Test Report

Curtis-Straus LLC, *a wholly owned subsidiary of BV CPS*

Report No	EM0848-1
Client	Trex Aviation Corporation
Address	10455 Pacific Center Court San Diego, CA 92121-4339
Phone	1-413-247-9440 ext. 10
Items tested	FOD
FCC ID	QEUFODDRA1
FRN	0021795323
Equipment Type	Radiolocation Service
Equipment Code	TNB
Emission Designator	2G82F3N
FCC Rule Parts	WT Docket No. 11-202
Test Dates	May 10-18, 2012
Results	As detailed within this report
Prepared by	Matthew Burman – Test Engineer
Authorized by	Mairaj Hussain – EMC Supervisor
Issue Date	July 3, 2012
Conditions of Issue	This Test Report is issued subject to the conditions stated in the '*Conditions of Testing*' section on page 28 of this report.

Contents

Form Final Report REV 7-20-07 (DW)

Summary

This test report supports an application for certification of a transmitter operating pursuant to FCC WT Docket No. 11-202. The product is the FOD. It is a transmitter that operates in the range 78-81GHz.

This technical report is to support the amendment of the commission's rules to permit radiolocation operation in the 78-81GHz band. It is a request for the waiver of section 90.103(b) of the commission's rules.

We found that the product met the above requirements with modification (see *Modifications Required for Compliance* section on page 5). Richard Chedester from Trex Aviation was present during the testing. The test sample was received in good condition.

The EUT is intended to be installed in an automobile.

Test Methodology

Radiated emission testing was performed according to the procedures specified in FCC *millimeter wave test procedures*. Radiated Emissions were maximized by rotating the device around base as well as varying the test antenna's height and polarity. The device antenna cannot be maximized separately.

Conducted emission at the antenna port was performed, as required by rule section.

The EUT operating voltage is 12Vdc. EUT operates on one frequency centered at 79.5GHz

The local oscillator frequency Stability is set by a crystal at +/- 5ppm. Approximately one 1mhz drift over the temperature range. The crystal oscillator is a Conner Winfield TFLD646.

The following bandwidths were used during radiated spurious emissions.

Frequency	RBW	VBW
30-1000MHz	120kHz	1MHz
1-200GHz	1MHz	3MHz

Release Control Record

Issue No.	Reason for change	Date Issued
1	Original Release	June 12, 2012

Product Tested - Configuration Documentation

EUT Configuration

Work Order: M0848
Company: Trex Aviation Corporation
Company Address: 10455 Pacific Center Court
San Diego, CA 92121-4339
Contact: Richard Chedester
Person Present: Richard Chedester

	MN	SN
EUT:	FOD	Sample 1

EUT Description: Foreign Object Debris Radar
EUT Tx Frequency: 78-81GHz

Support Equipment:	MN	SN
HP signal generator	3325B	sample 1
power supply	RSS-100-12	sample 1

EUT Ports:

Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out NEBS Type	Unpopulated Reason
Power	DC power	1	1	custom	No	None	25'	N/A	N/A	
Signal	SMA	1	1	coax	yes	none	25'	N/A	N/A	

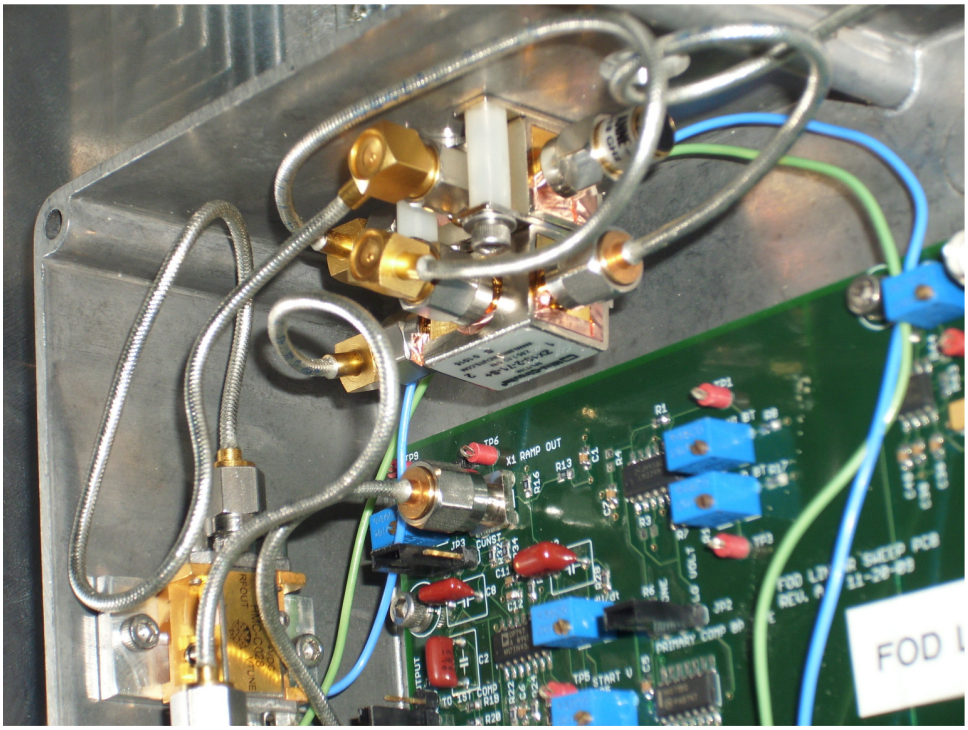
Software / Operating Mode Description:

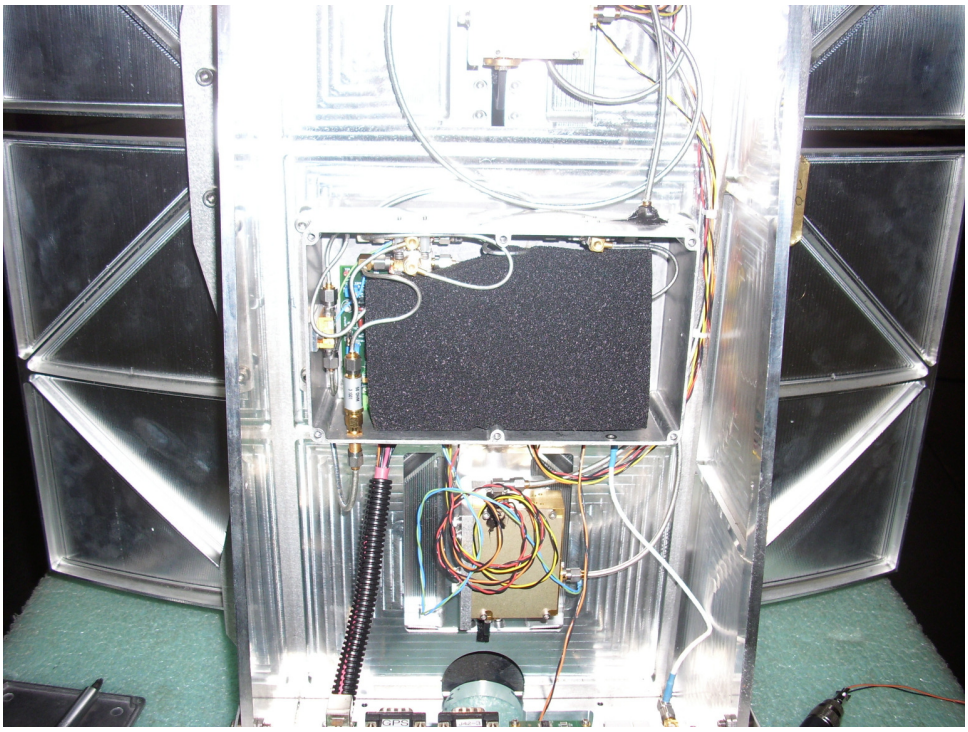
The EUT is transmitting a radar signal in the frequency range of 78-81GHz.

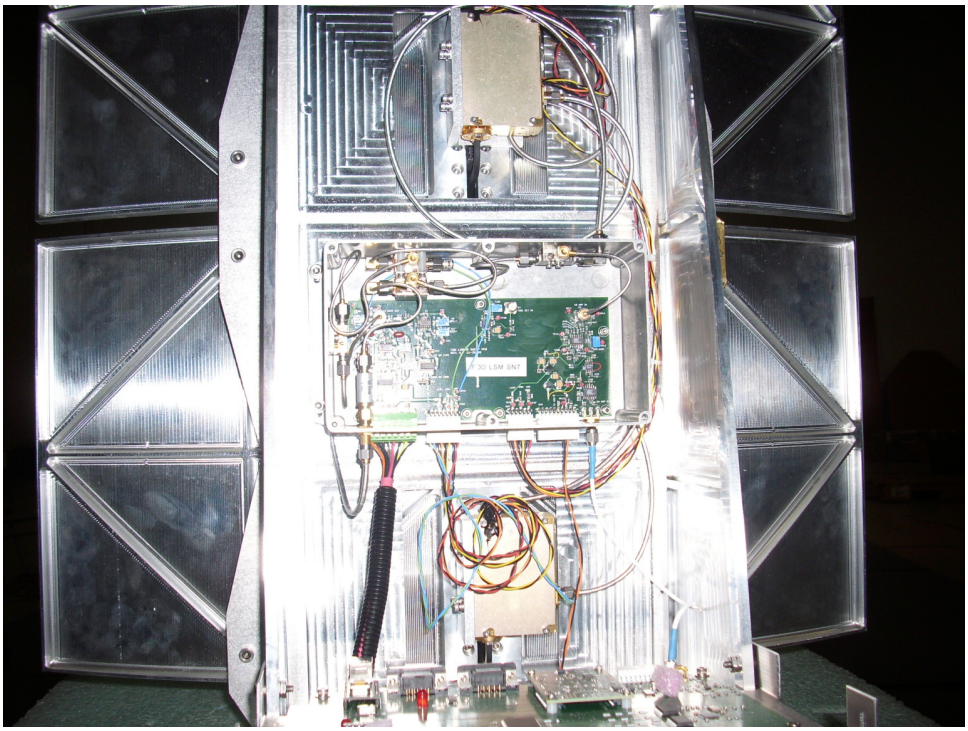
Modifications Required for Compliance

In order to meet the spurious emissions requirement for FCC 15.209, the following modifications were implemented:

The seams around MiniCircuits power splitter/combiner were sealed with copper tape. Also eccosorb material was placed inside the chassis (Emerson and Cummings PN: LS-18 1/2).







Test Results

Frequency Stability

LIMIT

The transmit frequency shall stay within the operating range of 78-81GHz.

MEASUREMENTS / RESULTS

Work Order: M0848
Test Engineer: Matthew Burman
Company: Trex Aviation Corporation
Site: Environmental Chamber #17
Date: 5/10/2012

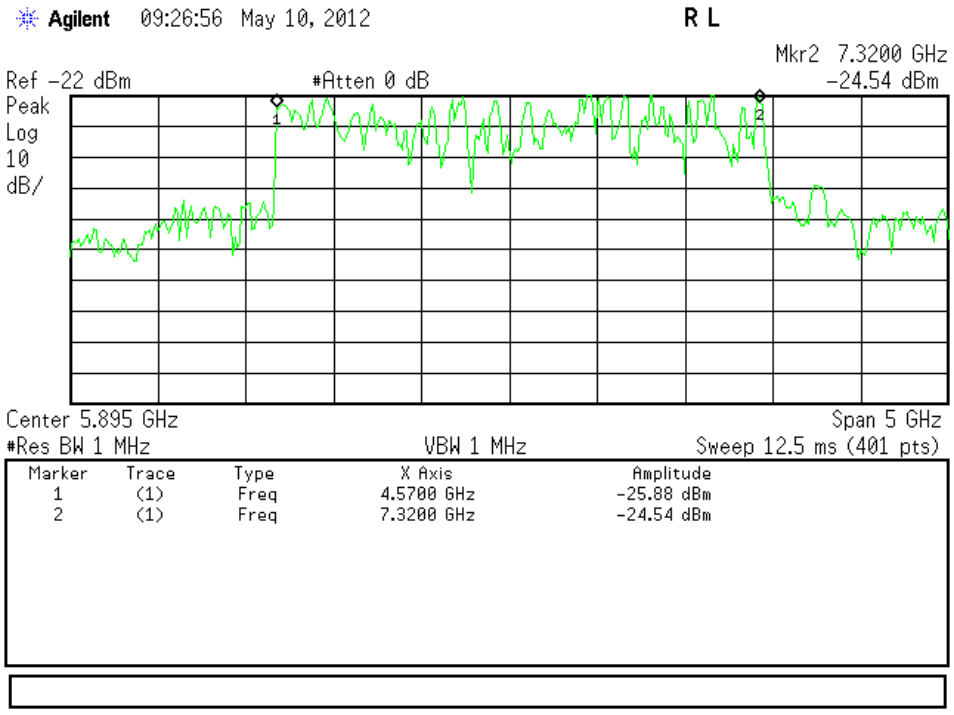
Temperature and Voltage Stability

Temperature (°C)	Input Voltage (Vdc)	Measured Frequency (GHz)	Bandedge Limit (GHz)	Result
-20	10.2	78.0950	78.0000	Pass
		80.8450	81.0000	Pass
	12	78.0700	78.0000	Pass
		80.8200	81.0000	Pass
	13.8	78.0825	78.0000	Pass
		80.8325	81.0000	Pass
+20	10.2	78.0575	78.0000	Pass
		80.8200	81.0000	Pass
	12	78.0700	78.0000	Pass
		80.8325	81.0000	Pass
	13.8	78.0825	78.0000	Pass
		80.7950	81.0000	Pass
+50	10.2	78.0700	78.0000	Pass
		80.7700	81.0000	Pass
	12	78.0700	78.0000	Pass
		80.7575	81.0000	Pass
	13.8	78.0450	78.0000	Pass
		80.7825	81.0000	Pass

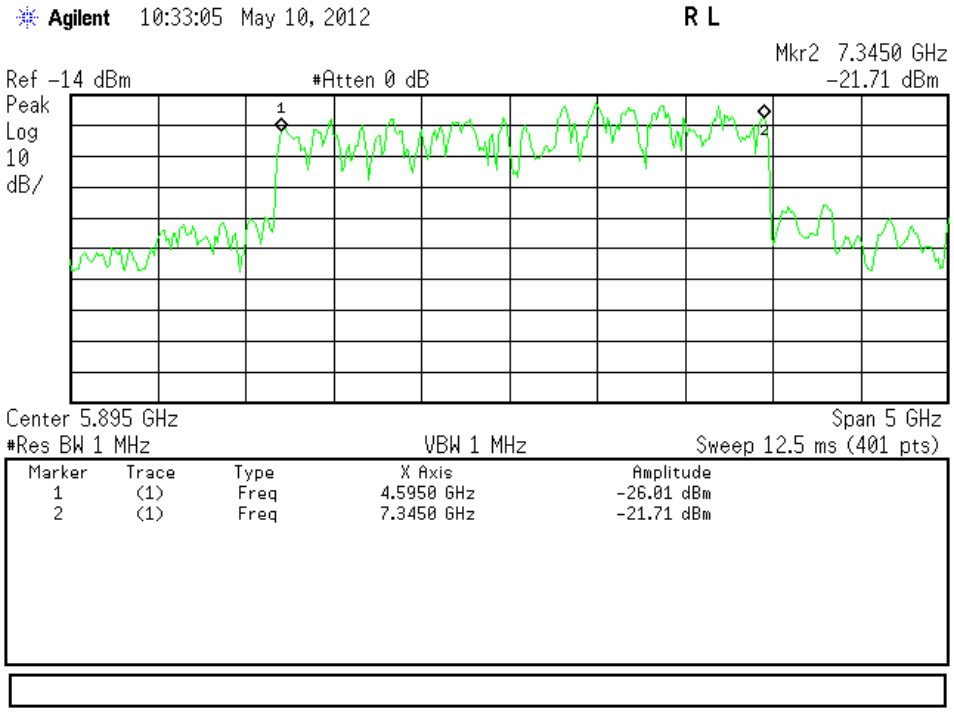
*Down converter was used during testing.

Note: Testing was not performed at -30°C as this is outside of the products operating specification. Please see the attached letter from TREX Aviation Systems.

Plots

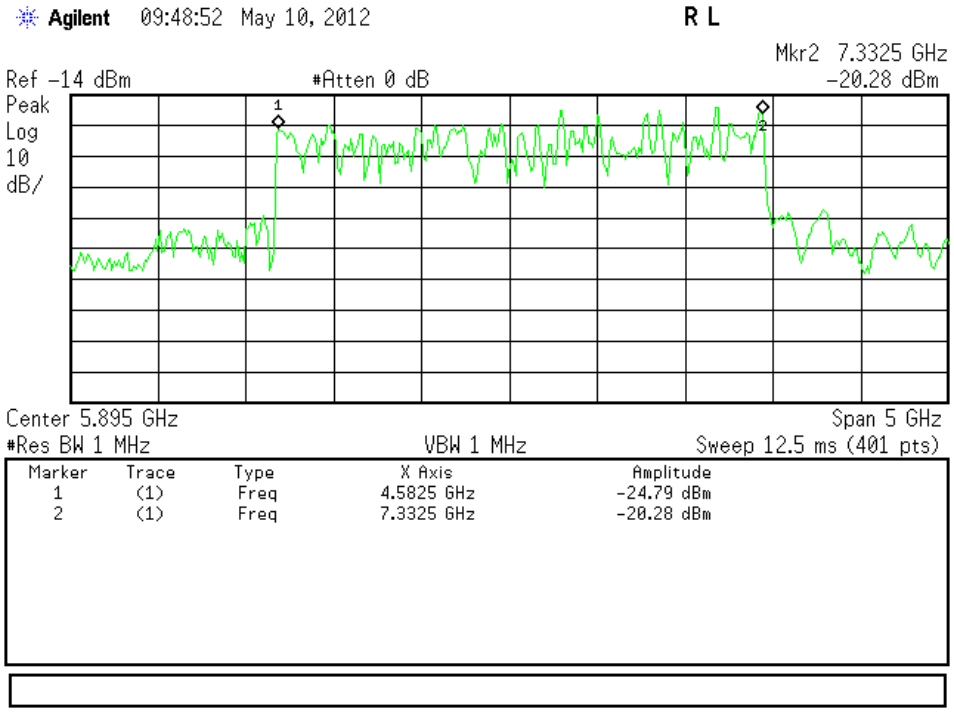


Frequency Low = 78.07GHz
Freqency High = 80.82GHz
Bandedge : -20℃ : 12Vdc



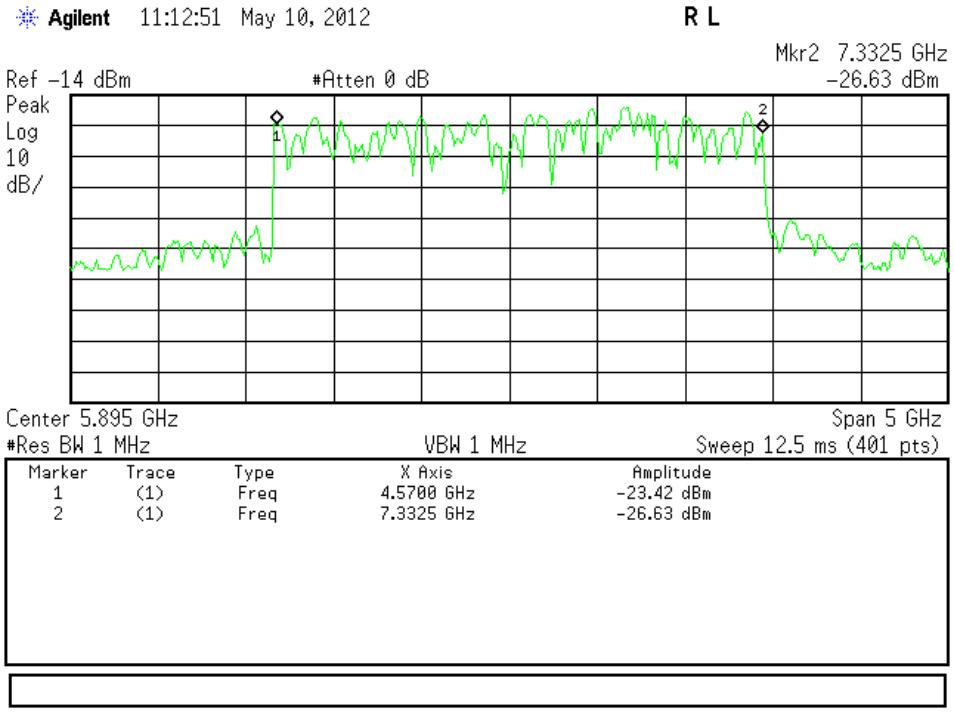
Frequency Low = 78.095GHz
Freqency High = 80.845GHz

Bandedge : -20℃ : 10.2Vdc



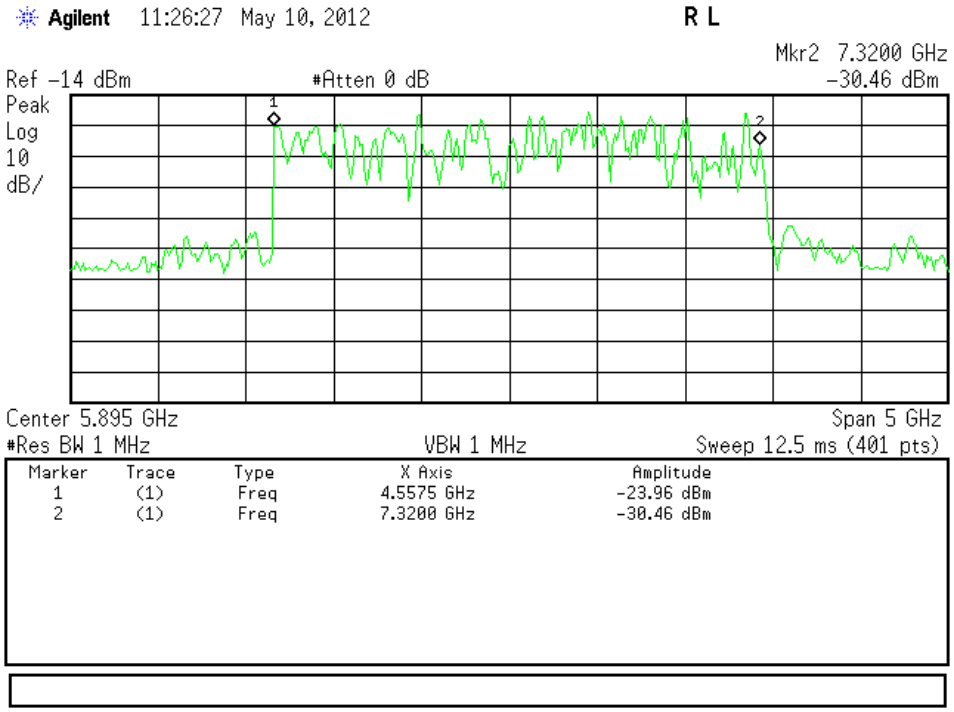
Frequency Low = 78.0825GHz
Freqency High = 80.8325GHz

Bandedge : -20℃ : 13.8Vdc

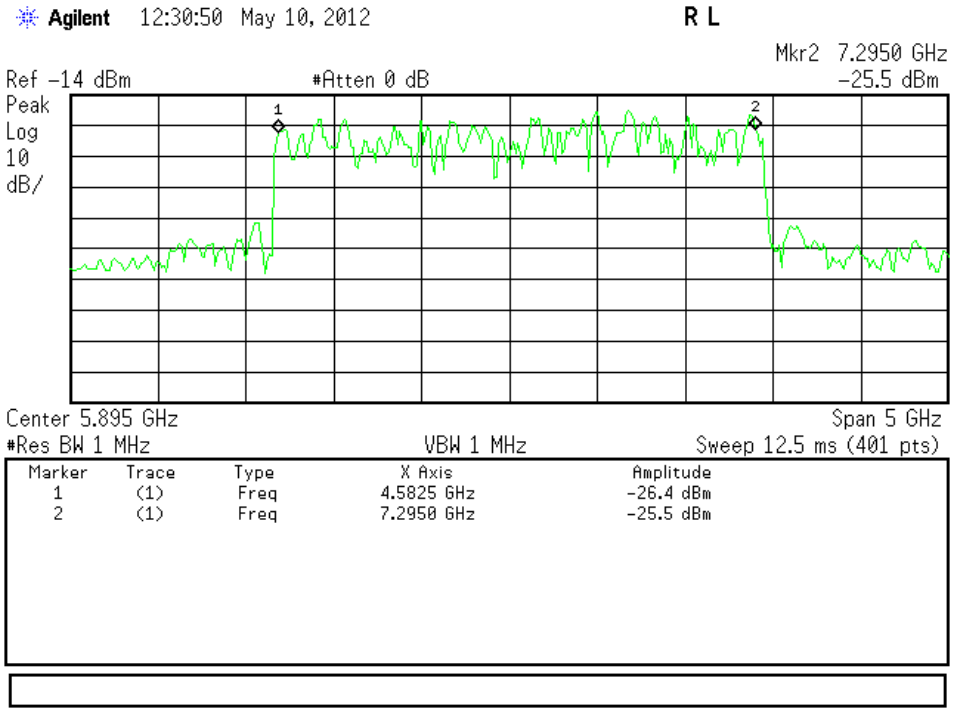


Frequency Low = 78.07GHz
Freqency High = 80.8325GHz

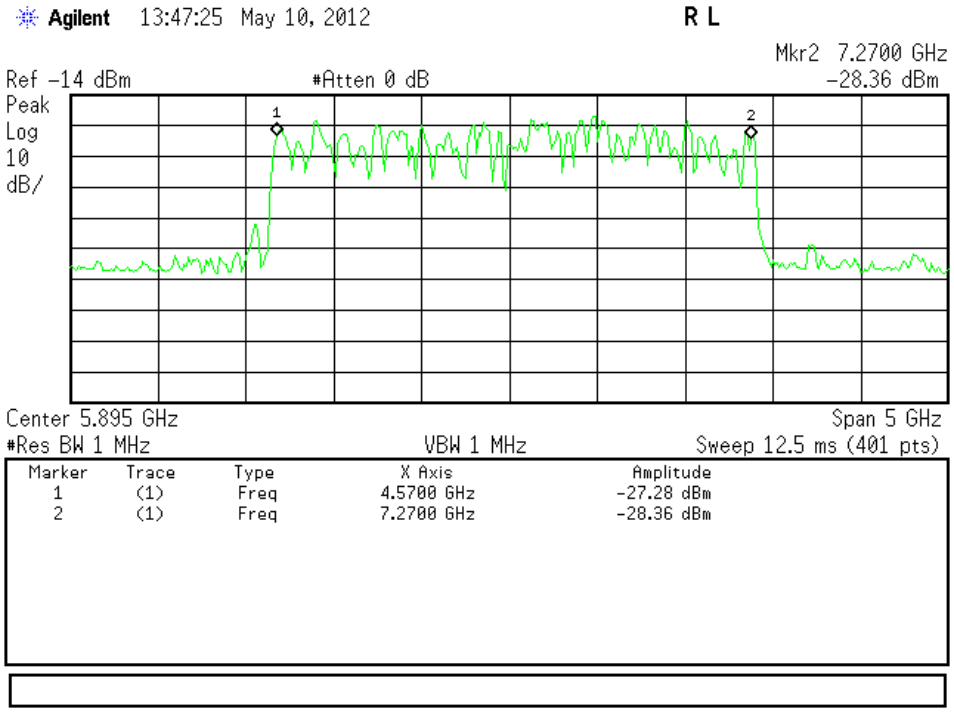
Bandedge : 20℃ : 12Vdc



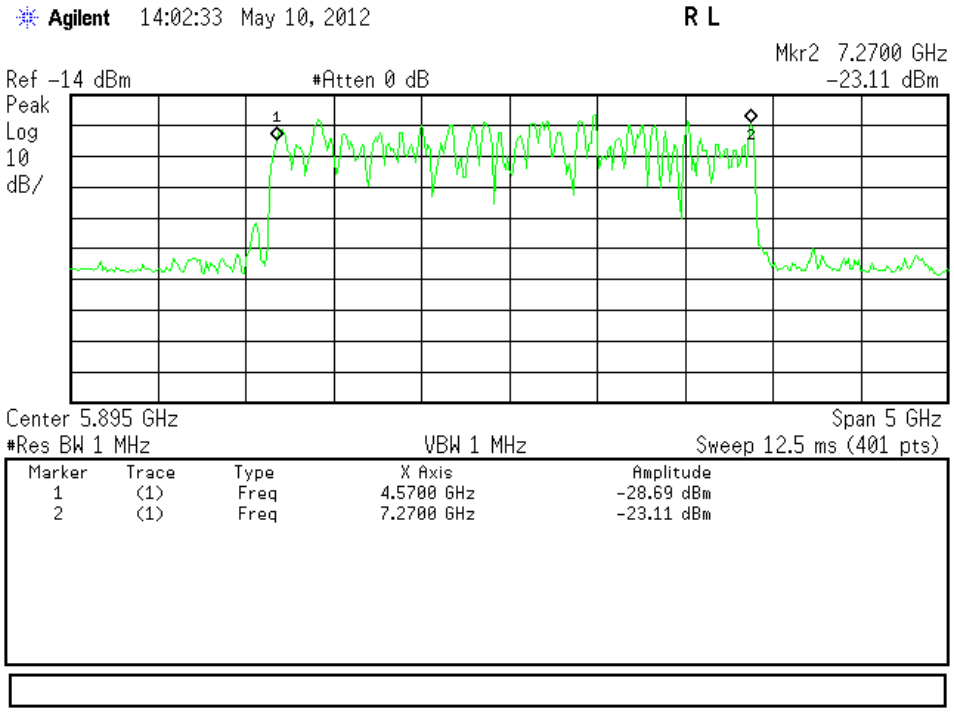
Frequency Low = 78.0575GHz
Freqency High = 80.82GHz
Bandedge : 20℃ : 10.2Vdc



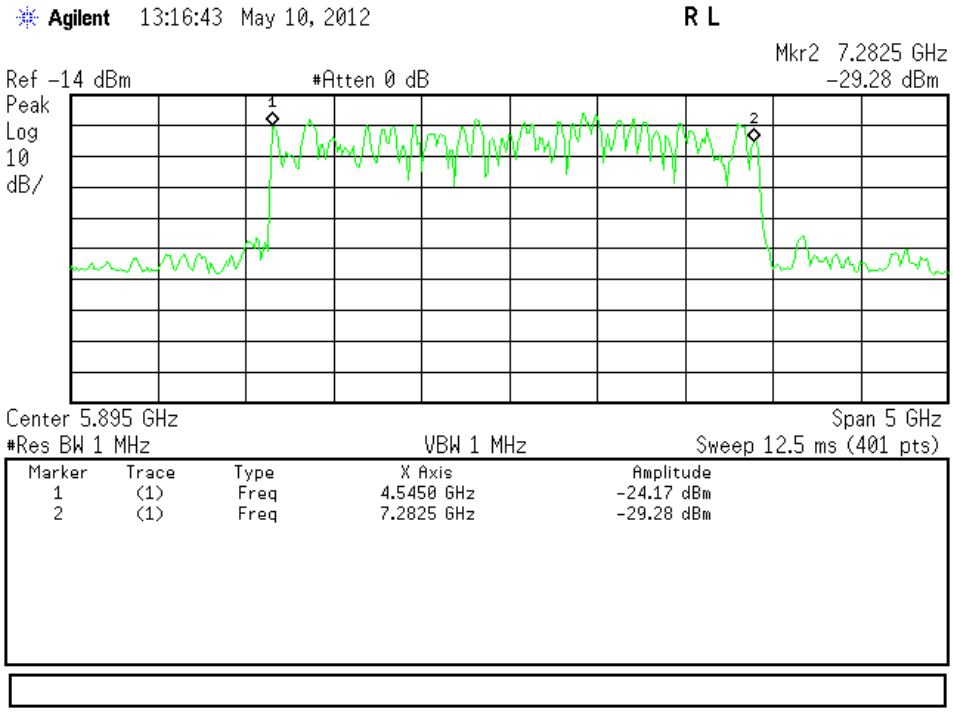
Frequency Low = 78.0825GHz
Freqency High = 80.795GHz
Bandedge : 20℃ : 13.8Vdc



Frequency Low = 78.07GHz
Freqency High = 80.7575GHz
Bandedge : 50℃ : 12Vdc



Frequency Low = 78.07GHz
Freqency High = 80.77GHz
Bandedge : 50℃ : 10.2Vdc



Frequency Low = 78.045GHz
Freqency High = 80.7825GHz
Bandedge : 50℃ : 13.8Vdc

EIRP

LIMIT

Conducted Output Power: 100mW
System EIRP: 35dBW

Work Order: M0848
Test Engineer: Matthew Burman
Company: Trex Aviation Corporation

Site: InSitu
Date: 5/10/2012
Temp: 22.9℃
Humidity: 26%
Pressure: 998mbar

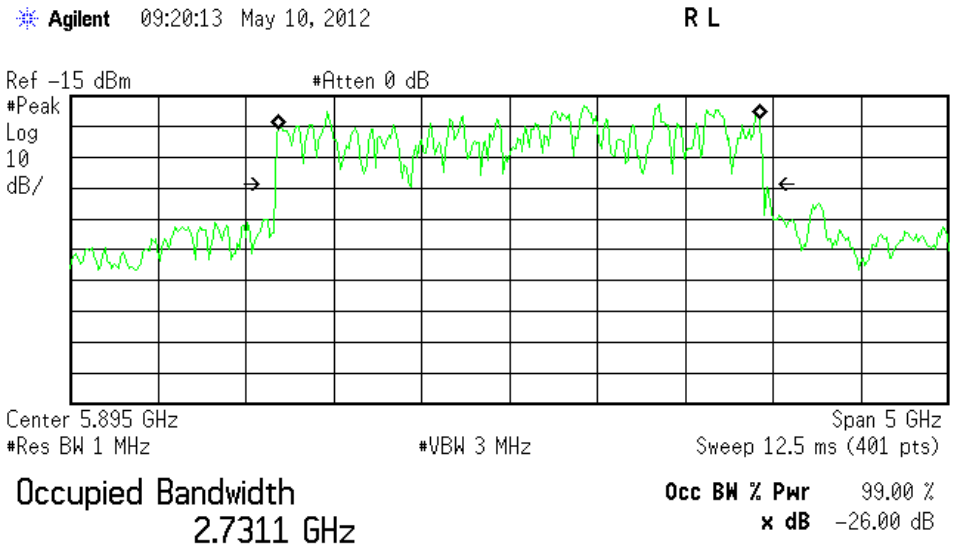
EIRP

Power (dBm)	Power Sensor Correction Factor (dB)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (dBW)	Limit (dBW)	Results
17.7	0.95	45.6	64.2500	34.2500	35	Pass

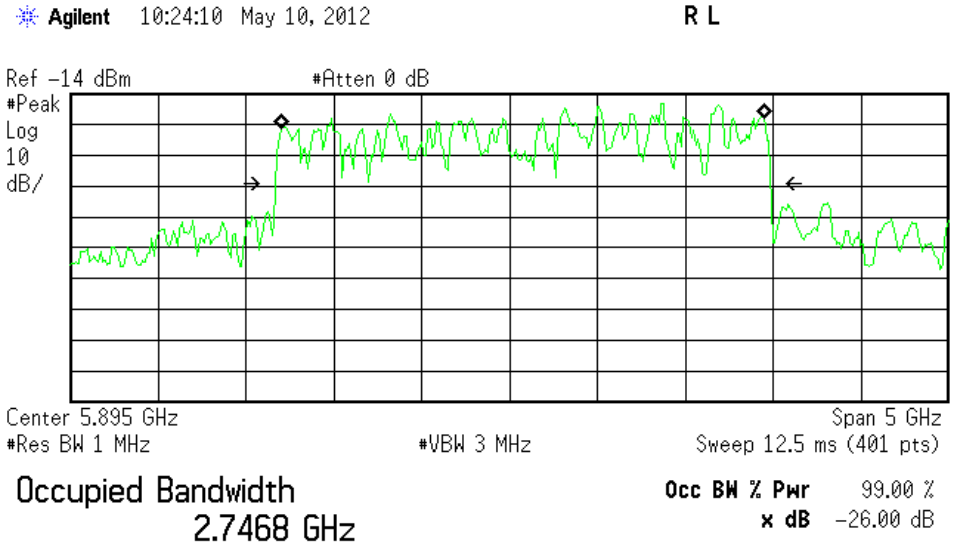
Conducted Output Power

Transmit Power (dBm)	Power Sensor Correction Factor (dB)	Adjusted Reading (dBm)	Adjusted Reading (W)	Limit (W)	Results
17.7	0.95	18.65	0.0733	0.1000	Pass

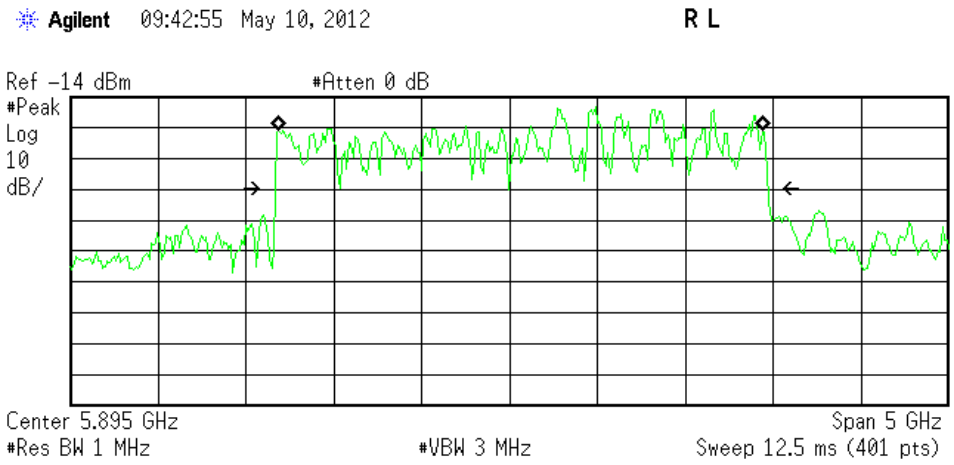
Occupied Bandwidth



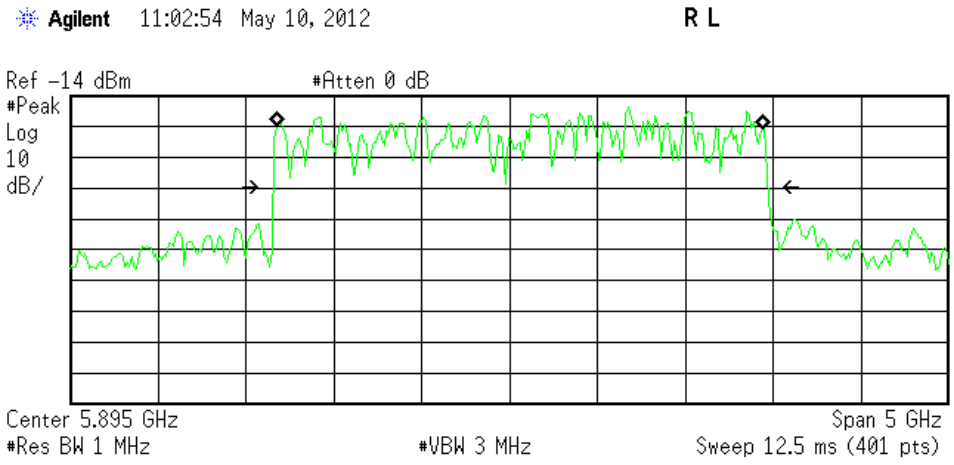
Occupied Bandwidth : -20°C : 12Vdc



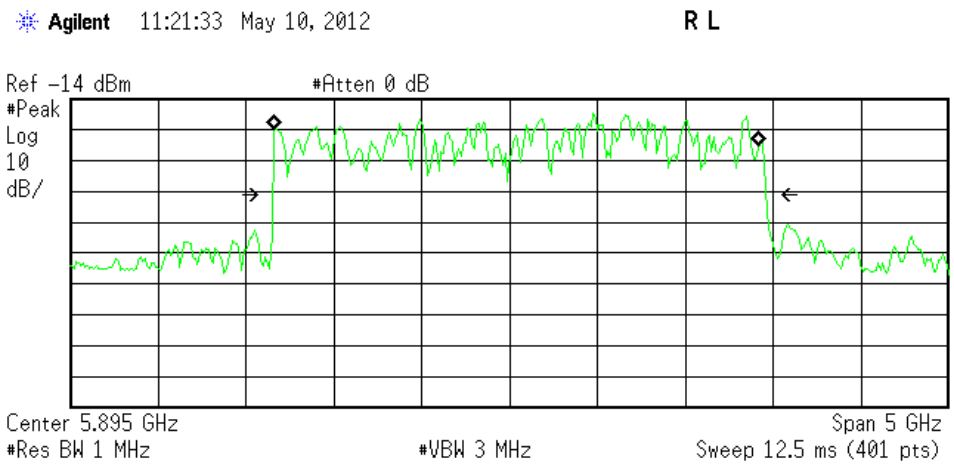
Occupied Bandwidth : -20°C : 10.2Vdc



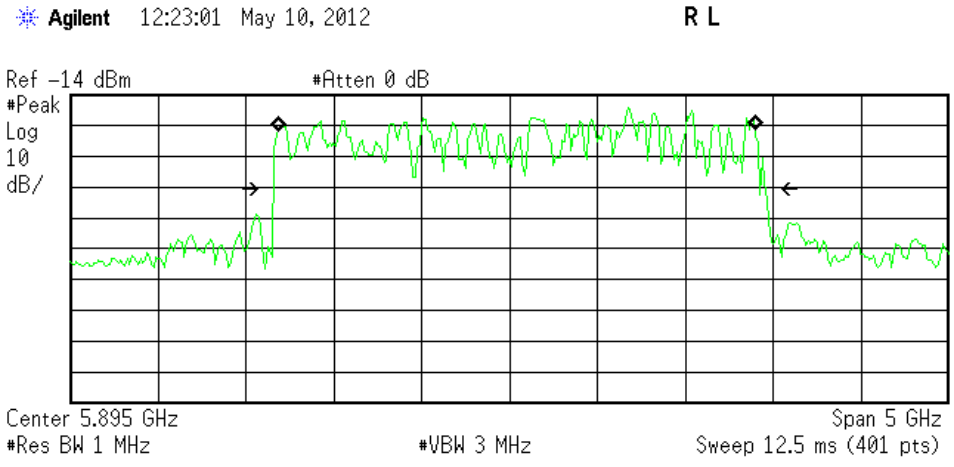
Occupied Bandwidth : -20℃ : 13.8Vdc



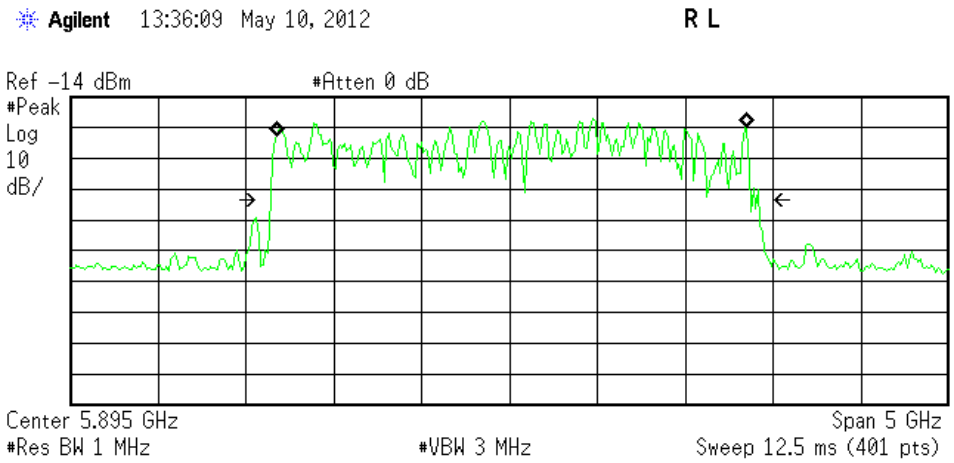
Occupied Bandwidth : 20℃ : 12Vdc



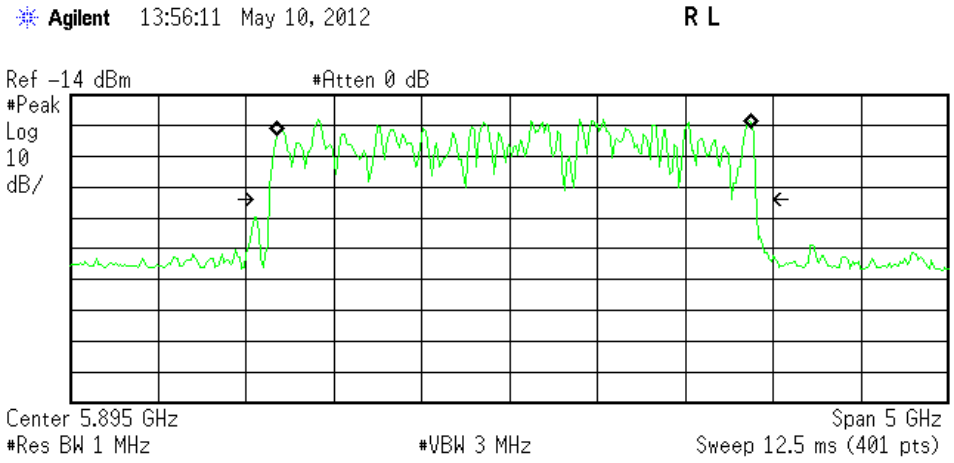
Occupied Bandwidth : 20℃ : 10.2Vdc



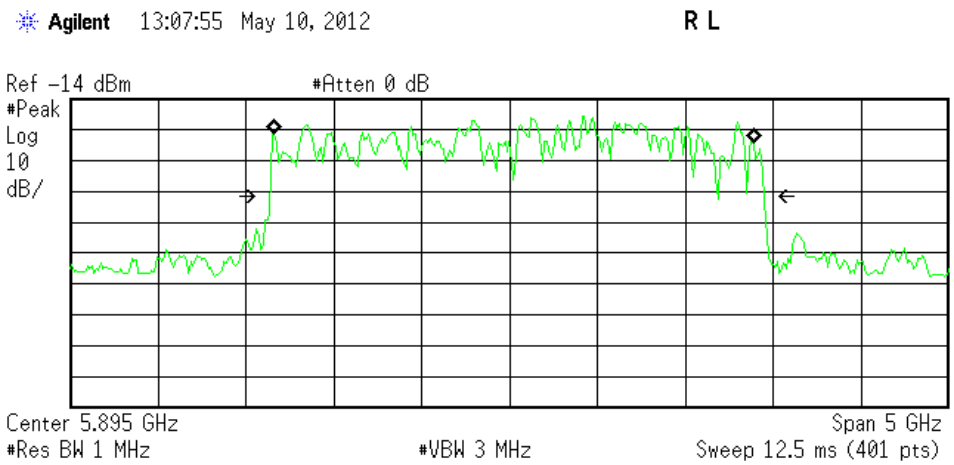
Occupied Bandwidth : 20℃ : 13.8Vdc



Occupied Bandwidth : 50℃ : 12Vdc



Occupied Bandwidth : 50℃ : 10.2Vdc



Occupied Bandwidth : 50℃ : 13.8Vdc

Radiated Spurious Emissions

LIMITS

Radiated emissions below 40GHz shall not exceed the general Part 15 emission limits in Section 15.209 of our Rules, 47 C.F.R. § 15.209, and radiated emissions outside the operating band and between 40 GHz and 200 GHz shall not exceed 600pW/cm² at a distance of three meters from the exterior surface of the radiating structure.

MEASUREMENTS / RESULTS

Radiated Emissions Table

Date: 11-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.7℃ **Humidity:** 21% **Pressure:** 1010mbar
Frequency Range: 30-1000MHz **Measurement Distance:** 3 m
Notes: FCC 15.209

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC 15.209(a) Limit (dBµV/m)	FCC 15.209(a) Margin (dB)	FCC 15.209(a) Result (Pass/Fail)
vbb	47.675	48.5	22.9	8.9	0.6	35.1	---	---	---	40.0	-4.9	Pass
vbb	98.4	48.8	22.7	10.2	0.8	37.1	---	---	---	43.5	-6.4	Pass
vbb	129.0	41.6	22.8	14.1	1.0	33.9	---	---	---	43.5	-9.6	Pass
vbb	181.075	32.3	22.8	11.1	1.2	21.8	---	---	---	43.5	-21.7	Pass
h	367.0	40.7	22.6	14.9	1.7	34.7	---	---	---	46.0	-11.3	Pass
v	612.0	32.4	23.0	19.1	2.4	30.9	---	---	---	46.0	-15.1	Pass

Table Result: Pass by -4.9 dB ***Worst Freq:*** 47.675 MHz

Test Site: EMI Chamber 2 **Cable 1:** Asset #1505 **Cable 2:** Asset #1507 **Cable 3:** ---
Analyzer: Rental SA#2 **Preamp:** Blue **Antenna:** Red-Brown **Preselector:** ---

Radiated Emissions Table

Date: 18-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOB radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 23.2℃ **Humidity:** 25% **Pressure:** 1012mBar
Frequency Range: 1-6GHz **Measurement Distance:** 3 m
Notes: FCC 15.209

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	FCC Class B High Frequency - Peak Margin (dB)	FCC Class B High Frequency - Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	FCC Class B High Frequency - Average Margin (dB)	FCC Class B High Frequency - Average Result (Pass/Fail)
v	4552.1	46.5	23.3	20.2	32.5	4.6	63.4	40.2	74.0	-10.6	Pass	54.0	-13.8	Pass

Table Result: Pass by -10.6 dB ***Worst Freq:*** 4552.1 MHz

Test Site: 1DCC-OATS-3M-I **Cable 1:** EMIR-HIGH-22 **Cable 2:** --- **Cable 3:** ---
Analyzer: Rental SA#1 **Preamp:** Asset #1517 **Antenna:** Orange Horn **Preselector:** ---

Radiated Emissions Table

Date: 18-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOB radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 23.2℃ **Humidity:** 25% **Pressure:** 1012mBar
Frequency Range: 6-18GHz **Measurement Distance:** 1m
Notes: FCC 15.209

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	FCC Class B High Frequency - Peak Margin (dB)	FCC Class B High Frequency - Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	FCC Class B High Frequency - Average Margin (dB)	FCC Class B High Frequency - Average Result (Pass/Fail)
v	9338.375	45.53	24.5	20.0	38.2	7.5	71.2	50.2	83.5	-12.3	Pass	63.5	-13.3	Pass
v	13900.0	42.67	22.4	19.3	42.4	11.8	77.6	57.3	83.5	-5.9	Pass	63.5	-6.2	Pass

Table Result: Pass by -1.7 dB ***Worst Freq:*** 13900.0 MHz

Test Site: 1DCC-OATS-3M-I **Cable 1:** EMIR-HIGH-22 **Cable 2:** --- **Cable 3:** ---
Analyzer: Rental SA#1 **Preamp:** Asset #1517 **Antenna:** Orange Horn **Preselector:** ---

Radiated Emissions Table

Date: 11-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.7°C **Humidity:** 21% **Pressure:** 1010mbar
Frequency Range: 18-26.5GHz **Measurement Distance:** 0.1 m
Notes: FCC 15.209

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak			FCC Class B High Frequency - Average		
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
v	19445.0	68.77	25.8	20.5	40.3	6.1	94.7	51.7	103.5	-8.8	Pass	83.5	-31.8	Pass
v	19934.0	65.4	26.1	20.9	40.2	6.2	90.9	51.6	103.5	-12.6	Pass	83.5	-31.9	Pass
v	24503.0	59.45	42.3	20.6	40.2	6.4	85.5	68.3	103.5	-18.0	Pass	83.5	-15.2	Pass

Table Result: Pass by -8.8 dB ***Worst Freq:*** 19445.0 MHz

Test Site: EMI Chamber 2 **Cable 1:** EMIR-HIGH-21 **Cable 2:** --- **Cable 3:** ---
Analyzer: Gold **Preamp:** 18-26.5GHz **Antenna:** 18-26.5GHz Horn **Preselector:** ---

Radiated Emissions Table

Date: 11-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.7°C **Humidity:** 21% **Pressure:** 1010mbar
Frequency Range: 26.5-40GHz **Measurement Distance:** 0.1 m
Notes: FCC 15.209

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak			FCC Class B High Frequency - Average		
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
v	36760.0	20.85	15.3	23.1	41.7	0.0	85.7	80.1	103.5	-17.9	Pass	83.5	-3.4	Pass

Table Result: Pass by -3.4 dB ***Worst Freq:*** 36760.0 MHz

Test Site: EMI Chamber 2 **Cable 1:** 40GHz Mixer/18-26.5GHz no cable **Cable 2:** --- **Cable 3:** ---
Analyzer: Gold **Preamp:** none **Antenna:** 40GHz Mixer **Preselector:** ---

Radiated Emissions Table

Date: 11-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.7°C **Humidity:** 21% **Pressure:** 1010mbar
Frequency Range: 40-50GHz **Measurement Distance:** 0.1 m
Notes: 15.253(c)
Readings are peak, and applied to the average limit. The given limit is 600pW/cm2 at 3m and is expressed
below as dBuV/m at 0.1m as calculated given the "Procedure from TCB Council Members - Millimeter Wave Tests Procedure" **Limit = 600pW/cm² at 3m**

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)				15.253(c)		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
v	43627.5	38.5	23.0	42.9	0.0	104.4	---	---	---	123.1	-18.7	Pass

Table Result: Pass by -18.7 (dB) ***Worst Freq:*** 43627.5 MHz

Test Site: EMI Chamber 2 **Cable 1:** Mixer Cables **Cable 2:** --- **Cable 3:** ---
Analyzer: Gold **Preamp:** none **Antenna:** 33-50GHz Mixer **Preselector:** ---

Radiated Emissions Table

Date: 14-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.4°C **Humidity:** 26% **Pressure:** 1004mbar
Frequency Range: 50-75GHz **Measurement Distance:** 0.1 m
Notes: 15.253(c)

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Avg Reading (dBµV/m)	Adjusted Avg Reading (pW/cm²)				15.253(c)		
								Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (pW/cm²)	Margin (pW/cm²)	Result (Pass/Fail)
no emissions found			---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- (pW/cm²) ***Worst Freq:*** --- MHz

Test Site: Indoor OATS I **Cable 1:** Mixer Cables **Cable 2:** --- **Cable 3:** ---
Analyzer: Brown **Preamp:** none **Antenna:** 50-75GHz Mixer **Preselector:** ---

Radiated Emissions Table

Date: 14-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.4℃ **Humidity:** 26% **Pressure:** 1004mbar
Frequency Range: 75-110GHz **Measurement Distance:** 0.1 m
Notes: 15.253(c)

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Avg Reading (dBµV/m)	Adjusted Avg Reading (pW/cm²)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	15.253(c) Limit (pW/cm²)	15.253(c) Margin (pW/cm²)	15.253(c) Result (Pass/Fail)
no emissions found			---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- (pW/cm²) ***Worst Freq:*** --- MHz

Test Site: Indoor OATS I **Cable 1:** Mixer Cables **Cable 2:** --- **Cable 3:** ---
Analyzer: Brown **Preamp:** none **Antenna:** 75-110GHz Mixer **Preselector:** ---

Radiated Emissions Table

Date: 14-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.4℃ **Humidity:** 26% **Pressure:** 1004mbar
Frequency Range: 110-140GHz **Measurement Distance:** 0.1 m
Notes: 15.253(c)

Antenna Polarization (H / V)	Frequency (GHz)	Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Avg Reading (dBµV/m)	Adjusted Avg Reading (pW/cm²)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	15.253(c) Limit (pW/cm²)	15.253(c) Margin (pW/cm²)	15.253(c) Result (Pass/Fail)
no emissions found			---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- (pW/cm²) ***Worst Freq:*** --- GHz

Test Site: Indoor OATS I **Cable 1:** Diplexer-01 **Cable 2:** diplexer-02 **Cable 3:** ---
Analyzer: Brown **Preamp:** none **Antenna:** 90-140GHz Mixer **Preselector:** ---

Radiated Emissions Table

Date: 14-May-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Matthew Burman **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 22.4℃ **Humidity:** 26% **Pressure:** 1004mbar
Frequency Range: 140-200GHz **Measurement Distance:** 0.1 m
Notes: 15.253(c)

Antenna Polarization (H / V)	Frequency (GHz)	Reading (dBµV)	Correction Loss (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Avg Reading (dBµV/m)	Adjusted Avg Reading (pW/cm²)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	15.253(c) Limit (pW/cm²)	15.253(c) Margin (pW/cm²)	15.253(c) Result (Pass/Fail)
no emissions found			---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- (pW/cm²) ***Worst Freq:*** --- GHz

Test Site: Indoor OATS I **Cable 1:** Diplexer-01 **Cable 2:** diplexer-02 **Cable 3:** ---
Analyzer: Brown **Preamp:** none **Antenna:** 140-200GHz Mixer **Preselector:** ---

Conducted Spurious Emissions

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Measurements/Results

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 26-40GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 26-40GHz Mixer **Preselector:** ---

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 40-50GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 33-50GHz Mixer **Preselector:** ---

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 50-75GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 50-75GHz Mixer **Preselector:** ---

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 75-110GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 75-110GHz Mixer **Preselector:** ---

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 110-140GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 90-140GHz Mixer **Preselector:** ---

Conducted Emissions Table

Date: 17-Sep-12 **Company:** Trex Aviation Corporation **Work Order:** M0848
Engineer: Chris Reynolds **EUT Desc:** FOD radar **EUT Operating Voltage/Frequency:** 12Vdc
Temp: 26℃ **Humidity:** 36% **Pressure:** 1001mBar
Frequency Range: 140-200GHz
Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: ENV **Cable 1:** EMIR-HIGH-13 IF **Cable 2:** EMIR-HIGH-21 LO **Cable 3:** ---
Analyzer: Gold **Mixer:** 140-220GHz Mixer **Preselector:** ---

Antenna Radiation Pattern

EUT shall transmit only in vertical polarization

Work Order: M0848
Test Engineer: Matthew Burman
Company: Trex Aviation Corporation

Site: 3m Indoor OATS I
Date: 5/18/2012
Temp: 23.5°C
Humidity: 24%
Pressure: 1011mbar

Transmit Power Density

Measurement Distance: 3m

Antenna Polarity	Center Frequency (GHz)	Field Strength (dBµV)	Antenna Factor (dB/m)	Mixer Factor (dB)	Adjusted Reading (dBµV/m)	Adjusted Reading (V/m)	Power Density (W/m²)	Power Density (µW/cm²)	Limit (uW/cm²)	Result
v	79.1	53.3	48.2	42	143.5000	14.9624	0.593825236	59.38252357	60	Pass
h	79.1	29.1	48.2	42	119.3000	0.9226	0.002257661	0.225766058	60	Pass

*Calculations
V/m = 10^(dBµV/m / 10)
W/m² = [(V/m)^2] / 377
µW/cm² = W/m² * 100

Measurement Uncertainty

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz) NIST CISPR	 5.6dB 4.6dB	 N/A 5.2dB (Ucispr)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Magnetic Radiated Emissions	5.6dB	N/A
Conducted Emissions NIST CISPR	 3.9dB 3.6dB	 N/A 3.6dB (Ucispr)
Telco Conducted Emissions (Current)	2.9dB	N/A
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Electrostatic Discharge	11.5%	N/A
Radiated RF Immunity (Uniform Field)	1.6dB	N/A
Electrical Fast Transients	23.1%	N/A
Surge	23.1%	N/A
Conducted RF Immunity	3dB	N/A
Magnetic Immunity	12.8%	N/A
Dips and Interrupts	2.3V	N/A
Harmonics	3.5%	N/A
Flicker	3.5%	N/A
Radio frequency (@ 2.4GHz)	3.23×10^{-8}	1×10^{-7}
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation: • Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	 3.4% 0.3dB	 5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%
The above reflects a 95% confidence level		

Test Equipment Used

Rev. 5/23/2012

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Gold	100Hz-26.5 GHz	E4407B	Agilent	MY45113816	1284	I	2/3/2013
Rental SA #1 (Brown)	9kHz-26.5GHz	E4407B	Agilent	SG44210511	1510	I	2/14/2013
Rental SA #2	9kHz-26.5 GHz	E7405A	Agilent	MY45104194	rental	I	1/5/2013
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**			**Cat**	**Calibration Due**
1DCC-OATS-3M-I	719150	2762A-8	A-0015			II	6/7/2012
EMI Chamber 2	719150	2762A-7	A-0015			II	2/15/2014
Mixers/Diplexers	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Mixer / Horn	26.5-40 GHz	11970A/28-442-6	HP/ATM	2332A01695/A046903-01	1087	I	11/5/2012
Mixer / Horn	33-50 GHz	11970Q/SGH-22-RP000	HP/Millitech	3003A03155/7676	104	I	12/20/2013
Mixer / Horn	50-75 GHz	11970V /QWH-VPRROO	HP/QuinStar	2521A01197/8794001	1179	I	12/20/2013
Mixer	75-110 GHz	11970W	HP	2521A01334	105	I	12/21/2013
Mixer / Horn	60-90 GHz	M12HW/A / M12RH	OML	E30110-1	822	I	1/20/2014
Mixer / Horn	90-140 GHz	MO8HW/A / M08RH	OML	F21206-1	811	I	1/20/2014
Mixer / Horn	140-220 GHz	MO5HW/A / M05RH	OML	G21206-1	812	I	1/20/2014
Diplexer	40-220 GHz	DPL.26	OML	N/A	813	I	1/20/2014
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Blue	0.009-2000MHz	ZFL-1000-LN	CS	N/A	759	II	6/1/2012
1517 HF Preamp	1-20GHz	CS	CS	N/A	1517	II	4/17/2013
HF (Yellow)	18-26.5GHz	AFS4-18002650-60-8P-4	CS	467559	1266	I	10/6/2012
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Red-Brown Bilog	30-2000MHz	JB1	Sunol	A0032406	1218	I	8/25/2012
Orange Horn	1-18GHz	3115	EMCO	0004-6123	390	I	7/27/2013
HF (White) Horn	18-26.5GHz	801-WLM	Waveline	758	758	I	Verify before Use
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4/4/2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	8/19/2013
CHAMBER2 Thermohygrometer		35519-044	Control Company	72457639	1347	II	8/19/2013
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
Asset #1505	9kHz - 18GHz		Florida RF			II	8/19/2012
Asset #1507	9kHz - 26.5GHz		Florida RF			II	1/31/2013
REMI-High-21	9kHz - 26.5GHz		C-S			II	1/31/2013
REMI-High-22	9kHz - 15GHz		C-S			II	1/31/2013

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Product Documentation

The following documentation has been provided by the client for inclusion in this report.

Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("**Client**"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "**Conditions**"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("**Test Report**") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "**BUREAU VERITAS**," "**BUREAU VERITAS CONSUMER PRODUCTS SERVICES**," "**BVCPS**", "**MTL**", "**ACTS**", "**MTL-ACTS**" and **CURTIS-STRAUS** (collectively, the "**Marks**") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only were such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.

13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B)NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

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