [L _C] (dB)	EIRP (dBm)	EIRP (W)	Limit (W)	Margin (dB)
906.0	549	BPSK-40	Max	23.56	1.59	0.5	25.65	0.37	4.0	10.4
914.0				23.44			25.53	0.36		10.5
924.0				23.99			26.08	0.41		9.9
Results:									Complies	

EIRP (dBm) = E_{Meas} + G_T + L_C

Margin = Limit - EIRP in dB

(1) The output power is factory set to maximum
 (2) Maximum permissible gain

10.0 POWER SPECTRAL DENSITY

Test Procedure

Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b), KDB 558074 (8.4), ANSI C63.10 (11.10.3)
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Limits	
47 CFR §15.247(e)	(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
RSS-247 (5.2)(b)	b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

General Procedure

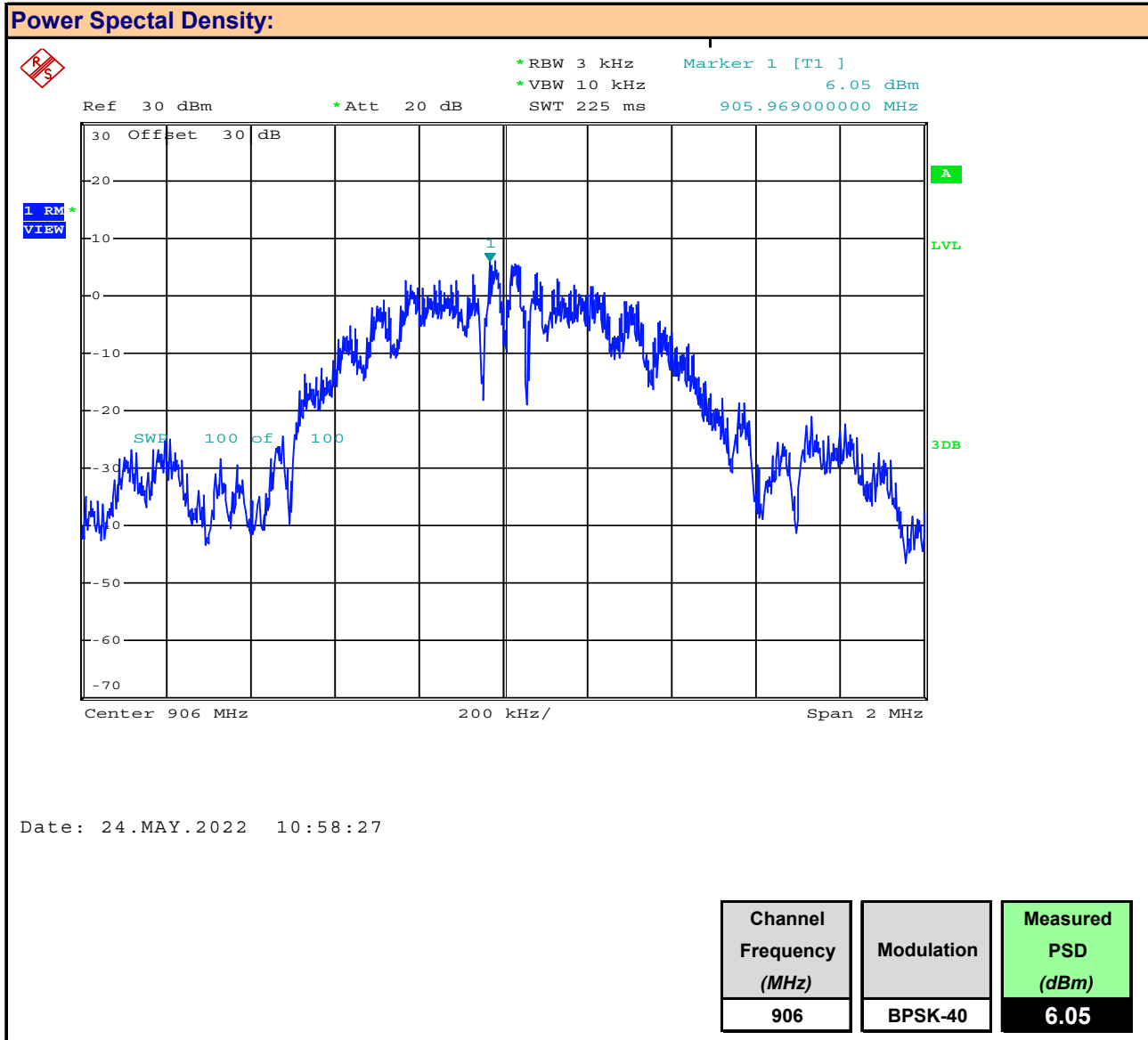
C63.10 (11.10.3)	<p>Method AVGPSD-1 (trace averaging with EUT transmitting at full power throughout each</p> <p>This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle $\geq 98\%$); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered).</p> <ol style="list-style-type: none"> Set instrument center frequency to DTS channel center frequency. Set span to at least 1.5 X OBW. Set RBW to: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$. Set VBW $\geq 3 \times \text{RBW}$. Detector = RMS Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span}/\text{RBW}$. Sweep time = auto couple. Employ trace averaging (RMS) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum amplitude level. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).
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Test Setup	Appendix A - Figure A.1
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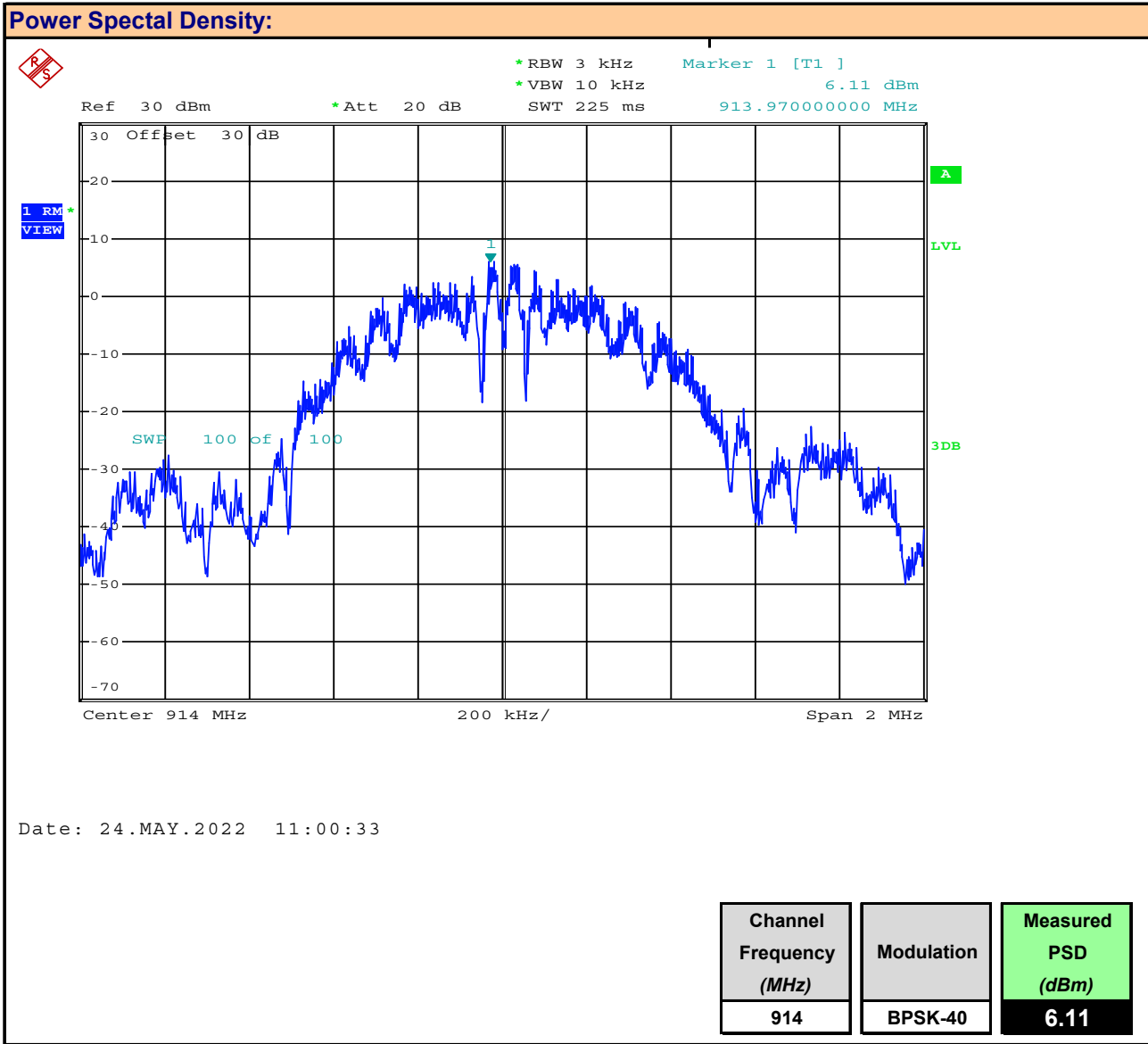
Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above. Number of Sweep Points $\geq 2 \times \text{Span} / \text{RBW} = 2 \times (1.5\text{MHz} / 3\text{kHz}) = 1000$, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Power Spectral Density was measured and recorded.

Plot 10.1 – Power Spectral Density, 906MHz



Plot 10.2 – Power Spectral Density, 914MHz



Plot 10.3 – Power Spectral Density, 924MHz

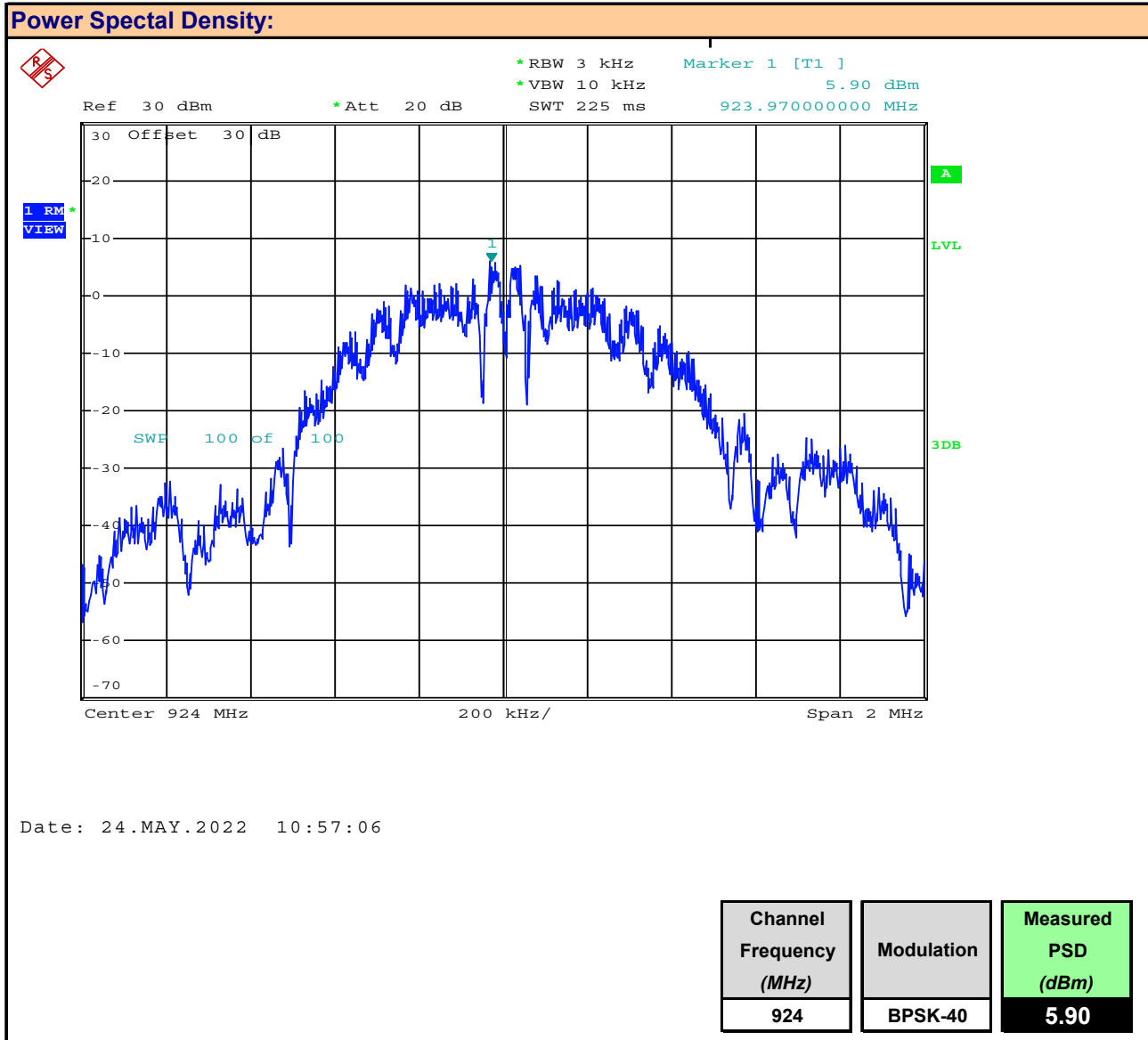


Table 10.1 – Summary of Power Spectral Density Measurements

Power Spectral Density Measurement Results: DTS				
Frequency (MHz)	Modulation	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Conducted Margin (dB)
906.0	BPSK-40	6.05	8	2.0
914.0		6.11	8	1.9
924.0		5.90	8	2.1
Result:			Complies	

$$\text{Margin} = P_{\text{Limit}} - P_{\text{Meas}}$$

11.0 CONDUCTED SPURIOUS EMISSIONS – BAND EDGE

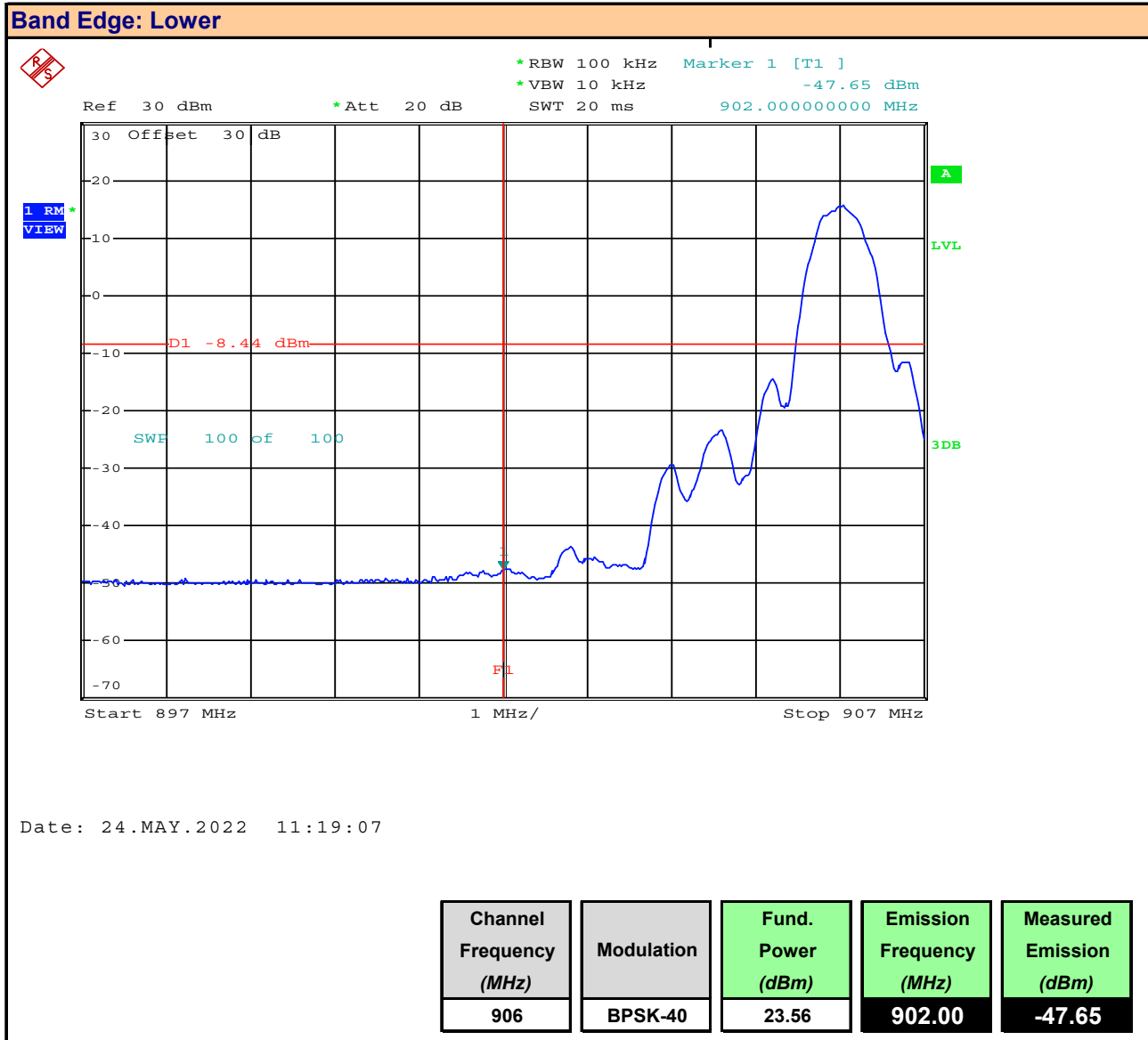
Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (8.7), ANSI C63.10 (11.13.3.3)
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Limits

47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.
RSS-247 (5.5)	<p>5.5 Unwanted emissions</p> <p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.</p> <p>d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).</p> <p>As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.</p>

Plot 11.1 – Spurious Emission Measurement, Lower Band Edge



Plot 11.2 – Spurious Emission Measurement, Upper Band Edge

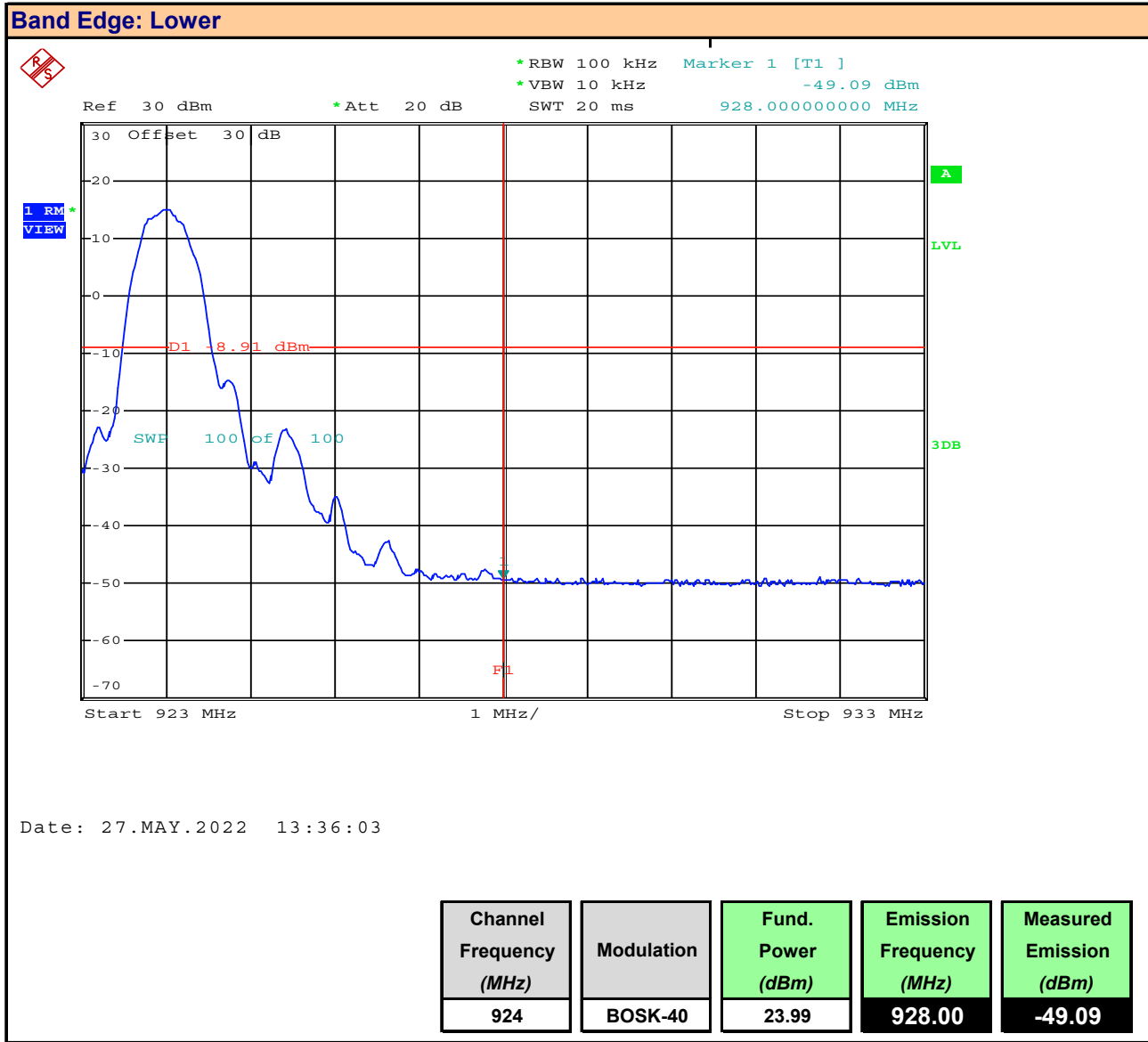


Table 11.1 – Summary of Conducted Spurious Emissions (Band Edge) Measurements

Unwanted Emissions Measurement Results: Band Edge							
Frequency (MHz)	Modulation	Fundamental Power [P _{Fund}] (dBm)	Emission Frequency (MHz)	Measured Emission [P _{Meas}] (dBm)	Attenuation [Att] (dBm)	Limit (dB)	Margin (dB)
906.0	BPSK-40	23.56	902.0	-47.65	71.21	30.0	41.2
924.0		23.99	928.0	-49.09	73.08		43.1
Result:							Complies

Attenuation [Att] = Fundamental Power [P_{f_{und}}] - Measured Emission [P_{meas}]

Margin = [Att] - Limit

12.0 CONDUCTED SPURIOUS EMISSIONS

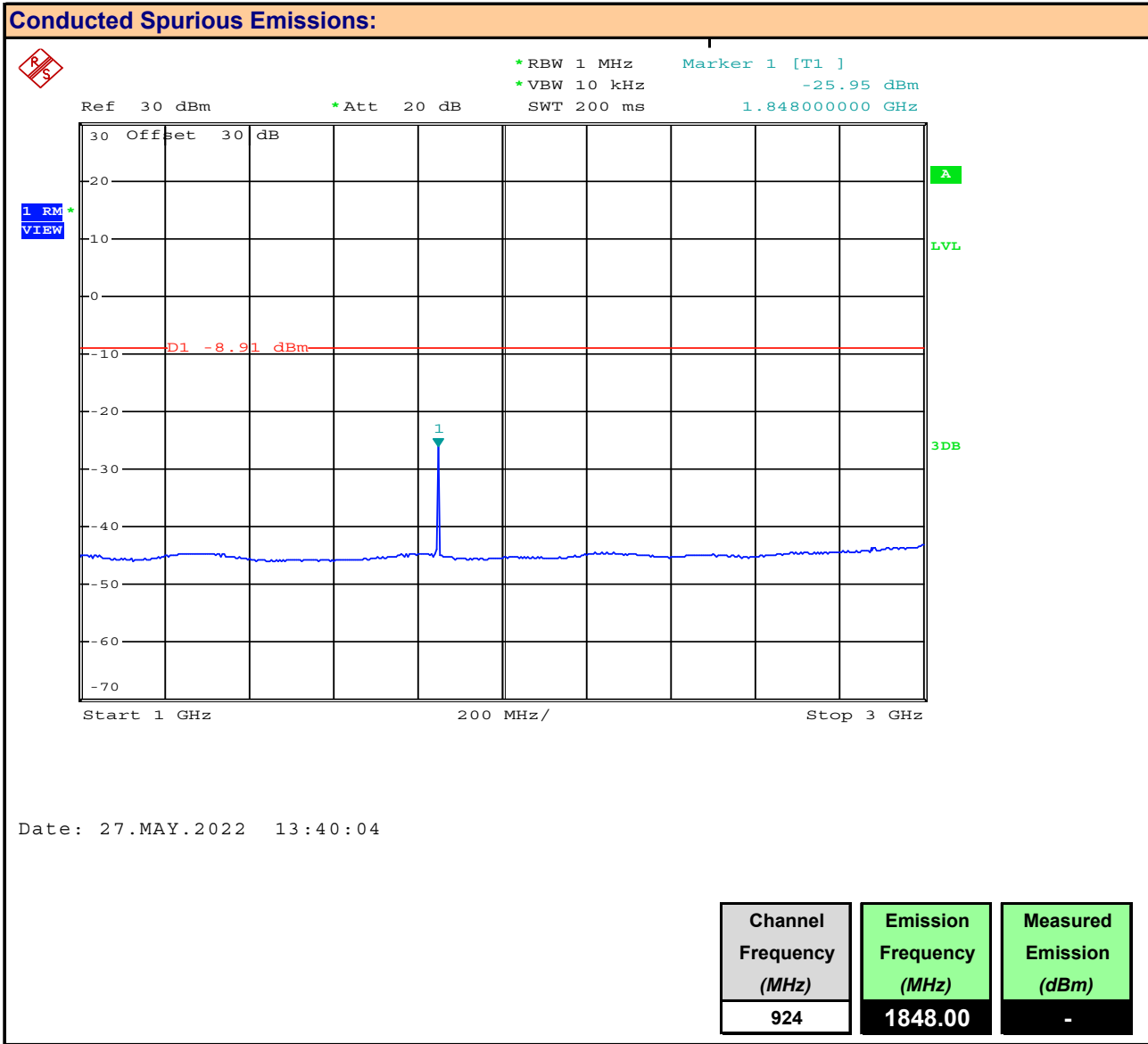
Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (8.7), ANSI C63.10 (11.13.3.3)
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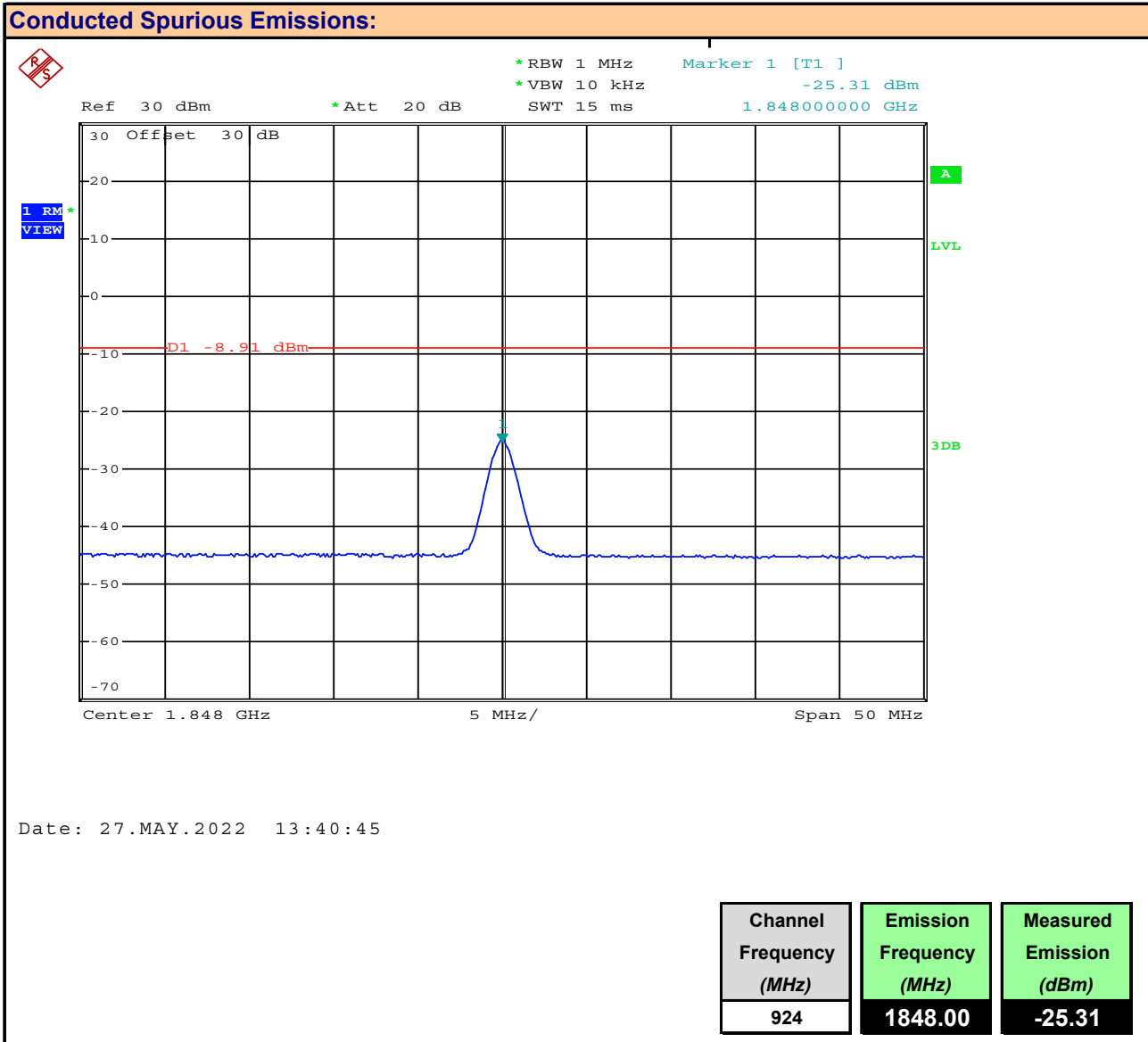
Limits

47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.
RSS-247 (5.5)	<p>5.5 Unwanted emissions</p> <p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.</p> <p>d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).</p> <p>As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.</p>

Plot 12.2 – Conducted Spurious Emissions, 1000 – 3000MHz



Plot 12.3 – Conducted Spurious Emissions, 1848MHz



Plot 12.4 – Conducted Spurious Emissions, 3 – 10GHz

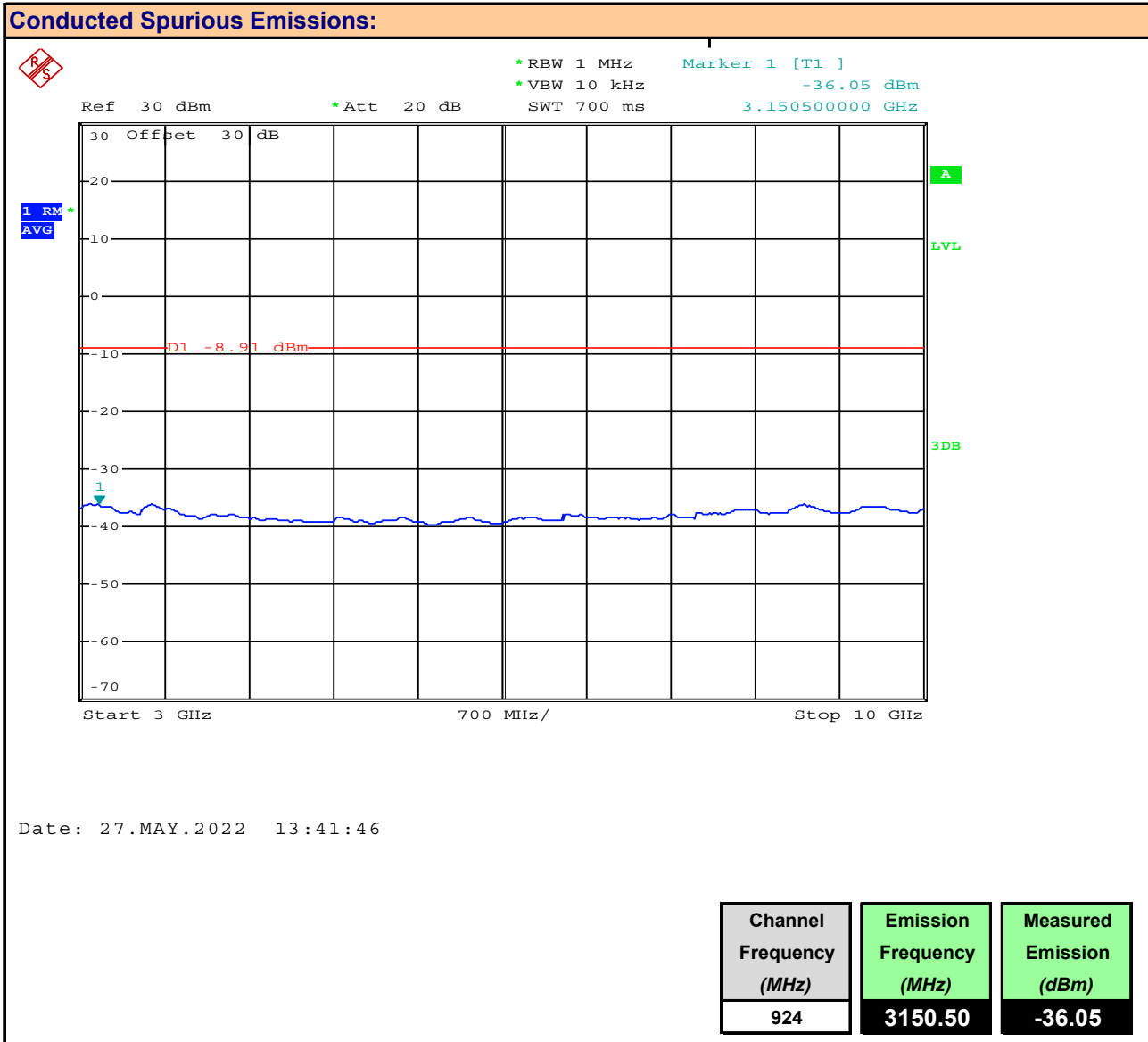


Table 12.1 – Summary of Conducted Spurious Emissions Measurements

Conducted Spurious Emissions Measurement Results:						
Frequen cy (MHz)	Fundamental Power [P_{Fund}] (dBm)	Emission Frequency (MHz)	Measured Emission [P_{Meas}] (dBm)	Attenuation [Att] (dBm)	Limit (dB)	Margin (dB)
924.0	23.99	939.3	-48.35	72.34	30.0	42.3
		1848.0	-25.34	49.33		19.3
		3150.5	-36.05	60.04		30.0
						Complies

13.0 RADIATED TX EMISSIONS – RESTRICTED BAND

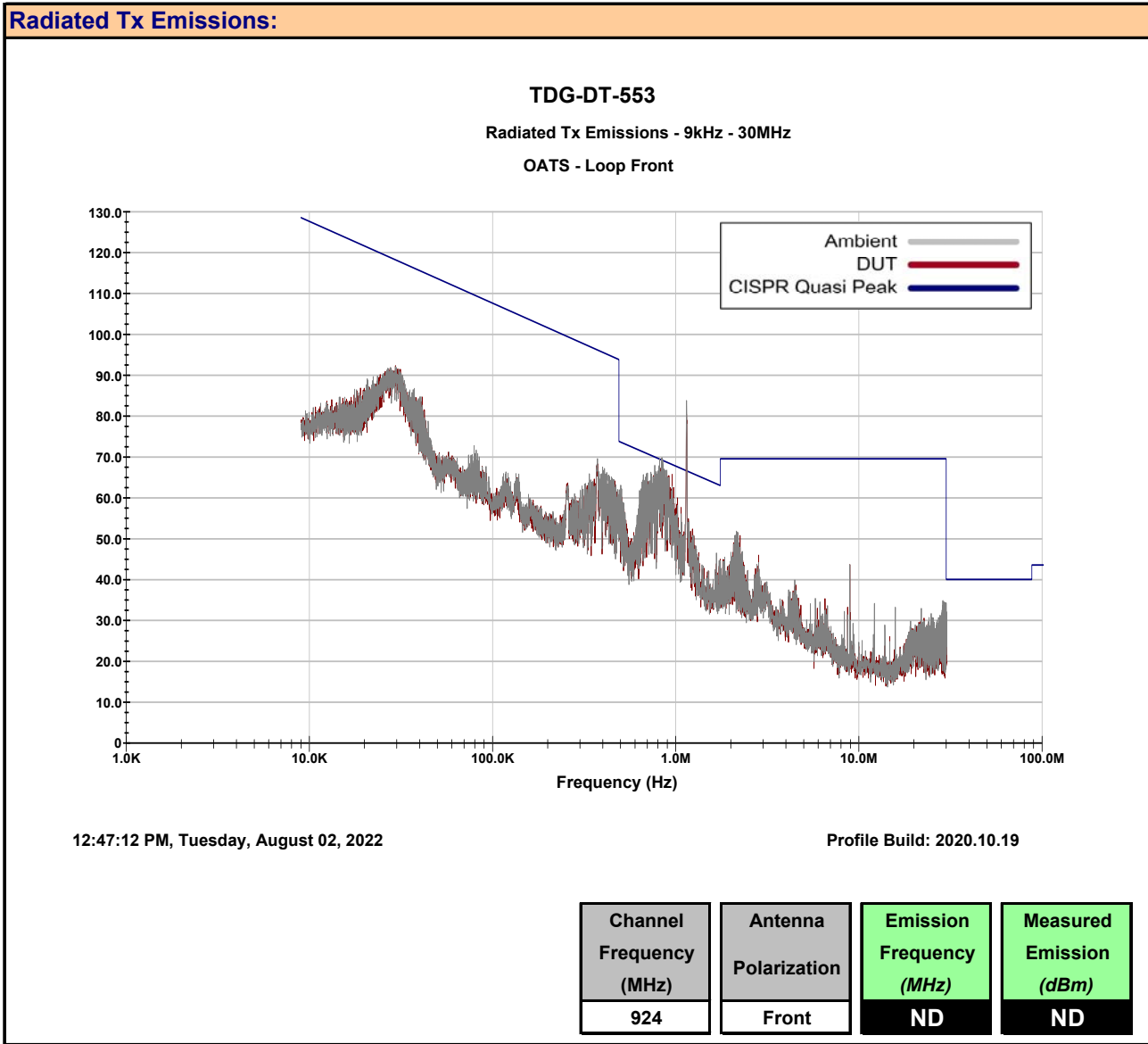
Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits

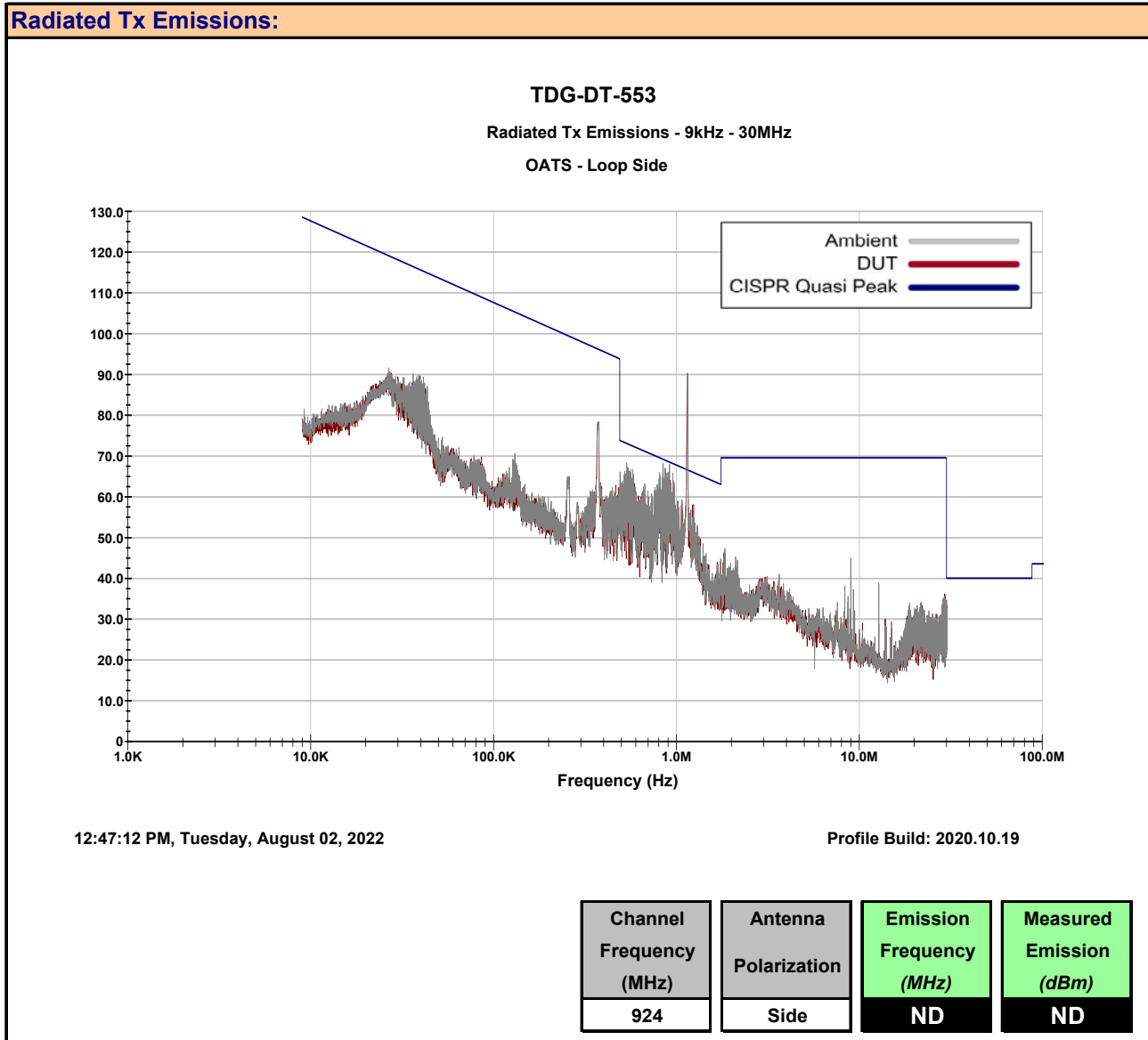
47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).																
47 CFR §15.209(a)	<p>§15.209 Radiated emission limits; general requirements.</p> <p>(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:</p> <table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Field Strength (microvolts/meter)</th> </tr> </thead> <tbody> <tr> <td>0.009 - 0.490</td> <td>2400/F (kHz) @300m</td> </tr> <tr> <td>0.490 - 1.705</td> <td>24000/F (kHz) @30m</td> </tr> <tr> <td>1.705 - 30</td> <td>30 @ 30m</td> </tr> <tr> <td>30 - 88</td> <td>100 @3m</td> </tr> <tr> <td>88 - 216</td> <td>150 @3m</td> </tr> <tr> <td>216 - 960</td> <td>200 @3m</td> </tr> <tr> <td>Above 960</td> <td>500 @3m</td> </tr> </tbody> </table>	Frequency (MHz)	Field Strength (microvolts/meter)	0.009 - 0.490	2400/F (kHz) @300m	0.490 - 1.705	24000/F (kHz) @30m	1.705 - 30	30 @ 30m	30 - 88	100 @3m	88 - 216	150 @3m	216 - 960	200 @3m	Above 960	500 @3m
Frequency (MHz)	Field Strength (microvolts/meter)																
0.009 - 0.490	2400/F (kHz) @300m																
0.490 - 1.705	24000/F (kHz) @30m																
1.705 - 30	30 @ 30m																
30 - 88	100 @3m																
88 - 216	150 @3m																
216 - 960	200 @3m																
Above 960	500 @3m																

Plot 13.1 – Radiated Tx Emissions, 9kHz to 30MHz, Front



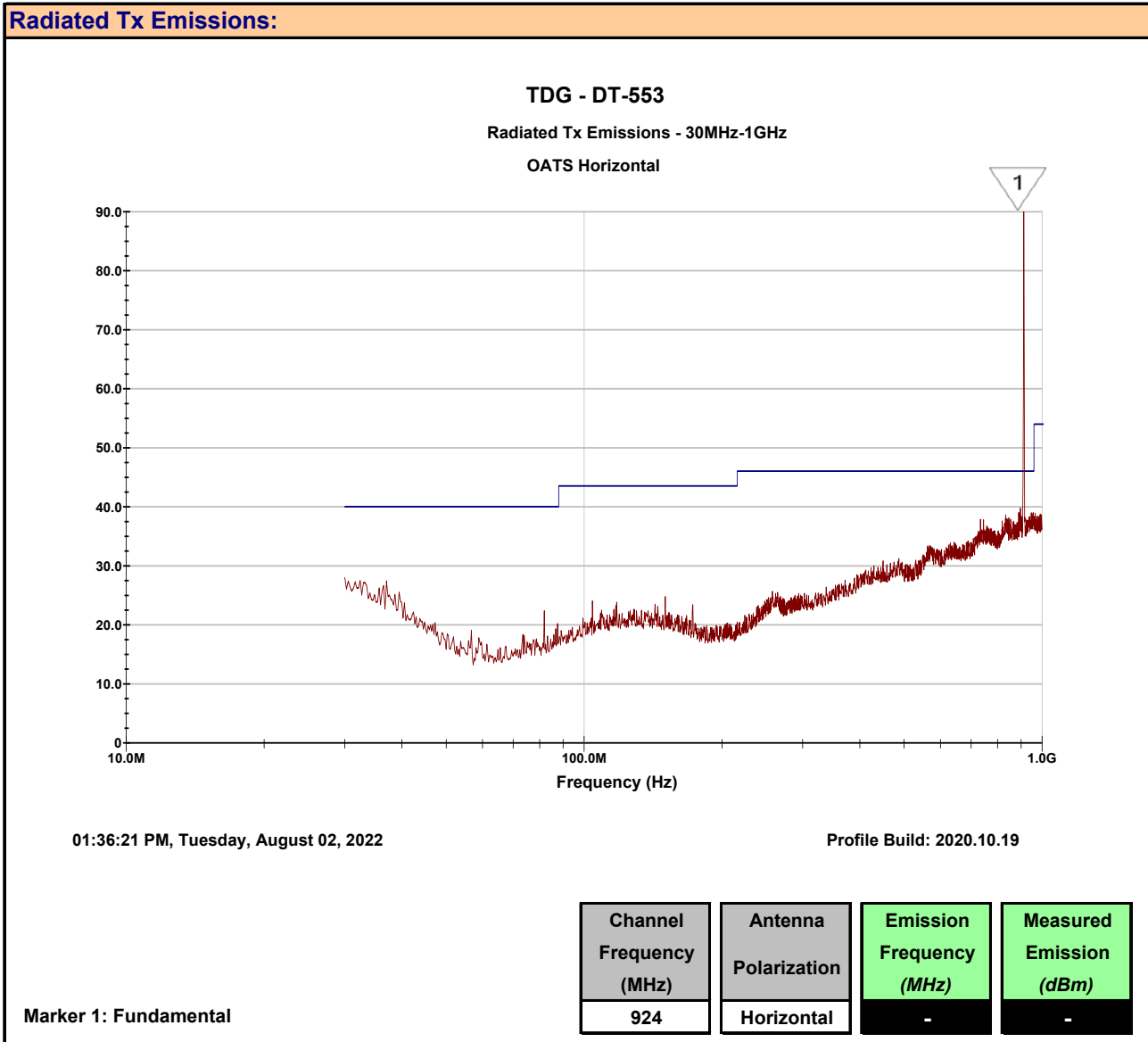
Note:
 Gray Trace (Foreground) = Ambient
 Red Trace (Background) = Ambient + DUT

Plot 13.2 – Radiated Tx Emissions, 9kHz to 30MHz, Side

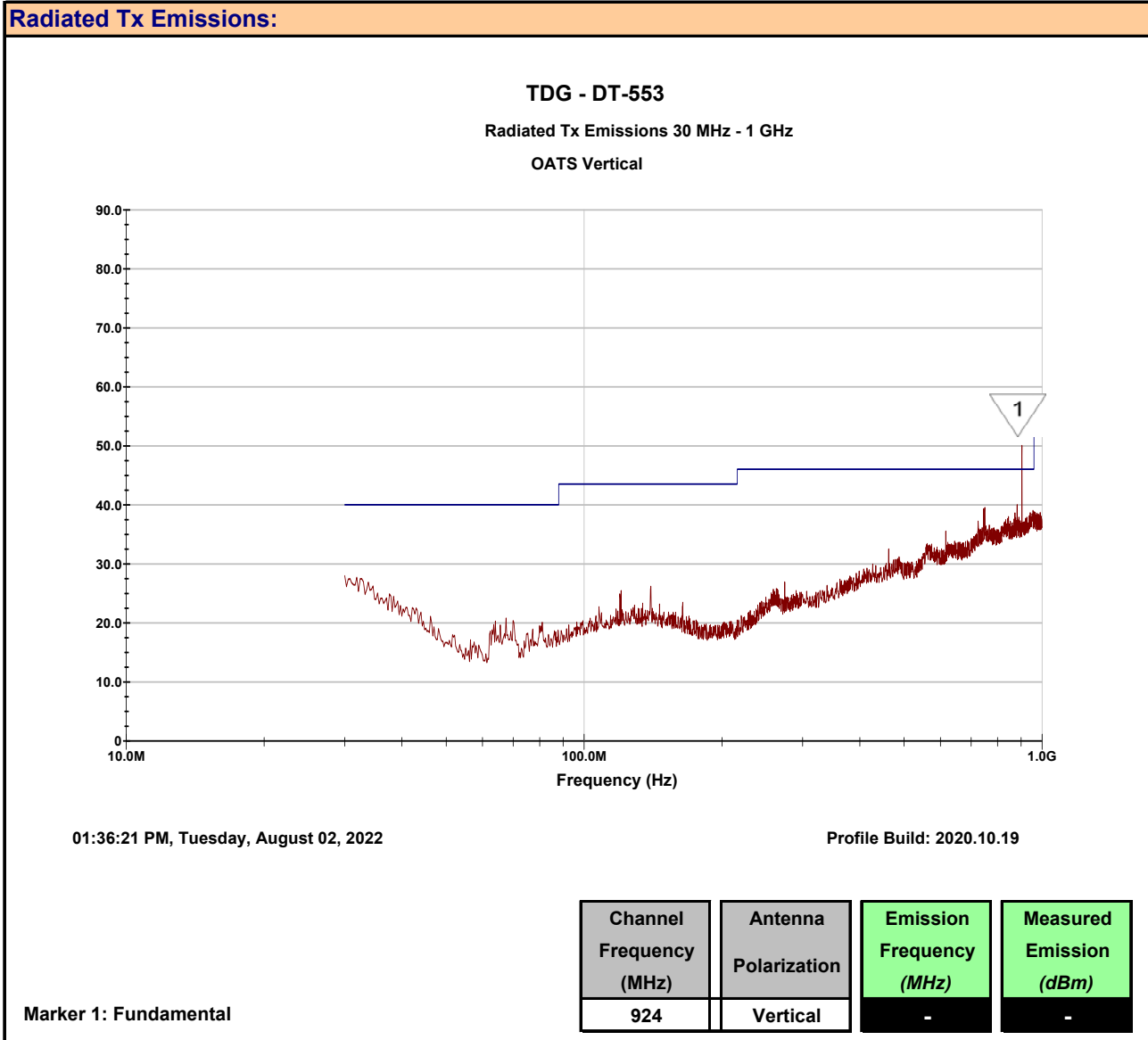


Note:
Gray Trace (Foreground) = Ambient
Red Trace (Background) = Ambient + DUT

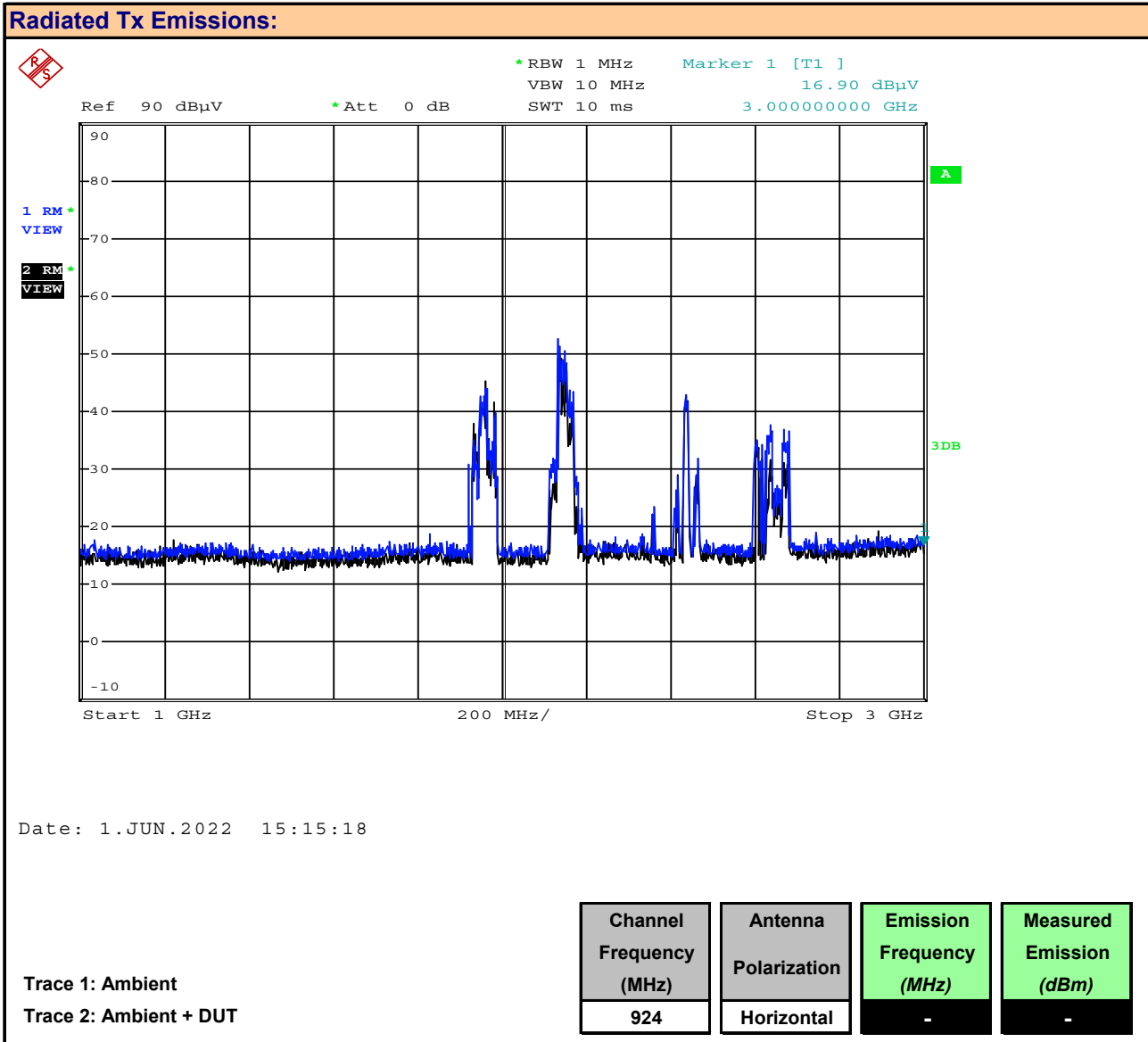
Plot 13.3 – Radiated Tx Emissions, 30 to 1000MHz, Horizontal



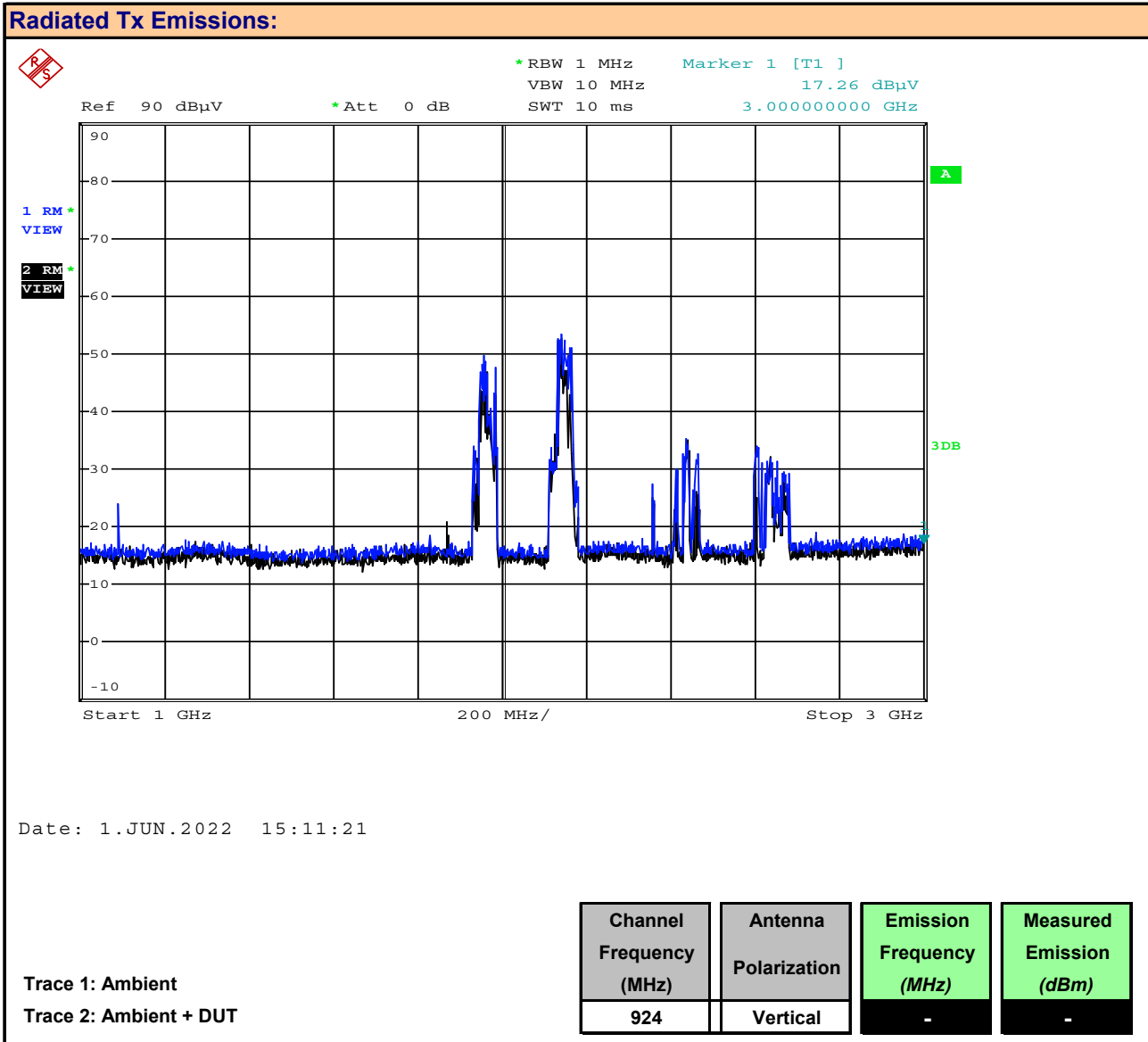
Plot 13.4 – Radiated Tx Emissions, 30 to 1000MHz, Vertical



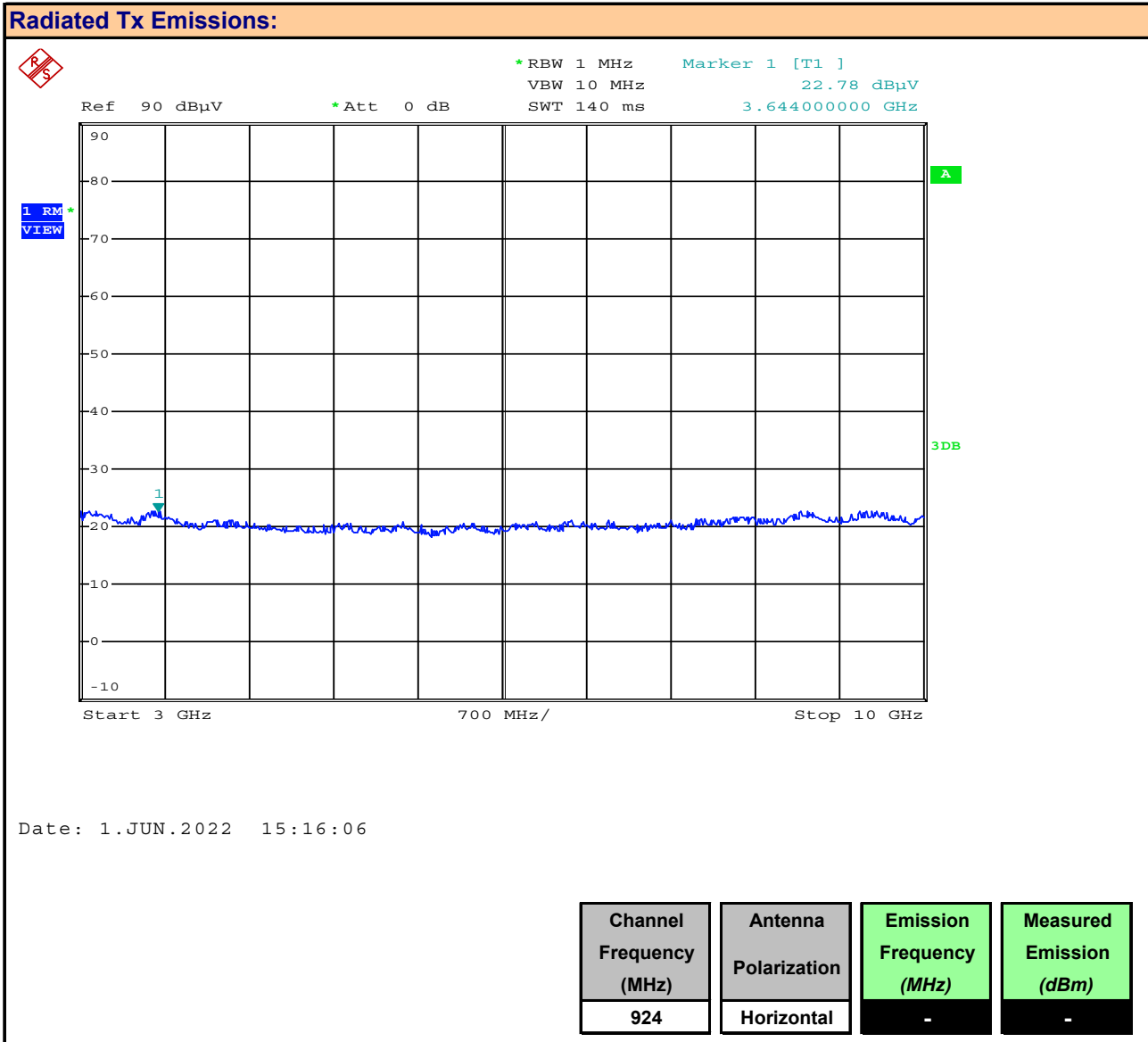
Plot 13.5 – Radiated Tx Emissions, 1 to 3GHz, Horizontal



Plot 13.6 – Radiated Tx Emissions, 1 to 3GHz, Vertical



Plot 13.7 – Radiated Tx Emissions, 3 to 10GHz, Horizontal



Plot 13.8 – Radiated Tx Emissions, 3 to 10GHz, Vertical

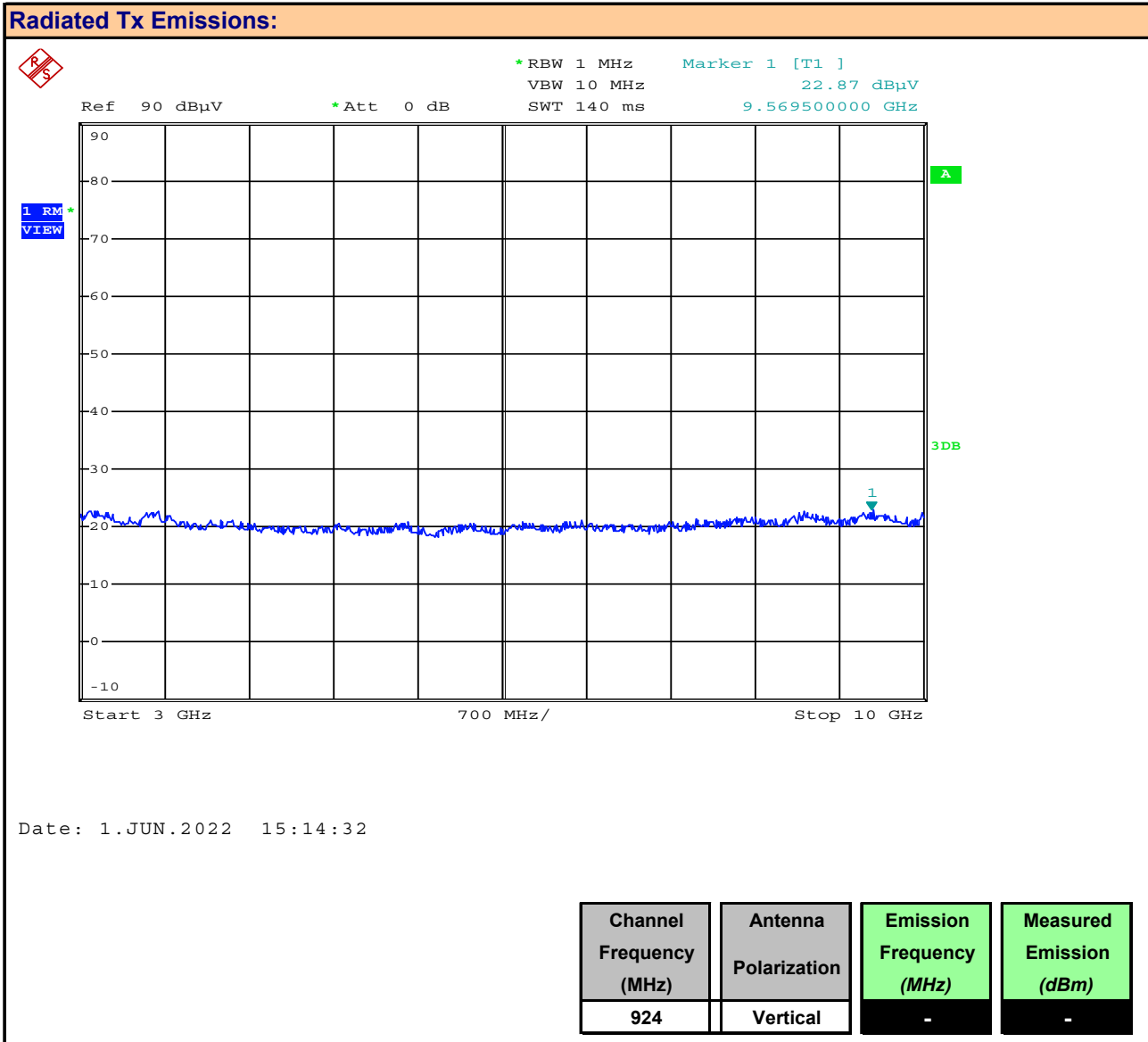


Table 13.1 – Summary of Radiated Tx Measurements

Summary of Radiated Tx Emissions												
Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _c] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)		
9kHz - 30MHz	924.000	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
9kHz - 30MHz		Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
30-1000MHz		Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
30-1000MHz		Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
1-3GHz		Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
1-3GHz		Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
3-10GHz		Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
3-10GHz		Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a		
Results:									Complies			

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$$

Where ACF^E is the Electric Antenna Correction Factor

14.0 RADIATED RX EMISSIONS

Test Procedure

Normative Reference	FCC 47 CFR §15.109, ICES-003(6.2) ANSI C63.4-2014
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Limits

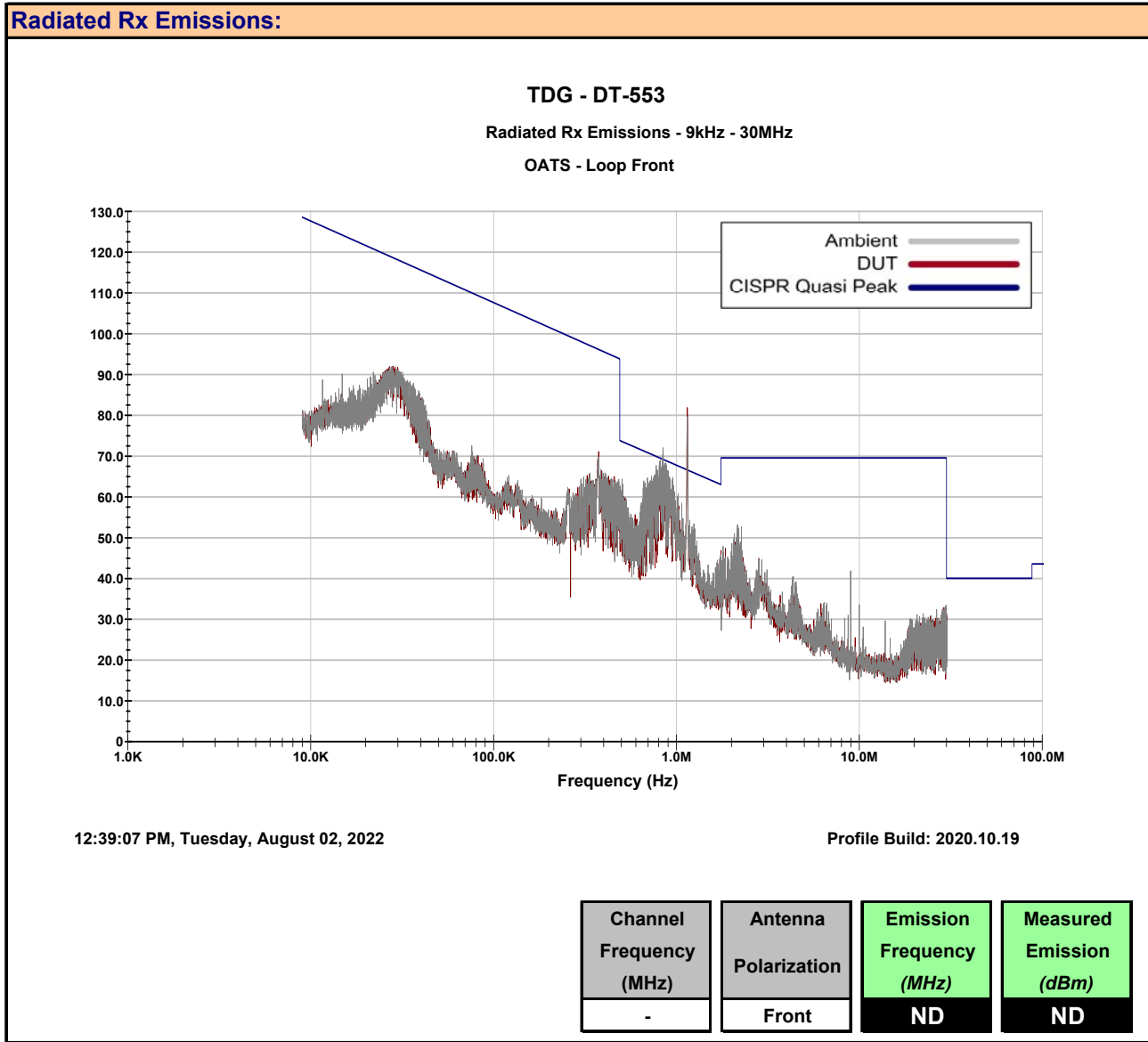
47 CFR §15.109	(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following: <table border="1"> <tr> <td>30-88MHz: 39.1dBuV/m</td> <td>30-88MHz: 49.6dBuV/m @ 3m</td> </tr> <tr> <td>88-216MHz: 43.5dBuV/m</td> <td>88-216MHz: 54.0dBuV/m @ 3m</td> </tr> <tr> <td>216-960MHz: 46.4dBuV/m</td> <td>216-960MHz: 56.9dBuV/m @ 3m</td> </tr> <tr> <td>> 960MHz: 49.5dBuV/m</td> <td>> 960MHz: 60.0dBuV/m @ 3m</td> </tr> </table>	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m
30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m								
88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m								
216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m								
> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m								
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class A: ITE that meets the conditions for Class A operation defined in Section 2.2 shall comply with the Class A radiated limits set out in Table 4 determined at a distance of 10 metres. <table border="1"> <tr> <td>30-88MHz: 39.1dBuV/m</td> <td>30-88MHz: 49.6dBuV/m @ 3m</td> </tr> <tr> <td>88-216MHz: 43.5dBuV/m</td> <td>88-216MHz: 54.0dBuV/m @ 3m</td> </tr> <tr> <td>216-960MHz: 46.4dBuV/m</td> <td>216-960MHz: 56.9dBuV/m @ 3m</td> </tr> <tr> <td>> 960MHz: 49.5dBuV/m</td> <td>> 960MHz: 60.0dBuV/m @ 3m</td> </tr> </table>	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m
30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m								
88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m								
216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m								
> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m								

Test Setup	Appendix A	Figure A.1
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Measurement Procedure

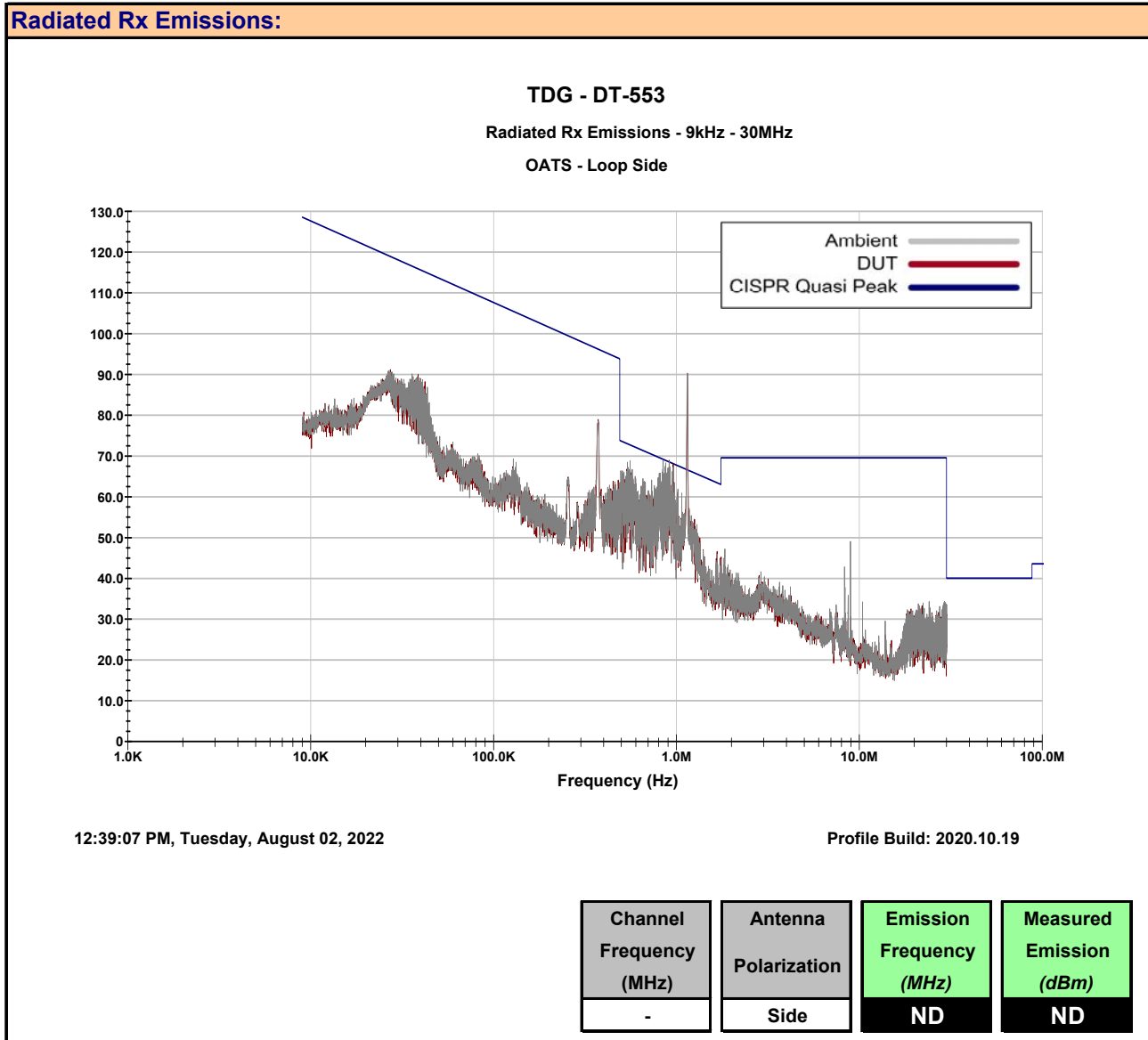
The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.

Plot 14.1 – Radiated Rx Emissions, 9kHz to 30MHz, Front



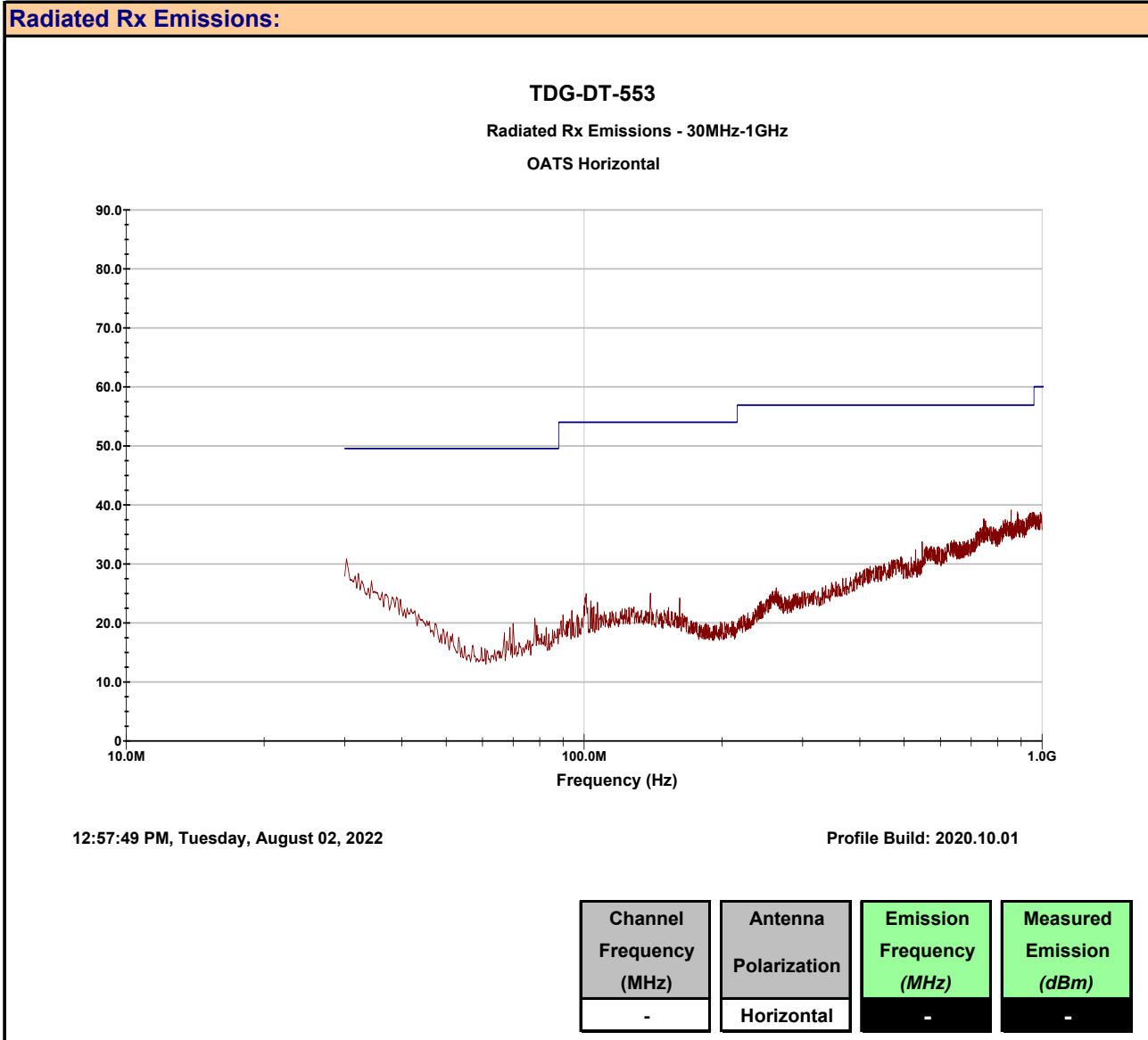
Note:
 Gray Trace (Foreground) = Ambient
 Red Trace (Background) = Ambient + DUT

Plot 14.2 – Radiated Rx Emissions, 9kHz to 30MHz, Side

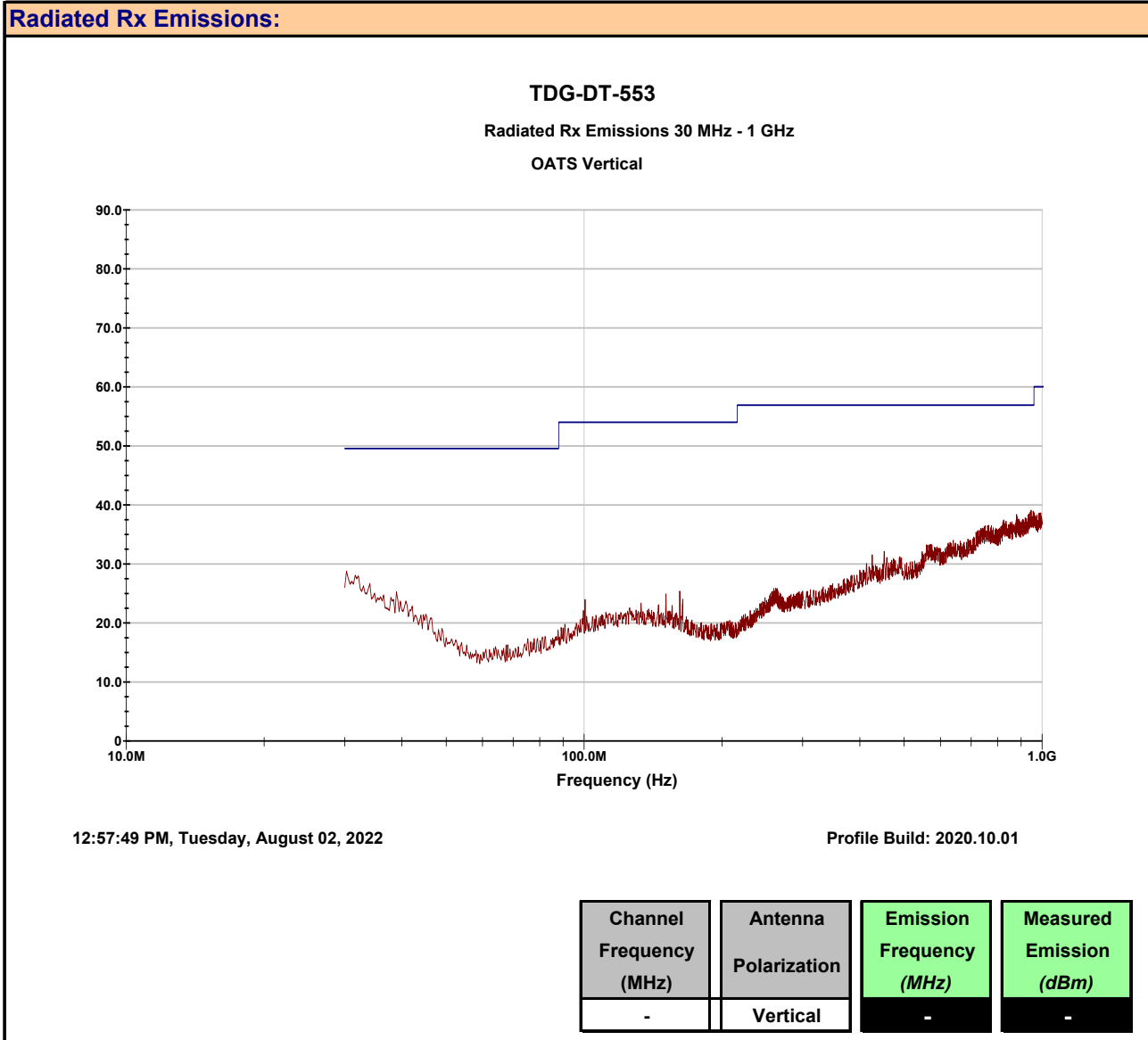


Note:
Gray Trace (Foreground) = Ambient
Red Trace (Background) = Ambient + DUT

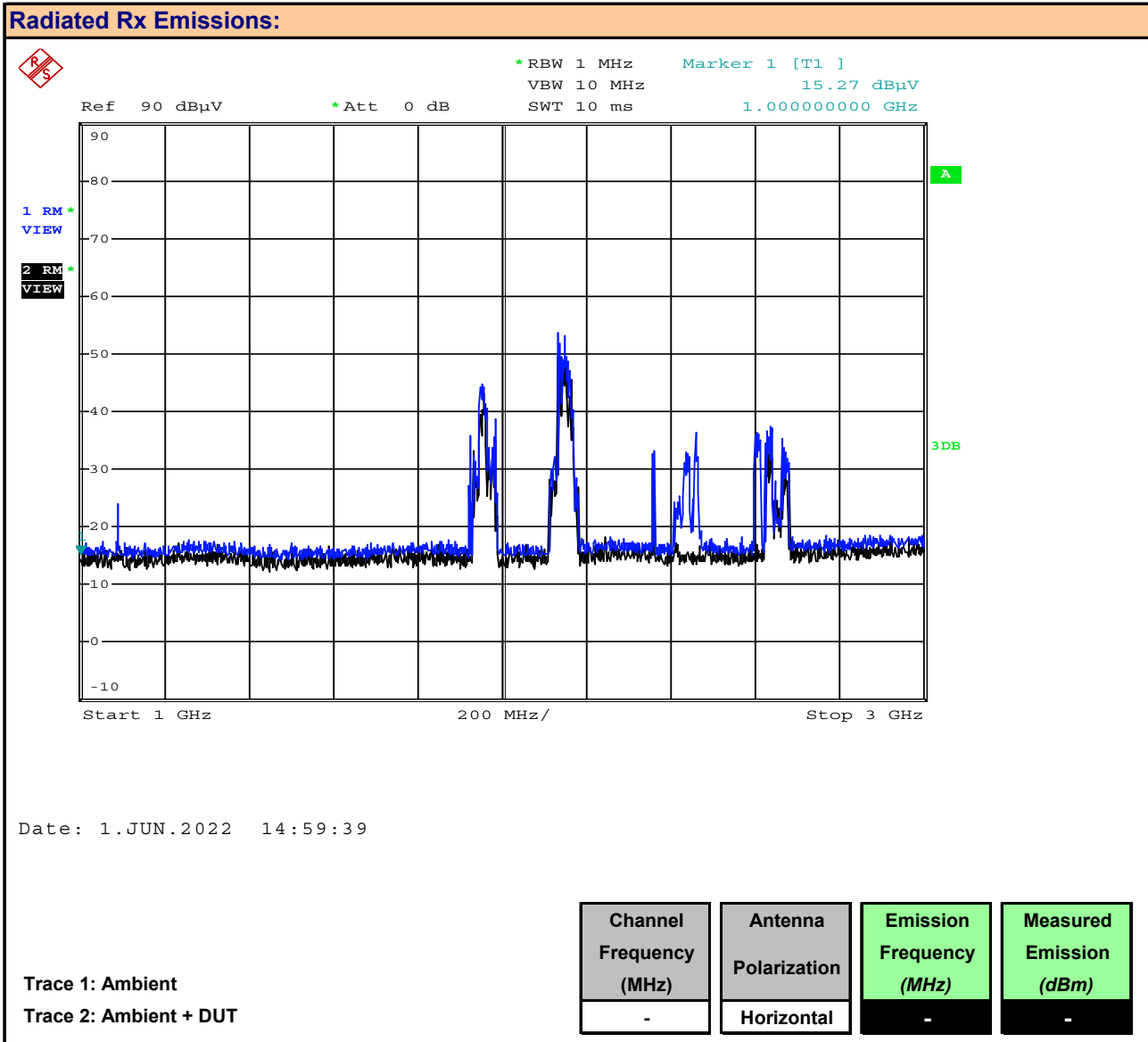
Plot 14.3 – Radiated Rx Emissions, 30 to 1000MHz, Horizontal



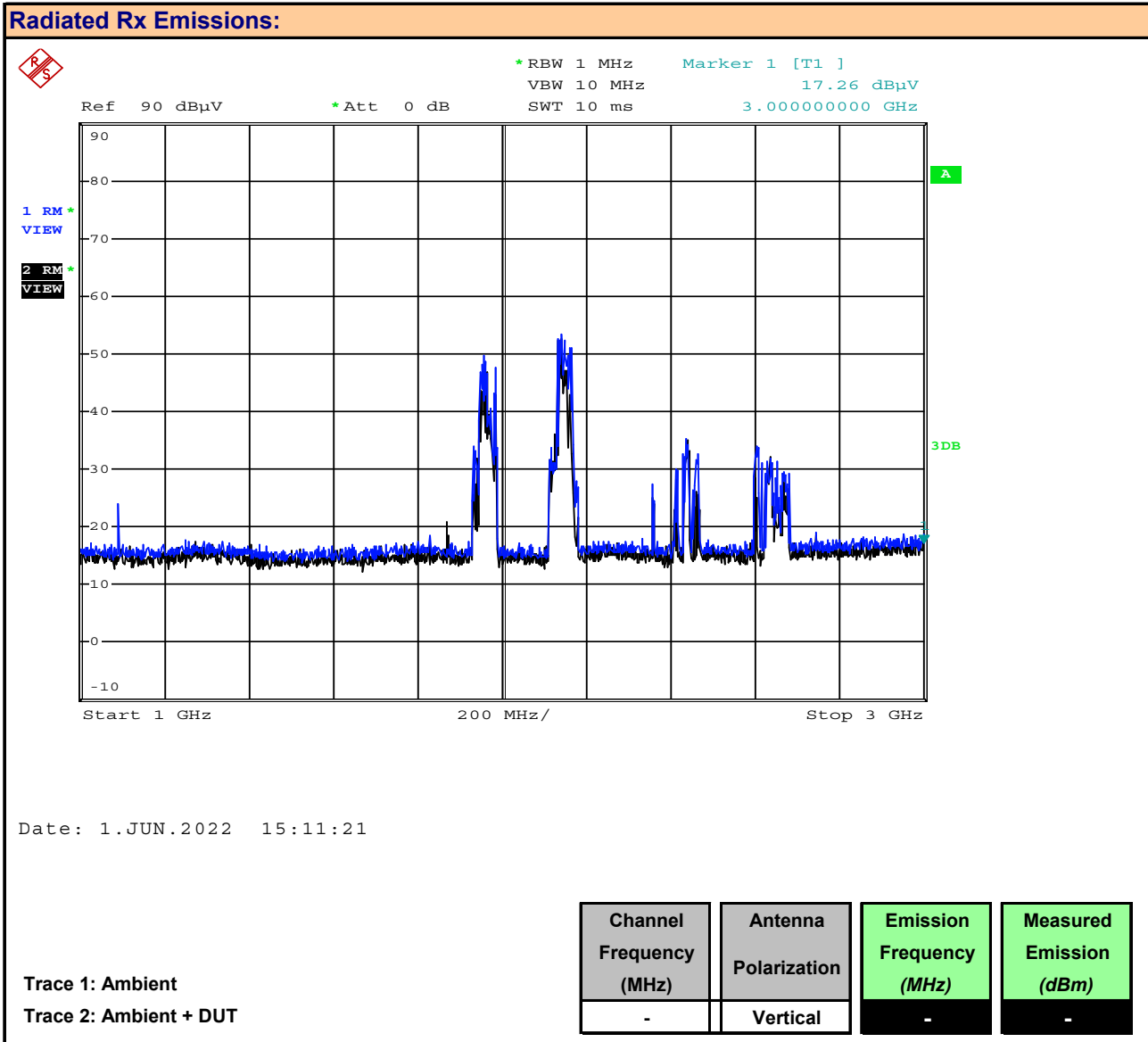
Plot 14.4 – Radiated Rx Emissions, 30 to 1000MHz, Vertical



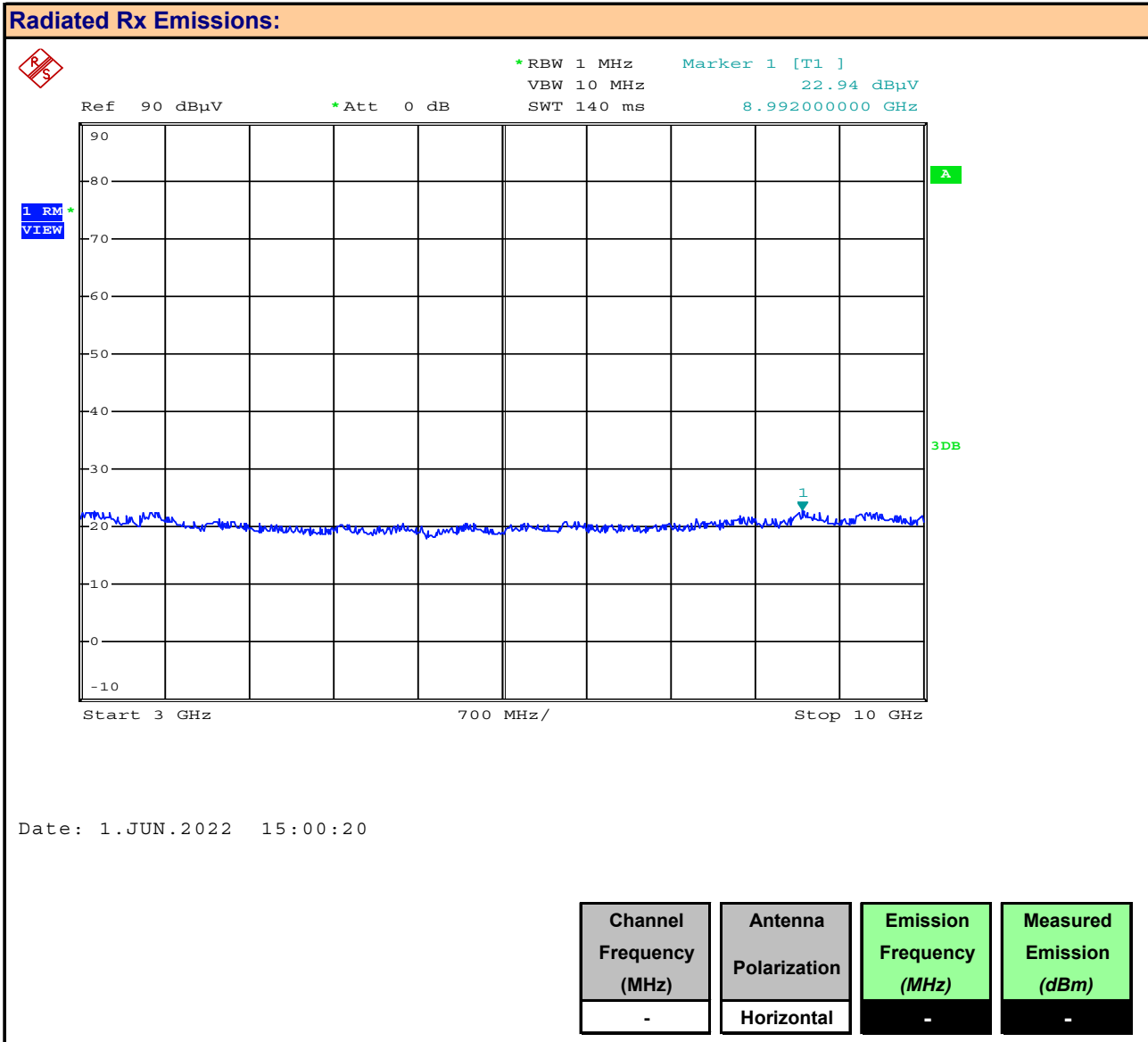
Plot 14.5 – Radiated Rx Emissions, 1 to 3GHz, Horizontal



Plot 14.6 – Radiated Rx Emissions, 1 to 3GHz, Vertical



Plot 14.7 – Radiated Rx Emissions, 3 to 10GHz, Horizontal



Plot 14.8 – Radiated Rx Emissions, 3 to 10GHz, Vertical

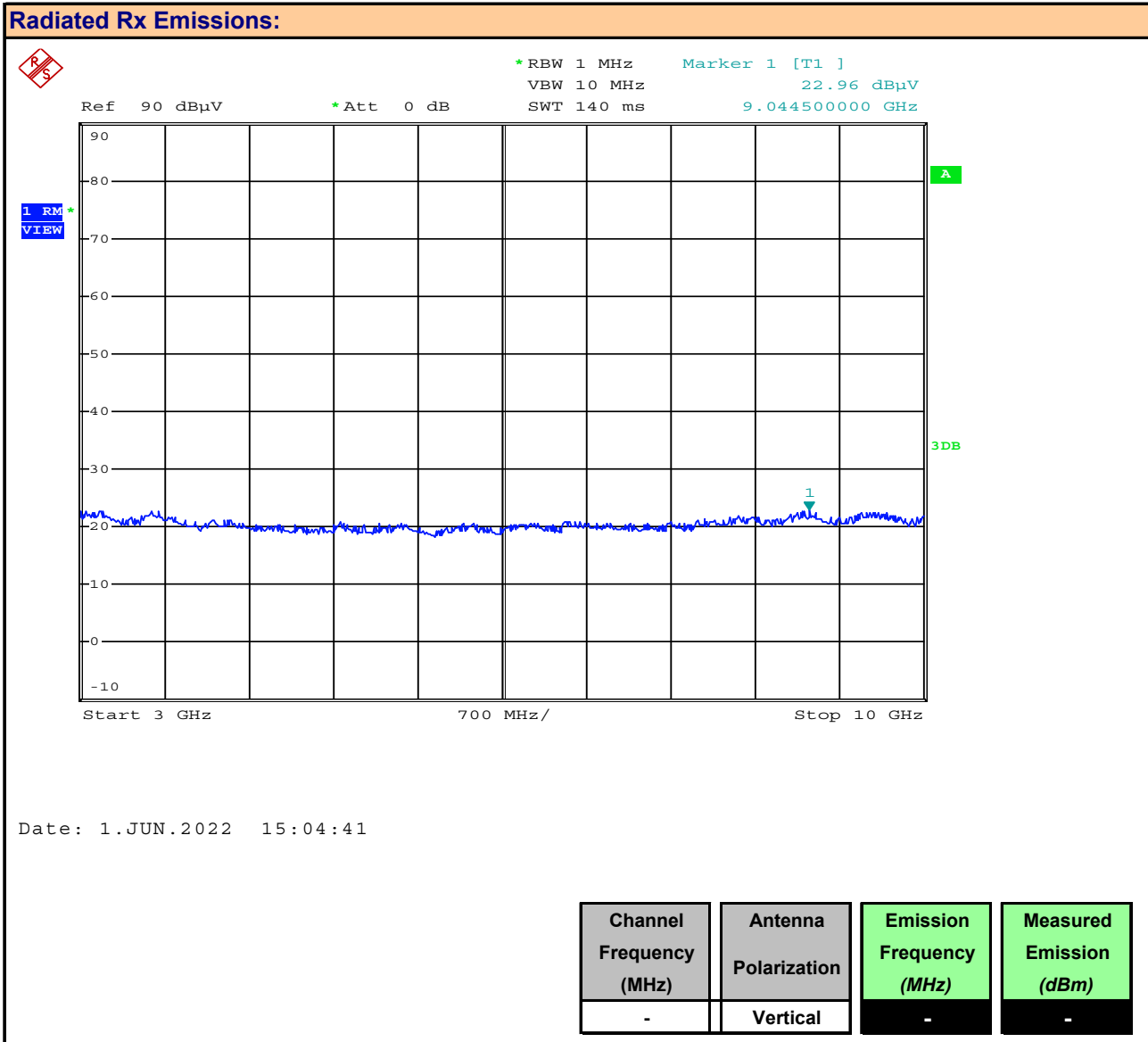


Table 14.1 – Summary of Radiated Rx Measurements

Summary of Radiated Rx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
9kHz - 30MHz	-	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
9kHz - 30MHz	-	Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
1-3GHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
1-3GHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
3-10GHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
3-10GHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
Results:									Complies		

- (1) No Emissions Detected (ND) above ambient or within 20dB of the limit
- (2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
- (3) External Amplifier not used

$$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$$

Where ACF^E is the Electric Antenna Correction Factor

15.0 LINE CONDUCTED EMISSIONS

Test Procedure

Normative Reference	FCC 47 CFR §15.107, ICES-003(6.1) ANSI C63.4-2014
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Limits

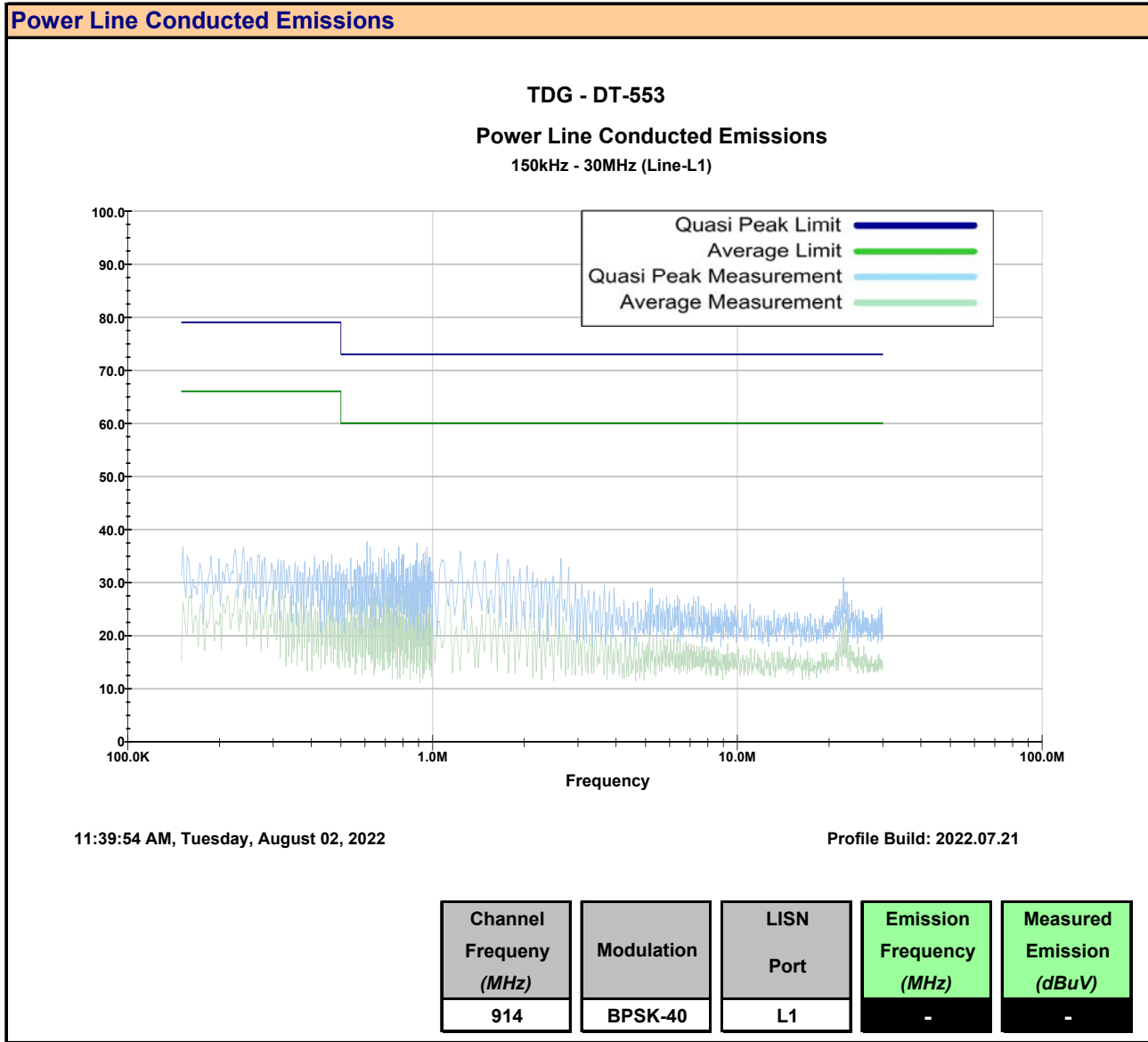
47 CFR §15.107	(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges. 0.15 - 0.5 MHz: 79 dBuV Quasi Peak, 66 dBuV Average 0.5 - 30.0 MHz: 73 dBuV Quasi Peak, 60 dBuV Average
ICES-003(6.1)	6.1 - AC Power Line Conducted Emissions Limits Class A: ITE that meets the conditions for Class A operation defined in Section 2.2 shall comply with the Class A conducted limits set out below in Table 1. 0.15 - 0.5 MHz: 79 dBuV Quasi Peak, 66 dBuV Average 0.5 - 30.0 MHz: 73 dBuV Quasi Peak, 60 dBuV Average

Test Setup	Appendix A	Figure A.1
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Measurement Procedure

The device was connected to the LISN as shown in Appendix A. The input power supply was connected to a 208VAC, 1PH power source. The AC Line Conducted emissions were measured from 150kHz to 30MHz on both Lines L1 and L2 while the DUT was set to maximum output power.

Plot 15.1 – Power Line Conducted Emissions, L1



Plot 15.2 – Power Line Conducted Emissions, L2

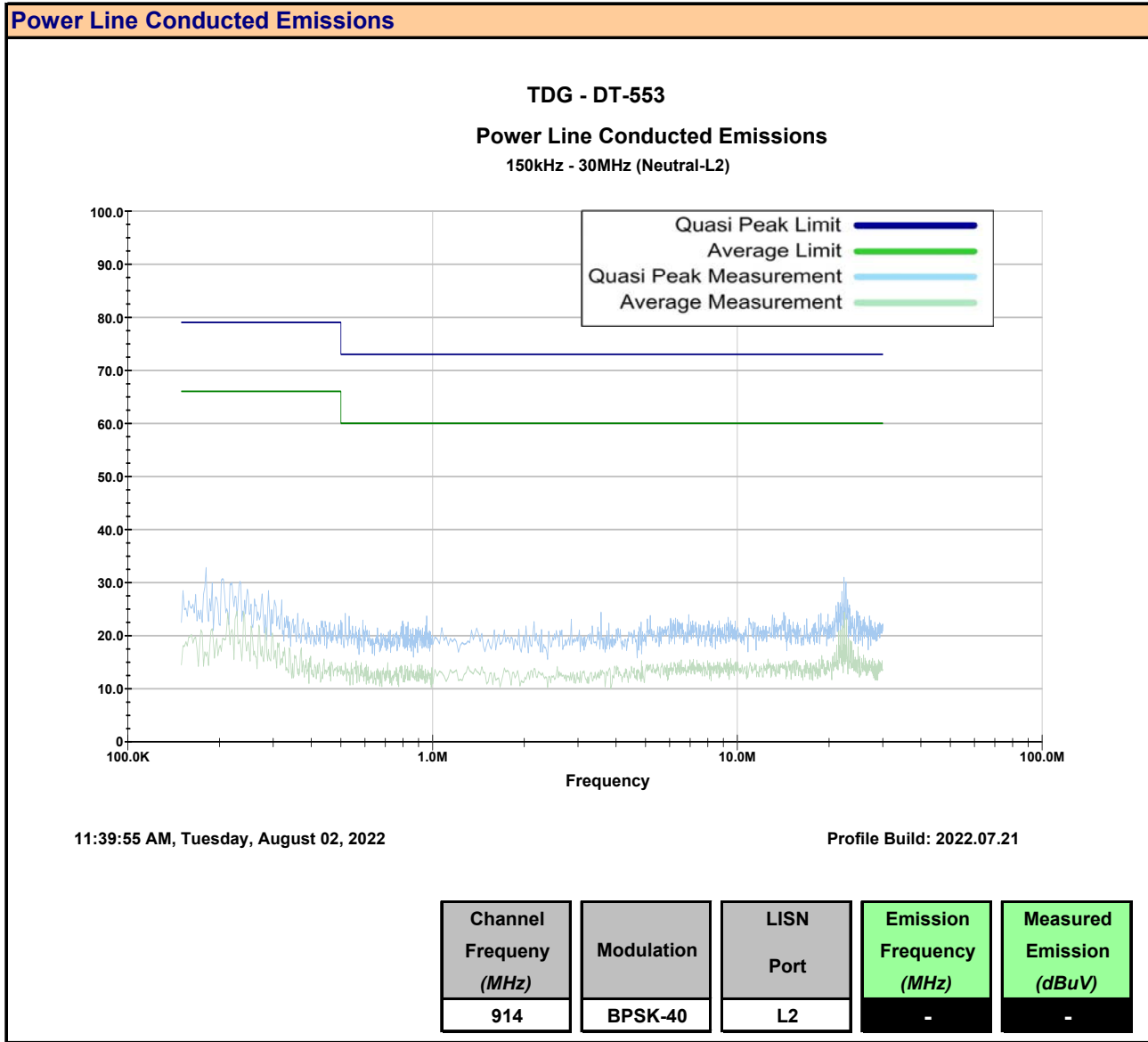


Table 15.1 – Summary of Power Line Conducted Measurements

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	914.0	L1	- kHz	ND	Peak	0.40	0.25	0.00 (3)	ND (2)	-	-
			- kHz	ND	Average	0.40	0.26		ND (2)	-	-
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ (2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
 (3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{corr}$$

ND = No Emissions Detected within 20dB of the Limit

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	914.0	L2	- kHz	ND	Peak	0.40	0.25	0.00 (3)	ND (2)	-	-
			- kHz	ND	Average	0.40	0.26		ND (2)	-	-
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ (2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
 (3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{corr}$$

ND = No Emissions Detected within 20dB of the Limit

APPENDIX A – TEST SETUP DRAWINGS

Table A.1 – Conducted Measurement Setup

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00241	R&S	F5U40	Spectrum Analyzer

Figure A.1 – Test Setup – Conducted Measurements

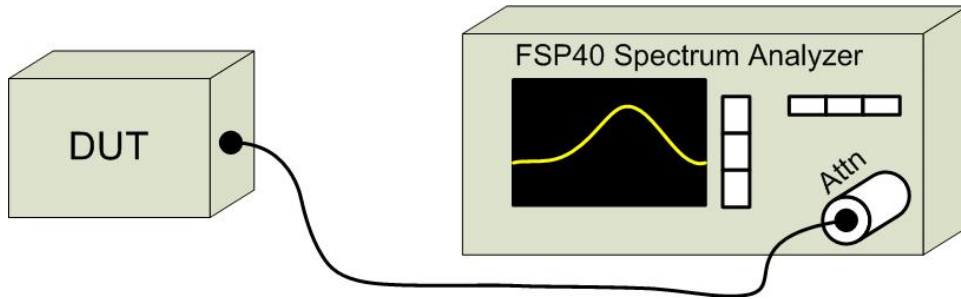


Table A.2 – Radiated Emissions Measurement Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00051	HP	8566B	Spectrum Analyzer
00049	HP	85650A	Quasi-peak Adapter
00047	HP	85685A	RF Preselector
00072	EMCO	2075	Mini-mast
00073	EMCO	2080	Turn Table
00071	EMCO	2090	Multi-Device Controller
00265	Miteq	JS32-00104000-58-5P	Microwave L/N Amplifier
00241	R&S	FSU40	Spectrum Analyzer
00050	Chase	CBL-6111A	Bilog Antenna
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00034	ETS	3115	Double Ridged Guide Horn
00085	EMCO	6502	Loop Antenna

Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz

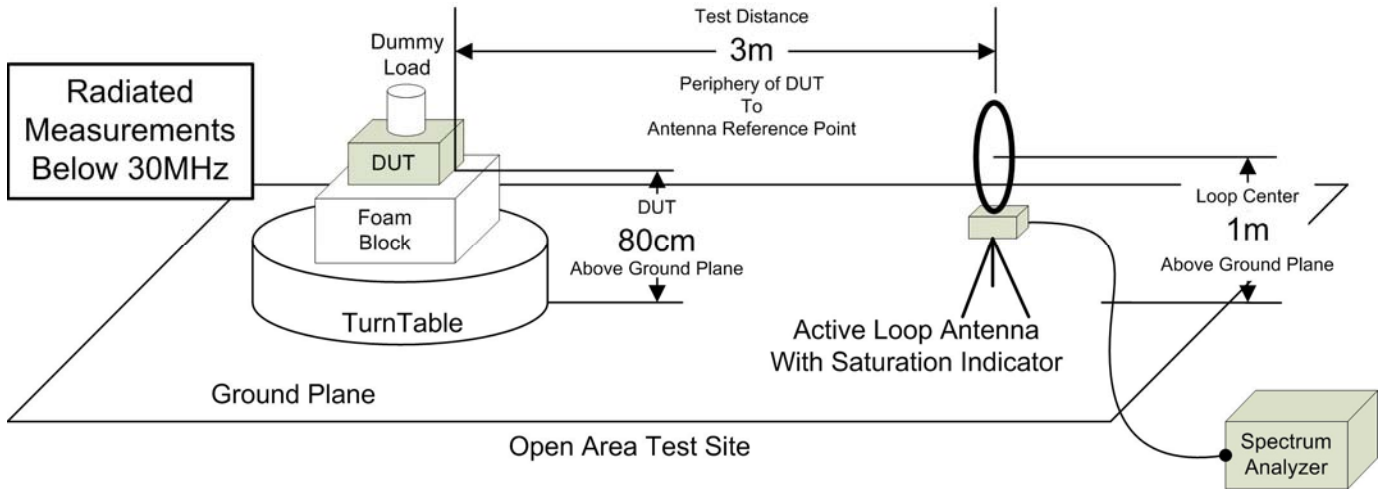


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

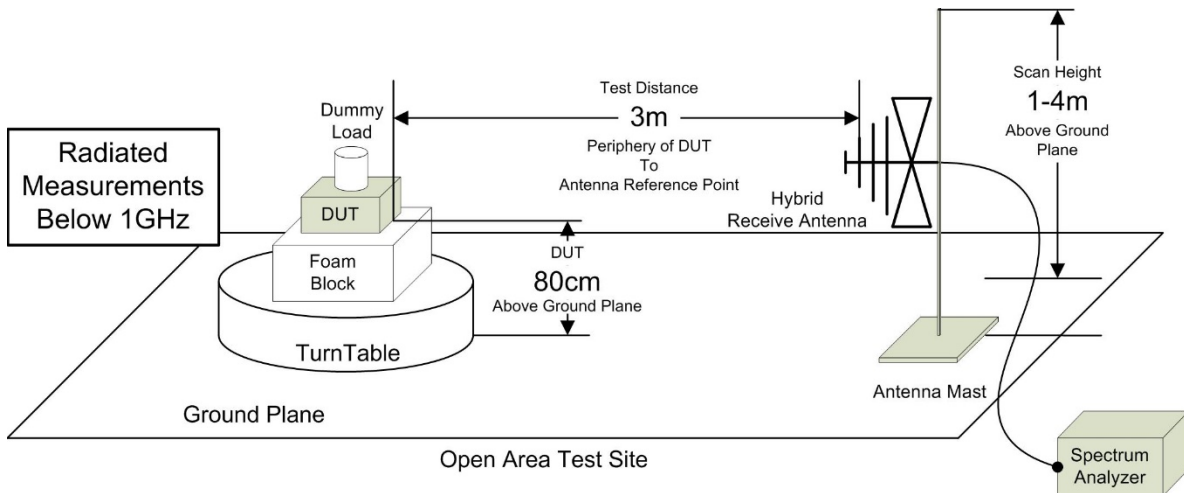


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

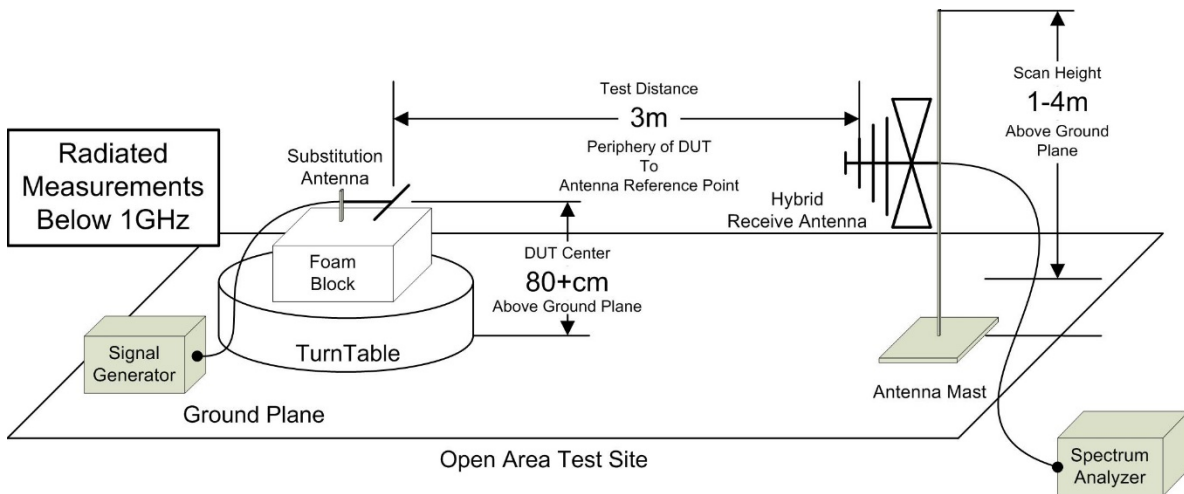


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz

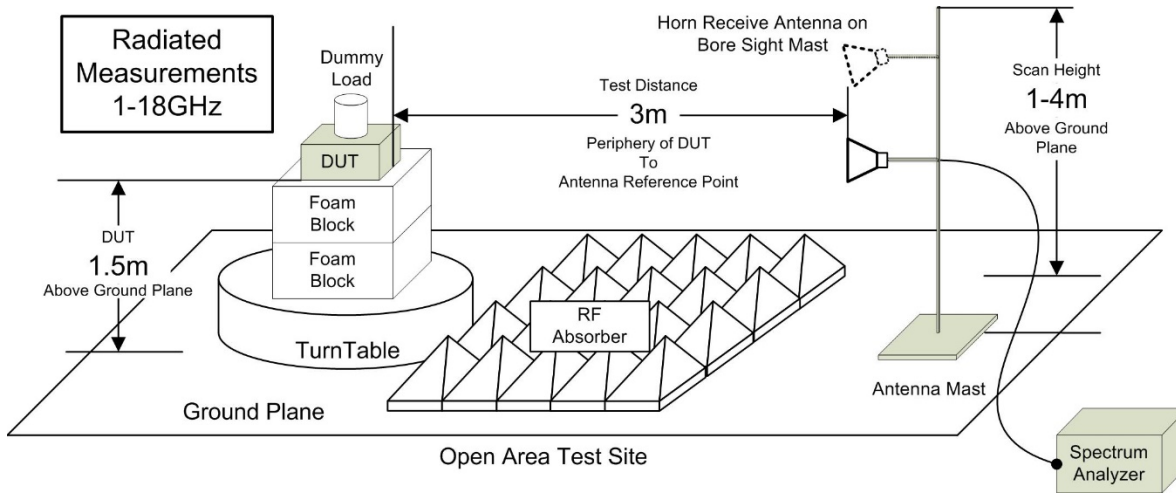


Table A.3 – Setup – Conducted Emissions Equipment List

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00223	HP	8901A	3749A07154	Modulation Analyzer
00257	Com-Power	LI-215A	191934	LISN
00276	TMS	LMR400	n/a	4m Cable

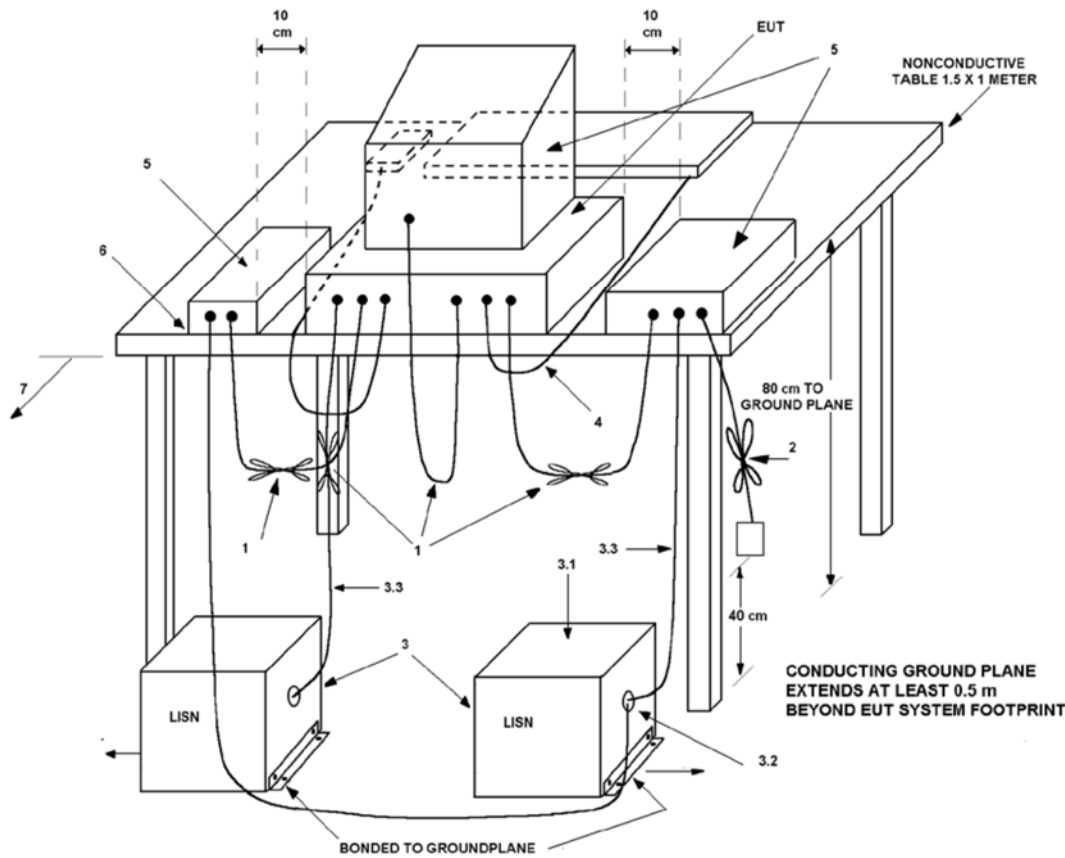


Figure A.6 – Test Setup Conducted Emissions Measurements

APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List					Last Calibrated	Calibration Interval	Calibration Due
Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00050	Chase	CBL-6111A	1607	Bilog Antenna	16 Nov 2020	Triennial	16 Nov 2023
00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2021	Triennial	26 Nov 2024
00085	EMCO	6502	9203-2724	Loop Antenna	11 Jun 2019	Triennial	11 Jun 2022
00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2020	Triennial	23 Jun 2023
00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2020	Triennial	23 Jun 2023
00241	R&S	FSU40	100500	Spectrum Analyzer	10 Aug 2021	Triennial	10 Aug 2024
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00257	Com-Power	LI-215A	191934	LISN	27 Dec 2021	Triennial	27 Dec 2024
00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

NCR: No Calibration Required

COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of k=2

Radiated Emissions 30MHz - 200MHz

U_{LAB} = 5.14dB U_{CISPR} = 6.3dB

Radiated Emissions 200MHz - 1000MHz

U_{LAB} = 5.90dB U_{CISPR} = 6.3dB

Radiated Emissions 1GHz - 6GHz

U_{LAB} = 4.80dB U_{CISPR} = 5.2dB

Radiated Emissions 6GHz - 18GHz

U_{LAB} = 5.1dB U_{CISPR} = 5.5dB

Power Line Conducted Emissions 9kHz to 150kHz

U_{LAB} = 2.96dB U_{CISPR} = 3.8dB

Power Line Conducted Emissions 150kHz to 30MHz

U_{LAB} = 3.12dB U_{CISPR} = 3.4dB

If the calculated uncertainty **U_{lab}** is **less** than **U_{CISPR}** then:

- | | |
|---|---|
| 1 | Compliance is deemed to occur if NO measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if ANY measured disturbance EXCEEDS the disturbance limit |

If the calculated uncertainty **U_{lab}** is **greater** than **U_{CISPR}** then:

- | | |
|---|---|
| 3 | Compliance is deemed to occur if NO measured disturbance, increased by (U_{lab} - U_{CISPR}), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if ANY measured disturbance, increased by (U_{lab} - U_{CISPR}), EXCEEDS the disturbance limit |

Other Measurement Uncertainties (U_{LAB})

RF Conducted Emissions 9kHz - 40GHz

U_{LAB} = 1.0dB U_{CISPR} = n/a

Frequency/Bandwidth 9kHz - 40GHz

U_{LAB} = 0.1ppm U_{CISPR} = n/a

Temperature

U_{LAB} = 1°C U_{CISPR} = n/a

END OF REPORT