The University of Michigan Radiation Laboratory
3228 EECS Building
Ann Arbor, Michigan 48109-2122 USA
Tel: (734) 483-4211
Fax: (734) 647-2106
e-mail: liepa@umich.edu

Testing of

Electromagnetic Emissions

per

USA: CFR Title 47, Part 15.245
Canada: RSS-210 and RSS-Gen

are herein reported for

Decatur Electronics, Inc.
SI-3

Test Report No.: 417124-664

Applicant/Provider:
Decatur Electronics, Inc.
3433 East Wood Street, Phoenix Arizona 85040 USA
Phone: +1 (217) 428-4315, Fax: +1 (602) 621-4200
Contact Person: Todd Cottle; todd.cottle@soncellna.com

Report by: Valdis V. Liepa, Ph.D. Report Date of Issue: July 31, 2013

Results of testing completed on (or before) July 31, 2013 are as follows.

Emissions: The transmitter fundamental emission meets the regulatory limit(s) by no less than 7.6 dB. Transmit chain spurious harmonic emissions comply by no less than 8.1 dB. Unintentional spurious emissions from digital circuitry comply with the radiated emission limit(s) by more than 2.2 dB. AC Power Line conducted emissions comply by more than 1.7 dB.

Contents

List of Tables

List of Figures

1 Test Specifications, General Procedures, and Location

1.1 Test Specification and General Procedures

The ultimate goal of Decatur Electronics, Inc. is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Decatur Electronics, Inc. SI-3 for compliance to:

Country/Region	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.245
Canada	Industry Canada	RSS-210 and RSS-Gen

In association with the rules and directives outlined above, the following specifications and procedures are followed herein.

ANSI C63.4-2003	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
FCC/TCB Council MMW Test Procedures	"Millimeter Wave Test Procedures"
ICES-003; Issue 5 (2012)	"Information Technology Equipment (ITE) Limits and methods of measurement"
Industry Canada	"The Measurement of Occupied Bandwidth"

1.2 Test Location and Equipment Used

Test Location The EUT was fully tested by **The University of Michigan Radiation Laboratory**, 3228 EECS Building, Ann Arbor, Michigan 48109-2122 USA. The Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 91050) and with Industry Canada, Ottawa, ON (File Ref. No: IC 2057A-1).

Test Equipment Pertinent test equipment used for measurements at this facility is listed in Table 1. The quality system employed at The University of Michigan Radiation Laboratory has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 1: The University of Michigan Radiation Laboratory Equipment List.

Test Instrument	Manufacturer/Model	Q Number
Spectrum Analyzer (9kHz-26GHz)	Hewlett-Packard 8593E, SN: 3412A01131	HP8593E1
Spectrum Analyzer (9kHz-6.5GHz)	Hewlett-Packard 8595E, SN: 3543A01546	JDB8595E
Power Meter	Hewlett-Packard, 432A	HP432A1
Harmonic Mixer (26-40 GHz)	Hewlett-Packard 11970A, SN: 3003A08327	HP11970A1
Harmonic Mixer (40-60 GHz)	Hewlett-Packard 11970U, SN: 2332A00500	HP11970U1
Harmonic Mixer (75-110 GHz)	Hewlett-Packard 11970W, SN: 2521A00179	HP11970W1
Harmonic Mixer (140-220 GHz)	Pacific Millimeter Prod., GMA, SN: 26	PMPGMA1
S-Band Std. Gain Horn	S/A, Model SGH-2.6	SBAND1
C-Band Std. Gain Horn	University of Michigan, NRL design	CBAND1
XN-Band Std. Gain Horn	University of Michigan, NRL design	XNBAND1
X-Band Std. Gain Horn	S/A, Model 12-8.2	XBAND1
X-band horn (8.2- 12.4 GHz)	Narda 640	XBAND2
X-band horn (8.2- 12.4 GHz)	Scientific Atlanta , 12-8.2, SN: 730	XBAND3
K-band horn (18-26.5 GHz)	FXR, Inc., K638KF	KBAND1
Ka-band horn (26.5-40 GHz)	FXR, Inc., U638A	KABAND1
U-band horn (40-60 GHz)	Custom Microwave, HO19	UBAND1
W-band horn(75-110 GHz)	Custom Microwave, HO10	WBAND1
G-band horn (140-220 GHz)	Custom Microwave, HO5R	GBAND1
Bicone Antenna (30-250 MHz)	University of Michigan, RLBC-1	LBBIC1
Bicone Antenna (200-1000 MHz)	University of Michigan, RLBC-2	HBBIC1
Dipole Antenna Set (30-1000 MHz)	University of Michigan, RLDP-1,-2,-3	UMDIP1
Dipole Antenna Set (30-1000 MHz)	EMCO 3121C, SN: 992 (Ref. Antennas)	EMDIP1
Active Rod Antenna (30 Hz-50 MHz)	EMCO 3301B, SN: 3223	EMROD1
Active Loop Antenna (30 Hz-50 MHz)	EMCO 6502, SN:2855	EMLOOP1
Ridge-horn Antenna (300-5000 MHz)	University of Michigan	UMRH1
Amplifier (5-1000 MHz)	Avantek, A11-1, A25-1S	AVAMP1
Amplifier (5-4500 MHz)	Avantek	AVAMP2
Amplifier (4.5-13 GHz)	Avantek, AFT-12665	AVAMP3
Amplifier (6-16 GHz)	Trek	TRAMP1
Amplifier (16-26 GHz)	Avantek	AVAMP4
LISN Box	University of Michigan	UMLISN1
Signal Generator	Hewlett-Packard 8657B	HPSG1

2 Configuration and Identification of the Equipment Under Test

2.1 Description and Declarations

The equipment under test is a commercial field disturbance speed sensor. The EUT is approximately 5 x 3 x 3 in (approx.) in dimension, and is depicted in Figure 1. It is powered by a 12 VDC integrator battery or power adaptor. The EUT is a radar designed to measure speeds and export that information as RS-232 data for commercial applications, such as roadway speed monitoring signs. Table 2 outlines provider declared EUT specifications.

Figure 1: Photos of EUT.

Table 2: EUT Declarations.

General Declarations			
Equipment Type:	Field Disturbance Sensor	**Country of Origin:**	USA
Nominal Supply:	12 VDC	**Oper. Temp Range:**	−30C to +70C
Frequency Range:	24.150 GHz	**Antenna Dimension:**	6.3 cm
Antenna Type:	aperture	**Antenna Gain:**	14 dBi (approx)
Number of Channels:	1	**Channel Spacing:**	Not Applicable
Alignment Range:	24.150 GHz (nominal)	**Type of Modulation:**	CW
United States			
FCC ID Number:	HTR-SI3	**Classification:**	FDS
Canada			
IC Number:	1270A-SI3	**Classification:**	Field Disturbance Sensor, Radar Device

2.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

2.1.2 Modes of Operation

The EUT is capable of only a single mode of operation, as a CW doppler radar.

2.1.3 Variants

There is only a single electrical variant of the EUT, as tested.

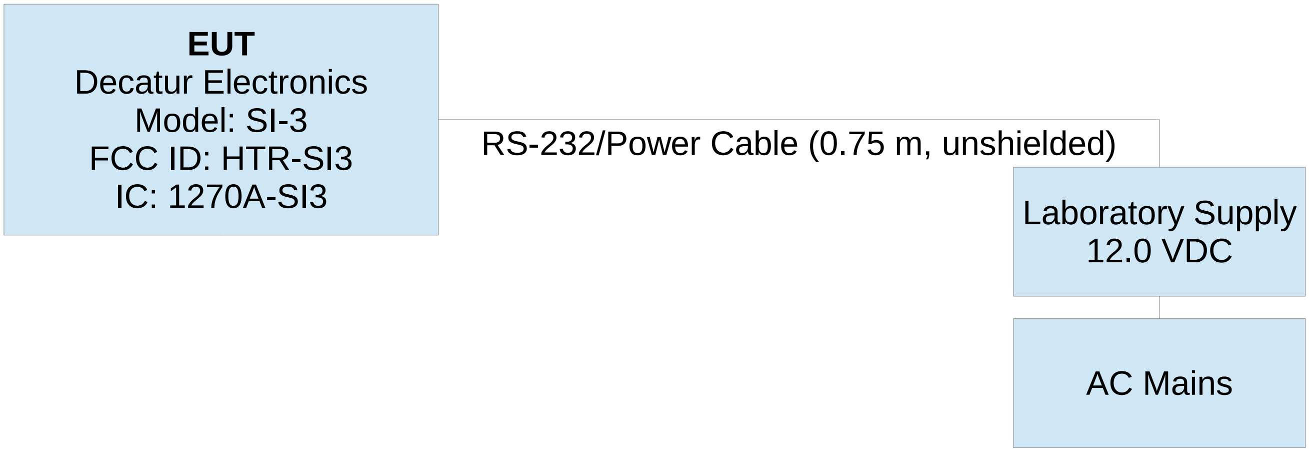

Figure 2: EUT Test Configuration Diagram.

2.1.4 Test Samples

One normal operating sample was provided for testing.

2.1.5 Functional Exerciser

Normal operating EUT functionality was verified by observation of transmitted signal.

2.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

2.1.7 Production Intent

The EUT appears to be a production ready sample.

2.1.8 Declared Exemptions and Additional Product Notes

This is an expensive product sold only through sales distributors for use only in commercial speed sensing applications. As such, it is subject to digital emissions regulation as a Class A commercial product. The manufacturer states that it will not be sold for use by the general public.

3 Emissions

3.1 General Test Procedures

3.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first evaluated in our shielded fully anechoic chamber. Spectrum and modulation characteristics of all emissions are recorded, and emissions above 1 GHz are fully characterized. The anechoic chamber contains a set-up similar to that of our outdoor 3-meter site, with a turntable and antenna mast. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.2 are employed. After indoor pre-scans, emission measurements are made on our outdoor 3-meter Open Area Test Site (OATS). If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.4 / CISPR-22 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All

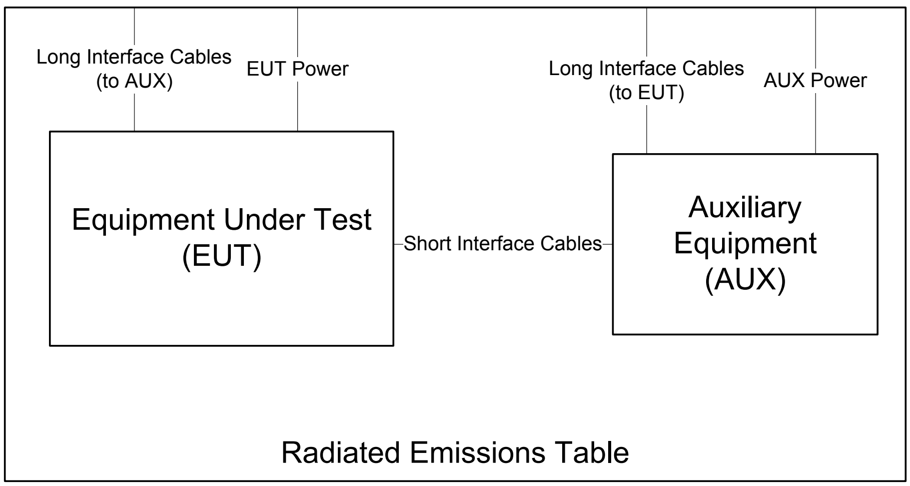

Figure 3: Radiated Emissions Diagram of the EUT.

intentionally radiating elements are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Photographs of the test setup employed are depicted in Figure 4.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used as the test antenna. It is placed at a 1 meter receive height and appropriate low frequency magnetic field extrapolation to the regulatory limit distance is employed. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas or calibrated broadband ridge-horn antennas. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is compute, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

When microwave measurements are made at a range different than the regulatory distance, the reading is corrected back to that distance. This is done using a 20 dB/decade far-field behavior relation and a 40 dB/decade near-field relation, as outlined in the FCCs mm-wave measurement procedures. The near-field/far-field boundary (N/F) is computed based on

$$N/F = 2D^2/\lambda$$

where D is the maximum dimension of the transmitter or receiver antenna , and λ is the wavelength at the measurement frequency. For example, suppose $N/F = 2$ m, but the measurement is made at 1 m. Here, the 40 dB/decade relation would be applied from 1 to 2 m, and the 20 dB/decade relation would be applied from 2 to 3 m. In dB, this gives a 15.6 dB adjustment. Typically, for microwave measurements either the receive antenna is connected directly to the spectrum analyzer, or it is connected to an external mixer followed by an insignificant length of cable. In this case, no cable loss term is used and mixer conversion losses are programmed in the spectrum analyzer to be included in the recorded dB values.

Figure 4: Radiated Emissions Test Setup Photograph(s).

3.1.2 Conducted Emissions Test Setup and Procedures

AC Port Conducted Spurious For this device, AC power line conducted emissions are measured in our screen room. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.4 / CISPR 22 are employed. Alternatively, an on-table layout more representative of actual use may be employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 5. Conducted

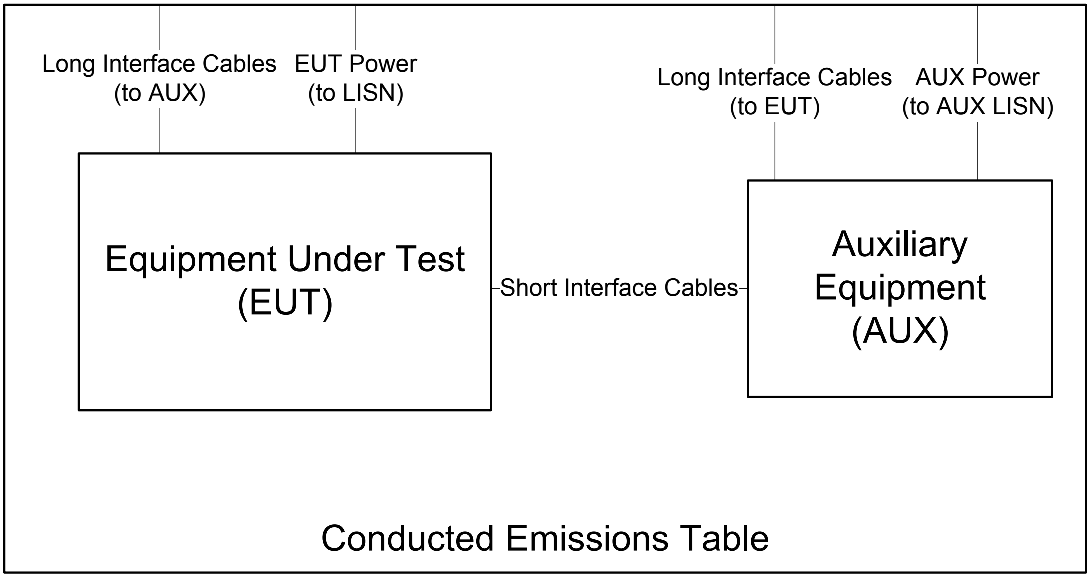

Figure 5: Conducted Emissions Setup Diagram of the EUT.

emissions are measured and recorded for each AC mains power source over the spectrum 0.15 MHz to 30 MHz for both the ungrounded (HI/PHASE) and grounded (LO/GRND) conductors with the EUT placed in its highest current draw operating mode(s). The test receiver is set to peak-hold mode in order to record the peak emissions throughout the course of functional operation. Only if an emission exceeds or is near the limit are quasi-peak and average detection applied. Photographs of the test setup employed are depicted in Figure 6.

3.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case of this EUT, measurements of the worst-case radiated emissions are performed with the supply voltage varied by no less than 85% and 115% of the nominal rated value for devices connecting to AC power mains.

Figure 6: Conducted Emissions Test Setup Photograph(s).

3.2 Intentional Emissions

3.2.1 Fundamental Emission Pulsed Operation

The details and results of testing the EUT for pulsed operation are summarized in Table 3.

Table 3: Pulsed Emission Characteristics (Duty Cycle).

The DUT is designed to operate as a CW source. Thus, Peak-to (Power) Average Ratio is 0.0 dB.

	Duty Cycle Computation						Decatur Radar; FCC/IC
1	KE = 0.0 dB						
2							

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3.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the worst case test mode. Radiated emissions are recorded following the test procedures listed in Section 1.1. The 20 dB EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. For complex modulations other than ASK and FSK, the 99% emission bandwidth per IC test procedures has a different result, and is also separately reported.The results of EBW testing are summarized in Table 4. Plots showing measurements employed to obtain the emission bandwidth reported are provided in Figure 7.

Table 4: Intentional Emission Bandwidth.

The emission bandwidth of the signal is shown in the following Figure.

Measured Emission Bandwidth							Decatur; FCC/IC
#	EBW meas. (kHz)						
1	400.0						

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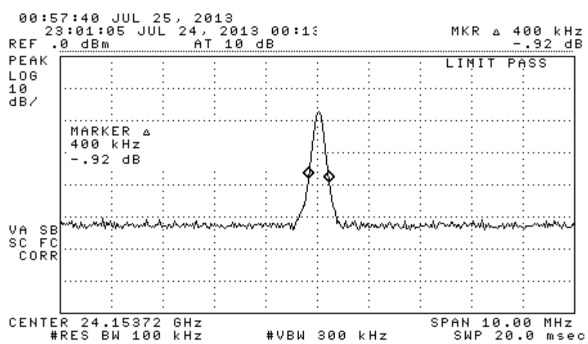

Figure 7: Intentional Emission Bandwidth.

3.2.3 Fundamental Emission

Following the test procedures listed in Section 1.1, radiated emissions measurements are made on the EUT for both Horizontal and Vertical polarized fields. Table 5 details the results of these measurements.

Table 5: Fundamental Radiated Emissions.

Frequency Range	**Detector**	**IF Bandwidth**	**Video Bandwidth**
30 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz/100Hz

Fundamental Microwave Radiated Emissions													Decatur SI-3 24 GHz Sensor; FCC/IC
#	Freq. GHz	Ant. Used	Ant. D,cm	Meas. dist,m	Pr dBm	N/F m	Pr(3m) dBm	Ka dB/m	Kg dB	E3 dBμV/m	E3lim* dBμV/m	Pass dB	Comments (Notes)
1	24.15	K-horn	10.2	3.00	-19.8	N/A	-19.8	33.2	.0	120.4	128.0	7.6	Pk (CW) meas. (5)
2													
3	DUT Ant. Dim.		6.3										
4	Ave. Factor, dB		.0										
5													
6	NOTES:												
7	(1) When measured at 0.3 m from the DUT, no signal was detected anywhere, even at the radome												
8	(2) Mixer conversion loss is programmed in the spectrum analyzer and automatically adjusts the readings												
9	(3) When extrapolating to 3 m, use Near (40 dB/dec) and Far Fld (20 dB/dec) behavior												
10	(4) For Ave. measurement a 1 Hz VBW was used, sometimes higher; RBW was always 1 MHz												
11	(5) DUT max. antenna size, D= 6.3 cm > Test Antenna Horn Dim for freq > 40 GHz.												
12	(6) At 24.150 GHz, Peak to Average ratio was measured to be 0.0 dB												
13													

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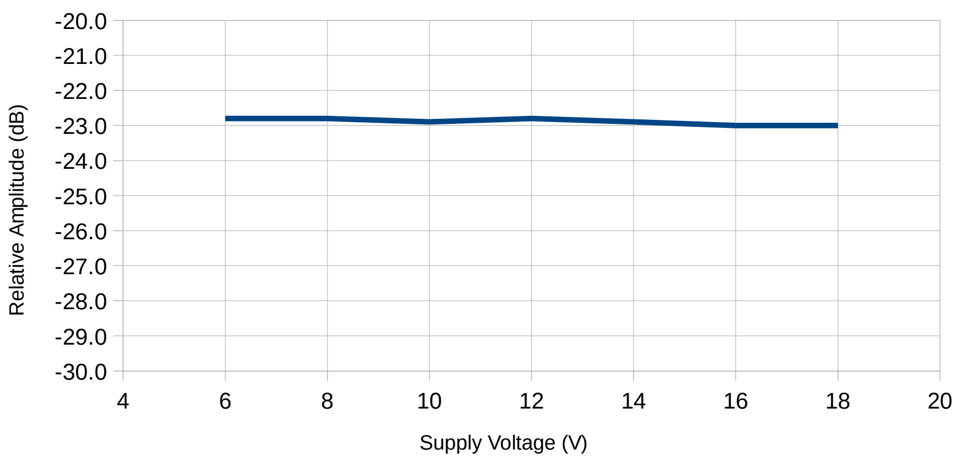
Example Calculation: E3 = 107 + -19.8 (Pr3m, dBm) + 33.2 (Ka, dB/m) – 0.0 (Avg Factor, dB) = 120.4 dBuV/m @ 3m



3.3 Unintentional Emissions

3.3.1 Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 6.

Table 6: Transmit Chain Spurious Emissions.

Frequency Range	**Detector**	**IF Bandwidth**	**Video Bandwidth**
30 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz/100Hz

Spurious RF Chain Radiated Emissions													Decatur SI-3 24 GHz Sensor; FCC/IC
#	Freq. GHz	Ant. Used	Ant. D,cm	Meas. dist, m	Pr dBm	N/F m	Pr(3m) dBm	Ka dB/m	Kg dB	E3 dBµV/m	E3lim* dBµV/m	Pass dB	Comments (Notes)
1	.03 - 1	Bic	N/A	3.00	-74.6	N/A	-65.6	10.1	18.0	25.3	40.0	14.7	max all, noise (Pk)
2	1 to 2	R-Horn	N/A	3.00	-65.2	N/A	-65.2	21.5	28.1	35.2	54.0	18.8	max all, noise (Pk)
3	2 to 4.5	R-Horn	N/A	3.00	-70.7	N/A	-70.7	26.0	25.0	37.3	54.0	16.7	max all, noise (Pk)
9	4.5 to 8	C-horn	21.6	3.00	-60.1	N/A	-60.1	24.7	37.5	34.1	54.0	19.9	max all, noise (Pk)
10	6 to 8.6	XN-horn	28.9	3.00	-56.2	N/A	-56.2	25.3	37.0	39.1	54.0	14.9	max all, noise (Pk)
11	8.6to13	X-horn	19.4	3.00	-57.6	N/A	-57.6	28.5	37.0	40.9	54.0	13.1	max all, noise (Pk)
12	13to18	Ku-horn	15.2	1.00	-56.9	2.00	-72.5	29.3	17.0	46.9	54.0	7.1	max all, noise (Pk)
13	18to26	K-horn	10.2	.30	-61.4	1.25	-93.8	33.2	.0	46.4	54.0	7.6	max all, noise (Avg)
14	26to40	Ka-horn	9.2	.30	-78.0	1.47	-111.8	36.0	.0	31.2	54.0	22.8	max all, noise (Pk)
15	40-76	U-horn	6.3	.30	-67.8	1.06	-98.8	41.0	.0	-106.5	54.0	74.7	max all, noise (Avg)
16	48.31	U-horn	6.3	.30	-44.1	1.28	-76.7	39.1	.0	69.4	77.5	**8.1**	ave. meas. (2-5)
17	77-125	W-horn	6.3	.30	-53.5	2.04	-90.1	46.4	.0	-92.5	54.0	35.4	noise, ave. meas. (1-5)
18	72.46	W-horn	6.3	.30	-55.8	1.92	-91.9	41.0	.0	56.1	77.5	21.4	Noise, ave. meas. (2-5)
19	96.61	W-horn	6.3	.10	-55.8	2.56	-113.5	46.4	.0	39.9	54.0	14.1	noise, ave. meas. (1-5)
20													
21													
22	DUT Ant. Dim.		6.3										
23	Ave. Factor, dB		.0										
24													
25	NOTES:												
26	(1) When measured at 0.3 m from the DUT, no signal was detected anywhere, even at the radome												
27	(2) Mixer conversion loss is programmed in the spectrum analyzer and automatically adjusts the readings												
28	(3) When extrapolating to 3 m, use Near (40 dB/dec) and Far Fld (20 dB/dec) behavior												
29	(4) For Ave. measurement a 1 Hz VBW was used, sometimes higher; RBW was always 1 MHz												
30	(5) DUT max. antenna size, D= 6.3 cm > Test Antenna Horn Dim for freq > 40 GHz.												
31	(6) At 24.150 GHz, Peak to Average ratio was measured to be 0.0 dB												
32													
													Meas. 07/25/13; U of Mich.

Example Calculation (line 12): Pr(3m) = -56.9Pr(dBm) - 40 x log(2m/1m) - 20 x log(3m/2m) = -72.5 dBm @ 3m
E3 = 107 + -72.5 (Pr3m, dBm) + 29.3 (Ka, dB/m) – 17.0 (Kg, dB) - 0.0 (Avg Factor, dB) = 46.9 dBuV/m @ 3m

3.3.2 Radiated Digital Spurious

The results for the measurement of digital spurious emissions (emissions arising from digital circuitry) at the nominal voltage and temperature are provided in Table 7. Radiation from digital components has been measured to 4 GHz, or to five times the maximum digital component operating frequency, whichever is greater.

Table 7: Radiated Digital Spurious Emissions.

Frequency Range	**Detector**	**IF Bandwidth**	**Video Bandwidth**
30 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz/100Hz

Digital Radiated Emissions

#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Pr(3m) dBm	Ka dB/m	Kg dB	E3 dBμV/m	E3lim* dBμV/m	Pass dB	Comments
1	43.0	Bic	H	-64.1	Pk	-64.1	10.2	26.2	26.9	40.0	13.1	
2	43.0	Bic	V	-63.5	Pk	-63.5	10.2	26.2	27.5	40.0	12.5	
3	55.3	Bic	V	-65.7	Pk	-65.7	8.5	26.0	23.8	40.0	16.2	
4	55.7	Bic	V	-68.0	Pk	-68.0	8.4	26.0	21.4	40.0	18.6	
5	61.6	Bic	V	-68.2	Pk	-68.2	8.0	25.9	20.8	40.0	19.2	
6	70.5	Bic	H	-66.5	Pk	-66.5	7.6	25.8	22.3	40.0	17.7	
7	80.6	Bic	H	-51.1	Pk	-51.1	7.6	25.6	37.8	40.0	**2.2**	
8	80.6	Bic	V	-55.7	Pk	-55.7	7.6	25.6	33.2	40.0	6.8	
9	85.2	Bic	H	-55.6	Pk	-55.6	7.7	25.6	33.5	40.0	6.5	
10	85.2	Bic	V	-57.7	Pk	-57.7	7.7	25.6	31.4	40.0	8.6	
11	87.7	Bic	V	-58.9	Pk	-58.9	7.8	25.5	30.4	40.0	9.6	
12	105.8	Bic	V	-67.8	Pk	-67.8	8.8	25.2	22.8	43.5	20.7	
13	109.4	Bic	V	-68.2	Pk	-68.2	9.1	25.2	22.7	43.5	20.8	
14	123.0	Bic	H	-77.9	Pk	-77.9	10.2	25.0	14.4	43.5	29.1	
15	171.8	Bic	V	-75.4	Pk	-75.4	13.8	24.2	21.2	43.5	22.3	
16	221.3	Bic	H	-78.1	Pk	-78.1	14.8	23.6	20.1	46.0	25.9	
17	245.7	Bic	V	-77.2	Pk	-77.2	14.6	23.4	21.1	46.0	24.9	
18	249.0	Bic	H	-76.4	Pk	-76.4	14.6	23.4	21.9	46.0	24.1	
19	255.0	SBic	H	-74.9	Pk	-74.9	14.7	23.3	23.5	46.0	22.5	
20												
21	* Demonstrated compliance with 15.209 Class B limit. However, Class A Digital Device.											

Meas. 07/25/13; U of Mich.

3.3.3 Conducted Emissions Test Results - AC Power Port(s)

The results of emissions from the EUT's AC mains power port(s) are reported in Table 8.

Table 8: AC Mains Power Conducted Emissions Results.

Frequency Range	**Detector**	**IF Bandwidth**	**Video Bandwidth**
150 kHz < f < 30 MHz	Pk/Qpk/Avg	9 kHz	30 kHz

AC Mains Power Conducted Emissions — Decatur, SI-3 24 GHz Head; FCC/CISPR B

	Freq.	Line	Peak Det., dBμV		Pass	QP Det., dBμV		Pass	Ave. Det., dBμV		Pass	
#	MHz	Side	Vtest	Vlim*	dB*	Vtest	Vlim	dB	Vtest	Vlim	dB	Comments
1	.17	Lo	49.8	54.8	5.0		64.8			54.8		
2	.20	Lo	49.0	53.7	4.7		63.8			53.7		
3	.22	Lo	51.2	53.0	**1.7**		63.0			53.0		
4	.24	Lo	48.7	51.9	3.3		62.0			51.9		
5	.27	Lo	46.8	51.1	4.3		61.1			51.1		
6	.30	Lo	27.3	50.3	23.0		60.3			50.3		
7	.34	Lo	46.2	49.1	2.9		59.1			49.1		
8	.37	Lo	46.2	48.4	2.2		58.5			48.4		
9	.40	Lo	44.5	47.7	3.2		57.8			47.7		
10	.42	Lo	45.7	47.4	1.8		57.5			47.4		
11	20.34	Lo	33.0	50.0	17.0		60.0			50.0		
12	20.76	Lo	32.4	50.0	17.6		60.0			50.0		
13	21.25	Lo	31.7	50.0	18.3		60.0			50.0		
14	21.74	Lo	31.6	50.0	18.4		60.0			50.0		
15	22.16	Lo	32.1	50.0	17.9		60.0			50.0		
16	22.58	Lo	32.1	50.0	17.9		60.0			50.0		
17	23.27	Lo	32.9	50.0	17.1		60.0			50.0		
18	23.56	Lo	33.2	50.0	16.9		60.0			50.0		
19	24.05	Lo	31.6	50.0	18.4		60.0			50.0		
20	25.45	Lo	31.5	50.0	18.5		60.0			50.0		
21												
22	.17	Hi	51.0	54.8	3.7		64.8			54.8		
23	.21	Hi	44.0	53.2	9.1		63.2			53.2		
24	.23	Hi	48.0	52.3	4.3		62.4			52.3		
25	.25	Hi	49.0	51.6	**2.7**		61.7			51.6		
26	.29	Hi	47.0	50.4	3.4		60.5			50.4		
27	.36	Hi	45.2	48.6	3.4		58.7			48.6		
28	.39	Hi	43.6	48.0	4.4		58.1			48.0		
29	.44	Hi	43.4	47.1	3.7		57.1			47.1		
30	.47	Hi	42.6	46.6	4.0		56.6			46.6		
31	.54	Hi	41.1	46.0	5.0		56.0			46.0		
32	19.78	Hi	31.1	50.0	18.9		60.0			50.0		
33	20.34	Hi	32.6	50.0	17.4		60.0			50.0		
34	20.76	Hi	33.2	50.0	16.8		60.0			50.0		
35	21.18	Hi	32.0	50.0	18.0		60.0			50.0		
36	21.74	Hi	31.6	50.0	18.4		60.0			50.0		
37	22.09	Hi	30.9	50.0	19.1		60.0			50.0		
38	22.65	Hi	32.1	50.0	17.9		60.0			50.0		
39	23.07	Hi	34.5	50.0	15.6		60.0			50.0		
40	23.56	Hi	32.0	50.0	18.0		60.0			50.0		
41	24.12	Hi	31.0	50.0	19.0		60.0			50.0		
42												
40												

**Average limit* — Meas. 07/30/2013; U of Mich.

Since Vpeak >= Vqp >= Vave and if Vtestpeak < Vavelim, then Vqplim and Vavelim are met.