

Tehama Wireless

TEST REPORT FOR

**900 MHz transceiver
Model: MDT TW113**

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

**15.247
(DTS 902-928 MHz)**

Report No.: 102436-16

Date of issue: June 10, 2019



Test Certificate # 803.06

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Tehama Wireless
2607 7th St, Suite G
Berkeley, CA 94710

Representative: Laurence Plouvier
Customer Reference Number: 2238

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

Morgan Tramontin
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 102436

May 16, 2019

May 16-21, 2019

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink that reads "Steve Behm".

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.12

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS 902-928MHz)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable

NA1 = Not applicable because the EUT is operated by an internal battery.

ISO/IEC 17025 Decision Rule

The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions

The EUT is wired to present the worst case wiring configuration during testing.

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
900 MHz transceiver	Tehama Wireless	MDT TW113	1

Support Equipment:

Device	Manufacturer	Model #	S/N
AC/DC Adapter for Laptop	HP	PA-1121-12HN	PPP017L
Laptop	HP	EliteBook 8470p	N9193475

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
900 MHz transceiver	Tehama Wireless	MDT TW113	2

Support Equipment:

Device	Manufacturer	Model #	S/N
AC/DC Adapter for Laptop	HP	PA-1121-12HN	PPP017L
Laptop	HP	EliteBook 8470p	N9193475

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	DTS
Operating Frequency Range:	906-924MHz
Modulation Type(s):	Lora
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	2dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	3.6VDC
Software used for Test:	Super Term V2.21

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

Test Setup / Conditions

Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013)	Test Date(s):	5/16/2019
Configuration:	2		
Test Setup:	The EUT is placed on non-conductive table. It is operated and set as intended.		

Environmental Conditions

Temperature (°C)	22.7	Relative Humidity (%):	47
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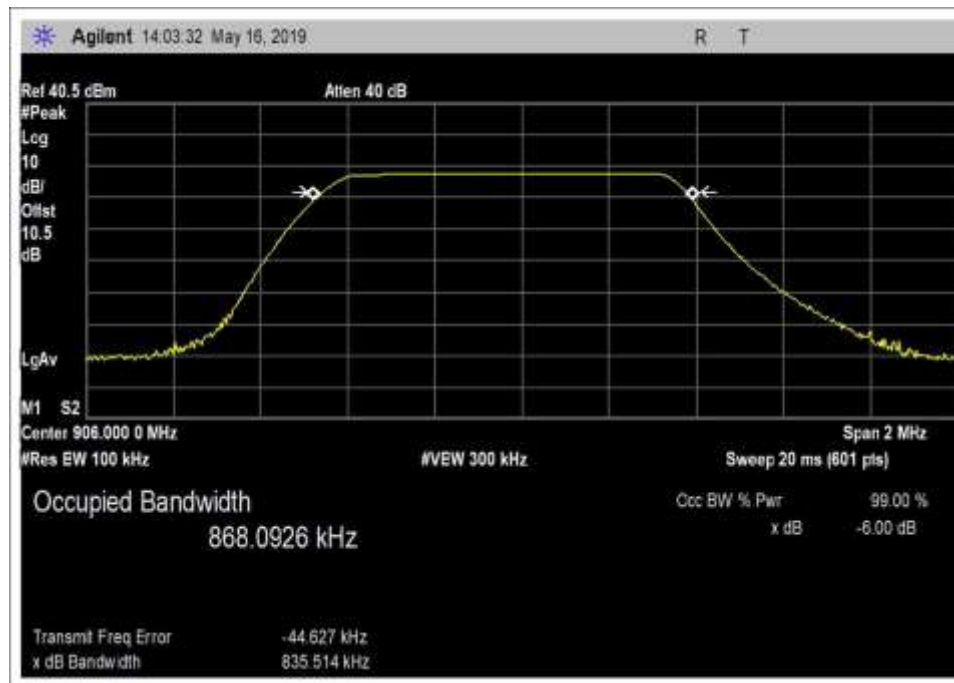
Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P07192	Cable	Astro	32022-29094K-29094K-48TC	10/9/2017	10/9/2019
P05411	Attenuator	Weinschel	54A-10	1/19/2018	1/19/2020
02660	Spectrum Analyzer	Agilent	E4446A	10/19/2018	10/19/2020

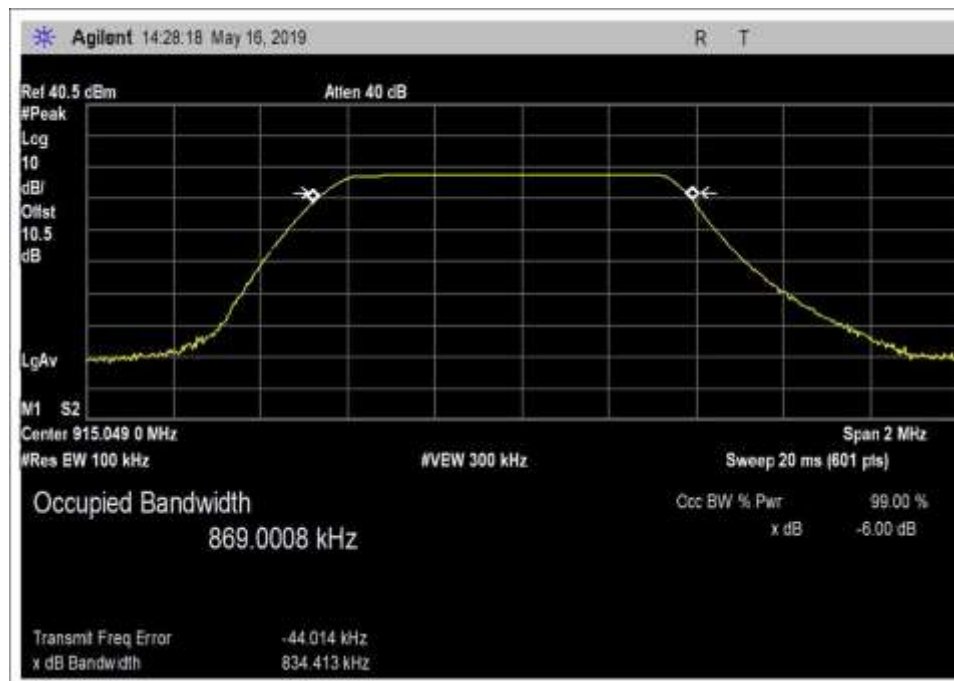
Test Data Summary

Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
906	1	Lora	835.514	≥500	Pass
915.049	1	Lora	834.413	≥500	Pass
924	1	Lora	831.283	≥500	Pass

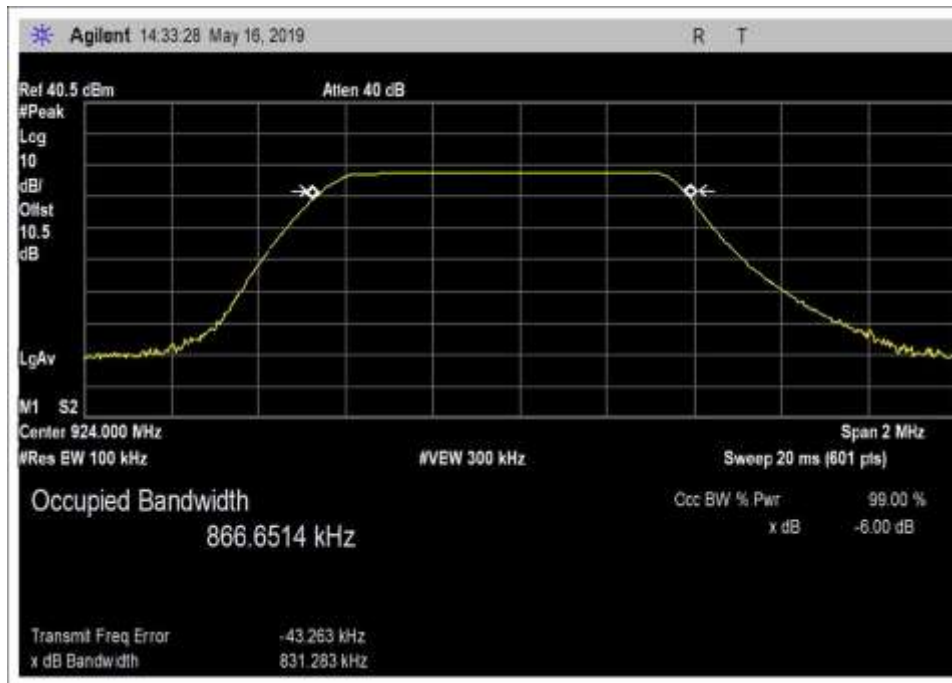
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



15.247(b)(3) Output Power

Test Setup / Conditions

Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013)	Test Date(s):	5/16/2019
Configuration:	2		
Test Setup:	The EUT is placed on non-conductive table. It is operated and set as intended.		

Environmental Conditions

Temperature (°C)	22.7	Relative Humidity (%):	47
------------------	------	------------------------	----

Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P07192	Cable	Astro	32022-29094K-29094K-48TC	10/9/2017	10/9/2019
P05411	Attenuator	Weinschel	54A-10	1/19/2018	1/19/2020
02660	Spectrum Analyzer	Agilent	E4446A	10/19/2018	10/19/2020

Test Data Summary - Voltage Variations

This equipment is battery powered. Power output tests were performed using a fresh battery.

Test Data Summary - RF Conducted Measurement

Measurement Option: RBW > DTS Bandwidth

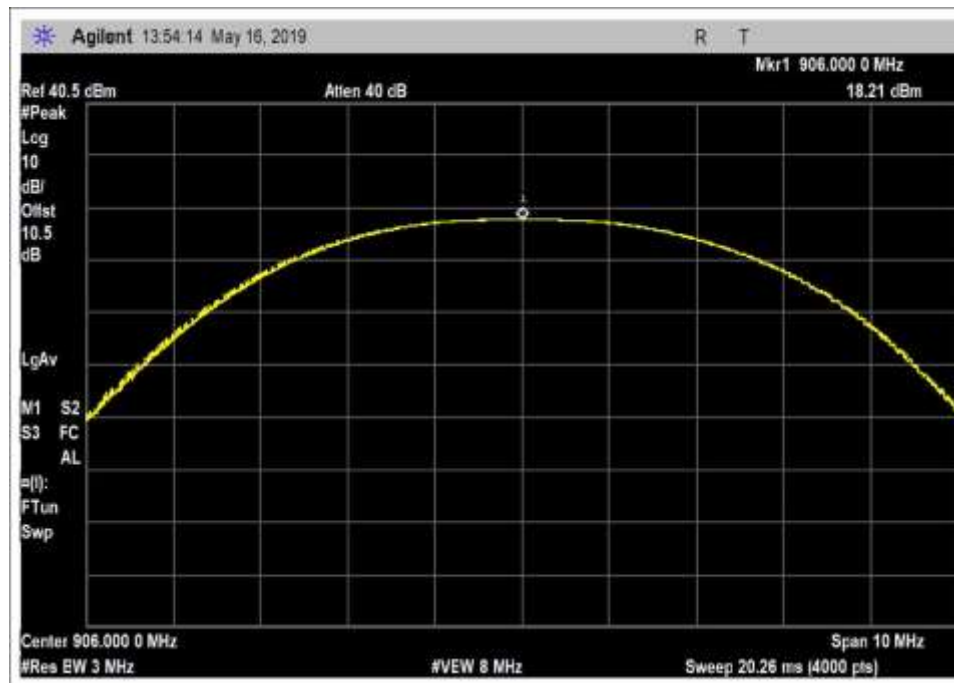
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
906	Lora	Integral/2	18.21	≤30	Pass
915.049	Lora	Integral/2	18.19	≤30	Pass
924	Lora	Integral/2	18.23	≤30	Pass

For fixed point-to-point antennas, the limit is calculated in accordance with 15.247(c)(1):

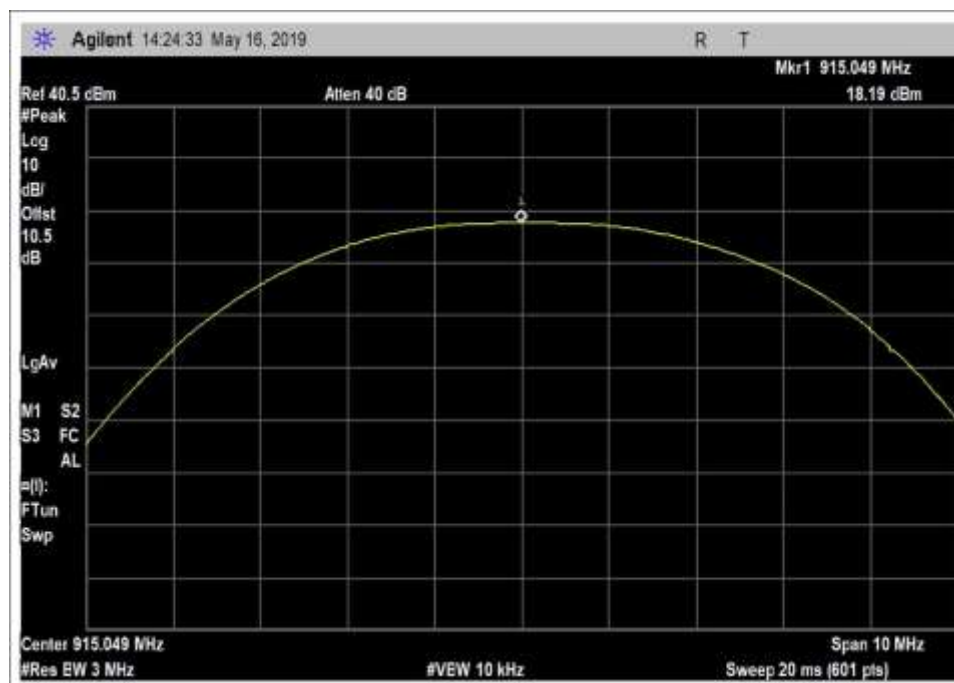
$$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$$

For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

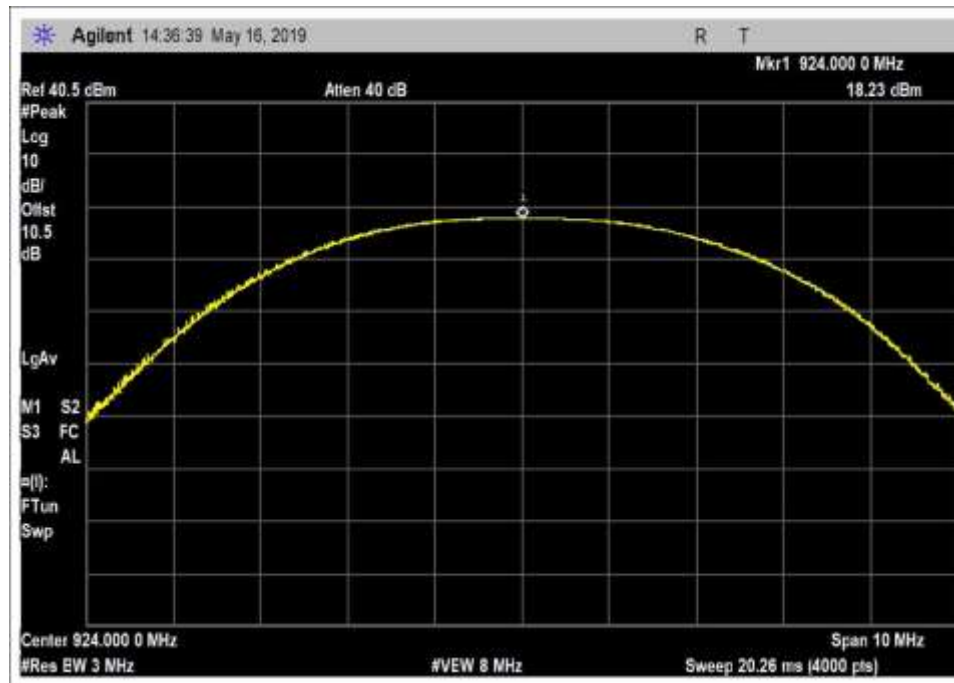
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



15.247(e) Power Spectral Density

Test Setup/Conditions

Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013)	Test Date(s):	5/16/2019
Configuration:	2		
Test Setup:	The EUT is placed on non-conductive table. It is operated and set as intended.		

Environmental Conditions

Temperature (°C)	22.7	Relative Humidity (%):	47
------------------	------	------------------------	----

Test Equipment

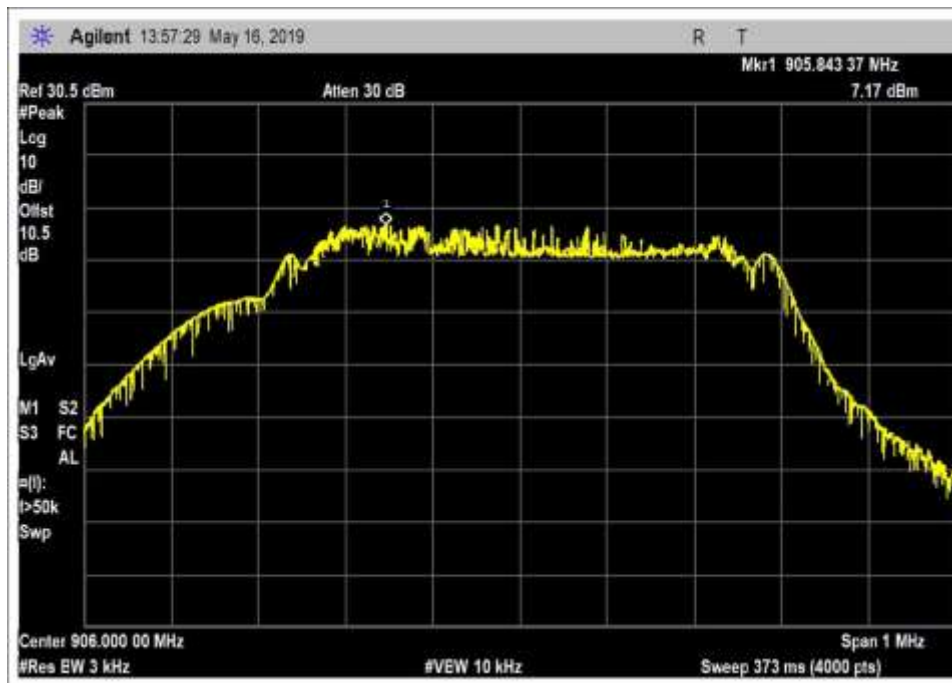
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
P07192	Cable	Astro	32022-29094K-29094K-48TC	10/9/2017	10/9/2019
P05411	Attenuator	Weinschel	54A-10	1/19/2018	1/19/2020
02660	Spectrum Analyzer	Agilent	E4446A	10/19/2018	10/19/2020

Test Data Summary - RF Conducted Measurement

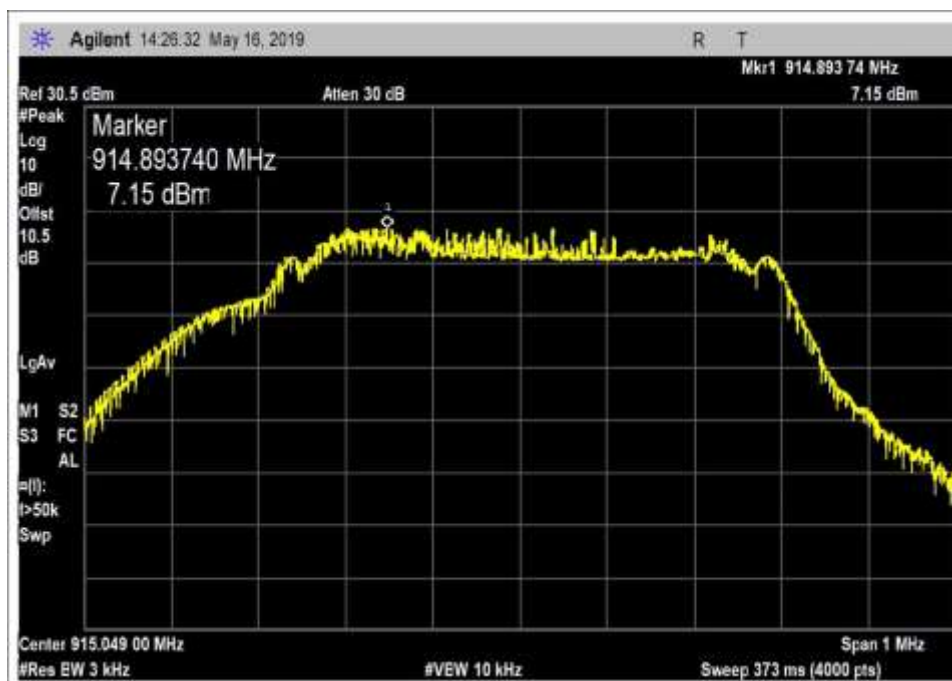
Measurement Method: PKPSD

Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
906	Lora	7.17	≤8	Pass
915.049	Lora	7.15	≤8	Pass
924	Lora	7.19	≤8	Pass

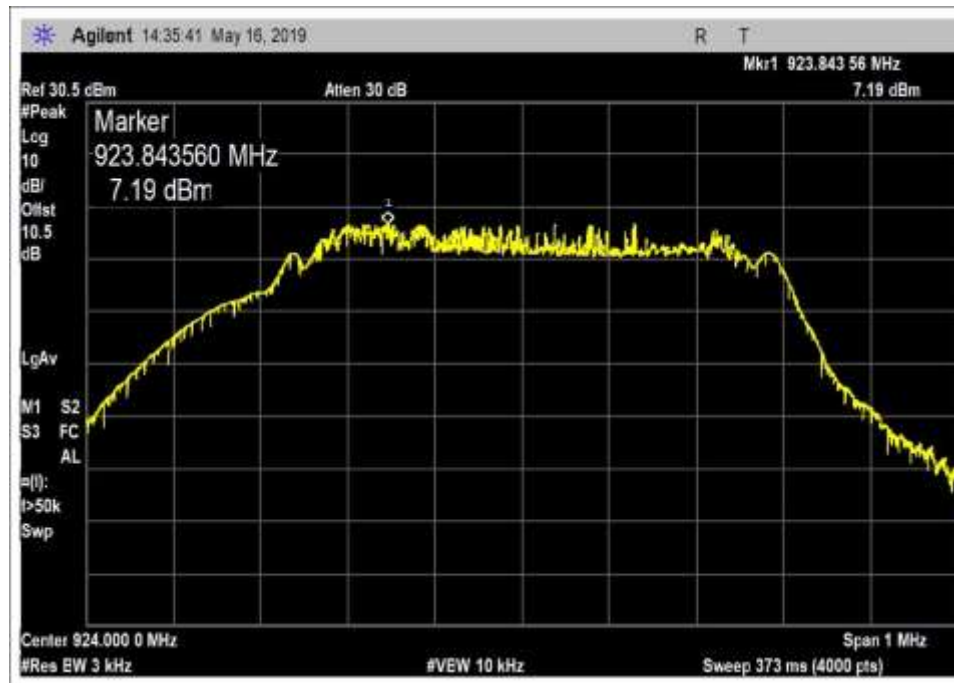
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **102436** Date: 5/16/2019
 Test Type: **Conducted Spurious Emission** Time: 3:58:17 PM
 Tested By: Hieu Song Nguyenpham Sequence#: 7
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

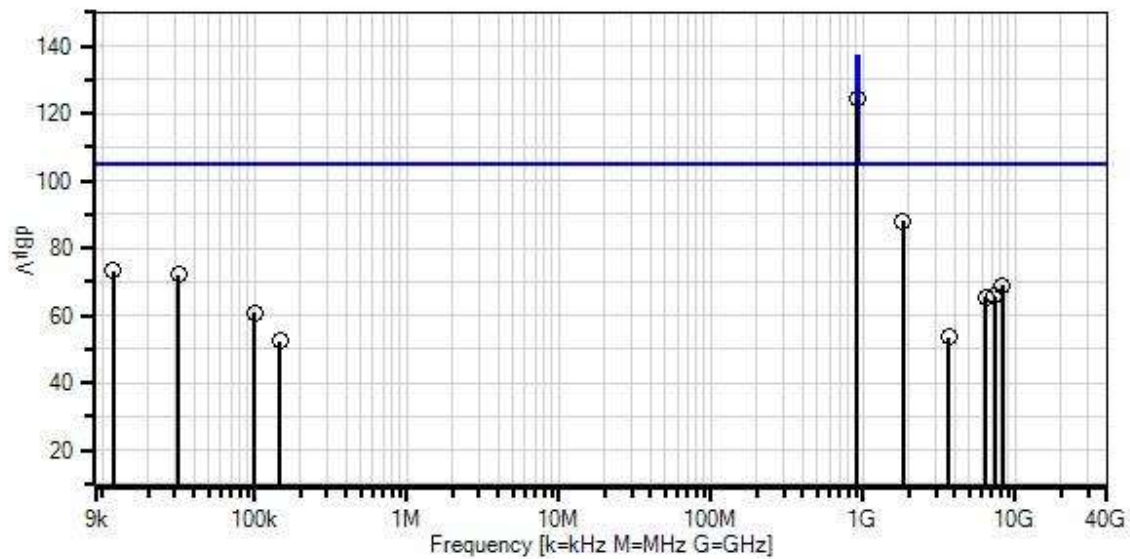
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Conducted Emission Frequency Range: 9kHz to 10000MHz Application: Super Term V2.21 Temperature: 22.7°C Humidity: 47 % Atmospheric Pressure: 101.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi RBW=100kHz VBW=300kHz The EUT is placed on a non-conductive table and set continuously transmitting as intended. DTS Lora Low Channel

Tehama Wireless W/O#: 102436 Sequence#: 7 Date: 5/16/2019
 15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) Conducted Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05411	Attenuator	54A-10	1/19/2018	1/19/2020
T2	ANP07192	Cable	32022-29094K- 29094K-48TC	10/9/2017	10/9/2019
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	905.870M	114.6	+9.3	+0.5		+0.0	124.4	137.0	-12.6	None
2	1812.288M	78.2	+9.3	+0.7		+0.0	88.2	105.0	-16.8	None
3	11.880k	64.1	+9.2	+0.0		+0.0	73.3	105.0	-31.7	None
4	31.623k	63.0	+9.2	+0.0		+0.0	72.2	105.0	-32.8	None
5	8157.032M	57.8	+9.5	+1.5		+0.0	68.8	105.0	-36.2	None
6	7248.876M	54.9	+9.4	+1.5		+0.0	65.8	105.0	-39.2	None
7	6340.719M	54.6	+9.4	+1.3		+0.0	65.3	105.0	-39.7	None
8	100.432k	51.7	+9.2	+0.0		+0.0	60.9	105.0	-44.1	None
9	3622.736M	43.2	+9.3	+1.0		+0.0	53.5	105.0	-51.5	None
10	146.272k	43.1	+9.2	+0.0		+0.0	52.3	105.0	-52.7	None



Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
Customer: **Tehama Wireless**
Specification: **15.247(d) Conducted Spurious Emissions**
Work Order #: **102436** Date: 5/16/2019
Test Type: **Conducted Spurious Emission** Time: 4:05:13 PM
Tested By: Hieu Song Nguyenpham Sequence#: 8
Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

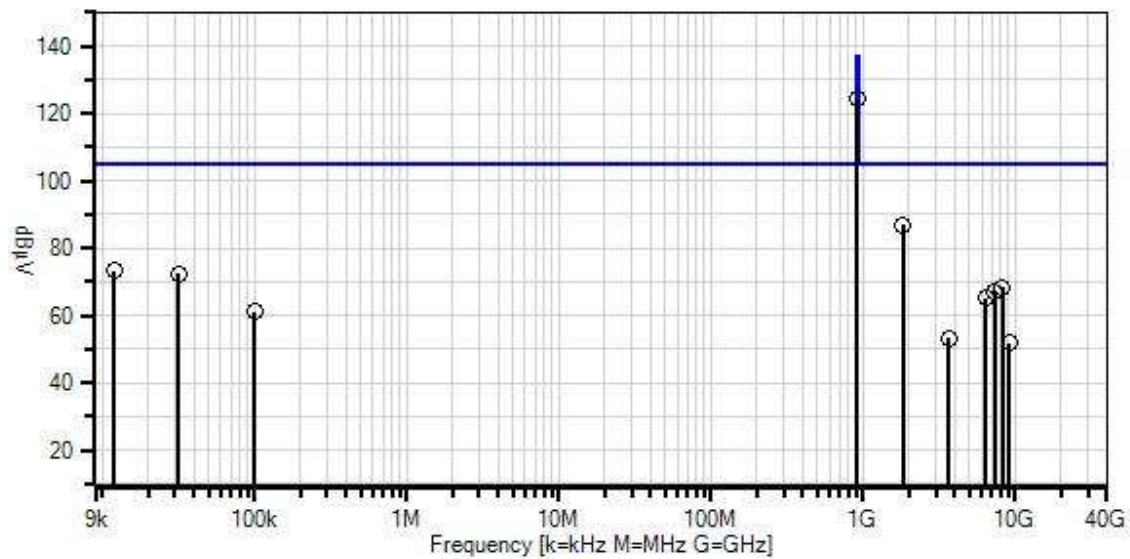
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Conducted Emission Frequency Range: 9kHz to 10000MHz Application: Super Term V2.21 Temperature: 22.7°C Humidity: 47 % Atmospheric Pressure: 101.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi RBW=100kHz VBW=300kHz The EUT is placed on a non-conductive table and set continuously transmitting as intended. DTS Lora Middle Channel
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Tehama Wireless W/O#: 102436 Sequence#: 8 Date: 5/16/2019
 15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) Conducted Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05411	Attenuator	54A-10	1/19/2018	1/19/2020
T2	ANP07192	Cable	32022-29094K- 29094K-48TC	10/9/2017	10/9/2019
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	914.952M	114.6	+9.3	+0.5		+0.0	124.4	137.0	-12.6	None
2	1828.698M	77.0	+9.3	+0.7		+0.0	87.0	105.0	-18.0	None
3	12.074k	64.2	+9.2	+0.0		+0.0	73.4	105.0	-31.6	None
4	31.623k	63.3	+9.2	+0.0		+0.0	72.5	105.0	-32.5	None
5	8234.874M	57.2	+9.5	+1.6		+0.0	68.3	105.0	-36.7	None
6	7320.231M	56.3	+9.4	+1.5		+0.0	67.2	105.0	-37.8	None
7	6405.587M	54.5	+9.4	+1.3		+0.0	65.2	105.0	-39.8	None
8	100.432k	51.9	+9.2	+0.0		+0.0	61.1	105.0	-43.9	None
9	3661.657M	43.0	+9.3	+1.0		+0.0	53.3	105.0	-51.7	None
10	9149.518M	40.8	+9.5	+1.6		+0.0	51.9	105.0	-53.1	None



Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **102436** Date: 5/16/2019
 Test Type: **Conducted Spurious Emission** Time: 4:12:13 PM
 Tested By: Hieu Song Nguyenpham Sequence#: 9
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

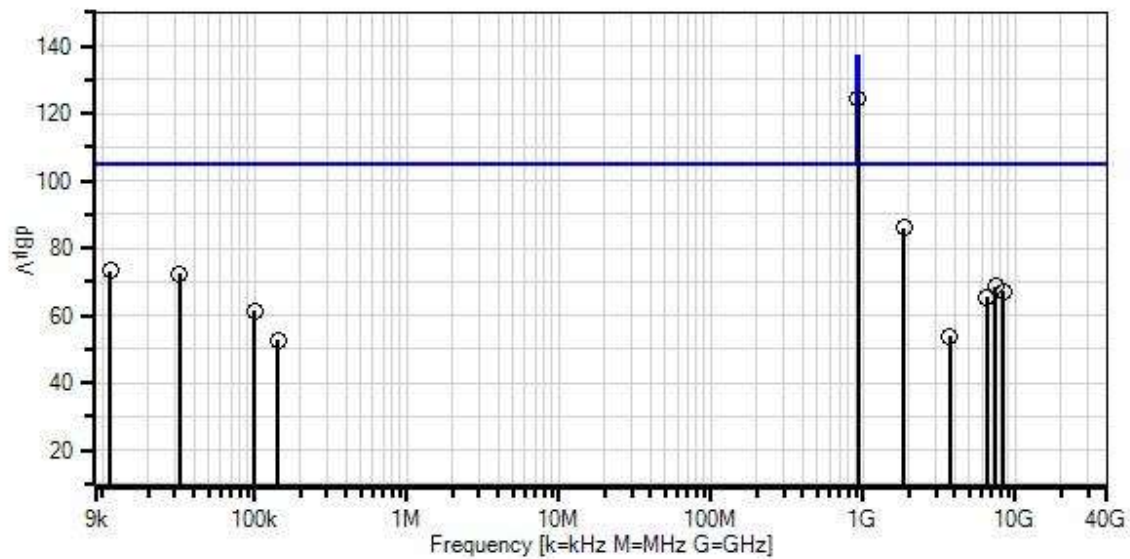
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Conducted Emission Frequency Range: 9kHz to 10000MHz Application: Super Term V2.21 Temperature: 22.7°C Humidity: 47 % Atmospheric Pressure: 101.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi RBW=100kHz VBW=300kHz The EUT is placed on a non-conductive table and set continuously transmitting as intended. DTS Lora High Channel
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Tehama Wireless W/O#: 102436 Sequence#: 9 Date: 5/16/2019
 15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) Conducted Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05411	Attenuator	54A-10	1/19/2018	1/19/2020
T2	ANP07192	Cable	32022-29094K- 29094K-48TC	10/9/2017	10/9/2019
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	924.033M	114.7	+9.3	+0.5		+0.0	124.5	137.0	-12.5	None
2	1847.160M	75.9	+9.3	+0.7		+0.0	85.9	105.0	-19.1	None
3	11.318k	64.2	+9.2	+0.0		+0.0	73.4	105.0	-31.6	None
4	32.101k	63.2	+9.2	+0.0		+0.0	72.4	105.0	-32.6	None
5	7391.586M	57.7	+9.4	+1.5		+0.0	68.6	105.0	-36.4	None
6	8312.716M	56.2	+9.5	+1.6		+0.0	67.3	105.0	-37.7	None
7	6470.456M	54.7	+9.4	+1.4		+0.0	65.5	105.0	-39.5	None
8	100.000k	52.2	+9.2	+0.0		+0.0	61.4	105.0	-43.6	None
9	3694.091M	43.6	+9.3	+1.0		+0.0	53.9	105.0	-51.1	None
10	143.678k	43.5	+9.2	+0.0		+0.0	52.7	105.0	-52.3	None

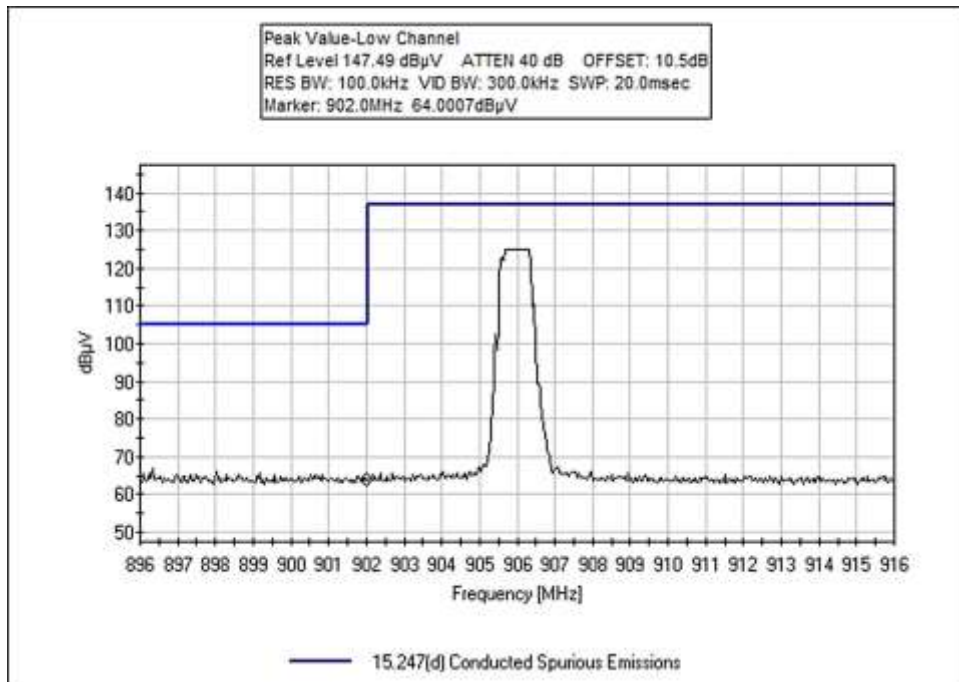
Band Edge

Band Edge Summary

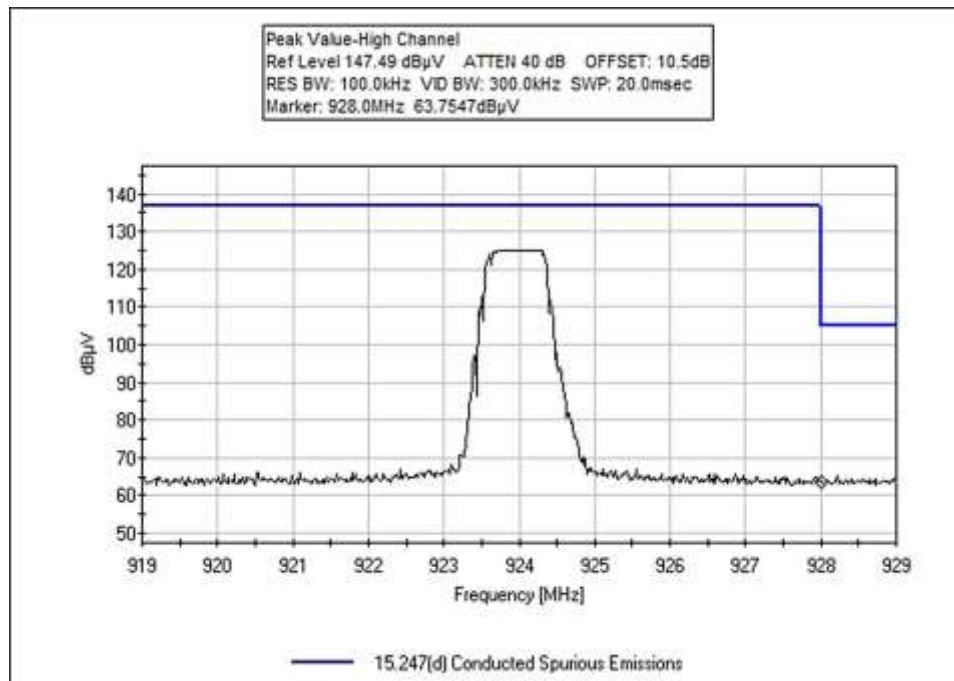
Limit applied: Max Power/100kHz - 20dB.

Frequency (MHz)	Modulation	Measured (dBuV)	Limit (dBuV)	Results
902	Lora	64.0007	<105	Pass
928	Lora	63.7547	<105	Pass

Band Edge Plots



Low Channel



High Channel

Test Setup Photo(s)



15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **102436** Date: 5/21/2019
 Test Type: **Radiated Scan** Time: 13:47:00
 Tested By: Hieu Song Nguyenpham Sequence#: 58
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
 Frequency Range: 9kHz to 1GHz

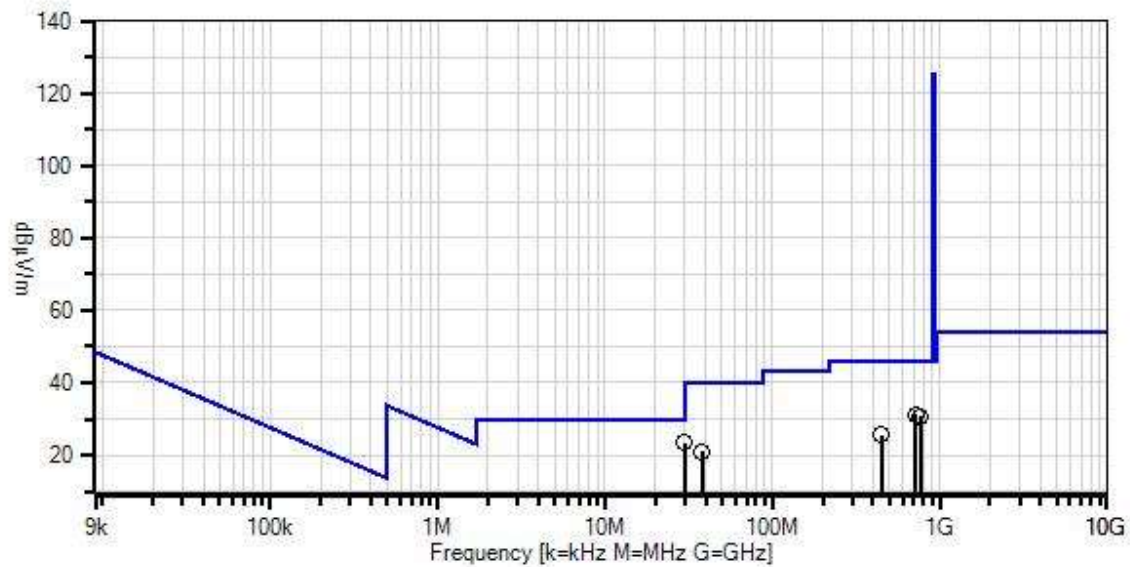
 Application: Super Term V2.21
 Temperature: 21.8°C
 Humidity: 43 %
 Atmospheric Pressure: 101.4kPa
 Highest Generation Frequency: 924MHz
 Method: ANSI C 63.10 2013
 Antenna Gain: 2dBi

 The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC.

 DTS Lora
 Low Channel

 The EUT is placed on the table per installation position and continuously transmitting as intended.
 It is powered by an internal battery at 3.6VDC.

Tehama Wireless W/O#: 102436 Sequence#: 58 Date: 5/21/2019
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	ANP07508	Preamplifier	310N	10/15/2018	10/15/2020
T2	ANP06049	Attenuator	PE7002-6	5/14/2018	5/14/2020
T3	ANP00880	Cable	RG214U	5/14/2018	5/14/2020
T4	ANP01187	Cable	CNT-195	8/20/2018	8/20/2020
T5	ANP06691	Cable	PE3062-180	5/14/2018	5/14/2020
T6	AN00852	Biconilog Antenna	CBL 6111C	5/1/2018	5/1/2020
	AN00432	Loop Antenna	6502	2/19/2019	2/19/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	719.766M	32.1	-32.3 +1.1	+6.0 +20.7	+2.9	+0.7	+0.0	31.2	46.0	-14.8	Horiz
2	768.807M	30.5	-32.3 +1.2	+6.0 +21.6	+2.9	+0.8	+0.0	30.7	46.0	-15.3	Horiz
3	30.000M	29.9	-32.1 +0.2	+5.9 +18.9	+0.5	+0.1	+0.0	23.4	40.0	-16.6	Horiz
4	37.870M	30.9	-32.1 +0.2	+5.9 +15.5	+0.5	+0.1	+0.0	21.0	40.0	-19.0	Horiz
5	451.208M	31.0	-31.9 +0.9	+5.9 +16.9	+2.2	+0.5	+0.0	25.5	46.0	-20.5	Horiz

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **102436** Date: 5/17/2019
 Test Type: **Radiated Scan** Time: 14:03:27
 Tested By: Hieu Song Nguyenpham Sequence#: 30
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

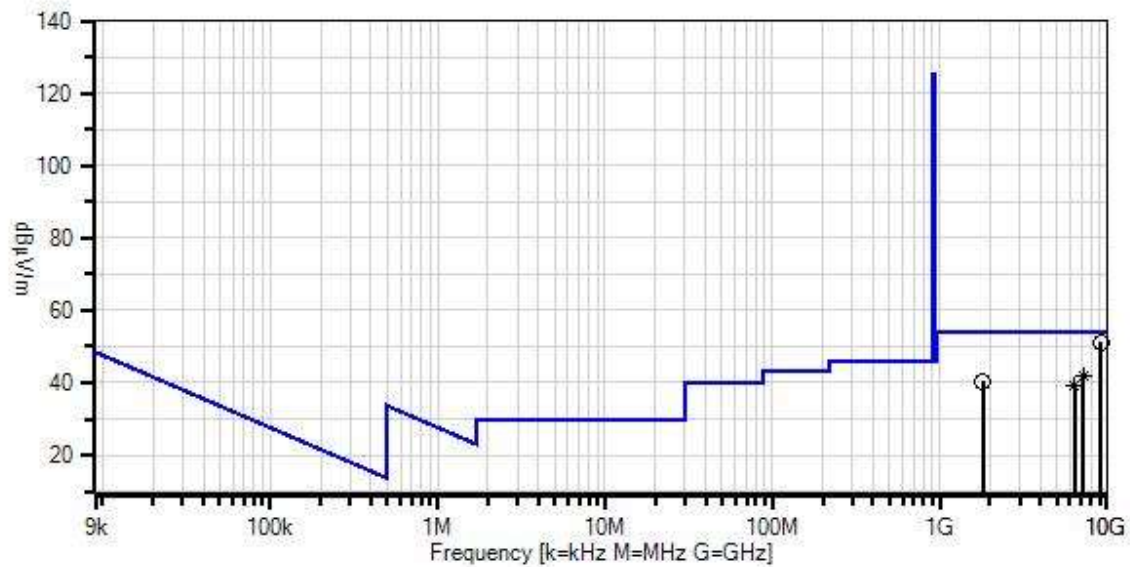
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Conducted Emission Frequency Range: 1GHz to 10GHz Application: Super Term V2.21 Temperature: 22.9°C Humidity: 44 % Atmospheric Pressure: 102.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC. DTS Lora Low Channel The EUT is placed on the table per installation position and continuously transmitting as intended. It is powered by an internal battery at 3.6VDC.
--

Tehama Wireless W/O#: 102436 Sequence#: 30 Date: 5/17/2019
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	AN03013	Cable	32022-2-2909K-36TC	6/25/2018	6/25/2020
T2	AN03607	Preamp	AMF-7D-00101800-30-10P	6/6/2017	6/6/2019
T3	AN02157	Horn Antenna-ANSI C63.5	3115	1/15/2019	1/15/2021
T4	AN03302	Cable	32026-29094K-29094K-72TC	1/15/2018	1/15/2020
T5	ANP01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
T6	AN03172	High Pass Filter	HM1155-11SS	4/5/2018	4/5/2020

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	9172.825M	62.2	+1.3 +5.4	-59.1 +0.1	+38.7	+2.6	+0.0	51.2	54.0	-2.8	Horiz
2	7248.197M	56.5	+1.1 +4.8	-59.2 +0.1	+36.2	+2.3	+0.0	41.8	54.0	-12.2	Horiz
^	7248.197M	69.4	+1.1 +4.8	-59.2 +0.1	+36.2	+2.3	+0.0	54.7	54.0	+0.7	Horiz
4	1811.818M	68.4	+0.5 +2.2	-58.1 +0.3	+26.1	+1.1	+0.0	40.5	54.0	-13.5	Horiz
5	6341.943M	56.4	+1.0 +4.4	-59.5 +0.1	+34.5	+2.1	+0.0	39.0	54.0	-15.0	Horiz
^	6341.943M	69.1	+1.0 +4.4	-59.5 +0.1	+34.5	+2.1	+0.0	51.7	54.0	-2.3	Horiz

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **102436** Date: 5/21/2019
 Test Type: **Radiated Scan** Time: 14:31:53
 Tested By: Hieu Song Nguyenpham Sequence#: 61
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

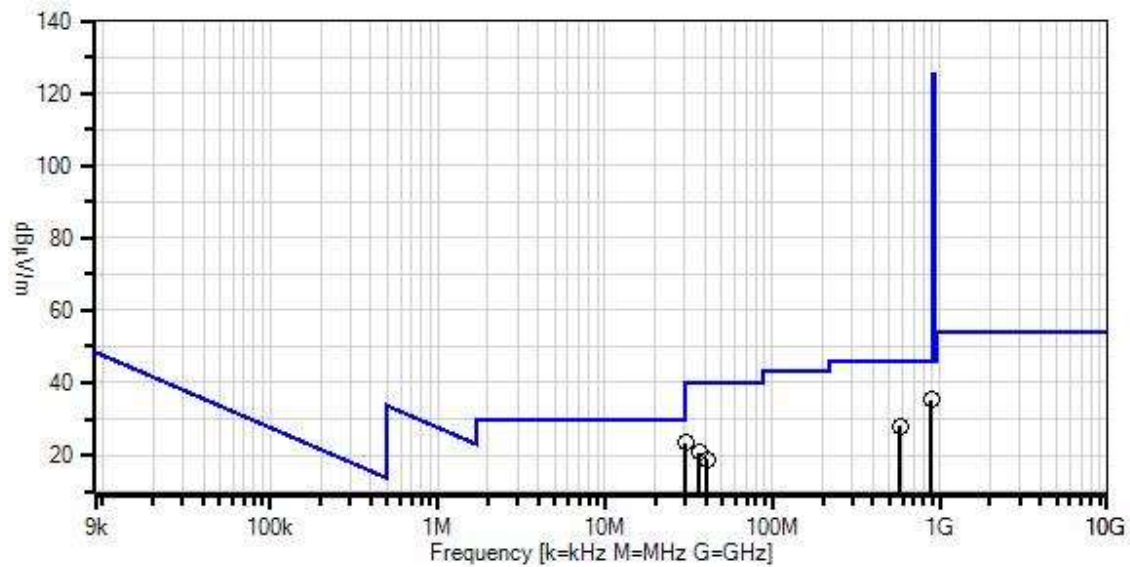
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission Frequency Range: 9kHz to 1GHz Application: Super Term V2.21 Temperature: 21.8°C Humidity: 43 % Atmospheric Pressure: 101.4kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC. DTS Lora Middle Channel The EUT is placed on the table per installation position and continuously transmitting as intended. It is powered by an internal battery at 3.6VDC.

Tehama Wireless W/O#: 102436 Sequence#: 61 Date: 5/21/2019
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	ANP07508	Preamplifier	310N	10/15/2018	10/15/2020
T2	ANP06049	Attenuator	PE7002-6	5/14/2018	5/14/2020
T3	ANP00880	Cable	RG214U	5/14/2018	5/14/2020
T4	ANP01187	Cable	CNT-195	8/20/2018	8/20/2020
T5	ANP06691	Cable	PE3062-180	5/14/2018	5/14/2020
T6	AN00852	Biconilog Antenna	CBL 6111C	5/1/2018	5/1/2020
	AN00432	Loop Antenna	6502	2/19/2019	2/19/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	893.745M	32.8	-31.9 +1.4	+5.9 +22.8	+3.3	+0.9	+0.0	35.2	46.0	-10.8	Horiz
2	30.210M	30.1	-32.1 +0.2	+5.9 +18.8	+0.5	+0.1	+0.0	23.5	40.0	-16.5	Horiz
3	574.978M	30.7	-32.1 +1.0	+6.0 +19.3	+2.5	+0.6	+0.0	28.0	46.0	-18.0	Horiz
4	36.271M	30.1	-32.1 +0.2	+5.9 +16.1	+0.5	+0.1	+0.0	20.8	40.0	-19.2	Horiz
5	40.437M	29.9	-32.1 +0.2	+5.9 +14.4	+0.5	+0.1	+0.0	18.9	40.0	-21.1	Horiz



Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Tehama Wireless**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **102436** Date: 5/17/2019
 Test Type: **Radiated Scan** Time: 14:27:23
 Tested By: Hieu Song Nguyenpham Sequence#: 31
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

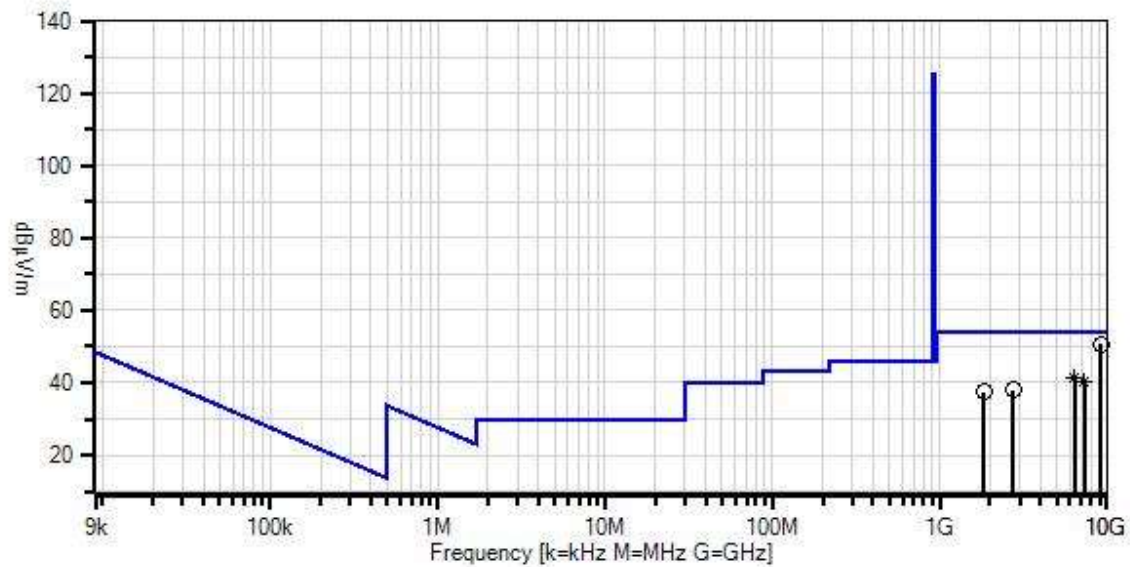
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Conducted Emission Frequency Range: 1GHz to 10GHz Application: Super Term V2.21 Temperature: 22.9°C Humidity: 44 % Atmospheric Pressure: 102.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC. DTS Lora Middle Channel The EUT is placed on the table per installation position and continuously transmitting as intended. It is powered by an internal battery at 3.6VDC.

Tehama Wireless W/O#: 102436 Sequence#: 31 Date: 5/17/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
× QP Readings
▼ Ambient
— 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
* Average Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	AN03013	Cable	32022-2-2909K-36TC	6/25/2018	6/25/2020
T2	AN03607	Preamp	AMF-7D-00101800-30-10P	6/6/2017	6/6/2019
T3	AN02157	Horn Antenna-ANSI C63.5	3115	1/15/2019	1/15/2021
T4	AN03302	Cable	32026-29094K-29094K-72TC	1/15/2018	1/15/2020
T5	ANP01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
T6	AN03172	High Pass Filter	HM1155-11SS	4/5/2018	4/5/2020

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV					Table	dBμV/m	dBμV/m	dB	Ant
1	9150.490M	61.7	+1.3 +5.4	-59.1 +0.1	+38.7	+2.6	+0.0	50.7	54.0	-3.3	Horiz
2	6405.343M	58.4	+1.0 +4.4	-59.2 +0.1	+34.5	+2.2	+0.0	41.4	54.0	-12.6	Horiz
^	6405.343M	70.7	+1.0 +4.4	-59.2 +0.1	+34.5	+2.2	+0.0	53.7	54.0	-0.3	Horiz
4	7320.392M	55.2	+1.1 +4.8	-59.4 +0.1	+36.4	+2.3	+0.0	40.5	54.0	-13.5	Horiz
^	7320.392M	68.4	+1.1 +4.8	-59.4 +0.1	+36.4	+2.3	+0.0	53.7	54.0	-0.3	Horiz
6	2745.132M	61.8	+0.6 +2.8	-58.5 +0.2	+29.6	+1.4	+0.0	37.9	54.0	-16.1	Horiz
7	1830.123M	65.3	+0.5 +2.2	-58.1 +0.3	+26.2	+1.1	+0.0	37.5	54.0	-16.5	Horiz



Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
Customer: **Tehama Wireless**
Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
Work Order #: **102436** Date: 5/21/2019
Test Type: **Radiated Scan** Time: 14:53:21
Tested By: Hieu Song Nguyenpham Sequence#: 64
Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

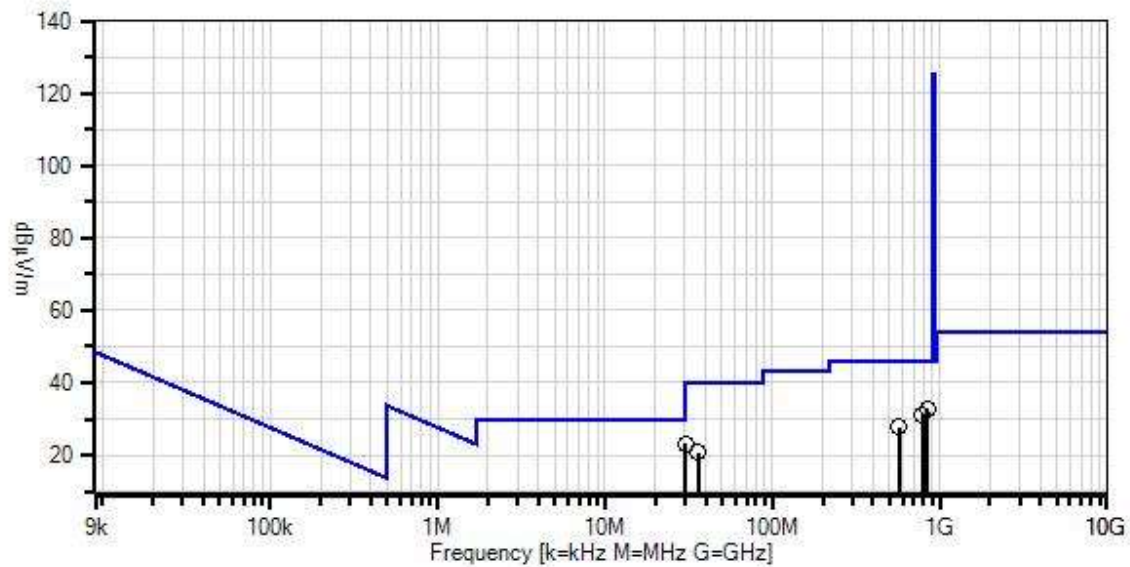
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

<p>Radiated Emission Frequency Range: 9kHz to 1GHz</p> <p>Application: Super Term V2.21 Temperature: 21.8°C Humidity: 43 % Atmospheric Pressure: 101.4kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi</p> <p>The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC.</p> <p>DTS Lora High Channel</p> <p>The EUT is placed on the table per installation position and continuously transmitting as intended. It is powered by an internal battery at 3.6VDC.</p>

Tehama Wireless W/O#: 102436 Sequence#: 64 Date: 5/21/2019
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	ANP07508	Preamp	310N	10/15/2018	10/15/2020
T2	ANP06049	Attenuator	PE7002-6	5/14/2018	5/14/2020
T3	ANP00880	Cable	RG214U	5/14/2018	5/14/2020
T4	ANP01187	Cable	CNT-195	8/20/2018	8/20/2020
T5	ANP06691	Cable	PE3062-180	5/14/2018	5/14/2020
T6	AN00852	Biconilog Antenna	CBL 6111C	5/1/2018	5/1/2020
	AN00432	Loop Antenna	6502	2/19/2019	2/19/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	842.368M	31.0	-32.0 +1.3	+6.0 +22.4	+3.2	+0.8	+0.0	32.7	46.0	-13.3	Horiz
2	783.986M	30.4	-32.2 +1.2	+6.0 +21.8	+3.0	+0.8	+0.0	31.0	46.0	-15.0	Horiz
3	30.084M	29.6	-32.1 +0.2	+5.9 +18.9	+0.5	+0.1	+0.0	23.1	40.0	-16.9	Horiz
4	569.724M	30.4	-32.1 +1.0	+6.0 +19.2	+2.5	+0.6	+0.0	27.6	46.0	-18.4	Horiz
5	35.934M	30.0	-32.1 +0.2	+5.9 +16.2	+0.5	+0.1	+0.0	20.8	40.0	-19.2	Horiz



Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
Customer: **Tehama Wireless**
Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
Work Order #: **102436** Date: 5/17/2019
Test Type: **Radiated Scan** Time: 14:38:53
Tested By: Hieu Song Nguyenpham Sequence#: 32
Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

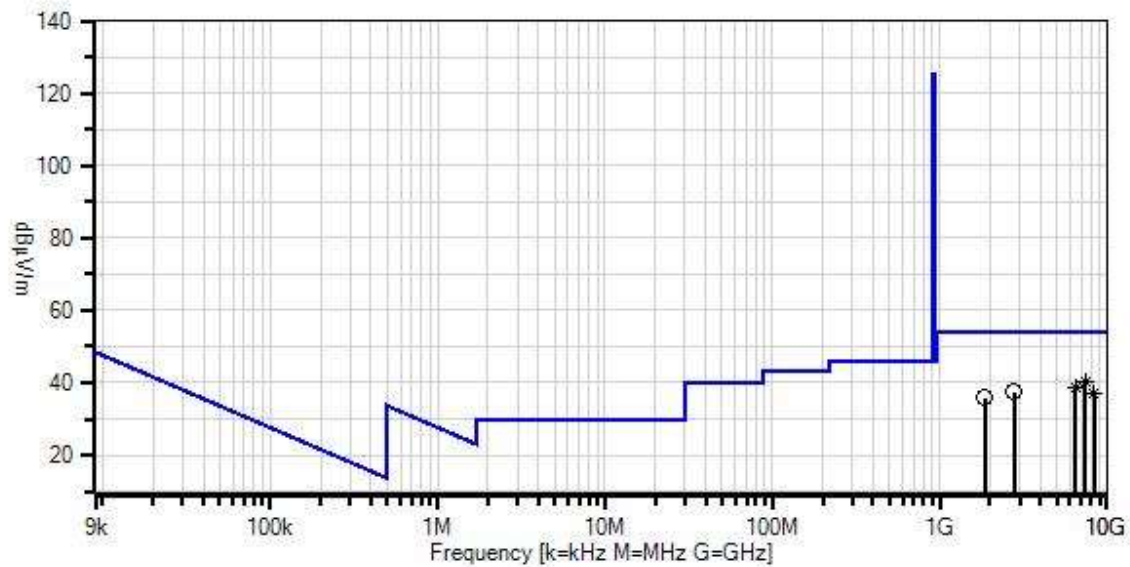
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Conducted Emission Frequency Range: 1GHz to 10GHz Application: Super Term V2.21 Temperature: 22.9°C Humidity: 44 % Atmospheric Pressure: 102.0kPa Highest Generation Frequency: 924MHz Method: ANSI C 63.10 2013 Antenna Gain: 2dBi The EUT is placed on the table and continuously receiving as intended. It is powered by an internal battery at 3.6VDC. DTS Lora High Channel The EUT is placed on the table per installation position and continuously transmitting as intended. It is powered by an internal battery at 3.6VDC.

Tehama Wireless W/O#: 102436 Sequence#: 32 Date: 5/17/2019
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
T1	AN03013	Cable	32022-2-2909K-36TC	6/25/2018	6/25/2020
T2	AN03607	Preamp	AMF-7D-00101800-30-10P	6/6/2017	6/6/2019
T3	AN02157	Horn Antenna-ANSI C63.5	3115	1/15/2019	1/15/2021
T4	AN03302	Cable	32026-29094K-29094K-72TC	1/15/2018	1/15/2020
T5	ANP01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
T6	AN03172	High Pass Filter	HM1155-11SS	4/5/2018	4/5/2020

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

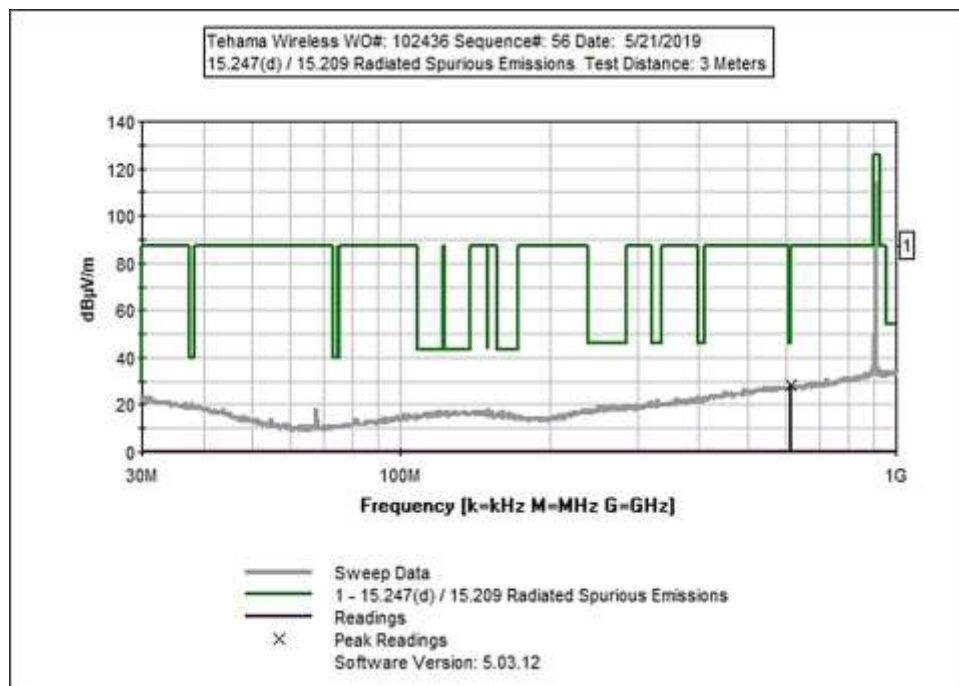
#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	7392.166M	54.5	+1.1	-59.3	+36.7	+2.3	+0.0	40.2	54.0	-13.8	Horiz
	Ave		+4.8	+0.1							
^	7392.166M	67.6	+1.1	-59.3	+36.7	+2.3	+0.0	53.3	54.0	-0.7	Horiz
			+4.8	+0.1							
3	6468.165M	55.5	+1.0	-59.2	+34.5	+2.2	+0.0	38.5	54.0	-15.5	Horiz
	Ave		+4.4	+0.1							
^	6468.165M	67.9	+1.0	-59.2	+34.5	+2.2	+0.0	50.9	54.0	-3.1	Horiz
			+4.4	+0.1							
5	2772.165M	61.3	+0.6	-58.5	+29.7	+1.4	+0.0	37.5	54.0	-16.5	Horiz
			+2.8	+0.2							
6	8316.166M	50.6	+1.2	-59.3	+37.0	+2.5	+0.0	37.3	54.0	-16.7	Horiz
	Ave		+5.2	+0.1							
^	8316.166M	64.2	+1.2	-59.3	+37.0	+2.5	+0.0	50.9	54.0	-3.1	Horiz
			+5.2	+0.1							
8	1848.170M	63.3	+0.5	-58.0	+26.3	+1.1	+0.0	35.7	54.0	-18.3	Horiz
			+2.2	+0.3							

Band Edge

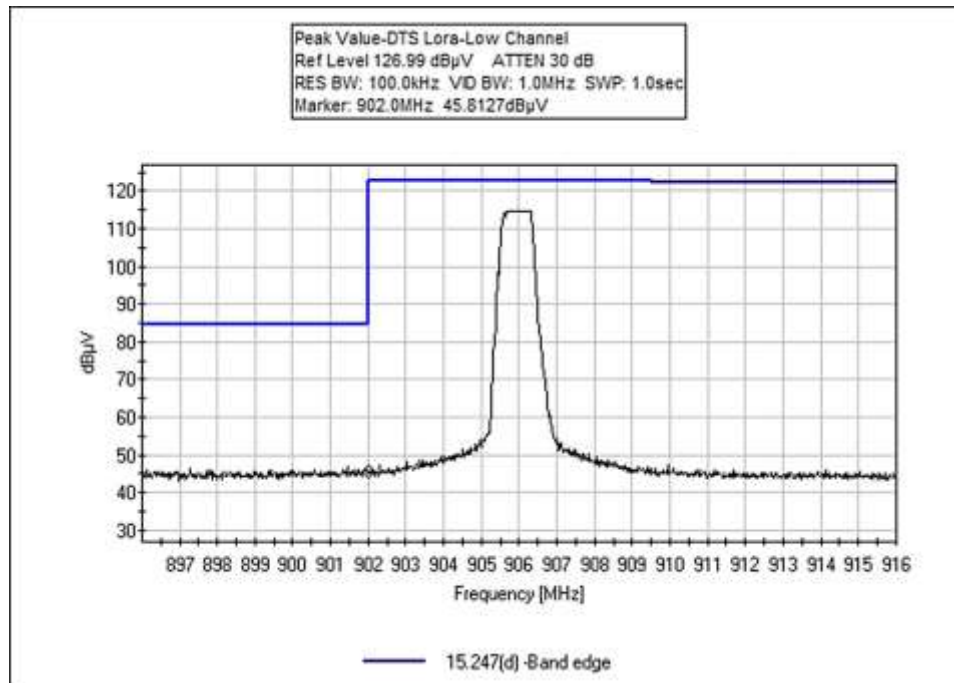
Band Edge Summary

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	Lora	Integral	29.6785	<46	Pass
902	Lora	Integral	45.8127	<93	Pass
928	Lora	Integral	45.0617	< 93	Pass
960	Lora	Integral	34.5671	<54	Pass

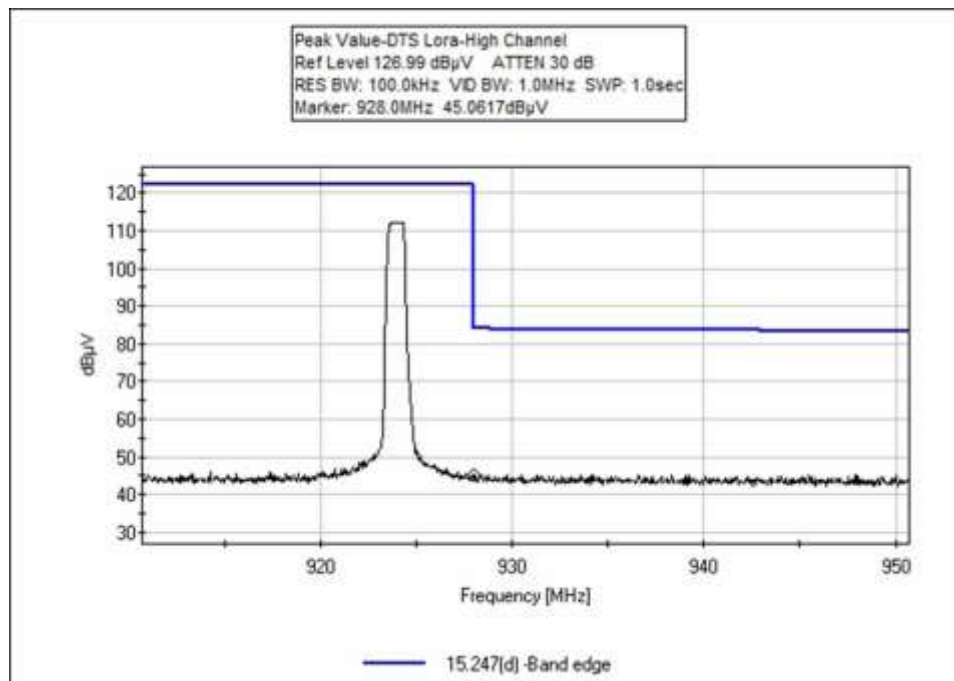
Band Edge Plots



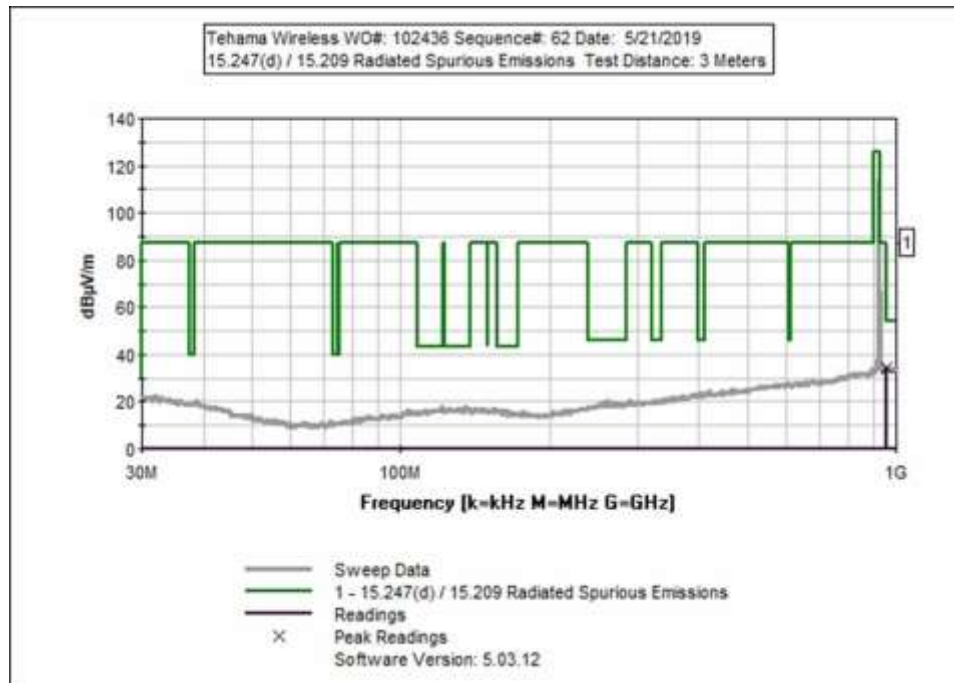
Low Channel, 614MHz



Low Channel, 902MHz

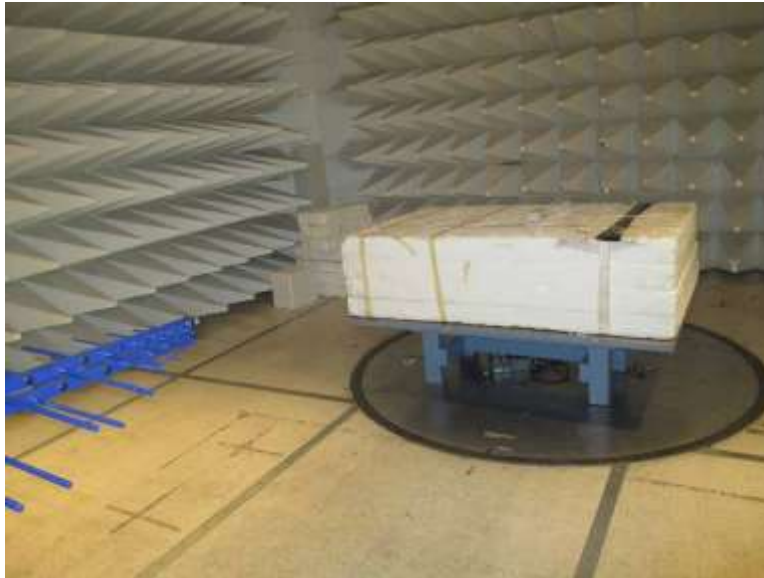


High Channel, 928MHz

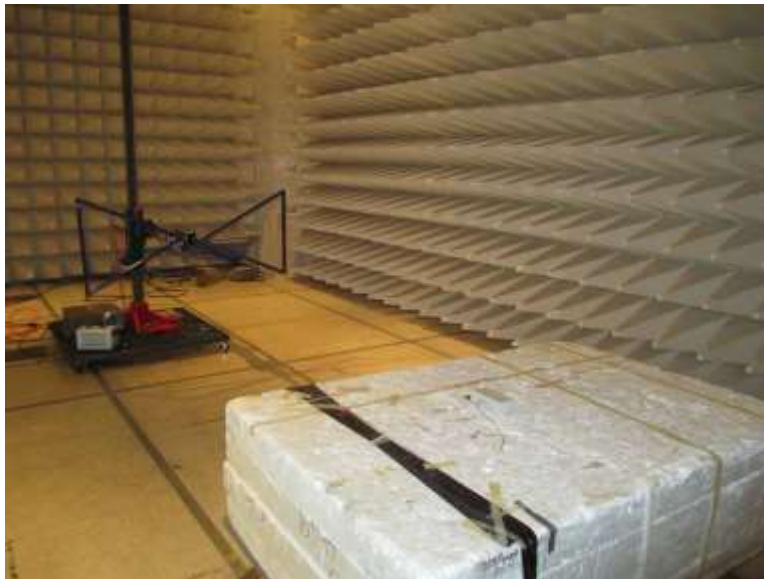


High Channel, 960MHz

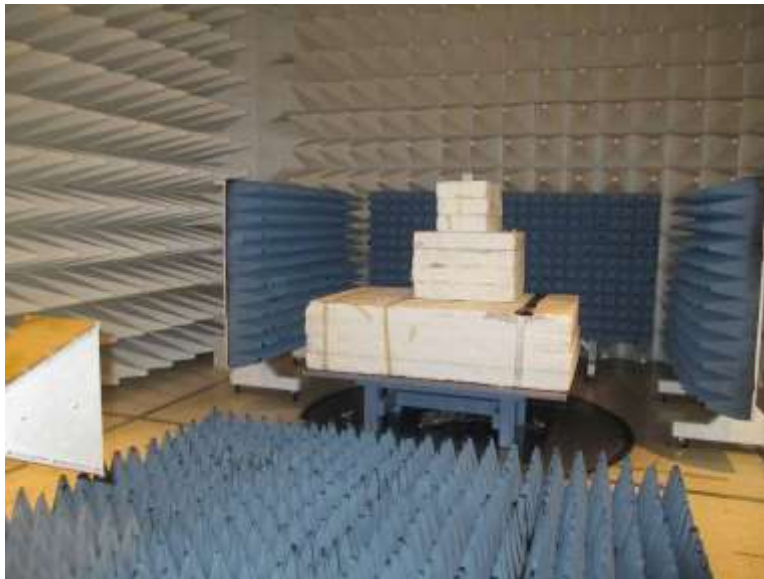
Test Setup Photo(s)



Below 1GHz



Below 1GHz



Above 1GHz



Above 1GHz

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dB μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dB μ V)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dB μ V/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.