



Image Sensing Systems, Inc. USA

RTMS Echo

FCC 15.245:2019

24.075 - 24.175 GHz transceiver

Report # IMGE0084.1



NVLAP LAB CODE: 200881-0



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CERTIFICATE OF TEST



Last Date of Test: October 4, 2019
Image Sensing Systems, Inc. USA
EUT: RTMS Echo

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2019	ANSI C63.10:2013
FCC 15.245:2019	

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
6.5, 6.6	Field Strength of Harmonics and Spurious Radiated Emissions	Yes	Pass	
6.6	Field Strength of Fundamental	Yes	Pass	
7.5	Dwell Time and Cycle Time	No	N/A	Not required - the KDB this comes from refers to a different FCC rule part to which the EUT is being tested.

Deviations From Test Standards

None

Approved By:

Matt Nuernberg, 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
00	None		

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

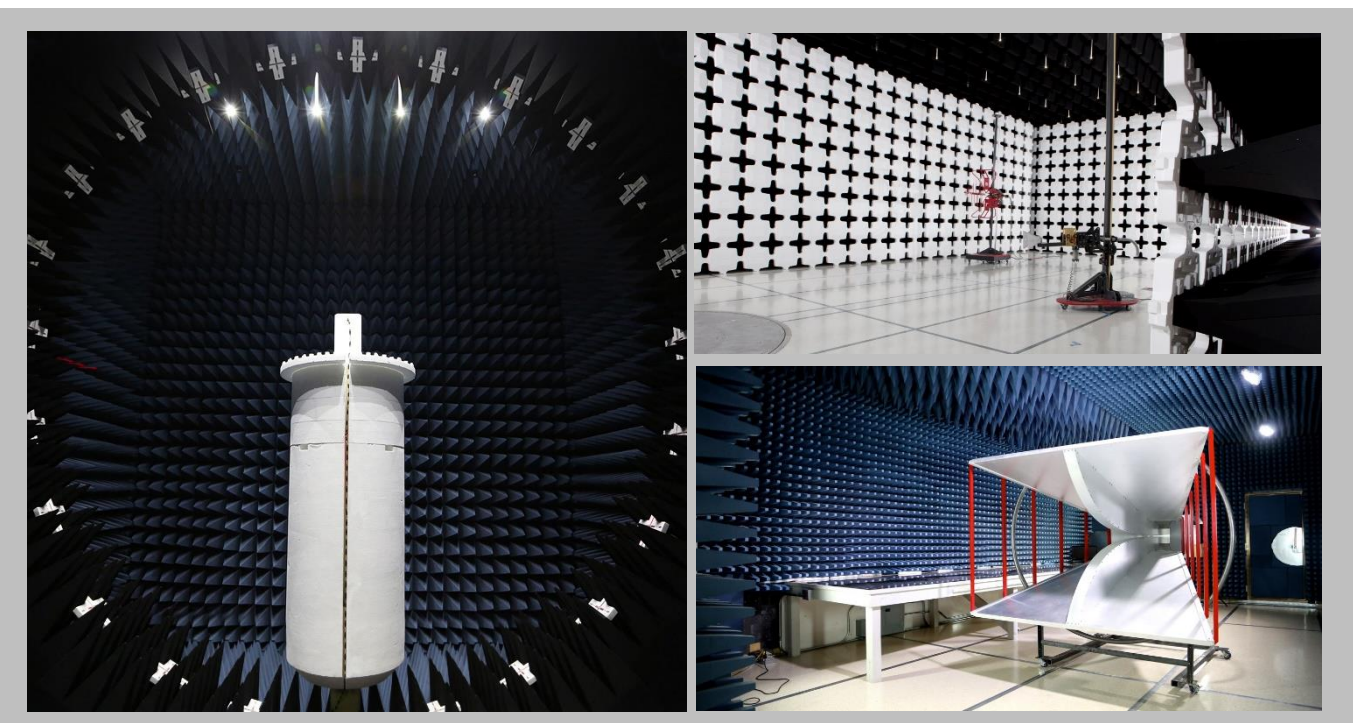
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th 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/RRR, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



MEASUREMENT UNCERTAINTY

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.

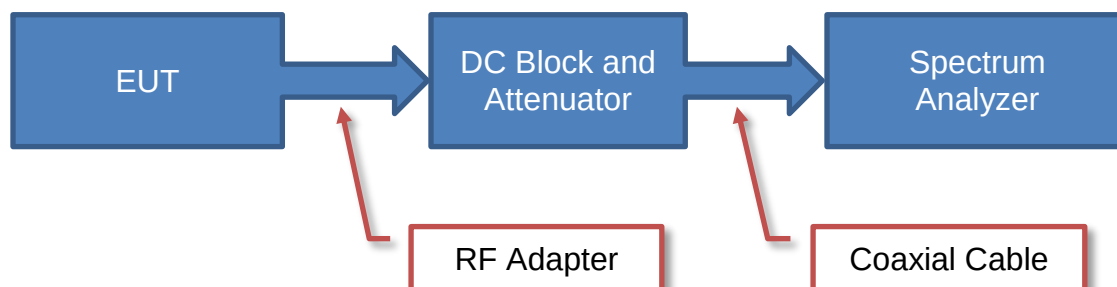
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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.

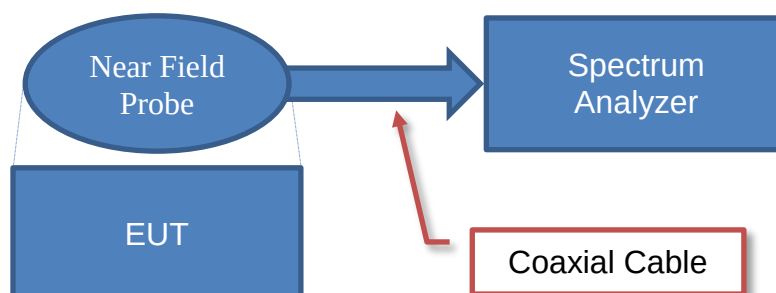
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

Test Setup Block Diagrams

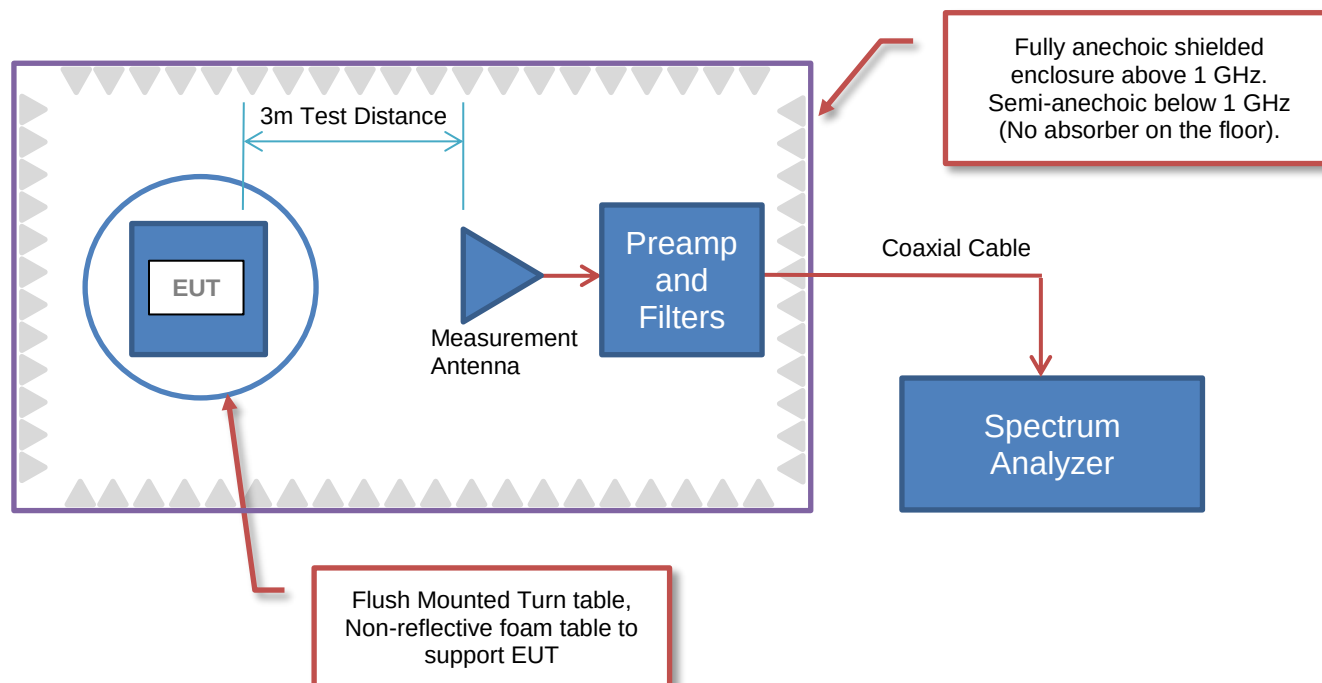
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name:	Image Sensing Systems, Inc. USA
Address:	1600 University Ave. W. Suite 500
City, State, Zip:	St. Paul, MN 55104
Test Requested By:	Ken Partyka
EUT:	RTMS Echo
First Date of Test:	September 11, 2019
Last Date of Test:	October 4, 2019
Receipt Date of Samples:	September 10, 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:
Radar Based vehicle detection product located adjacent to roadways, incorporating WiFi and GPS.
Testing Objective:
Seeking to demonstrate compliance under FCC 15.245:2019.

CONFIGURATIONS



Configuration IMGE0084- 1

Software/Firmware Running during test	
Description	Version
Beta Software	0.3.0.329 rev M1

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
RTMS Echo	Image Sensing Systems, Inc. USA	A700-1280	0019

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
DC Power Supply	Phoenix Contact	Mini-PS-100-240AC/24DC/4	None
Power I/O Cable	Image Sensing Systems, Inc. USA	A650-1280-13	N/A
Breakout Board	Image Sensing Systems	N/A	N/A

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Dell	M3800	JQJXH72
AC Adapter (Laptop)	Dell	CDA130PM130	CN-06TTY6-48661-5BR-2CGY-A01
USB to Ethernet Adapter	N/A	None	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
Power I/O Cable	Yes	15 m	No	RTMS Echo	Breakout Board
AC Cable	No	1.5 m	No	AC Adapter (Laptop)	AC Mains
DC Cable (Laptop)	No	1.5 m	No	Laptop	AC Adapter (Laptop)
Ethernet Cable	No	>3.0m	No	Breakout Board	USB to Ethernet Adapter
DC Leads (x2)	No	0.2m	No	Breakout Board	DC Power Supply
USB Cable (USB to Ethernet Adapter)	Yes	0.1m	No	Laptop	Ethernet Cable

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-09-11	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.
2	2019-09-13	Field Strength of Harmonics and Spurious Radiated Emissions Under 40 GHz	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	2019-09-25	Field Strength of Harmonics and Spurious Radiated Emissions Above 40 GHz	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	2019-10-04	Field Strength of Fundamental	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

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	ESR7	ARI	2019-07-08	2020-07-08
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2019-03-13	2020-03-13
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2019-03-15	2020-03-15

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

IMGE0084-1

MODES INVESTIGATED

Wifi idle, 24 GHz active, normal detection mode

POWERLINE CONDUCTED EMISSIONS



EUT:	RTMS Echo	Work Order:	IMGE0084
Serial Number:	0019	Date:	2019-09-11
Customer:	Image Sensing Systems, Inc. USA	Temperature:	22.2°C
Attendees:	Kenneth Partyka	Relative Humidity:	68.6%
Customer Project:	None	Bar. Pressure:	1018 mb
Tested By:	Dustin Sparks	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	IMGE0084-1

TEST SPECIFICATIONS

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

TEST PARAMETERS

Run #:	10	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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COMMENTS

None

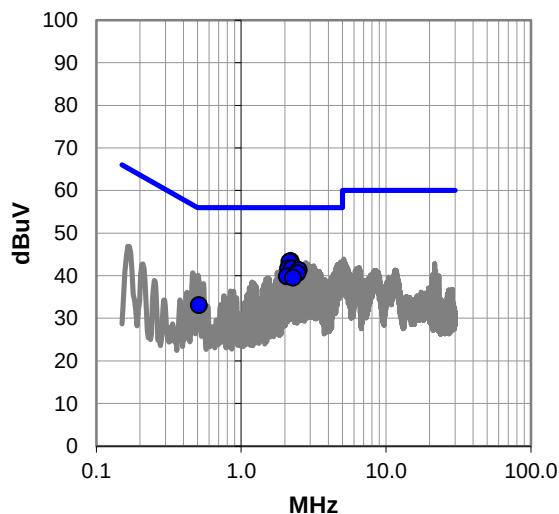
EUT OPERATING MODES

Wifi idle, 24 GHz active, normal detection mode

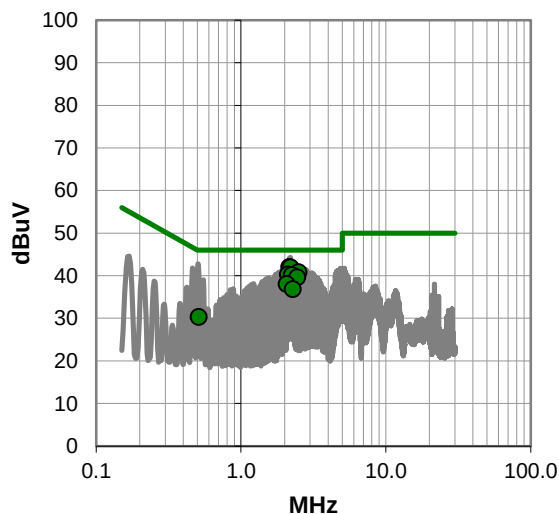
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #10

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.200	22.7	20.7	43.4	56.0	-12.6
2.158	22.6	20.7	43.3	56.0	-12.7
2.115	21.1	20.6	41.7	56.0	-14.3
2.241	21.0	20.7	41.7	56.0	-14.3
2.496	20.6	20.7	41.3	56.0	-14.7
2.453	19.9	20.7	40.6	56.0	-15.4
2.073	19.2	20.6	39.8	56.0	-16.2
2.285	18.8	20.7	39.5	56.0	-16.5
0.512	12.5	20.6	33.1	56.0	-22.9

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.158	21.3	20.7	42.0	46.0	-4.0
2.200	21.2	20.7	41.9	46.0	-4.1
2.496	20.1	20.7	40.8	46.0	-5.2
2.115	19.7	20.6	40.3	46.0	-5.7
2.241	19.4	20.7	40.1	46.0	-5.9
2.453	18.9	20.7	39.6	46.0	-6.4
2.073	17.4	20.6	38.0	46.0	-8.0
2.285	16.1	20.7	36.8	46.0	-9.2
0.512	9.7	20.6	30.3	46.0	-15.7

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	RTMS Echo	Work Order:	IMGE0084
Serial Number:	0019	Date:	2019-09-11
Customer:	Image Sensing Systems, Inc. USA	Temperature:	22.2°C
Attendees:	Kenneth Partyka	Relative Humidity:	68.6%
Customer Project:	None	Bar. Pressure:	1018 mb
Tested By:	Dustin Sparks	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	IMGE0084-1

TEST SPECIFICATIONS

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

TEST PARAMETERS

Run #:	11	Line:	High Line	Add. Ext. Attenuation (dB):	0
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COMMENTS

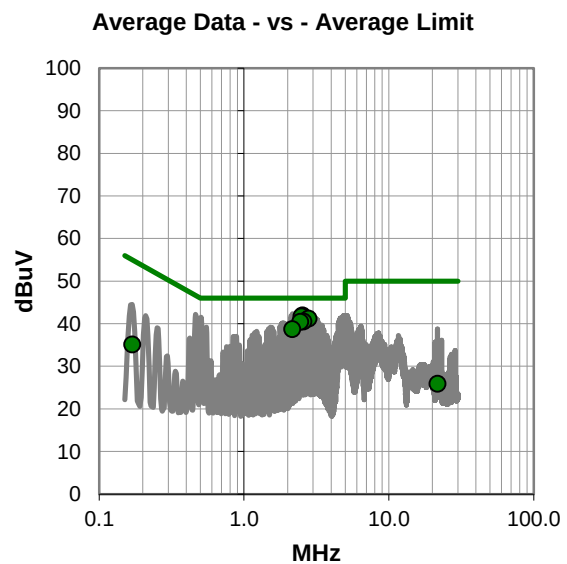
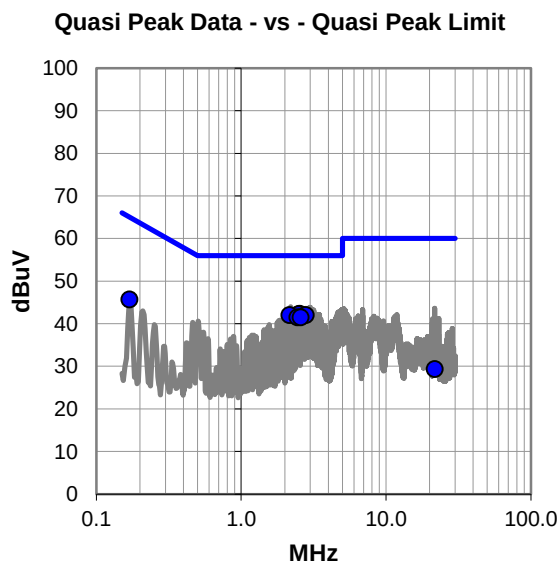
None

EUT OPERATING MODES

Wifi idle, 24 GHz active, normal detection mode

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #11

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.539	21.6	20.7	42.3	56.0	-13.7
2.496	21.5	20.7	42.2	56.0	-13.8
2.793	21.3	20.7	42.0	56.0	-14.0
2.158	21.3	20.7	42.0	56.0	-14.0
2.455	20.8	20.7	41.5	56.0	-14.5
2.581	20.8	20.7	41.5	56.0	-14.5
0.169	24.8	20.9	45.7	65.0	-19.3
21.694	8.1	21.2	29.3	60.0	-30.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.539	21.2	20.7	41.9	46.0	-4.1
2.496	21.0	20.7	41.7	46.0	-4.3
2.793	20.5	20.7	41.2	46.0	-4.8
2.581	19.8	20.7	40.5	46.0	-5.5
2.455	19.7	20.7	40.4	46.0	-5.6
2.158	18.0	20.7	38.7	46.0	-7.3
0.169	14.2	20.9	35.1	55.0	-19.9
21.694	4.7	21.2	25.9	50.0	-24.1

CONCLUSION

Pass



Tested By

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz



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
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19
Antenna - Standard Gain	OML, Inc.	M19HWAX	AIJ	20-Sep-19	20-Sep-22
Antenna - Standard Gain	OML, Inc.	M12HWAX	AIK	17-Sep-19	17-Sep-22
Cable	OML, Inc.	S119BFSS100390443	SUN	NCR	NCR

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 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 analyzer display was offset with the value of the test equipment losses (mixers, duplexers, and cables) specific to each band. The specification limit was adjusted for the closer test distances at 20 dB per decade.

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.

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz



XMI 2019.09.05

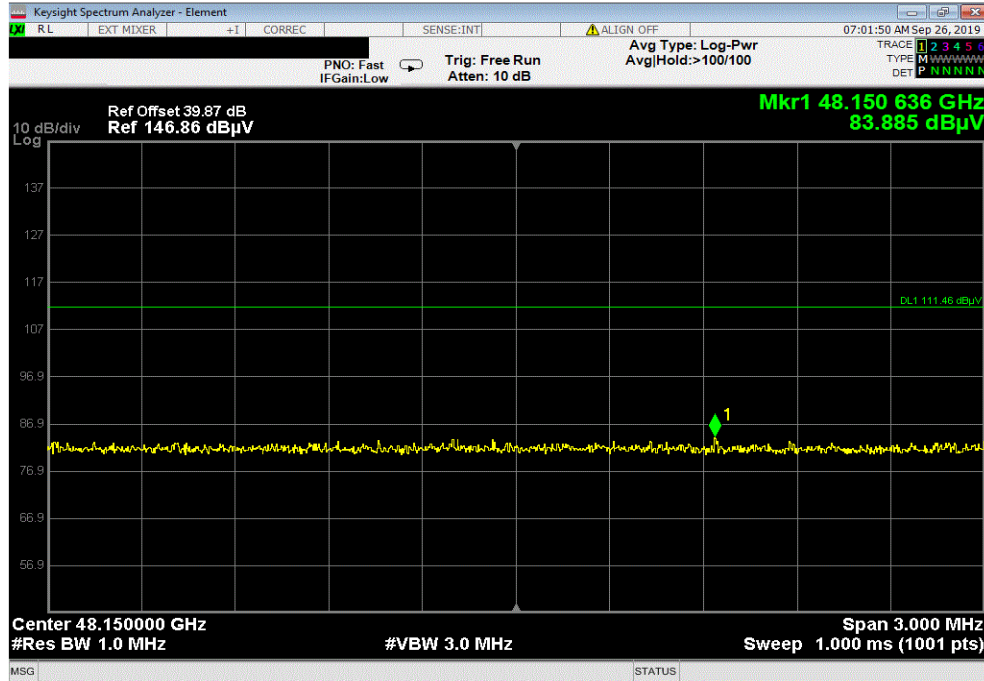
EUT: RTMS Echo		Work Order: IMGE0084	
Serial Number: 0019		Date: 25-Sep-19	
Customer: Image Sensing Systems, Inc. USA		Temperature: 21.1 °C	
Attendees: Kenneth Partyka		Humidity: 69.6% RH	
Project: None		Barometric Pres.: 1010 mbar	
Tested by: Dustin Sparks		Power: 24VDC	
Job Site: MN05			
TEST SPECIFICATIONS		Test Method	
FCC 15.245:2019		ANSI C63.10:2013	
COMMENTS			
Measurements taken at 20 cm test distance. Only peak detector data was taken since it was lower than the average detector limit. The 111.5 dBµV line on the screenshots is the distance corrected average limit at 20 cm. Transmitting CW signals at 24.075 GHz (low channel), 24.124 GHz (mid channel), and 24.175 GHz (high channel.)			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Dustin Sparks</i>	
		Raw Value at 20cm (dBµV)	Adjusted Value at 3m (dBµV/m)
		Limit (< dBµV/m)	Result
24.075-24.175 GHz Swept FM-CW			
Second Harmonic			
Horizontal Polarity			
	Low Channel	83.89	47.83
	Mid Channel	83.14	47.08
	High Channel	83.02	46.96
Vertical Polarity			
	Low Channel	84.13	48.07
	Mid Channel	83.44	47.38
	High Channel	82.73	46.67
Third Harmonic			
Horizontal Polarity			
	Low Channel	94.93	58.87
	Mid Channel	95.2	59.14
	High Channel	94.87	58.81
Vertical Polarity			
	Low Channel	95.23	59.17
	Mid Channel	95.5	59.44
	High Channel	95.31	59.25

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

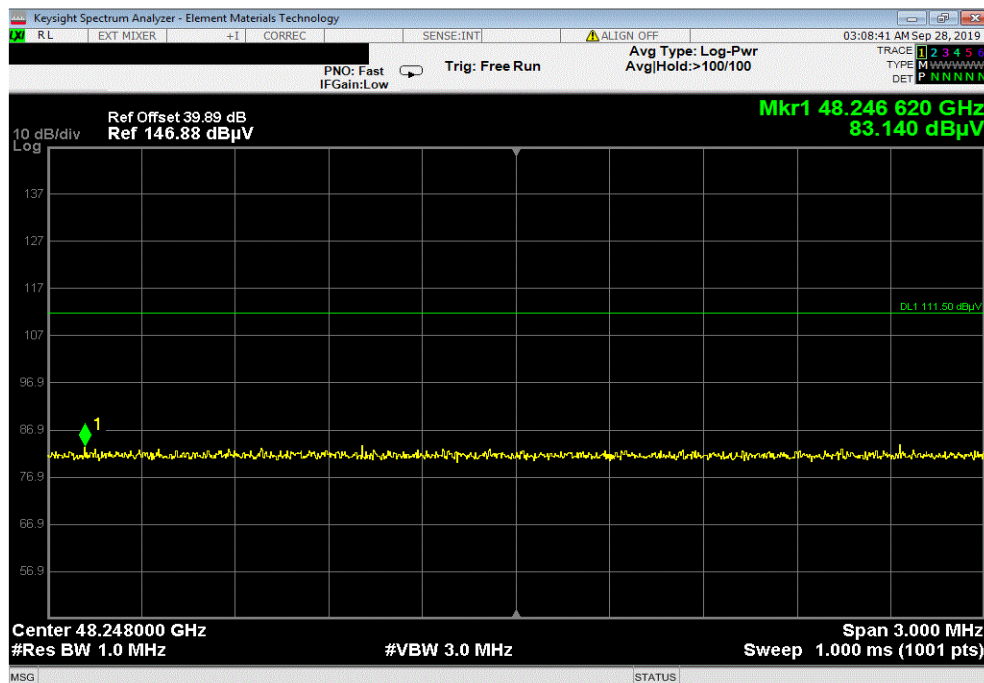


XMI 2019.09.05

24.075-24.175 GHz Swept FM-CW, Second Harmonic, Horizontal Polarity, Low Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	83.89	47.83	68	Pass		



24.075-24.175 GHz Swept FM-CW, Second Harmonic, Horizontal Polarity, Mid Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	83.14	47.08	68	Pass		

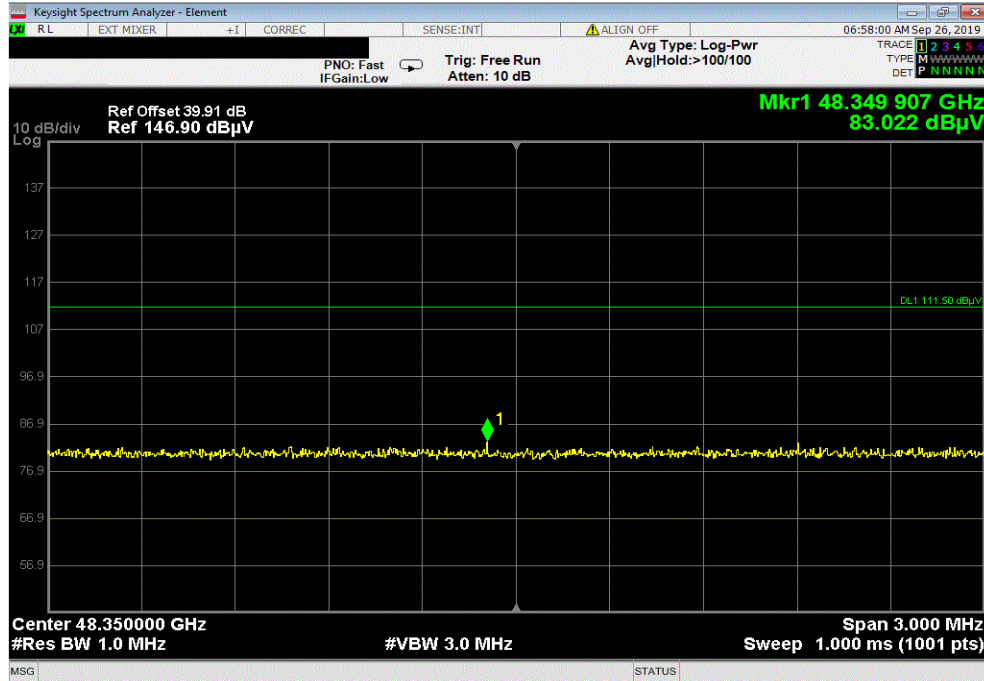


FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

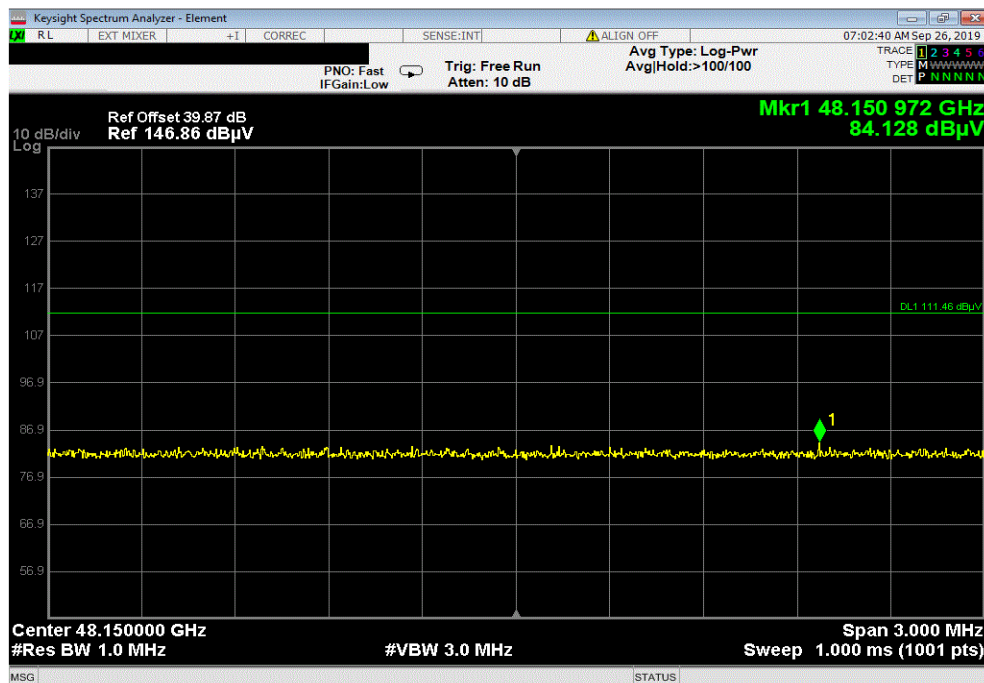


XMM 2019.09.05

24.075-24.175 GHz Swept FM-CW, Second Harmonic, Horizontal Polarity, High Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	83.02	46.96	68	Pass		



24.075-24.175 GHz Swept FM-CW, Second Harmonic, Vertical Polarity, Low Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	84.13	48.07	68	Pass		

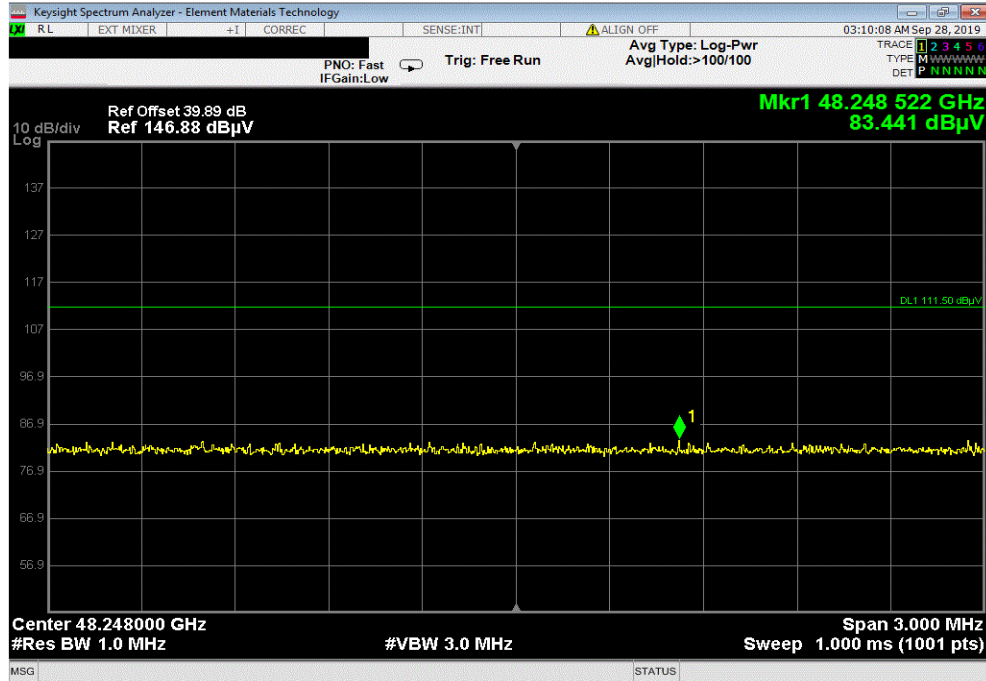


FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

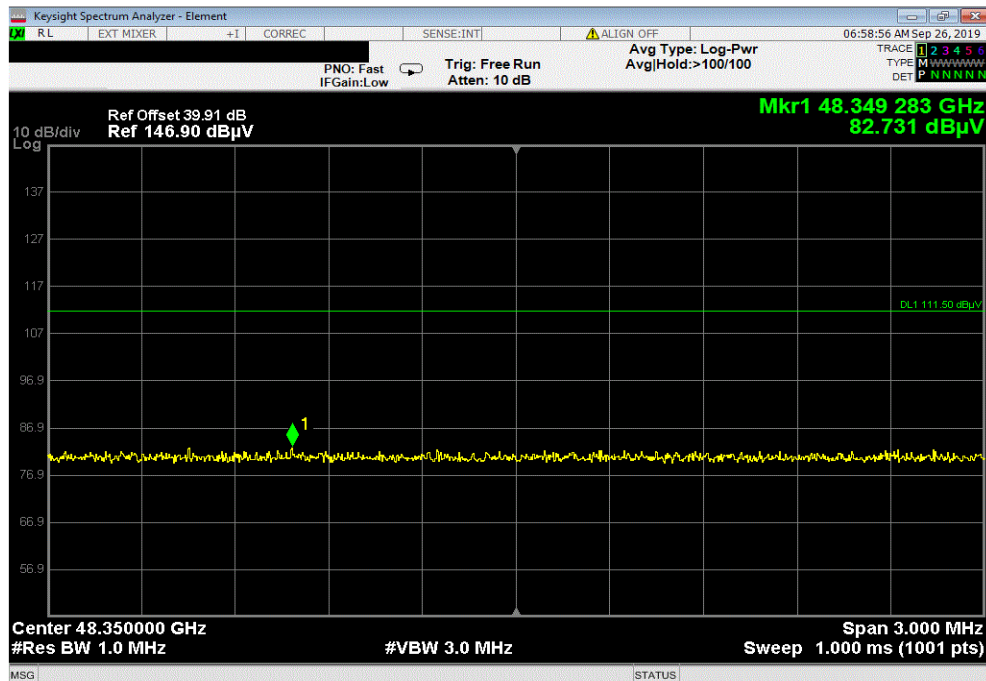


XMM 2019.09.05

24.075-24.175 GHz Swept FM-CW, Second Harmonic, Vertical Polarity, Mid Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	83.44	47.38	68	Pass		



24.075-24.175 GHz Swept FM-CW, Second Harmonic, Vertical Polarity, High Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	82.73	46.67	68	Pass		

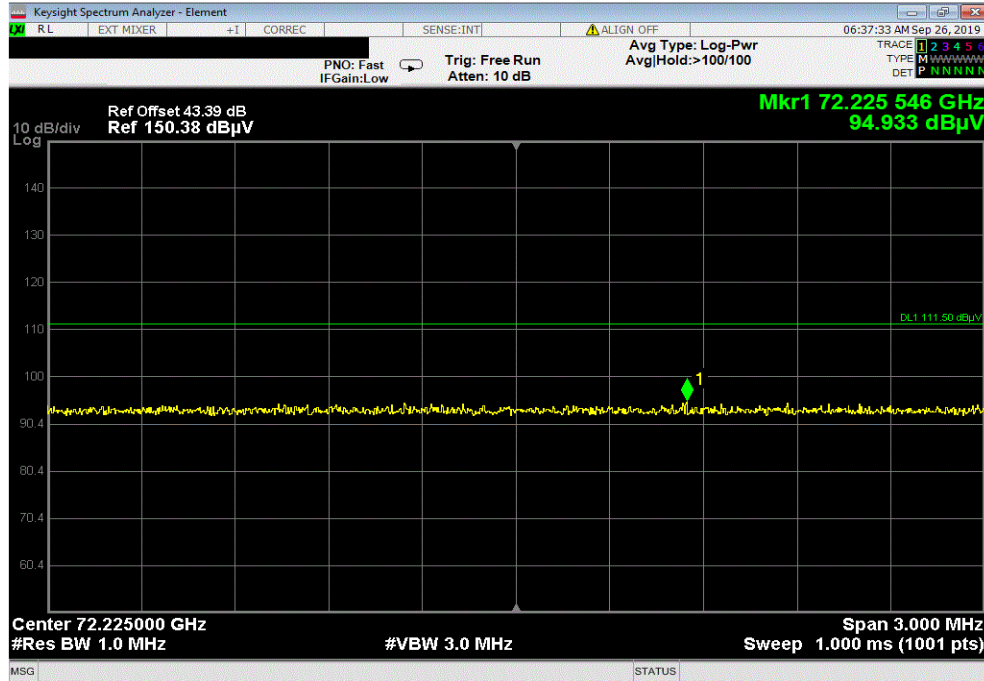


FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

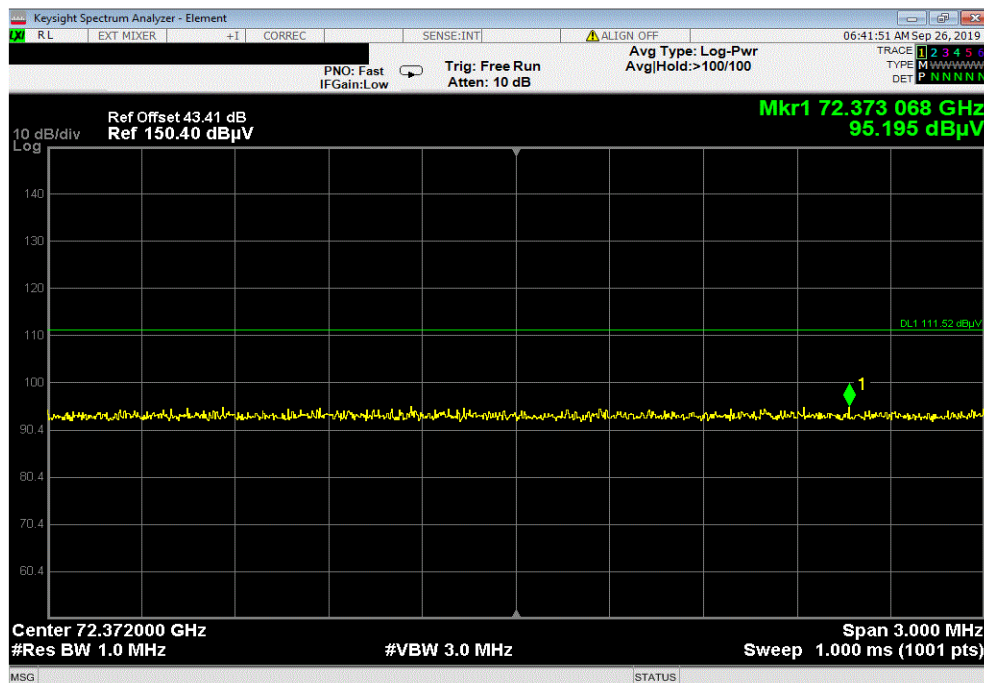


XMM 2019.09.05

24.075-24.175 GHz Swept FM-CW, Third Harmonic, Horizontal Polarity, Low Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	94.93	58.87	68	Pass		



24.075-24.175 GHz Swept FM-CW, Third Harmonic, Horizontal Polarity, Mid Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	95.2	59.14	68	Pass		

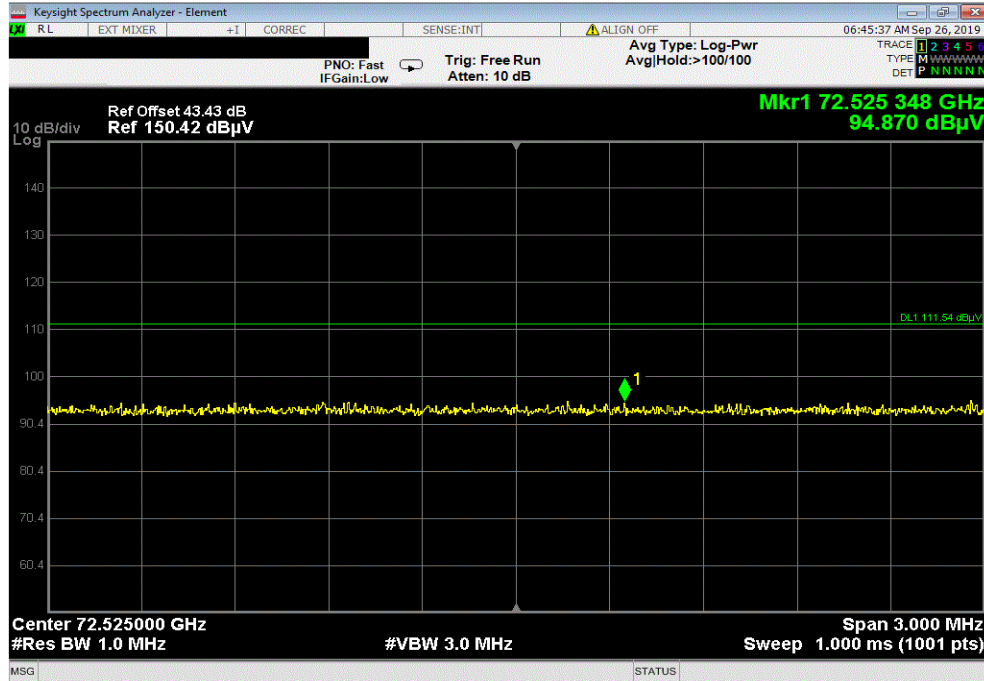


FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

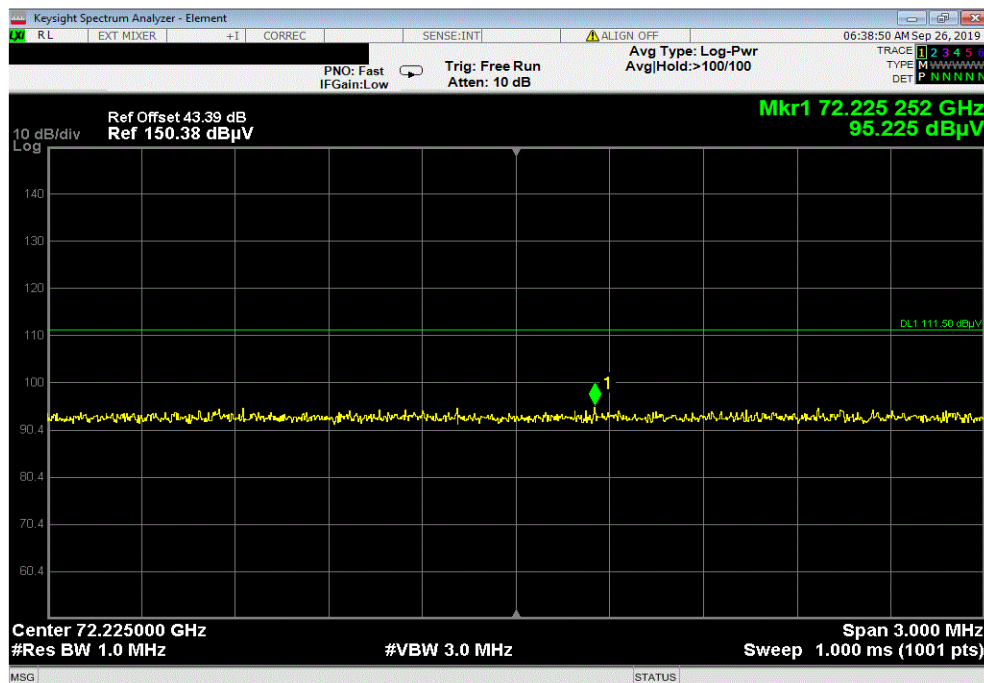


XMM 2019.09.05

24.075-24.175 GHz Swept FM-CW, Third Harmonic, Horizontal Polarity, High Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	94.87	58.81	68	Pass		



24.075-24.175 GHz Swept FM-CW, Third Harmonic, Vertical Polarity, Low Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	95.23	59.17	68	Pass		

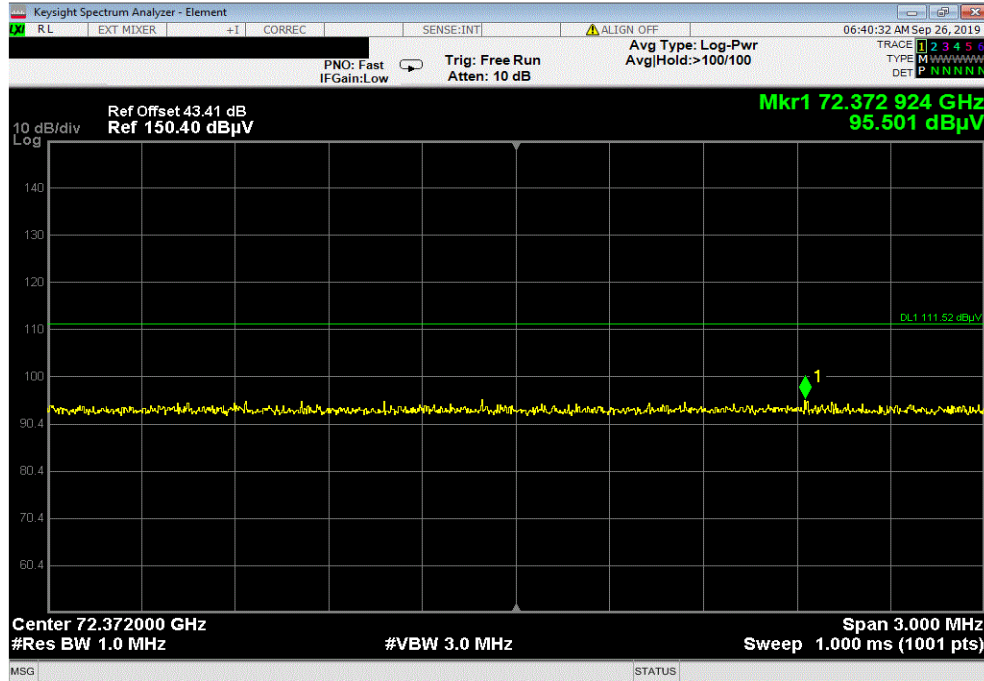


FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS ABOVE 40 GHz

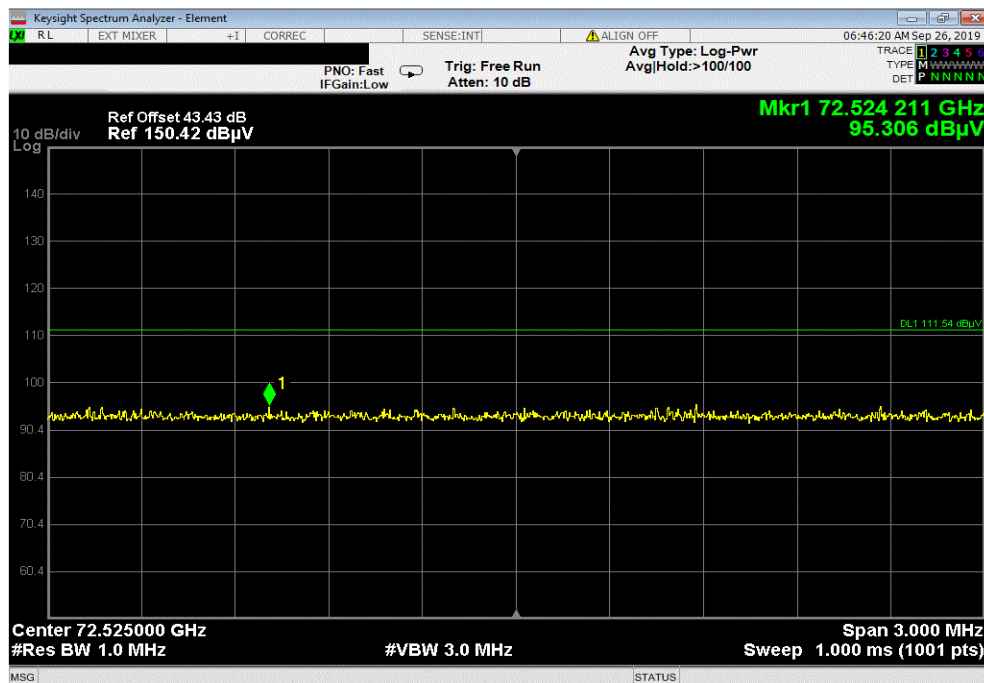


XMM 2019.09.05

24.075-24.175 GHz Swept FM-CW, Third Harmonic, Vertical Polarity, Mid Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	95.5	59.44	68	Pass		



24.075-24.175 GHz Swept FM-CW, Third Harmonic, Vertical Polarity, High Channel						
	Raw Value at 20cm (dBμV)	Adjusted Value at 3m (dBμV/m)	Limit (< dBμV/m)	Result		
	95.31	59.25	68	Pass		



FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS UNDER 40 GHz



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

Transmitting 24 GHz swept FMCW, 24.075-24.175 GHz (US)

POWER SETTINGS INVESTIGATED

24VDC

CONFIGURATIONS INVESTIGATED

IMGE0084 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	40000 MHz
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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	HGG	26-Sep-2018	12 mo
Antenna - Biconilog	Ametek	CBL 6141B	AYS	19-Mar-2019	24 mo
Cable	ESM Cable Corp.	TTBJ141-KMKM-72	MNQ	11-Sep-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	JSW45-26004000-40-5P	AVN	11-Sep-2019	12 mo
Antenna	AH Systems	SAS-588	AJO	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	11-Sep-2019	12 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNP	11-Sep-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-2018	12 mo
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-12001800-30-10P	PAP	23-Feb-2019	12 mo
Cable	Element	Biconilog Cable	MNX	23-Feb-2019	12 mo
Cable	Element	Standard Gain Cable	MNV	23-Feb-2019	12 mo
Cable	Element	Double Ridge Guide Horn Cables	MNV	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVX	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVC	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	23-Feb-2019	12 mo
Antenna - Standard Gain	ETS-Lindgren	3160-08	AJP	NCR	0 mo
Antenna - Standard Gain	ETS-Lindgren	3160-07	AJJ	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIB	27-Aug-2018	24 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

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, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass 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.

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

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS UNDER 40 GHz



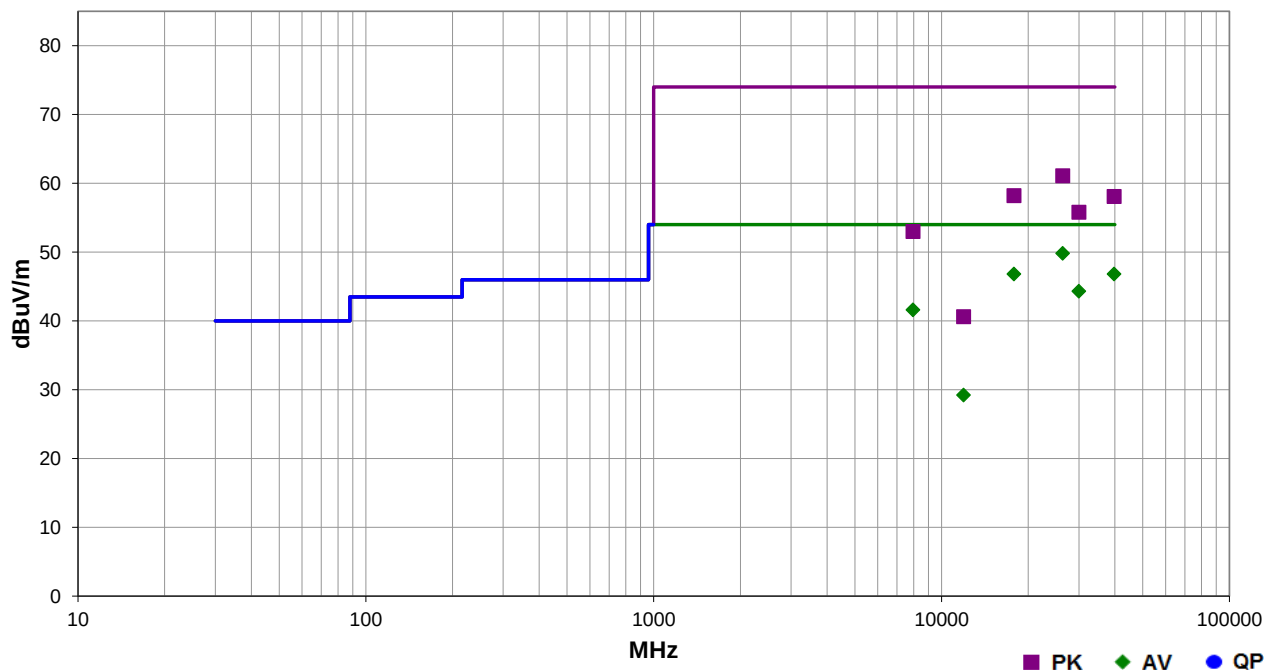
EmiR5 2019.08.01

PSA-ESCI 2019.05.10

Work Order:	IMGE0084	Date:	13-Sep-2019	
Project:	None	Temperature:	22.2 °C	
Job Site:	MN09	Humidity:	57.3% RH	
Serial Number:	0019	Barometric Pres.:	1017 mbar	
EUT:		RTMS Echo		
Configuration:	1			
Customer:	Image Sensing Systems, Inc. USA			
Attendees:	Kenneth Partyka			
EUT Power:	24VDC			
Operating Mode:	Transmitting 24 GHz swept FMCW, 24.075-24.175 GHz (US)			
Deviations:	None			
Comments:	Points shown are noise floor measurements included for reference.			

Test Specifications	Test Method
FCC 15.245:2019	ANSI C63.10:2013

Run #	42	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
26366.020	30.0	19.8	1.8	212.0	3.0	0.0	Vert	AV	0.0	49.8	54.0	-4.2	EUT vertical
17837.310	26.0	20.8	3.9	183.0	3.0	0.0	Vert	AV	0.0	46.8	54.0	-7.2	EUT vertical
39764.800	45.9	0.9	1.7	300.0	3.0	0.0	Vert	AV	0.0	46.8	54.0	-7.2	EUT vertical
29992.590	38.3	6.0	1.7	271.0	3.0	0.0	Vert	AV	0.0	44.3	54.0	-9.7	EUT vertical
7959.275	28.4	13.2	2.0	239.0	3.0	0.0	Horz	AV	0.0	41.6	54.0	-12.4	EUT vertical
26365.390	41.3	19.8	1.8	212.0	3.0	0.0	Vert	PK	0.0	61.1	74.0	-12.9	EUT vertical
17835.640	37.4	20.8	3.9	183.0	3.0	0.0	Vert	PK	0.0	58.2	74.0	-15.8	EUT vertical
39764.790	57.2	0.9	1.7	300.0	3.0	0.0	Vert	PK	0.0	58.1	74.0	-15.9	EUT vertical
29992.770	49.8	6.0	1.7	271.0	3.0	0.0	Vert	PK	0.0	55.8	74.0	-18.2	EUT vertical
7959.592	39.8	13.2	2.0	239.0	3.0	0.0	Horz	PK	0.0	53.0	74.0	-21.0	EUT vertical
11933.280	30.8	-1.6	1.2	78.0	3.0	0.0	Horz	AV	0.0	29.2	54.0	-24.8	EUT vertical
11930.020	42.2	-1.6	1.2	78.0	3.0	0.0	Horz	PK	0.0	40.6	74.0	-33.4	EUT vertical

FIELD STRENGTH OF FUNDAMENTAL



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

Transmitting swept FM-CW single channels - 24.075 GHz (low channel), 24.124 GHz (mid channel), and 24.175 GHz (high channel)

POWER SETTINGS INVESTIGATED

24VDC

CONFIGURATIONS INVESTIGATED

IMGE0084 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	24000 MHz	Stop Frequency	24250 MHz
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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
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNP	11-Sep-2019	12 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	28-Jul-2019	12 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was transmitting and while set at the lowest channel, a middle channel, and the highest channel available. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT and EUT antenna in 3 orthogonal planes.

FIELD STRENGTH OF FUNDAMENTAL

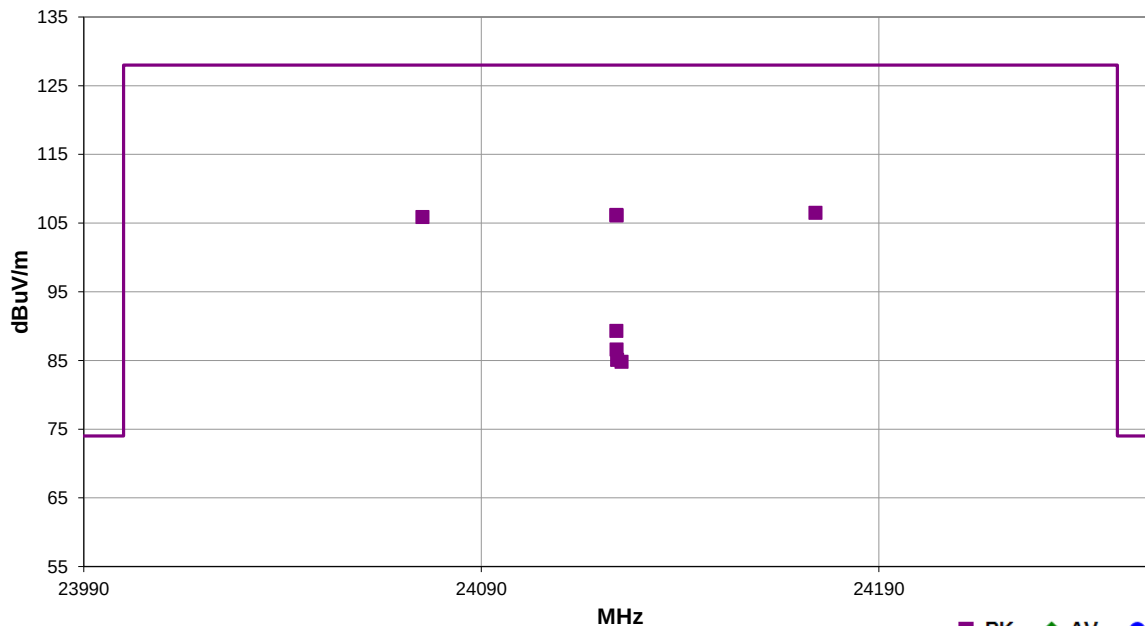


EmiRS 2019.08.01 PSA-ESCI 2019.05.10

Work Order:	IMGE0084	Date:	4-Oct-2019	<i>Dustin Sparks</i>
Project:	None	Temperature:	21.2 °C	
Job Site:	MN05	Humidity:	42% RH	
Serial Number:	0019	Barometric Pres.:	1034 mbar	
EUT:	RTMS Echo			
Configuration:	1			
Customer:	Image Sensing Systems, Inc. USA			
Attendees:	Kenneth Partyka			
EUT Power:	24VDC			
Operating Mode:	Transmitting swept FM-CW single channels - 24.075 GHz (low channel), 24.124 GHz (mid channel), and 24.175 GHz (high channel)			
Deviations:	None			
Comments:	None			

Test Specifications	Test Method
FCC 15.245:2019	ANSI C63.10:2013

Run #	10	Test Distance (m)	3	Antenna Height(s)	1 to 1.25(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
24174.030	58.3	48.2	1.65	347.0	3.0	0.0	Vert	PK	0.0	106.5	128.0	-21.5	High ch, EUT vertical
24123.960	58.0	48.2	1.7	340.9	3.0	0.0	Vert	PK	0.0	106.2	128.0	-21.8	Mid ch, EUT vertical
24124.030	57.9	48.2	1.7	346.0	3.0	0.0	Horz	PK	0.0	106.1	128.0	-21.9	Mid ch, EUT on side
24075.170	57.8	48.1	1.7	347.9	3.0	0.0	Vert	PK	0.0	105.9	128.0	-22.1	Low ch, EUT vertical
24123.970	41.1	48.2	1.75	268.0	3.0	0.0	Horz	PK	0.0	89.3	128.0	-38.7	Mid ch, EUT vertical
24124.000	38.4	48.2	1.75	347.9	3.0	0.0	Vert	PK	0.0	86.6	128.0	-41.4	Mid ch, EUT on side
24124.140	36.9	48.2	1.5	160.9	3.0	0.0	Vert	PK	0.0	85.1	128.0	-42.9	Mid ch, EUT horizontal
24125.290	36.6	48.2	1.5	52.0	3.0	0.0	Horz	PK	0.0	84.8	128.0	-43.2	Mid ch, EUT horizontal