Project 18951-15

Sagetech Corporation

XPG-TR, XPC-TR, XPS-TR

Mode A, C, and S Transponders
1090 MHz Transceiver

Wireless Certification Report

FCC Part 87

Prepared for:

Sagetech Corporation LLC
P.O. Box 1146
186 E. Jewett Blvd
White Salmon, WA 98672

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

17 Mar 2017

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
DRAFT 03	Draft for review.	21 Apr 2017
01	Final released.	21 Apr 2017

Errata:

None.

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Certificate of Compliance

Applicant	Device & Test Identification	
Sagetech Corporation LLC P.O. Box 1146 186 E. Jewett Blvd White Salmon, WA 98672 Certificate Date: 17 Apr 2017	Model(s): FCC ID: Laboratory Project ID:	XPG-TR, XPC-TR, XPS-TR YT5XP-TR 18951-15

The EUT model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR, FCC Part 87 and Part 2	
Section	**Description**
87.131; 2.1046	Power and emissions; conducted output power
87.135; 87.137; 2.1049	Bandwidth of & type of emission; occupied bandwidth: 14M0M1D
2.1047	Modulation characteristics
87.139(a); 2.1051	Emission limitations; Spurious/harmonic emissions at antenna terminals
87.139(a); 2.1053	Emission limitations; radiated emissions 30 MHz - 10 GHz
87.133; 2.1055(a)(1)	Frequency stability; *Aeronautical utility mobile stations on 1090 MHz; 1000 ppm.*
87.143	Transmitter control requirements

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States.

1.2 EUT Description

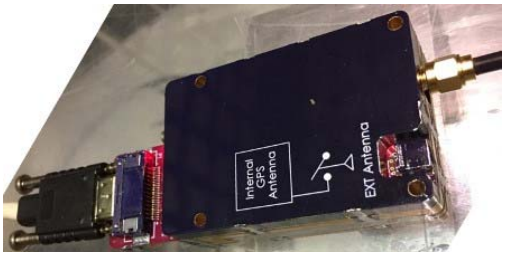
Table 1.2.1 Equipment Under Test			
Manufacturer & Description	**Model**	**Serial #**	**Photo**
Sagetech Corporation LLC Mode A, C, and S Transponder for 1090 MHz	XPG-TR	06267	
Model(s) Represented By Above:	XPC-TR, XPS-TR, XPS-TRB		
Operating Voltage:	14 VDC nominal; 10 – 32 VDC overall		

Table 1.2.2 Compliance Statements	
Requirement	**Compliance Statement**
FCC 87.143	Power control requirement; power is removed at the aircraft operator's position by the user either removing power from the EUT itself, pulling the circuit breaker, or removing the power plug at the end of the power cable.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. To insure accurate measurement, the EUT was placed into higher than normal duty cycle modes by interrogation commands from an external protocol tester attached via the antenna port. Measurements were made possible by using a forward power coupler.

1.4 Modifications to EUT

None.

1.5 Test Site

Radiated measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards

and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.6 Measurement Correction Methods

Table 1.6 1 Measurement Corrections

Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as 1/d above 30 MHz) are applied and documented where used.

2.0 Applicable Documents

Table 2.0.1: Applicable Documents	
Document #	**Title/Description**
TIA/EIA 603C 2004	Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards
47 CFR	FCC Part 87 – Subpart D – Technical requirements FCC Part 2 – Subpart J – Equipment authorization procedures

3.0 Conducted Output Power at Antenna Terminal

3.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the spectrum analyzer. A peak detector was used for the measurement. The transmitter was switched on, and the measurement receiver was tuned to the frequency of the transmitter under test. The loss of the attenuator was compensated by adding an offset to the analyzer amplitude. Power was measured directly with the spectrum analyzer using a resolution bandwidth greater than the occupied bandwidth of the transmitter.

3.2 Test Criteria

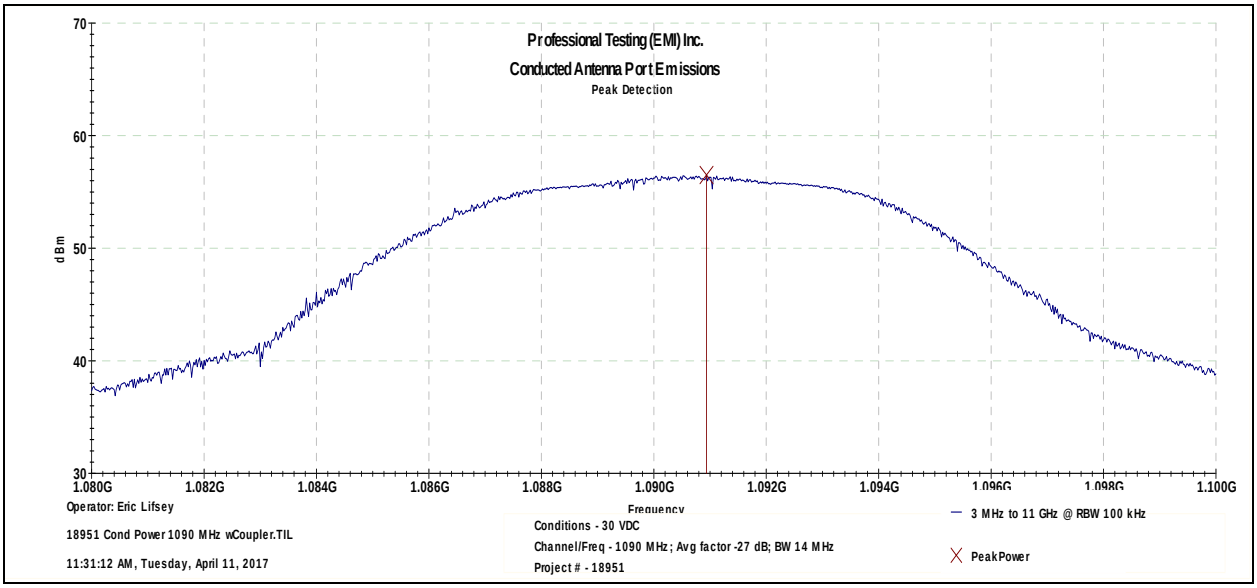
Table 3.2.1 Authorized Power, 87.131 (Radionavigation Unspecified), 2.1046
Minimum 125 Watts per RTCA/DO-181D

3.3 Test Results

Table 3.3.1 Peak Power Measured In 10 MHz RBW, 50 MHz VBW	
Measured Power (peak)	56.5 dBm or 446.7 Watts

Table 3.3.2 Calculated Duty Cycle and Average Power	
Measured Power (peak)	56.5 dBm or 446.7 Watts
Transmit Times (µs)	Per DO-181E: 500 Mode A/C, 50 Mode S replies, 6.2 Squitters/second
Total Transmit Time	7215 **µs**
Maximum Duty Cycle	0.72 %
Averaging Factor	10 $\log_{10}$ (0.72%) = -21.4 dB
Average Power	P_{peak} + $Factor_{avg}$ = 56.5 – 21.4 = 35.1 dBm or 3236 mW

The EUT satisfied the requirements. Plotted results included below.



Peak Power

4.0 Occupied Bandwidth and Modulation Characteristics

4.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the spectrum analyzer. The spectrum analyzer was tuned to the frequency of the transceiver under test and the EUT activated in continuous transmit mode. Bandwidth is measured relative to the peak power measurement measured separately in full bandwidth. Modulation is a pulse train; to verify a time-domain capture of the pulse train was recorded and compared to expected timings.

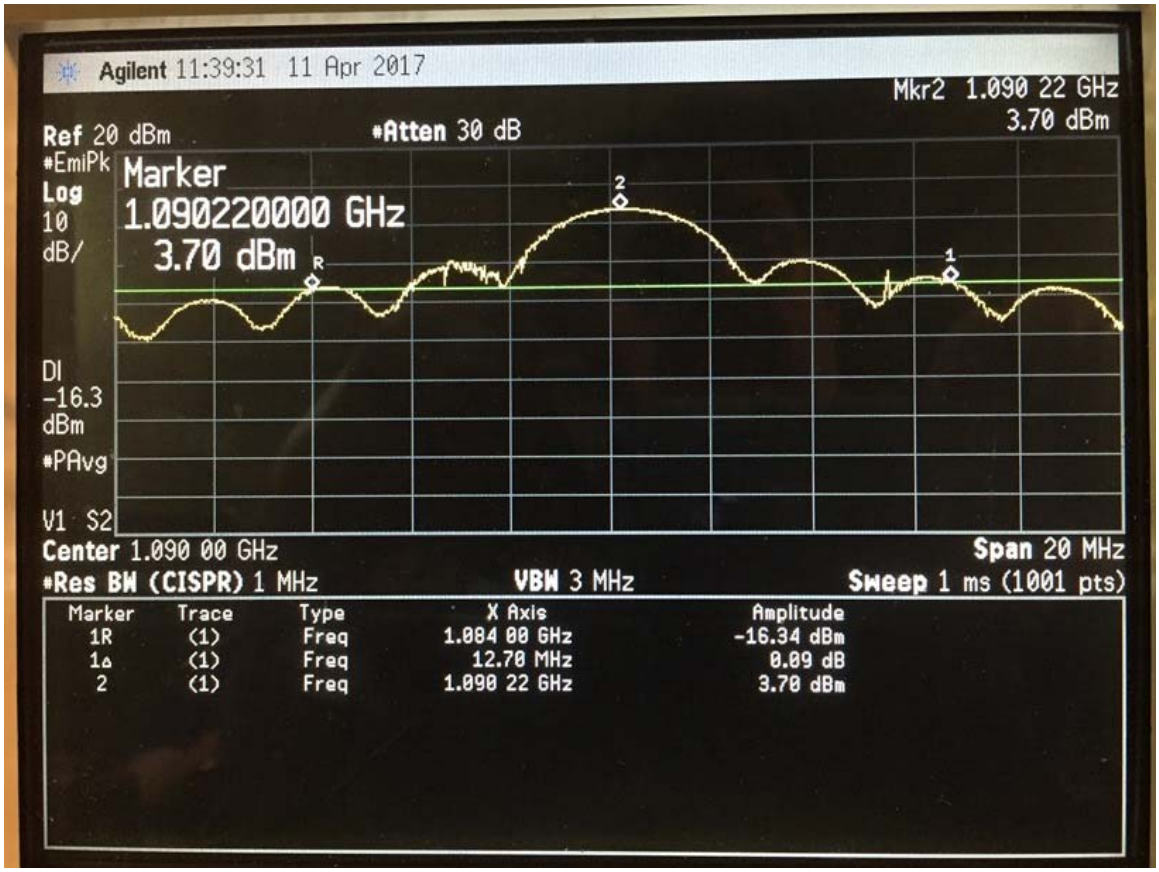
4.2 Test Criteria

Table 4.2.1 Authorized Bandwidth, 87.135; 87.137; 2.1049
14 MHz per 87.137 table; emission designator 14M0M1D

4.3 Test Results, Bandwidth

Table 4.3.1 Bandwidth In 20 dB (1 MHz RBW 3 MHz VBW)	
Reference Power Level	56.5 dBm
Measured 20 dB Bandwidth	12700 kHz
Emission Designator	12M7M1D

The EUT satisfied the requirements. Results appear below.

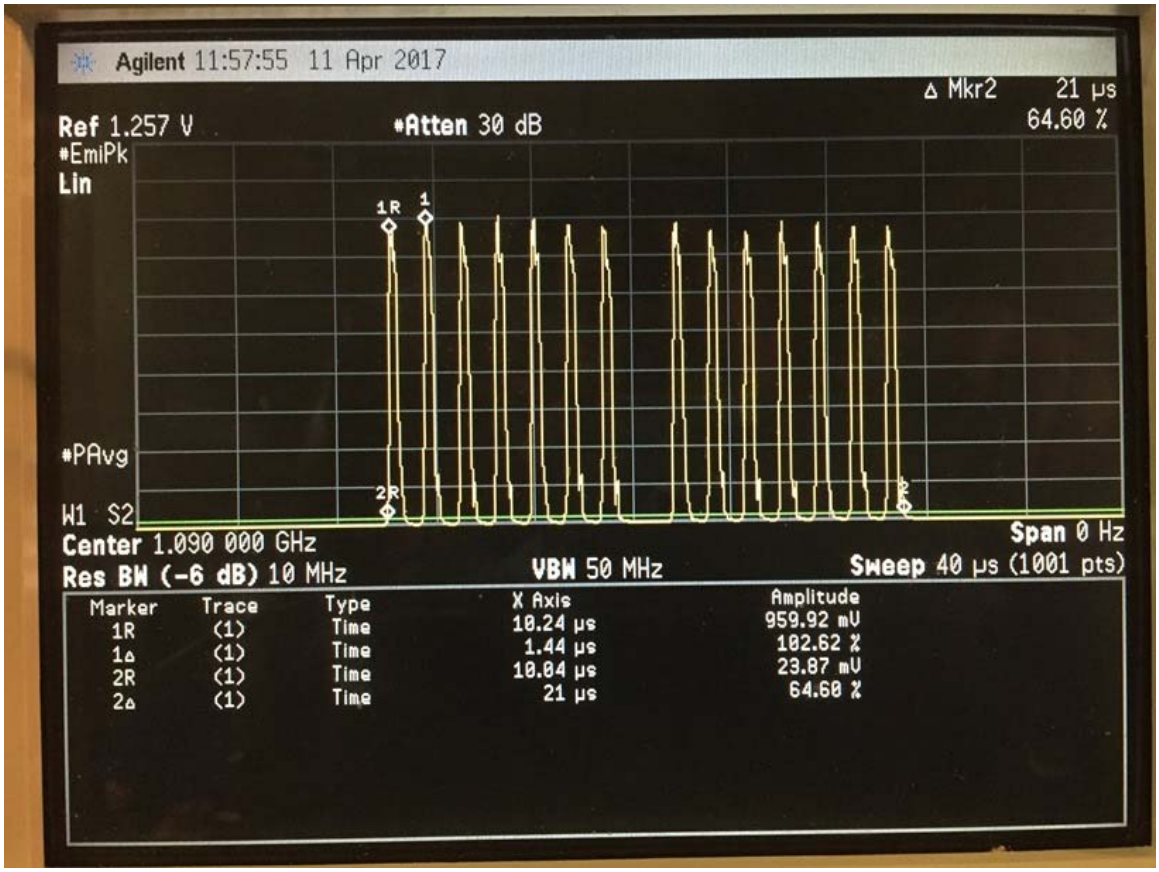


Bandwidth Measured

4.4 Test Results, Modulation Characteristics

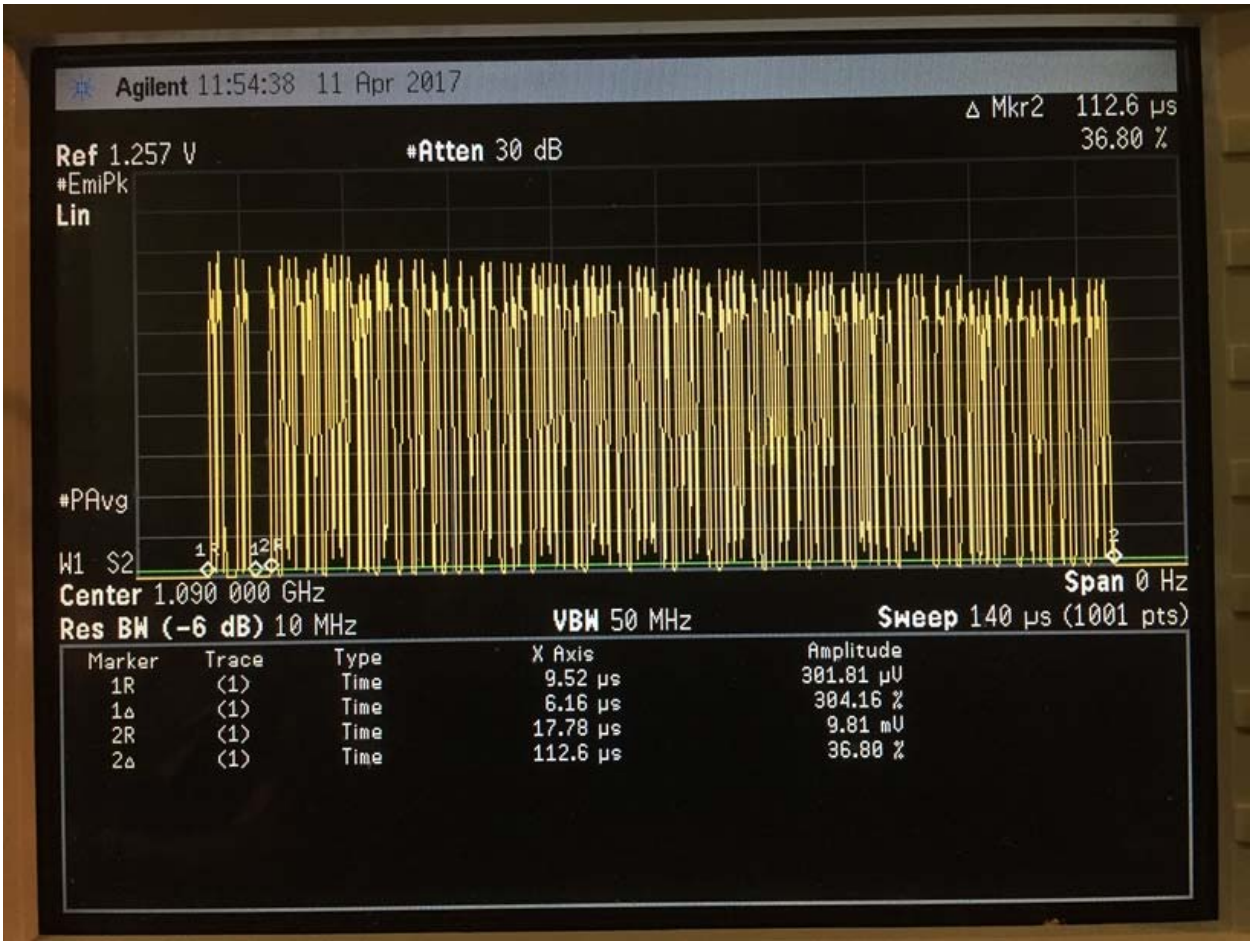
The pulse train was captured in time domain and observed for basic parameters listed below. These were found to be within the expected limits.

Table 4.4.1 Modulation Characteristics Measured, Short Packet	
Bit-Bit Time	1.44 µsec (Marker 1 delta)
Payload Time	21.0 µsec (Marker 2 delta)



Captured Modulated Data Stream; Short Packet

Table 4.4.2 Modulation Characteristics Measured, Long Packet	
Preamble Time	6.16 µsec (Marker 1 delta)
Payload Time	112.6 µsec (Marker 2 delta)



5.0 Spurious Emissions at Antenna Terminals

5.1 Test Procedure

The output of the EUT was connected directly to a power attenuator, forward power coupler, and then to a spectrum analyzer. The transmitter was switched on, and the measurement receiver was swept with TILE V4 software up to the 10th harmonic. EUT could not operate in continuous transmit mode but was adjusted to a higher rate that the transmitter could sustain. Software was adjusted to maximize capture of emissions using maximum point capability (8192 points), running 50 sweeps of 500 ms each, and 20 sweep ranges dividing up 3 MHz to 11 GHz.

5.2 Test Criteria

Table 5.2.1 Spurious Limit, FCC 87.139(a) Basis for limit calculations.	
Measured Peak Transmitter Power:	56.5 dBm or 446.7 Watts
Average Power Calculated P_t:	P_t = 35.1 dBm or 3236 mW

Table 5.2.2 Spurious Limit, FCC 87.139(a)(1)	
Attenuation & Frequency Range:	25 dB out to ±7 MHz (50% of BW)
Deduct Attenuation from Measured Power:	35.1 dBm – 25 dB **=** 10.1 dBm

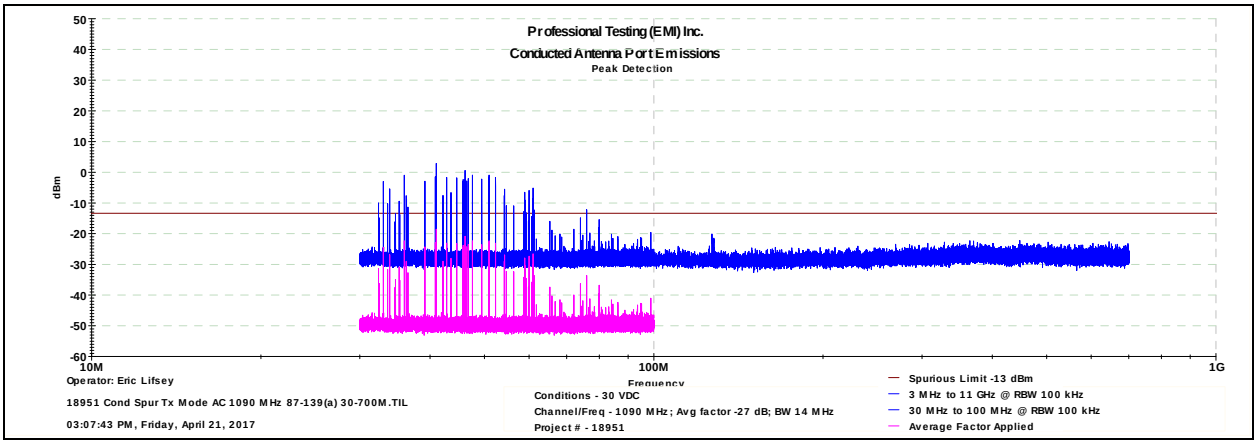
Table 5.2.3 Spurious Limit, FCC 87.139(a)(2)	
Attenuation & Frequency Range:	35 dB from ±7 to ±14 MHz (100% of BW)
Deduct Attenuation from Measured Power:	35.1 dBm – 35 dB **=** 0.1 dBm

Table 5.2.4 Spurious Limit, FCC 87.139(a)(3)	
Attenuation & Frequency Range:	40 dB beyond ±35 MHz (250% of BW)
Deduct Attenuation from Measured Power:	35.1 dBm – 40 dB **=** -4.9 dBm

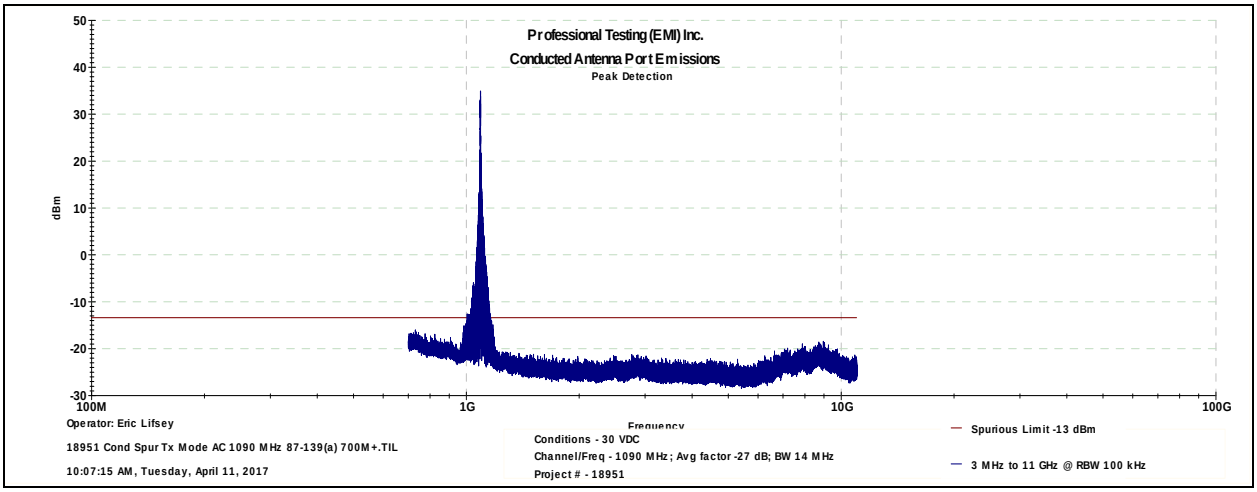
5.3 Test Results

Limits are based on mean or average levels. The overall graph is peak levels. Where applicable the averaging factor is numerically applied with peak and average levels displayed.

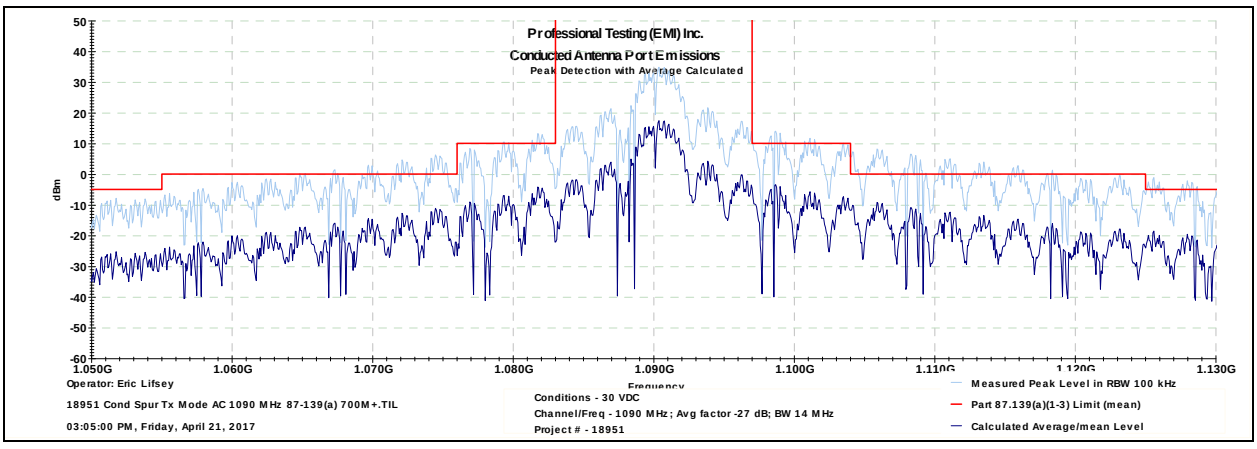
The EUT satisfied the requirements. Plotted measurements appear below.



Conducted Antenna Port Spurious; Full Range 30 MHz to 700 MHz
Measured Peak Levels and Applicable Calculated Averages Presented



Conducted Antenna Port Spurious; Full Range 700 MHz to 11 GHz
Measured Peak Levels

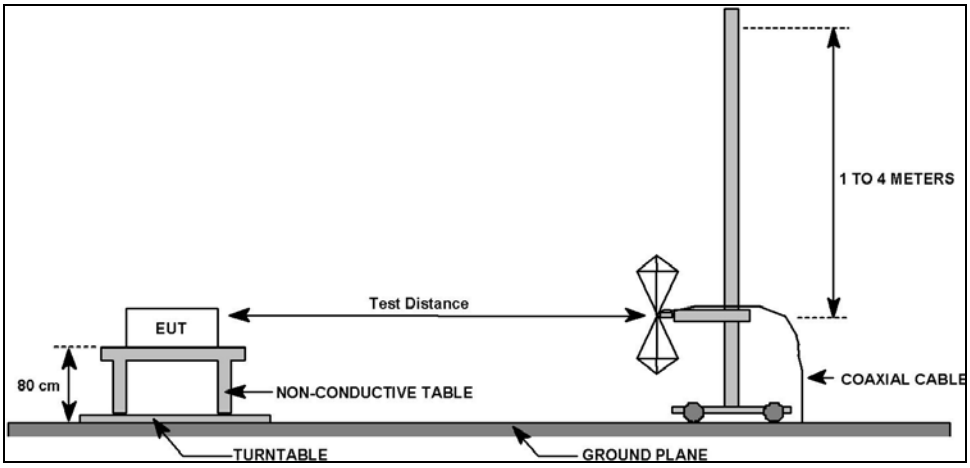


Conducted Antenna Port Spurious; 87.139(a)(1-3) Mask Detail
Measured Peak and Calculated Average Presented

6.0 Field Strength of Spurious Emissions

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable. Antennas were located from the EUT at distances of 10 meters for below 1 GHz and 3 meters for above 1 GHz. The EUT was placed into transmit mode with the antenna removed and a resistive terminator substituted. EUT duty cycle was raised to a safe maximum and the measurement software sweep count increased to capture the signals.



Field Strength of Radiated Emissions Test Setup

6.2 Test Criteria

Table 6.2.1 Radiated Spurious Limit, 87.139(a)(3) *(Calculated limit -13.4 dBm.)*	
Method:	$P_r = P_t + G_t + G_r + 20\log_{10}\left(\frac{\lambda}{4\pi R}\right)$
Path Loss Term:	10 m: 20 $\log_{10}$ (λ/ 4πR) = 20 $\log_{10}$ (0.30675 / 4π10) = -52.25 dB 3 m: 20 $\log_{10}$ (λ/ 4πR) = 20 $\log_{10}$ (0.30675 / 4π3) = -41.79 dB
Power at *R*:	10 m: -13.4 dBm + 0 dB + 0 dB + [-52.25 dB] = -65.65 dBm 3 m: -13.4 dBm + 0 dB + 0 dB + [-41.79 dB] = -55.19 dBm
Field Strength Limit Conversion Formula:	$E(dB\mu V/m) = P_{meas}(dBm) - P_{gain}(dB) + 77.2dB + 20\log(f, MHz) - G_{ant}(dB)$
Field Strength Limit Calculation, 10 m:	[-65.65 dBm] – 0 dB + 77.2 dB + 20 $\log_{10}$ (1090 MHz) - 0 dB = 72.3 dBµV/m
Field Strength Limit Calculation, 3 m:	[-55.19 dBm] – 0 dB + 77.2 dB + 20 $\log_{10}$ (1090 MHz) - 0 dB = 82.8 dBµV/m

6.3 Test Results

The EUT satisfied the requirements. Plotted measurements appear below. Above 1 GHz, emissions were measured for modes A/C and S.

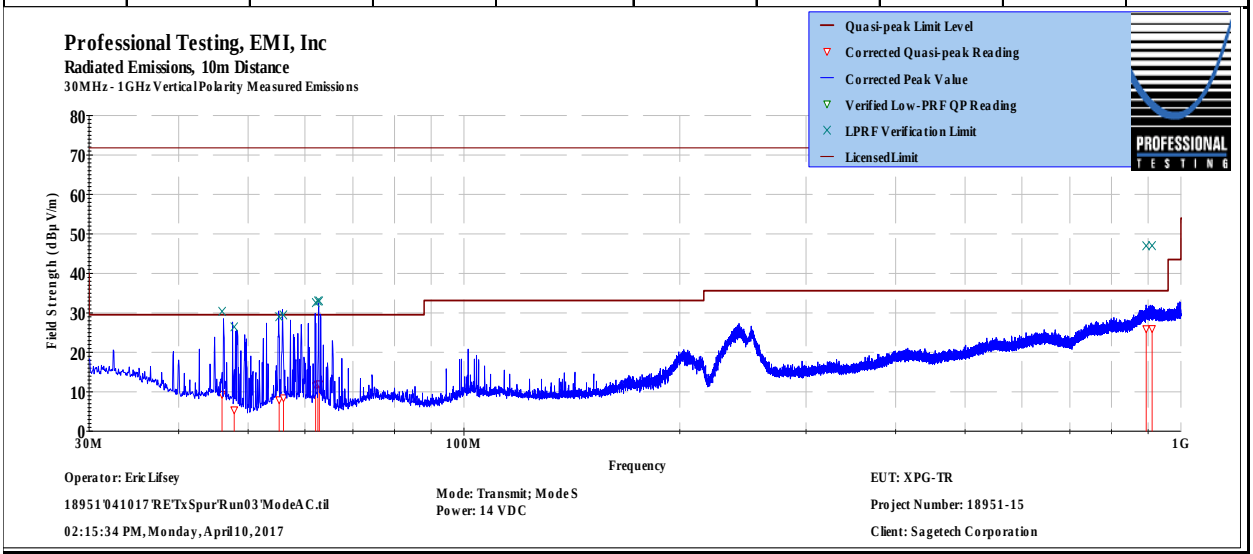
Emissions were below the peak/QP limits of Part 15 and are reflected in the tabular data. The 87.139 field limits calculated above are included as the uppermost limit line in the plotted results.

6.3.1 Transmit Mode; Radiated Emissions, 30 MHz to 1 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit A/C Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
45.9819	10	76	1.25	Quasi-peak	26.8	9.378	29.5	-20.1	Pass
47.8122	10	254	1.31	Quasi-peak	24.9	5.457	29.5	-24.0	Pass
55.2299	10	142	1.75	Quasi-peak	25.7	8.005	29.5	-21.5	Pass
56.0104	10	10	4.03	Quasi-peak	26.3	8.465	29.5	-21.0	Pass
62.1136	10	99	4.04	Quasi-peak	31.2	11.59	29.5	-17.9	Pass
62.5627	10	109	2.4	Quasi-peak	31.8	11.996	29.5	-17.5	Pass
62.818	10	238	3.14	Quasi-peak	32	12.002	29.5	-17.5	Pass
894.181	10	169	2.96	Quasi-peak	21.4	25.973	35.6	-9.6	Pass
911.531	10	46	2.92	Quasi-peak	21.2	26.014	35.6	-9.6	Pass



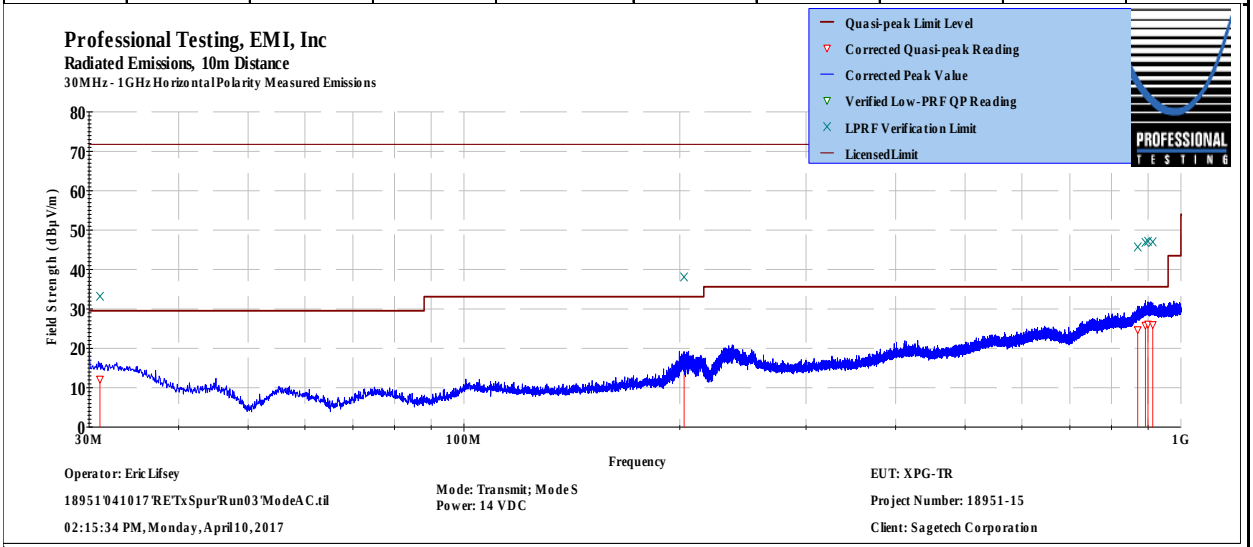
≤ 1GHz Vertical Antenna Polarity Measured Emissions

6.3.2 Transmit Mode; Radiated Emissions, 30 MHz to 1 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit A/C Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.0722	10	56	2.09	Quasi-peak	24.2	12.186	29.5	-17.3	Pass
202.783	10	37	2.95	Quasi-peak	31.5	17.09	33.1	-16.0	Pass
870.373	10	44	3.35	Quasi-peak	21.4	24.718	35.6	-10.9	Pass
892.062	10	122	1.28	Quasi-peak	21.4	25.876	35.6	-9.7	Pass
899.862	10	41	1.97	Quasi-peak	21.3	26.136	35.6	-9.5	Pass
913.434	10	267	1.82	Quasi-peak	21.2	26.015	35.6	-9.6	Pass

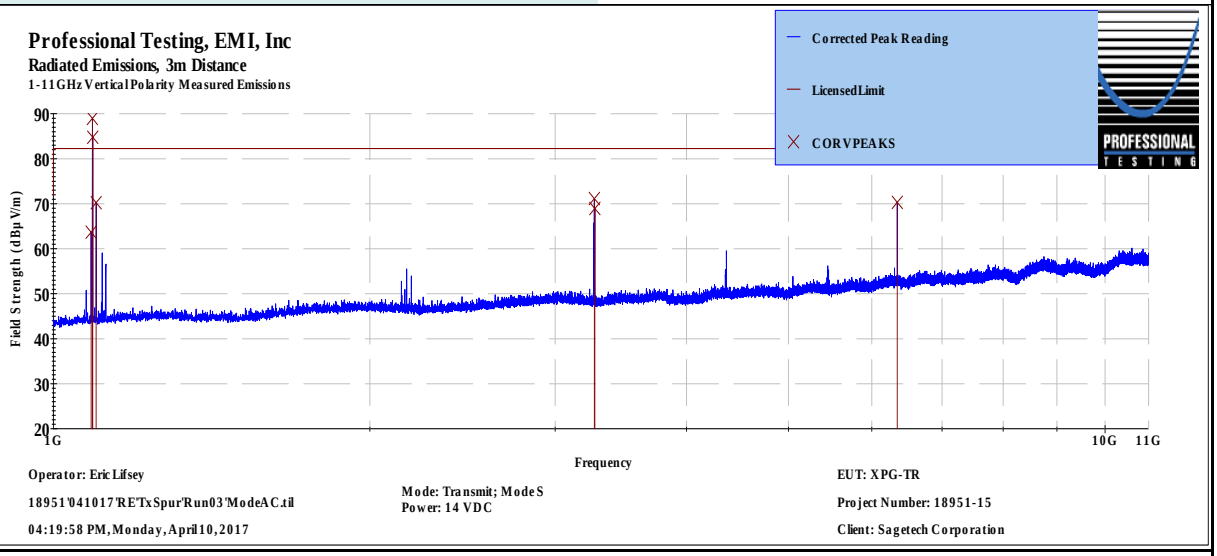


≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Transmit Mode A/C; Radiated Emissions, 1 to 11 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit A/C Mode	

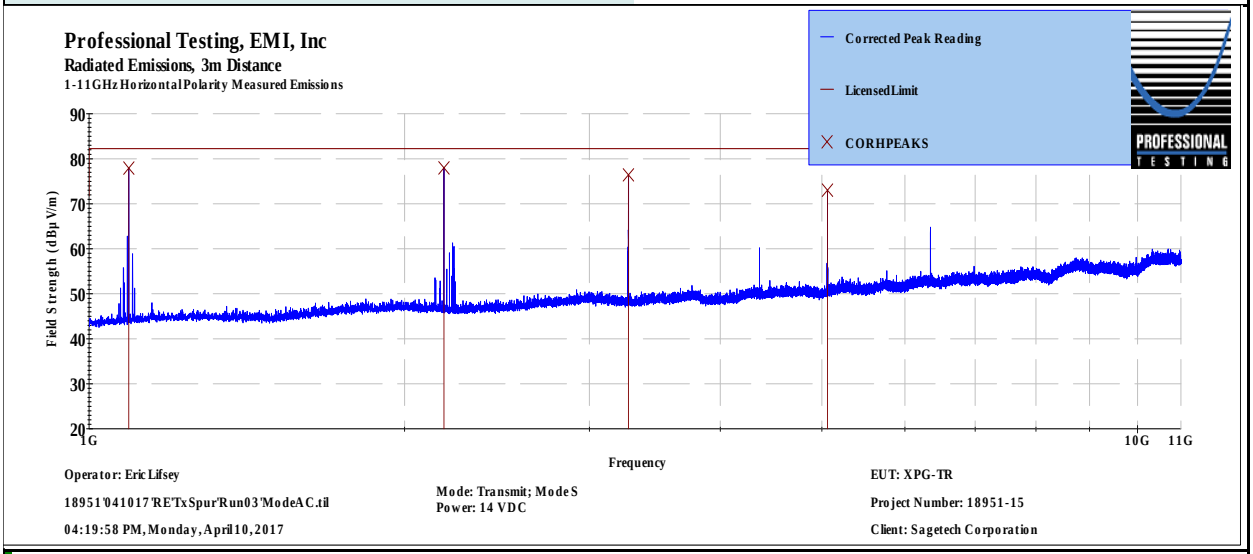


> 1GHz Vertical Antenna Polarity Measured Emissions

6.3.4 Transmit Mode A/C; Radiated Emissions, 1 to 11 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit A/C Mode	

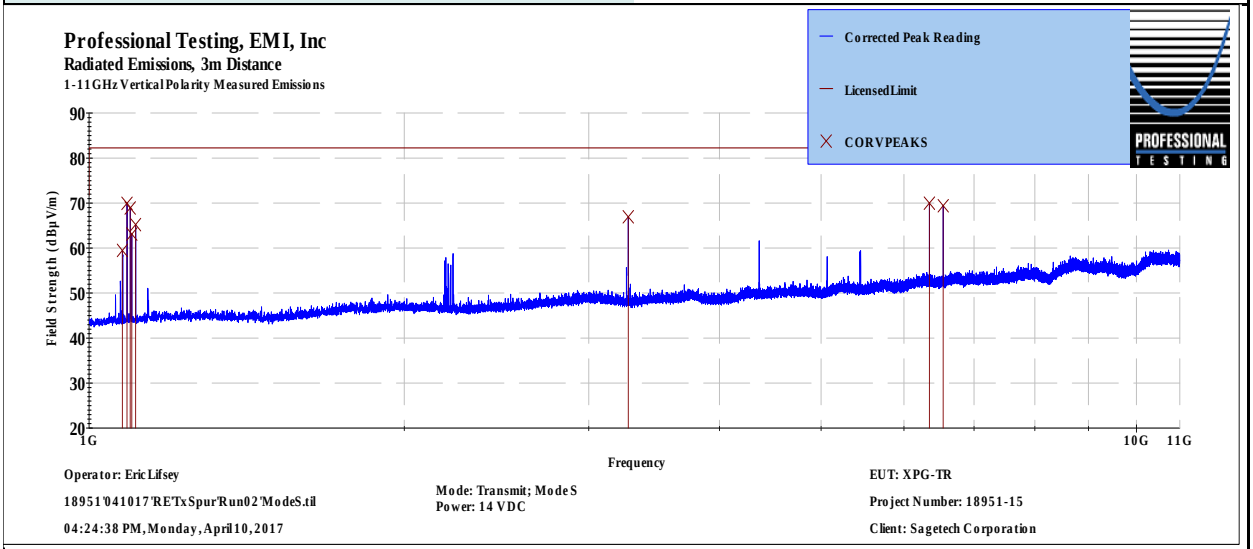


> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.5 Transmit Mode S; Radiated Emissions, 1 to 11 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	**EUT Serial #:**	267
Customer:	Sagetech Corporation	**EUT Part #:**	None
Project Number:	18951-10	**Test Technician:**	Dave Kohutek
Purchase Order #:	8196	**Supervisor:**	Lisa Arndt
Equip. Under Test:	XPG-TR	**Witness' Name:**	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	**EUT Power Frequency:**	N/A N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit S Mode	

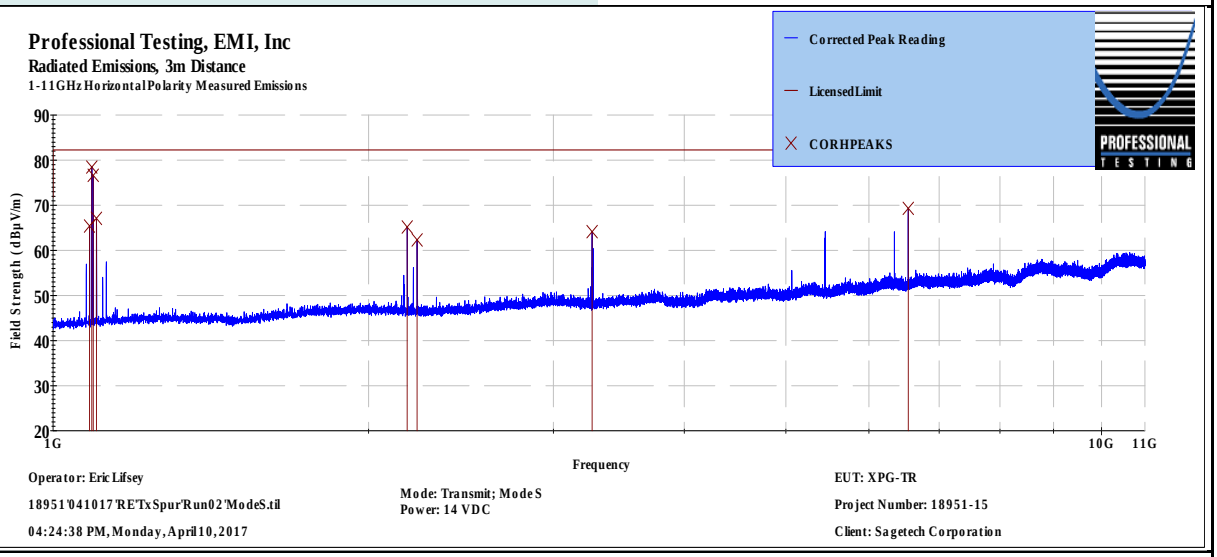


> 1GHz Vertical Antenna Polarity Measured Emissions

6.3.6 Transmit Mode S; Radiated Emissions, 1 to 11 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit S Mode	



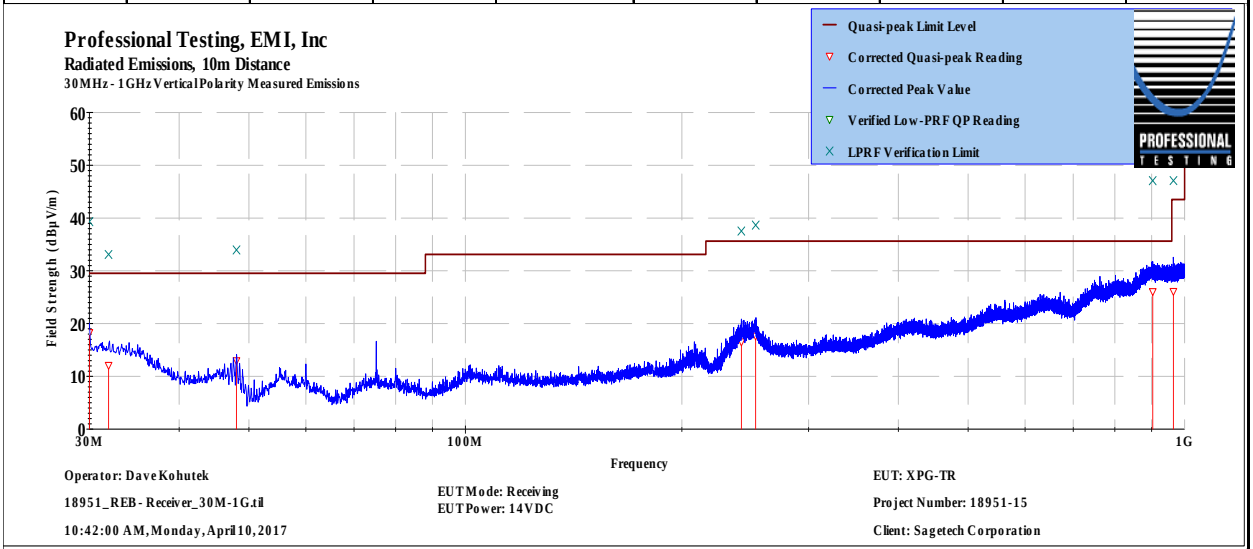
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.7 Receive Mode; Radiated Emissions, 30 MHz to 1 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receiving	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
30	10	41	1	Quasi-peak	30.4	18.303	29.5	-11.2	Pass
31.898	10	100	3.91	Quasi-peak	24.1	12.086	29.5	-17.4	Pass
48.0469	10	180	2.48	Quasi-peak	32.7	12.944	29.5	-16.6	Pass
241.957	10	232	1.57	Quasi-peak	27.9	16.52	35.6	-19.1	Pass
253.309	10	110	1.34	Quasi-peak	27.7	17.644	35.6	-18.0	Pass
903.111	10	207	2.57	Quasi-peak	21.2	26.06	35.6	-9.5	Pass
964.86	10	58	2.27	Quasi-peak	21	26.091	43.5	-17.4	Pass



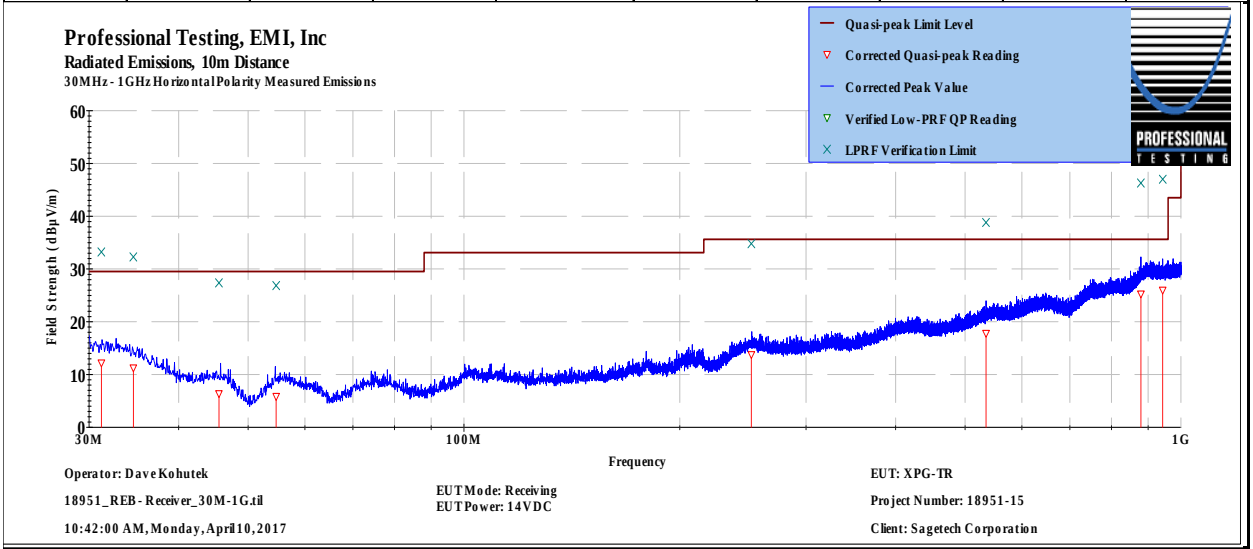
≤ 1GHz Vertical Antenna Polarity Measured Emissions

6.3.8 Receive Mode; Radiated Emissions, 30 MHz to 1 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receiving	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.209	10	176	2.84	Quasi-peak	24.2	12.212	29.5	-17.3	Pass
34.5848	10	299	2.92	Quasi-peak	23.1	11.272	29.5	-18.2	Pass
45.5237	10	61	3.45	Quasi-peak	23.3	6.379	29.5	-23.1	Pass
54.7125	10	263	3.26	Quasi-peak	23.8	5.851	29.5	-23.6	Pass
251.741	10	250	2.17	Quasi-peak	23.8	13.783	35.6	-21.8	Pass
534.657	10	197	2.15	Quasi-peak	22.2	17.82	35.6	-17.8	Pass
879.454	10	326	1.41	Quasi-peak	21.4	25.284	35.6	-10.3	Pass
943.258	10	244	1.93	Quasi-peak	21.1	26.009	35.6	-9.6	Pass



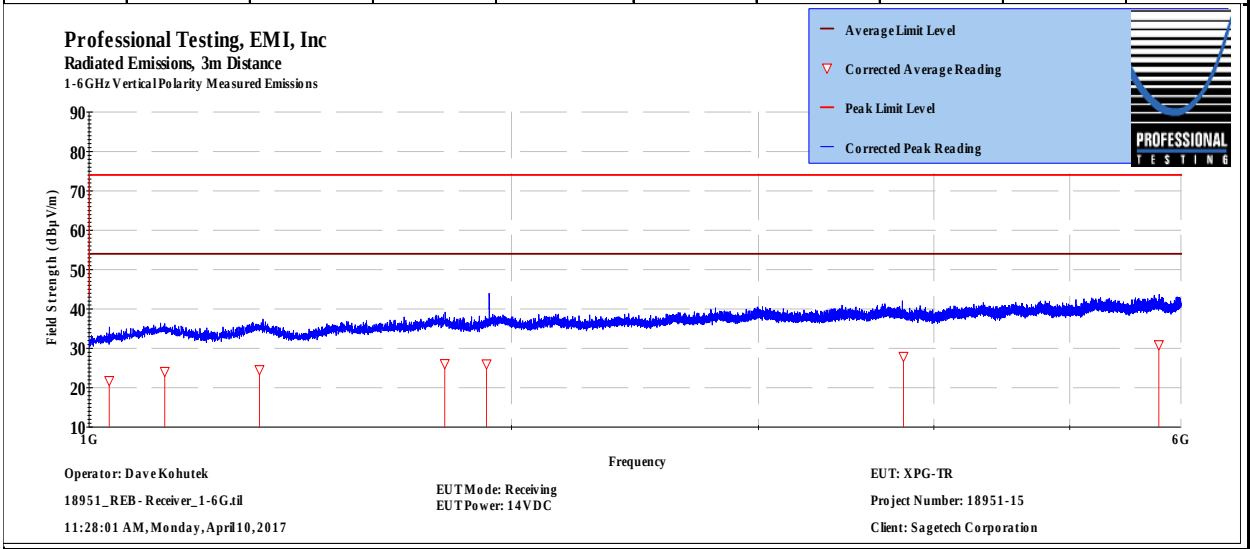
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.9 Receive Mode; Radiated Emissions, 1 to 11 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receiving	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1033.69	3	97	1.23	Average	35.1	21.851	54.0	-32.1	Pass
1132.13	3	199	3.42	Average	36.8	24.153	54.0	-29.8	Pass
1322.74	3	143	2.66	Average	36.5	24.598	54.0	-29.4	Pass
1792.59	3	174	3.31	Average	36	26.156	54.0	-27.8	Pass
1919.81	3	153	1.7	Average	35.5	26.089	54.0	-27.9	Pass
3804.99	3	256	3.01	Average	34.5	27.978	54.0	-26.0	Pass
5786.67	3	175	1.15	Average	32.2	30.944	54.0	-23.0	Pass



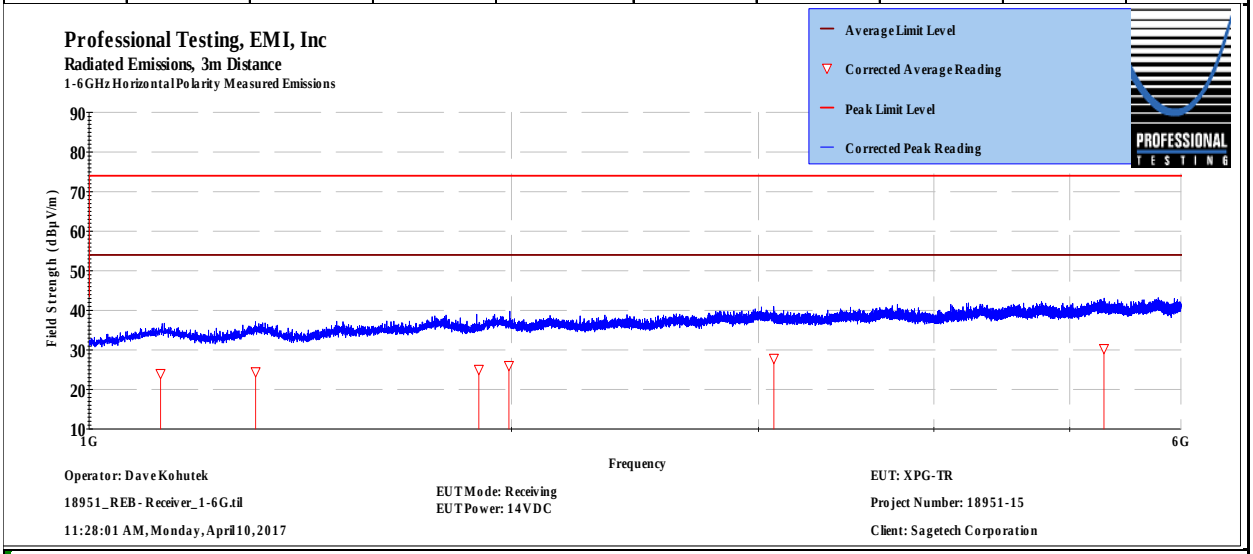
> 1GHz Vertical Antenna Polarity Measured Emissions

6.3.10 Receive Mode; Radiated Emissions, 1 to 11 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	4/10/2017	EUT Serial #:	267
Customer:	Sagetech Corporation	EUT Part #:	None
Project Number:	18951-10	Test Technician:	Dave Kohutek
Purchase Order #:	8196	Supervisor:	Lisa Arndt
Equip. Under Test:	XPG-TR	Witness' Name:	Matt Hamilton

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receiving	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1124.37	3	48	3.02	Average	36.7	24.032	54.0	-29.9	Pass
1314.15	3	107	2.25	Average	36.4	24.522	54.0	-29.4	Pass
1895.64	3	183	3.11	Average	34.6	25.093	54.0	-28.9	Pass
1991.89	3	141	3.59	Average	35.3	26.076	54.0	-27.9	Pass
3076.32	3	102	2.79	Average	35.2	27.889	54.0	-26.1	Pass
5287.85	3	15	1.1	Average	32.9	30.336	54.0	-23.6	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Frequency Stability

7.1 Test Procedure

The EUT was placed into a temperature chamber and connected by cable to a spectrum analyzer; attenuation added if needed. On reaching each set point temperature, the EUT was allowed to soak until the internal temperature sensor stabilized. After soak time was satisfied, the EUT transmitter was powered on in transmit mode and the frequency was observed until it became stable; then the measurement of frequency was taken.

Operating voltage stability was also measured for selected extremes based on operating design.

The EUT was operated in a modulated mode.

7.2 Test Criteria

Table 7.2.1 Frequency Stability Criteria, 87.133; 2.1055(a)(1)
Parameter: Frequency Tolerance
1000 ppm or ±1,090,000 Hz for 1090 MHz Operating Frequency

Table 7.2.2 Test Conditions, Temperatures
-30 C to 50 C and by 10 C steps

Table 7.2.3 Test Conditions, Voltage (From manufacturers specifications.)	
Low Voltage	10 VDC
Nominal Voltage	14 VDC
High Voltage	32 VDC

7.3 Test Results

The EUT satisfies the requirement. Tabular results appear below.

7.3.1 Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	1090.000000	1089.938700	-61300
-20	1090.000000	1090.083900	83900
-10	1090.000000	1089.967300	-32700
0	1090.000000	1089.931300	-68700
10	1090.000000	1089.984400	-15600
20	1090.000000	1089.970400	-29600
30	1090.000000	1089.985000	-15000
40	1090.000000	1089.966100	-33900
50	1090.000000	1089.996600	-3400
Max Deviation (Hz)			83900
Min Deviation (Hz)			-68700

7.3.2 Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.00	1090.000000	1090.000300	300
Nominal	14.00	1090.000000	1089.946000	-54000
High	32.00	1090.000000	1089.996000	-4000

8.0 Equipment Lists

Table 8.1 Equipment List; Power, Bandwidth, Spurious Conducted, and Mask				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
0835	Narda	3293-1	Forward Power Coupler -10 dB	8 Oct 2018
A105	Narda	768-20	Attenuator, 20 W, 20 dB	5 Oct 2018
0856	Narda	702-60	Step Attenuator 60 dB in 10 dB Steps	7 Oct 2018
0472	Tektronix	THS730A	Scope/DMM	15 Nov 2017
1831	HP	6622A	Adjustable DC Power Supply	CIU

Table 8.2 Equipment List; Frequency Stability (In addition to equipment listed in 8.1.)				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
2134	Tenny	TPC T2C	Temperature Chamber	12 Oct 2017
C247	Pasternack	RG type	Coaxial Cable, double shielded	CNR

Table 8.3 Equipment List; Radiated Emissions

Radiated Emissions Test Equipment List					
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**				
Test Profile:	**2016 RE_ClassB - Boresite+Mast_LowPRF_032117.til**				
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2017
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/1/2018
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
C027D	PTI	None	Relay	none	N/A
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/19/2017
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2017
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019
A114	none	none	Attenuator, SMA, 10dB, 1W, DC-18GHz	none	10/4/2018
846	SMT	41241	Filter, High Pass, 1.5 GHz	101	4/6/2018
2205	Astron	VS-35M	Power Supply	204100014	N/A

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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