



REGULATORY COMPLIANCE TEST REPORT

FCC Part 15 Subpart F 15.519 UWB Device

Report No.: CATA10-U6 Rev A

Company: Catapult Sports Pty Ltd

Model Name: T7001

REGULATORY COMPLIANCE TEST REPORT

Company: Catapult Sports Pty Ltd

Model Name: T7001

To: FCC CFR 47 Part 15 Subpart F 15.519,

Test Report Serial No.: CATA10-U6 Rev A

This report supersedes: NONE

Applicant: Catapult Sports Pty Ltd Company
75-83 High St, Prahran
Melbourne, Victoria 3181
Australia

Issue Date: 23rd December 2021

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
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Pleasanton California 94566
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www.micomlabs.com



MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



Accredited Laboratory

A2LA has accredited

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Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 24th day of February 2020.



Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to February 28, 2022
Revised November 16, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.



1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM test reports. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	MRA Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Test Site Designation #: US1084
Canada	Industry Canada (ISED)	FCB	APEC MRA 2	US0159 Test Company #: 4143A
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	Japan MRA 2	RCB 210
	Japan Approvals Institute for Telecommunication Equipment (JATE)			
	VCCI			
Europe	European Commission	NB	EU MRA 2	NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Mexico	Instituto Federal de Telecomunicaciones (IFT)	CAB	Mexico MRA 1	US0159
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)			
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)			
Singapore	Infocomm Development Authority (IDA)			
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)			
Vietnam	Ministry of Communication (MIC)			

TCB- Telecommunications Certification Bodies (TCB)

FCB – Foreign Certification Body

CAB – Conformity Assessment Body

NB – Notified Body;

AB – Approved Body

MRA – Mutual Recognition Agreement

MRA Phases

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 Requirements for bodies certifying products, processes and services. This product certification body also meets the A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements and A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.



Presented this 24th day of February 2020



Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to February 28, 2022
Revised November 16, 2021

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier – 2280
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	21st December 2021	Draft report for client review.
Rev A	23rd December 2021	Initial release.

In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer: Catapult Sports Pty Ltd 75-83 High St Prahran Melbourne, Victoria 3181 Australia	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: T7001	Telephone: +1 925 462 0304
Equipment Type: Mobile & Portable Client Device	Fax: +1 925 462 0306
S/N's: 000112	
Test Date(s): 8th & 9th December 2021	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart F 15.519	EQUIPMENT COMPLIES

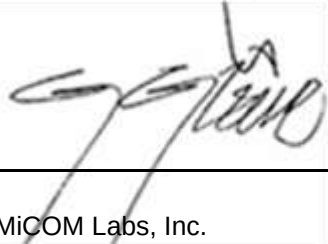
MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:





Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	FCC 47 CFR Part F	2018	Radio Frequency Devices; Subpart F – Ultra Wide Band Devices
II	A2LA	5th Oct 2020	R105 - Requirement's When Making Reference to A2LA Accreditation Status
III	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
IV	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
V	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VI	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
VII	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.
VIII	KDB 393764 D01 UWB FAQ v02	January 29, 2018	Ultra-Wideband (UWB) Devices frequently asked questions
IX	ISED RSS-220	July 2018	Devices Using Ultra-Wideband (UWB) Technology

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Catapult Sports Pty Ltd Tag T7001 to FCC CFR 47 Part 15 Subpart F 15.519.& ISED RSS-220
Applicant:	Catapult Sports Pty Ltd 75-83 High St, Prahran Melbourne, Victoria 3181 Australia
Manufacturer:	As applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	CATA10-U6
Date EUT received:	25 th October 2021
Standard(s) applied:	FCC Part 15 Subpart F 15.519
Dates of test (from - to):	8 th & 9 th December 2021
No of Units Tested:	1
Product Family Name:	Tag T7001
Model(s):	T7001
Location for use:	Indoors and Outdoors
Declared Frequency Range(s):	3993.6 MHz, 4492.8 MHz, and 6489.60 MHz;
Type of Modulation:	BPM/BPSK
EUT Modes of Operation:	UWB
Declared Nominal Output Power (dBm):	-41.3 dBm
Rated Input Voltage and Current:	DC: 4.2VDC
Operating Temperature Range:	0° C to +45° C
Equipment Dimensions:	5.4 cm (L) x 3.5 cm (W) x 0.82 cm (H)
Weight:	22 grams
Hardware Rev:	1.0.0
Software Rev:	1.0.0
Product Application:	Mobile & Portable Client Device

5.2. Scope Of Test Program

Catapult Sports Pty Ltd Company

The scope of the test program was to test the Catapult Sports Pty Ltd Company Tag T7001 for compliance against the following specifications:

FCC CFR 47 Part 15 Subpart F – Ultra-Wideband Operation; 15.519, 15.521

Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 3100 - 10600 MHz bands.

15.519 Technical requirements for hand-held UWB systems.

15.521 Technical requirements applicable to all UWB devices.

5.3. Equipment Model(s) and Serial Number(s)

Type (EUT/Support)	Equipment Description	Manufacturer	Model No.	Serial No.
EUT	Mobile & Portable Client Device	Catapult Sports Pty Ltd	T7001	000112

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Catapult Sports Pty Ltd	-	Patch	1.37	--	--	--	3750 – 4250
Integral	Catapult Sports Pty Ltd	-	Patch	4.33	--	--	--	4250 – 4750
Integral	Catapult Sports Pty Ltd	-	Patch	6.55	--	--	--	6250 – 6750
BF Gain - Beamforming Gain Dir BW - Directional BeamWidth X-Pol - Cross Polarization								

5.5. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Screened	Connector Type	Data Type	Data Rate(s)
USB	5m	1	Yes	USB	Digital	Unknown

5.6. Test Configurations

Results for the following configurations are provided in this report:

Results for the following configurations are provided in this report:				
Operational Mode(s)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
3100-10600 MHz				
UWB	--	3993.6	4492.8	6489.60

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

6. TEST SUMMARY

List of Measurements

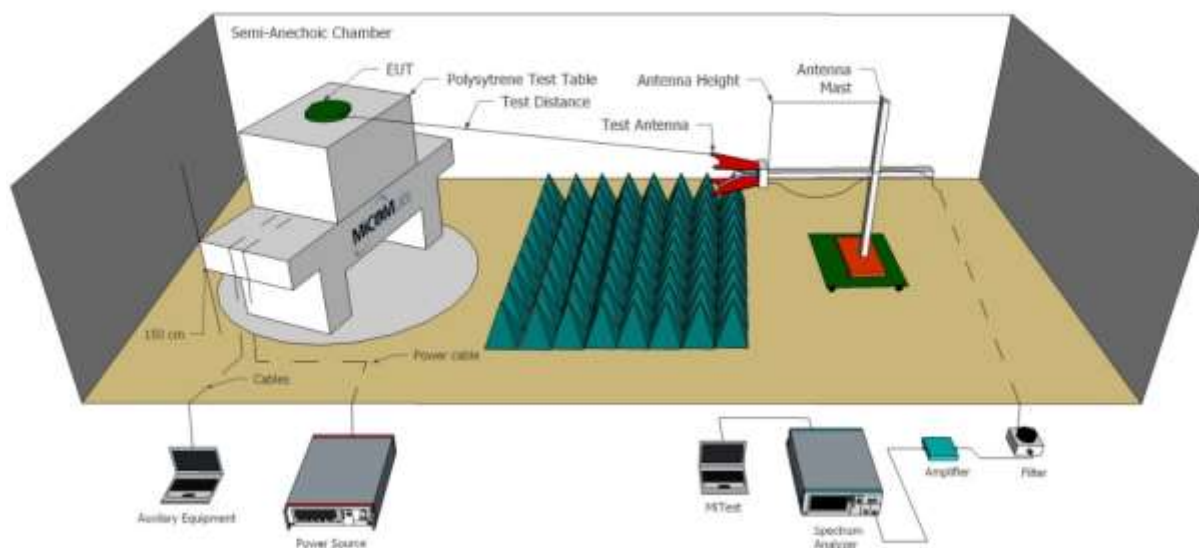
Test Header	Result	Data Link
UWB Bandwidth	Complies	View Data
Peak Power	Complies	View Data
Peak Power Density	Complies	View Data
Spurious Radiated Emissions	Complies	View Data
Spurious Radiated Emissions in GPS Bands	Complies	View Data
Shutoff Timing Requirements	Complies	View Data
Comments: None		

7. TEST EQUIPMENT CONFIGURATION(S)

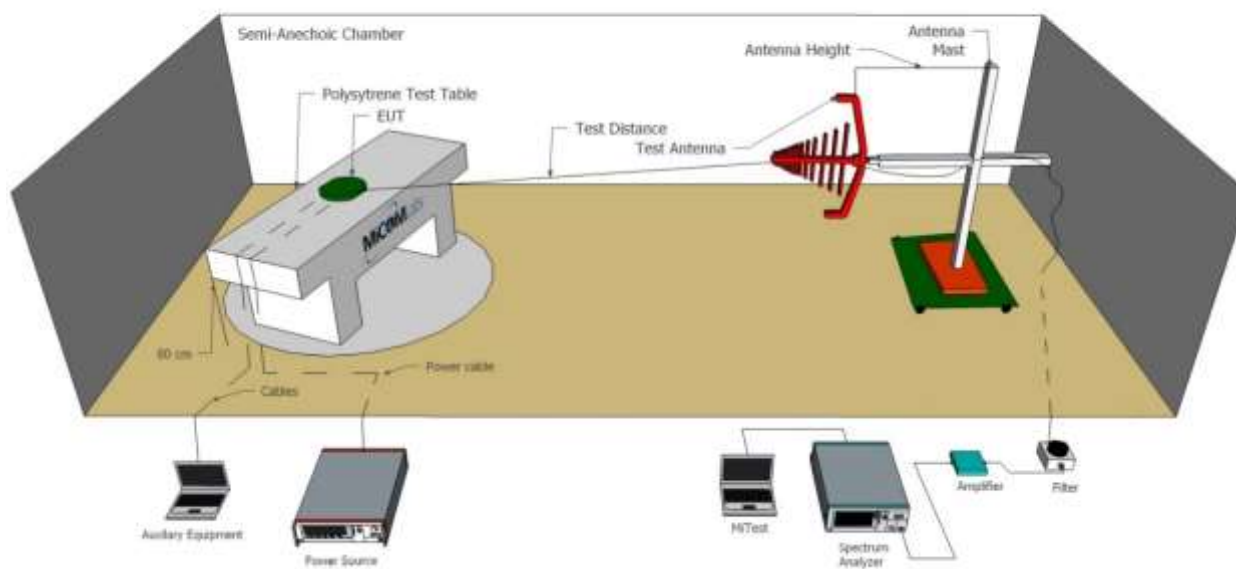
7.1. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below. Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Radiated Emissions Below 1GHz Test Setup



A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	8 Oct 2022
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
336	Active loop Ant 10kHz to 30 MHz	EMCO	EMCO 6502	00060498	29 Nov 2022
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	29 Sep 2023
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	29 Sep 2022
396	2.4 GHz Notch Filter	Microtronics	BRM50701	001	6 Oct 2022
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	27 Oct 2022
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	30 Sep 2023
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	2 Nov 2022
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	27 Oct 2022
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	27 Oct 2022
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	27 Oct 2022
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	6 Oct 2022
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	23 Jun 2022
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	23 Jun 2022
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	20 Dec 2022

554	Precision SMA Cable	Fairview Microwave	SCE18060101-400CM	554	23 Jun 2022
555	Rhode & Schwarz Receiver (Firmware Version : 2.00 SP1)	Rhode & Schwarz	ESW 44	101893	28 Jun 2023
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The MiCOM Labs "[MiTest](#)" Automated Test System" (Patent Pending)

9. TEST RESULTS

9.1. UWB Bandwidth

Conducted Test Conditions for UWB Bandwidth			
Standard:	FCC CFR 47:15.519(b)	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	UWB Bandwidth	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10 Section 10.1	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

15.519 (b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

Test Procedure for UWB Bandwidth Measurement

The spectrum analyzer is configured with a 1 MHz RBW and RMS trace capture.

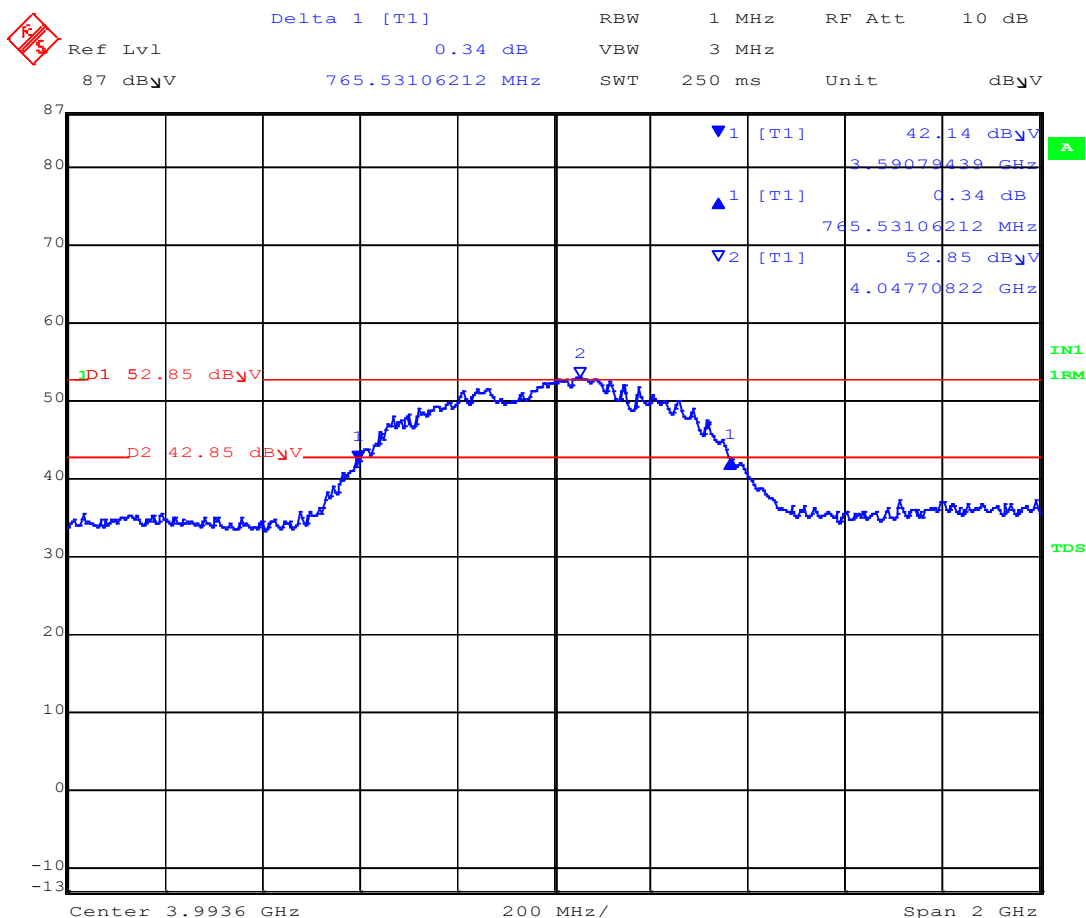
In order to clearly identify the required limits and thus measurement procedures it is essential to define the operating bandwidth of the UWB DUT, the operating bandwidth of the UWB DUT test shall be the -10 dBc bandwidth of the intended UWB signal under normal operational conditions. The Resolution Bandwidth was set to 1MHz RBW IAW ANSI C63.10.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document.

Equipment Configuration for UWB Bandwidth

Variant:	UWB	Duty Cycle (%):	100
Data Rate:	-	Antenna Gain (dBi):	1.37
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)	
MHz	Port A	Highest	Lowest
3993.6	765.53	765.53	765.53



Date: 10.DEC.2021 09:13:33

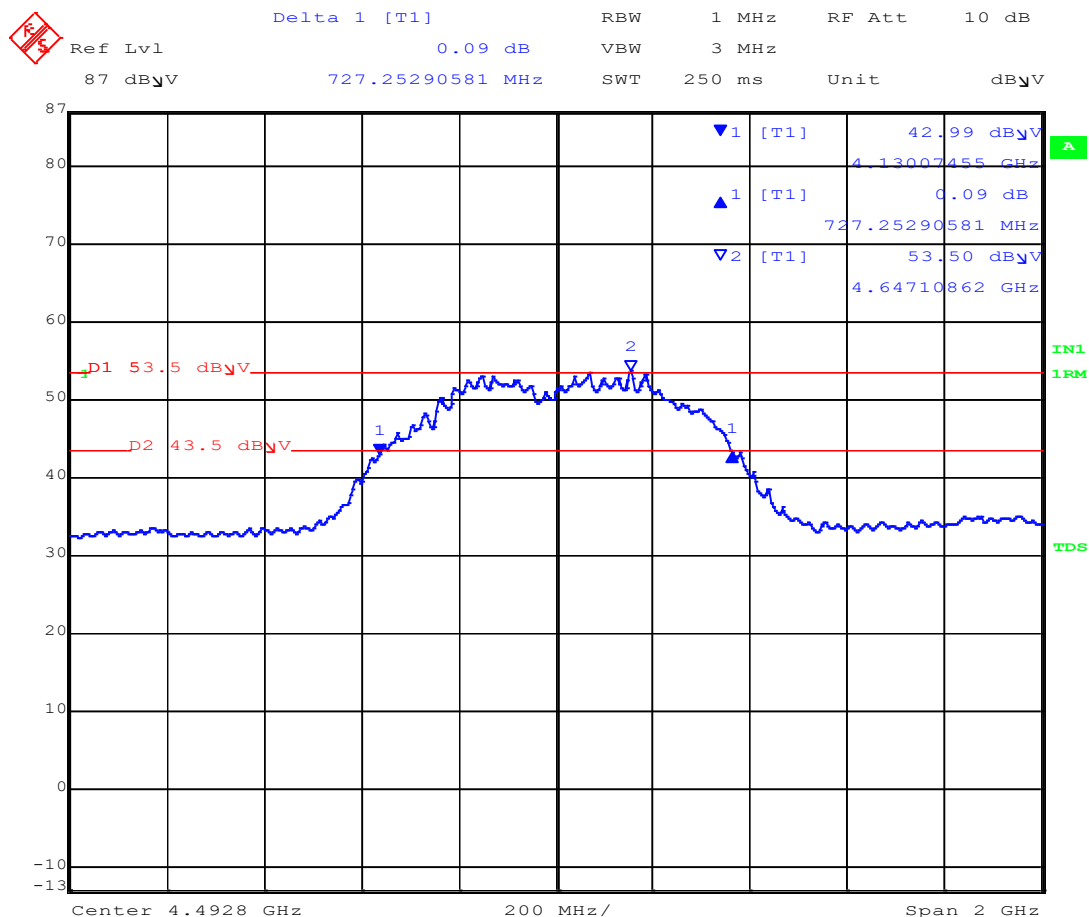
Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

The above values are representative of the worst-case value between polarities and based on the power measurements.

Equipment Configuration for UWB Bandwidth

Variant:	UWB	Duty Cycle (%):	100
Data Rate:	-	Antenna Gain (dBi):	4.33
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)	
MHz	Port A	Highest	Lowest
4492.8	727.25	727.25	727.25



Date: 10.DEC.2021 09:16:21

Traceability to Industry Recognized Test Methodologies

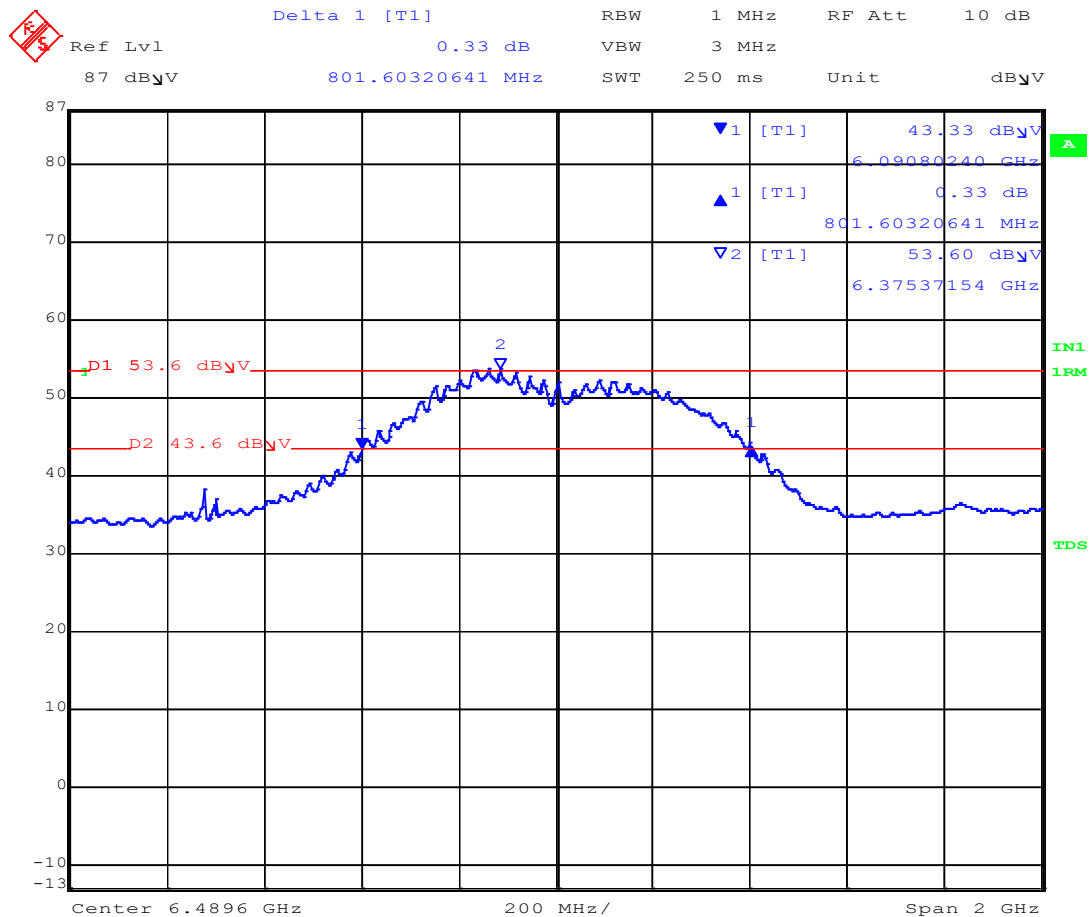
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

The above values are representative of the worst-case value between polarities and based on the power measurements.

Equipment Configuration for UWB Bandwidth

Variant:	UWB	Duty Cycle (%):	100
Data Rate:	-	Antenna Gain (dBi):	6.55
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)	
MHz	Port A	Highest	Lowest
6489.60	801.603	801.603	801.603



Date: 10.DEC.2021 09:19:54

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

The above values are representative of the worst-case value between polarities and based on the power measurements.

9.2. Transmit Power

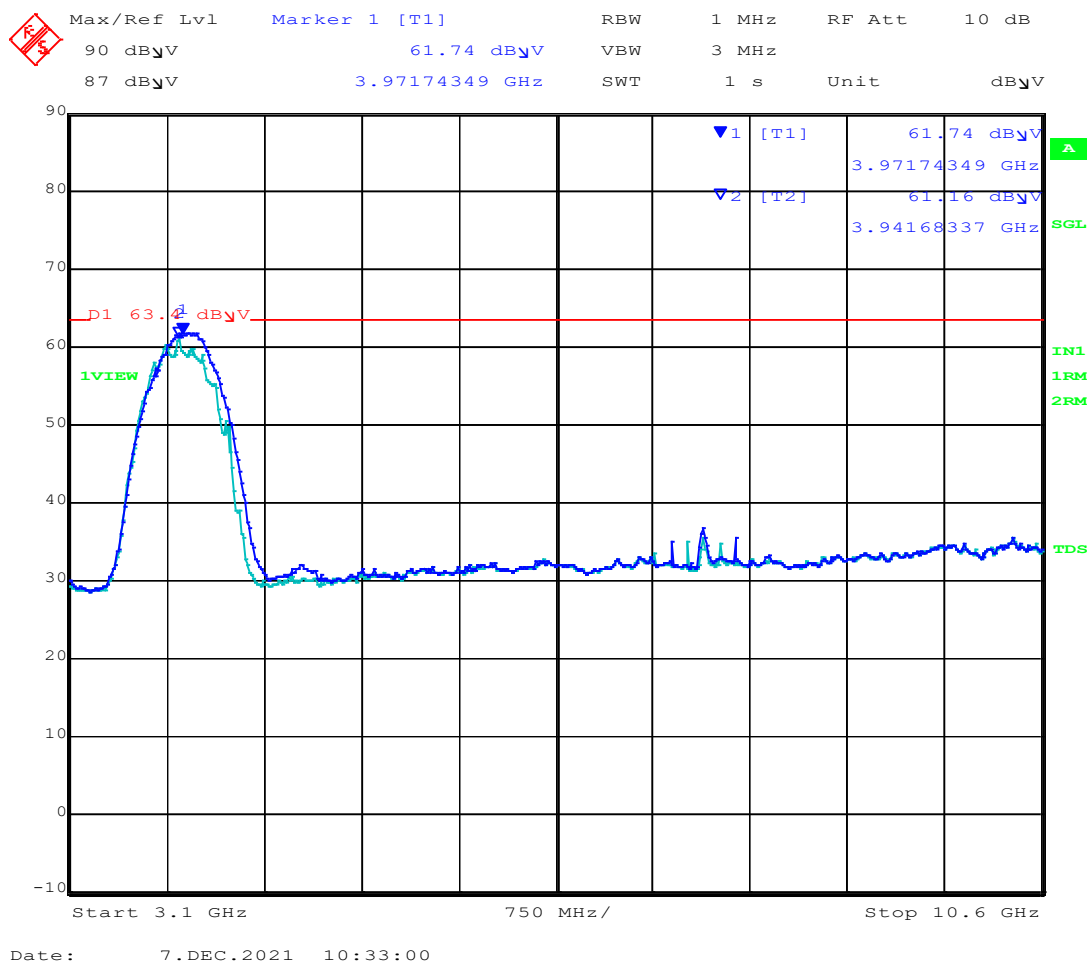
Conducted Test Conditions for Maximum Radiated Output Power									
Standard:	FCC CFR 47:15.519 (c)	Ambient Temp. (°C):	24.0 - 27.5						
Test Heading:	Radiated Emissions UWB Transmission	Rel. Humidity (%):	32 - 45						
Standard Section(s):	ANSI C63.10 Section 10.3.5	Pressure (mBars):	999 - 1001						
Reference Document(s):	None								
Test Procedure for UWB Transmission Testing was performed under ambient conditions at nominal voltage. Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document. 15.519 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209 . The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz: Operating Frequency Band: 3100-10600 MHz Limits Maximum EIRP (dBm) <table><tr><th>Frequency (MHz)</th><th>EIRP Limit (dBm)</th><th>EIRP at 1 Meters (dBuv/m)</th></tr><tr><td>3100 - 10600</td><td>-41.3</td><td>63.4</td></tr></table>				Frequency (MHz)	EIRP Limit (dBm)	EIRP at 1 Meters (dBuv/m)	3100 - 10600	-41.3	63.4
Frequency (MHz)	EIRP Limit (dBm)	EIRP at 1 Meters (dBuv/m)							
3100 - 10600	-41.3	63.4							

Equipment Configuration for RF Output Power

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	1.37
Modulation:	-	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Radiated Output Power (dBuV/m)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBuV/n)	Margin (dB)	EUT Power Setting
3993.6	61.74	61.74	63.4	-1.66	18.0



Traceability to Industry Recognized Test Methodologies

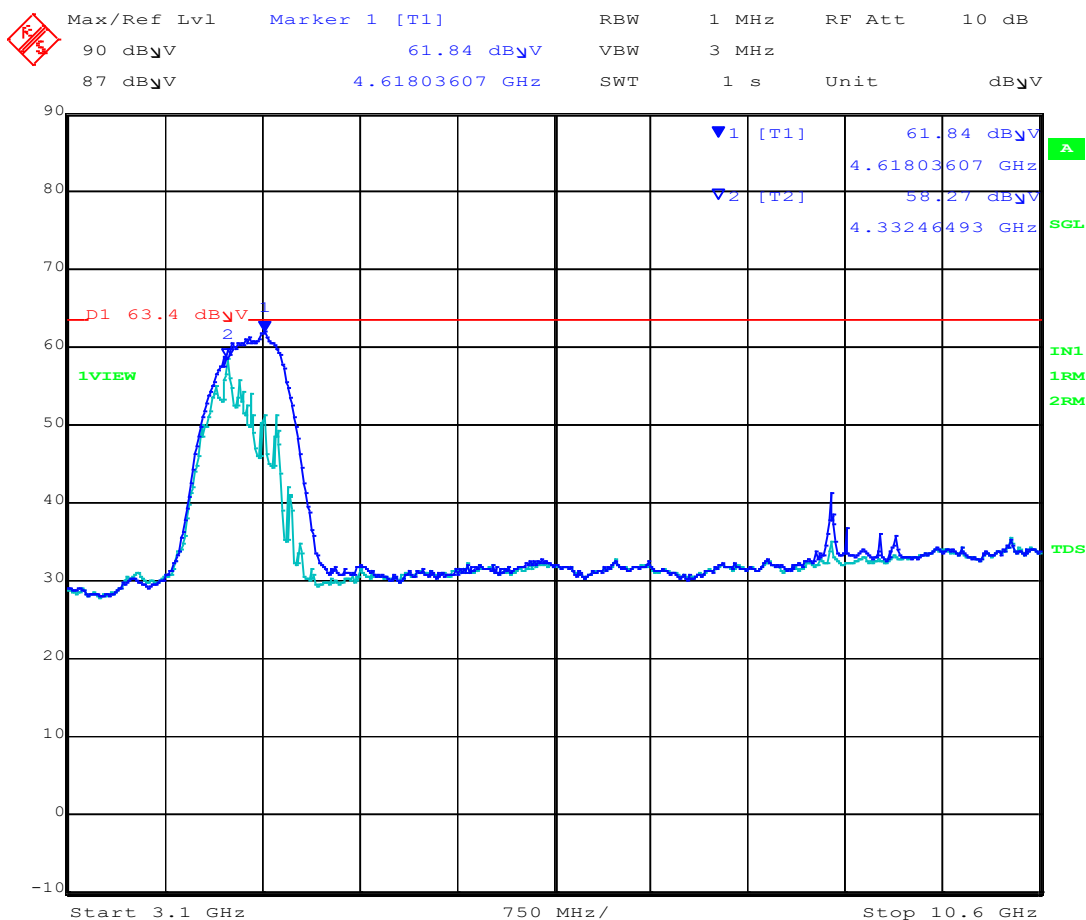
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

Equipment Configuration for RF Output Power

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	4.33
Modulation:	-	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Radiated Output Power (dBuV/m)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBuV/n)	Margin (dB)	EUT Power Setting
4492.8	61.84	61.84	63.4	-1.56	18.0



Date: 7.DEC.2021 14:42:06

Traceability to Industry Recognized Test Methodologies

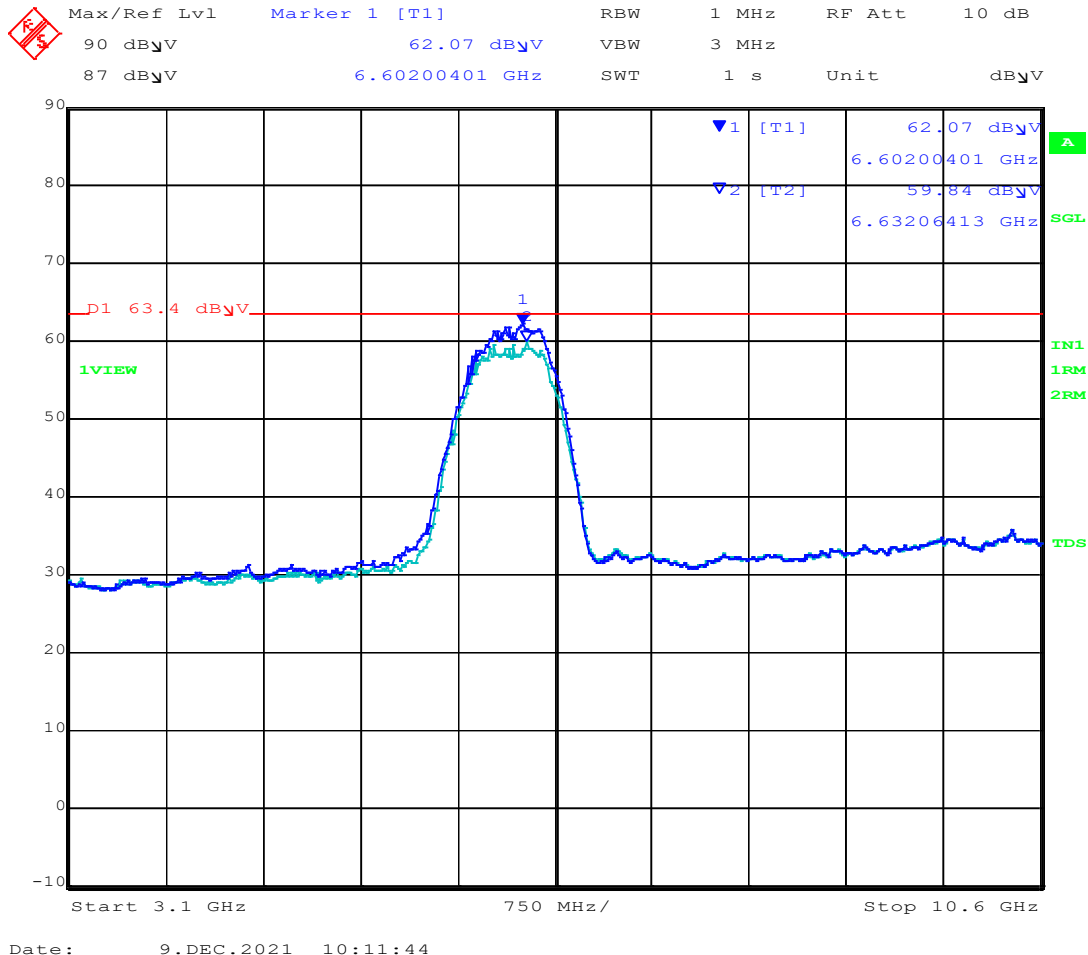
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

Equipment Configuration for RF Output Power

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	6.55
Modulation:	-	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Radiated Output Power (dBuV/m)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBuV/n)	Margin (dB)	EUT Power Setting
6489.60	62.07	62.07	63.4	-1.33	22.0



Date: 9.DEC.2021 10:11:44

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

9.3. Peak Power Density

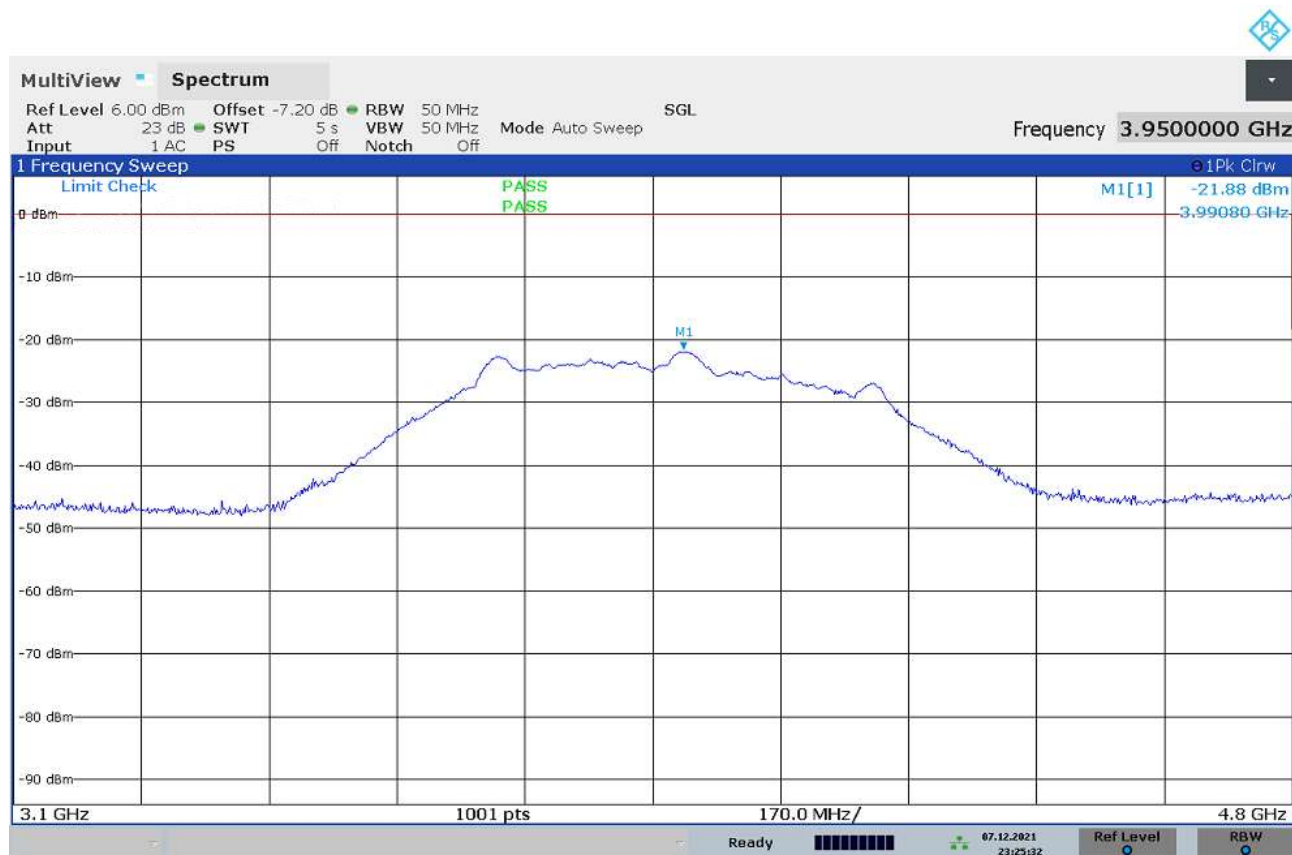
Test Conditions for Maximum Peak Power Density			
Standard:	FCC CFR 47:15.519 (e)	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Radiated Emissions UWB Transmission	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10 Section 10.3.6	Pressure (mBars):	999 - 1001
Reference Document(s):	None		
Test Procedure for UWB Transmission			
15.519 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.			
Testing was performed under ambient conditions at nominal voltage.			
Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document. Supporting KDB's referenced below.			
Operating Frequency Band: 3100-10600 MHz			
Limits Maximum EIRP (dBm)			
Frequency (MHz)	EIRP Limit (dBm/50MHz)	EIRP Limit (dBm/1MHz)	
3100 - 10600	0	-34	

Equipment Configuration for Peak Power Density

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	1.37
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Peak Power Density (dBm)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBm)	Margin (dB)	EUT Power Setting
3993.6	-21.88	-20.51	0.0	-20.51	18.0



Date: 7.DEC.2021 23:25:31

Traceability to Industry Recognized Test Methodologies

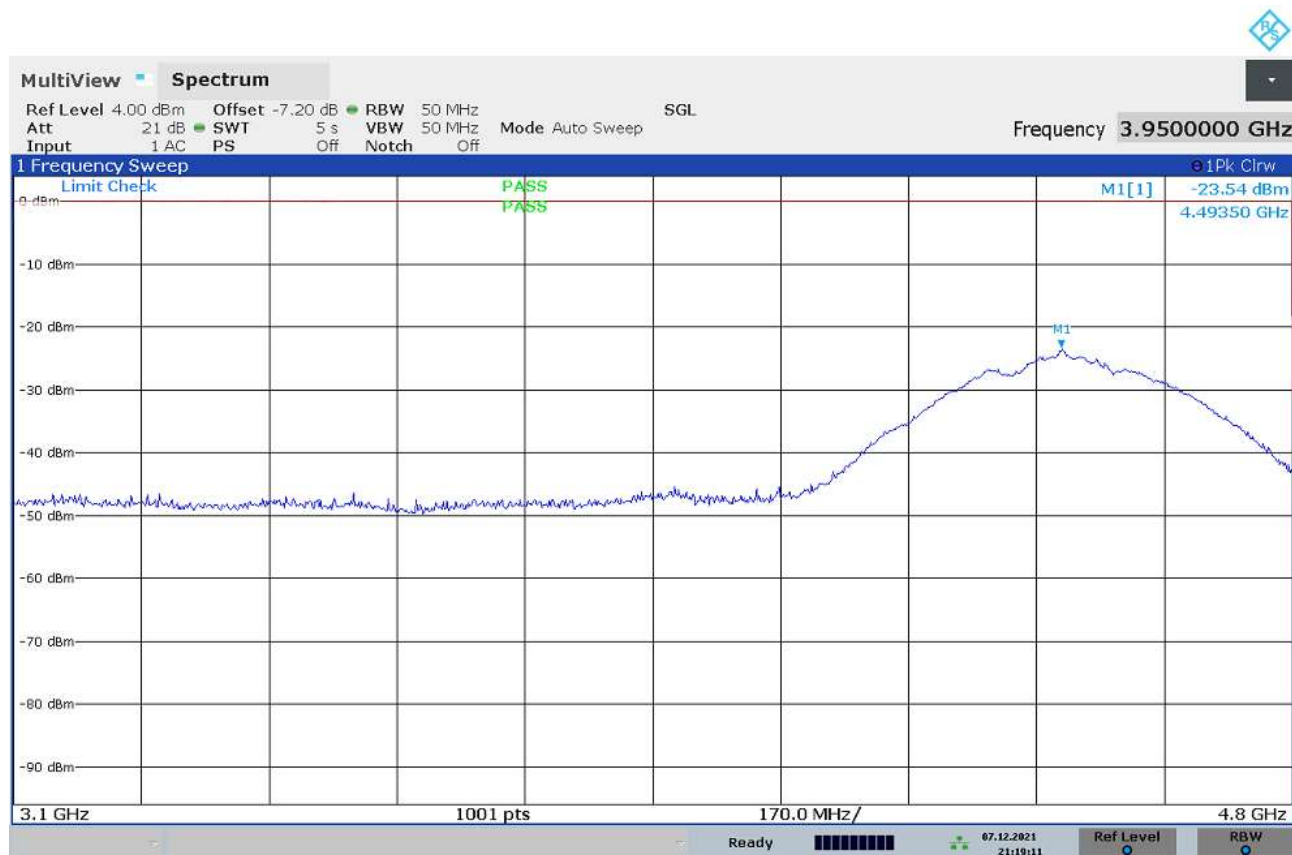
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

Equipment Configuration for Peak Power Density

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	4.33
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Peak Power Density (dBm)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBm)	Margin (dB)	EUT Power Setting
4492.8	-23.54	-19.21	0.0	-19.21	18.0



Date: 7.DEC.2021 21:19:11

Traceability to Industry Recognized Test Methodologies

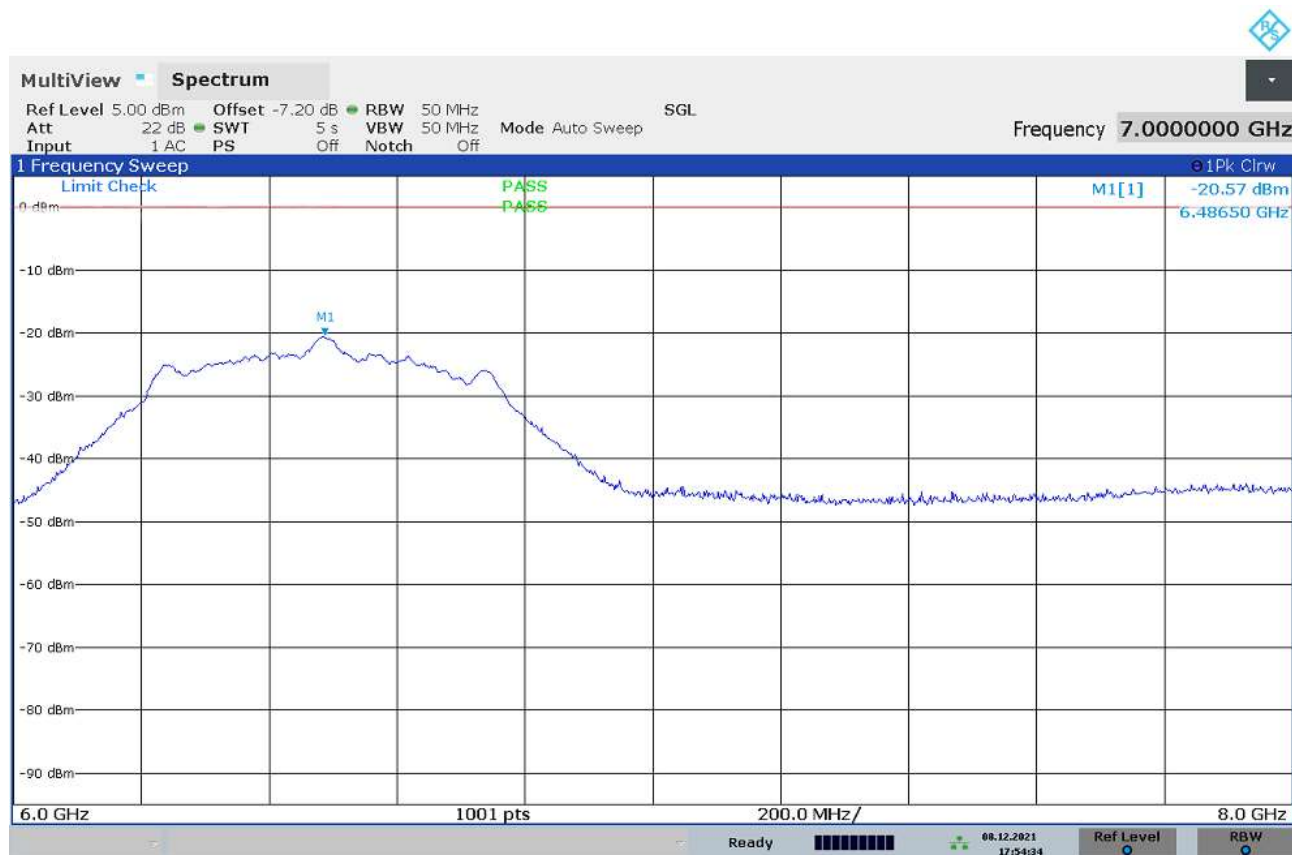
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

Equipment Configuration for Peak Power Density

Variant:	UWB	Duty Cycle (%):	99
Data Rate:	-	Antenna Gain (dBi):	6.55
Modulation:	--	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Peak Power Density (dBm)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBm)	Margin (dB)	EUT Power Setting
6489.60	-20.57	-14.02	0.0	-12.27	22.0



Date: 8.DEC.2021 17:54:34

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

9.4. Transmitter Spurious Band Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47 15.519	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10 Section 10.2 + 10.3	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions

Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in max hold mode. Depending on the frequency band spanned a notch filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Limits for Restricted Bands (15.205, 15.209)

Peak emission: 68.23 dBuV/m

Average emission: 54 dBuV/m

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where:

FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss

FCC 15.519(c) Measurements made at 1 meter to meet noise floor to limit requirements.

Radiated Spurious Emissions in the GPS Bands 15.519 (c), 15.521 (d)

15.519 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency Range		Average Limit	
MHz	MHz	EIRP (dBm)	EIRP at 1 Meters (dBuV/m)
960	1610	-75.3	29.4
1610	1990	-63.3	41.4
1990	3100	-61.3	43.4
3100	10600	-41.3	63.4
10600	18000	-61.3	43.4

Radiated Spurious Emissions in the GPS Bands FCC 15.519 (d)

15.519 (d) In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency Range		Average Limit	
MHz	MHz	EIRP (dBm)	EIRP at 1 Meters (dBuV/m)
1164	1240	-85.3	19.47
1559	1610	-85.3	19.47

50 MHz Peak Emissions FCC 15.519 (e)

15.519 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521

Within 50 MHz bandwidth centered on highest radiated emissions f_M , Limit is 0.0 dBm EIRP. At 1-meter distance the equivalent level is 104.77 dBuV/m

9.4.1. Transmitter Spurious Emissions

9.4.1.1. 3993.6 MHz

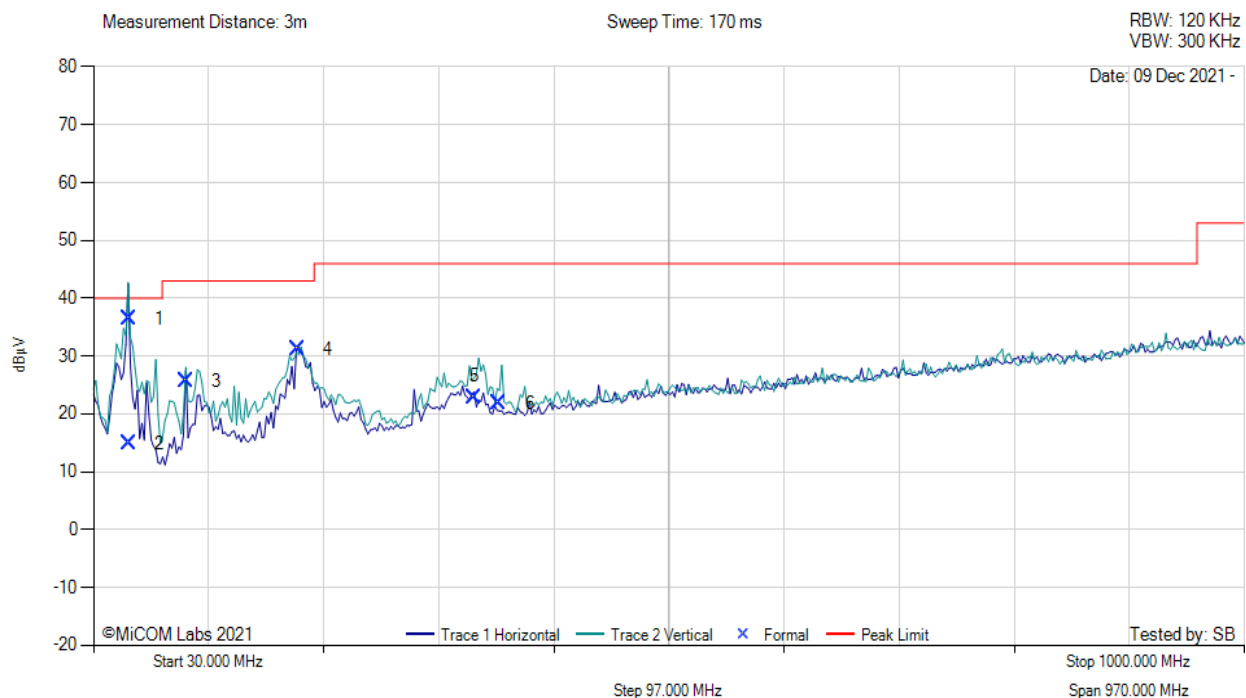
Equipment Configuration for Radiated Digital Emissions

Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	-
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	3993.6 to 6489.6	Data Rate:	Not Applicable
Power Setting:	18	Tested By:	SB

Test Measurement Results



Power Setting: 18, Duty Cycle (%): 99



30.00 - 1000.00 MHz

Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	60.15	56.23	3.82	-23.59	36.46	MaxQP	Vertical	100	160	40.0	-3.5	Pass
2	60.15	34.64	3.82	-23.59	14.87	MaxQP	Horizontal	98	253	40.0	-25.1	Pass
3	107.99	40.74	4.13	-19.21	25.66	Peak (NRB)	Vertical	100	0	--	--	Pass
4	202.22	46.17	4.61	-19.67	31.11	Peak (NRB)	Vertical	100	0	--	--	Pass
5	350.77	34.45	5.19	-16.76	22.88	Peak (NRB)	Vertical	100	0	--	--	Pass
6	371.89	32.62	5.26	-16.01	21.87	Peak (NRB)	Vertical	100	0	--	--	Pass

Equipment Configuration for Spurious Emissions

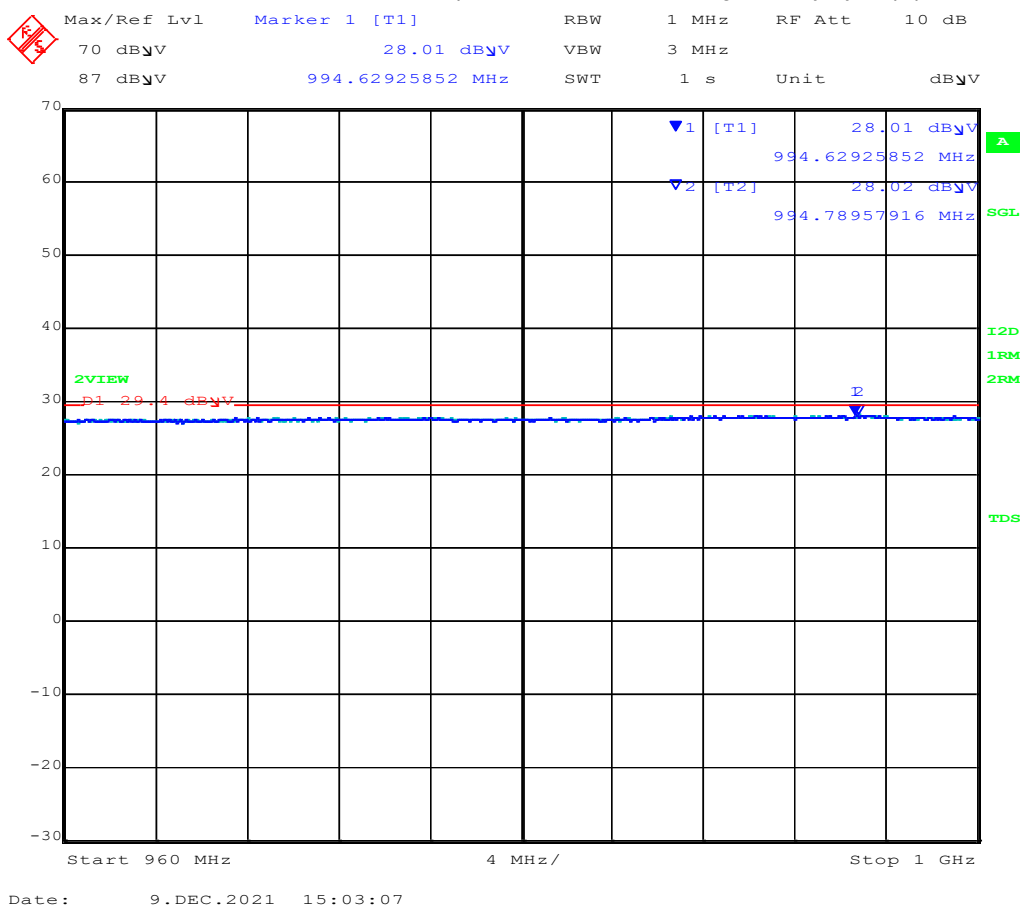
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 960MHz-1.00GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



960.00– 1000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	994.62	28.01	Average	Horizontal	150	0	29.4	-1.39	Pass
2	994.78	28.02	Average	Vertical	150	0	29.4	-1.38	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

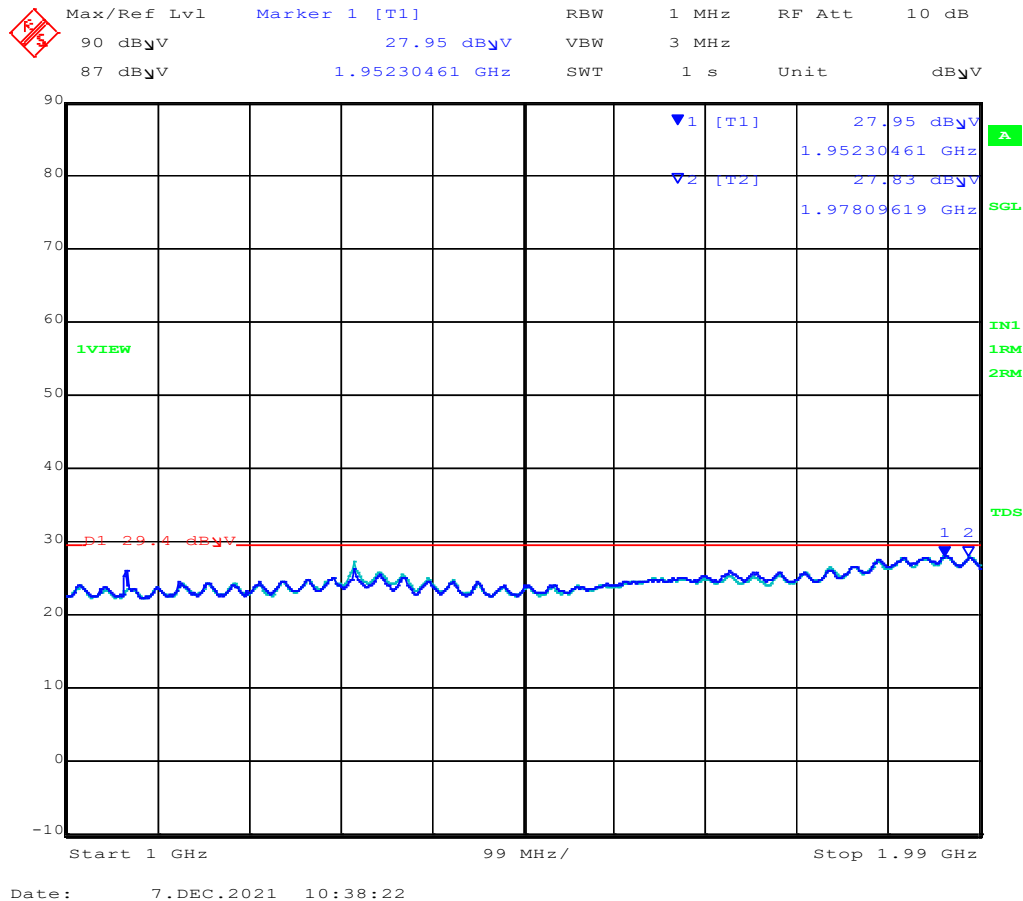
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.0-1.61GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



1000.00– 1610.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1952.30	27.95	Average	Horizontal	150	0	29.4	-1.45	Pass
2	1978.09	27.83	Average	Vertical	150	0	29.4	-1.57	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

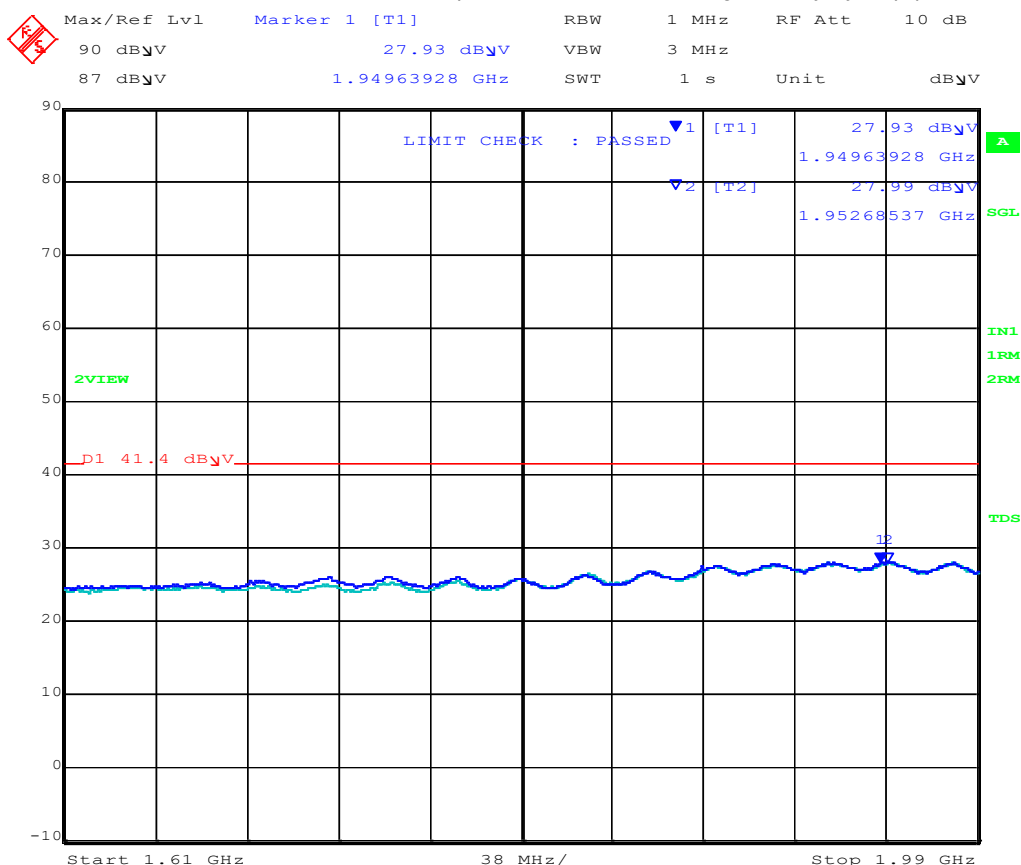
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.61-1.99GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



Date: 7.DEC.2021 10:36:01

1610.00 – 1990.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1949.63	27.93	Average	Horizontal	150	0	41.40	-13.47	Pass
2	1952.68	27.99	Average	Vertical	150	0	41.40	-13.41	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

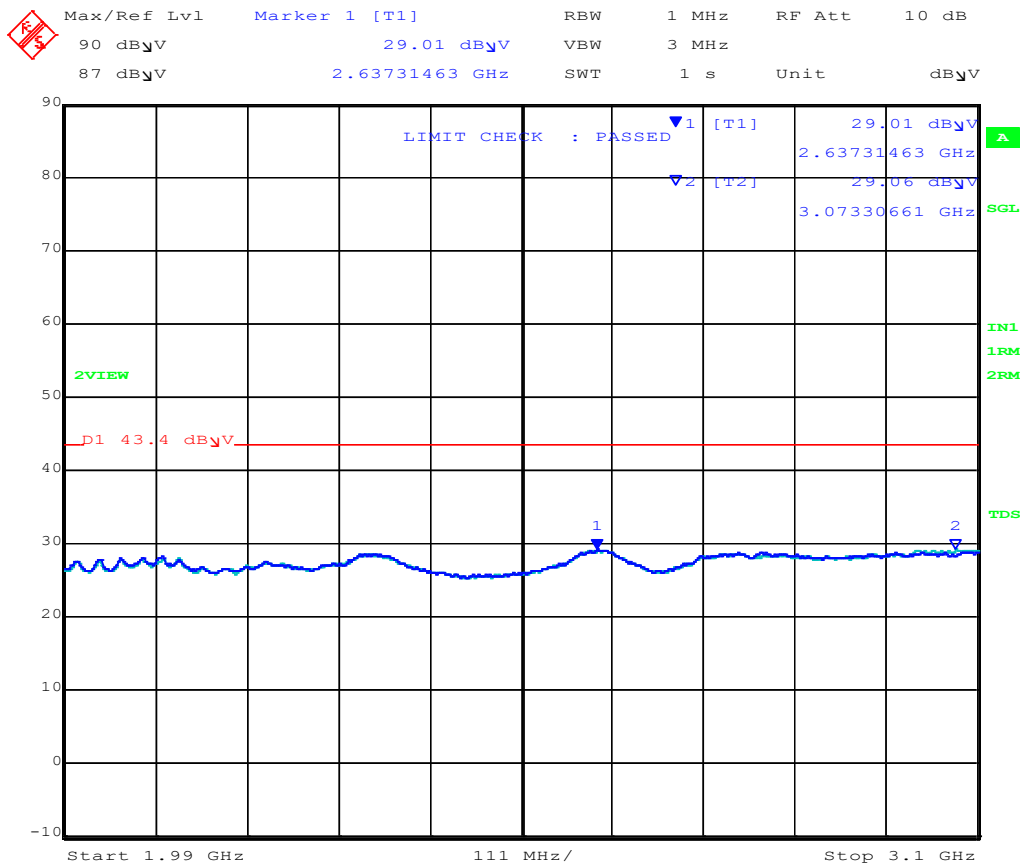
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.99-3.1GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



Date: 7.DEC.2021 10:40:19

1990.00 – 3100.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	2637.31	29.01	Average	Horizontal	150	0	43.40	-14.39	Pass
2	3073.30	29.06	Average	Vertical	150	0	43.40	-14.34	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

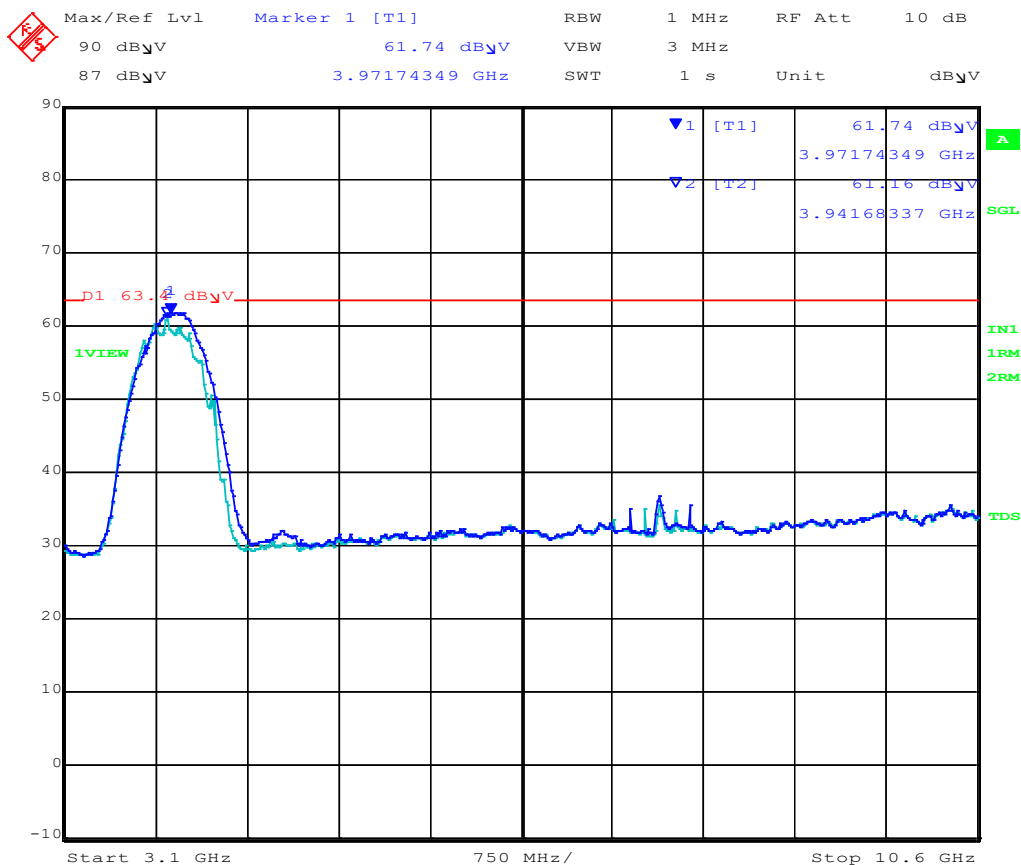
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 3.1-10.6GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



Date: 7.DEC.2021 10:33:00

3100.00 – 10600.00 MHz									
Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	3971.74	61.74	Average	Horizontal	150	0	63.4	-1.66	Pass
2	3941.68	61.16	Average	Vertical	150	0	63.4	-2.25	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

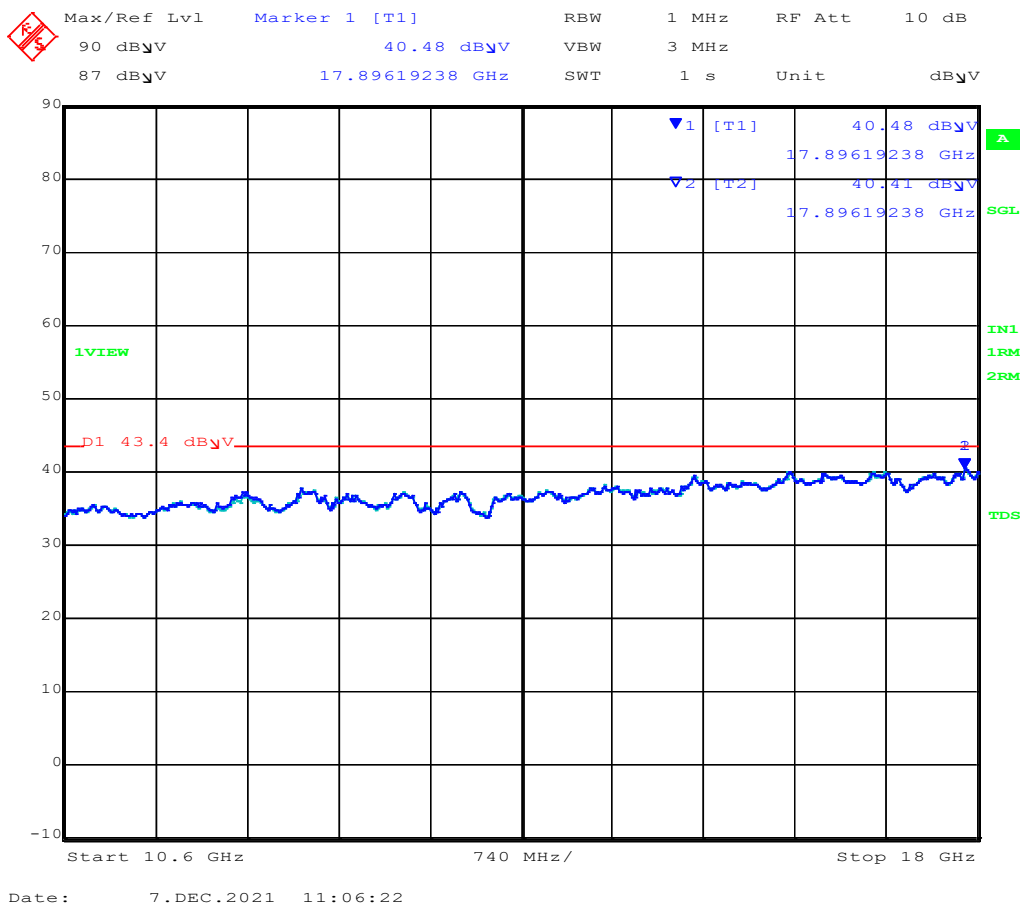
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 10.6-18GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



10600.00 – 18000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	17896.19	40.48	Average	Vertical	150	0	43.4	-2.92	Pass
2	17896.19	40.41	Average	Horizontal	150	0	43.4	-2.99	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

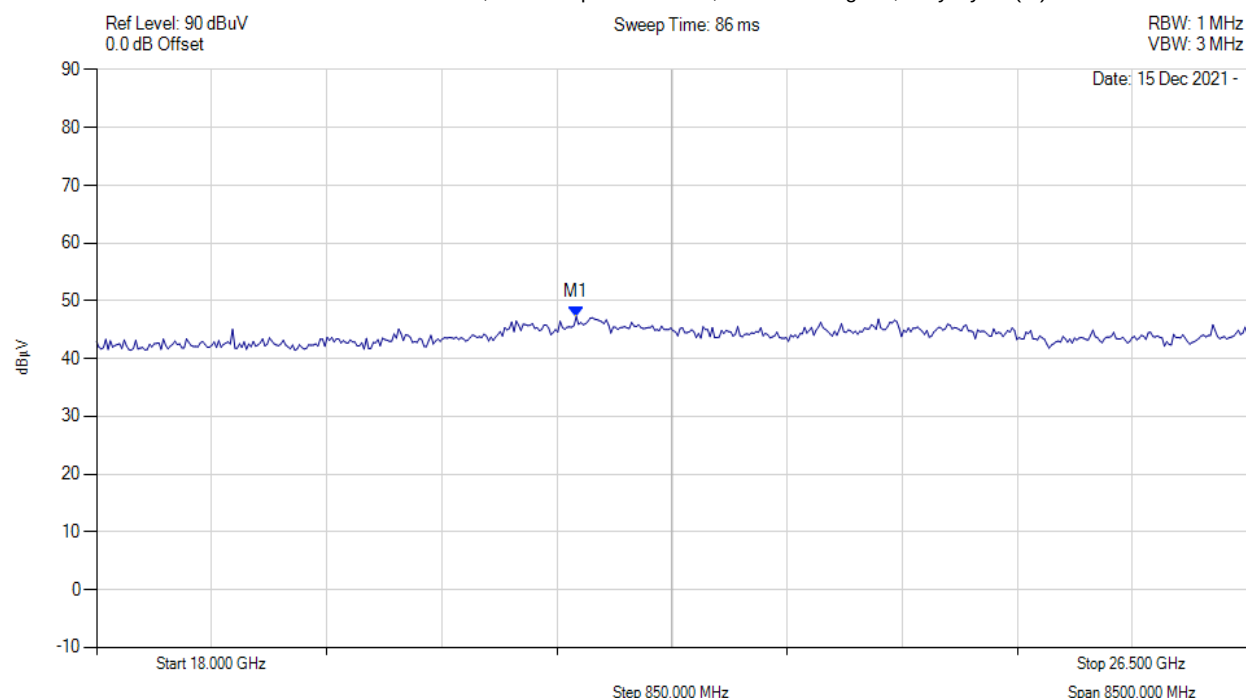
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 18-26GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



Analyzer Setup	Marker: Frequency: Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 21.543 GHz : 47.303 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

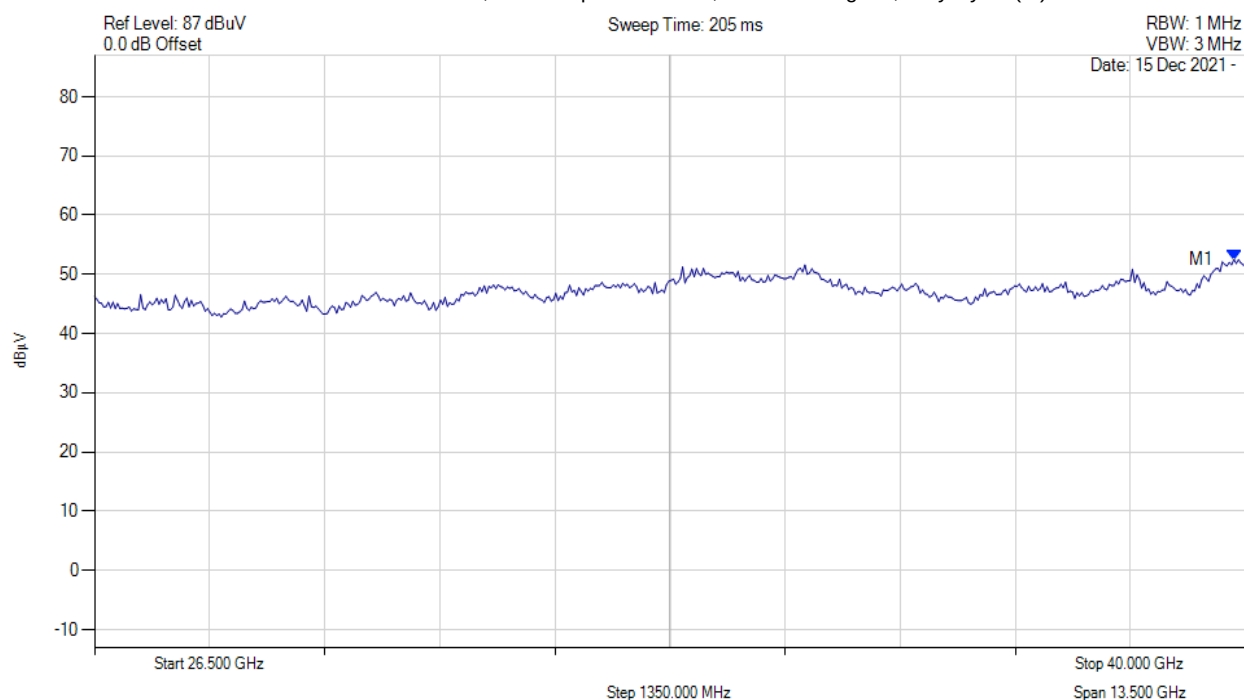
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18.0	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 26 – 40 GHz

Variant: UWB, Test Freq: 3993.6 MHz, Power Setting: 18, Duty Cycle (%): 99



Analyzer Setup	Marker: Frequency: Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 39.811 GHz : 53.379 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

9.4.1.2. 4492.6 MHz

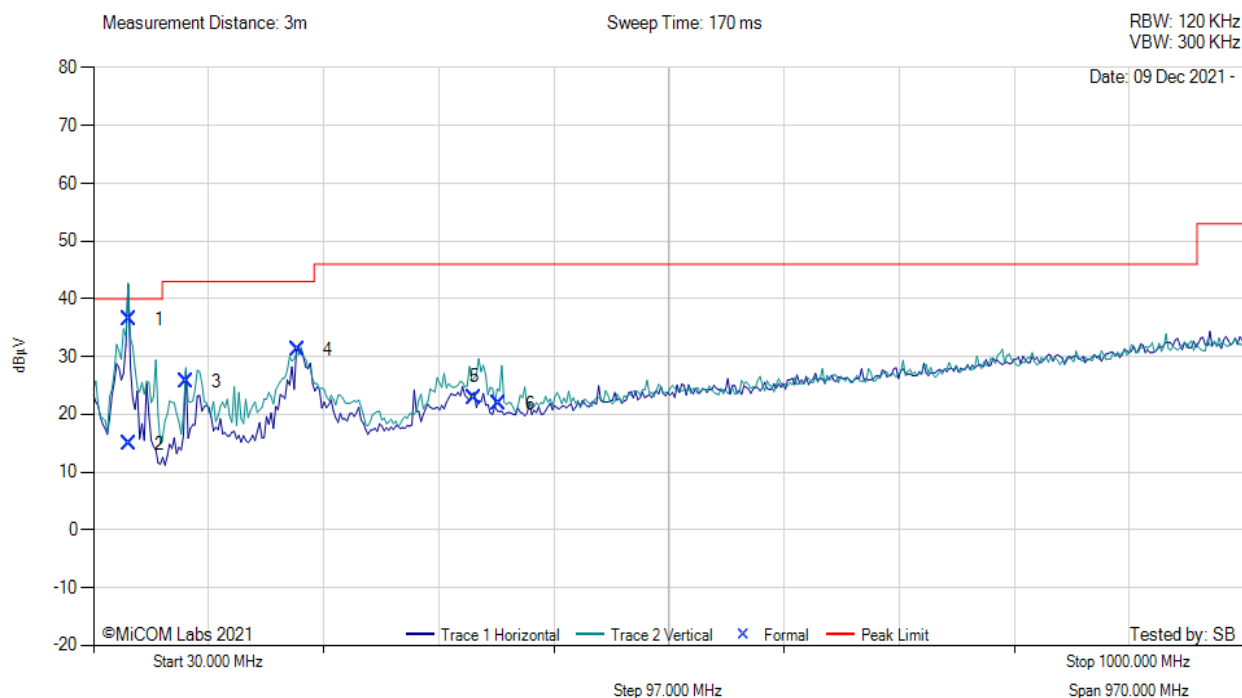
Equipment Configuration for Radiated Digital Emissions

Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	-
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	3993.6 to 6489.6	Data Rate:	Not Applicable
Power Setting:	18	Tested By:	SB

Test Measurement Results



Power Setting: 18, Duty Cycle (%): 99



30.00 - 1000.00 MHz

Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	60.15	56.23	3.82	-23.59	36.46	MaxQP	Vertical	100	160	40.0	-3.5	Pass
2	60.15	34.64	3.82	-23.59	14.87	MaxQP	Horizontal	98	253	40.0	-25.1	Pass
3	107.99	40.74	4.13	-19.21	25.66	Peak (NRB)	Vertical	100	0	--	--	Pass
4	202.22	46.17	4.61	-19.67	31.11	Peak (NRB)	Vertical	100	0	--	--	Pass
5	350.77	34.45	5.19	-16.76	22.88	Peak (NRB)	Vertical	100	0	--	--	Pass
6	371.89	32.62	5.26	-16.01	21.87	Peak (NRB)	Vertical	100	0	--	--	Pass

Equipment Configuration for Spurious Emissions

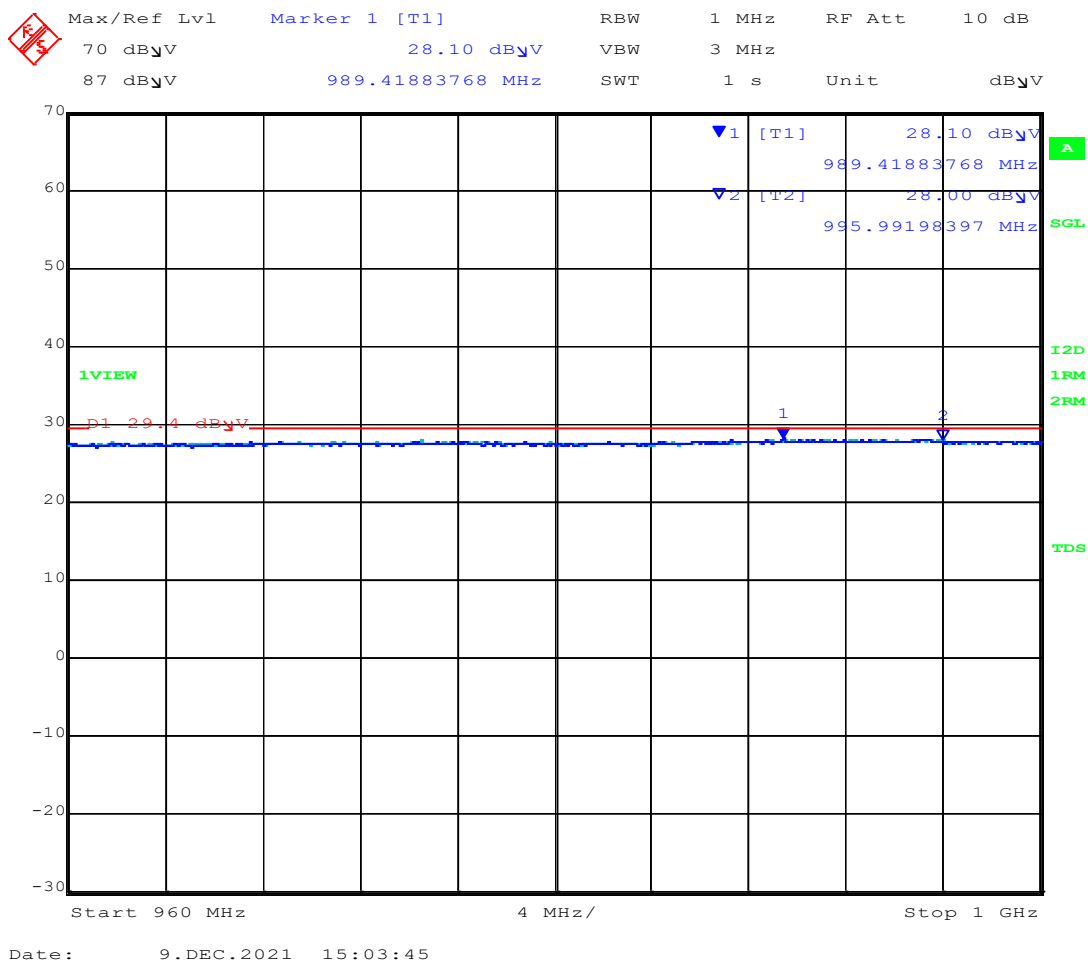
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 960MHz-1.00GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



960.00– 1000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	989.41	28.10	Average	Horizontal	150	0	29.4	-1.30	Pass
2	995.99	28.00	Average	Vertical	150	0	29.4	-1.40	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

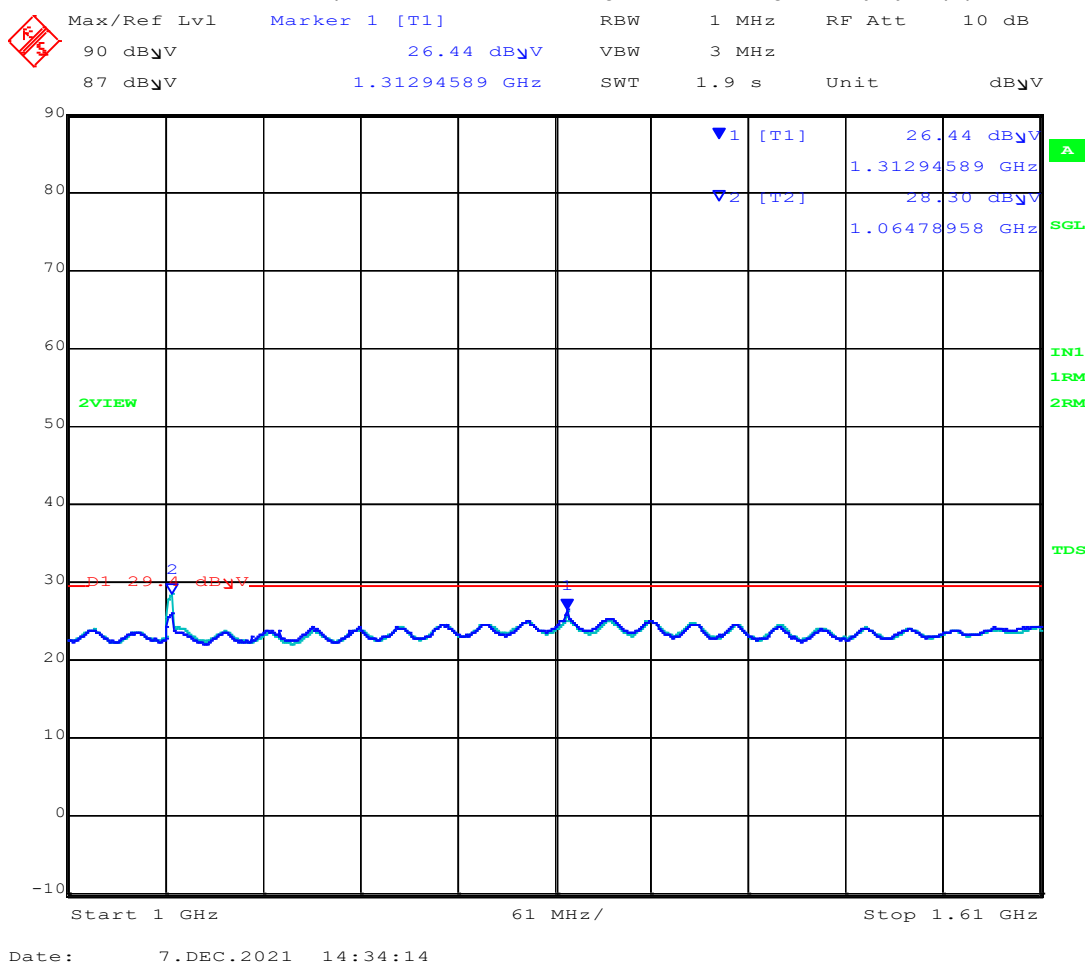
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.0-1.61GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



1000.00– 1610.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1312.94	26.44	Average	Horizontal	150	0	29.4	-2.96	Pass
2	1064.78	26.30	Average	Vertical	150	0	29.4	-3.10	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

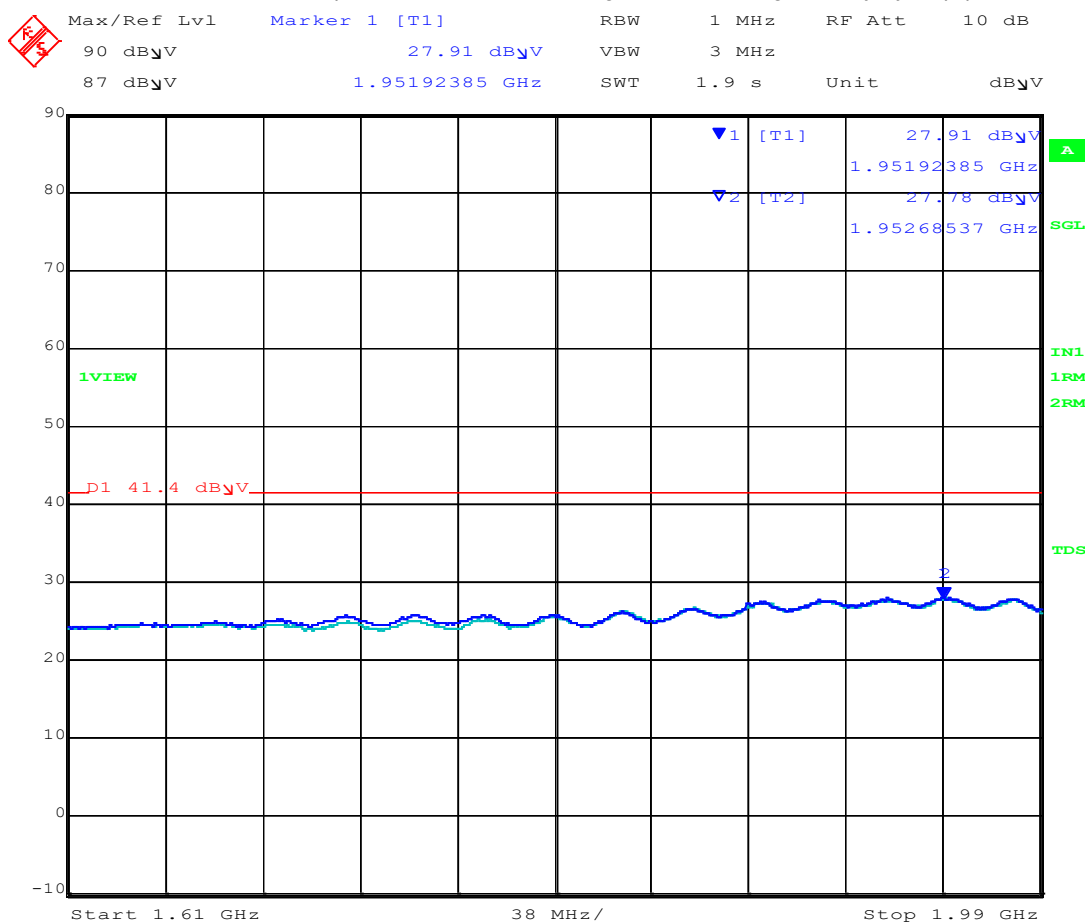
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.61-1.99GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



Date: 7.DEC.2021 14:36:05

1610.00 – 1990.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1951.92	27.91	Average	Horizontal	150	0	41.40	-13.49	Pass
2	1952.68	27.78	Average	Vertical	150	0	41.40	-13.62	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

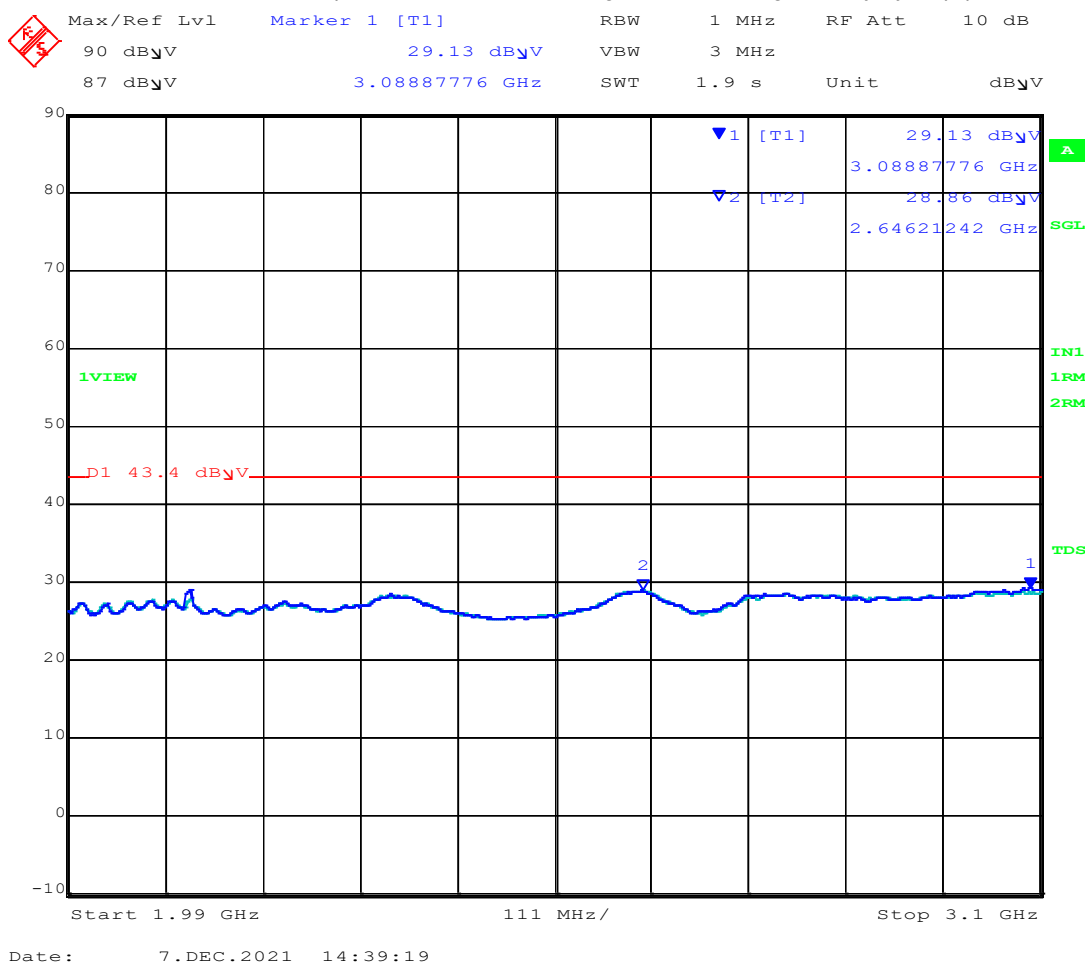
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.99-3.1GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



1990.00 – 3100.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	3088.87	29.13	Average	Horizontal	150	0	43.40	-14.27	Pass
2	2646.21	28.86	Average	Vertical	150	0	43.40	-14.54	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

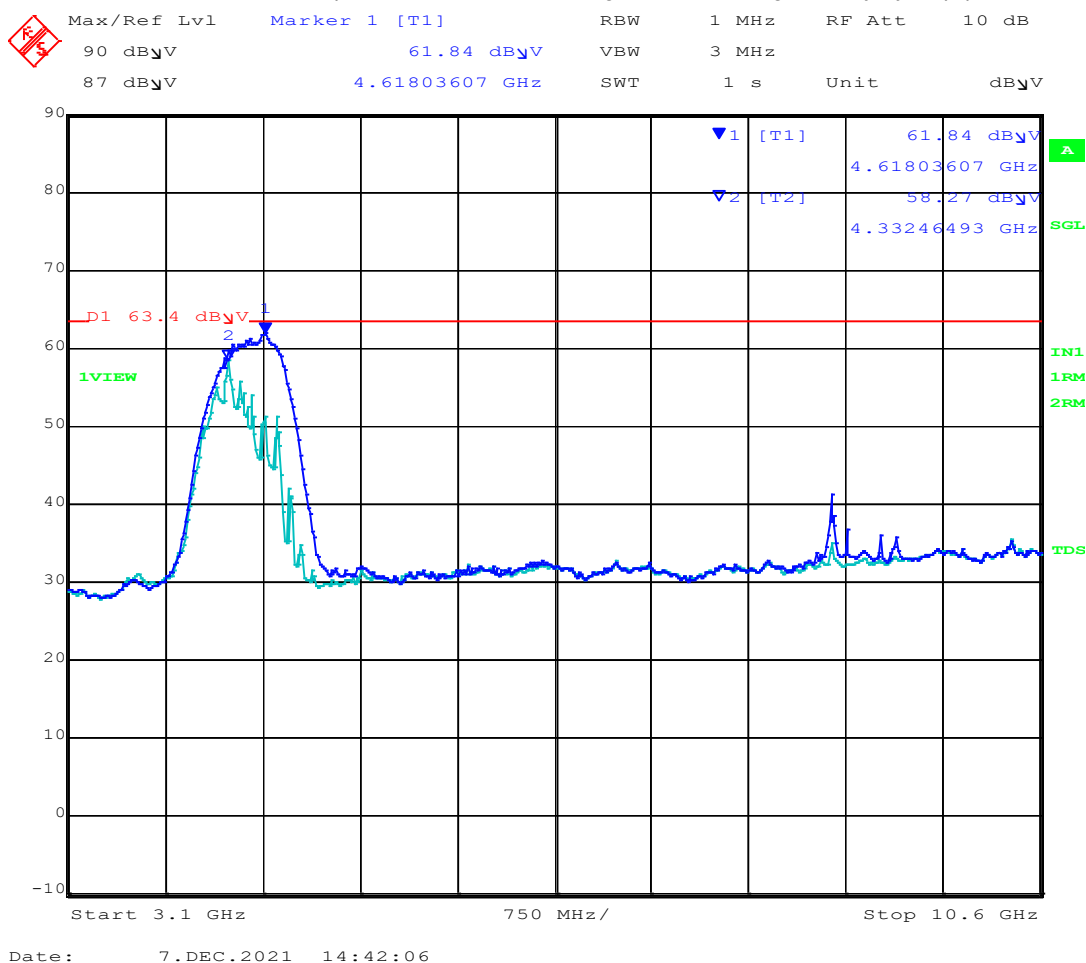
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 3.1-10.6GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



3100.00 – 10600.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	4618.03	61.84	Average	Horizontal	150	0	63.4	-1.56	Pass
2	4332.46	58.27	Average	Vertical	150	0	63.4	-5.13	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

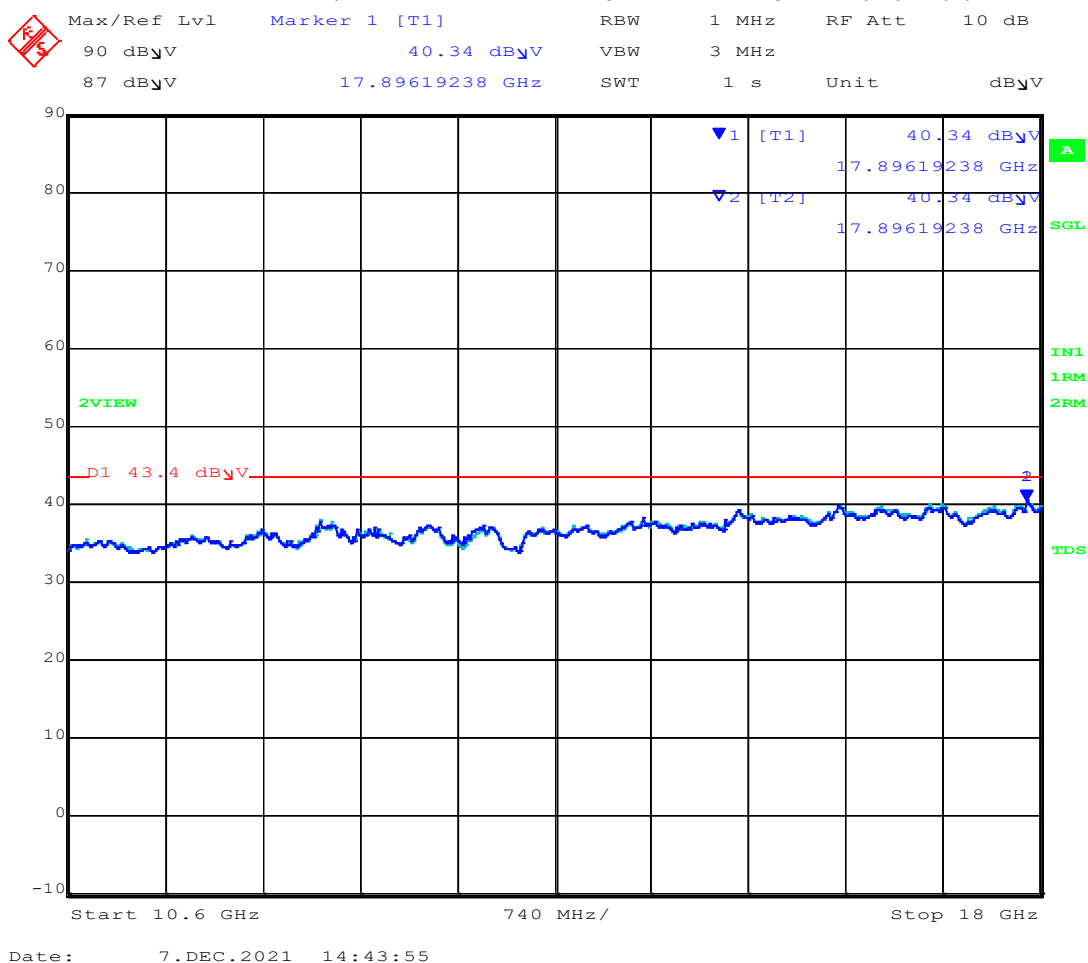
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 10.6-18GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



10600.00 – 18000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	17896.19	40.34	Average	Vertical	150	0	43.4	-3.06	Pass
2	17896.19	40.34	Average	Horizontal	150	0	43.4	-3.06	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

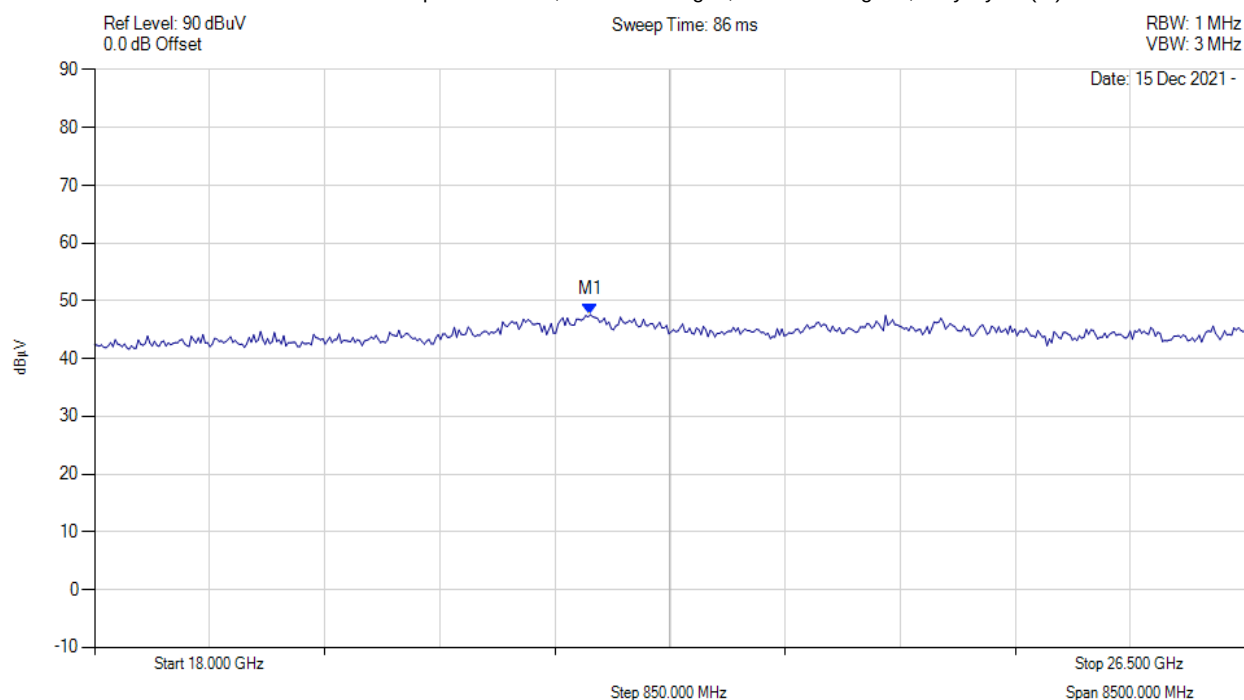
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 18-26GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 21.662 GHz : 47.675 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

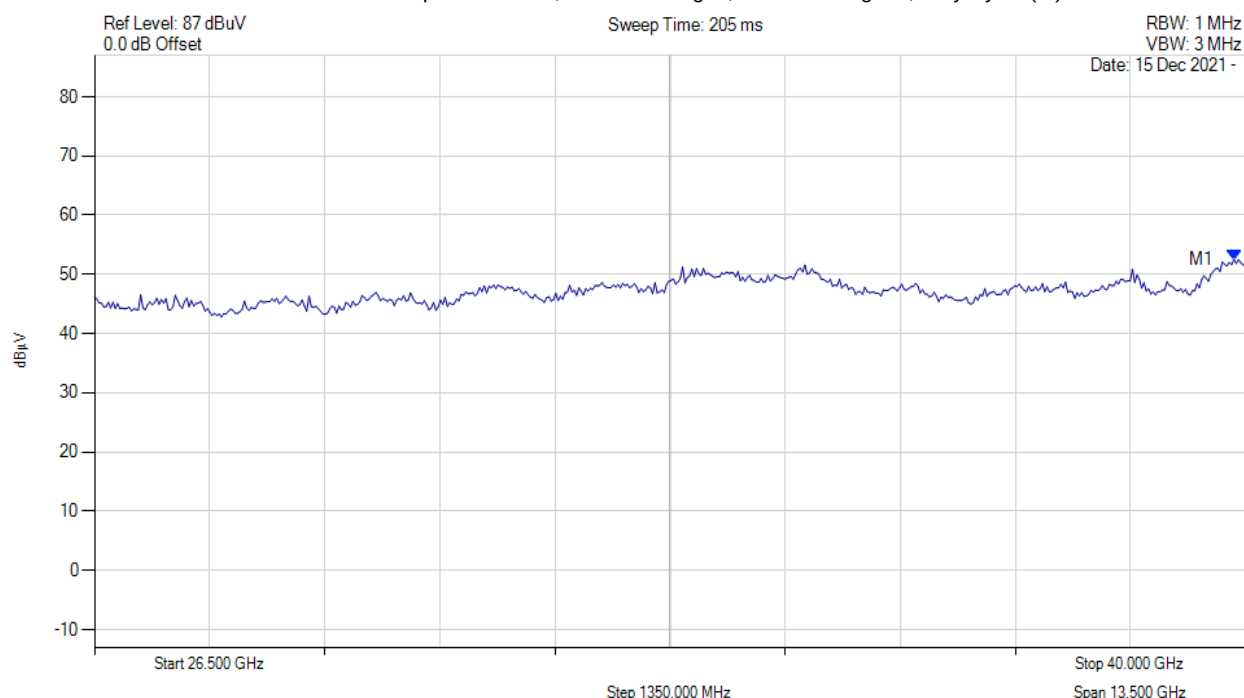
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 26 – 40 GHz

Test Freq: 4492.6 MHz, Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



Analyzer Setup	Marker: Frequency: Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 39.865 GHz : 52.480 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

9.4.1.3. 6489.6 MHz

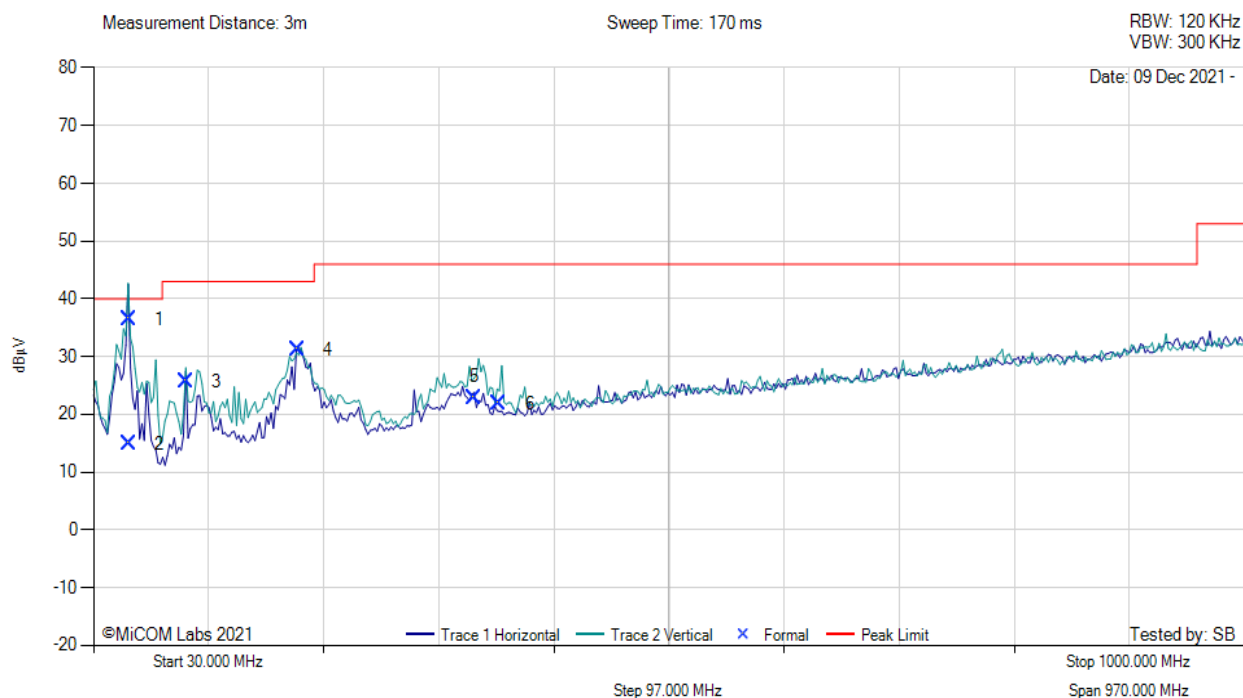
Equipment Configuration for Radiated Digital Emissions

Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	-
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	3993.6 to 6489.6	Data Rate:	Not Applicable
Power Setting:	22	Tested By:	SB

Test Measurement Results



Power Setting: 18, Duty Cycle (%): 99



30.00 - 1000.00 MHz

Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	60.15	56.23	3.82	-23.59	36.46	MaxQP	Vertical	100	160	40.0	-3.5	Pass
2	60.15	34.64	3.82	-23.59	14.87	MaxQP	Horizontal	98	253	40.0	-25.1	Pass
3	107.99	40.74	4.13	-19.21	25.66	Peak (NRB)	Vertical	100	0	--	--	Pass
4	202.22	46.17	4.61	-19.67	31.11	Peak (NRB)	Vertical	100	0	--	--	Pass
5	350.77	34.45	5.19	-16.76	22.88	Peak (NRB)	Vertical	100	0	--	--	Pass
6	371.89	32.62	5.26	-16.01	21.87	Peak (NRB)	Vertical	100	0	--	--	Pass

Equipment Configuration for Spurious Emissions

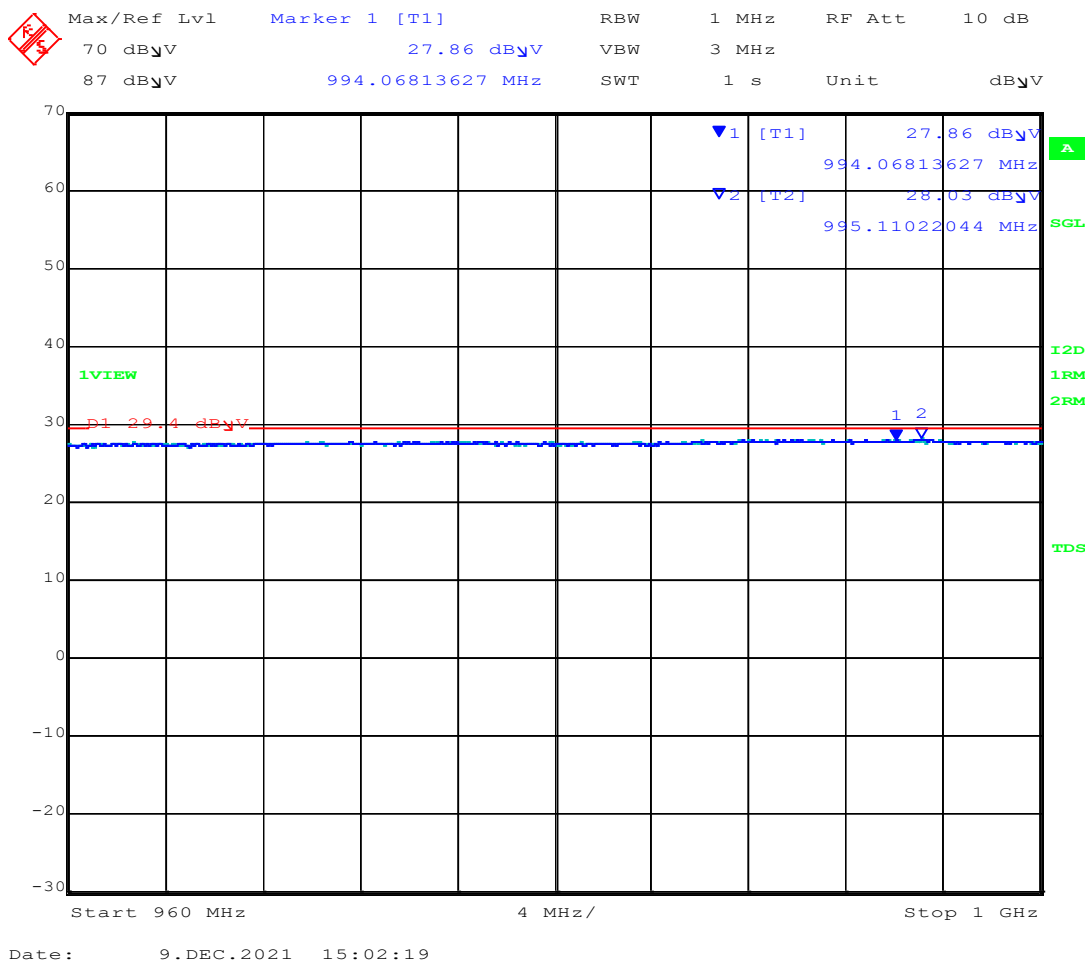
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 960MHz-1.00GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



960.00– 1000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	994.06	27.66	Average	Horizontal	150	0	29.4	-1.74	Pass
2	995.11	28.03	Average	Vertical	150	0	29.4	-1.37	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

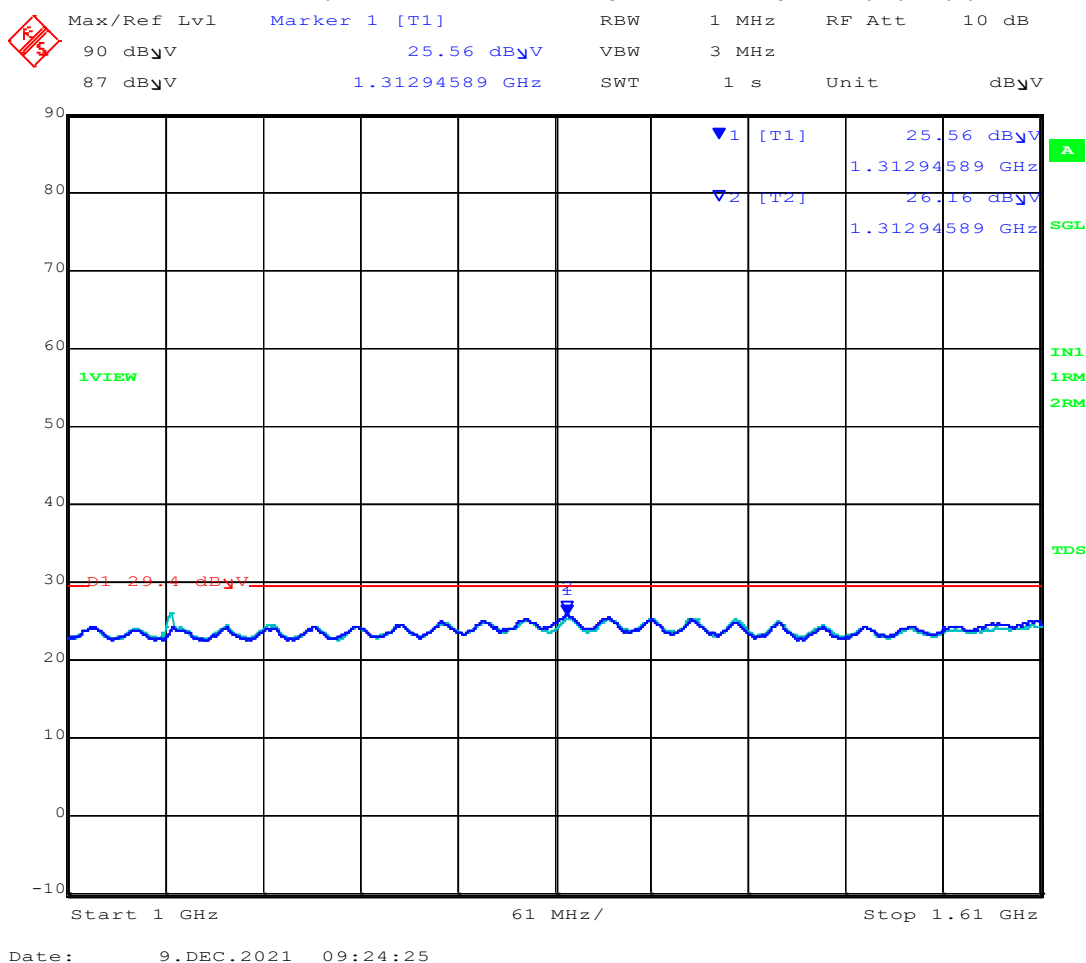
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.0-1.61GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



1000.00– 1610.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1312.94	25.56	Average	Horizontal	150	0	29.4	-3.84	Pass
2	1312.94	26.16	Average	Vertical	150	0	29.4	-3.24	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

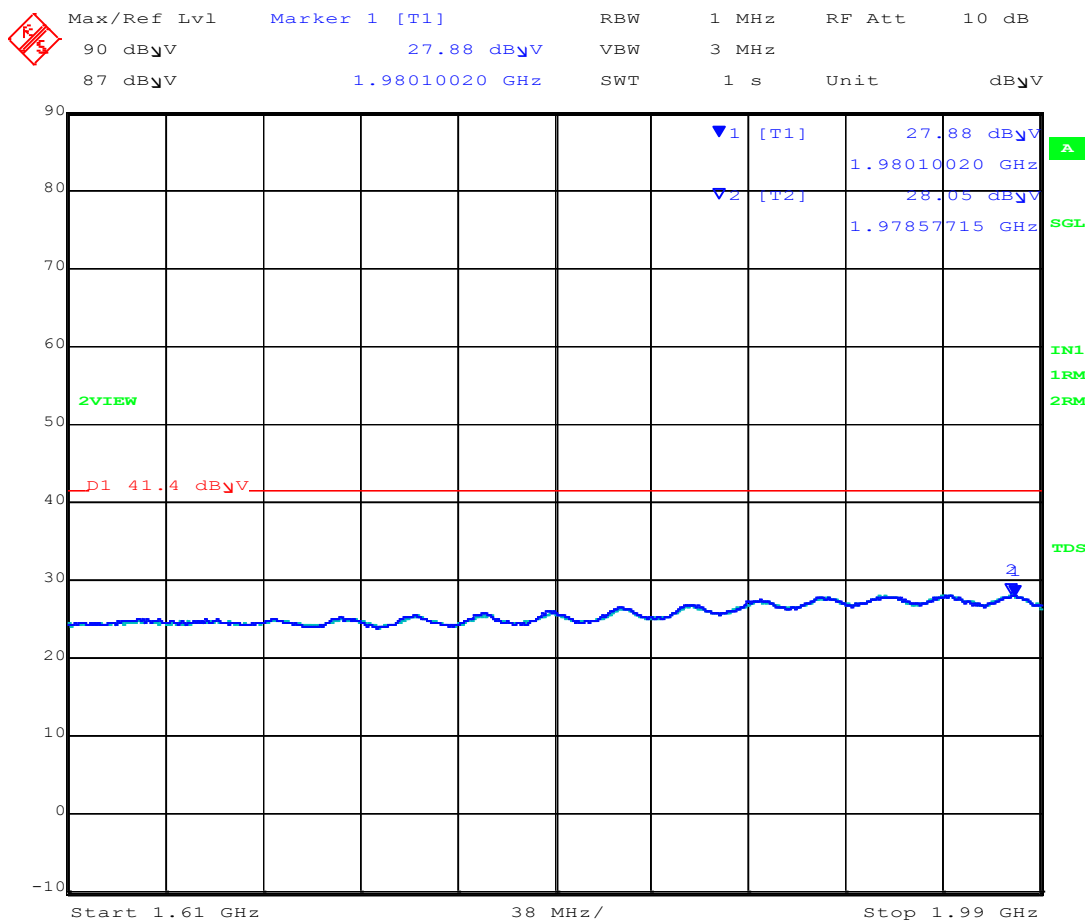
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.61-1.99GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



Date: 9.DEC.2021 09:45:54

1610.00 – 1990.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1980.01	27.88	Average	Horizontal	150	0	41.40	-13.52	Pass
2	1978.57	28.05	Average	Vertical	150	0	41.40	-13.35	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

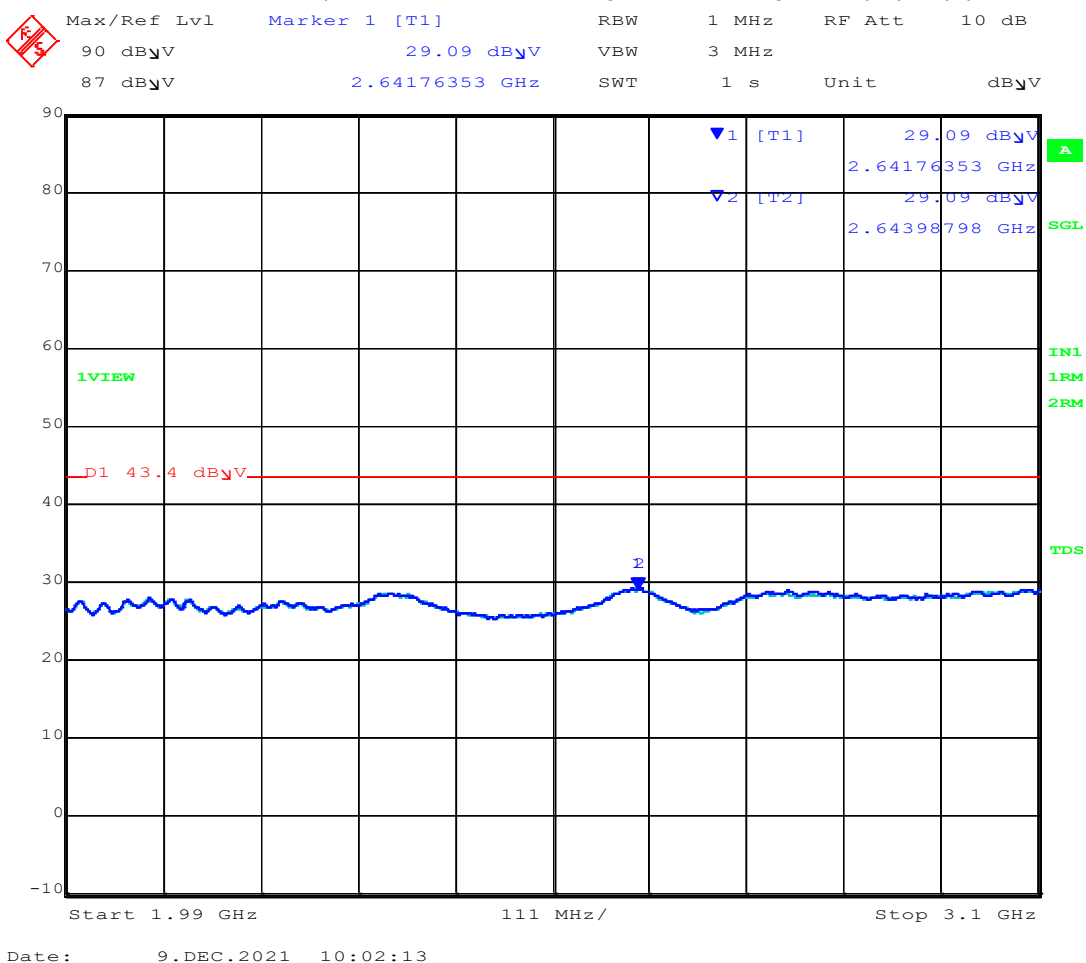
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 1.99-3.1GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



1990.00 – 3100.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	2641.76	29.98	Average	Horizontal	150	0	43.40	-13.42	Pass
2	2643.98	29.09	Average	Vertical	150	0	43.40	-14.31	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

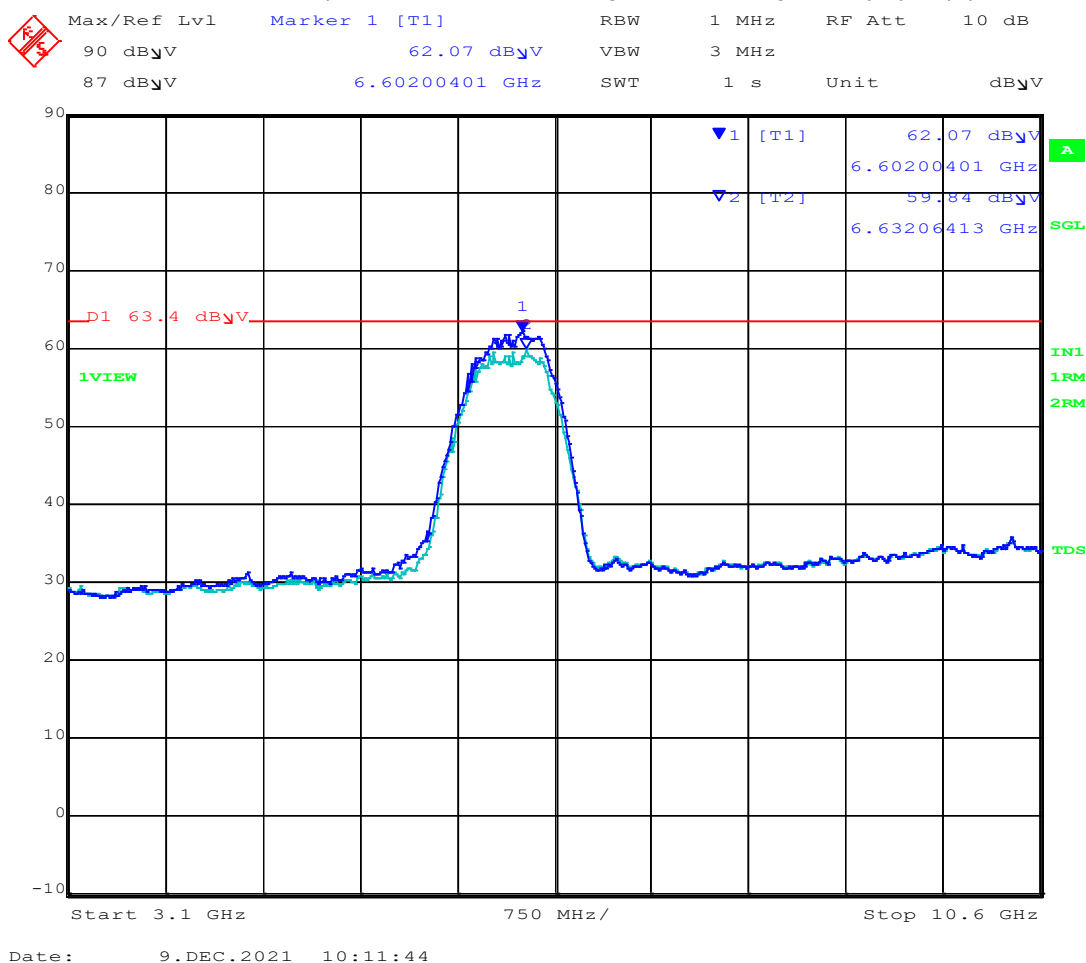
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 3.1-10.6GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



3100.00 – 10600.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	6602.20	62.07	Average	Horizontal	150	0	63.4	-1.33	Pass
2	6632.06	59.84	Average	Vertical	150	0	63.4	-3.56	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

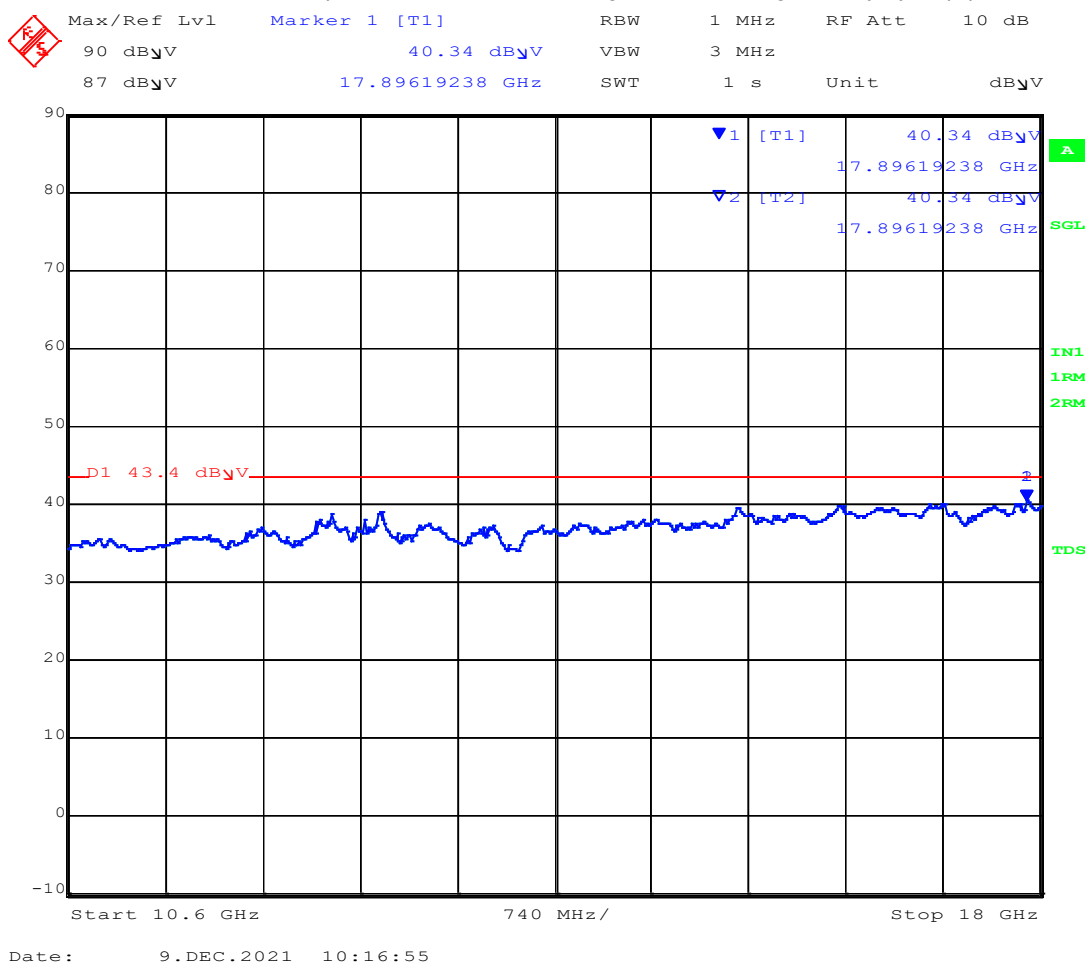
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 10.6-18GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 16, Duty Cycle (%): 99



10600.00 – 18000.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	17896.19	40.34	Average	Horizontal	150	0	43.4	-3.06	Pass
2	17896.19	40.34	Average	Vertical	150	0	43.4	-3.06	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

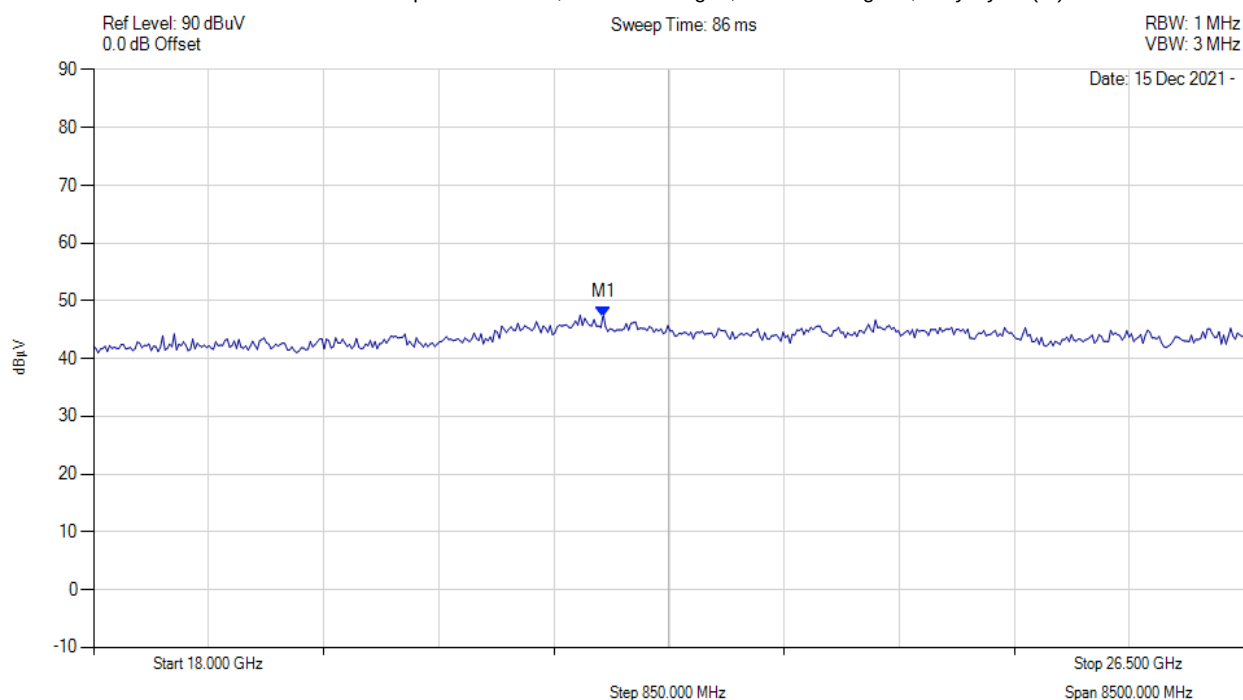
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 18-26GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 22, Duty Cycle (%): 99



Analyzer Setup	Marker: Frequency: Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 21.765 GHz : 47.097 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

Equipment Configuration for Spurious Emissions Horizontal (Worst Case)

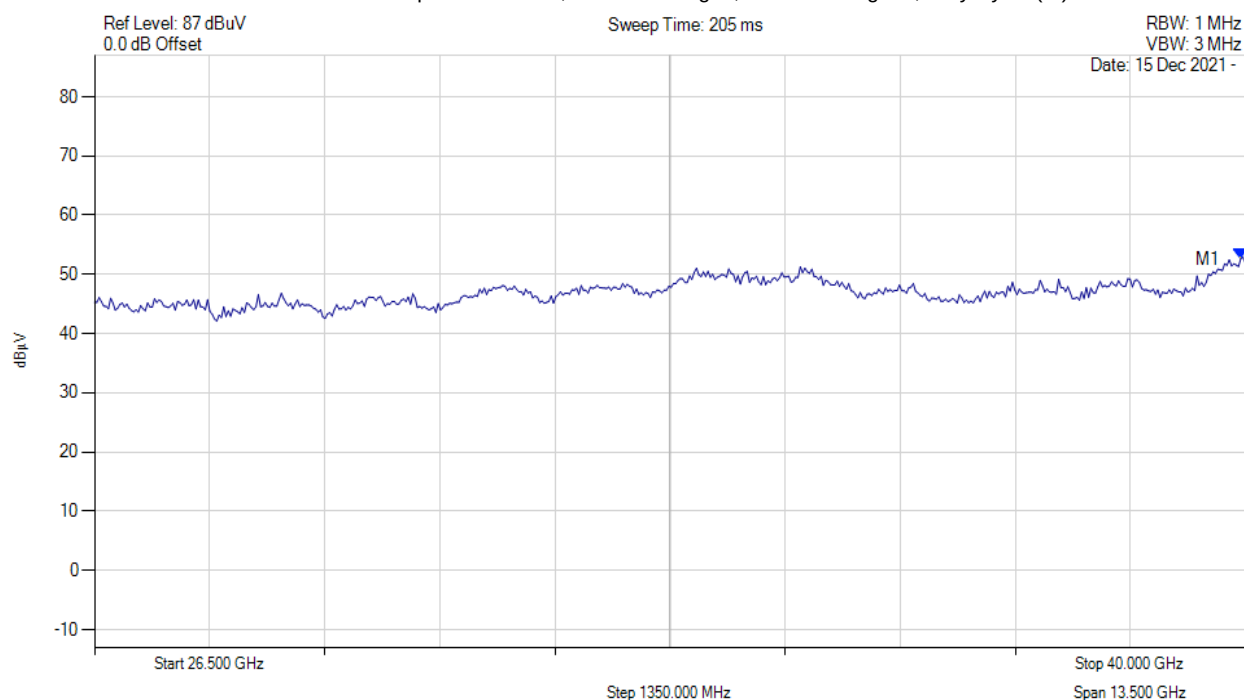
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS 26 – 40 GHz

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 22, Duty Cycle (%): 99



Analyzer Setup	Marker: Frequency: Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 39.946 GHz : 52.630 dBuV	Pass

Note: Emissions were higher for horizontal polarity as such only horizontal is reported.

9.4.2. GPS Band Emissions

9.4.2.4. 3993.6 MHz operation

Equipment Configuration for Spurious Emissions

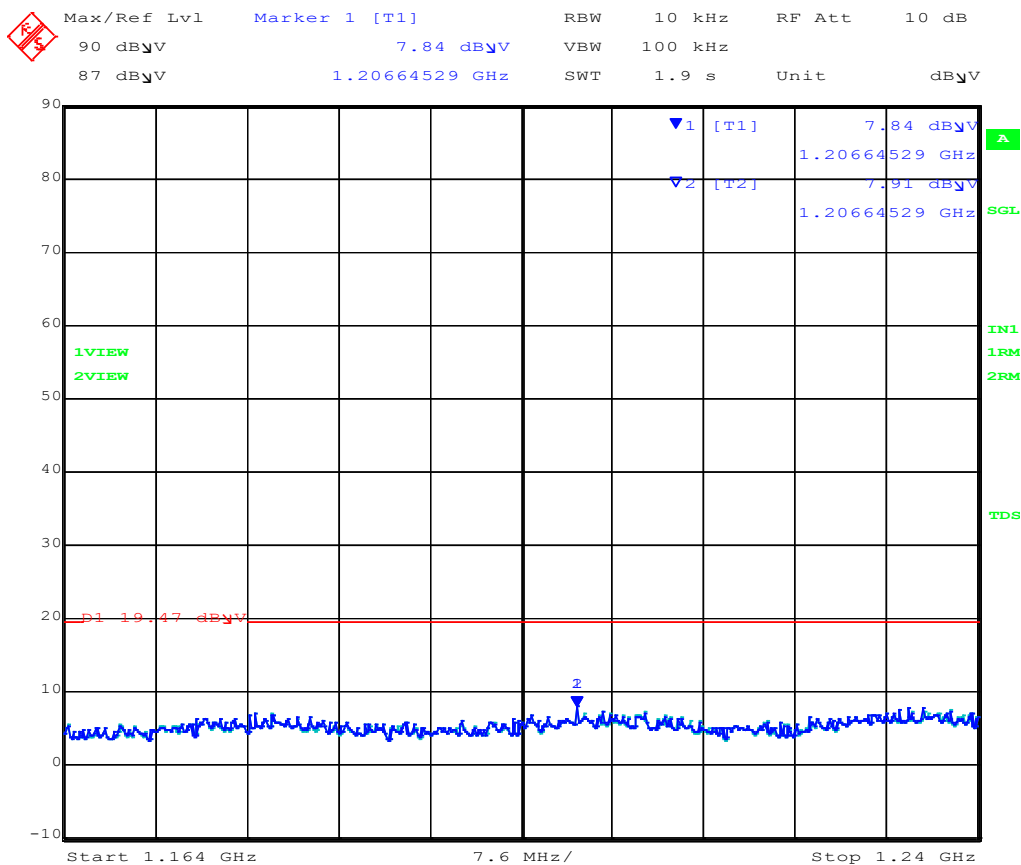
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.164-1.240GHz

Antenna: integral, Power Setting: 22, Duty Cycle (%): 99



Date: 7.DEC.2021 13:38:24

1164.00-1240.00 MHz									
Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1206.64	7.84	Average	Horizontal	150	0	19.47	-11.63	Pass
2	1206.64	7.91	Average	Vertical	150	0	19.47	-11.56	Pass

Test Notes: None

Equipment Configuration for Spurious Emissions

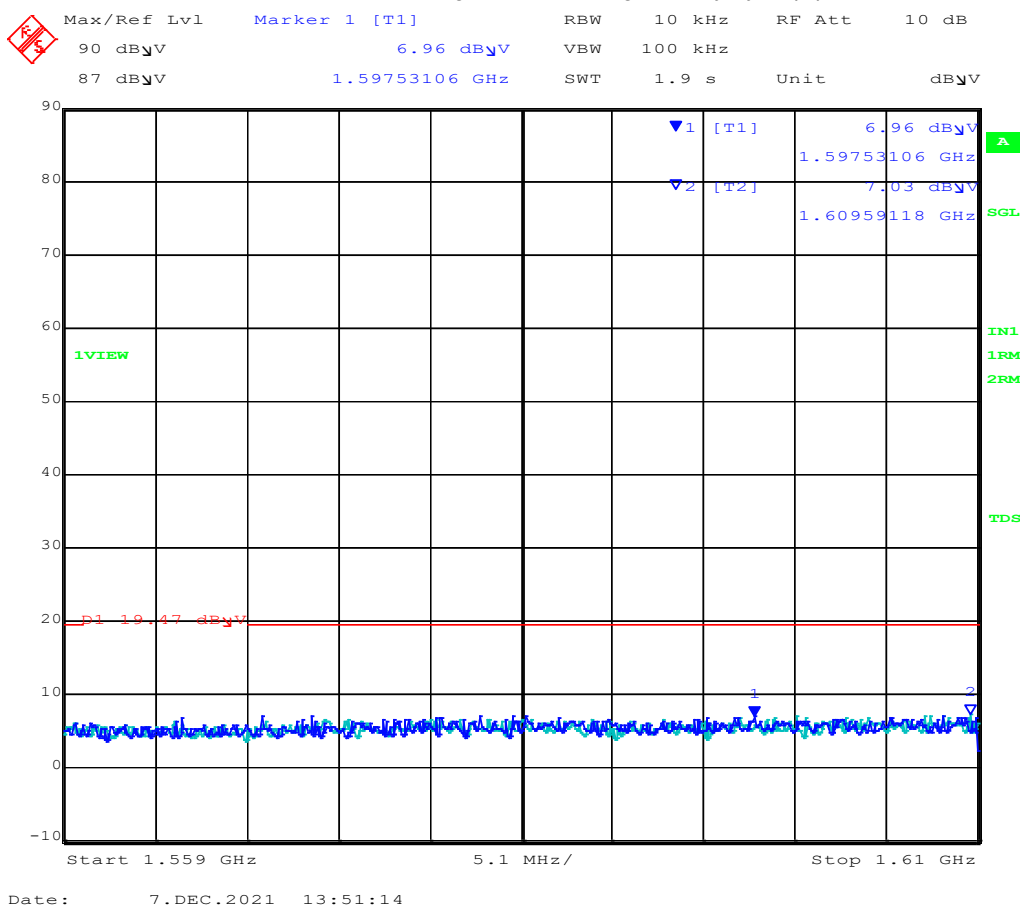
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	1.37	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	3993.6	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.559-1.610GHz

Antenna: integral, Power Setting: 22, Duty Cycle (%): 99



1164.00-1240.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
No Signals Found within 6 dB of Limit									
Test Notes: None									

9.4.2.5. 4492.8 MHz operation

Equipment Configuration for Spurious Emissions

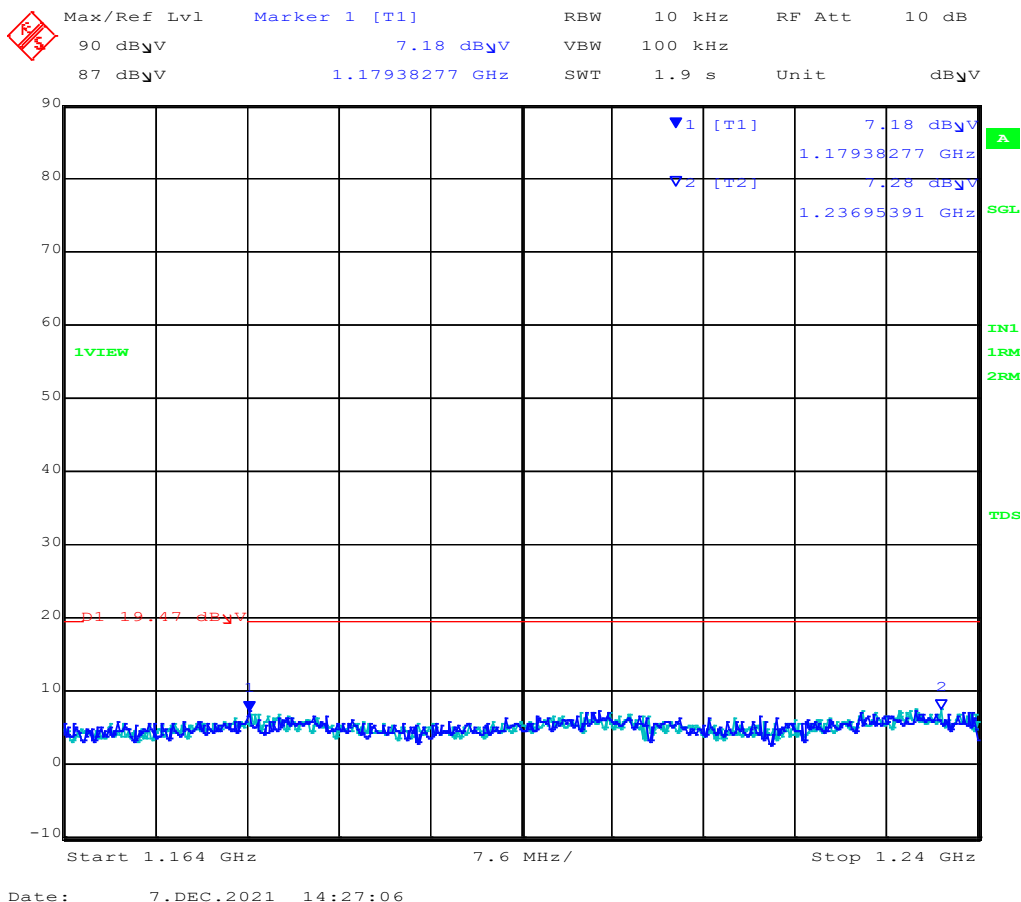
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.8	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.164-1.240GHz

Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



Date: 7.DEC.2021 14:27:06

1164.00-1240.00 MHz									
Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
No Signals Found within 6 dB of Limit									
Test Notes: None									

Equipment Configuration for Spurious Emissions

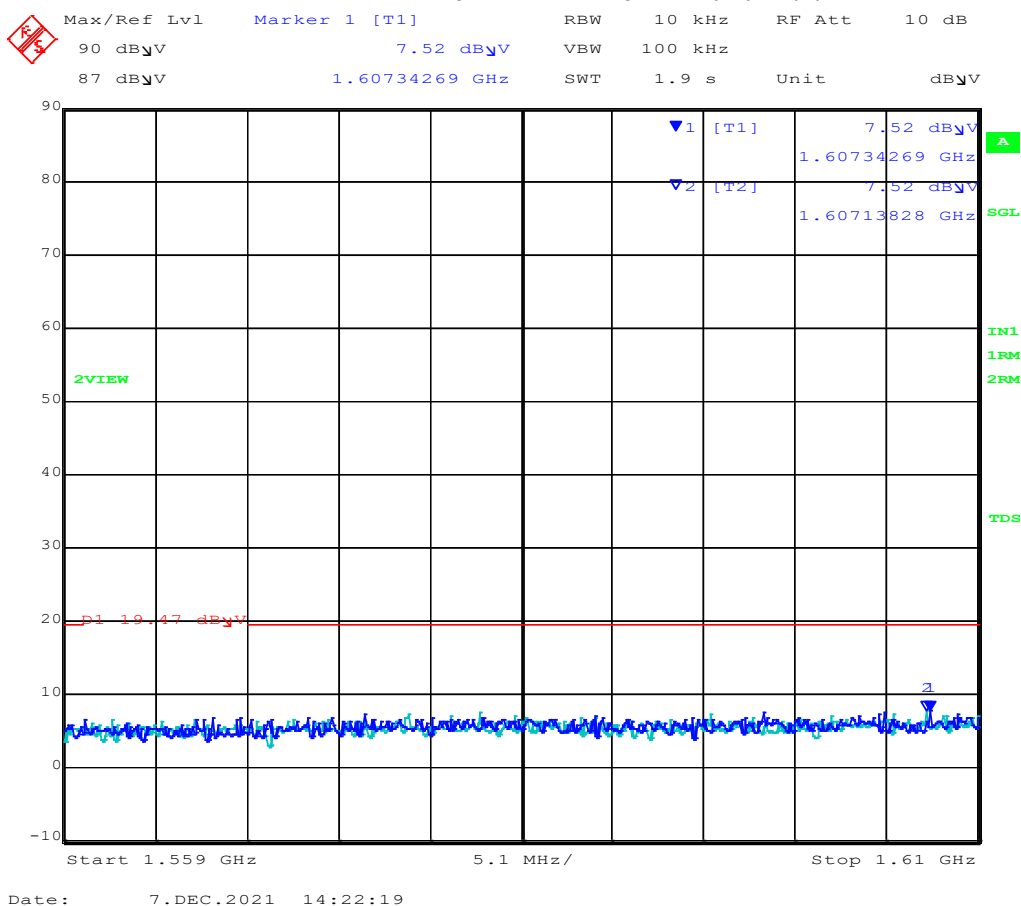
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	4.33	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	4492.8	Data Rate:	
Power Setting:	18	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.559-1.610GHz

Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



1164.00-1240.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
No Signals Found within 6 dB of Limit									
Test Notes: None									

9.4.2.6. 6489.6 MHz operation

Equipment Configuration for Spurious Emissions

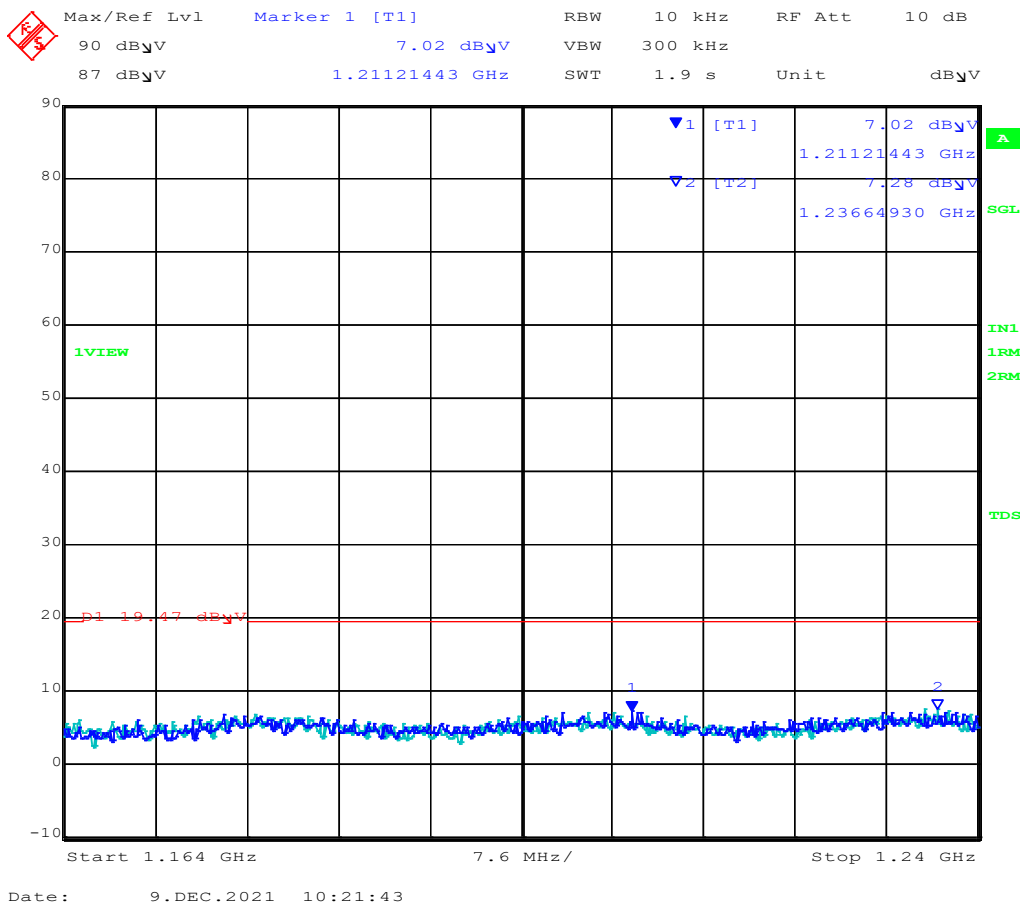
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.164-1.240GHz

Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



1164.00-1240.00 MHz									
Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
No Signals Found within 6 dB of Limit									
Test Notes: None									

Equipment Configuration for Spurious Emissions

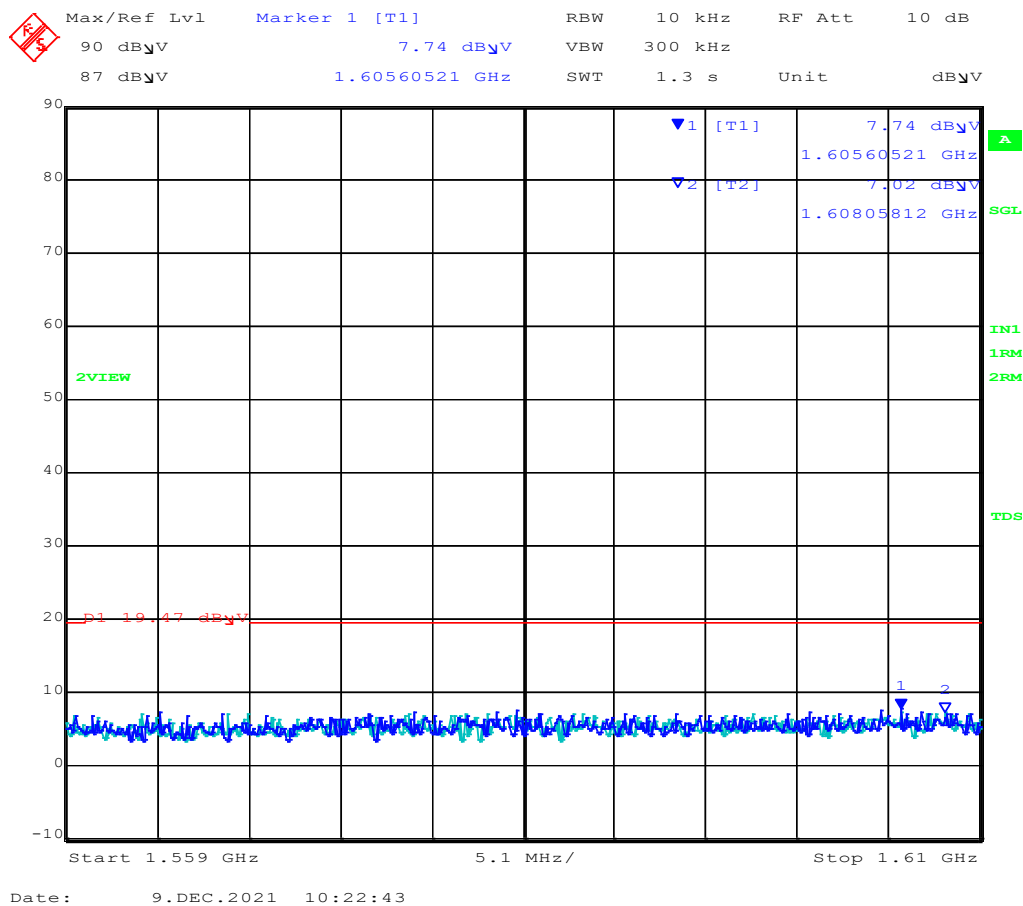
Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99%
Channel Frequency (MHz):	6489.60	Data Rate:	
Power Setting:	22	Tested By:	SB

Test Measurement Results



RADIATED SPURIOUS EMISSIONS GPS 1.559-1.610GHz

Antenna: integral, Power Setting: 18, Duty Cycle (%): 99



1164.00-1240.00 MHz

Num	Frequency MHz	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
No Signals Found within 6 dB of Limit									
Test Notes: None									

9.5. Shutoff Timing Requirements

Radiated Test Conditions for Shutoff Timing Requirements			
Standard:	FCC CFR 47:15.519 (a)(1)	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Shutoff Timing Requirements	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10 Section 10.3.6	Pressure (mBars):	999 - 1001
Reference Document(s):	None		

Test Procedure for UWB Transmission

15.519 (a) (1) A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

Testing was performed under ambient conditions at nominal voltage.

Test configuration and setup used for the measurement was per the Radiated Test Set-up section specified in this document.

Operating Frequency Band:
3100-10600 MHz

Limits
The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received.

Equipment Configuration for Shutdown Timing Requirements

Antenna:	Integral	Variant:	UWB
Antenna Gain (dBi):	6.55	Modulation:	--
Modulation:	Not Applicable	Duty Cycle (%):	<10%
TPC:	6490.60	Data Rate:	
Engineering Test Notes:			

Test Measurement Results

Frequency (MHz)	Marker 2 – Marker 1 = Shutdown Time	Limit (Delta Marker 1)	Margin	EUT Power Setting
	(s)	(s)	(s)	Numeric
6489.60	0.06	10	-9.94	22

Traceability to Industry Recognized Test Methodologies

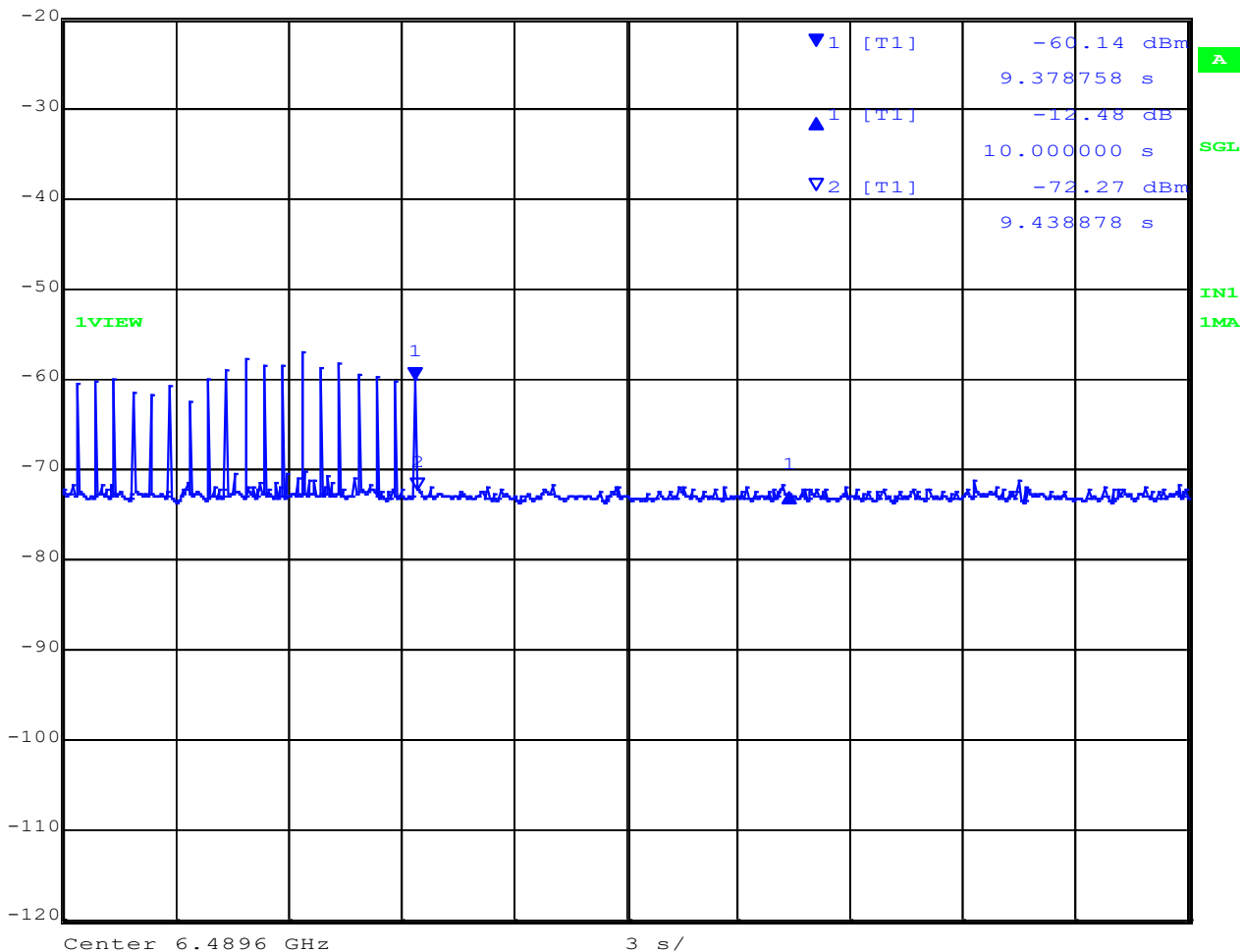
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

Shutdown Timing Requirement

Test Freq: 6489.60 MHz, Antenna: integral, Power Setting: 22



Ref Lvl	Delta 1 [T1]	RBW	1 MHz	RF Att	0 dB
-20 dBm	-12.48 dB	VBW	1 MHz		
	10.000000 s	SWT	30 s	Unit	dBm



Date: 16.DEC.2021 10:29:37

Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	Marker 1 : 9.37 s : -60.14 dBm Delta Marker 1 : 10.0 s : -12.48 dBm Marker 2 : 9.436678 s : -72.27 dBm	Pass

Operational Markers M1, M2, DM1

The graphical representation above contains 3 markers, marker M1 indicates the start of a 10 second window at the point when the associated receiver is removed from the network. Marker M2 marks when the transmitter ceases transmissions, and delta marker M1 indicates the end of the 10 second window.



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