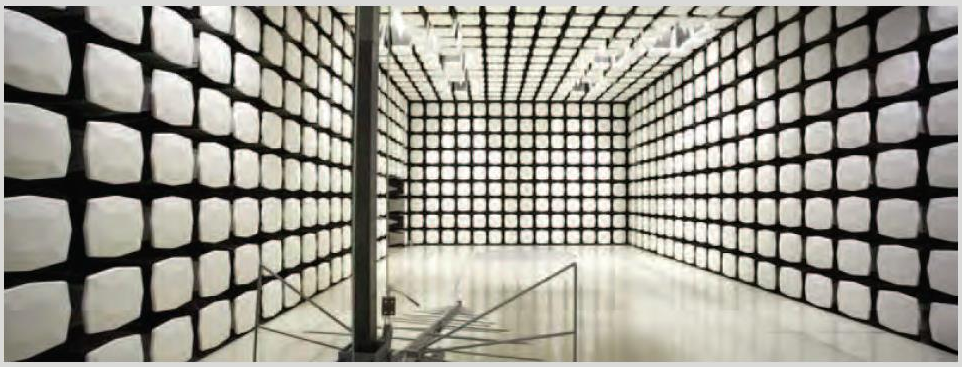
Pulsar Process Measurement

60 GHz Radar

FCC 15.255:2019

Report # ELEM0096 Rev. 1



NVLAP LAB CODE: 200630-0

CERTIFICATE OF TEST

Last Date of Test: October 10, 2019
Pulsar Process Measurement
EUT: 60 GHz Radar

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2019	ANSI C63.10:2013
FCC 15.209:2019	
FCC 15.255:2019	

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	AC Powerline Conducted Emissions	Yes	Pass	
6.5	Spurious Emissions 30-1000 MHz (FCC 15.209)	Yes	Pass	
6.6	Spurious Emissions 1-40GHz (FCC 15.209)	Yes	Pass	
9.3	6 dB Bandwidth	Yes	Pass	
9.5, 9.11	Equivalent Isotopically Radiated Power (EIRP)	Yes	Pass	
9.11	Conducted Output Power	Yes	Pass	
9.12	Spurious Emissions 40-200GHz (FCC 15.255)	Yes	Pass	
9.14	Frequency Stability	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Kyle Holgate, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Headers and Bookmarks were swapped for Conducted Output Power and Equivalent Isotropic Radiated Power	2020-05-06	30-33

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

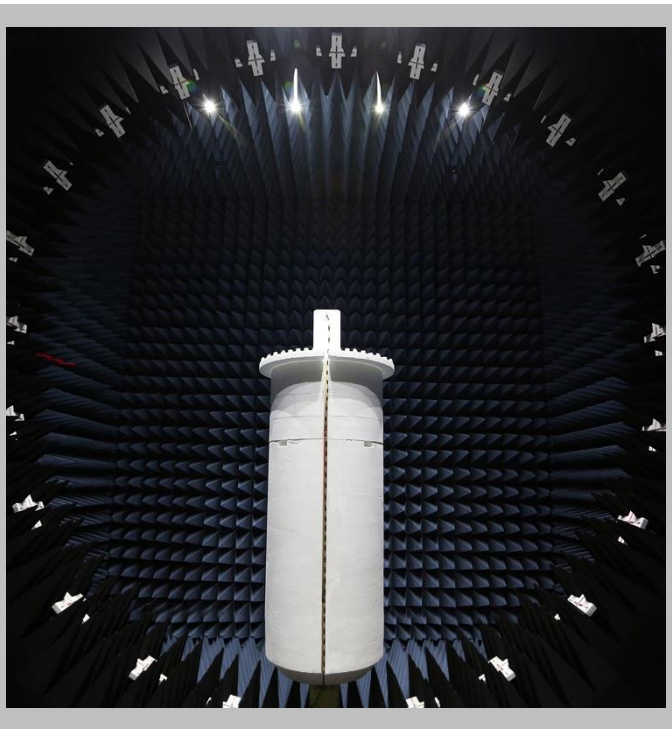
MIC – Recognized by MIC as a CAB for the acceptance of test data.

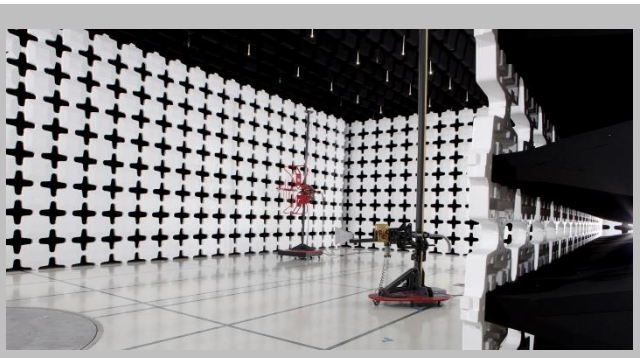
SCOPE

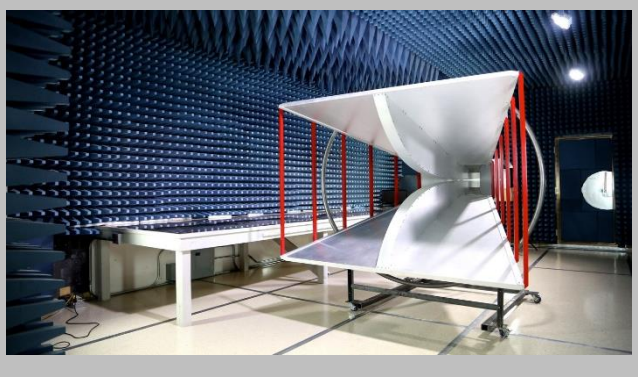
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

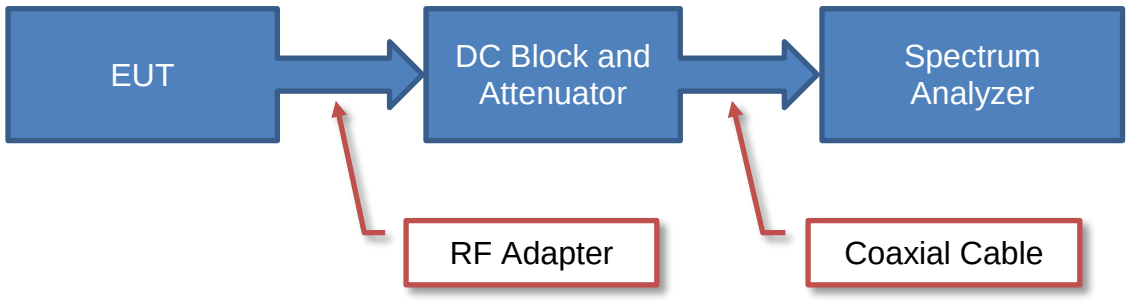
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

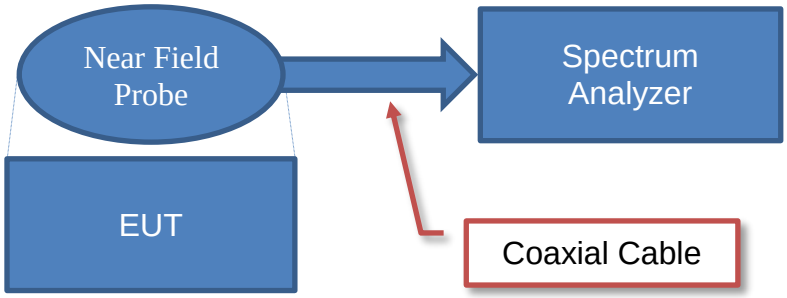
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

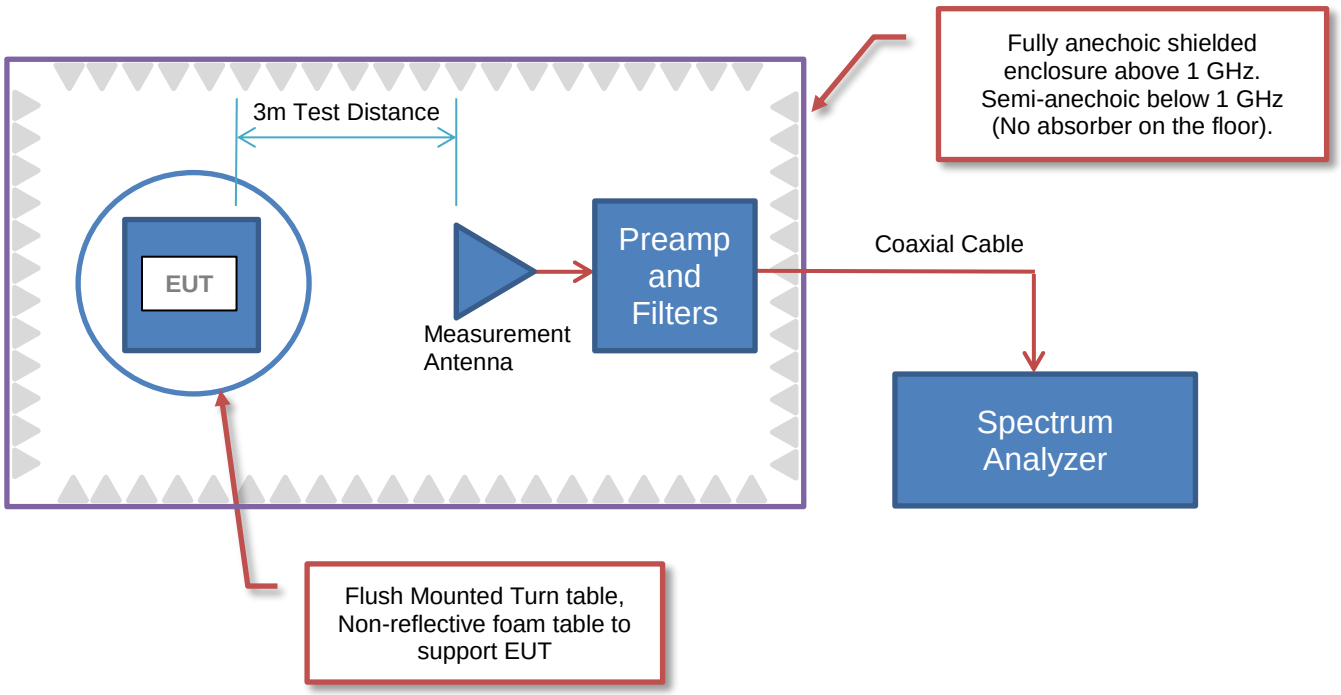
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Pulsar Process Measurement
Address:	Cardinal Building, Enigma Commercial Centre Sandy's Road, Malvern
City, State, Zip:	WR14 1JJ, U.K.
Test Requested By:	Alex Toohie of Element Materials Technology
EUT:	60 GHz Radar
First Date of Test:	June 5, 2019
Last Date of Test:	October 10, 2019
Receipt Date of Samples:	June 5, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
60 GHz Radar

Testing Objective:
Seeking to demonstrate compliance under FCC 15.255:2018 for operation in the 57 - 71 GHz Band.

CONFIGURATIONS

Configuration ELEM0019- 1

Software/Firmware Running during test	
Description	**Version**
Hercules SETUP utility	3.2.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
60 GHz Radar	Pulsar Process Measurement	mmWave/dBR8	FCC001/2019

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Laptop	Lenovo	IdeaPad	CB17045993
I/O Break-out Box	Unknown	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
I/O Cable	Yes	10.1 m	No	60 GHz Radar	I/O Break-out Box
USB Cable	Yes	1.0 m	No	I/O Break-out Box	Remote Laptop

Configuration ELEM0019- 2

Software/Firmware Running during test	
Description	**Version**
Hercules SETUP utility	3.2.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
60 GHz Radar	Pulsar Process Measurement	mmWave/dBR16	FCC002/2019

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Laptop	Lenovo	IdeaPad	CB17045993
I/O Break-out Box	Unknown	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
I/O Cable	Yes	10.1 m	No	60 GHz Radar	I/O Break-out Box
USB Cable	Yes	1.0 m	No	I/O Break-out Box	Remote Laptop

CONFIGURATIONS

Configuration ELEM0096- 1

Software/Firmware Running during test	
Description	**Version**
Hercules SETUP utility	3.2.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
60 GHz Radar	Pulsar Process Measurement	mmWave/dBR8	FCC001/2019

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Laptop	Lenovo	IdeaPad	CB17045993
I/O Break-out Box	Unknown	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
I/O Cable	Yes	10.1 m	No	60 GHz Radar	I/O Break-out Box
USB Cable	Yes	1.0 m	No	I/O Break-out Box	Remote Laptop

Configuration ELEM0096- 2

Software/Firmware Running during test	
Description	**Version**
Hercules SETUP utility	3.2.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
60 GHz Radar	Pulsar Process Measurement	mmWave/dBR16	FCC002/2019

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Laptop	Lenovo	IdeaPad	CB17045993
I/O Break-out Box	Unknown	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
I/O Cable	Yes	10.1 m	No	60 GHz Radar	I/O Break-out Box
USB Cable	Yes	1.0 m	No	I/O Break-out Box	Remote Laptop

CONFIGURATIONS

Configuration ELEM0096- 3

Software/Firmware Running during test	
Description	**Version**
Hercules SETUP utility	3.2.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
60 GHz Radar	Pulsar Process Measurement	mmWave/dBR16	317411/2019

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Laptop	Lenovo	IdeaPad	CB17045993
I/O Break-out Box	Unknown	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
I/O Cable	Yes	10.1 m	No	60 GHz Radar	I/O Break-out Box
USB Cable	Yes	1.0 m	No	I/O Break-out Box	Remote Laptop

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-06-05	Spurious Emissions 30-1000 MHz (FCC 15.209)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2019-06-05	Spurious Emissions 1-40GHz (FCC 15.209)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2019-08-19	AC Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2019-08-22	Frequency Stability	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2019-08-22	Spurious Emissions 40-200GHz (FCC 15.255)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2019-10-10	6 dB Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2019-10-10	Equivalent Isotopically Radiated Power (EIRP)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2019-10-10	Conducted Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

AC POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Rohde & Schwarz	ESCI	ARH	2019-05-02	2020-05-02
LISN	Solar Electronics	9252-50-R-24-BNC	LIP	2018-09-11	2019-09-11
Cable - Conducted Cable Assembly	Northwest EMC	EVG, HHD, RKT	EVGA	2019-01-07	2020-01-07
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

ELEM0096-1
ELEM0096-2

MODES INVESTIGATED

Continuous Tx, Mid Ch. = 60.9 GHz, No Modulation

AC POWERLINE CONDUCTED EMISSIONS

EUT:	60 GHz Radar	Work Order:	ELEM0096
Serial Number:	FCC002/2019	Date:	2019-08-19
Customer:	Pulsar Process Measurement	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	45.5%
Customer Project:	None	Bar. Pressure:	1019 mb
Tested By:	Brandon Hobbs, Cole Ghizzone	Job Site:	EV07
Power:	110VAC/60Hz	Configuration:	ELEM0096-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	13	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

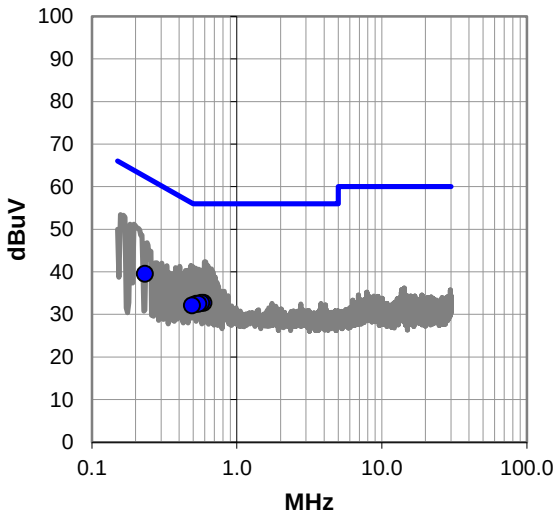
EUT OPERATING MODES

Continuous Tx, Mid Ch. = 60.9 GHz, No Modulation

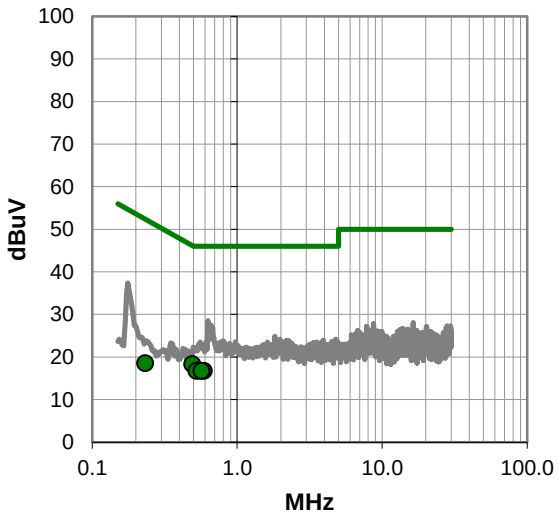
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



AC POWERLINE CONDUCTED EMISSIONS

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RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.232	19.5	20.0	39.5	62.4	-22.9
0.588	12.7	20.0	32.7	56.0	-23.3
0.568	12.7	20.0	32.7	56.0	-23.3
0.525	12.5	20.0	32.5	56.0	-23.5
0.542	12.5	20.0	32.5	56.0	-23.5
0.490	12.2	19.9	32.1	56.2	-24.1

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.490	-1.6	19.9	18.3	46.2	-27.9
0.542	-3.2	20.0	16.8	46.0	-29.2
0.588	-3.3	20.0	16.7	46.0	-29.3
0.525	-3.3	20.0	16.7	46.0	-29.3
0.568	-3.3	20.0	16.7	46.0	-29.3
0.232	-1.5	20.0	18.5	52.4	-33.9

CONCLUSION

Pass

Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	60 GHz Radar	Work Order:	ELEM0096
Serial Number:	FCC002/2019	Date:	2019-08-19
Customer:	Pulsar Process Measurement	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	45.5%
Customer Project:	None	Bar. Pressure:	1019 mb
Tested By:	Brandon Hobbs, Cole Ghizzone	Job Site:	EV07
Power:	110VAC/60Hz	Configuration:	ELEM0096-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	14	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

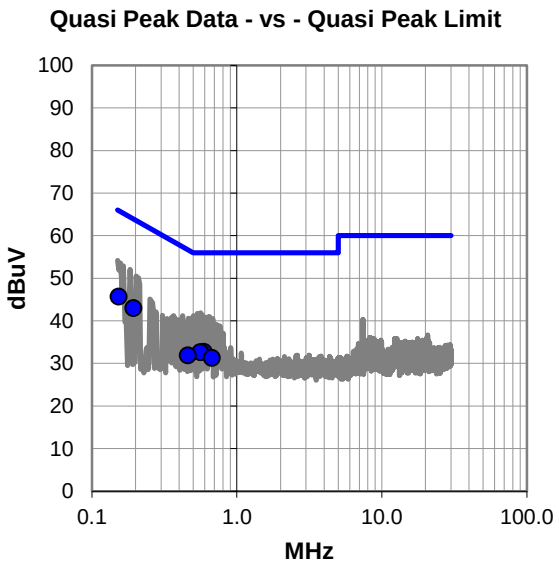
None

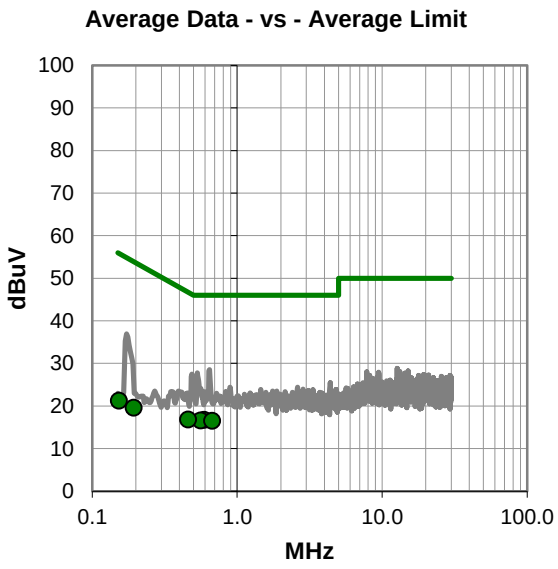
EUT OPERATING MODES

Continuous Tx, Mid Ch. = 60.9 GHz, No Modulation

DEVIATIONS FROM TEST STANDARD

None





AC POWERLINE CONDUCTED EMISSIONS

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RESULTS - Run #14

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.153	25.6	20.1	45.7	65.8	-20.1
0.193	23.0	20.0	43.0	63.9	-20.9
0.592	12.7	20.0	32.7	56.0	-23.3
0.561	12.6	20.0	32.6	56.0	-23.4
0.671	11.3	20.0	31.3	56.0	-24.7
0.459	12.0	19.9	31.9	56.7	-24.8

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.592	-3.3	20.0	16.7	46.0	-29.3
0.561	-3.4	20.0	16.6	46.0	-29.4
0.671	-3.5	20.0	16.5	46.0	-29.5
0.459	-3.1	19.9	16.8	46.7	-29.9
0.193	-0.4	20.0	19.6	53.9	-34.3
0.153	1.1	20.1	21.2	55.8	-34.6

CONCLUSION

Pass

Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	60 GHz Radar	Work Order:	ELEM0096
Serial Number:	FCC001/2019	Date:	2019-08-19
Customer:	Pulsar Process Measurement	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	45.5%
Customer Project:	None	Bar. Pressure:	1019 mb
Tested By:	Brandon Hobbs, Cole Ghizzone	Job Site:	EV07
Power:	110VAC/60Hz	Configuration:	ELEM0096-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	18	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

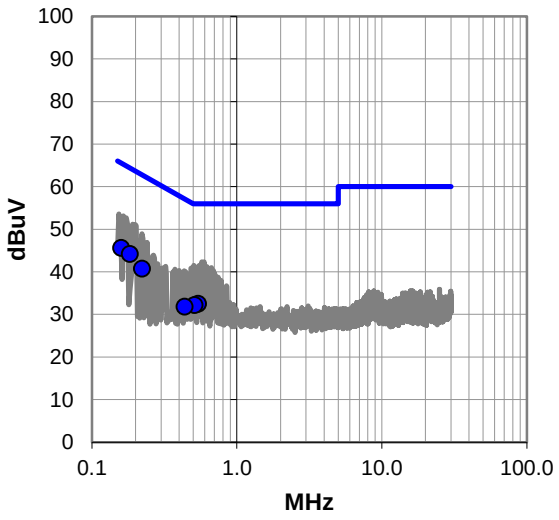
EUT OPERATING MODES

Continuous Tx, Low Ch. = 58.3 GHz, Mid Ch. = 60.9 GHz, High Ch. = 63.6 GHz, No Modulation

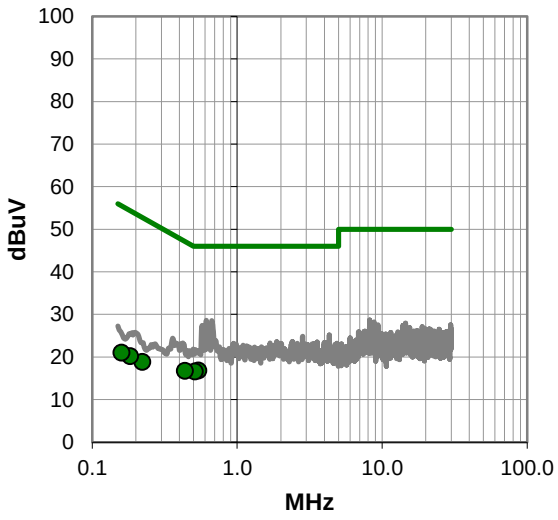
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



AC POWERLINE CONDUCTED EMISSIONS

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WTD.2019.1.24

RESULTS - Run #18

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.159	25.5	20.1	45.6	65.5	-19.9
0.183	24.2	20.0	44.2	64.4	-20.2
0.222	20.7	20.0	40.7	62.8	-22.1
0.540	12.5	20.0	32.5	56.0	-23.5
0.511	12.3	19.9	32.2	56.0	-23.8
0.436	11.9	19.9	31.8	57.1	-25.3

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.540	-3.2	20.0	16.8	46.0	-29.2
0.511	-3.3	19.9	16.6	46.0	-29.4
0.436	-3.2	19.9	16.7	47.1	-30.4
0.222	-1.2	20.0	18.8	52.8	-34.0
0.183	0.2	20.0	20.2	54.4	-34.2
0.159	0.9	20.1	21.0	55.5	-34.5

CONCLUSION

Pass

Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	60 GHz Radar	Work Order:	ELEM0096
Serial Number:	FCC001/2019	Date:	2019-08-19
Customer:	Pulsar Process Measurement	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	45.5%
Customer Project:	None	Bar. Pressure:	1019 mb
Tested By:	Brandon Hobbs, Cole Ghizzone	Job Site:	EV07
Power:	110VAC/60Hz	Configuration:	ELEM0096-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	19	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

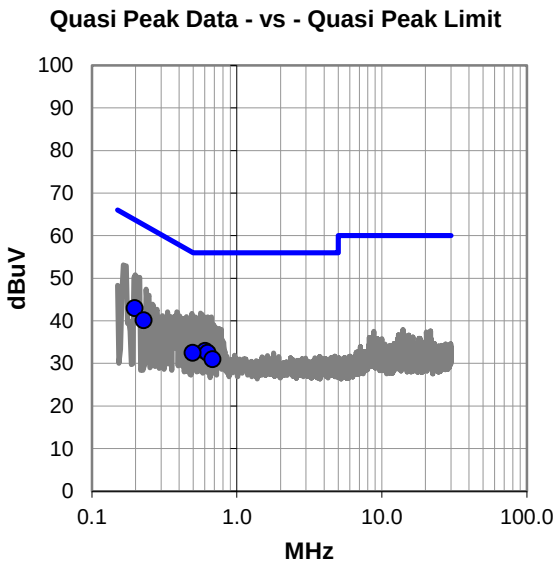
None

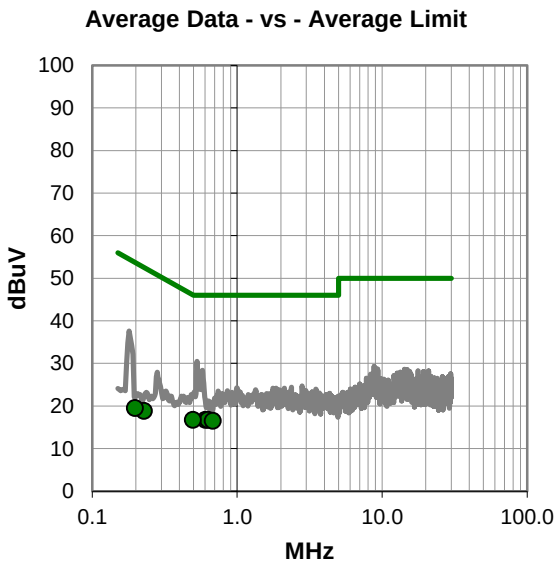
EUT OPERATING MODES

Continuous Tx, Low Ch. = 58.3 GHz, Mid Ch. = 60.9 GHz, High Ch. = 63.6 GHz, No Modulation

DEVIATIONS FROM TEST STANDARD

None





AC POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

RESULTS - Run #19

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.197	23.0	20.0	43.0	63.7	-20.7
0.227	20.1	20.0	40.1	62.5	-22.4
0.603	12.9	20.0	32.9	56.0	-23.1
0.628	12.5	20.0	32.5	56.0	-23.5
0.494	12.6	19.9	32.5	56.1	-23.6
0.678	11.0	20.0	31.0	56.0	-25.0

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.603	-3.3	20.0	16.7	46.0	-29.3
0.628	-3.3	20.0	16.7	46.0	-29.3
0.494	-3.2	19.9	16.7	46.1	-29.4
0.678	-3.5	20.0	16.5	46.0	-29.5
0.227	-1.2	20.0	18.8	52.5	-33.7
0.197	-0.5	20.0	19.5	53.7	-34.2

CONCLUSION

Pass

Tested By

SPURIOUS EMISSIONS 1-40GHZ (FCC 15.209)

PSA-ESCI 2019.05.10

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Continuous Tx, Low Ch. = 58.3 GHz, Mid Ch. = 60.9 GHz, High Ch. = 63.6 GHz, No Modulation

POWER SETTINGS INVESTIGATED

30 VDC

CONFIGURATIONS INVESTIGATED

ELEM0019 - 1

ELEM0019 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	40 GHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Filter - Low Pass	Micro-Tronics	LPM50004	LFD	15-Feb-2019	12 mo
Cable	ESM Cable Corp.	KNKN-72 SMA Cable	EVZ	23-Apr-2019	12 mo
Cable	ESM Cable Corp.	KMKM-72	EVY	24-Aug-2018	12 mo
Cable	None	Standard Gain Horns Cable	EVF	24-Nov-2018	12 mo
Cable	N/A	Double Ridge Horn Cables	EVB	24-Nov-2018	12 mo
Cable	N/A	Bilog Cables	EVA	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	JSW45-26004000-40-5P	PAE	23-Apr-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AVU	24-Aug-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVD	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-08001200-30-10P	PAO	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	24-Nov-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-10	AIW	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AIV	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AHV	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	7-Feb-2018	24 mo
Antenna - Biconilog	Teseq	CBL 6141B	AXR	2-Oct-2018	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-2019	12 mo

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

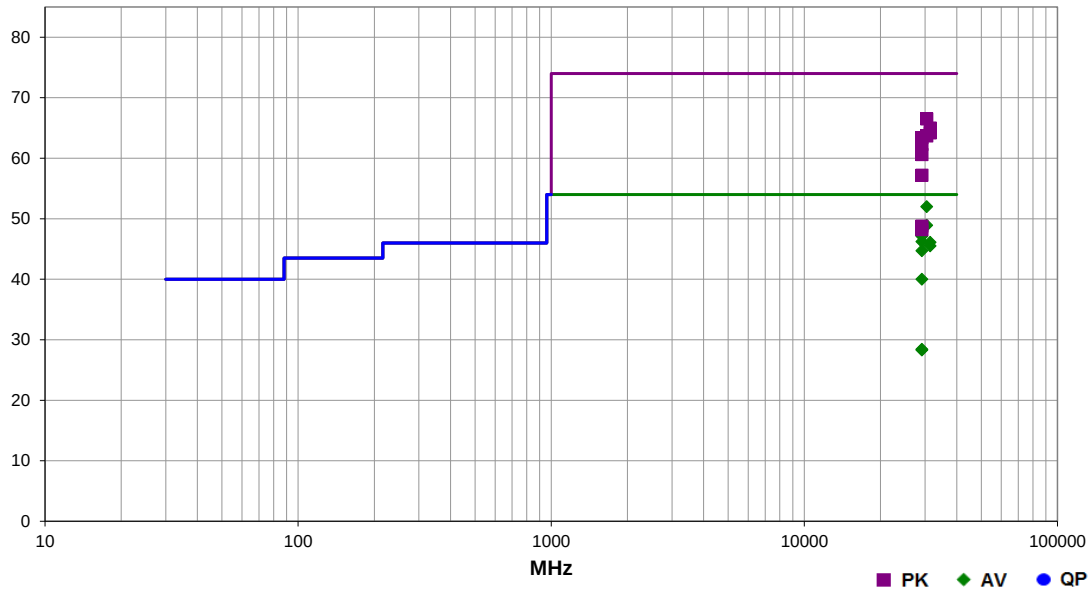
SPURIOUS EMISSIONS 1-40GHZ (FCC 15.209)

EmiRS 2019.05.20 PSA-ESCI 2019.05.10

Work Order:	ELEM0019	**Date:**	5-Jun-2019		
Project:	None	**Temperature:**	22.6 °C		
Job Site:	EV01	**Humidity:**	42.3% RH		
Serial Number:	FCC002/2019	**Barometric Pres.:**	1019 mbar	**Tested by:**	Jeff Alcoke
EUT:	60 GHz Radar				
Configuration:	2				
Customer:	Pulsar Process Measurement				
Attendees:	None				
EUT Power:	30 VDC				
Operating Mode:	Continuous Tx, Low Ch. = 58.3 GHz, Mid Ch. = 60.9 GHz, High Ch. = 63.6 GHz, No Modulation				
Deviations:	None				
Comments:	See comments below for Channel and EUT orientation. The EUT employs FMCW modulation with a worst case duty (DC) cycle of 32%. The RMS Avg data was downwardly corrected by a factor of 20*log (DC) = 20*log(0.32) ≈ -9.9 dB.				

Test Specifications	**Test Method**
FCC 15.255:2019	ANSI C63.10:2013

Run #	33	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
30473.920	74.4	-12.5	1.8	351.0	-9.9	0.0	Vert	AV	0.0	52.0	54.0	-2.0	Mid Ch, EUT Horz
30473.500	71.3	-12.5	1.7	351.0	-9.9	0.0	Horz	AV	0.0	48.9	54.0	-5.1	Mid Ch, EUT on Side
29148.830	69.6	-12.6	1.8	350.0	-9.9	0.0	Horz	AV	0.0	47.1	54.0	-6.9	Low Ch, EUT on Side
30472.380	79.0	-12.5	1.8	351.0	0.0	0.0	Vert	PK	0.0	66.5	74.0	-7.5	Mid Ch, EUT Horz
29148.790	68.7	-12.6	1.8	348.0	-9.9	0.0	Horz	AV	0.0	46.2	54.0	-7.8	Low Ch, EUT Horz
31436.250	67.6	-11.6	1.8	352.0	-9.9	0.0	Horz	AV	0.0	46.1	54.0	-7.9	High Ch, EUT on Side
31436.250	67.0	-11.6	1.8	352.0	-9.9	0.0	Vert	AV	0.0	45.5	54.0	-8.5	High Ch, EUT Horz
31435.580	76.6	-11.6	1.8	352.0	0.0	0.0	Horz	PK	0.0	65.0	74.0	-9.0	High Ch, EUT on Side
29148.830	67.2	-12.6	1.7	346.0	-9.9	0.0	Vert	AV	0.0	44.7	54.0	-9.3	Low Ch. EUT Horz
31436.750	75.8	-11.6	1.8	352.0	0.0	0.0	Vert	PK	0.0	64.2	74.0	-9.8	High Ch, EUT Horz
30473.120	76.2	-12.5	1.7	351.0	0.0	0.0	Horz	PK	0.0	63.7	74.0	-10.3	Mid Ch, EUT on Side
29149.290	76.0	-12.6	1.8	350.0	0.0	0.0	Horz	PK	0.0	63.4	74.0	-10.6	Low Ch, EUT on Side
29147.960	74.9	-12.6	1.8	348.0	0.0	0.0	Horz	PK	0.0	62.3	74.0	-11.7	Low Ch, EUT Horz
29150.120	73.1	-12.5	1.7	346.0	0.0	0.0	Vert	PK	0.0	60.6	74.0	-13.4	Low Ch. EUT Horz
29148.500	62.5	-12.6	1.8	353.0	-9.9	0.0	Vert	AV	0.0	40.0	54.0	-14.0	Low Ch, EUT on Side
29148.290	69.8	-12.6	1.8	353.0	0.0	0.0	Vert	PK	0.0	57.2	74.0	-16.8	Low Ch, EUT on Side
29148.420	61.4	-12.6	1.6	345.0	0.0	0.0	Horz	PK	0.0	48.8	74.0	-25.2	Low Ch. EUT Vert
29148.120	50.9	-12.6	1.6	345.0	-9.9	0.0	Horz	AV	0.0	28.4	54.0	-25.6	Low Ch. EUT Vert
29148.710	50.8	-12.6	1.6	345.0	-9.9	0.0	Vert	AV	0.0	28.3	54.0	-25.7	Low Ch. EUT Vert
29147.920	60.8	-12.6	1.6	345.0	0.0	0.0	Vert	PK	0.0	48.2	74.0	-25.8	Low Ch. EUT Vert

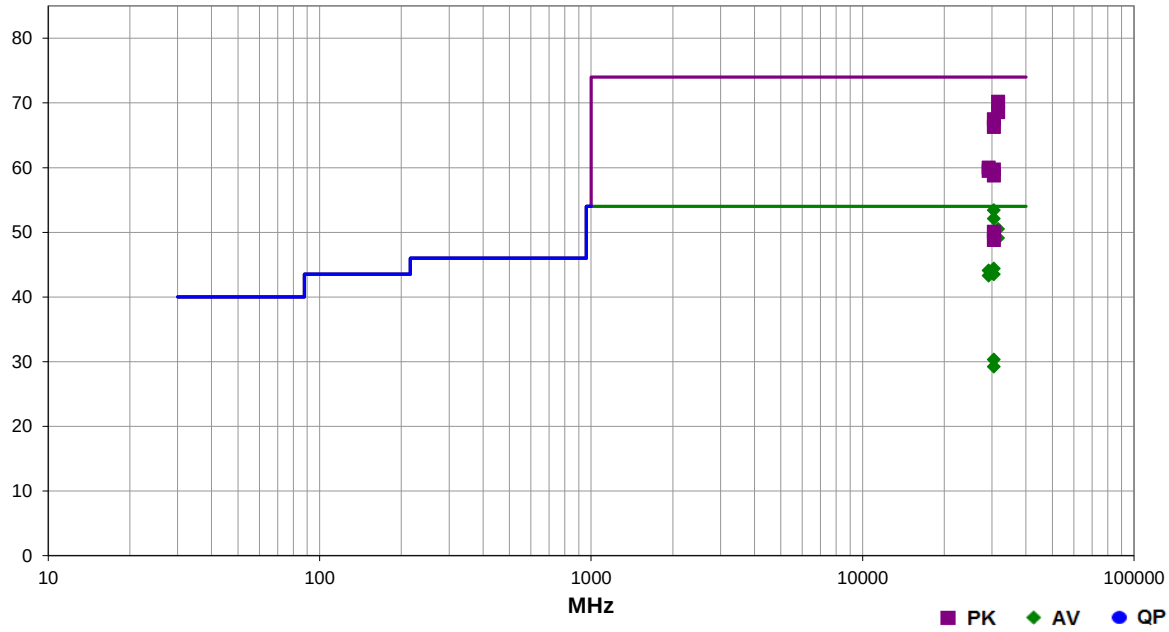
SPURIOUS EMISSIONS 30MHZ-40GHZ (FCC 15.209)

EmiR5 2019.05.20 PSA-ESCI 2019.05.10

Work Order:	ELEM0019	**Date:**	5-Jun-2019		
Project:	None	**Temperature:**	22.6 °C		
Job Site:	EV01	**Humidity:**	42.3% RH		
Serial Number:	FCC001/2019	**Barometric Pres.:**	1019 mbar	**Tested by:**	Jeff Alcoke
EUT:	60 GHz Radar				
Configuration:	1				
Customer:	Pulsar Process Measurement				
Attendees:	None				
EUT Power:	30 VDC				
Operating Mode:	Continuous Tx, Low Ch. = 58.3 GHz, Mid Ch. = 60.9 GHz, High Ch. = 63.6 GHz, No Modulation				
Deviations:	None				
Comments:	See comments below for Channel and EUT orientation. The EUT employs FMCW modulation with a worst case duty (DC) cycle of 32%. The RMS Avg data was downwardly corrected by a factor of 20*log (DC) = 20*log(0.32) ≈ -9.9 dB.				

Test Specifications	**Test Method**
FCC 15.255:2019	ANSI C63.10:2013

Run #	39	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
30473.470	75.8	-12.5	1.5	350.0	-9.9	0.0	Horz	AV	0.0	53.4	54.0	-0.6	Mid Ch, EUT Horz
30473.570	74.5	-12.5	1.5	344.0	-9.9	0.0	Vert	AV	0.0	52.1	54.0	-1.9	Mid Ch, EUT on Side
31586.660	71.9	-11.5	1.5	354.0	-9.9	0.0	Horz	AV	0.0	50.5	54.0	-3.5	High Ch, EUT Horz
31586.660	81.7	-11.5	1.5	354.0	0.0	0.0	Horz	PK	0.0	70.2	74.0	-3.8	High Ch, EUT Horz
31587.500	70.4	-11.4	1.4	350.0	-9.9	0.0	Vert	AV	0.0	49.1	54.0	-4.9	High Ch, EUT on Side
31587.830	80.0	-11.4	1.4	350.0	0.0	0.0	Vert	PK	0.0	68.6	74.0	-5.4	High Ch, EUT on Side
30474.770	80.0	-12.5	1.5	350.0	0.0	0.0	Horz	PK	0.0	67.5	74.0	-6.5	Mid Ch, EUT Horz
30474.730	78.8	-12.5	1.5	344.0	0.0	0.0	Vert	PK	0.0	66.3	74.0	-7.7	Mid Ch, EUT on Side
30473.660	66.8	-12.5	1.5	346.0	-9.9	0.0	Vert	AV	0.0	44.4	54.0	-9.6	Mid Ch, EUT Horz
29148.660	66.6	-12.6	1.5	346.0	-9.9	0.0	Vert	AV	0.0	44.1	54.0	-9.9	Low Ch, EUT on Side
30473.580	65.9	-12.5	1.5	344.0	-9.9	0.0	Horz	AV	0.0	43.5	54.0	-10.5	Mid Ch, EUT on Side
29148.450	65.8	-12.6	1.5	347.0	-9.9	0.0	Horz	AV	0.0	43.3	54.0	-10.7	Low Ch, EUT Horz
29148.210	72.6	-12.6	1.5	346.0	0.0	0.0	Vert	PK	0.0	60.0	74.0	-14.0	Low Ch, EUT on Side
30474.330	72.2	-12.5	1.5	346.0	0.0	0.0	Vert	PK	0.0	59.7	74.0	-14.3	Mid Ch, EUT Horz
29149.980	72.1	-12.6	1.5	347.0	0.0	0.0	Horz	PK	0.0	59.5	74.0	-14.5	Low Ch, EUT Horz
30473.280	71.3	-12.5	1.5	344.0	0.0	0.0	Horz	PK	0.0	58.8	74.0	-15.2	Mid Ch, EUT on Side
30473.670	52.7	-12.5	1.5	263.0	-9.9	0.0	Horz	AV	0.0	30.3	54.0	-23.7	Mid Ch, EUT Vert
30472.900	62.6	-12.5	1.5	263.0	0.0	0.0	Horz	PK	0.0	50.1	74.0	-23.9	Mid Ch, EUT Vert

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
30473.530	51.6	-12.5	1.5	0.0	-9.9	0.0	Vert	AV	0.0	29.2	54.0	-24.8	Mid Ch, EUT Vert
30477.220	61.3	-12.5	1.5	0.0	0.0	0.0	Vert	PK	0.0	48.8	74.0	-25.2	Mid Ch, EUT Vert

6 dB BANDWIDTH

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR
Diplexer	OML, Inc.	DPL26	DAA	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	17-Sep-19	17-Sep-22
Antenna - Standard Gain	OML, Inc.	M19HWAX	AIJ	20-Sep-19	20-Sep-22
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-19	24-Mar-20

TEST DESCRIPTION

The measurement was made in a radiated configuration of the fundamental with the carrier fully maximized for its highest radiated power. The EUT was set to the mode listed in the datasheet.

The 6dB occupied bandwidth was measured using 8 MHz Resulotion Bandwidth, and 50 MHz Video Bandwidth. Because the radio turns across two different external mixers, measurements were taken at the low and high side of the envelope.

The 6 dB bandwidth was calculated using the following equation:

F_High - F_Low = 6 dB Bandwidth, where:

F_High is the frequency 6 dB down from the peak on the high side of the envelope
F_Low is the frequency 6 dB down from the peak on the low side of the envelope

6 dB BANDWIDTH

XMit 2019.09.05

EUT:	60 GHz Radar			**Work Order:**	ELEM0096
Serial Number:	317411/2019			**Date:**	10-Oct-19
Customer:	Pulsar Process Measurement			**Temperature:**	19.8 °C
Attendees:	None			**Humidity:**	35.7% RH
Project:	None			**Barometric Pres.:**	1032 mbar
Tested by:	Jeff Alcoke	**Power:**	30 VDC	**Job Site:**	EV01

TEST SPECIFICATIONS	**Test Method**
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**3**	*Signature*

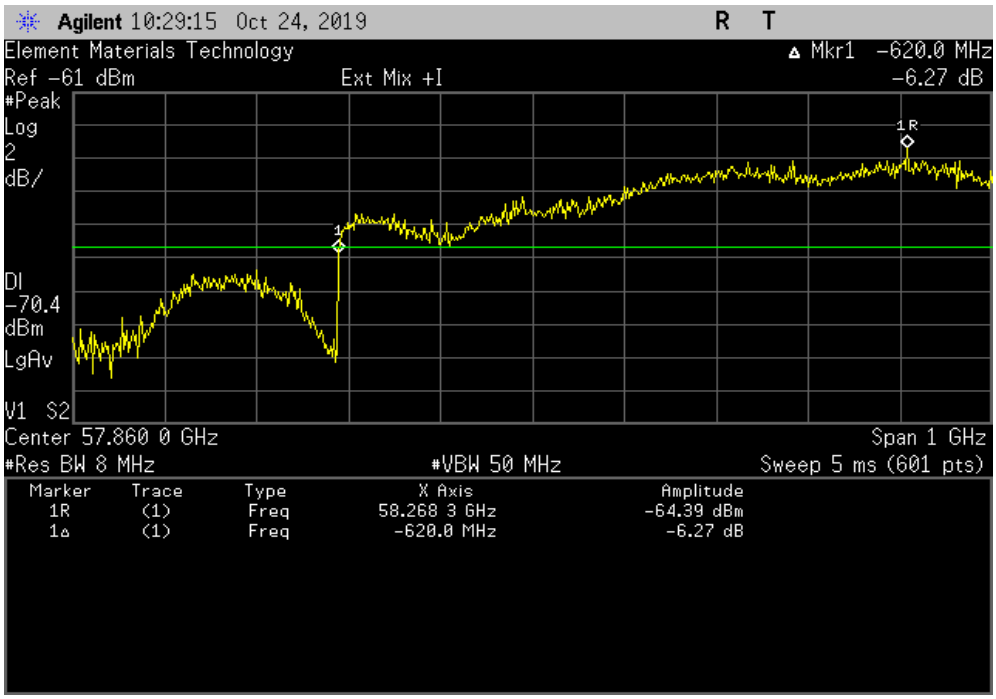
	F_Low (GHz)	**F_High (GHz)**
FMCW, 58.3 - 63.9 GHz		
Low Band Edge	57.65	-
High Band Edge	-	63.81

			6 dB BW (GHz)	**Limit**	**Result**
6 dB Bandwidth	57.65	63.81	6.16	-	-

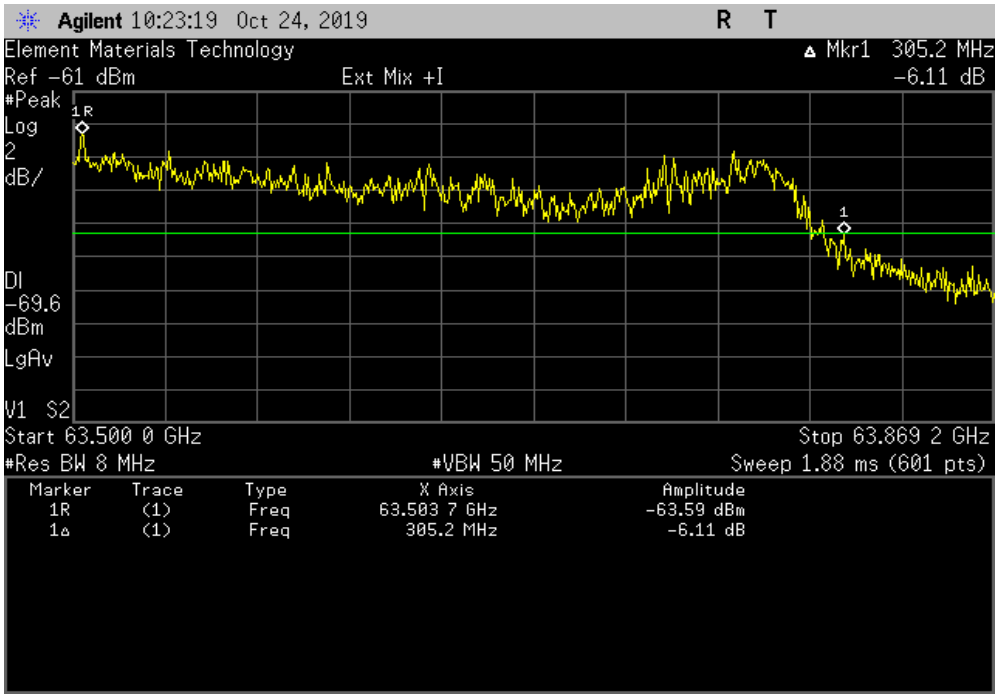
6 dB BANDWIDTH

XMit 2019.09.05

FMCW, 58.3 - 63.9 GHz, Low Band Edge						
		F_Low (GHz)	F_High (GHz)			
		57.65	-			



FMCW, 58.3 - 63.9 GHz, High Band Edge						
		F_Low (GHz)	F_High (GHz)			
		-	63.81			



EQUIVALENT ISOTROPIC RADIATED POWER

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Oscilloscope	Tektronix	TDS 3052	TOF	NCR	NCR
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Cable	ESM Cable Corp.	TTBJ141-KMKM-72	EV3	28-Mar-19	28-Mar-20
RF Detector, 50 GHz - 75 GHz	Millitech	DET-15-RPFW0	ZZD	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M15RH	AYJ	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M15RH	AYK	NCR	NCR
Signal Generator	Agilent	N5181A	TGZ	31-Aug-18	31-Aug-21
Power Meter	Agilent	N1913A	SQR	8-Oct-19	8-Oct-20
Power Sensor	Keysight	V8486A	STV	29-Mar-19	29-Mar-22
Signal Generator	OML, Inc.	S15MS	TFW	NCR	NCR

TEST DESCRIPTION

The measurement was made in a radiated configuration, using an RF Detector with a detection bandwidth that encompasses the 57 - 71 GHz band, with a video bandwidth of at least 10 MHz.

The radio was configurd to operate in the mode/s listed in the subsequent data sheets.

The average values were determined by sutracting the Average Factor from the Peak Values. The Average Factor was determined using the following steps:

1. Calculate the dwell time, (T_D), of the sweep frequency signal per MHz of the sweep frequency span:

   T_D = Ts / ΔF where:

   Ts is the signal sweep frequency time in seconds
   ΔF is the signal sweep frequency span in MHz

2. Calculate the average factor:

   Average Factor (dB) = 10 * log(T_D / Cycle Time) where:

   Cycle Time is the total time for a complete cycle of the signal including retrace and any other latency times

Calculations:

Ts = 0.03 s
Cycle Time = 1 s
ΔF = 13300 MHz

T_D = Ts / ΔF = 0.03 / 13300 = 2.25*10^-6 s/MHz

EQUIVALENT ISOTROPIC RADIATED POWER

XMit 2019.09.05

EUT:	60 GHz Radar			**Work Order:**	ELEM0096
Serial Number:	See configurations			**Date:**	10-Oct-19
Customer:	Pulsar Process Measurement			**Temperature:**	19.6 °C
Attendees:	None			**Humidity:**	35.9% RH
Project:	None			**Barometric Pres.:**	1031 mbar
Tested by:	Jeff Alcoke	**Power:**	30 VDC	**Job Site:**	EV01

TEST SPECIFICATIONS	**Test Method**
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

Measurements were made at a distance of 5 cm from the radome. The AVG values were determined by subtracting the Average Factor of -56.47 dB from the PK values.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**1, 2**	*Signature*

		Value (dBm)	Limit (dBm)	Result
dBR8, CW				
	Low Channel, 58.3 GHz			
	PK	-14.35	≤ 43	Pass
	AVG	-70.82	≤ 40	Pass
	Mid Channel, 60.9 GHz			
	PK	-14.76	≤ 43	Pass
	AVG	-71.23	≤ 40	Pass
	High Channel, 63.6 GHz			
	PK	-14.76	≤ 43	Pass
	AVG	-71.23	≤ 40	Pass
dBR16, CW				
	Low Channel, 58.3 GHz			
	PK	-14.35	≤ 43	Pass
	AVG	-70.82	≤ 40	Pass
	Mid Channel, 60.9 GHz			
	PK	-14.76	≤ 43	Pass
	AVG	-71.23	≤ 40	Pass
	High Channel, 63.6 GHz			
	PK	-14.76	≤ 43	Pass
	AVG	-71.23	≤ 40	Pass

CONDUCTED OUTPUT POWER

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Oscilloscope	Tektronix	TDS 3052	TOF	NCR	NCR
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Cable	ESM Cable Corp.	TTBJ141-KMKM-72	EV3	28-Mar-19	28-Mar-20
RF Detector, 50 GHz - 75 GHz	Millitech	DET-15-RPFW0	ZZD	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M15RH	AYJ	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M15RH	AYK	NCR	NCR
Signal Generator	Agilent	N5181A	TGZ	31-Aug-18	31-Aug-21
Power Meter	Agilent	N1913A	SQR	8-Oct-19	8-Oct-20
Power Sensor	Keysight	V8486A	STV	29-Mar-19	29-Mar-22
Signal Generator	OML, Inc.	S15MS	TFW	NCR	NCR

TEST DESCRIPTION

The measurement was made in a radiated configuration, using an RF Detector with a detection bandwidth that encompasses the 57 - 71 GHz band, with a video bandwidth of at least 10 MHz.

The radio was configurd to operate in the mode/s listed in the subsequent data sheets.

To determine the conducted output power, the antenna gain was subracted from the EIRP.

The average values were determined by sutracting the Average Factor from the Peak Values. The Average Factor was determined using the following steps:

1. Calculate the dwell time, (T_D), of the sweep frequency signal per MHz of the sweep frequency span:

   T_D = Ts / ΔF where:

   Ts is the signal sweep frequency time in seconds
   ΔF is the signal sweep frequency span in MHz

2. Calculate the average factor:

   Average Factor (dB) = 10 * log(T_D / Cycle Time) where:

   Cycle Time is the total time for a complete cycle of the signal including retrace and any other latency times

Calculations:

Ts = 0.03 s
Cycle Time = 1 s
ΔF = 13300 MHz

T_D = Ts / ΔF = 0.03 / 13300 = 2.25*10^-6 s/MHz

CONDUCTED OUTPUT POWER

XMit 2019.09.05

EUT:	60 GHz Radar			**Work Order:**	ELEM0096
Serial Number:	See configurations			**Date:**	10-Oct-19
Customer:	Pulsar Process Measurement			**Temperature:**	19.6 °C
Attendees:	None			**Humidity:**	35.9% RH
Project:	None			**Barometric Pres.:**	1031 mbar
Tested by:	Jeff Alcoke	**Power:**	30 VDC	**Job Site:**	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

Measurements were made at a distance of 5 cm from the radome. The AVG values were determined by subtracting the Average Factor of -56.47 dB from the PK values.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	1, 2	Signature

		EIRP (dBm)	Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)	Result
dBR8, CW						
	Low Channel, 58.3 GHz					
	PK	-14.35	18	-32.35	≤ 27	Pass
	AVG	-70.82	18	-88.82	≤ 27	Pass
	Mid Channel, 60.9 GHz					
	PK	-14.76	18	-32.76	≤ 27	Pass
	AVG	-71.23	18	-89.23	≤ 27	Pass
	High Channel, 63.6 GHz					
	PK	-14.76	18	-32.76	≤ 27	Pass
	AVG	-71.23	18	-89.23	≤ 27	Pass
dBR16, CW						
	Low Channel, 58.3 GHz					
	PK	-14.35	20.5	-34.85	≤ 27	Pass
	AVG	-70.82	20.5	-91.32	≤ 27	Pass
	Mid Channel, 60.9 GHz					
	PK	-14.76	20.5	-35.26	≤ 27	Pass
	AVG	-71.23	20.5	-91.73	≤ 27	Pass
	High Channel, 63.6 GHz					
	PK	-14.76	20.5	-35.26	≤ 27	Pass
	AVG	-71.23	20.5	-91.73	≤ 27	Pass

SPURIOUS EMISSIONS 40-200GHz dbr 8

XMit 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Generator - Signal	OML, Inc.	S15MS	TFW	NCR	NCR
Attenuator	S.M. Electronics	SA18N-06/SM4032	REE	30-Jul-19	30-Jul-20
Meter - Power	Spanawave	8651A	SOT	9-May-19	9-May-20
Power Sensor	Spanawave	80701A	SPL	9-May-19	9-May-20
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR
Diplexer	OML, Inc.	DPL26	DAA	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M05HWAX	AIM	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M08HWAX	AIL	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M19HWAX	AIJ	25-Aug-16	25-Aug-19
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-19	24-Mar-20

TEST DESCRIPTION

The EUT was transmitting with an unmodulated carrier. The testing was done at distances closer than 3m as called out in the data sheets. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna orientat ion and polarization, and manipulating the EUT and EUT antenna in 3 orthogonal planes (per ANSI C63.10:2013). The specifiation li mit was converted from pW/cm^2 to dBµV/m and then adjusted at 20 dB per decade for measurements made at a closer distance then the specified distance. The corrected limit with respect to distance is shown in the table below.

Harmonics above 40 GHz

	Spec limit	Spec limit	Spec limit	Spec limit	Spec limit
	3m	20 cm	10 cm	5 cm	2 cm
Average (dBuV/m)	85.31	108.8	114.9	120.9	128.8
Peak (dBuV/m)	105.31	128.8	134.9	140.9	148.8

The analyzer display was offset with the value of the test equipment losses (mixers, duplexers, and cables) specific to each band and the antenna factor per the following table:

Fundamental 58.3 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
116600.00	24.00	47.55	43.60	91.15
174900.00	24.00	51.08	42.68	93.76

Fundamental 60.9 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
121800.00	24.00	47.93	42.68	90.61
182700.00	24.00	51.45	46.00	97.45

Fundamental 63.6 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
127200.00	24.00	48.31	43.40	91.71
190800.00	24.00	51.83	49.26	101.09

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element

XMit 2019.06.11

EUT:	60 GHz Radar			**Work Order:**	ELEM0096
Serial Number:	FCC001/2019			**Date:**	22-Aug-19
Customer:	Pulsar Process Measurement			**Temperature:**	22.9 °C
Attendees:	None			**Humidity:**	45.4% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Brandon Hobbs, Jeff Alcoke	**Power:**	30 VDC	**Job Site:**	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

The maximum oscillator bias voltage was applied during testing. The peak and average final limits were first converted to field strength using a 2 cm distance correction from the originally specified 3 meter distance. The limit is expressed as the red line in the subsequent screen catpures.

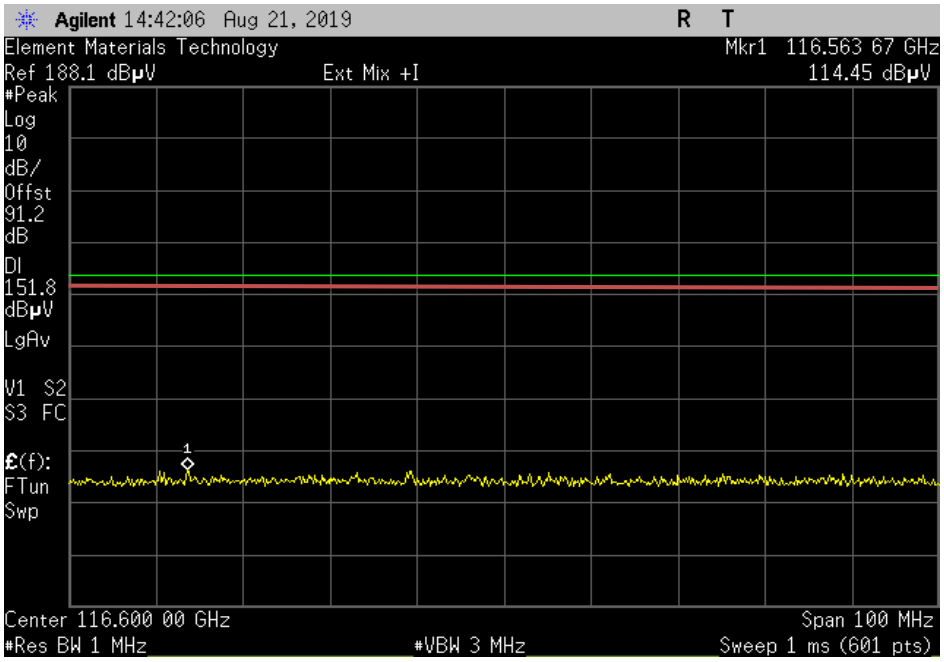
DEVIATIONS FROM TEST STANDARD

None

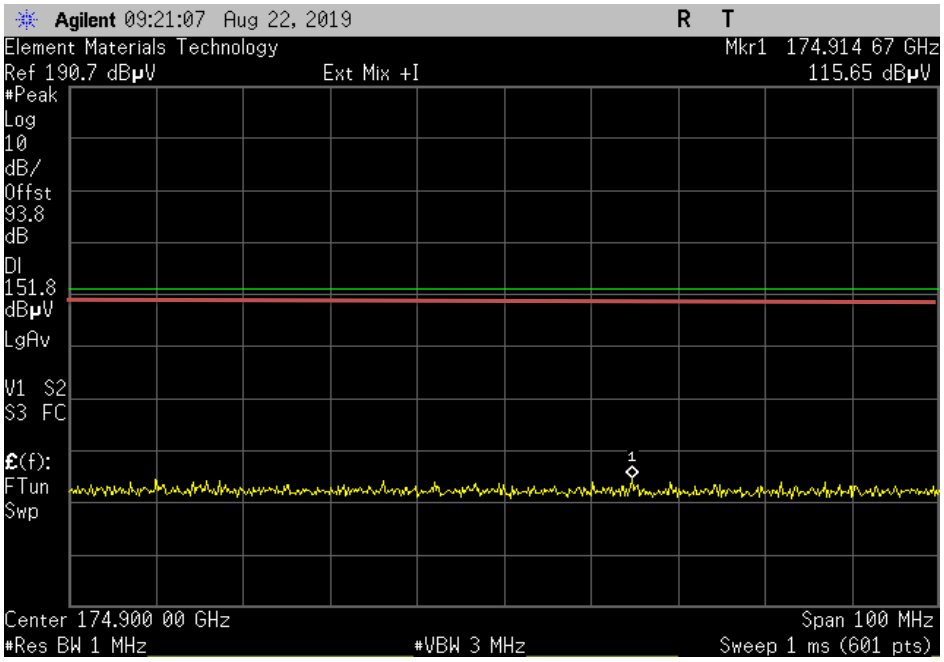
Configuration #	1	Signature

Sheet			Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
Continuous Transmission Without Modulation					
	Peak Detector				
		Low Ch. 58.3 GHz			
1 Top		2nd Harmonic	114.45	≤ 148.8	Pass
1 Bottom		3rd Harmonic	115.65	≤ 148.8	Pass
		Mid Ch. 60.9 GHz			
2 Top		2nd Harmonic	114.19	≤ 148.8	Pass
2 Bottom		3rd Harmonic	120.14	≤ 148.8	Pass
		High Ch. 63.9 GHz			
3 Top		2nd Harmonic	113.17	≤ 148.8	Pass
3 Bottom		3rd Harmonic	122.34	≤ 148.8	Pass
	Average Detector				
		Low Ch. 58.3 GHz			
4 Top		2nd Harmonic	102.84	≤ 128.8	Pass
4 Bottom		3rd Harmonic	104.02	≤ 128.8	Pass
		Mid Ch. 60.9 GHz			
5 Top		2nd Harmonic	101.6	≤ 128.8	Pass
5 Bottom		3rd Harmonic	108.18	≤ 128.8	Pass
		High Ch. 63.9 GHz			
6 Top		2nd Harmonic	101.24	≤ 128.8	Pass
6 Bottom		3rd Harmonic	110.85	≤ 128.8	Pass

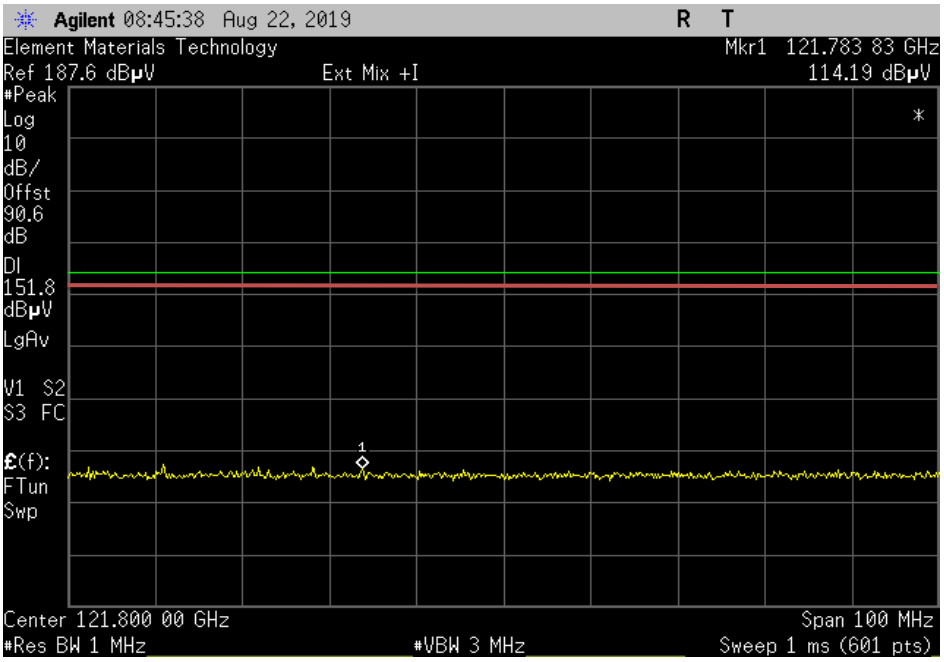
Continuous Transmission Without Modulation, Peak Detector, Low Ch. 58.3 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				114.45	≤ 148.8	Pass



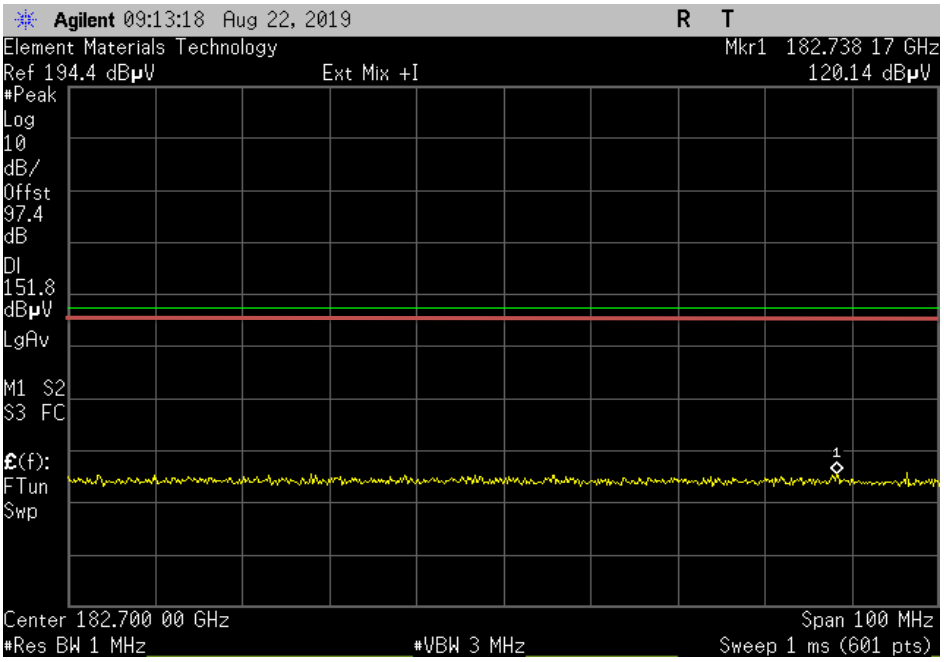
Continuous Transmission Without Modulation, Peak Detector, Low Ch. 58.3 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				115.65	≤ 148.8	Pass



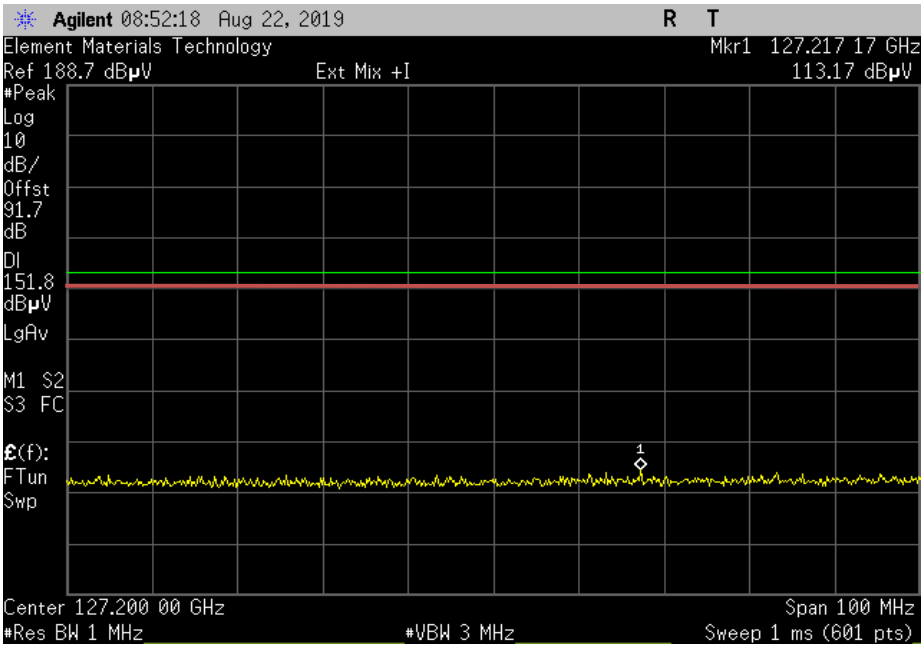
Continuous Transmission Without Modulation, Peak Detector, Mid Ch. 60.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				114.19	≤ 148.8	Pass



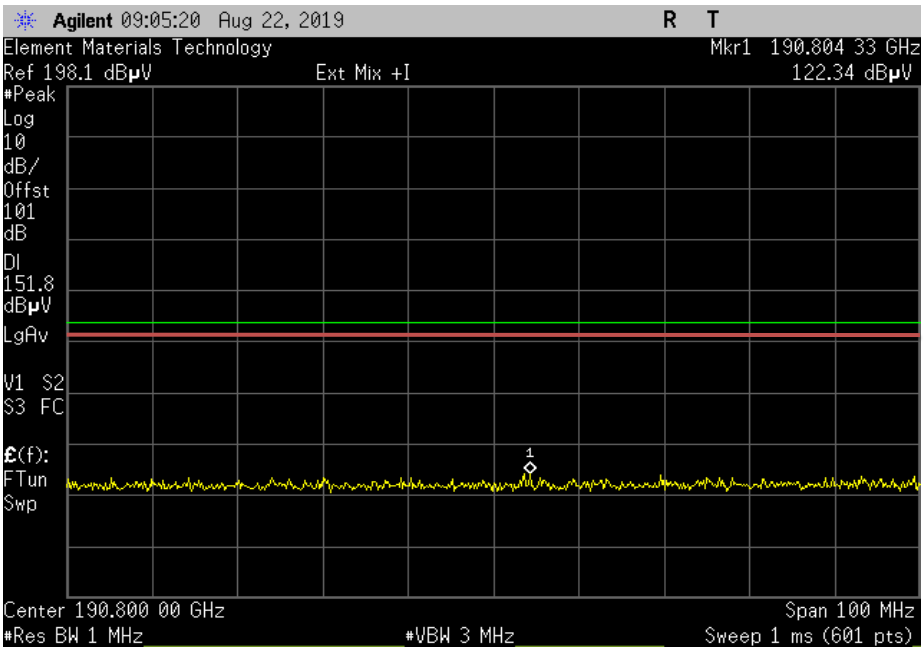
Continuous Transmission Without Modulation, Peak Detector, Mid Ch. 60.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				120.14	≤ 148.8	Pass



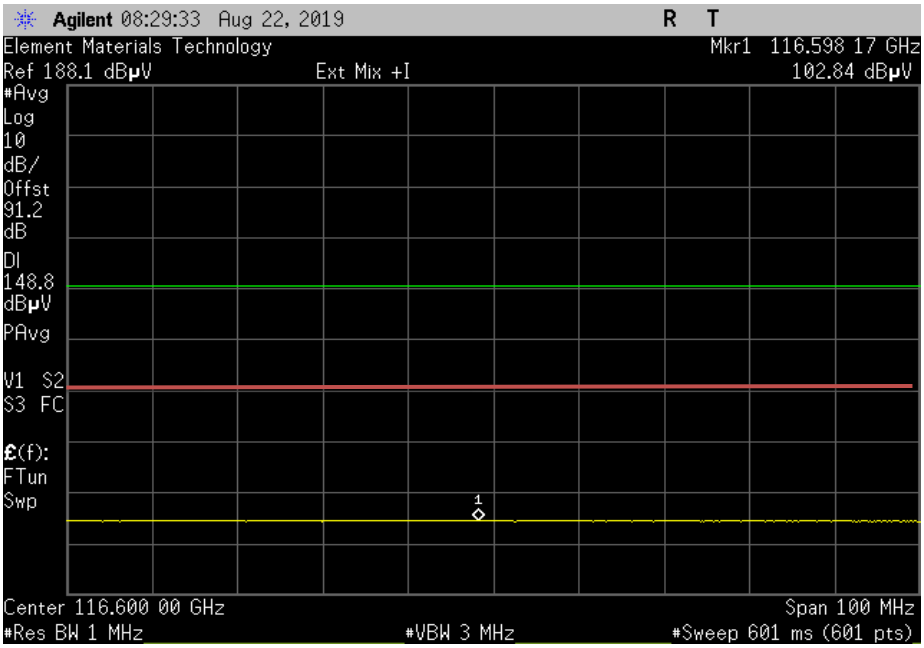
Continuous Transmission Without Modulation, Peak Detector, High Ch. 63.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				113.17	≤ 148.8	Pass



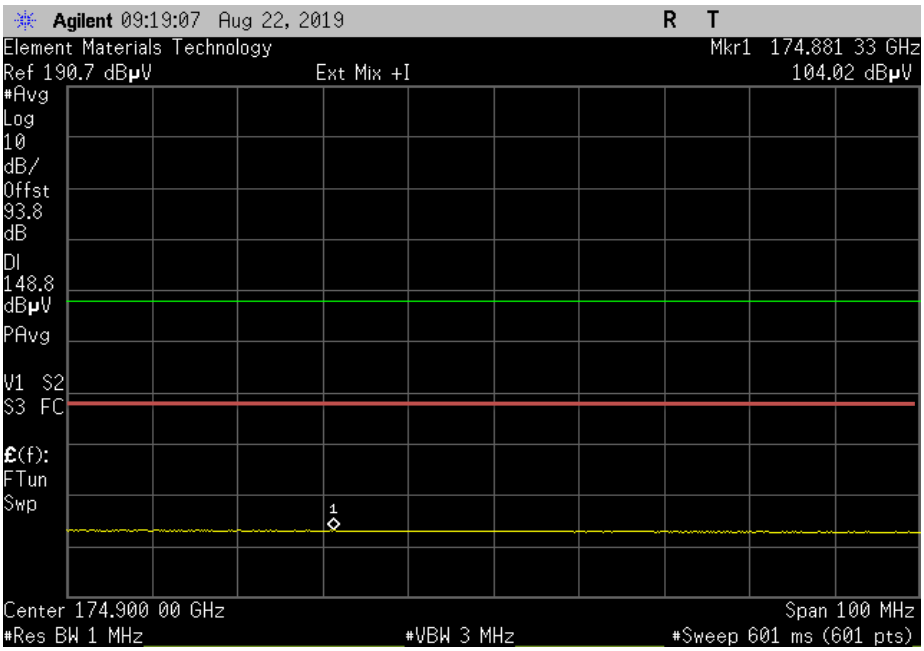
Continuous Transmission Without Modulation, Peak Detector, High Ch. 63.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				122.34	≤ 148.8	Pass



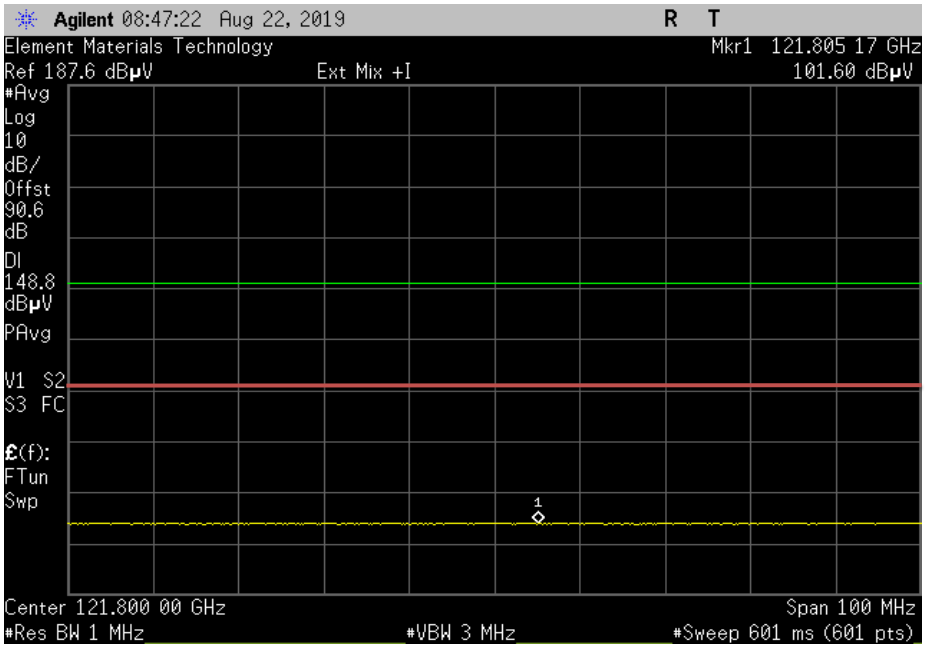
Continuous Transmission Without Modulation, Average Detector, Low Ch. 58.3 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				102.84	≤ 128.8	Pass



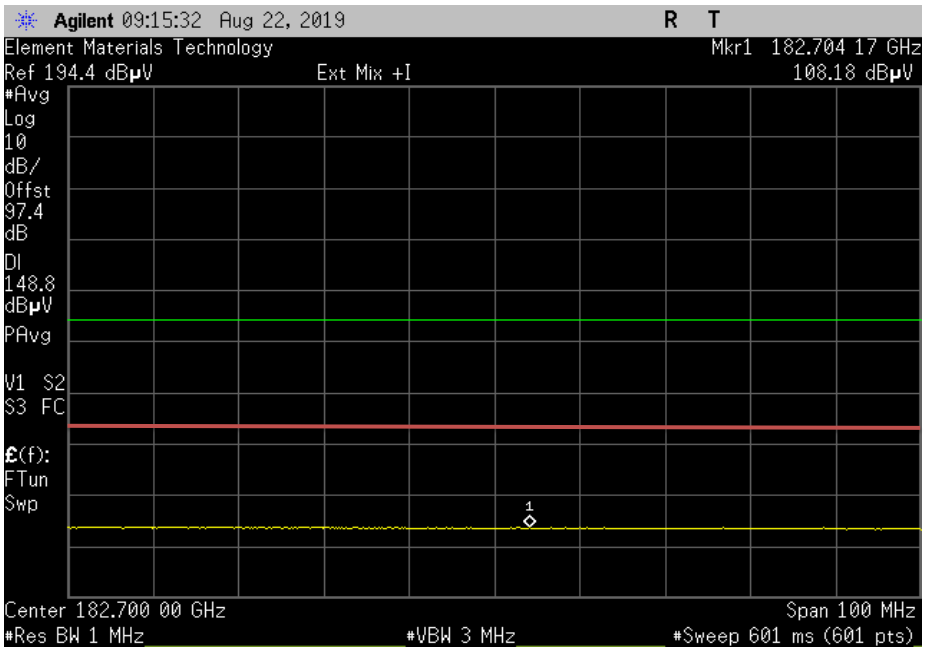
Continuous Transmission Without Modulation, Average Detector, Low Ch. 58.3 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				104.02	≤ 128.8	Pass



Continuous Transmission Without Modulation, Average Detector, Mid Ch. 60.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				101.6	≤ 128.8	Pass



Continuous Transmission Without Modulation, Average Detector, Mid Ch. 60.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				108.18	≤ 128.8	Pass



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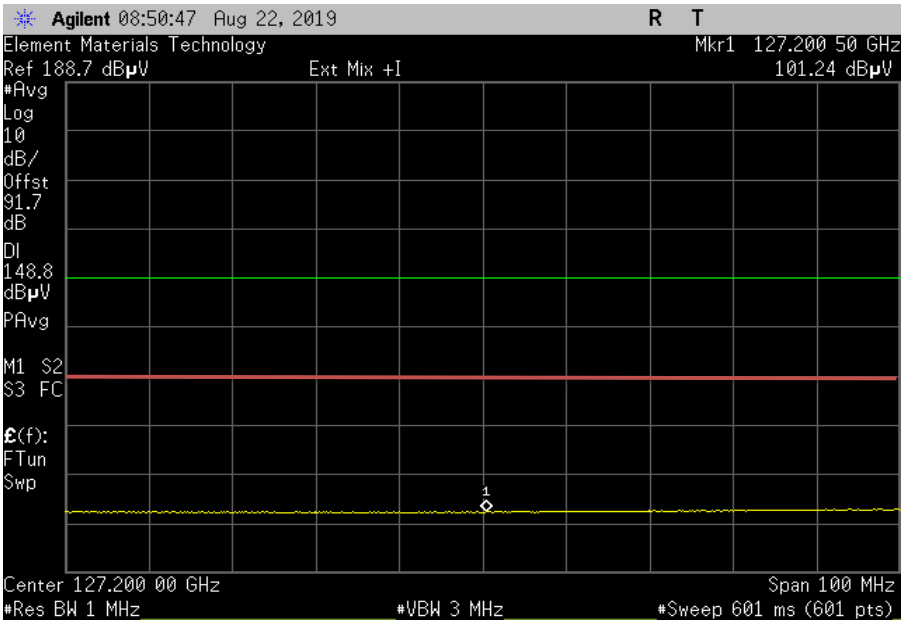
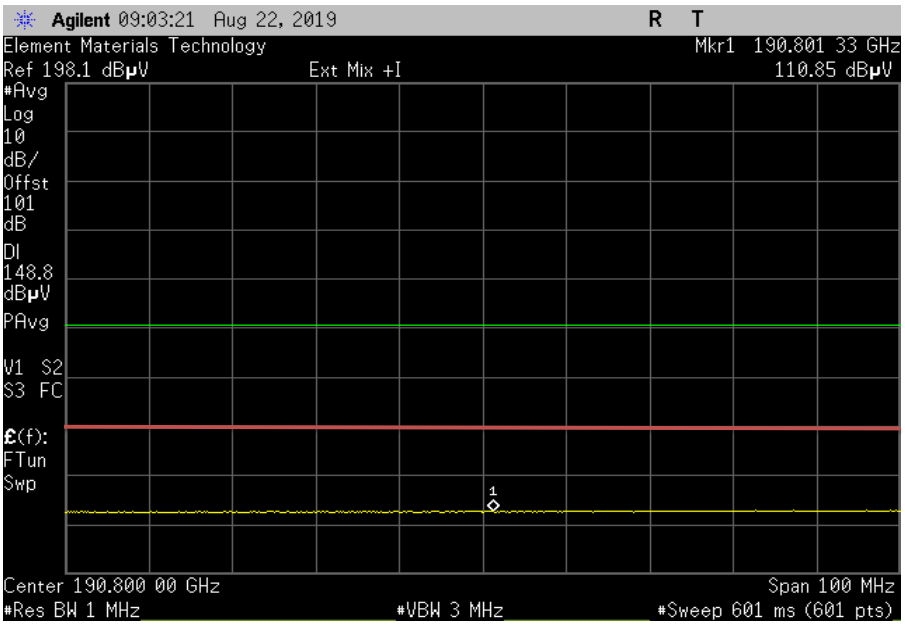
Continuous Transmission Without Modulation, Average Detector, High Ch. 63.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				101.24	≤ 128.8	Pass



Continuous Transmission Without Modulation, Average Detector, High Ch. 63.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				110.85	≤ 128.8	Pass



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Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Generator - Signal	OML, Inc.	S15MS	TFW	NCR	NCR
Attenuator	S.M. Electronics	SA18N-06/SM4032	REE	30-Jul-19	30-Jul-20
Meter - Power	Spanawave	8651A	SOT	9-May-19	9-May-20
Power Sensor	Spanawave	80701A	SPL	9-May-19	9-May-20
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR
Diplexer	OML, Inc.	DPL26	DAA	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M05HWAX	AIM	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M08HWAX	AIL	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	25-Aug-16	25-Aug-19
Antenna - Standard Gain	OML, Inc.	M19HWAX	AIJ	25-Aug-16	25-Aug-19
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-19	24-Mar-20

TEST DESCRIPTION

The EUT was transmitting with an unmodulated carrier. The testing was done at distances closer than 3m as called out in the data sheets. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna orientation and polarization, and manipulating the EUT and EUT antenna in 3 orthogonal planes (per ANSI C63.10:2013). The specifiation limit was converted from pW/cm^2 to dBµV/m and then adjusted at 20 dB per decade for measurements made at a closer distance then the specified distance. The corrected limit with respect to distance is shown in the table below.

Harmonics above 40 GHz

	Spec limit	Spec limit	Spec limit	Spec limit	Spec limit
	3m	20 cm	10 cm	5 cm	2 cm
Average (dBuV/m)	85.31	108.8	114.9	120.9	128.8
Peak (dBuV/m)	105.31	128.8	134.9	140.9	148.8

The analyzer display was offset with the value of the test equipment losses (mixers, duplexers, and cables) specific to each band and the antenna factor per the following table:

Fundamental 58.3 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
116600.00	24.00	47.55	43.60	91.15
174900.00	24.00	51.08	42.68	93.76

Fundamental 60.9 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
121800.00	24.00	47.93	42.68	90.61
182700.00	24.00	51.45	46.00	97.45

Fundamental 63.6 GHz

Freq (MHz)	Antenna Gain (dBi)	Antenna Factor (dB/m)	Mixer / Diplexer loss (dB)	Analyzer Offset (dB)
127200.00	24.00	48.31	43.40	91.71
190800.00	24.00	51.83	49.26	101.09

SPURIOUS EMISSIONS 40-200GHz dbr 16

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EUT:	60 GHz Radar			**Work Order:**	ELEM0096
Serial Number:	FCC002/2019			**Date:**	22-Aug-19
Customer:	Pulsar Process Measurement			**Temperature:**	22.9 °C
Attendees:	None			**Humidity:**	45.4% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Brandon Hobbs, Jeff Alcoke	**Power:**	30 VDC	**Job Site:**	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

The maximum oscillator bias voltage was applied during testing. The peak and average final limits were first converted to field strength using a 2 cm distance correction from the originally specified 3 meter distance. The limit is expressed as the red line in the subsequent screen catpures.

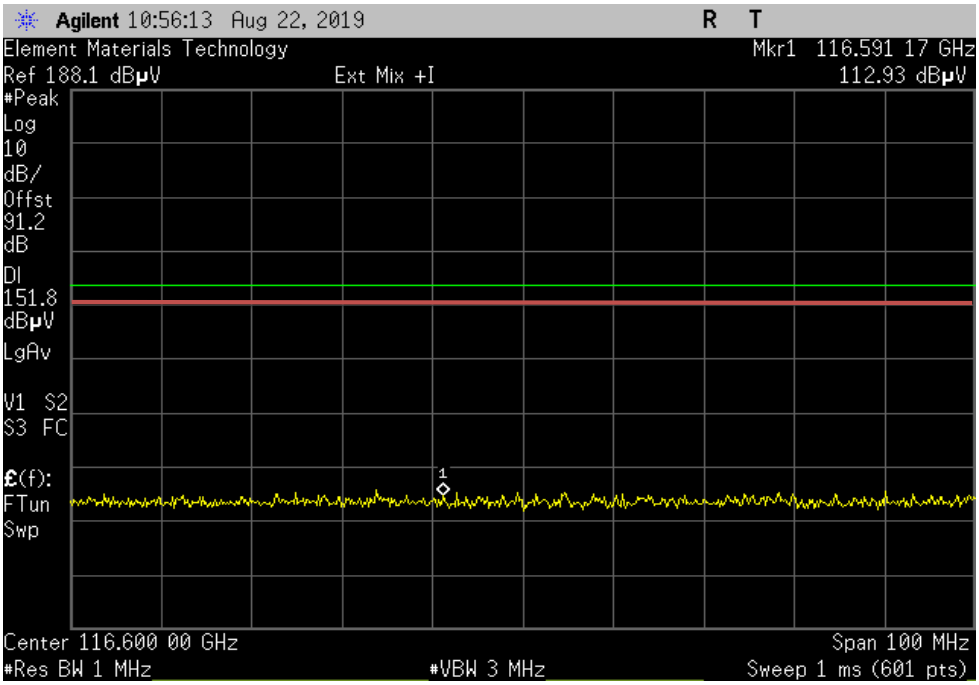
DEVIATIONS FROM TEST STANDARD

None

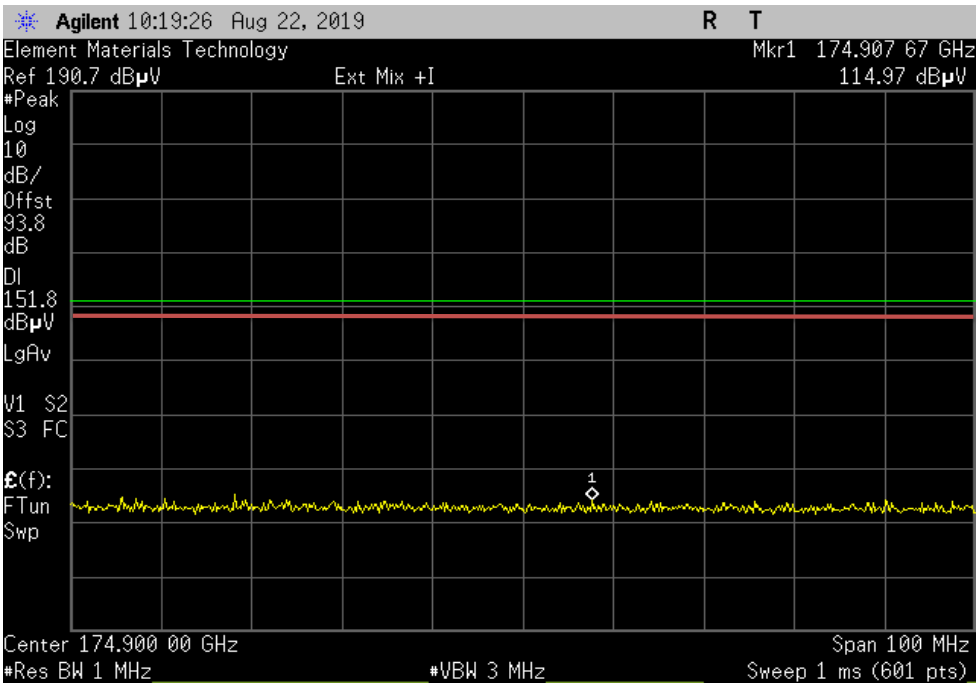
Configuration #	2	Signature

	Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
Continuous Transmission Without Modulation			
Peak Detector			
Low Ch. 58.3 GHz			
2nd Harmonic	112.93	≤ 148.8	Pass
3rd Harmonic	114.97	≤ 148.8	Pass
Mid Ch. 60.9 GHz			
2nd Harmonic	113.31	≤ 148.8	Pass
3rd Harmonic	120.29	≤ 148.8	Pass
High Ch. 63.9 GHz			
2nd Harmonic	113.24	≤ 148.8	Pass
3rd Harmonic	123.11	≤ 148.8	Pass
Average Detector			
Low Ch. 58.3 GHz			
2nd Harmonic	102.94	≤ 128.8	Pass
3rd Harmonic	103.83	≤ 128.8	Pass
Mid Ch. 60.9 GHz			
2nd Harmonic	101.81	≤ 128.8	Pass
3rd Harmonic	108.12	≤ 128.8	Pass
High Ch. 63.9 GHz			
2nd Harmonic	101.36	≤ 128.8	Pass
3rd Harmonic	110.84	≤ 128.8	Pass

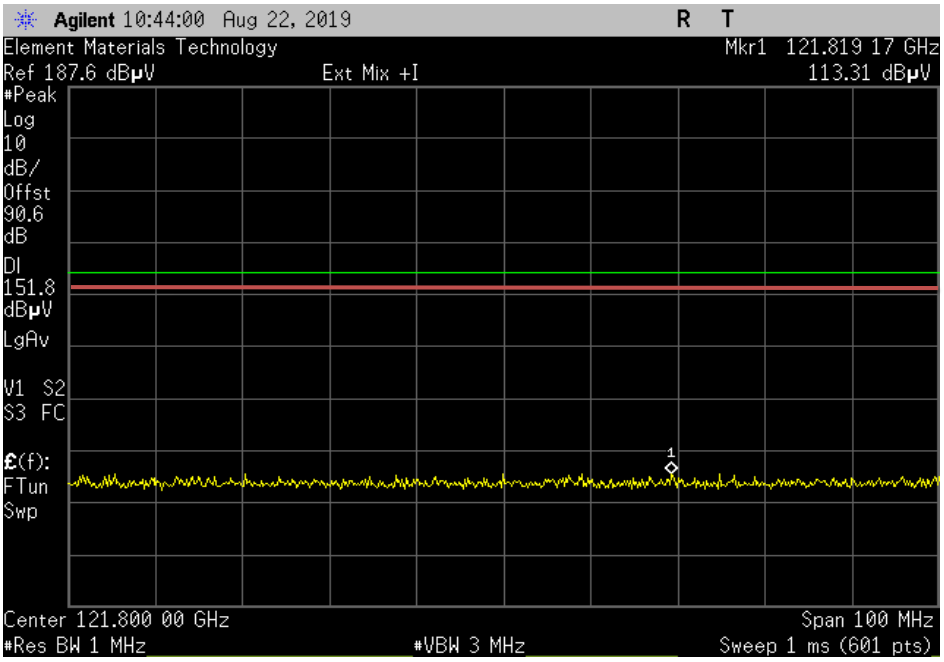
Continuous Transmission Without Modulation, Peak Detector, Low Ch. 58.3 GHz, 2nd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					112.93	≤ 148.8	Pass



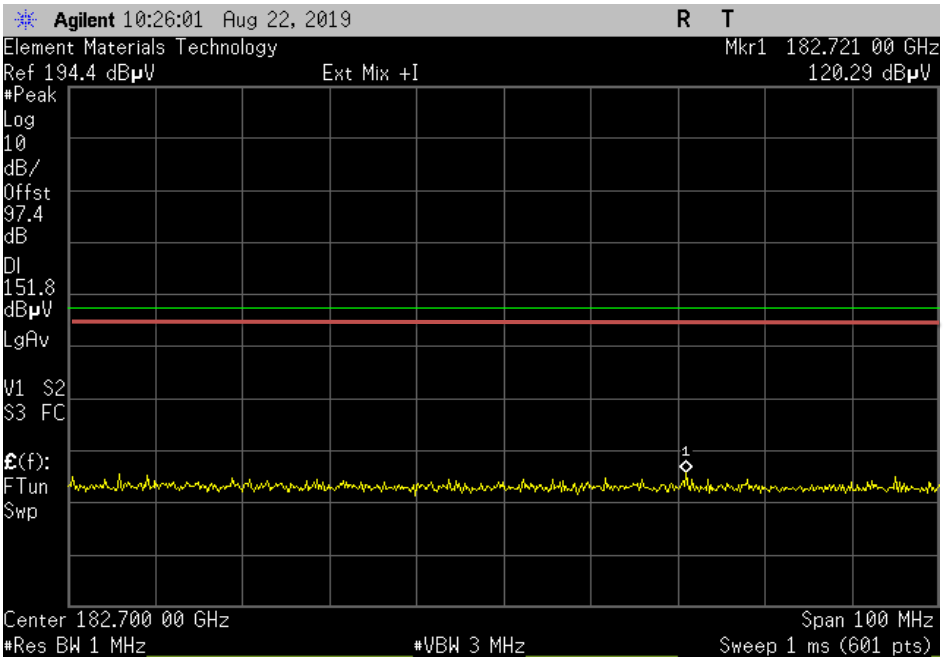
Continuous Transmission Without Modulation, Peak Detector, Low Ch. 58.3 GHz, 3rd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					114.97	≤ 148.8	Pass



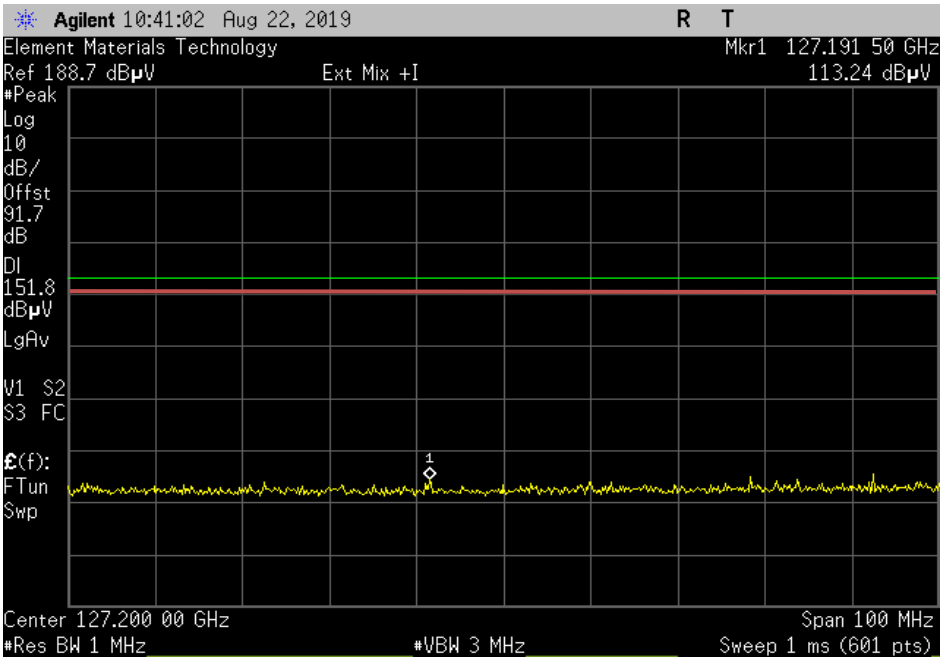
Continuous Transmission Without Modulation, Peak Detector, Mid Ch. 60.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				113.31	≤ 148.8	Pass



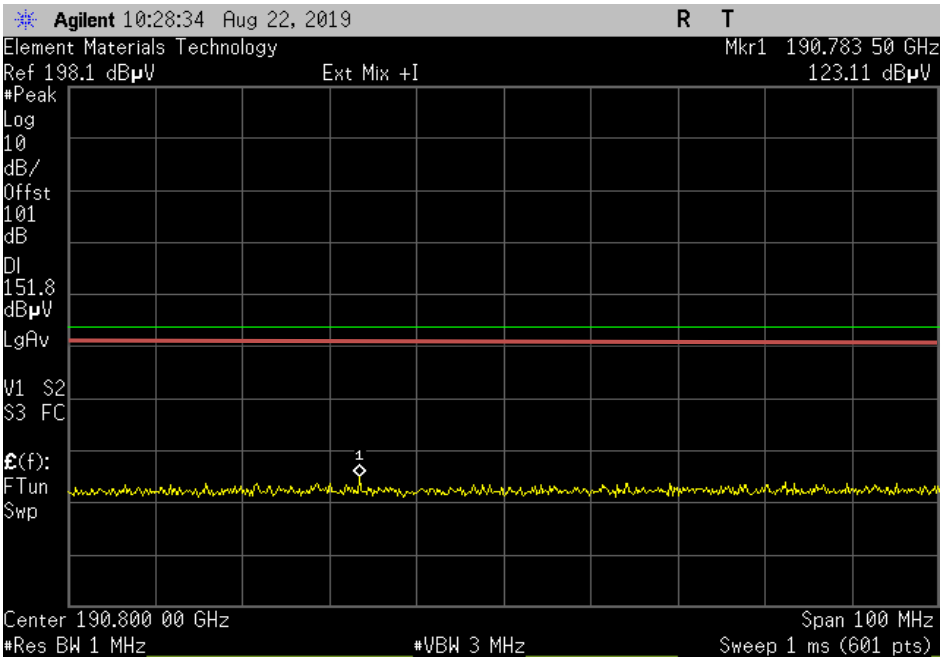
Continuous Transmission Without Modulation, Peak Detector, Mid Ch. 60.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				120.29	≤ 148.8	Pass



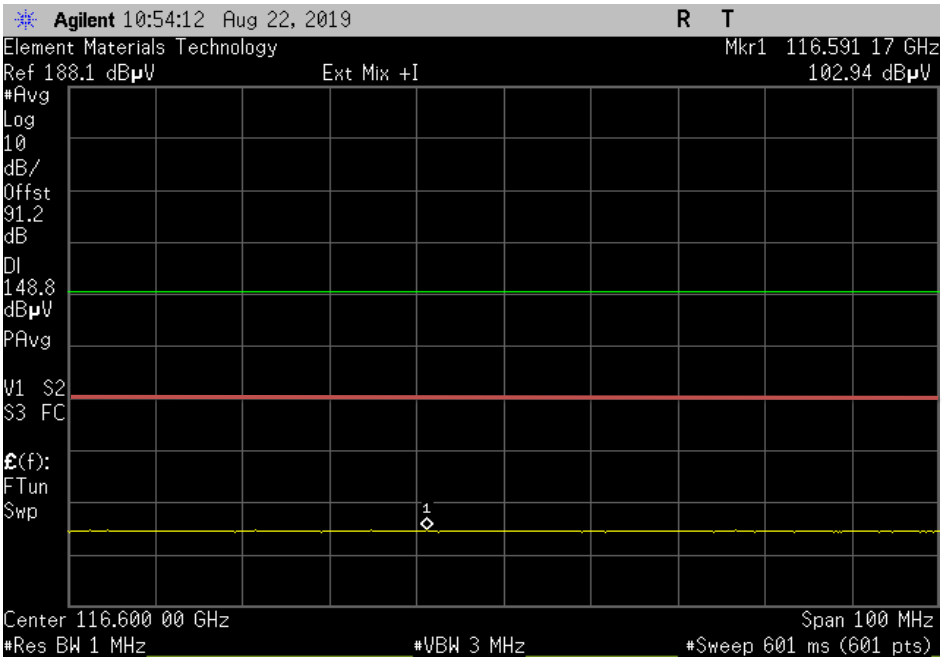
Continuous Transmission Without Modulation, Peak Detector, High Ch. 63.9 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				113.24	≤ 148.8	Pass



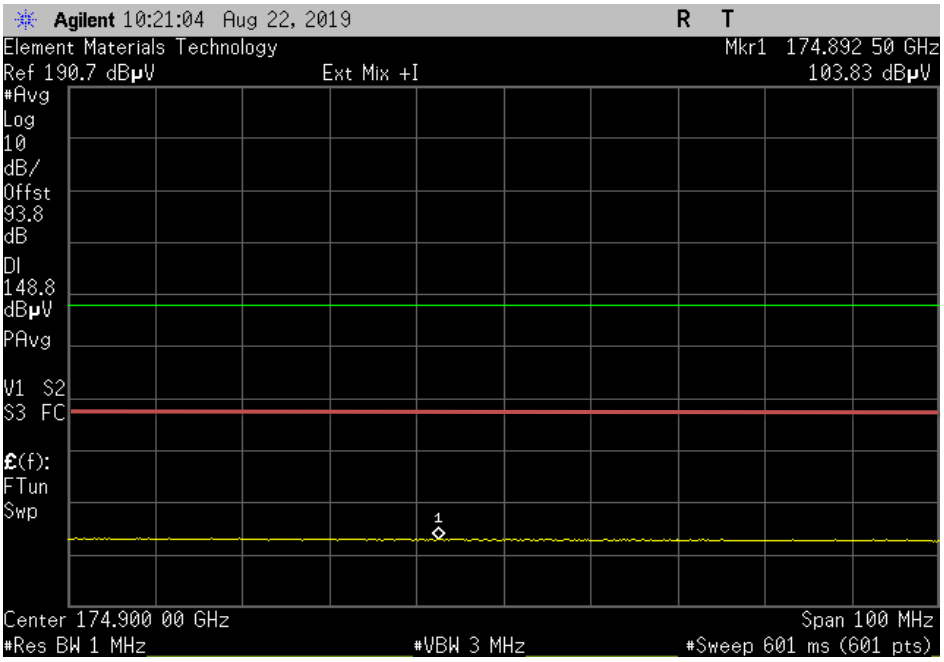
Continuous Transmission Without Modulation, Peak Detector, High Ch. 63.9 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				123.11	≤ 148.8	Pass



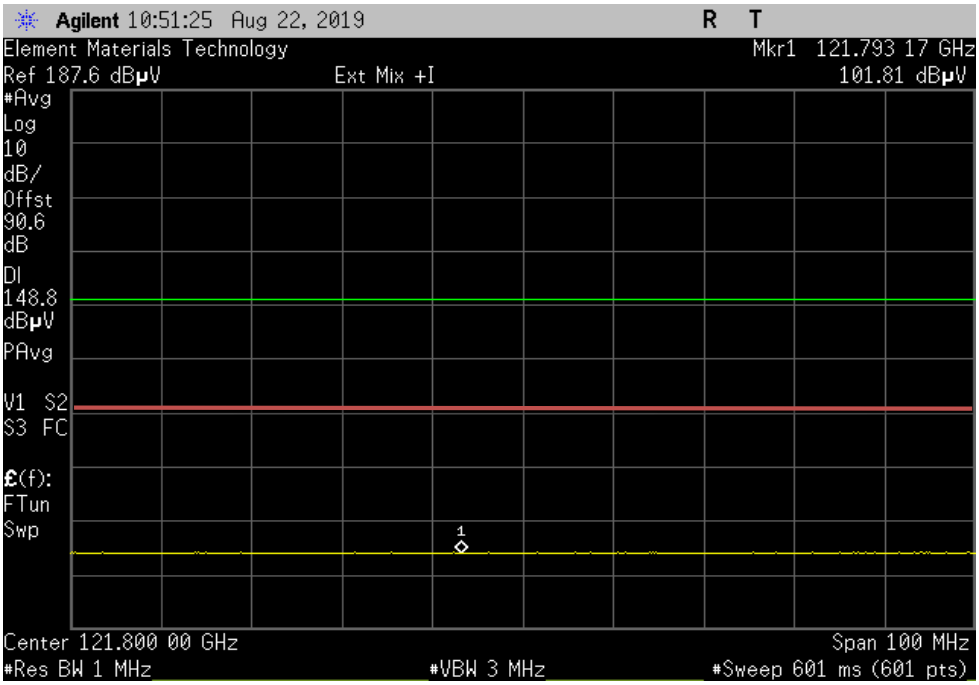
Continuous Transmission Without Modulation, Average Detector, Low Ch. 58.3 GHz, 2nd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				102.94	≤ 128.8	Pass



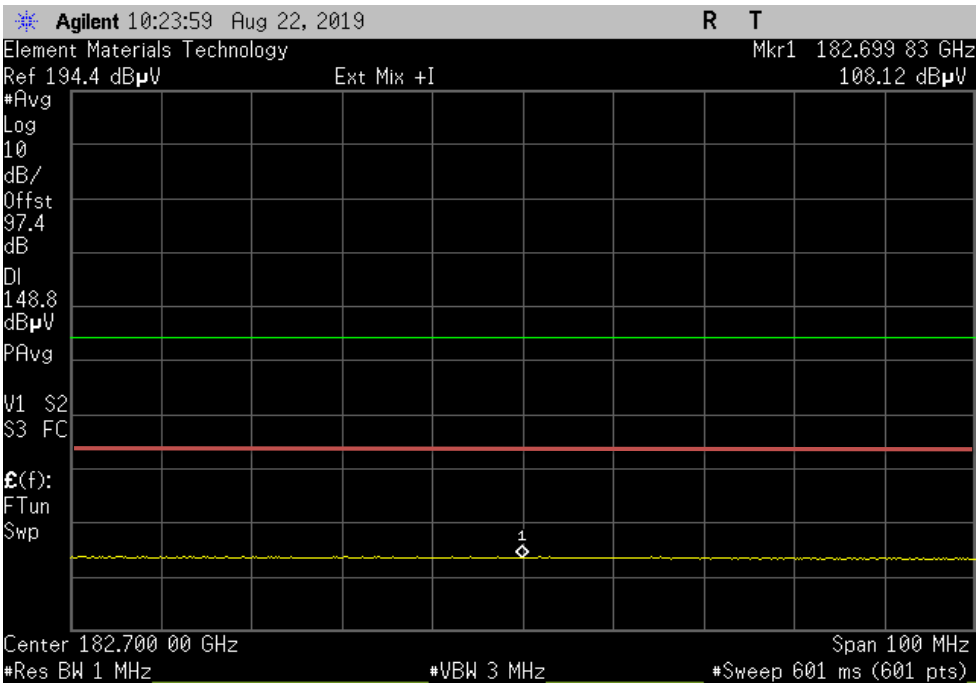
Continuous Transmission Without Modulation, Average Detector, Low Ch. 58.3 GHz, 3rd Harmonic						
				Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
				103.83	≤ 128.8	Pass



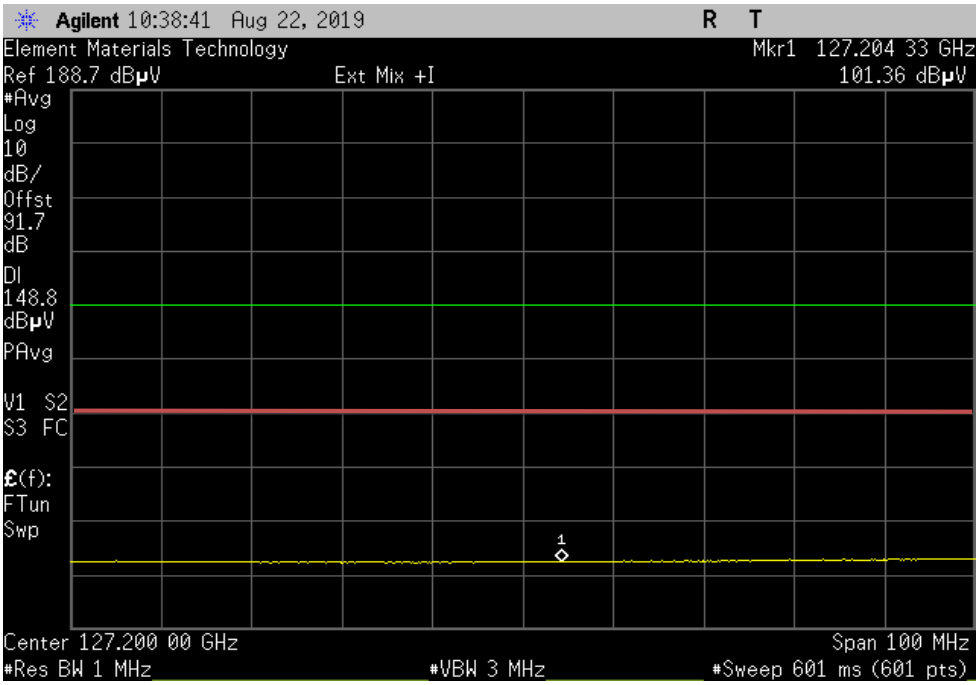
Continuous Transmission Without Modulation, Average Detector, Mid Ch. 60.9 GHz, 2nd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					101.81	≤ 128.8	Pass



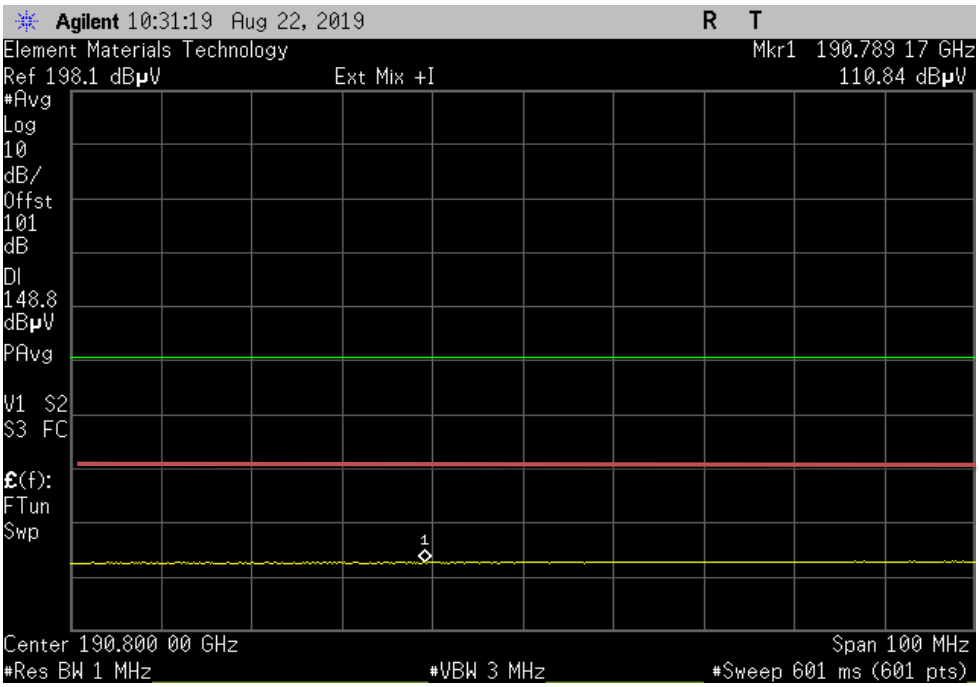
Continuous Transmission Without Modulation, Average Detector, Mid Ch. 60.9 GHz, 3rd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					108.12	≤ 128.8	Pass



Continuous Transmission Without Modulation, Average Detector, High Ch. 63.9 GHz, 2nd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					101.36	≤ 128.8	Pass



Continuous Transmission Without Modulation, Average Detector, High Ch. 63.9 GHz, 3rd Harmonic							
					Measured Value @ 2 cm (dBuV/m)	2 cm Distance Corrected Radiated Limit (dBuV/m)	Result
					110.84	≤ 128.8	Pass



FREQUENCY STABILITY dbr 8

XMit 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Meter - Multimeter	Tektronix	DMM912	MMH	15-Feb-19	15-Feb-22
Thermometer	Omegaette	HH311	DTY	5-Jan-18	5-Jan-21
Diplexer	OML, Inc.	DPL26	DAA	NCR	NCR
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	25-Aug-16	25-Aug-19
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR
Chamber - Temperature/Humidity	Cincinnati Sub Zero (CSZ)	ZPH-8-2-SCT/AC	TBI	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-19	24-Mar-20

TEST DESCRIPTION

The measurements were made using a high frequency horn at a distance of 2 cm. The EUT antenna was then maximized by investigating all 3 orthogonal sides.

Measurements were made in the middle of the main transmit bands as called out on the data sheets. Testing was done with an absence of modulation.

The primary supply voltage was varied from 85 % to 115% of the nominal voltage Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range (-30 ° to +50° C) and at 10°C intervals.

Where a ppm limit applies: ppm = (Measured Frequency / Measured Nominal Frequency - 1) * 1,000,000

Per the requirements of FCC 15.255:

Manufacturers of mm wave devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

No specific limits are provided in either FCC 15.255, the product specific rule part, or FCC 2.1055, the equipment authorization procedure for testing frequency stability. While there are no limits called out, any results less than 100ppm will still allow the radio to be operating within the band.

FREQUENCY STABILITY dbr 8

element

XMit 2019.06.11

EUT:	60 GHz Radar			Work Order:	ELEM0096
Serial Number:	FCC001/2019			Date:	22-Aug-19
Customer:	Pulsar Process Measurement			Temperature:	23.2 °C
Attendees:	None			Humidity:	46.5% RH
Project:	None			Barometric Pres.:	1019 mbar
Tested by:	Brandon Hobbs, Jeff Alcoke	Power:	24 VDC Nominal	Job Site:	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

Configuration #	1	Signature

Mid Channel, CW, 57 GHz - 71 GHz Band

Frequency Stability with Variation of DC Voltage (Ambient Temperature = 20° C)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Tolerance (ppm)	Specification (ppm)
30 ≥ (115%)	60947.500000	60947.282000	3.58	100
24 (100%)	60947.500000	60947.383000	1.92	100
18 ≤ (85%)	60947.500000	60947.742000	3.97	100

Frequency Stability with Variation of Ambient Temperature (Primary Supply = 18 VDC)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Tolerance (ppm)	Specification (ppm)
50	60947.500000	60947.022000	7.84	100
40	60947.500000	60947.102000	6.53	100
30	60947.500000	60947.122000	6.20	100
20	60947.500000	60947.142000	5.87	100
10	60947.500000	60947.202000	4.89	100
0	60947.500000	60947.282000	3.58	100
-10	60947.500000	60947.962000	7.58	100
-20	60947.500000	60947.042000	7.51	100
-30	60947.500000	60947.943000	7.27	100

FREQUENCY STABILITY dbr 16

XMit 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Meter - Multimeter	Tektronix	DMM912	MMH	15-Feb-19	15-Feb-22
Thermometer	Omegaette	HH311	DTY	5-Jan-18	5-Jan-21
Diplexer	OML, Inc.	DPL26	DAA	NCR	NCR
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	25-Aug-16	25-Aug-19
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR
Chamber - Temperature/Humidity	Cincinnati Sub Zero (CSZ)	ZPH-8-2-SCT/AC	TBI	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-19	24-Mar-20

TEST DESCRIPTION

The measurements were made using a high frequency horn at a distance of 2 cm. The EUT antenna was then maximized by investigating all 3 orthogonal sides.

Measurements were made in the middle of the main transmit bands as called out on the data sheets. Testing was done with an absence of modulation.

The primary supply voltage was varied from 85 % to 115% of the nominal voltage Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range (-30 ° to +50° C) and at 10°C intervals.

Where a ppm limit applies: ppm = (Measured Frequency / Measured Nominal Frequency - 1) * 1,000,000

Per the requirements of FCC 15.255:

Manufacturers of mm wave devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

No specific limits are provided in either FCC 15.255, the product specific rule part, or FCC 2.1055, the equipment authorization procedure for testing frequency stability. While there are no limits called out, any results less than 100ppm will still allow the radio to be operating within the band.

FREQUENCY STABILITY dbr 16

element

XMit 2019.06.11

EUT:	60 GHz Radar			Work Order:	ELEM0096
Serial Number:	FCC002/2019			Date:	22-Aug-19
Customer:	Pulsar Process Measurement			Temperature:	23.2 °C
Attendees:	None			Humidity:	46.5% RH
Project:	None			Barometric Pres.:	1019 mbar
Tested by:	Brandon Hobbs, Jeff Alcoke	Power:	24 VDC Nominal	Job Site:	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.255:2019	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

Configuration #	2	Signature

Mid Channel, 57 GHz - 71 GHz Band

Frequency Stability with Variation of DC Voltage (Ambient Temperature = 20° C)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Tolerance (ppm)	Specification (ppm)
30 ≥ (115%)	60947.500000	60947.723000	3.66	100
24 (100%)	60947.500000	60947.322000	2.92	100
18 ≤ (85%)	60947.500000	60947.142000	5.87	100

Frequency Stability with Variation of Ambient Temperature (Primary Supply = 18 VDC)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Tolerance (ppm)	Specification (ppm)
50	60947.500000	60947.202000	4.89	100
40	60947.500000	60947.222000	4.56	100
30	60947.500000	60947.302000	3.25	100
20	60947.500000	60947.443000	0.94	100
10	60947.500000	60947.423000	1.26	100
0	60947.500000	60947.643000	2.35	100
-10	60947.500000	60947.755000	4.18	100
-20	60947.500000	60947.848000	5.71	100
-30	60947.500000	60947.943000	7.27	100