Company: DOVEN LLC

Test of: DV11, DV21, DV31

To: FCC Part 15 Subpart F 15.517 – Indoor UWB Devices

Report No.: JANU01-U2B Rev D

TEST REPORT

COMBINED TEST REPORT

FROM

Test of: DOVEN LLC – DV11, DV21, DV31

To: FCC CFR 47 Part 15 Subpart F 15.517 – Indoor UWB Devices

Test Report Serial No.: JANU01-U2B Rev D

This report supersedes: NONE

Applicant:	DOVEN LLC 2408 Timberloch PL Ste A6 The Woodlands TX 77380 USA
Product Function:	Distance Measurement
Issue Date:	19th June 2018

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. Test Accreditation

MiCOM Labs, Inc. an accredited laboratory complies with the international standard EN ISO/IEC 17025. The company is accreditedby 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

ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

MiCOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *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 14th day of May 2018.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

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

1.2. Recognition

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
model	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries

**NB – Notified Body

1.3. Product Certification

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065. 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 14th day of May 2018

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

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)
TCB Identifier – US0159

Industry Canada – Certification Body
CAB Identifier – US0159

Europe – Notified Body
Notified Body Identifier - 2280

Japan – Recognized Certification Body (RCB)
RCB Identifier – 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	20th February 2018	Initial draft for client review
Draft #2	22nd February 2018	
Rev A	27th February 2018	Initial Release
Rev B	28th March 2018	Removed references to 15.511 and 15.519 See reports JANU01-U2A and JANU01-U2C for other rule parts.
Rev C	9th May 2018	Added KDB references Included AC Wireline Emissions data
Rev D	19th June 2018	Included additional testing sections 9.3 and 9.5 per FCC request

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

3. TEST RESULT CERTIFICATE

Manufacturer:	DOVEN LLC 2408 Timberloch PL Ste A6 The Woodlands TX 77380 USA	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model(s):	DV11AC, DV21AC, DV21DC, DV31DC	**Telephone:** **Fax:**	+1 925 462 0304 +1 925 462 0306
Equipment Type:	Distance Measurement		
S/N's:	DV11-AC: 1C-11-A4-00-7B-2B-C7-9A DV21- AC: 1C-11-A5-00-7B-2B-C7-91 DV21-DC: 1C-11-EB-00-7B-2B-C7-94 DV31-DC: 1C-11-A5-00-7B-2B-C7-9B		
Test Date(s):	29th – 31st January 2018	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart F 15.517	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.

A2LA ACCREDITED
TESTING CERT #2381.01

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	August 2017	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

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 DOVEN DV11, DV21, DV31 to FCC CFR 47 Part 15 Subpart F 15.517
Applicant:	DOVEN LLC 2408 Timberloch PL Ste A6 The Woodlands TX 77380 USA
Manufacturer:	As applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	JANU01-U2
Date EUT received:	29th January 2018
Standard(s) applied:	FCC CFR 47 Part 15 Subpart F 15.517
Dates of test (from - to):	29th - 31st January 2018
No of Units Tested:	4
Product Family Name:	DOVEN
Model(s):	DV11-AC, DV21-AC, DV21-DC, DV31-DC
Location for use:	Indoor environments only
Declared Frequency Range(s):	3100-10600 MHz
Type of Modulation:	BPM/BPSK
EUT Modes of Operation:	500 MHz Bandwidth
Declared Nominal Output Power (dBm):	-41 dBm
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	DV11-AC & DV21-AC: 100 – 240 V_{AC}, 0.018 Amps (Max) DV21-DC & DV31-DC: 24 $V_{DC,}$, 0.085 Amps
Operating Temperature Range:	-20 ~ +70°C
ITU Emission Designator:	500MX0D
Equipment Dimensions:	DV11-AC, DV21-AC, DV21-DC: 369.9x340.1x60.4 mm, DV31-DC: 110.1 x 180.5 x75.2
Weight:	DV11-AC: 2.12 Kg DV21-AC: 2.06 Kg DV21-DC: 1.97 Kg DV31-DC: 0.95 Kg
Hardware Rev:	1.0.0
Software Rev:	1.0.0

5.2. Scope Of Test Program

The scope of the test program was to test the Janus Automation DOVEN Series configurations in the frequency ranges 3100 - 10600 MHz for compliance against the following specification:

FCC CFR 47 Part 15 Subpart F – 15.517
Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 3100 - 10600 MHz bands.

Model Differences
DV11-AC - 120 VAC Unit with integrated directional antenna
DV21-AC - 120 VAC Unit with integrated wide-angle antenna
DV31-DC - 24 VDC Unit with external omnidirectional antenna
DV21-DC - 24 VDC Unit with integrated wide-angle antenna

The circuitry between the DV11-AC and DV21-AC is identical.
The circuitry between the DV21-DC and DV31-DC is identical.

DV11-AC, DV21-AC, DV21-DC

Front View

DV11-AC, DV21-AC, DV21-DC

Rear View

DV31-DC

Front View

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr.	Model No.	Serial No.
EUT	120 VAC Unit with integrated directional antenna	DOVEN LLC	DV11-AC	1C-11-A4-00-7B-2B-C7-9A
EUT	120 VAC Unit with integrated wide-angle antenna	DOVEN LLC	DV21-AC	1C-11-A5-00-7B-2B-C7-91
EUT	24 VDC Unit with integrated wide-angle antenna	DOVEN LLC	DV21-DC	1C-11-A5-00-7B-2B-C7-9B
EUT	24 VDC Unit with external omnidirectional antenna	DOVEN LLC	DV31-DC	1C-11-EB-00-7B-2B-C7-94

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
Integral	DOVEN LLC	DV11-AC	Directional	13.0	--	--	No	3250 - 4250
Integral	DOVEN LLC	DV21-AC	Wide	9.28	--	--	No	3250 - 4250
Integral	DOVEN LLC	DV21-DC	Wide	9.28	--	--	No	3250 - 4250
External*	DOVEN LLC	DV31-DC	OMNI	6.0	--	--	No	3250 - 4250

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

*Note: External antenna sold with model DV31-DC is the only antenna permitted to be used with this device. Antenna must also be professionally installed.

5.5. Cabling and I/O Ports

None

5.6. Test Configurations

Results for the following configurations are provided in this report:

Channel Bandwidth(s)	Transmission Rate	Channel Frequency (MHz)		
		Low	Mid	High
500MHz	6.8 Mbit/s	Single Frequency 3492.00		

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

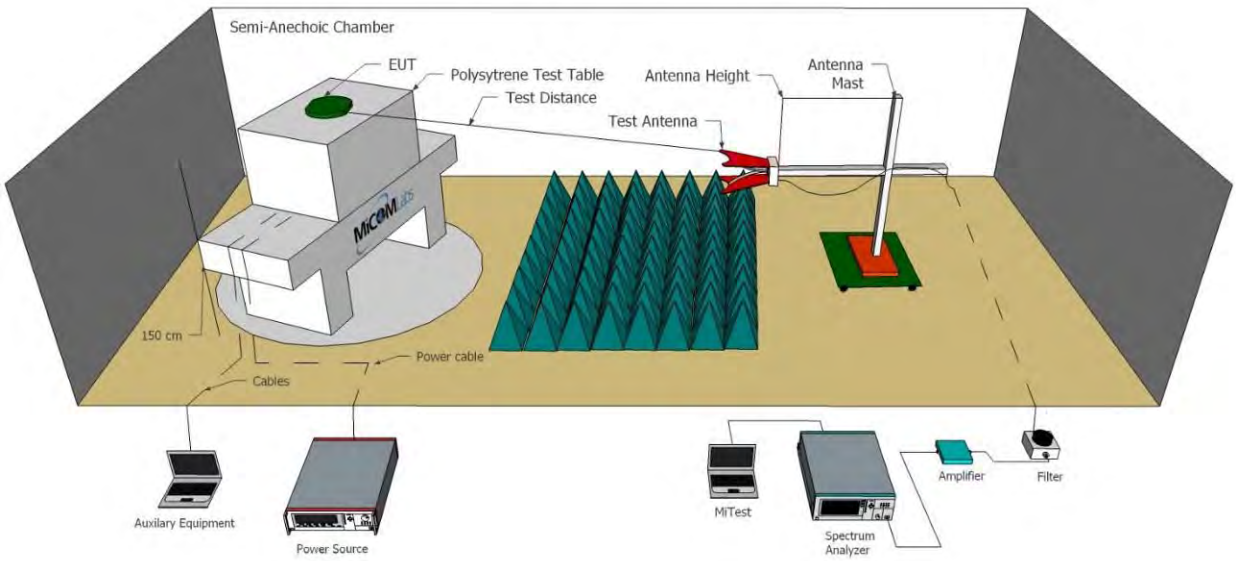
Test Header	Result	Data Link
Radiated Test Methodology	Complies	-
UWB Bandwidth	Complies	View Data
Radiated Power	Complies	View Data
Peak Power Density	Complies	View Data
Spurious Radiated Emissions 30 MHz - 1000 MHz	Complies	View Data
Spurious Radiated Emissions 1000 MHz - 18000 MHz	Complies	View Data
Spurious Radiated Emissions in GPS Bands	Complies	View Data
Shutdown Timing Requirements	Complies	View Data
AC Wireline Emissions	Complies	View Data
Comments: None		

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Radiated Emissions - 3m Chamber

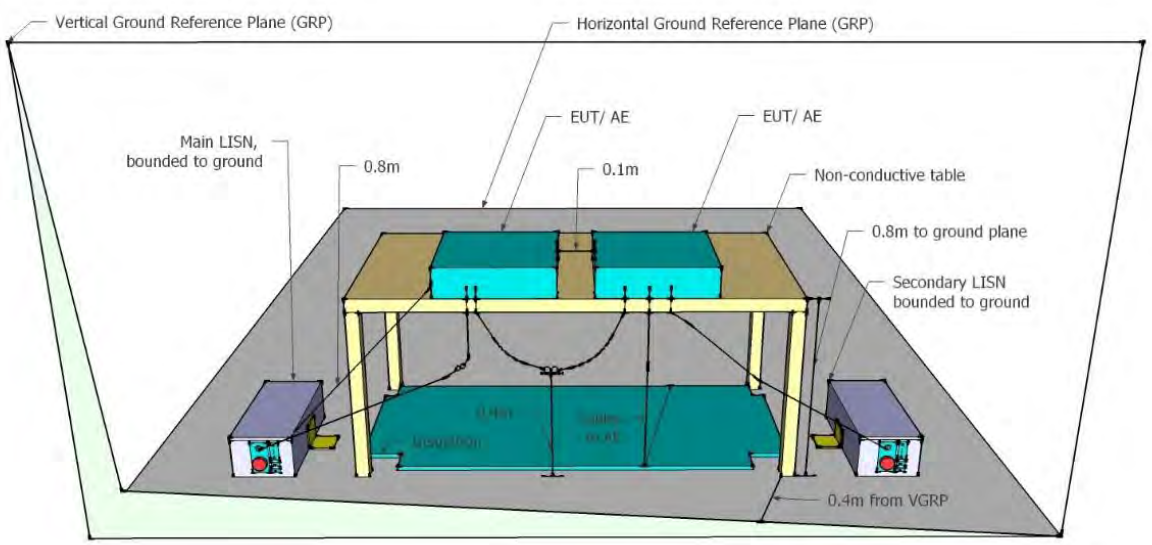
The following tests were performed using the radiated test set-up shown in the diagram below. Radiated emissions above 1GHz.

Radiated Emissions Above 1GHz Test Setup



7.2. AC Wireline Emissions

The following tests were performed using the test set-up shown in the diagram below.



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

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account 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
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	6 Oct 2018
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	18 Oct 2018
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2019
295	Conducted Emissions Chamber Maintenance Check	MiCOM	Conducted Emissions Chamber	295	19 Dec 2018
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	27 Jul 2018
307	BNC-CABLE	Megaphase	1689 1GVT4	15F50B002	6 Oct 2018
316	Dell desktop computer workstation	Dell	Desktop	WS04	Not Required
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	5 Oct 2018
372	AC Variable PS	California Instruments	1251P	L06951	Cal when used
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
388	LISN (3 Phase) 9kHz - 30MHz	Rohde & Schwarz	ESH2-Z5	892107/022	20 Oct 2018
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 Oct 2018
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2018
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Oct 2018
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
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
447	MiTest Rad Emissions Test Software	MiCOM	Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	4 Oct 2018
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	4 Oct 2018
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	4 Oct 2018
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	6 Oct 2018
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	6 Oct 2018
482	Cable - Amp to Antenna	SRC Haverhill	157-3051574	482	6 Oct 2018
496	MiTest Conducted Emissions test software.	MiCOM	Conducted Emissions Test Software Version 1.0	496	Not Required
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
CCEMC01	Confidence Check.	MiCOM	CCEMC01	None	2 Jul 2018

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 26 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.517	**Ambient Temp. (ºC):**	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		

Test Procedure for UWB Bandwidth Measurement
The UWB Bandwidth is measured radiated, at a 3-meter distance, while EUT is operating in transmission mode at the appropriate center frequency. The Resolution Bandwidth was set to 1MHz RBW IAW ANSI C63.10.
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.

Equipment Configuration for UWB Bandwidth			
Variant:	500 MHz Bandwidth	**Duty Cycle (%):**	100
Data Rate:	-	**Antenna Gain (dBi):**	Varies By EUT
Modulation:	BPM/BPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

DV11-AC

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)			
MHz	Port A	Highest	Lowest		
3650.00	430.9	430.9	430.9		

DV21-AC

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)			
MHz	Port A	Highest	Lowest		
3650.00	543.1	543.1	543.1		

DV21-DC

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)			
MHz	Port A	Highest	Lowest		
3650.00	501.0	501.0	501.0		

DV31-DC

Test Frequency	Measured 10 dB Bandwidth (MHz)	10 dB Bandwidth (MHz)			
MHz	Port A	Highest	Lowest		
3650.00	545.1	545.1	545.1		

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

Note: click the links in the above matrix to view the graphical image (plot).

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

9.2. Peak Transmit Power

Conducted Test Conditions for Maximum Radiated Output Power			
Standard:	FCC CFR 47:15.517 (c)	**Ambient Temp. (ºC):**	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. Supporting KDB's referenced below.

Operating Frequency Band:
3100-10600 MHz

Limits Maximum EIRP (dBm)

Frequency (MHz)	EIRP Limit (dBm)	EIRP at 3 Meters (dBuv/m)
3100 - 10600	-41.3	53.93

Equipment Configuration for RF Output Power

Variant:	500 MHz Bandwidth	**Duty Cycle (%):**	99
Data Rate:	-	**Antenna Gain (dBi):**	Varies by EUT
Modulation:	BPM/BPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Measured Output Power (dBuv/m)	Calculated Total Power	Limit	Margin	EUT Power Setting
	Port A	dBuv/m	dBuv/m	Numeric	Numeric
DV11-AC	52.9	52.9	53.9	-1.0	Max
DV21-AC	49.8	49.8	53.9	-4.1	Max
DV21-DC	49.1	49.1	53.9	-4.8	Max
DV31-DC	51.7	51.7	53.9	-2.2	Max

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

9.3. Peak Power Density

Radiated Test Conditions for Maximum Peak Power Density			
Standard:	FCC CFR 47:15.517 (e)	**Ambient Temp. (ºC):**	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

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.

Measurements were gathered with a RBW of 1MHz and converted to 50MHz using the following formula:

$EIRP_{1\ MHz} = EIRP_{50\ MHz} + 20\log(1MHz/50MHz) = 0dBm + (-34dBm) = -34dBm$

Operating Frequency Band:
3100-10600 MHz

Limits Maximum EIRP (dBm)

Frequency (MHz)	EIRP Limit (dBm/50MHz)	EIRP Limit (dBm/1MHz)	EIRP at 3 Meters (dBuv/m)
3100 - 10600	0	-34	61.23

Equipment Configuration for Peak Power Density			
Variant:	500 MHz Bandwidth	**Duty Cycle (%):**	99
Data Rate:	-	**Antenna Gain (dBi):**	Varies by EUT
Modulation:	BPM/BPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JH
Engineering Test Notes:			

Test Measurement Results

Device	Measured Output Power	Limit	Margin	EUT Power Setting
	dBuv/m	dBuv/m	Numeric	Numeric
DV11-AC	55.06	61.23	-6.17	Max
DV21-AC	47.86	61.23	-13.37	Max
DV21-DC	46.32	61.23	-14.91	Max
DV31-DC	42.75	61.23	-18.48	Max

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

9.4. Radiated Spurious Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47 15.517	**Ambient Temp. (ºC):**	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 peak 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

Frequency Range		Limit	
MHz	**MHz**	**EIRP (dBm)**	**EIRP at 3 Meters (dBuV/m)**
960	1610	-75.3	19.9
1610	1990	-53.3	41.9
1990	3100	-51.3	43.9
3100	10600	-41.3	53.9
10600	18000	-51.3	43.9

Radiated Spurious Emissions in the GPS Bands 15.517(d)

Frequency Range		Limit	
MHz	**MHz**	**EIRP (dBm)**	**EIRP at 3 Meters (dBuV/m)**
1164	**1240**	**-85.3**	**9.9**
1559	**1610**	**-85.3**	**9.9**

9.4.1. TX Spurious Band Emissions

9.4.1.1. DV21-AC

Equipment Configuration for Spurious Emissions			
Antenna:	DV21-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	-
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max

1000.00 - 1610.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1399.22	33.07	1.83	-16.28	18.62	Peak (Scan)	Vertical	100	0	19.9	-1.3	Pass
2	1403.63	33.39	1.83	-16.28	18.94	Peak (Scan)	Horizontal	100	0	19.9	-1.0	Pass
3	1528.16	33.04	1.88	-16.62	18.30	Peak (Scan)	Vertical	100	0	19.9	-1.6	Pass

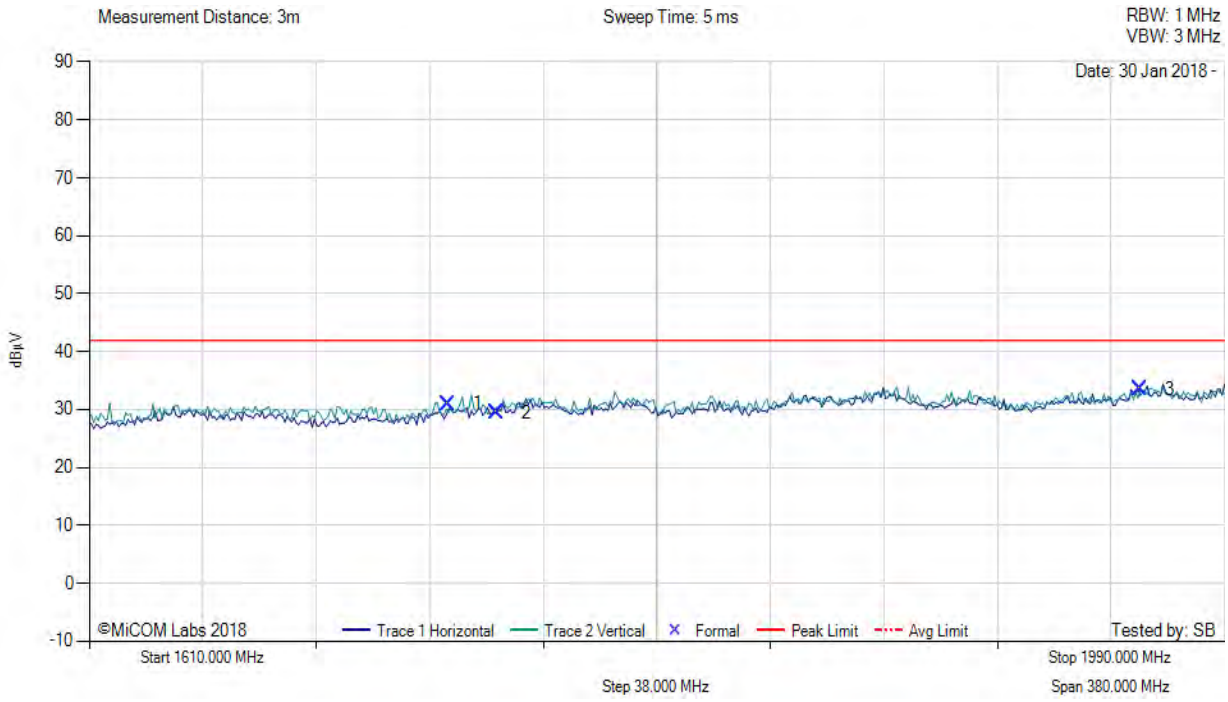
Test Notes:

Equipment Configuration for Spurious Emissions

Antenna:	DV21-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



1610.00 - 1990.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1730.00	44.38	1.96	-15.35	30.99	Peak (NRB)	Horizontal	100	0	--	--	Pass
2	1746.42	42.67	1.99	-15.16	29.50	Peak (NRB)	Horizontal	100	0	--	--	Pass
3	1961.67	44.54	2.09	-13.12	33.51	Peak (NRB)	Horizontal	100	0	--	--	Pass

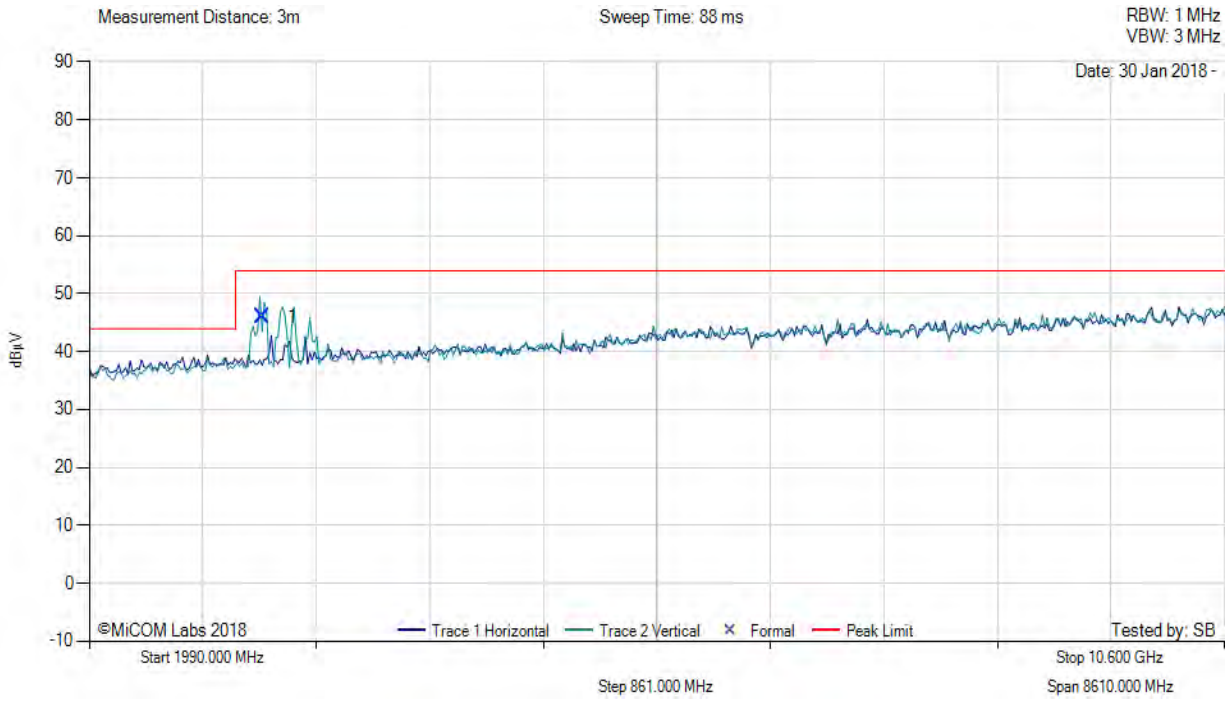
Test Notes:

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV21-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



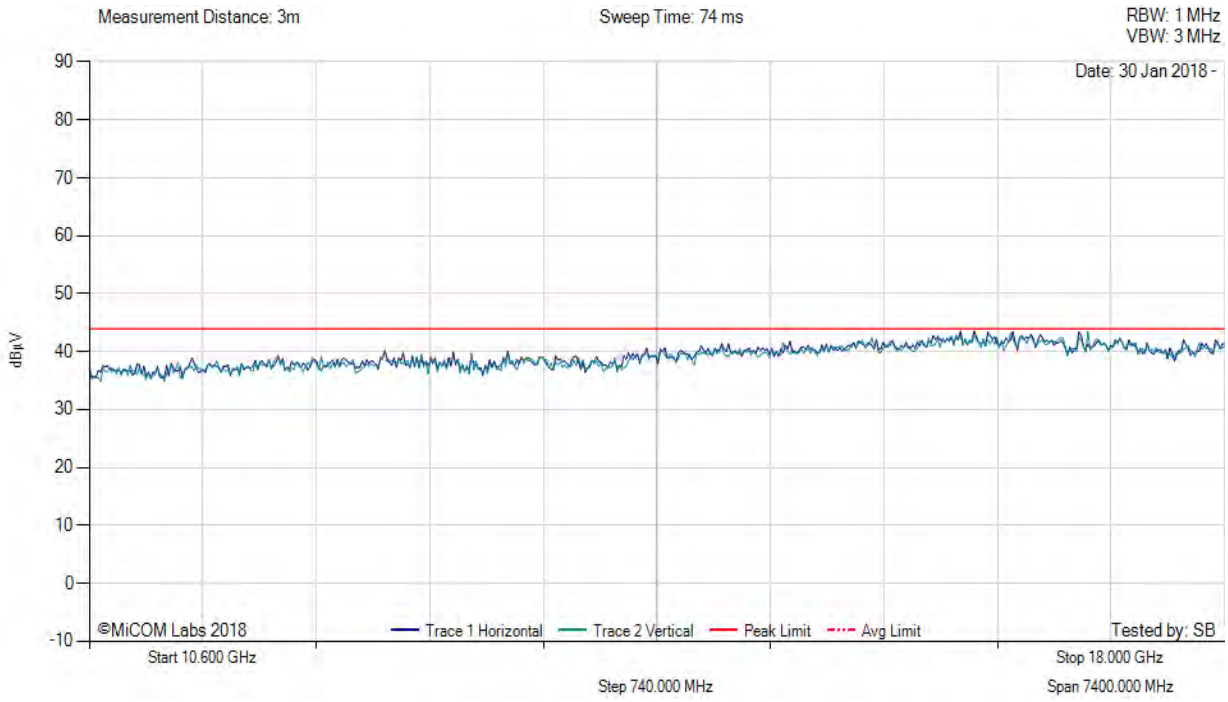
1990.00 - 10600.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	3301.01	55.15	2.58	-11.77	45.96	Fundamental	Vertical	100	0	--	--	

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV21-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



There are no emissions found within 6dB of the limit line.

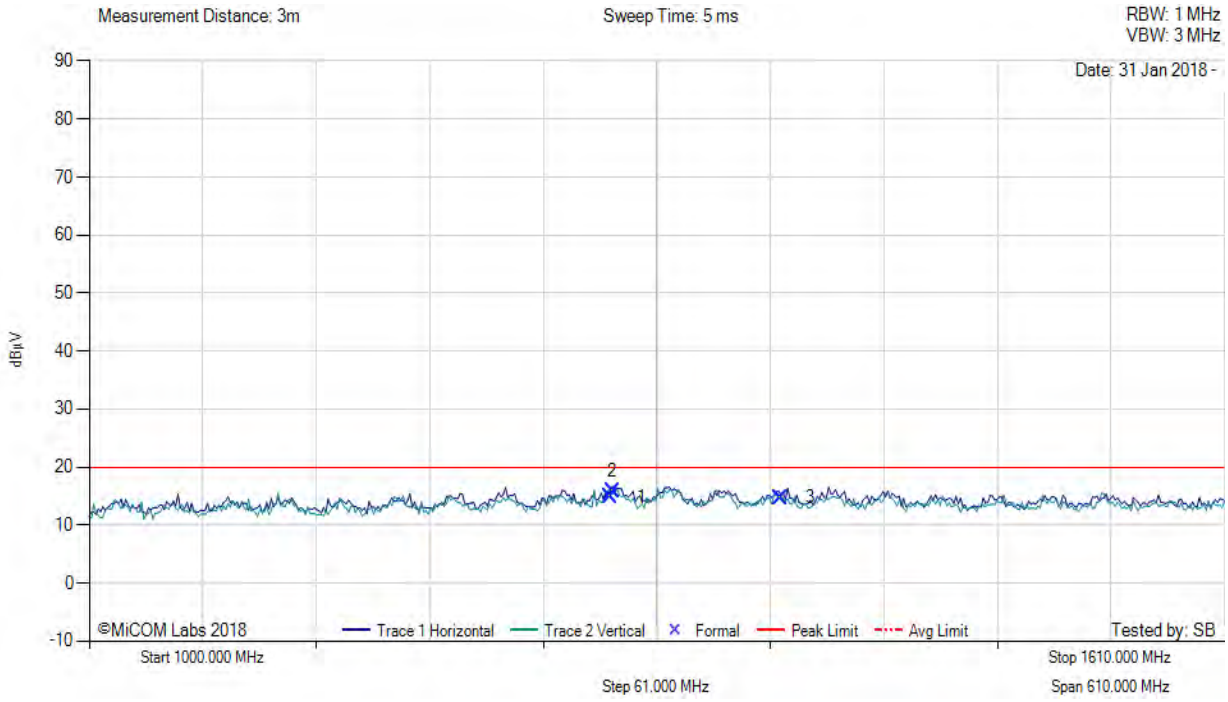
Test Notes:

9.4.1.2. DV21-DC

Equipment Configuration for Restricted Band Spurious Emissions			
Antenna:	DV21-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



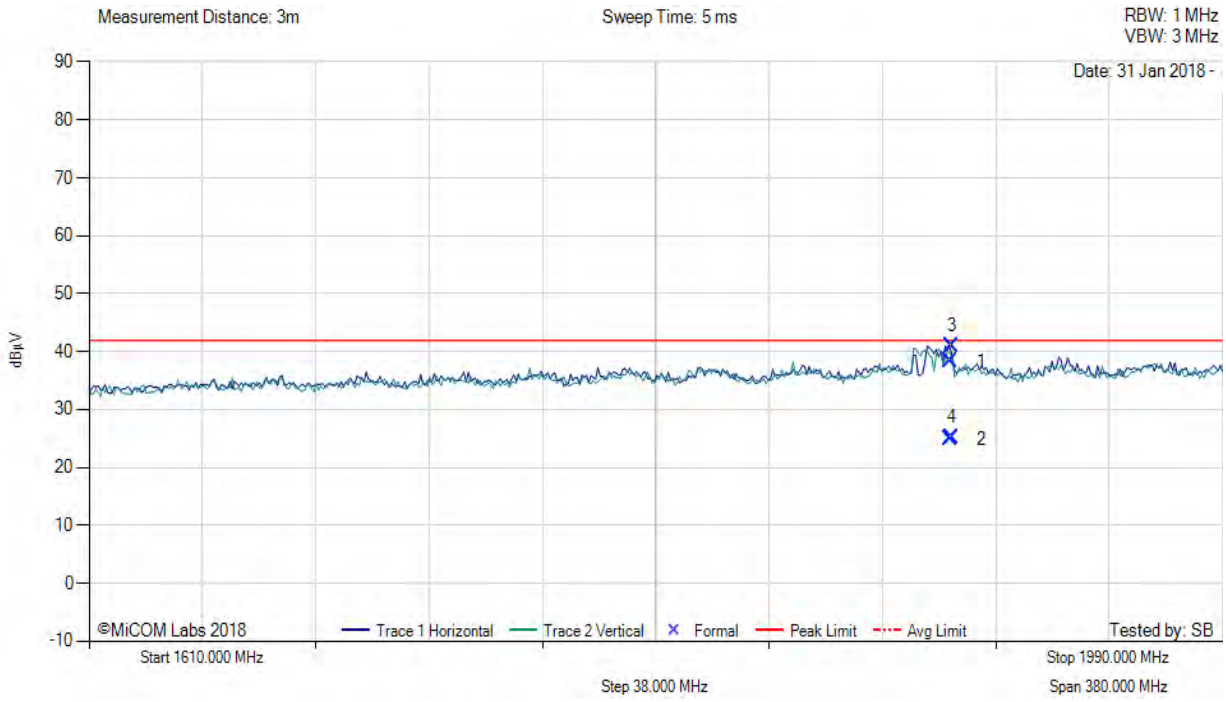
1000.00 - 1610.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1280.33	29.05	1.78	-16.01	14.82	Peak (NRB)	Vertical	100	0	--	--	Pass
2	1281.16	30.00	1.78	-16.01	15.77	Peak (NRB)	Horizontal	100	0	--	--	Pass
3	1371.16	28.94	1.82	-16.02	14.74	Peak (Scan)	Horizontal	100	0	19.9	-5.2	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV21-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



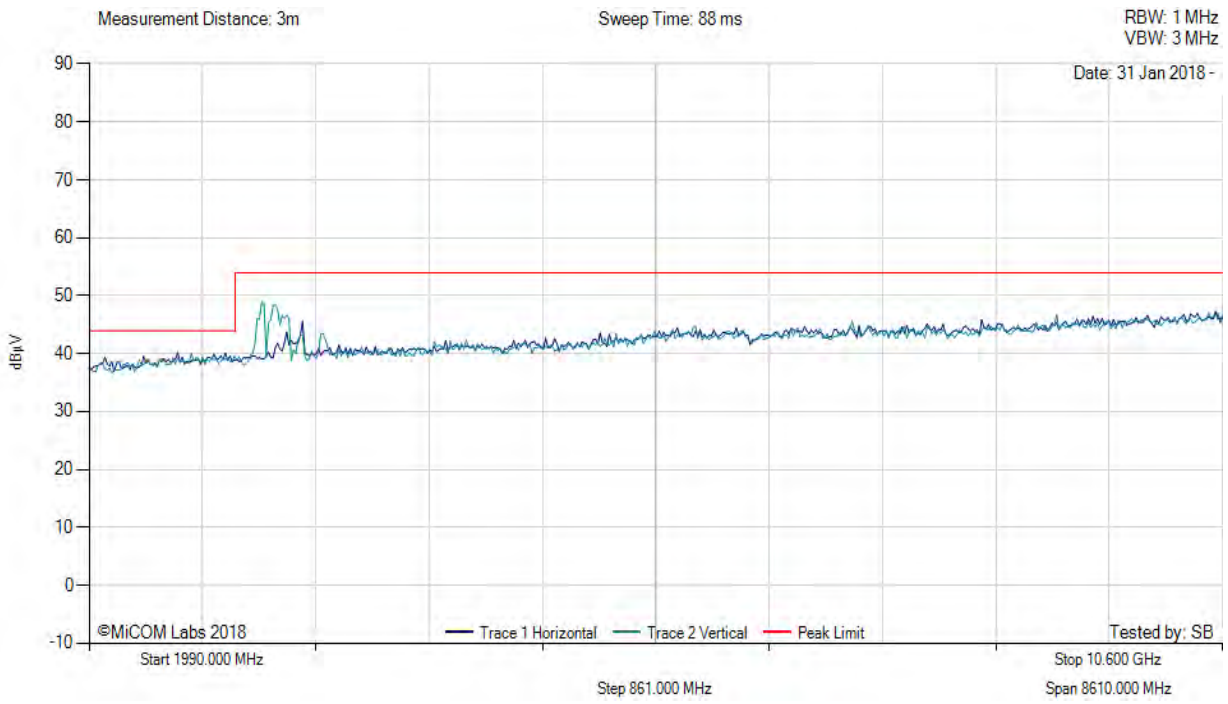
1610.00 - 1990.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1898.99	49.87	2.05	-13.67	38.25	Max Peak	Horizontal	172	66	41.9	-3.7	Pass
2	1898.99	36.58	2.05	-13.67	24.96	Max Avg	Horizontal	172	66	41.9	-17.0	Pass
3	1899.21	52.49	2.05	-13.67	40.87	Max Peak	Vertical	99	135	41.9	-1.1	Pass
4	1899.21	36.68	2.05	-13.67	25.06	Max Avg	Vertical	99	135	41.9	-16.9	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV21-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



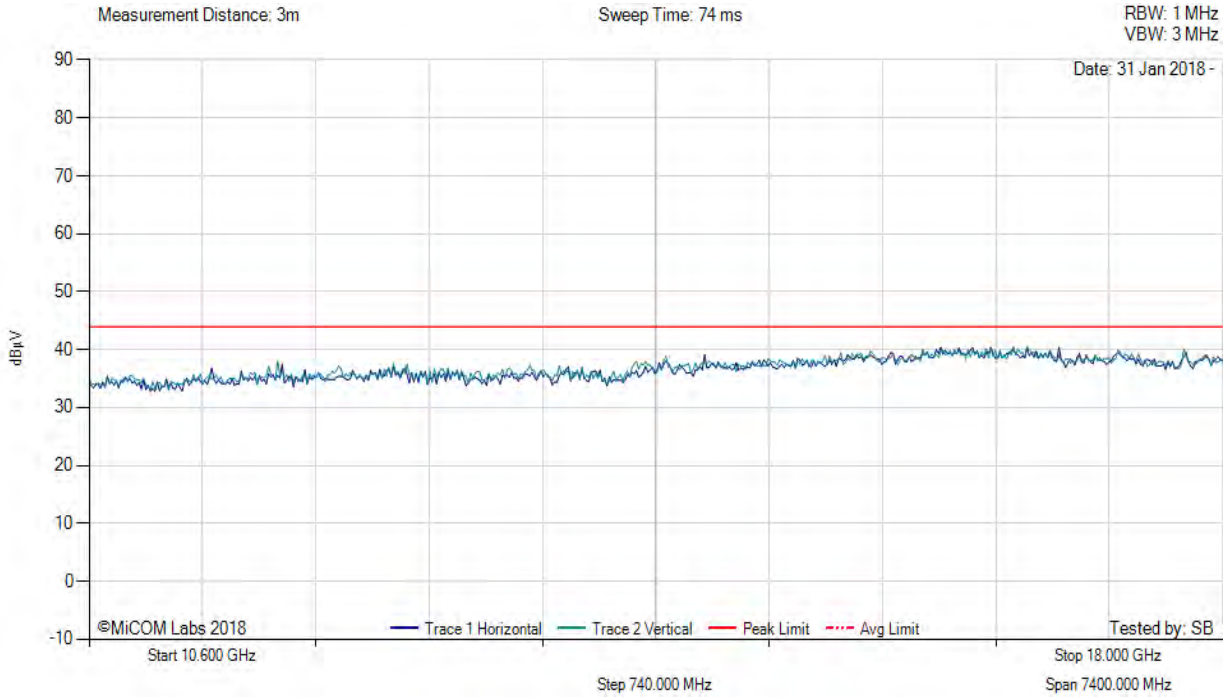
There are no emissions found within 6dB of the limit line.

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV21-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	9.28	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



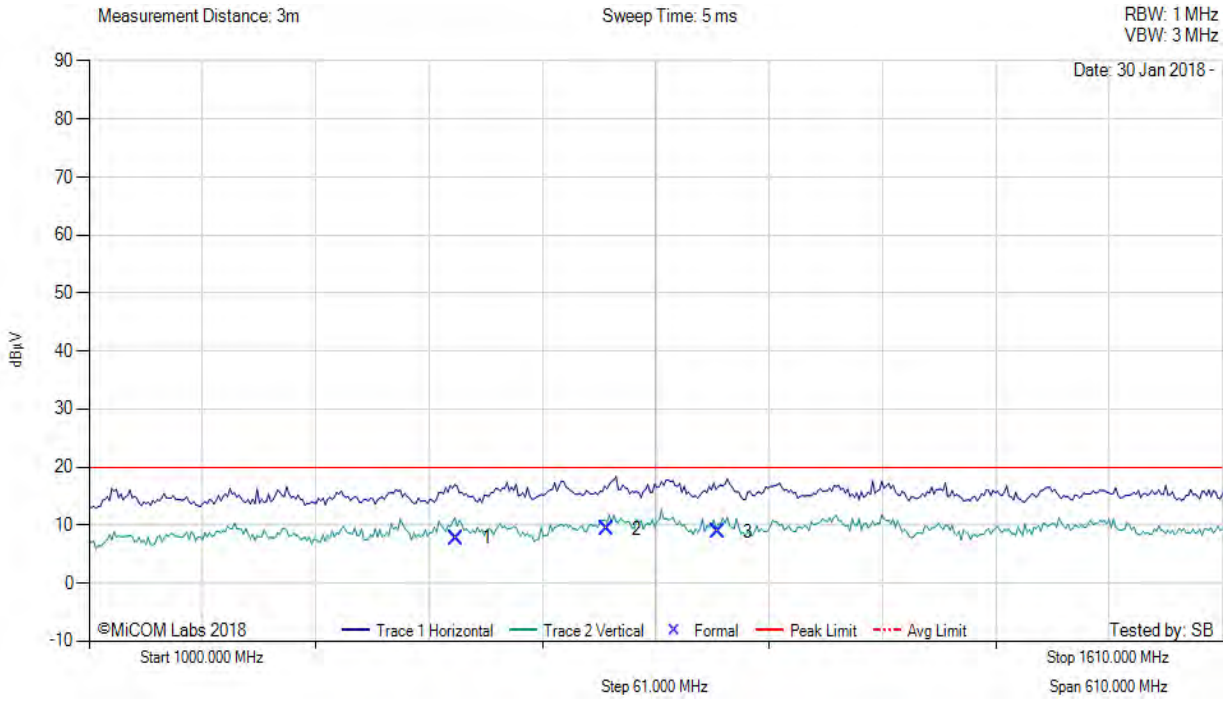
There are no emissions found within 6dB of the limit line.

9.4.1.3. DV11-AC

Equipment Configuration for Restricted Band Spurious Emissions			
Antenna:	DV11-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



1000.00 - 1610.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1197.87	22.77	1.73	-16.77	7.73	Peak (Scan)	Horizontal	100	0	19.9	-12.2	Pass
2	1278.59	23.66	1.77	-16.05	9.38	Peak (NRB)	Horizontal	100	0	--	--	Pass
3	1338.49	22.74	1.80	-15.74	8.80	Peak (Scan)	Horizontal	100	0	19.9	-11.1	Pass

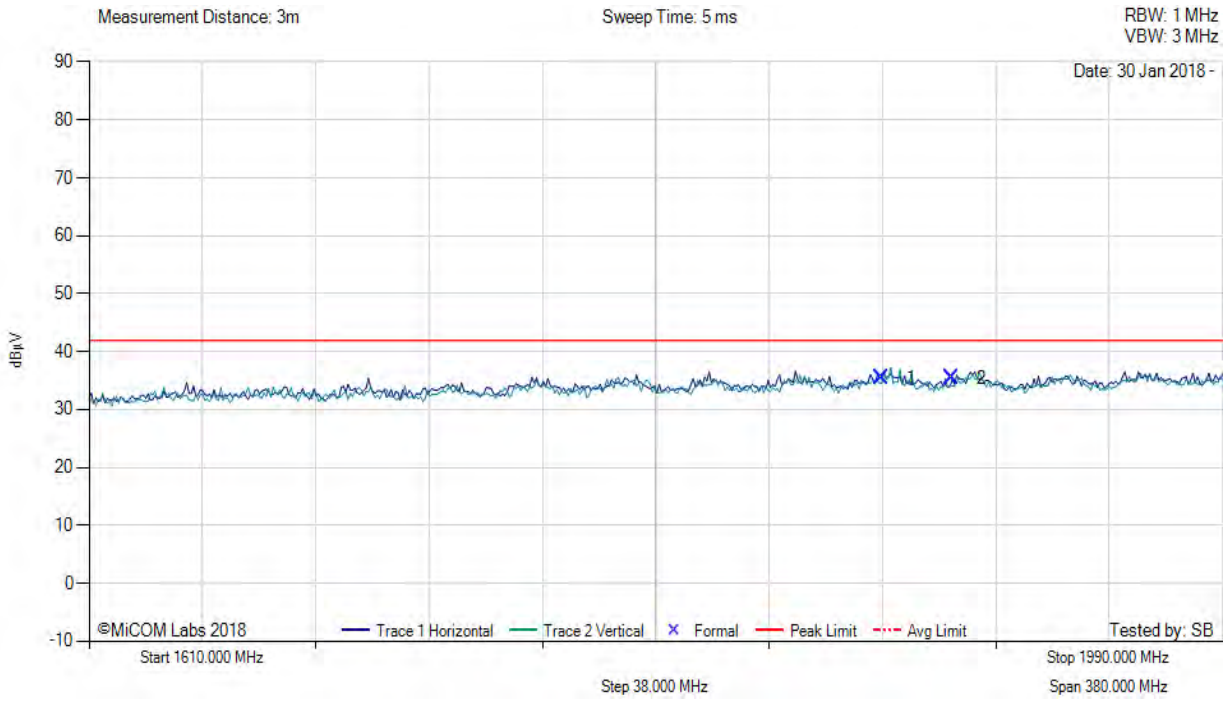
Test Notes:

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV11-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



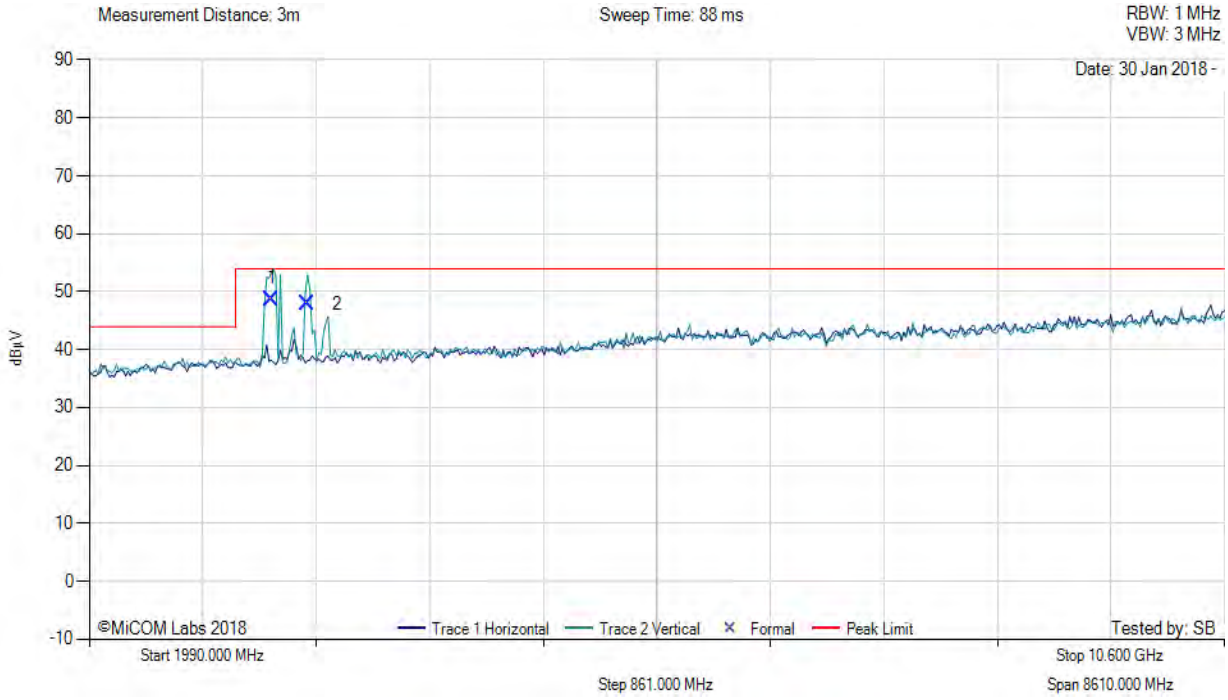
1610.00 - 1990.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1875.68	47.10	2.04	-13.70	35.44	Peak (NRB)	Vertical	100	0	--	--	Pass
2	1899.33	47.06	2.05	-13.67	35.44	Peak (NRB)	Horizontal	100	0	--	--	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV11-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



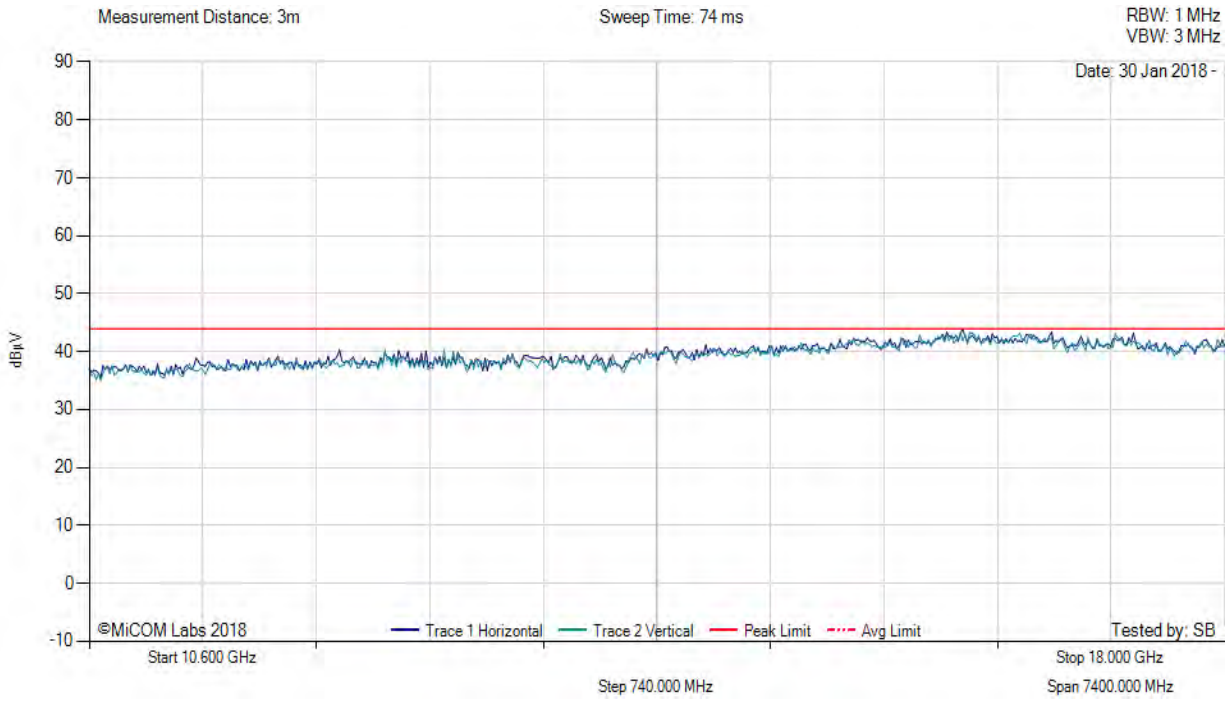
1990.00 - 10600.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	3370.36	57.97	2.62	-11.84	48.75	Fundamental	Vertical	100	0	--	--	
2	3646.43	56.85	2.73	-11.74	47.84	Fundamental	Vertical	100	0	--	--	

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV11-AC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



There are no emissions found within 6dB of the limit line.

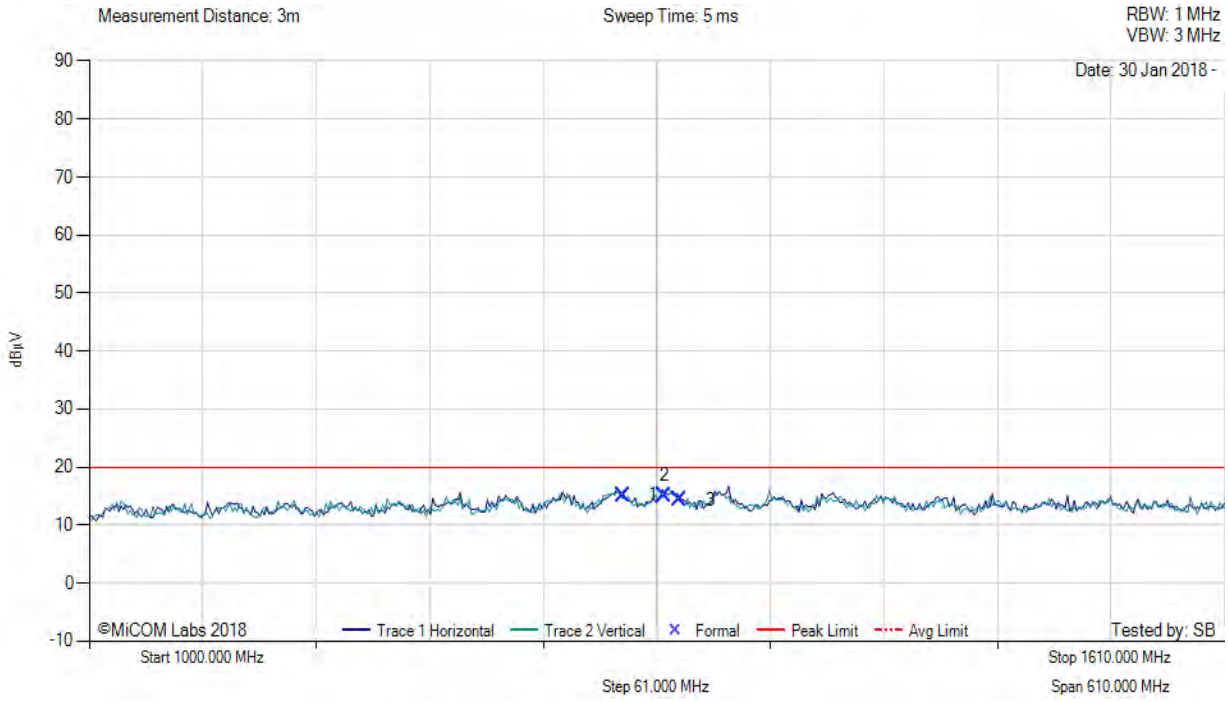
9.4.1.4. DV31-DC

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV31-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max

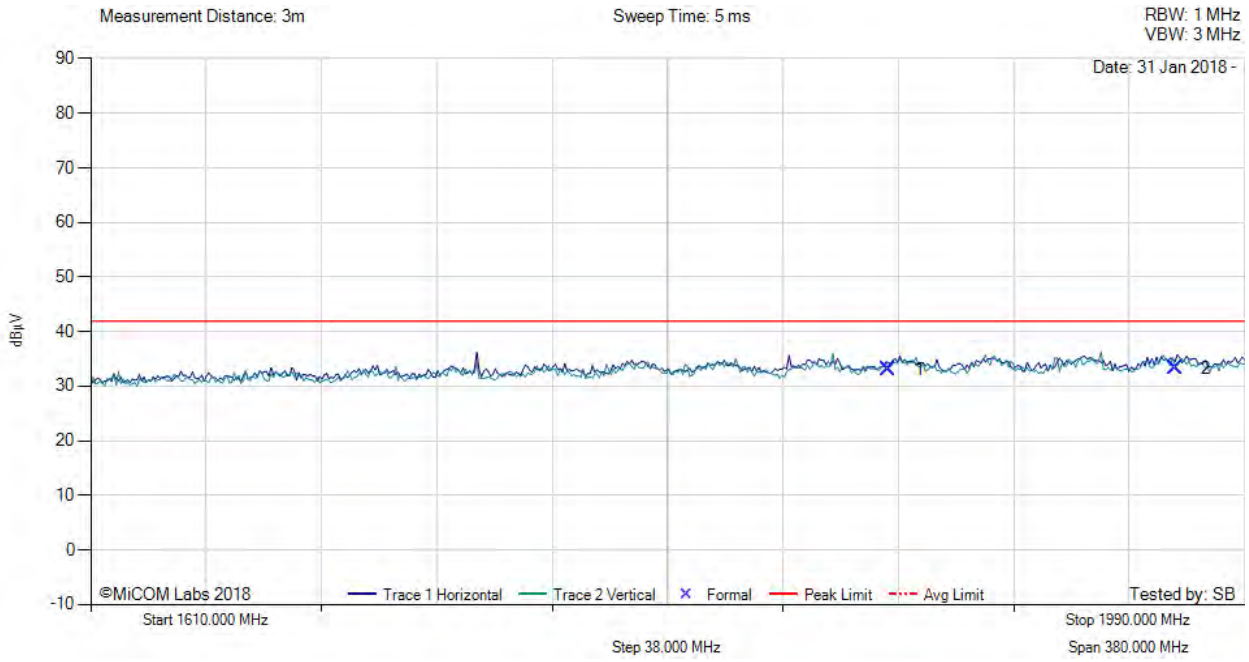


1000.00 - 1610.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1286.86	29.35	1.79	-15.92	15.22	Peak (NRB)	Horizontal	100	0	19.9	-3.7	Pass
2	1309.22	29.09	1.80	-15.79	15.10	Peak (Scan)	Horizontal	100	0	19.9	-4.8	Pass
3	1317.44	28.20	1.80	-15.68	14.32	Peak (Scan)	Horizontal	100	0	19.9	-5.6	Pass

Equipment Configuration for Restricted Band Spurious Emissions			
Antenna:	DV31-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



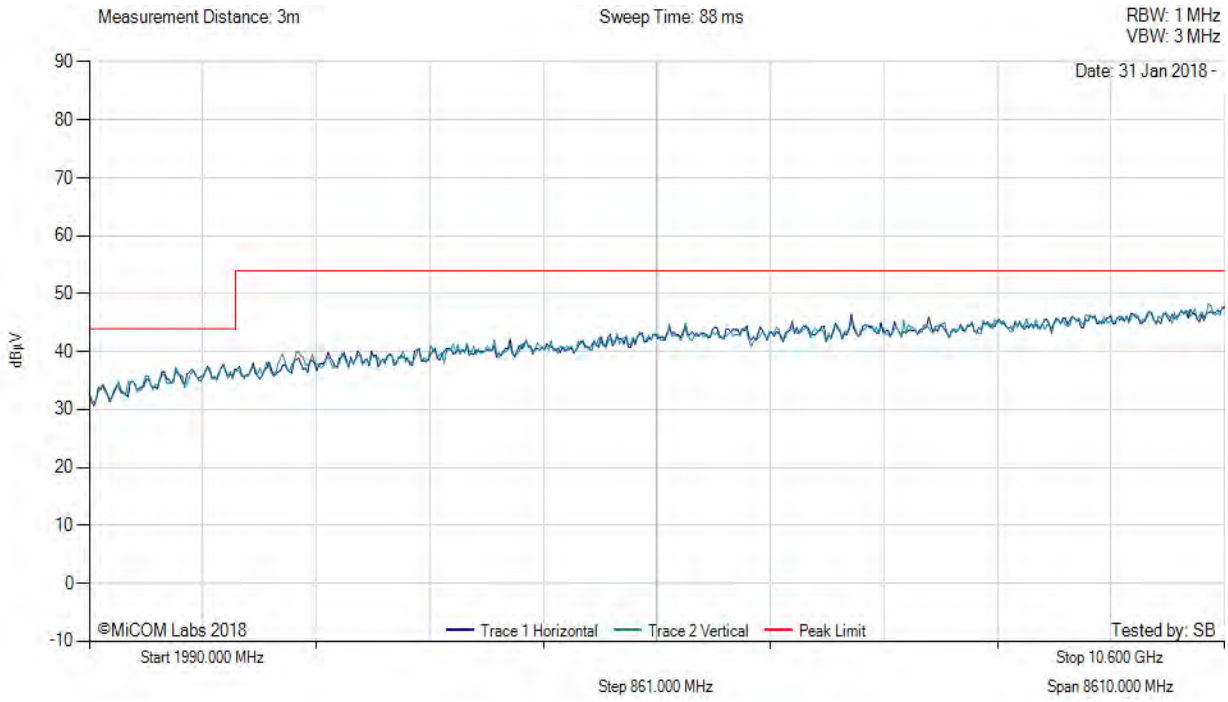
1610.00 - 1990.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1872.80	44.72	2.04	-13.74	33.02	Peak (NRB)	Vertical	100	0	43.9	-10.8	Pass
2	1967.31	44.27	2.09	-13.12	33.24	Peak (NRB)	Vertical	100	0	43.9	-10.6	Pass
3	1990.19	45.27	2.09	-12.90	34.46	Peak (NRB)	Vertical	100	0	43.9	-9.4	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV31-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



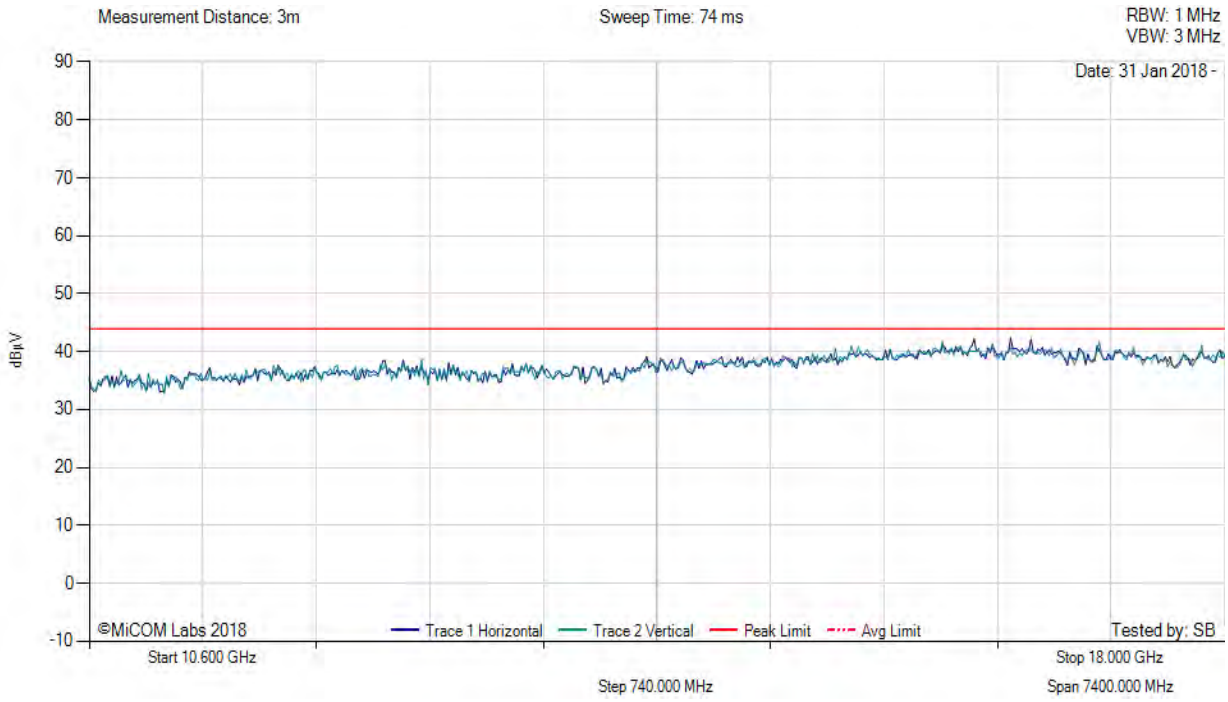
There are no emissions found within 6dB of the limit line.

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	DV31-DC	**Variant:**	500 MHz Bandwidth
Antenna Gain (dBi):	13.0	**Modulation:**	BPM/BPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99%
Channel Frequency (MHz):	3492.00	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: , Test Freq: 3492.00 MHz, Power Setting: Max



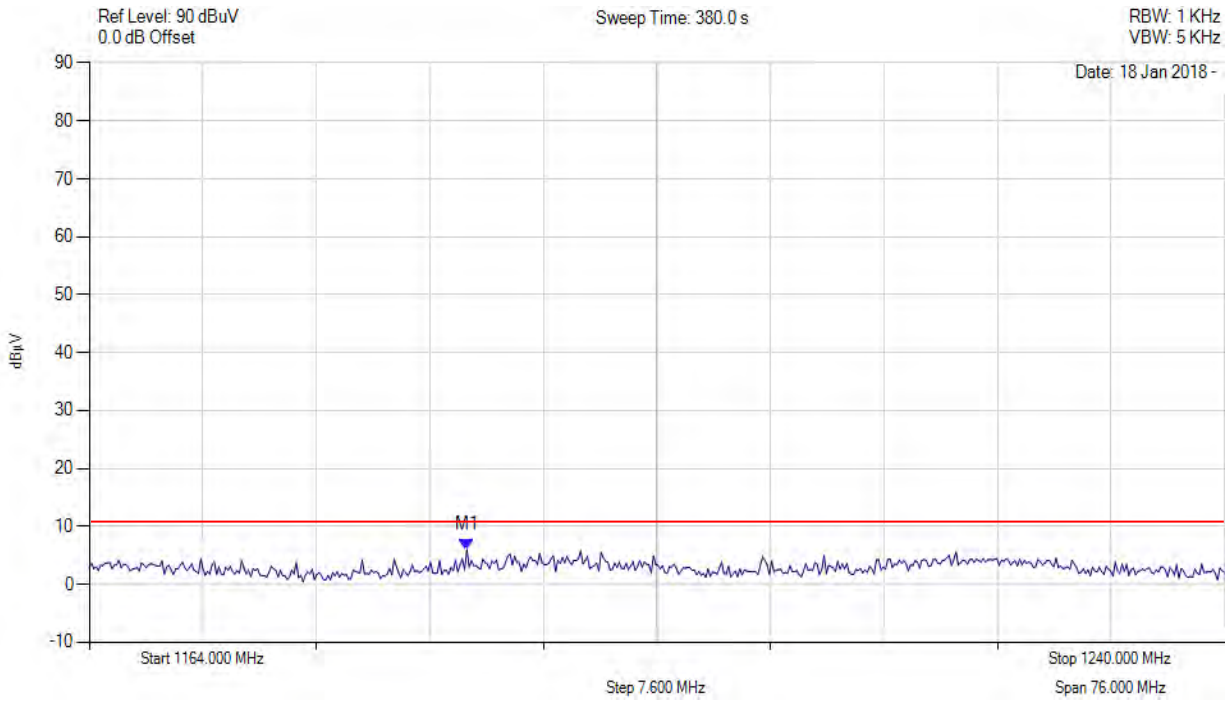
There are no emissions found within 6dB of the limit line.

9.4.2. GPS Band Emissions

9.4.2.5. DV21-AC V 1164-1240

GPS_1164_1240_V

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

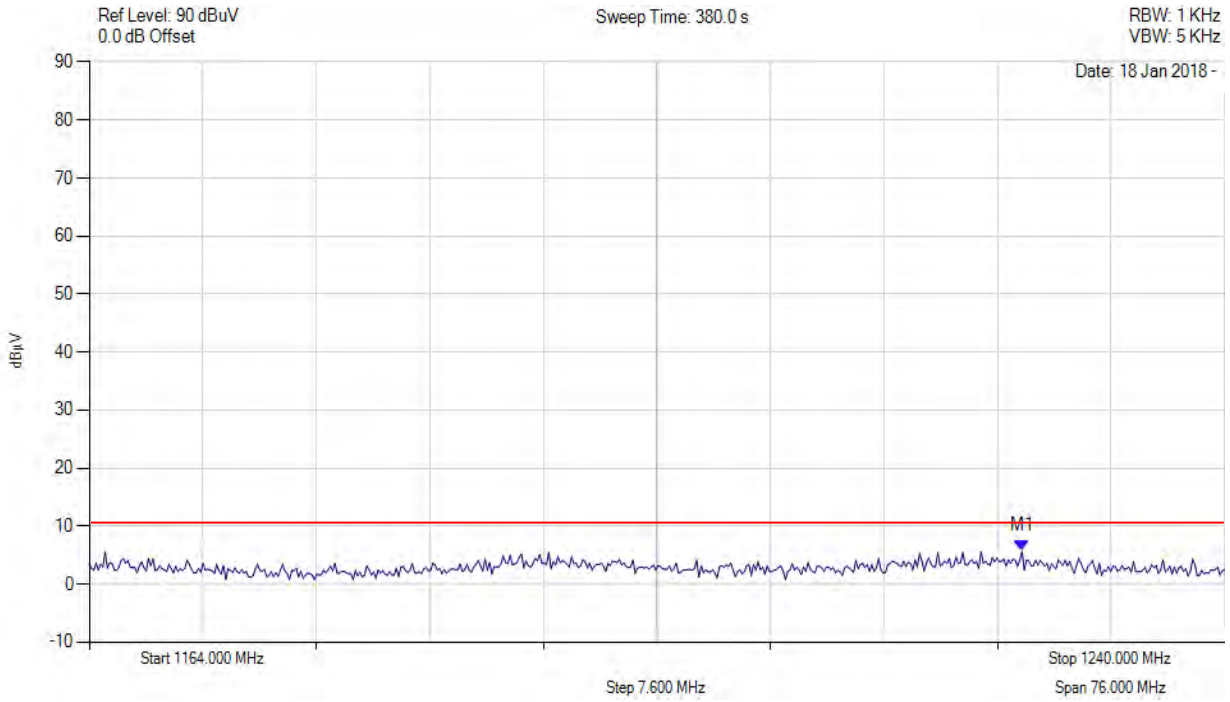


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1189.283 MHz : 5.982 dBµV	Channel Frequency: 3492.00 MHz

DV21-AC H 1164-1240

GPS_1164_1240_H

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

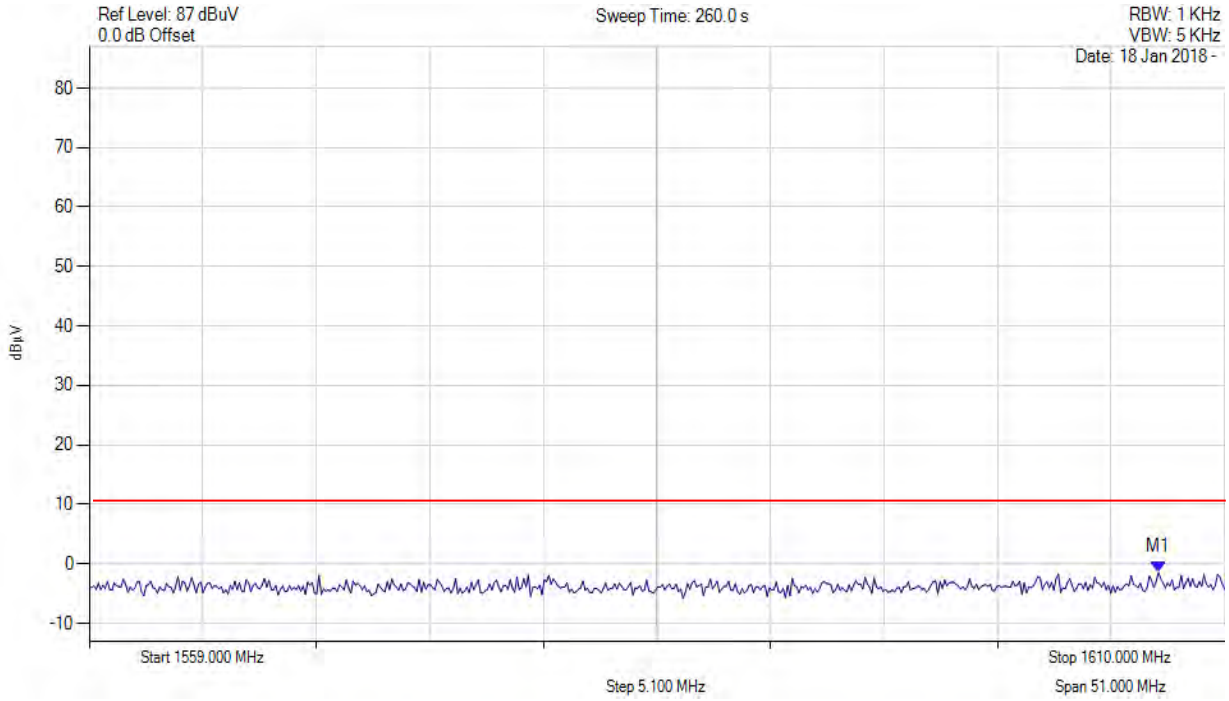


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1226.445 MHz : 5.694 dBµV	Channel Frequency: 3492.00 MHz

V 1559-1610

GPS_1559_1610_V

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

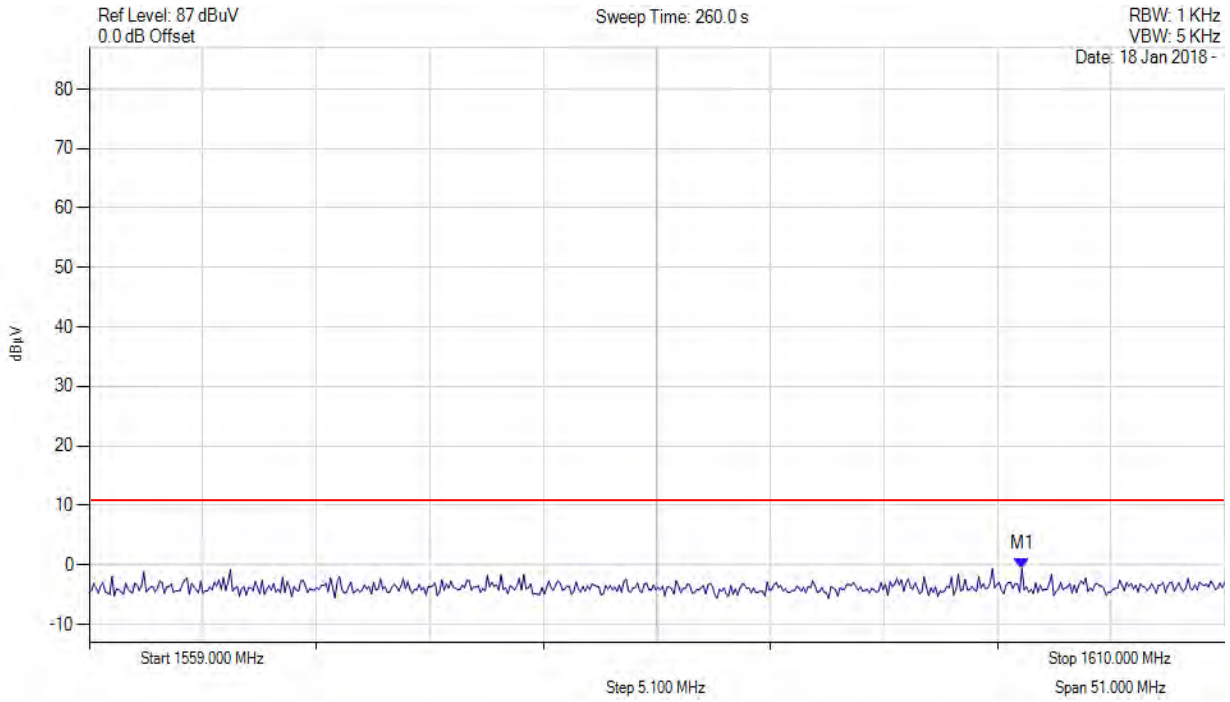


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1607.036 MHz : -1.419 dBµV	Channel Frequency: 3492.00 MHz

H 1559-1610

GPS_1559_1610_H

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

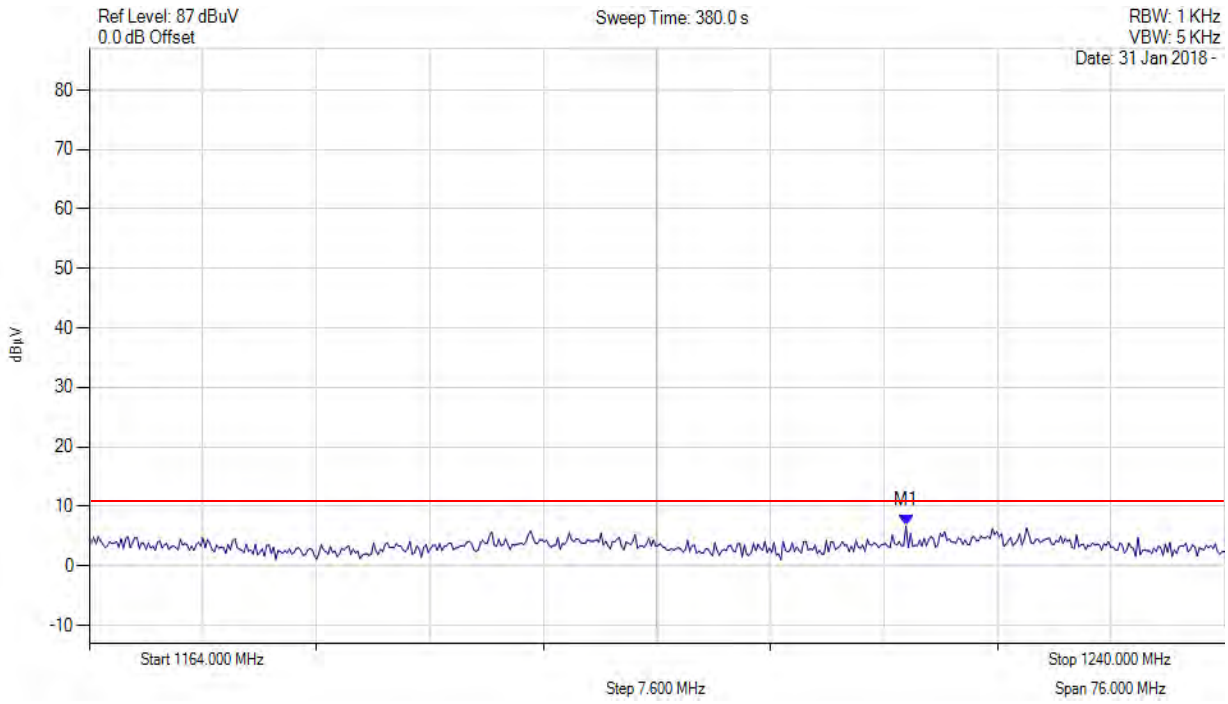


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1600.904 MHz : -0.638 dBµV	Channel Frequency: 3492.00 MHz

9.4.2.6. DV21-DC V 1164-1240

GPS 1164_1240MHz V

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

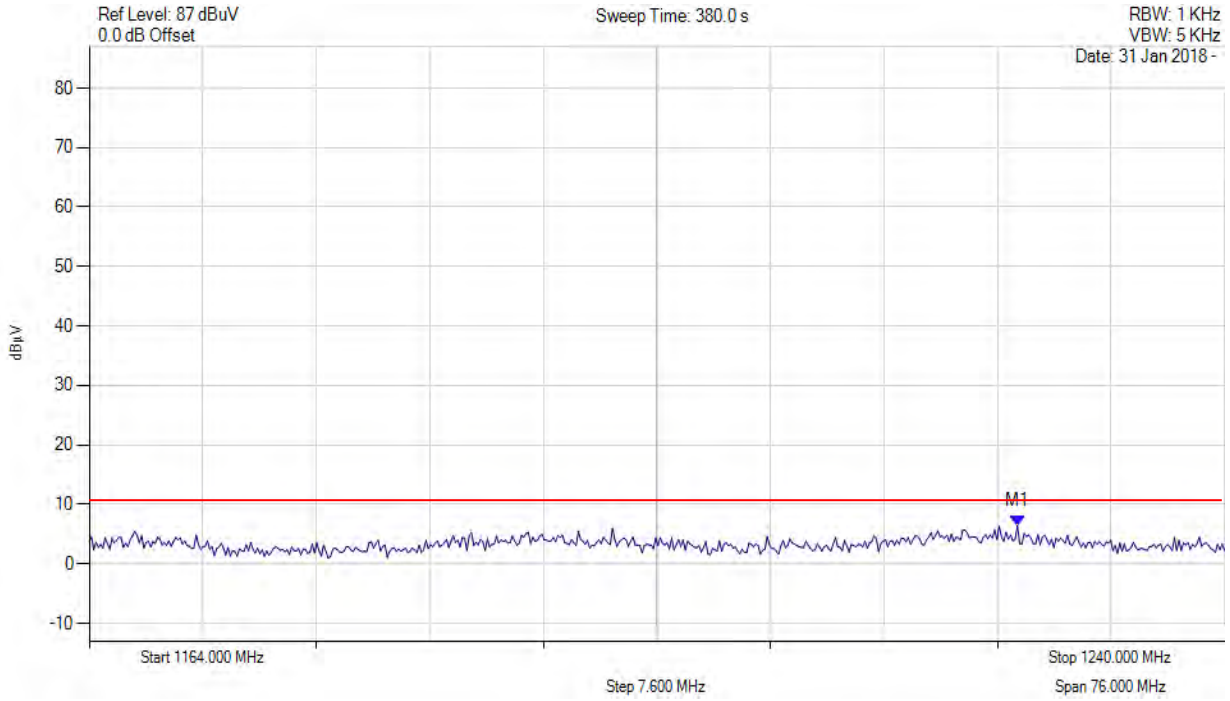


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1218.677 MHz : 6.735 dBµV	Channel Frequency: 3492.00 MHz

H 1164-1240

GPS 1164_1240MHz H

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

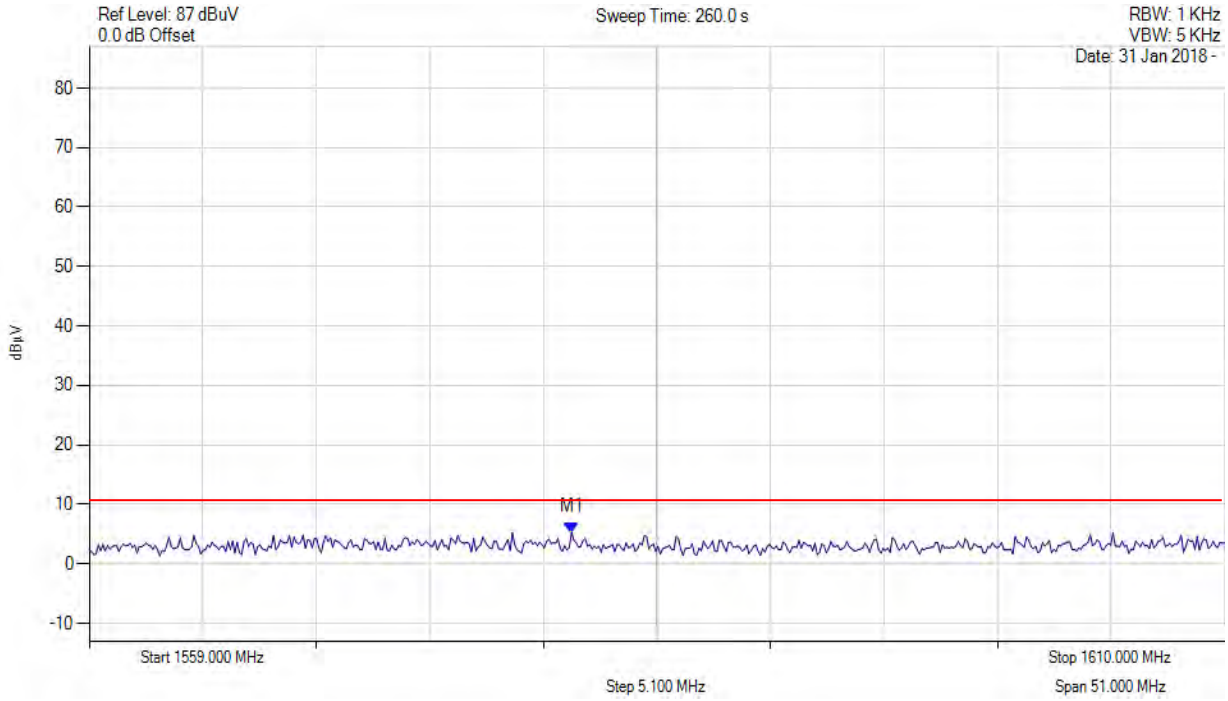


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1226.140 MHz : 6.424 dBµV	Channel Frequency: 3492.00 MHz

V 1559-1610

GPS 1559_1610MHz V

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc

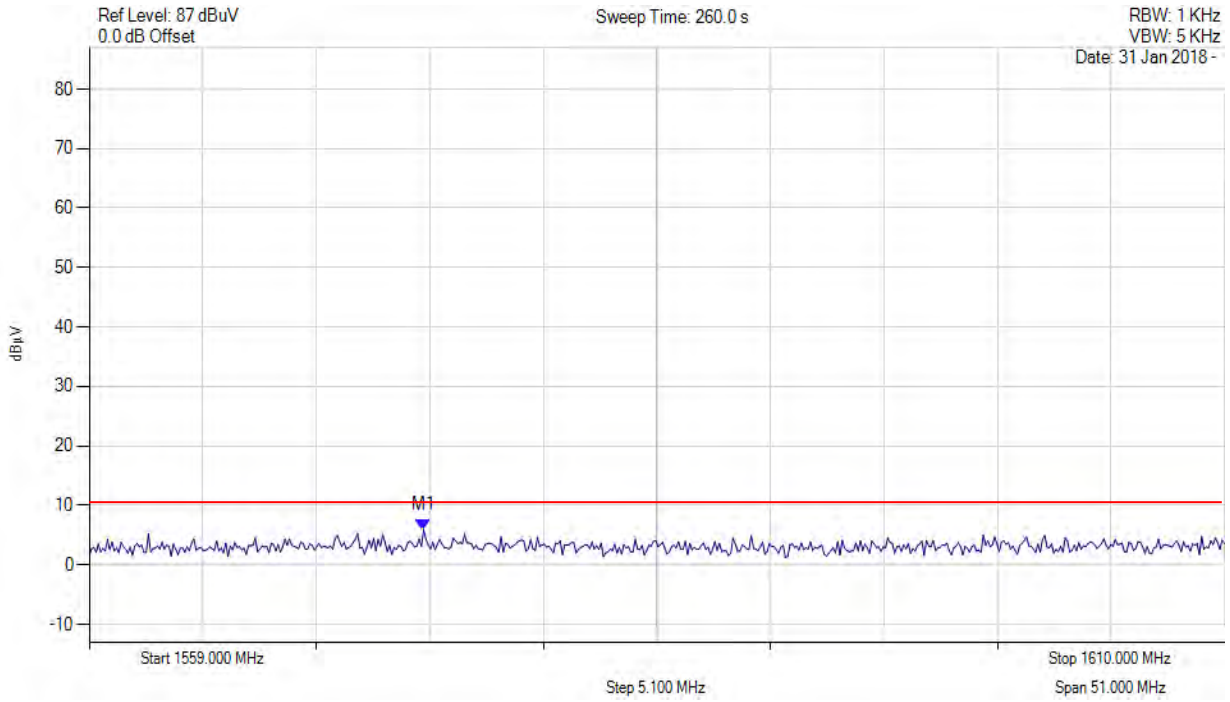


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1580.667 MHz : 5.294 dBµV	Channel Frequency: 3492.00 MHz

H 1559-1610

GPS 1559_1610MHz H

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 1574.024 MHz : 5.934 dBµV	Channel Frequency: 3492.00 MHz

9.5. Shutoff Timing Requirements

Radiated Test Conditions for Shutoff Timing Requirements			
Standard:	FCC CFR 47:15.517 (a)(5)	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Shutoff Timing Requirements	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10 Section 7.4	**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.

Operating Frequency Band:
3100-10600 MHz

Limits
A communications system shall transmit only when the intentional radiator is sending information to an associated receiver. If no associated receiver acknowledgement is received, the device must shutdown within 10 seconds.

Equipment Configuration for Shutdown Timing Requirements			
Variant:	500 MHz Bandwidth	**Duty Cycle (%):**	99
Data Rate:	-	**Antenna Gain (dBi):**	Varies by EUT
Modulation:	BPM/BPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	EM
Engineering Test Notes:	1. Timing behavior is identical in all 4 models. Testing performed on the DV31-DC is representative of all 4 models. 2. Additional Timing plots are shown in Annex A for informative purposes only.		

Test Measurement Results

Frequency (MHz)	Shutdown Time	Limit	Margin	EUT Power Setting
	(s)	(s)	(s)	Numeric
3492	9.833	10	0.167	Max

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Uncertainty:	±1.33 dB

9.6. AC Wireline Emissions

Test Conditions for AC Wireline			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Digital Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.207	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Scope
This test assesses the ability of the EUT to limit its internal noise from being present on the AC mains power input/output ports.

Test Method
The test method shall be in accordance with §15.207 and the Artificial Mains Networks (AMNs) shall be connected to the AC mains power source.

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies for measurements in the transmit mode of operation.

Test Procedure
The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Limits
The equipment shall meet the class B limits given in §15.207. Alternatively, for equipment intended to be used in telecommunication centres only, the class A limits given in §15.207 may be used.

Class B Emissions
* Decreases with the logarithm of the frequency

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Quasi-peak
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Class A Emissions

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	79	66
0.5-30	73	60

Traceability

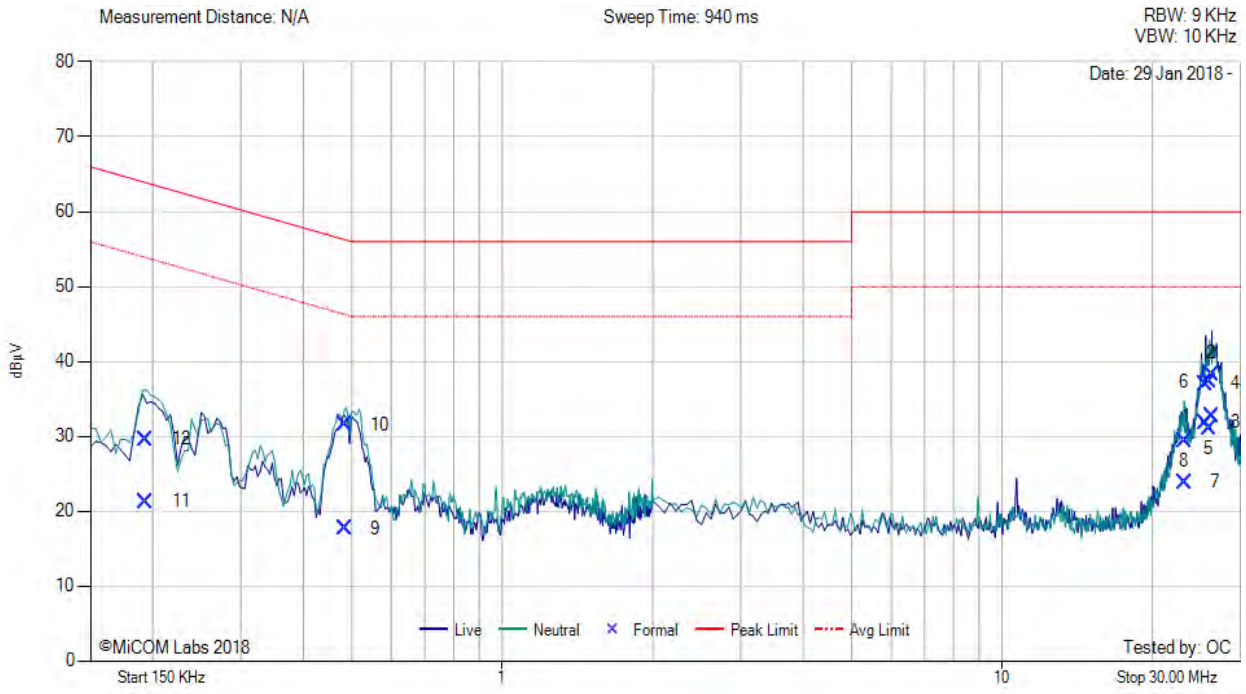
All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ±2.64 dB.

Laboratory Measurement Uncertainty	
Measurement uncertainty	Measurement uncertainty
Method	
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	

Measurement Results

Model:	DV11AC	Configuration tested:	AC POWERED
Input power:	120V_{AC}/60Hz	Standard:	FCC 15.207

Variant: AC Wireline, Test Freq: 0.15 - 30 MHz

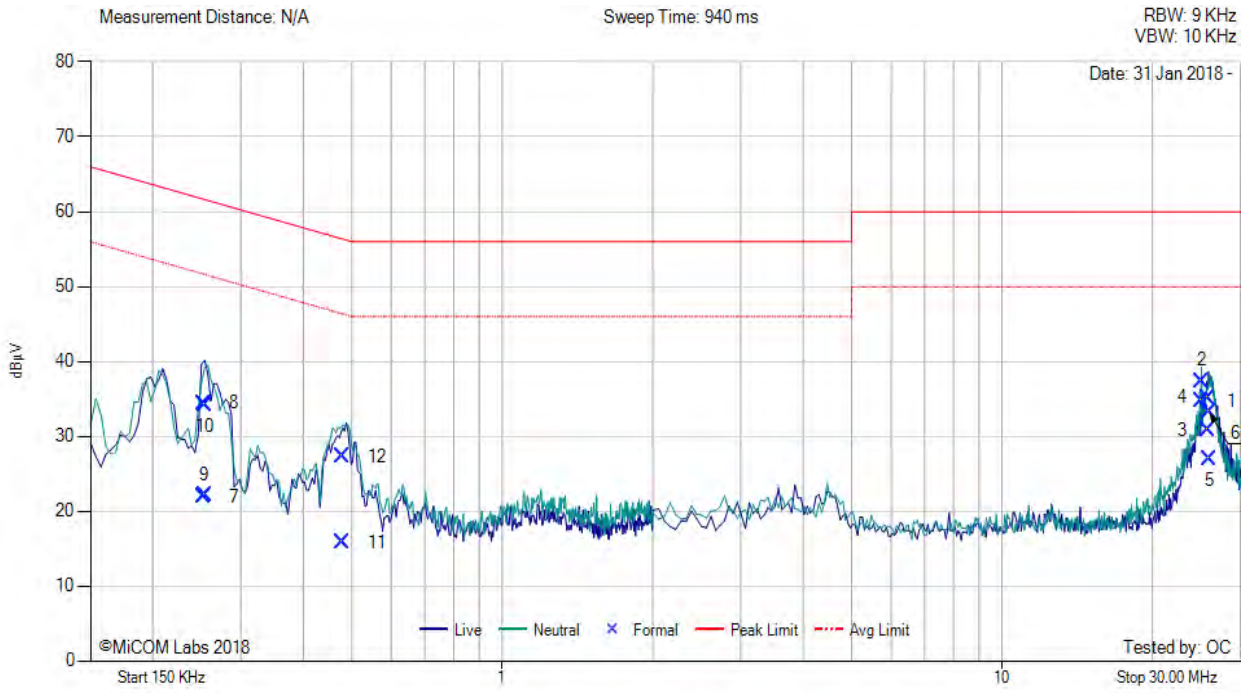


Num	Frequency MHz	Raw dBµV	Cable Loss dB	Factor dB	Total Correction dBµV	Corrected Value dBµV	Measurement Type	Line	Limit dBµV	Margin dB	Pass /Fail
1	26.268	21.04	0.72	10.88	11.60	32.64	Max Avg	Live	50.0	-17.4	Pass
2	26.268	26.71	0.72	10.88	11.60	38.31	Max Qp	Live	60.0	-21.7	Pass
3	25.533	20.28	0.70	10.85	11.55	31.83	Max Avg	Live	50.0	-18.2	Pass
4	25.533	25.46	0.70	10.85	11.55	37.01	Max Qp	Live	60.0	-23.0	Pass
5	25.951	19.54	0.72	10.87	11.59	31.13	Max Avg	Neutral	50.0	-18.9	Pass
6	25.951	25.70	0.72	10.87	11.59	37.29	Max Qp	Neutral	60.0	-22.7	Pass
7	23.156	12.38	0.64	10.85	11.49	23.87	Max Avg	Neutral	50.0	-26.1	Pass
8	23.156	17.96	0.64	10.85	11.49	29.45	Max Qp	Neutral	60.0	-30.6	Pass
9	0.485	7.64	0.08	9.93	10.01	17.65	Max Avg	Neutral	46.4	-28.8	Pass
10	0.485	21.55	0.08	9.93	10.01	31.56	Max Qp	Neutral	56.4	-24.9	Pass
11	0.194	11.29	0.06	9.92	9.98	21.27	Max Avg	Neutral	54.7	-33.5	Pass
12	0.194	19.62	0.06	9.92	9.98	29.60	Max Qp	Neutral	64.7	-35.1	Pass

Test Notes: Model DV11-AC, S/N: WSA106070003, Anchor 1. AC mains 120V 60Hz. The Anchor 1 communicating with Beacon 2 S/N: WSA106110025, powered by 24Vdc.

Model:	DV21AC	Configuration tested:	AC POWERED
Input power:	120V_{AC}/60Hz	Standard:	FCC 15.207

Variant: AC Wireline, Test Freq: 0.15 - 30 MHz



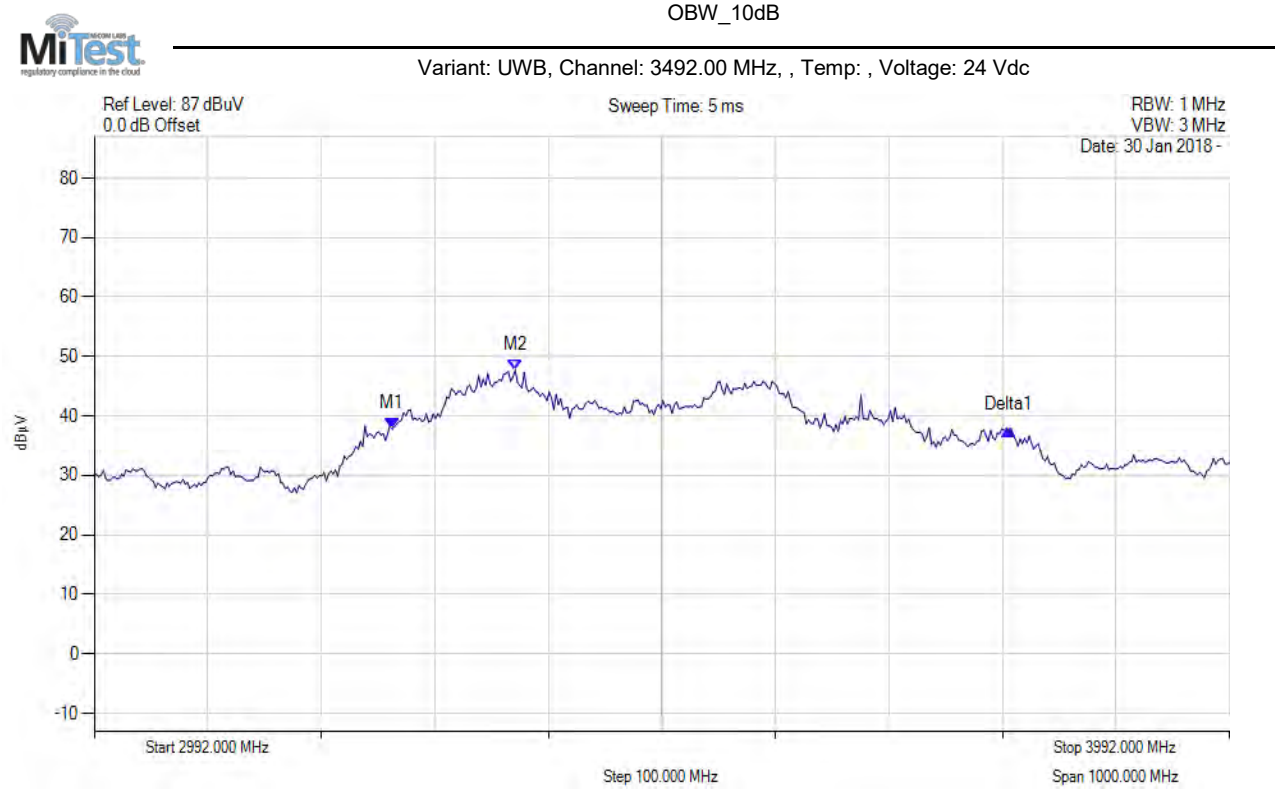
Num	Frequency MHz	Raw dBµV	Cable Loss dB	Factor dB	Total Correction dBµV	Corrected Value dBµV	Measurement Type	Line	Limit dBµV	Margin dB	Pass /Fail
1	25.061	23.22	0.68	10.84	11.52	34.74	Max Avg	Neutral	50.0	-15.3	Pass
2	25.061	25.87	0.68	10.84	11.52	37.39	Max Qp	Neutral	60.0	-22.6	Pass
3	25.897	19.21	0.72	10.87	11.59	30.80	Max Avg	Live	50.0	-19.2	Pass
4	25.897	23.56	0.72	10.87	11.59	35.15	Max Qp	Live	60.0	-24.9	Pass
5	26.001	15.36	0.72	10.87	11.59	26.95	Max Avg	Neutral	50.0	-23.1	Pass
6	26.001	21.63	0.72	10.87	11.59	33.22	Max Qp	Neutral	60.0	-26.8	Pass
7	0.252	11.98	0.07	9.92	9.99	21.97	Max Avg	Live	53.1	-31.1	Pass
8	0.252	24.47	0.07	9.92	9.99	34.46	Max Qp	Live	63.1	-28.6	Pass
9	0.254	12.18	0.07	9.92	9.99	22.17	Max Avg	Neutral	53.0	-30.9	Pass
10	0.254	24.16	0.07	9.92	9.99	34.15	Max Qp	Neutral	63.0	-28.9	Pass
11	0.479	5.82	0.08	9.93	10.01	15.83	Max Avg	Live	46.6	-30.8	Pass
12	0.479	17.29	0.08	9.93	10.01	27.30	Max Qp	Live	56.6	-29.3	Pass

Test Notes: Model DV21-AC, S/N; WSA106070006, Anchor 2. AC mains 120V 60Hz. The Anchor 2 communicating with Beacon 2 S/N: WSA106110025, powered by 24Vdc.

A. APPENDIX - GRAPHICAL IMAGES

A.1. UWB Bandwidth

DV21-AC



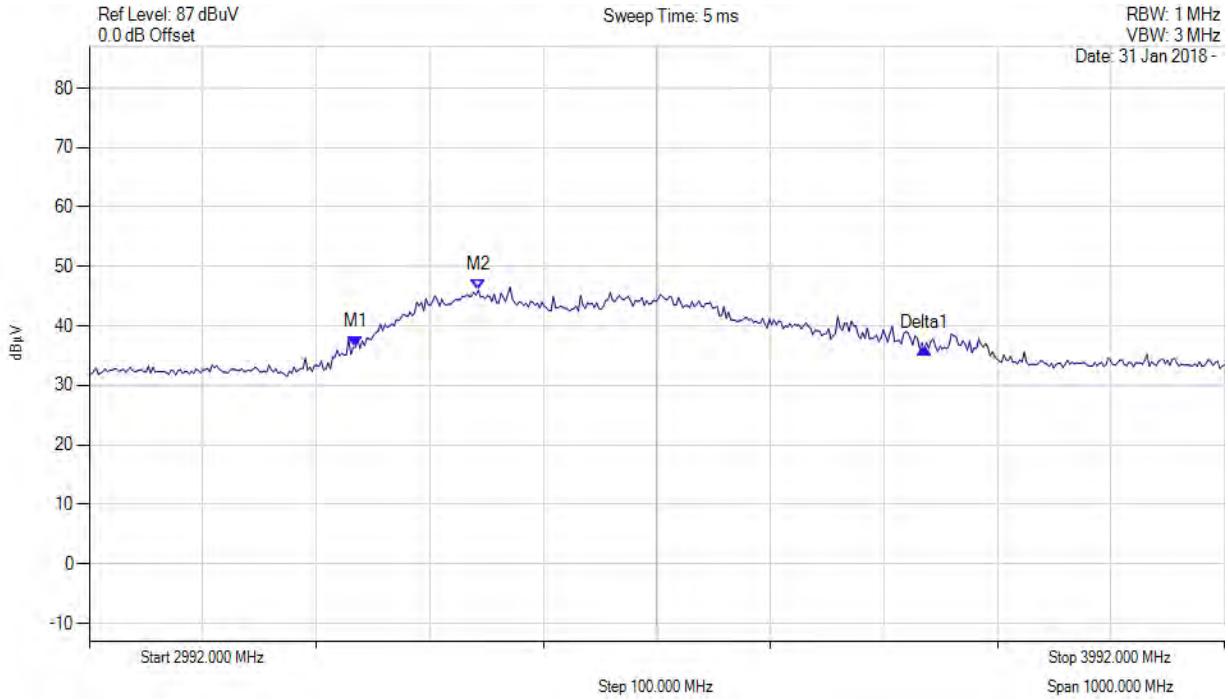
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 0 Trace Mode = VIEW	M1 : 3254.525 MHz : 37.797 dBµV M2 : 3362.741 MHz : 47.699 dBµV Delta1 : 543.086 MHz : -0.176 dB	Channel Frequency: 3492.00 MHz

back to matrix

DV21-DC

OBW_10dB

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc



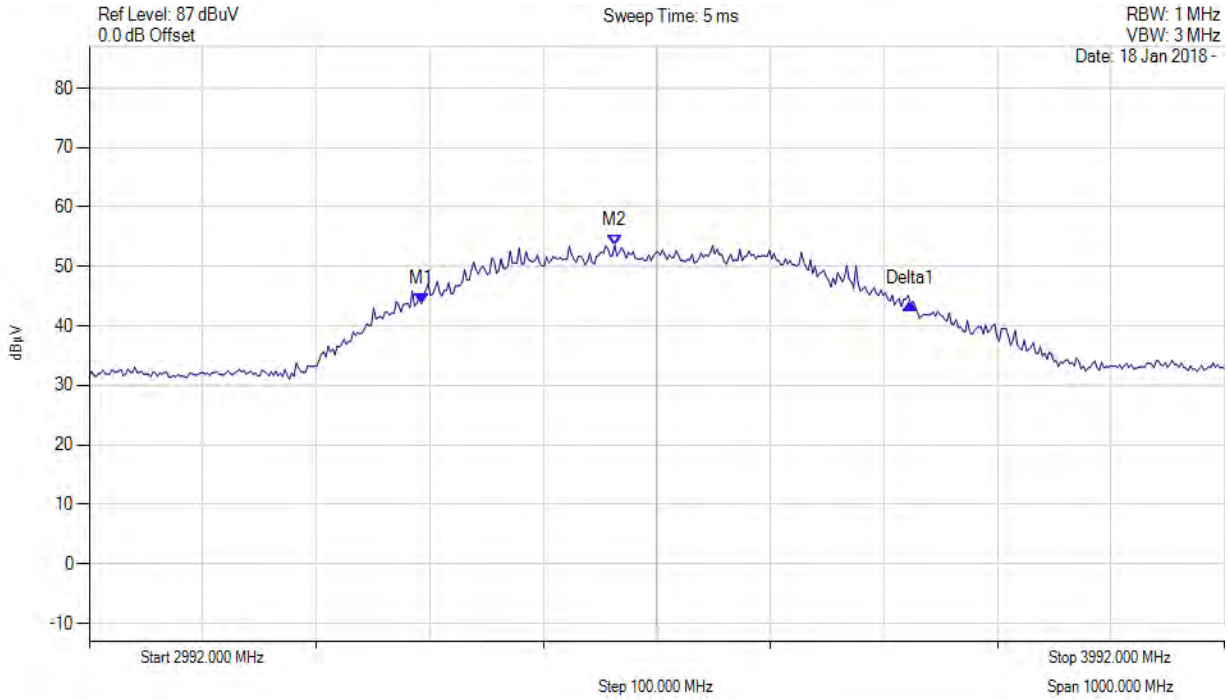
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = MAX HOLD	M1 : 3226.469 MHz : 36.409 dBµV M2 : 3334.685 MHz : 46.012 dBµV Delta1 : 501.002 MHz : -0.172 dB	Channel Frequency: 3492.00 MHz

back to matrix

DV11-AC

OBW_10dB

Variant: UWB, Channel: 3492.00 MHz, , Temp: , Voltage: Vdc



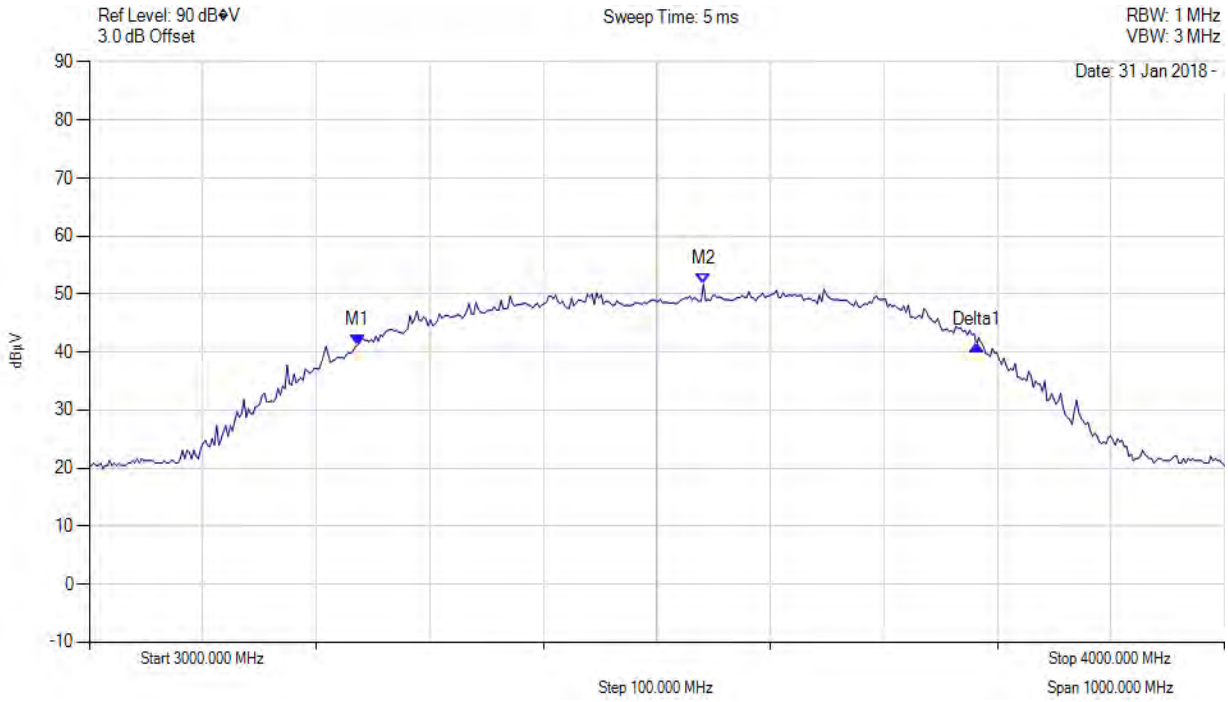
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 3284.585 MHz : 43.803 dBµV M2 : 3454.926 MHz : 53.514 dBµV Delta1 : 430.862 MHz : -0.140 dB	Channel Frequency: 3492.00 MHz

back to matrix

DV31-DC

Output Power

Variant: UWB, Channel: 3500.00 MHz, , Temp: , Voltage: Vdc

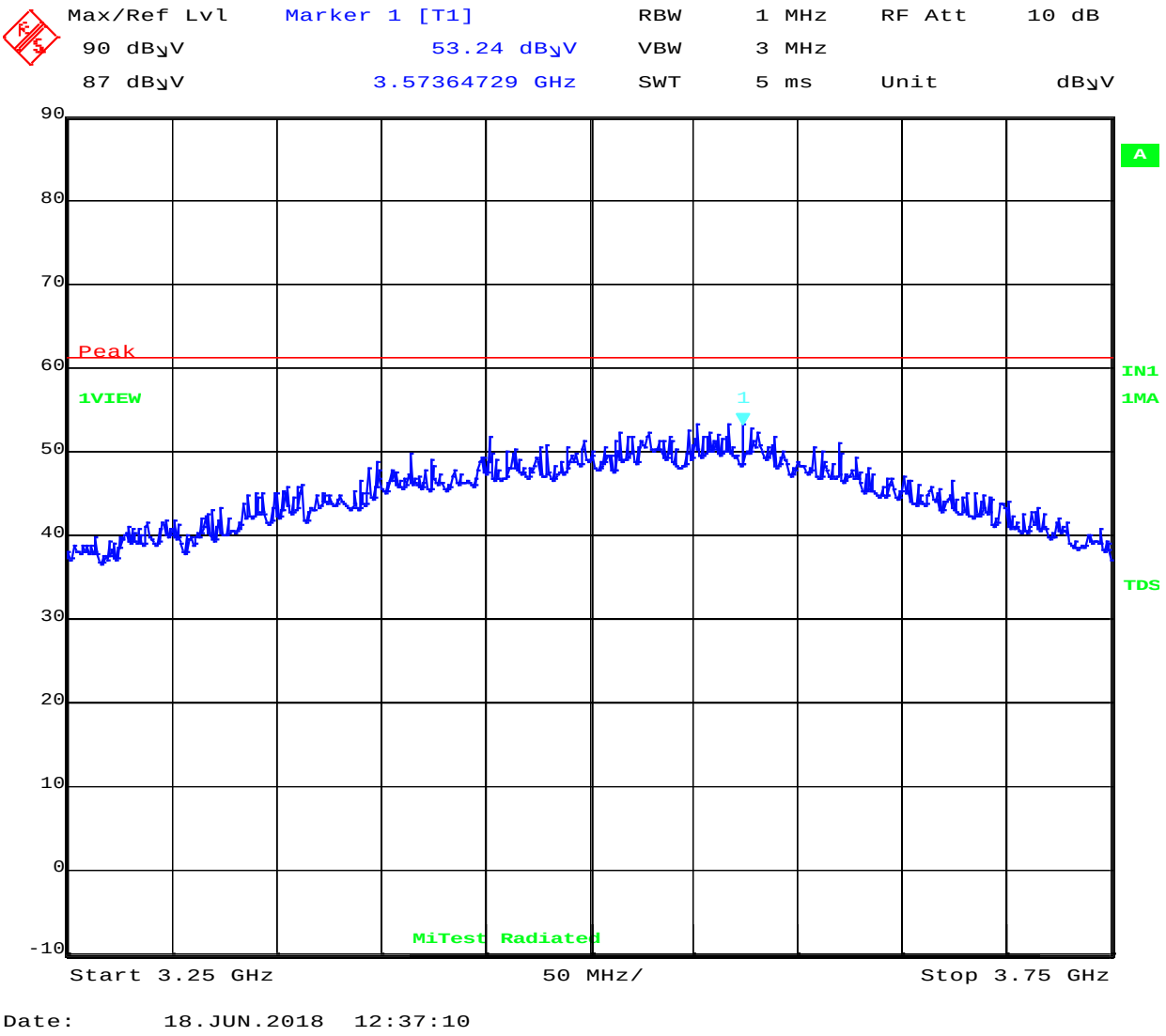


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 0 Trace Mode = VIEW	M1 : 3236.473 MHz : 41.244 dBµV M2 : 3541.082 MHz : 51.689 dBµV Delta1 : 545.090 MHz : -0.042 dB	Channel Frequency: 3500.00 MHz

back to matrix

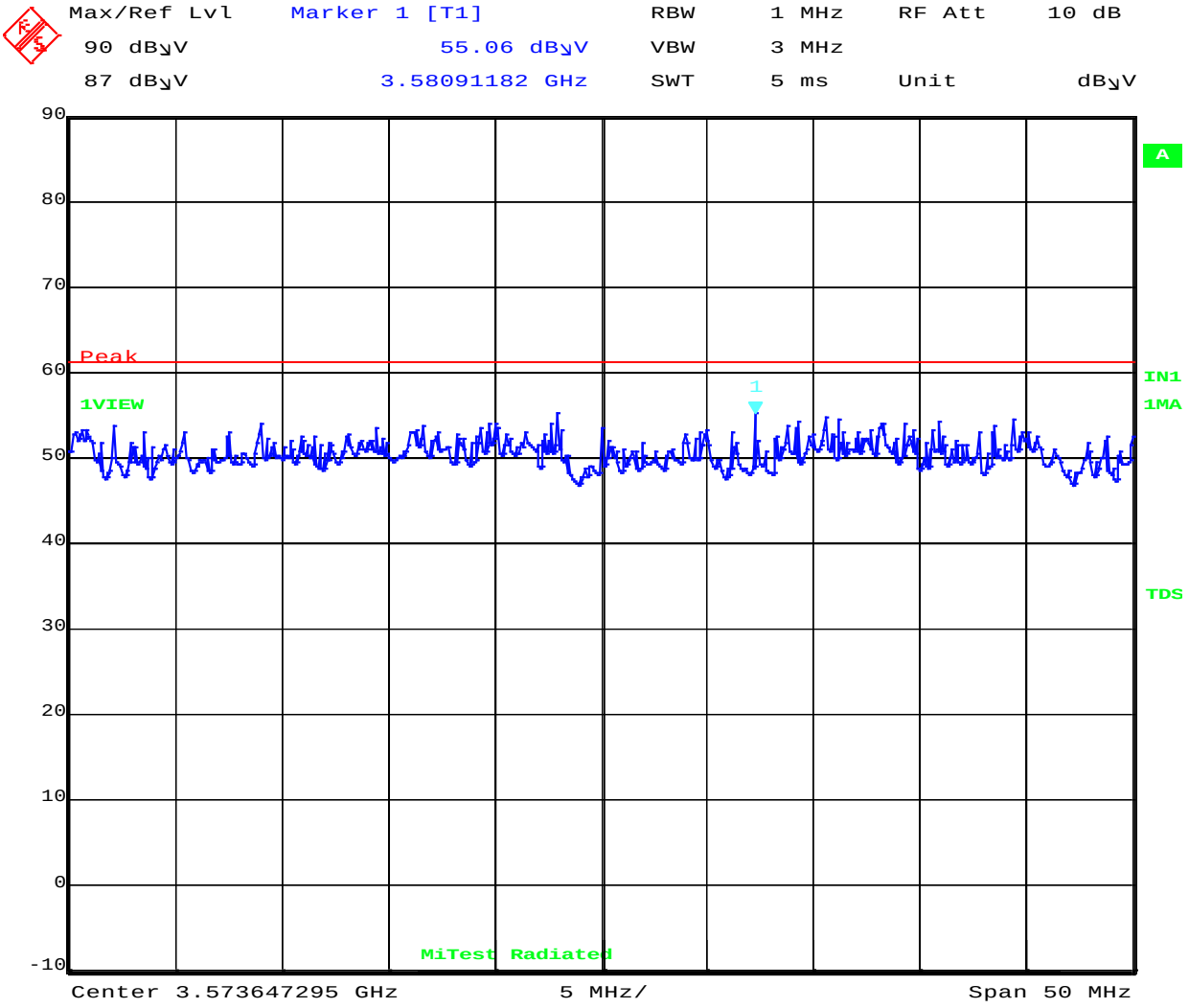
A.2. Peak Power Density

DV11-AC – 500MHz Span



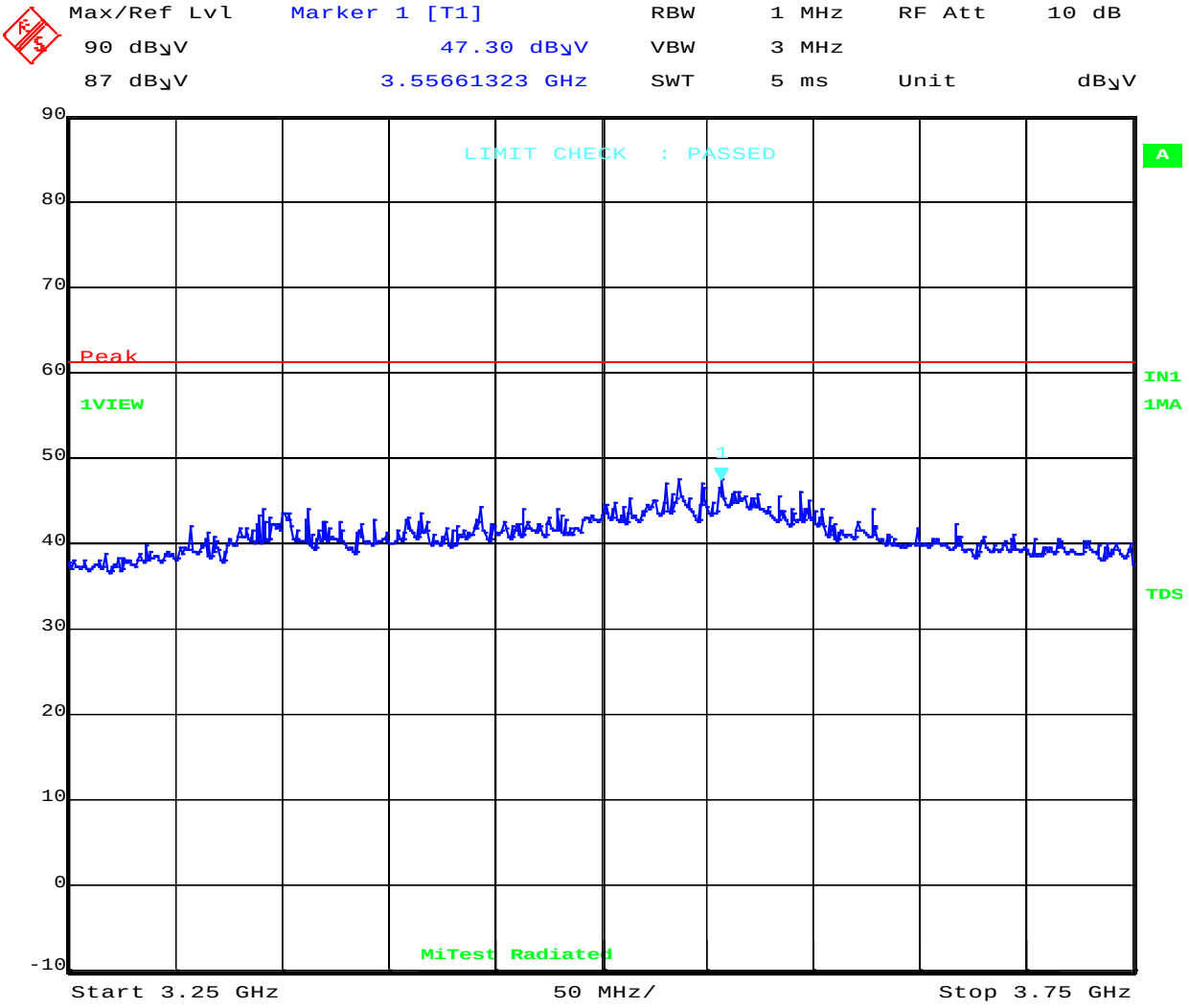
back to matrix

DV11-AC – 50MHz Span



back to matrix

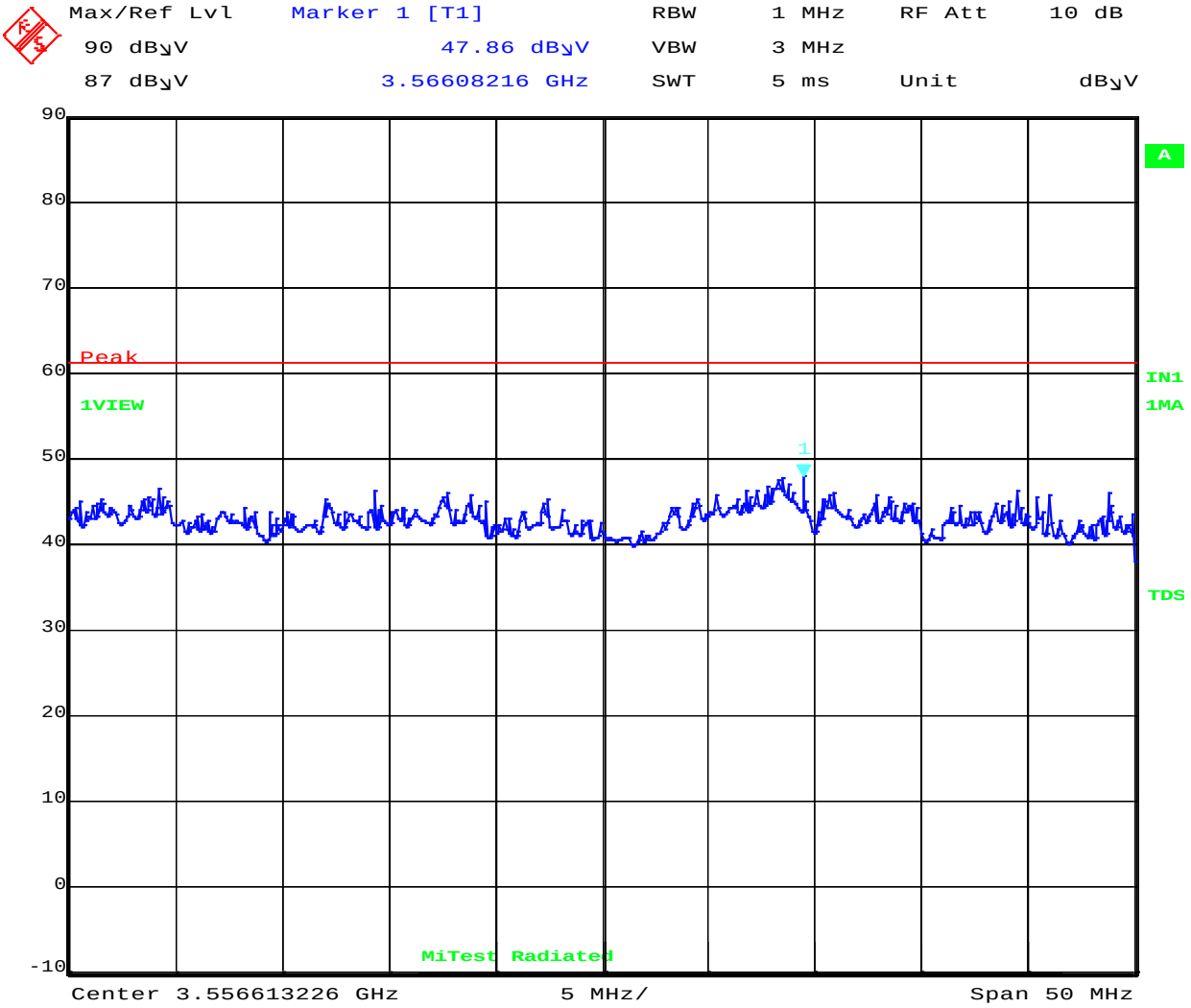
DV21-AC – 500MHz Span



Date: 18.JUN.2018 12:44:14

back to matrix

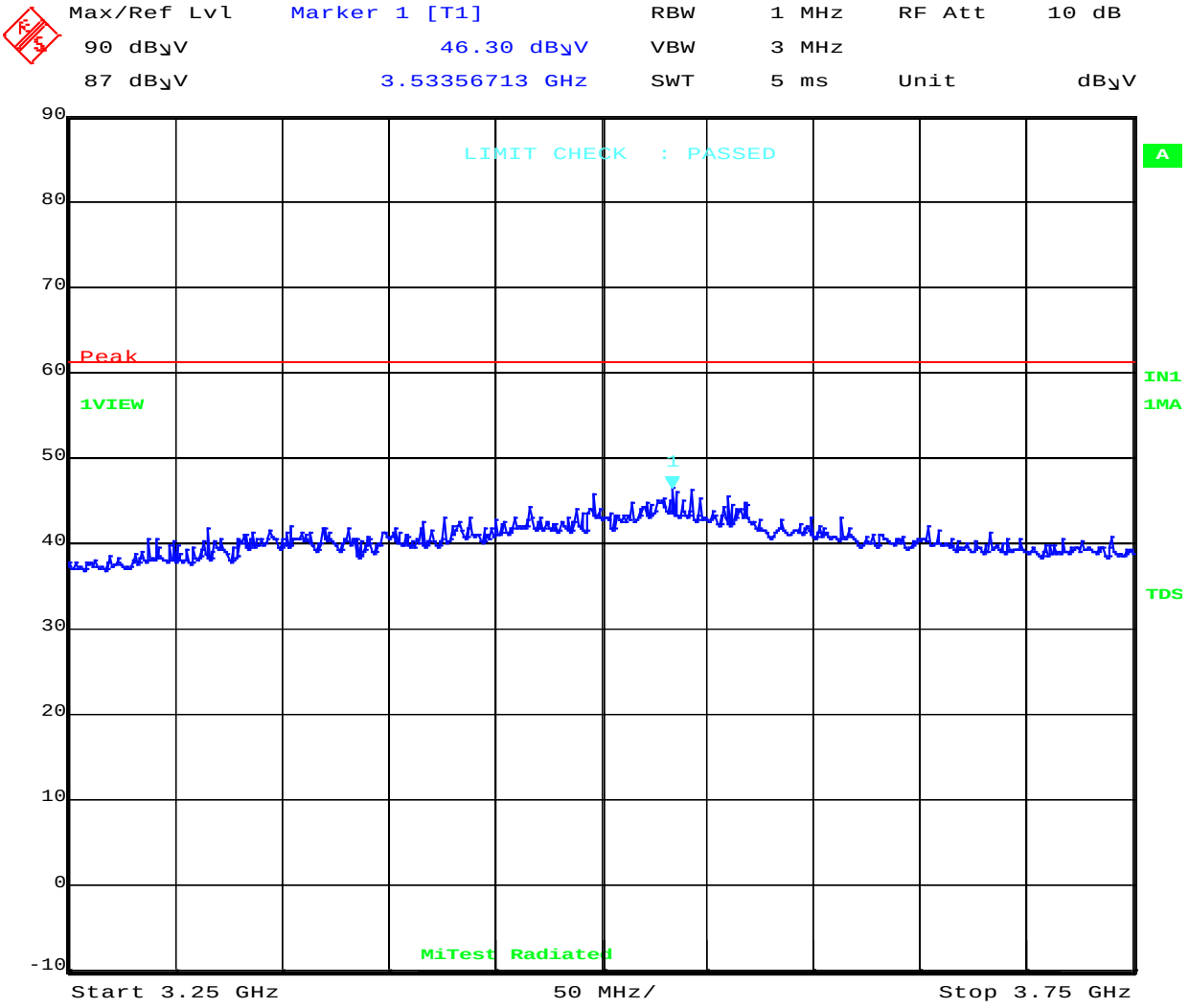
DV21-AC – 50MHz Span



Date: 18.JUN.2018 12:46:40

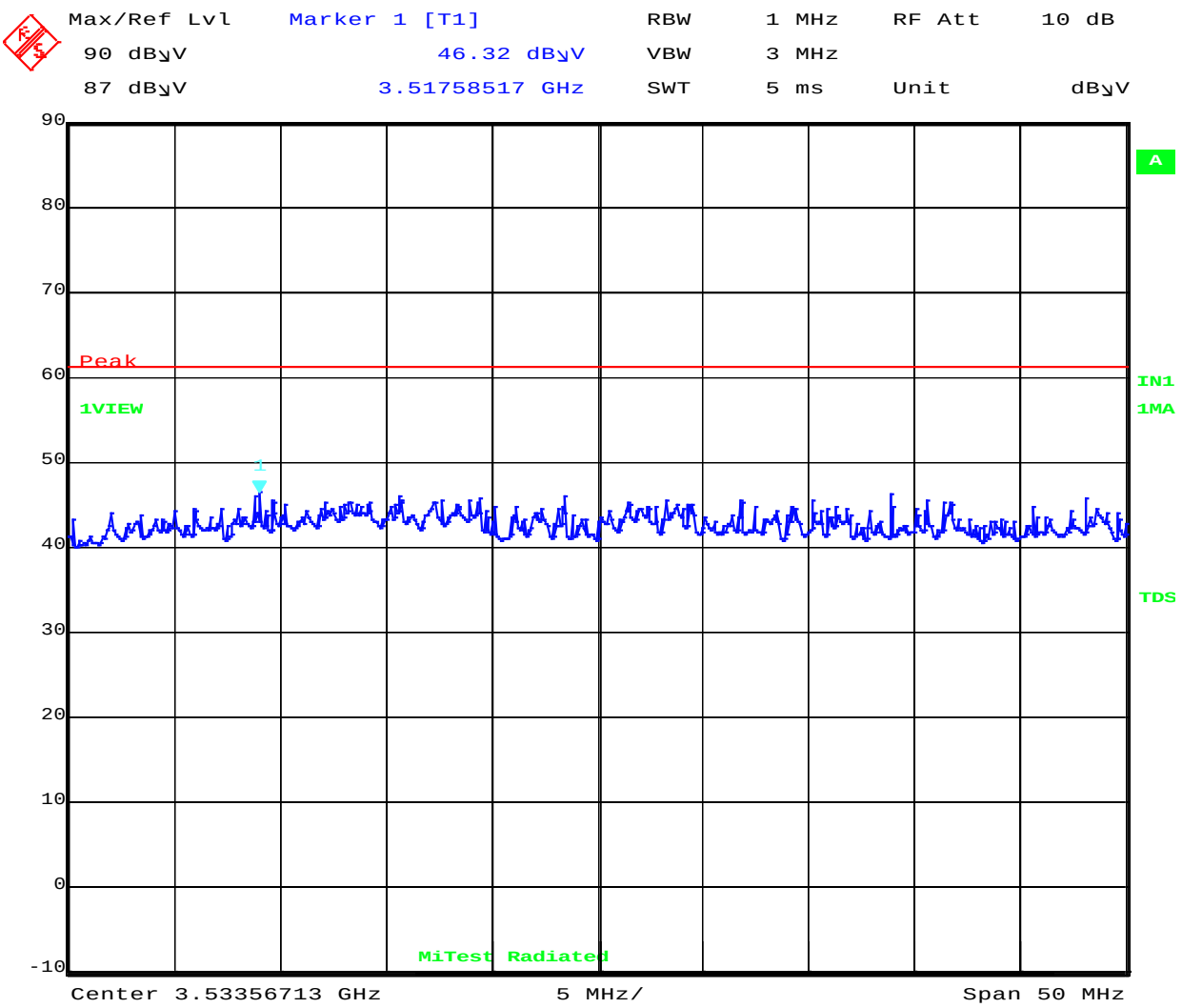
back to matrix

DV21-DC – 500MHz Span



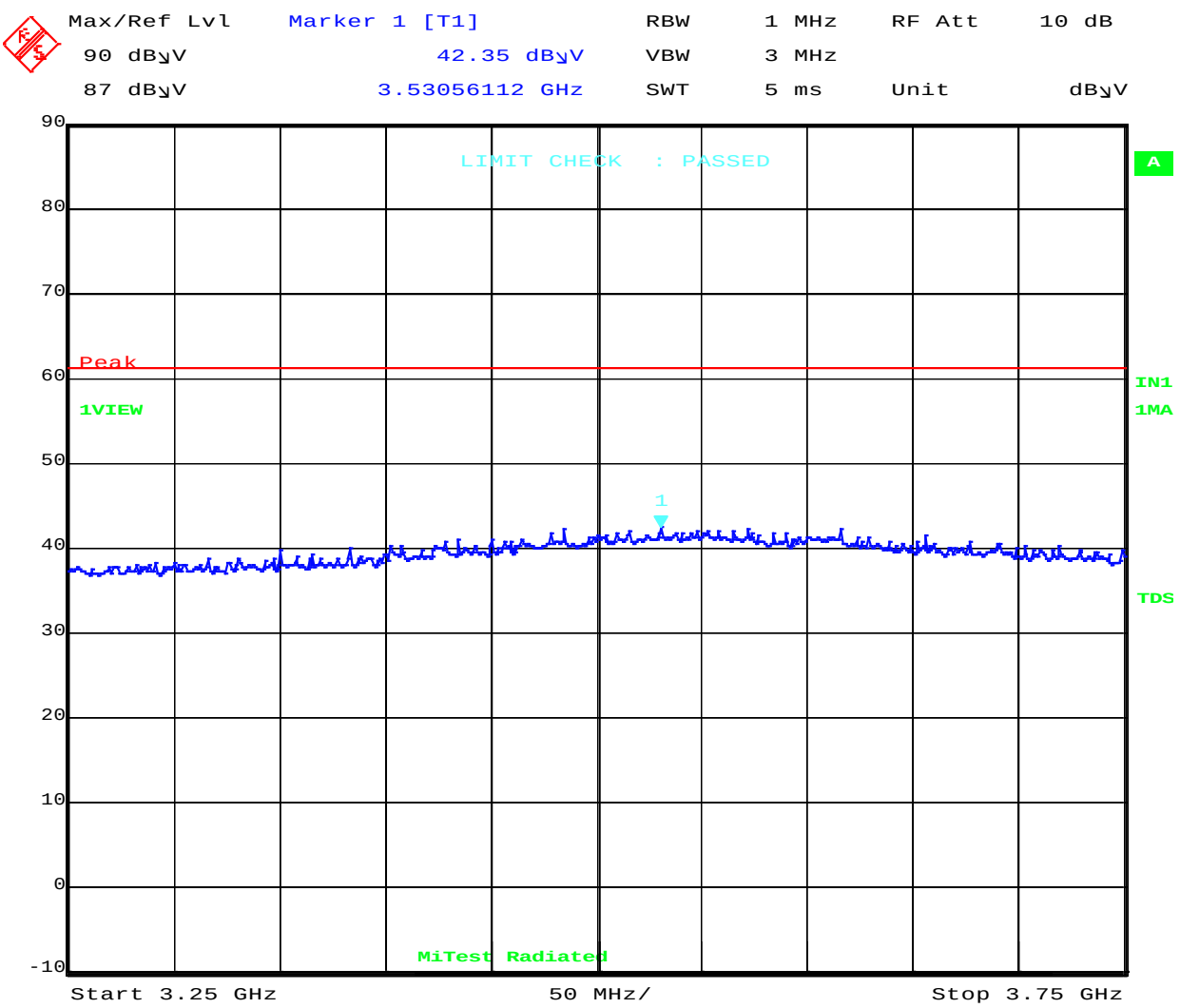
back to matrix

DV21-DC – 50MHz Span



back to matrix

DV31-DC – 500MHz Span



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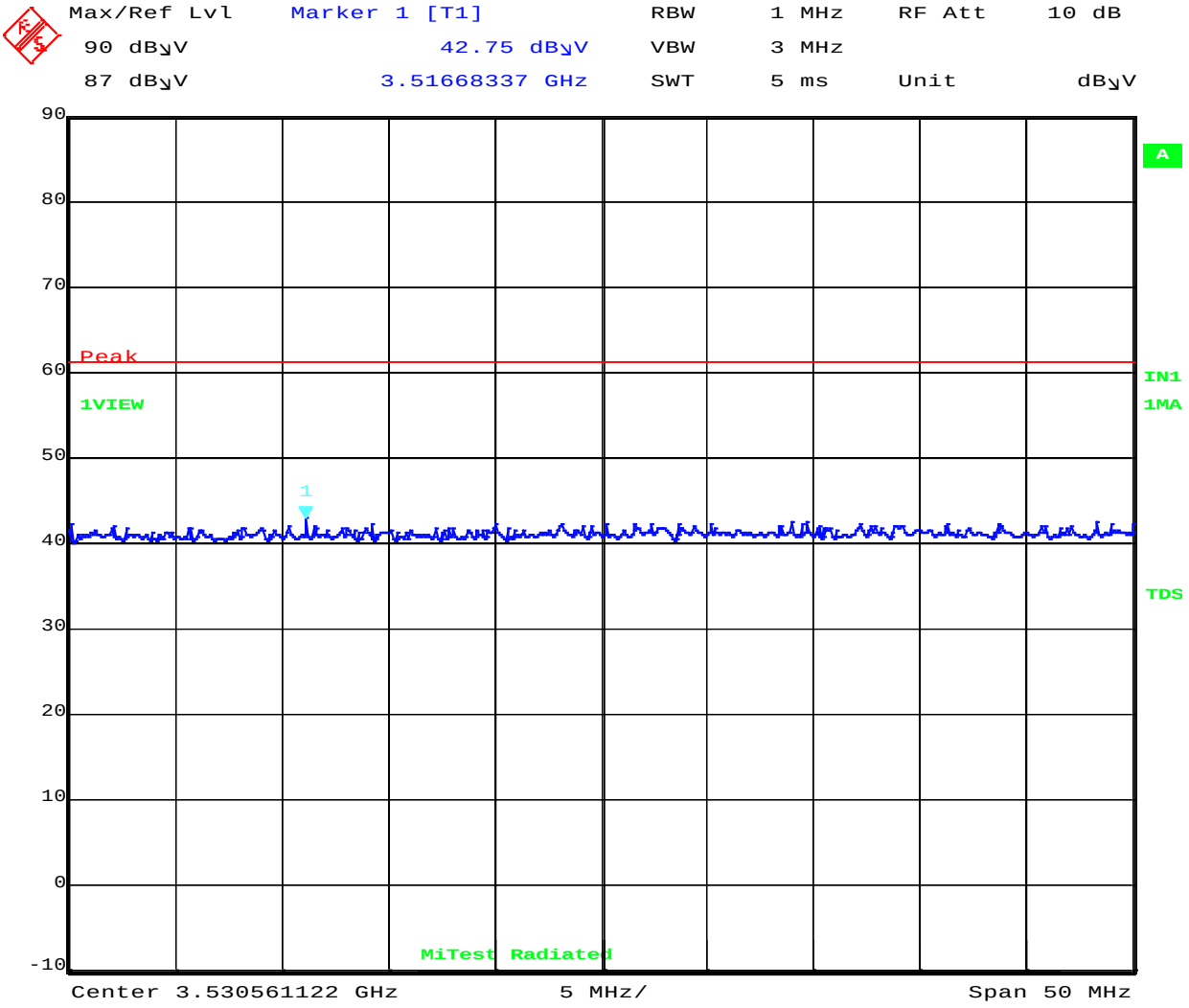
back to matrix

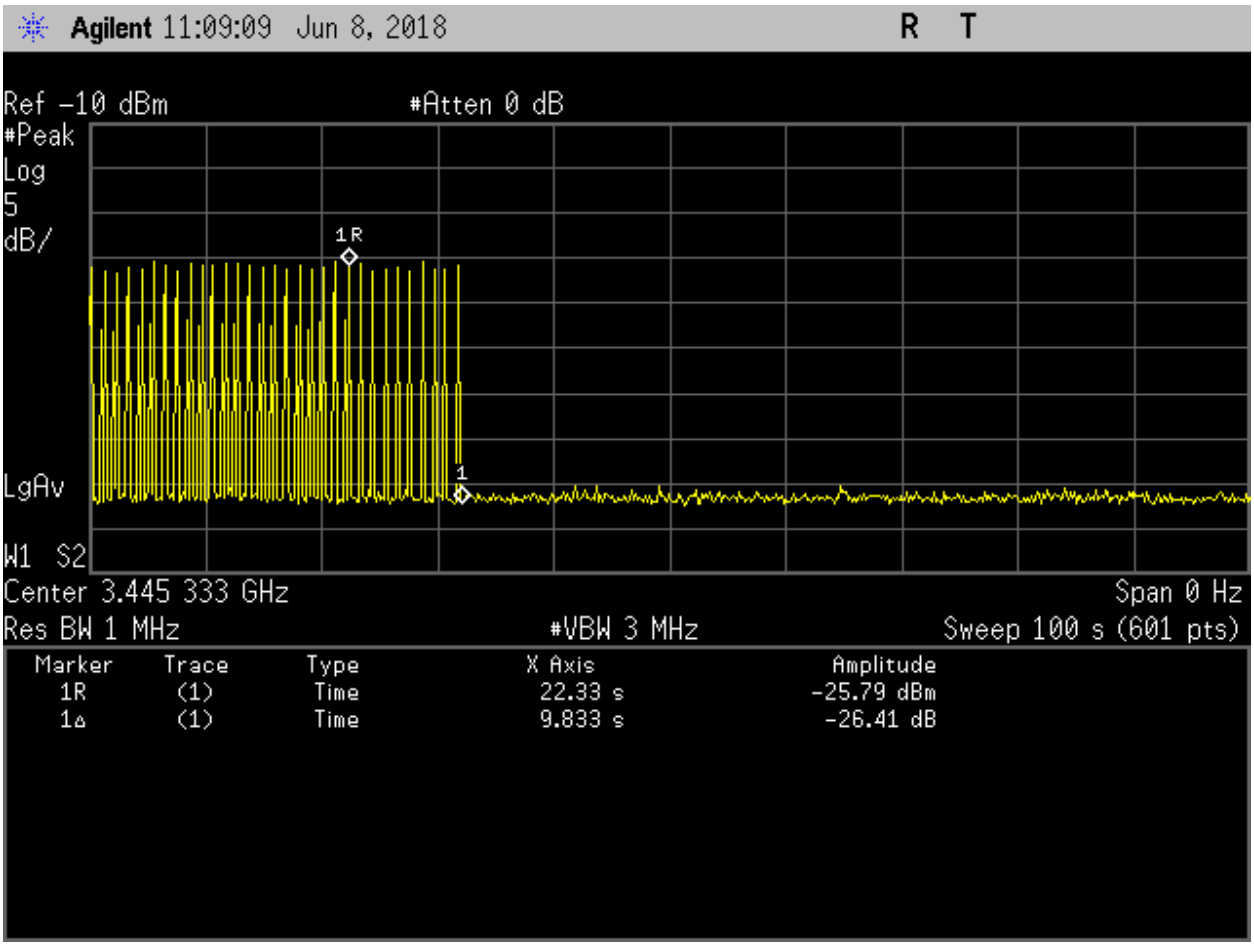
DV31-DC – 50MHz Span



back to matrix

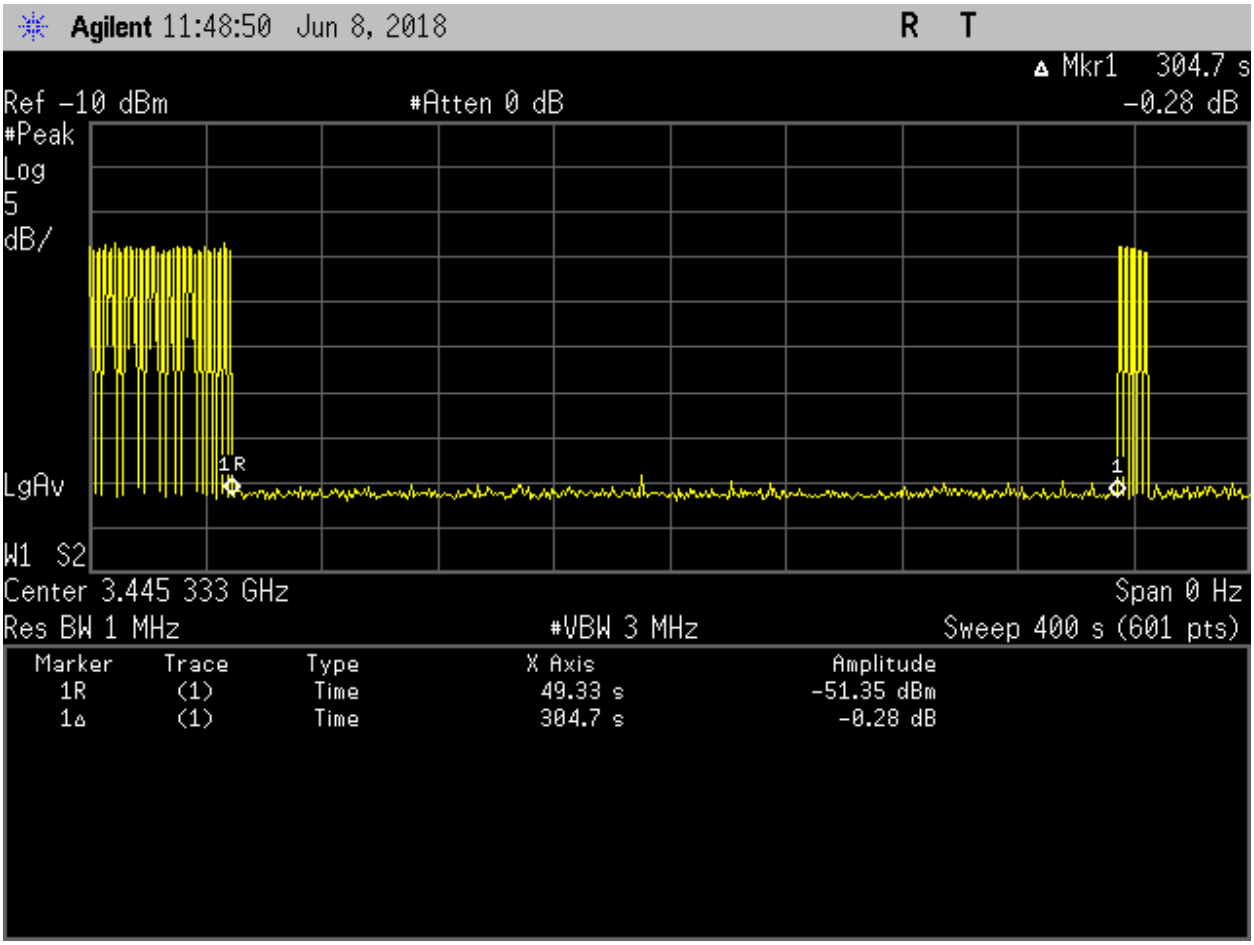
A.3. Shutoff Timing Requirements

10s Shutdown Time



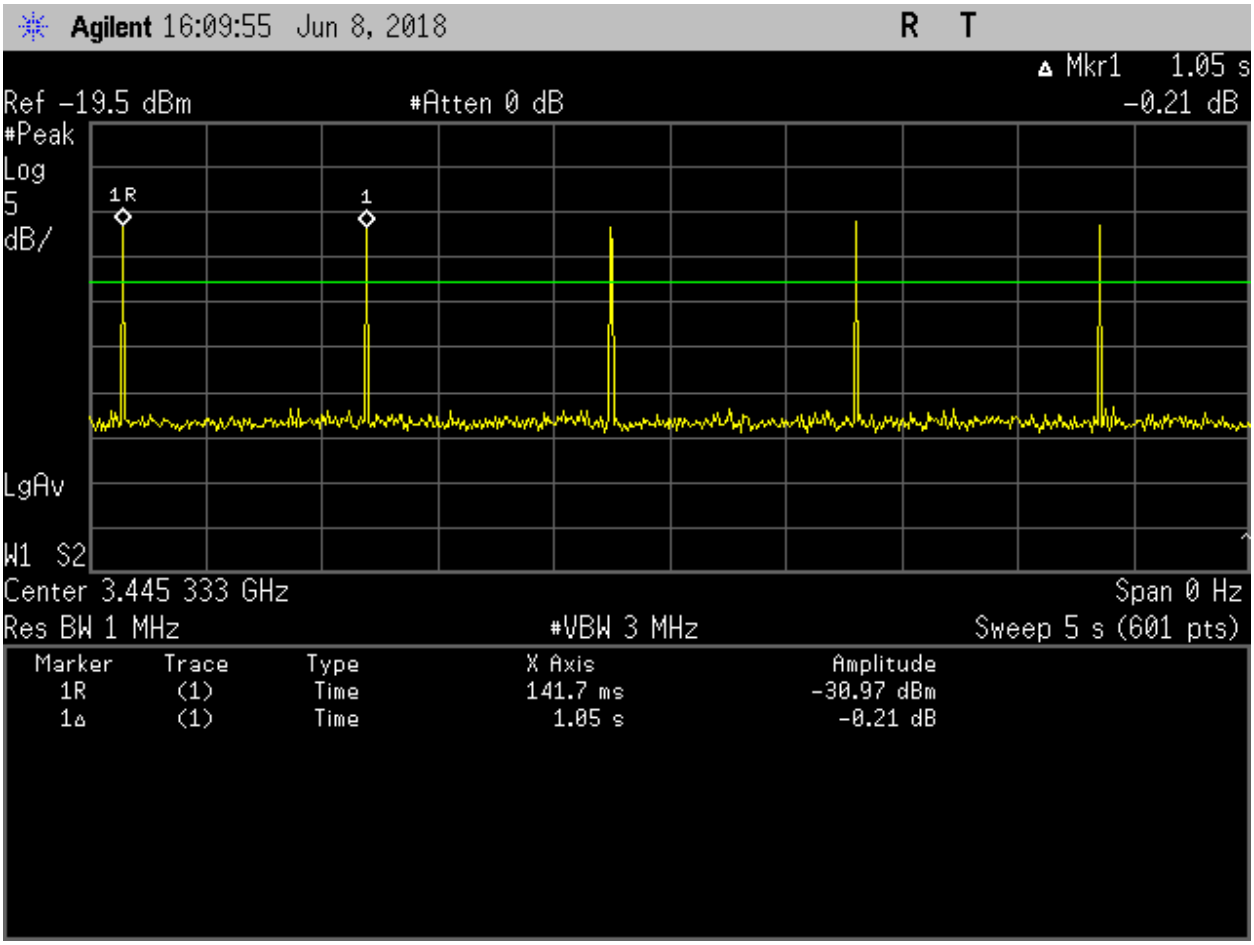
back to matrix

5min Shutdown Time



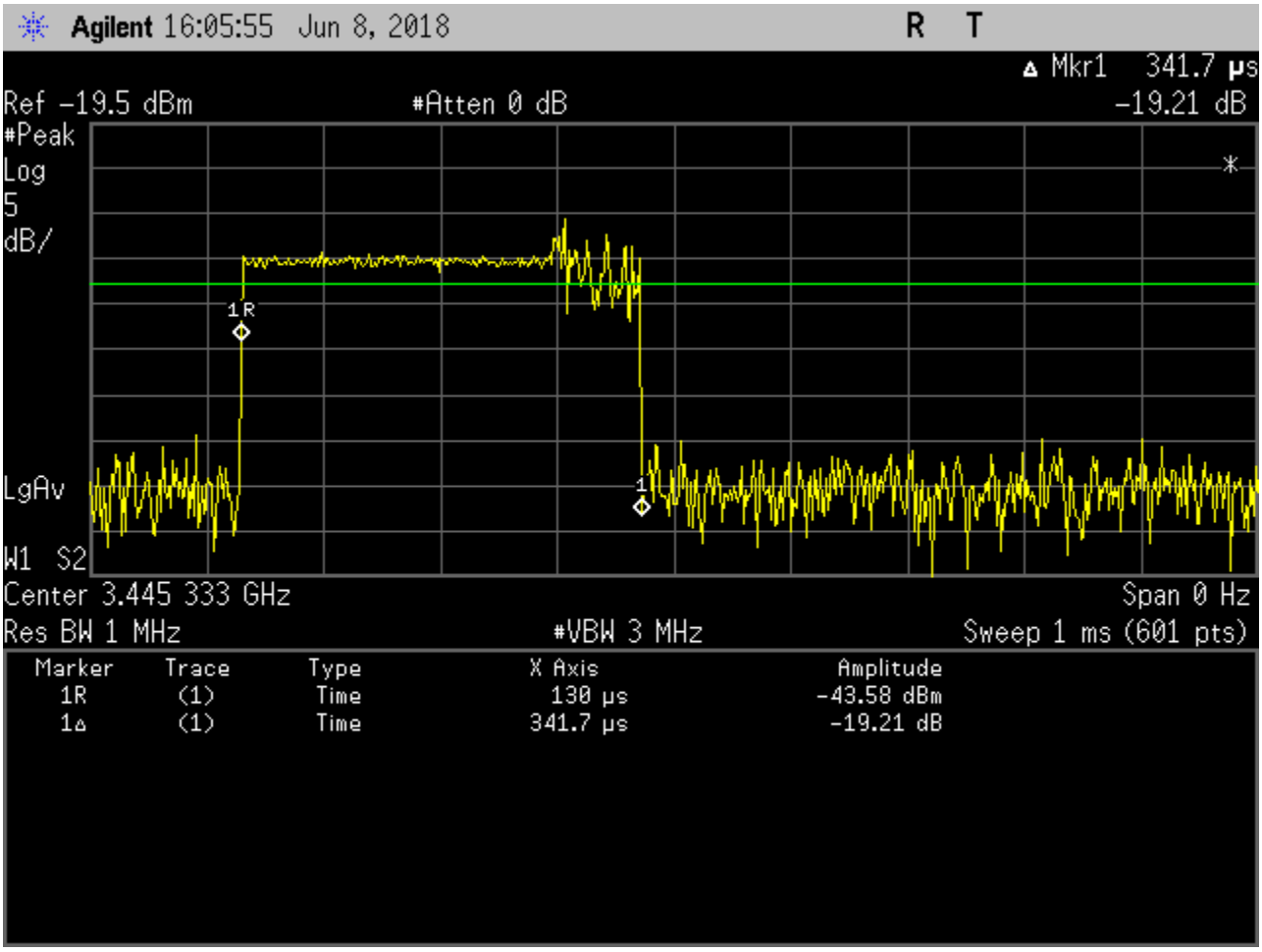
back to matrix

On Time – 5s sweep



back to matrix

On Time – Single Pulse



back to matrix

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