

NORTHWEST EMC

Multi-Tech Systems

MTAC-Lora

FCC 15.247:2015

Report # MLTI0031



NVLAP Lab Code: 201049-0

CERTIFICATE OF TEST

Last Date of Test: March 06, 2015
Multi-Tech Systems
Model: MTAC-Lora

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2015	ANSI C63.10:2009

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	AC Powerline Conducted Emissions	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
6.7	Band Edge Compliance	Yes	Pass	
6.7	Spurious Conducted Emissions	Yes	Pass	
6.9.1	Occupied Bandwidth	Yes	Pass	
6.10.2	Output Power	Yes	Pass	
6.11.2	Power Spectral Density	Yes	Pass	
7.5	Duty Cycle	Yes	Pass	

Deviations From Test Standards

None

Approved By:



Jeremiah Darden, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test.

REVISION HISTORY

Revision Number	Description	Date	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Northwest EMC to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

IC - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

European Union

European Commission - Validated by the European Commission as a Conformity Assessment Body (CAB) under the EMC directive and as a Notified Body under the R&TTE Directive.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIP / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI - Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA - Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC - Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA - Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC - Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

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

<http://www.nwemc.com/accreditations/>

<http://gsi.nist.gov/global/docs/cabs/designations.html>

MEASUREMENT UNCERTAINTY

Measurement Uncertainty

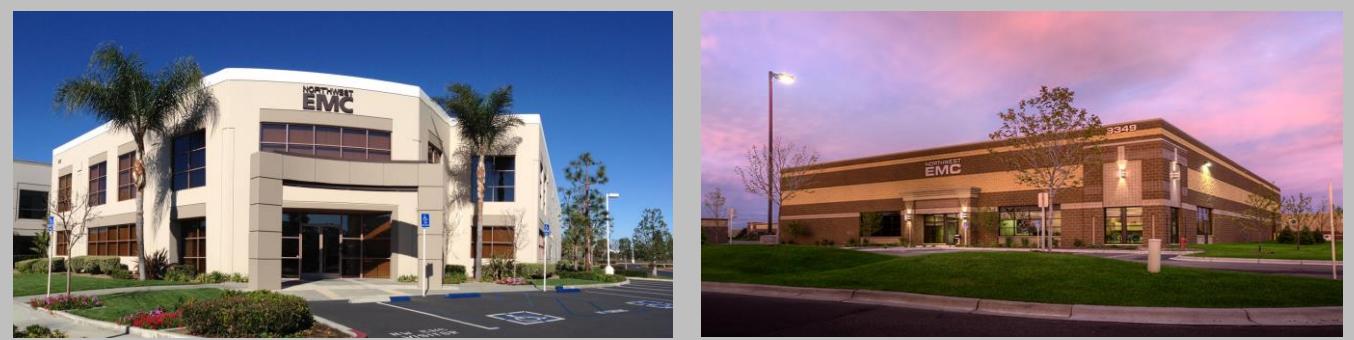
When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

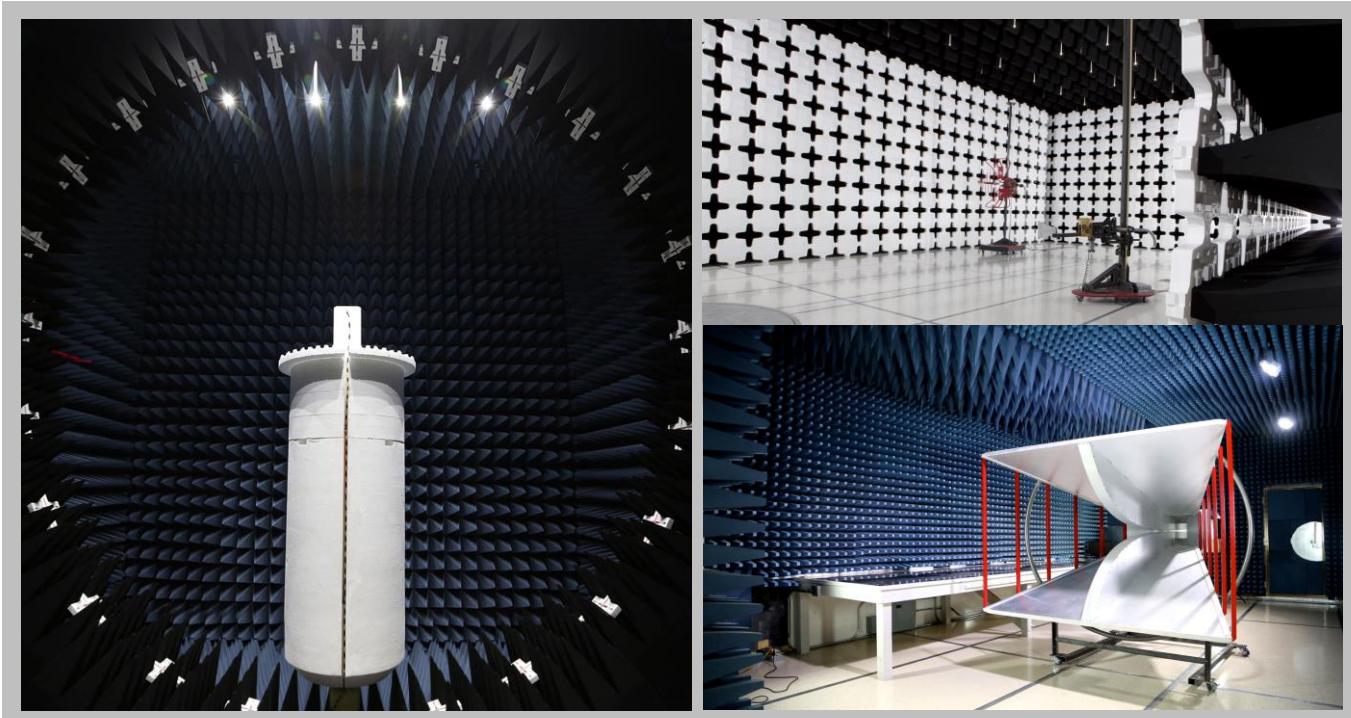
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	4.7 dB	-4.7 dB
AC Powerline Conducted Emissions (dB)	2.9 dB	-2.9 dB

FACILITIES



California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120 th Ave NE Bothell, WA 9801 (425)984-6600
NVLAP					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code: 201049-0	NVLAP Lab Code: 200629-0
Industry Canada					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-2	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Multi-Tech Systems
Address:	2205 Woodale Drive
City, State, Zip:	Mounds View, MN 55112
Test Requested By:	Bud Sundein
Model:	MTAC-Lora
First Date of Test:	February 26, 2015
Last Date of Test:	March 06, 2015
Receipt Date of Samples:	February 26, 2015
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Lora Gateway Accessory Card
Testing Objective:
To demonstrate compliance of the Lora radio to FCC 15.247 requirements.

CONFIGURATIONS

Configuration MLTI0031- 1

EUT				
Description	Manufacturer	Model/Part Number	Serial Number	
MTAC-Lora	Multi-Tech Systems	MTAC-LORA-915	None	

Peripherals in test setup boundary				
Description	Manufacturer	Model/Part Number	Serial Number	
Laptop Computer	Hewlett Packard	Bres2-29-02XT	CNU72602XT	
AC Power Adapter (for laptop)	Hewlett Packard	PPP014S	3892A300	
Wireless External Antenna	Pulse	W1063	None	
AC Power Adapter (for controller)	GlobTek	01006610L	None	
Controller	Multi-Tech Systems	MTCDT-H5	18062244	

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Power	Unknown	0.8 m	No	AC Power Adapter (for laptop)	AC Mains
DC Power	Unknown	1.1 m	Yes	AC Power Adapter (for laptop)	Laptop Computer
USB Cable	Unknown	1.8 m	Yes	Controller	MTAC-Lora FCC (EUT1) / MTAC-Lora EN (EUT2)
Ethernet Cable	Unknown	1.95 m	No	Controller	Laptop Computer

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2/26/2015	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
2	2/27/2015	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
3	2/27/2015	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
4	2/27/2014	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
5	2/27/2015	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
6	2/27/2015	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
7	2/27/2015	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
8	3/6/2015	AC Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

AC POWERLINE CONDUCTED EMISSIONS

TEST DESCRIPTION

The EUT will be powered either directly or indirectly from the AC power line. Therefore, conducted emissions measurements were made on the AC input of the EUT, or on the AC input of the device used to power the EUT. The AC power line conducted emissions were measured with the EUT operating at the lowest, the highest, and a middle channel in the operational band. The EUT was transmitting at its maximum data rate. For each mode, the spectrum was scanned from 150 kHz to 30 MHz. The test setup and procedures were in accordance with ANSI C63.10.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Receiver	Rohde & Schwarz	ESCI	ARF	05/27/2014	12 mo
LISN	Solar	9252-50-R-24-BNC	LJK	09/14/2014	12 mo
TX01 Cable	Northwest EMC	CE 9kHz-108MHz	TXA	09/14/2014	12 mo
High Pass Filter	TTE	H97-100K-50-720B	HHZ	09/13/2014	12 mo
LISN	Solar	9252-50-R-24-BNC	LJL	09/14/2014	12 mo
Attenuator	Fairview Microwave	SA6B10W-20	TQR	09/13/2014	12 mo

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

MLTI0031-1

MODES INVESTIGATED

Transmitting Lora at High Channel @ 927 MHz.
Transmitting Lora at Low Channel @ 903 MHz.
Transmitting Lora at Mid Channel @ 917 MHz.

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	8	Line:	High Line	Ext. Attenuation (dB):	20
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COMMENTS

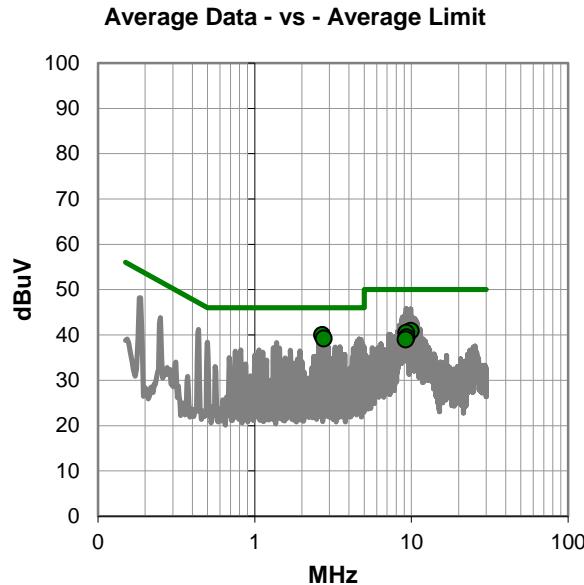
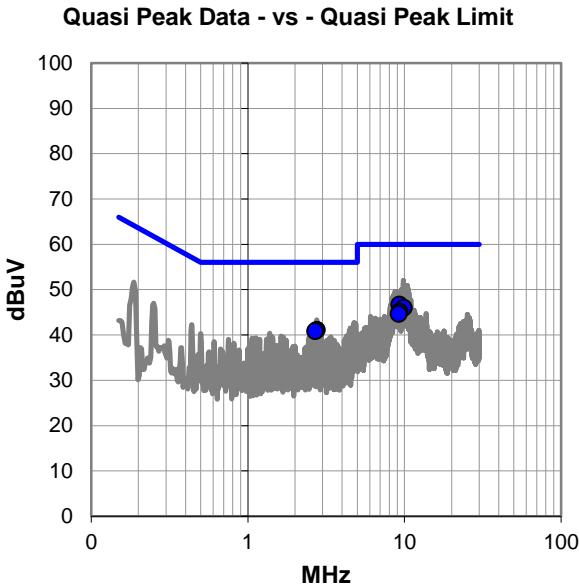
None

EUT OPERATING MODES

Transmitting Lora at Low Channel @ 903 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #8

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
9.278	26.5	20.2	46.7	60.0	-13.3
9.903	25.8	20.2	46.0	60.0	-14.0
2.758	20.9	20.2	41.1	56.0	-14.9
9.340	24.9	20.2	45.1	60.0	-14.9
2.695	20.6	20.2	40.8	56.0	-15.2
9.211	24.4	20.2	44.6	60.0	-15.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.695	19.8	20.2	40.0	46.0	-6.0
2.758	19.0	20.2	39.2	46.0	-6.8
9.903	20.7	20.2	40.9	50.0	-9.1
9.278	20.3	20.2	40.5	50.0	-9.5
9.340	19.3	20.2	39.5	50.0	-10.5
9.211	18.8	20.2	39.0	50.0	-11.0

CONCLUSION

Pass



Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	9	Line:	Neutral	Ext. Attenuation (dB):	20
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COMMENTS

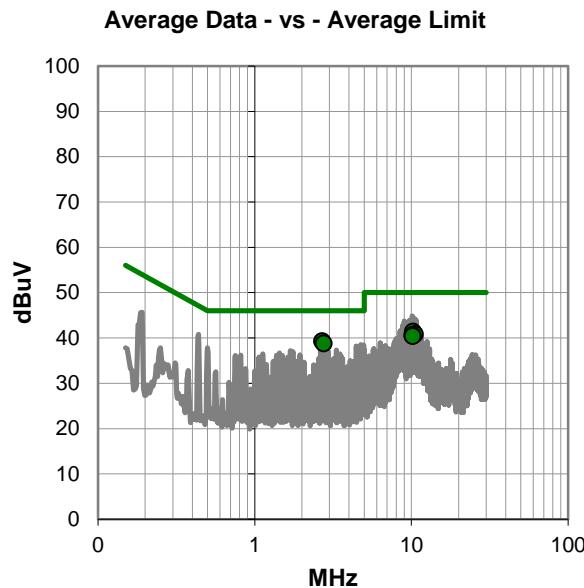
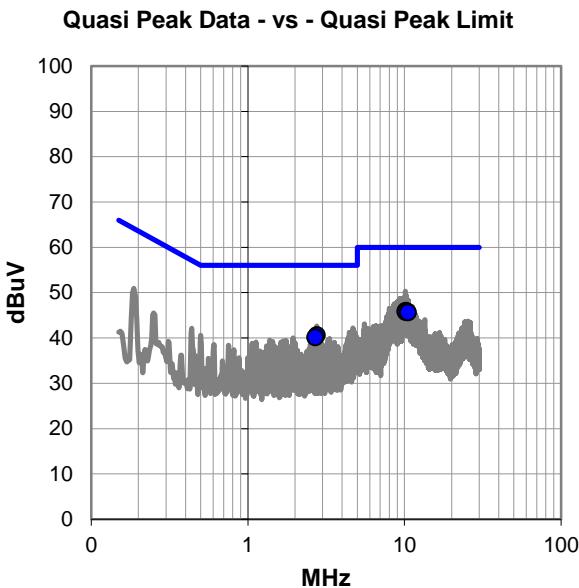
None

EUT OPERATING MODES

Transmitting Lora at Low Channel @ 903 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #9

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
10.277	25.8	20.2	46.0	60.0	-14.0
10.154	25.7	20.2	45.9	60.0	-14.1
10.217	25.5	20.2	45.7	60.0	-14.3
10.530	25.4	20.2	45.6	60.0	-14.4
2.757	20.4	20.2	40.6	56.0	-15.4
2.694	19.9	20.2	40.1	56.0	-15.9

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.694	19.1	20.2	39.3	46.0	-6.7
2.757	18.6	20.2	38.8	46.0	-7.2
10.277	21.2	20.2	41.4	50.0	-8.6
10.530	20.6	20.2	40.8	50.0	-9.2
10.154	20.4	20.2	40.6	50.0	-9.4
10.217	20.2	20.2	40.4	50.0	-9.6

CONCLUSION

Pass



Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	10	Line:	High Line	Ext. Attenuation (dB):	20
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COMMENTS

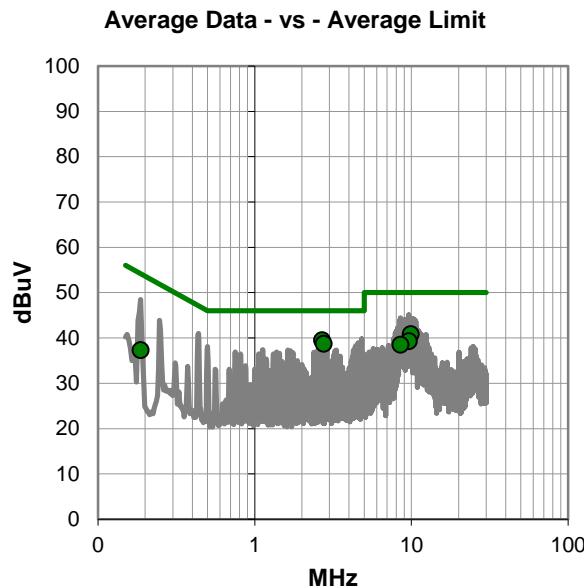
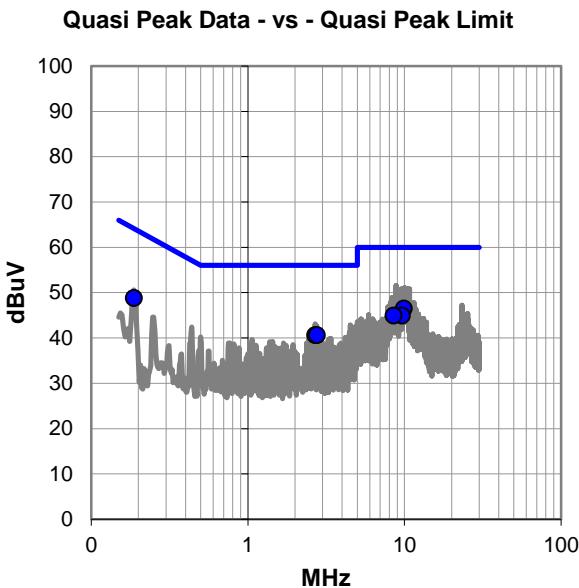
None

EUT OPERATING MODES

Transmitting Lora at Mid Channel @ 917 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #10

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
9.901	26.3	20.2	46.5	60.0	-13.5
9.647	24.7	20.2	44.9	60.0	-15.1
8.523	24.7	20.2	44.9	60.0	-15.1
0.188	28.7	20.1	48.8	64.1	-15.4
2.695	20.4	20.2	40.6	56.0	-15.4
2.757	20.4	20.2	40.6	56.0	-15.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.695	19.3	20.2	39.5	46.0	-6.5
2.757	18.5	20.2	38.7	46.0	-7.3
9.901	20.6	20.2	40.8	50.0	-9.2
9.647	19.1	20.2	39.3	50.0	-10.7
8.523	18.3	20.2	38.5	50.0	-11.5
0.188	17.2	20.1	37.3	54.1	-16.9

CONCLUSION

Pass



Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	11	Line:	Neutral	Ext. Attenuation (dB):	20
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COMMENTS

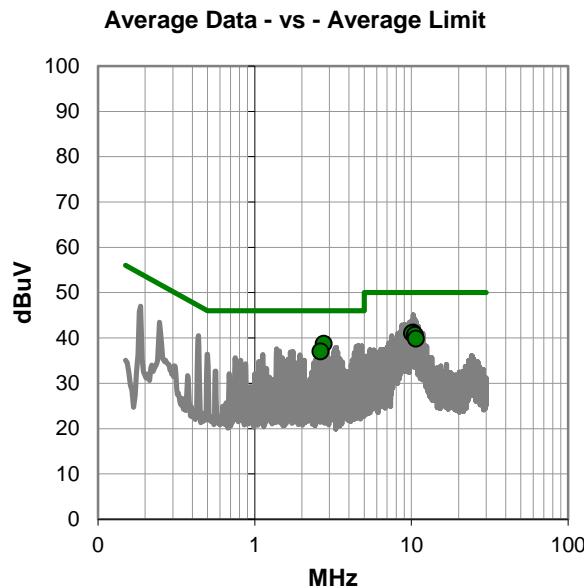
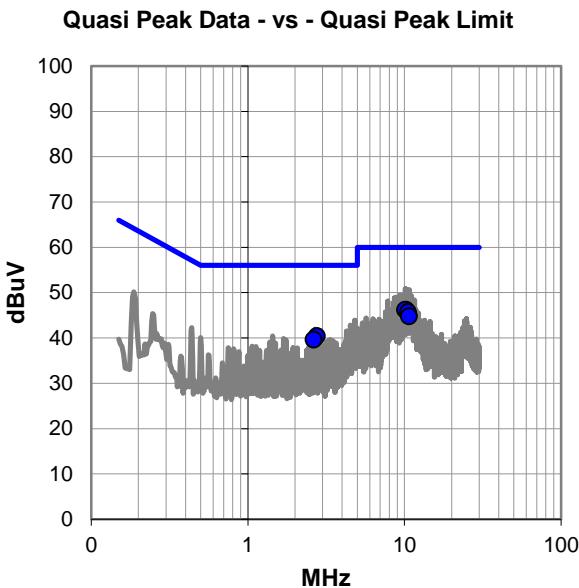
None

EUT OPERATING MODES

Transmitting Lora at Mid Channel @ 917 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #11

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
10.275	26.0	20.2	46.2	60.0	-13.8
10.089	26.0	20.2	46.2	60.0	-13.8
10.525	25.5	20.2	45.7	60.0	-14.3
10.715	24.6	20.2	44.8	60.0	-15.2
2.757	20.2	20.2	40.4	56.0	-15.6
2.632	19.4	20.2	39.6	56.0	-16.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.757	18.5	20.2	38.7	46.0	-7.3
10.275	21.0	20.2	41.2	50.0	-8.8
10.089	20.8	20.2	41.0	50.0	-9.0
2.632	16.8	20.2	37.0	46.0	-9.0
10.525	20.5	20.2	40.7	50.0	-9.3
10.715	19.6	20.2	39.8	50.0	-10.2

CONCLUSION

Pass



Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	12	Line:	High Line	Ext. Attenuation (dB):	20
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COMMENTS

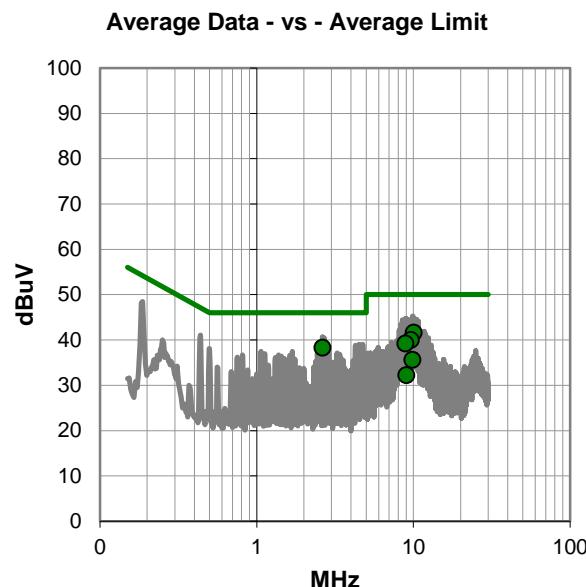
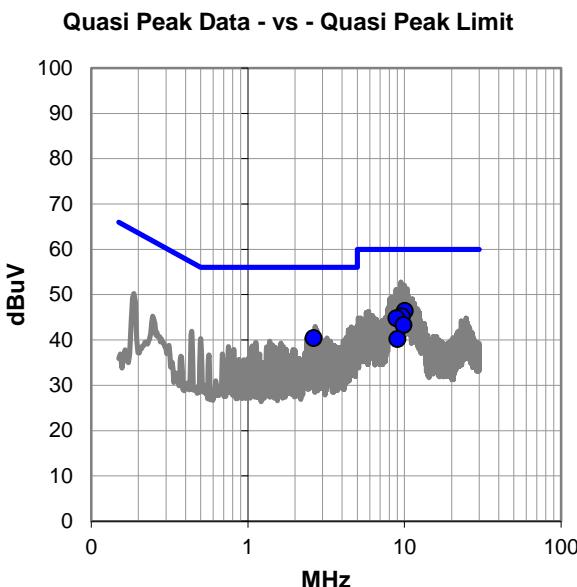
None

EUT OPERATING MODES

Transmitting Lora at High Channel @ 927 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
10.087	26.2	20.2	46.4	60.0	-13.6
9.649	25.0	20.2	45.2	60.0	-14.8
8.898	24.6	20.2	44.8	60.0	-15.2
2.631	20.2	20.2	40.4	56.0	-15.6
9.885	23.1	20.2	43.3	60.0	-16.7
9.049	20.0	20.2	40.2	60.0	-19.8

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
2.631	18.1	20.2	38.3	46.0	-7.7
10.087	21.4	20.2	41.6	50.0	-8.4
9.649	19.8	20.2	40.0	50.0	-10.0
8.898	19.0	20.2	39.2	50.0	-10.8
9.885	15.4	20.2	35.6	50.0	-14.4
9.049	12.0	20.2	32.2	50.0	-17.8

CONCLUSION

Pass



Tested By

AC POWERLINE CONDUCTED EMISSIONS

EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	03/06/2015
Customer:	Multi-Tech Systems	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	19.9%
Customer Project:	None	Bar. Pressure:	1037 mb
Tested By:	Jonathan Kiefer	Job Site:	TX01
Power:	USB via 110VAC/60Hz	Configuration:	MLTI0031-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2015	ANSI C63.10:2009

TEST PARAMETERS

Run #:	13	Line:	Neutral	Ext. Attenuation (dB):	20
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COMMENTS

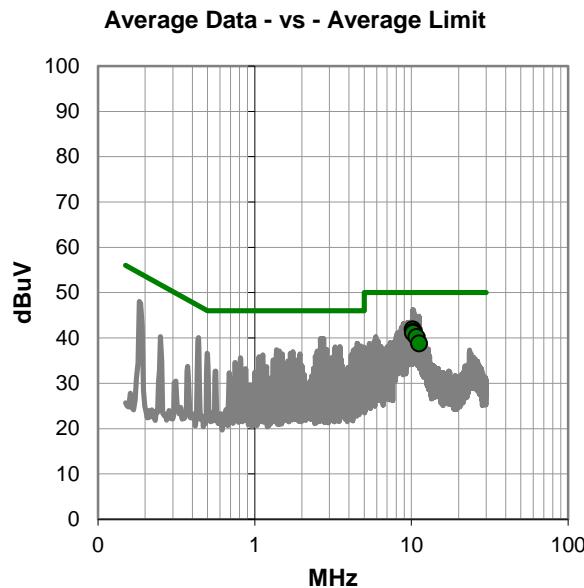
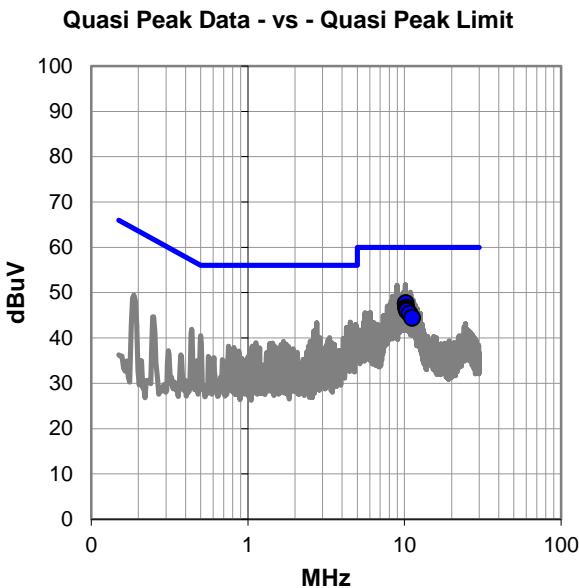
None

EUT OPERATING MODES

Transmitting Lora at High Channel @ 927 MHz.

DEVIATIONS FROM TEST STANDARD

None



AC POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
10.211	27.5	20.2	47.7	60.0	-12.3
10.270	26.5	20.2	46.7	60.0	-13.3
10.338	26.2	20.2	46.4	60.0	-13.6
10.398	25.8	20.2	46.0	60.0	-14.0
10.776	25.1	20.2	45.3	60.0	-14.7
11.214	24.2	20.2	44.4	60.0	-15.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
10.211	21.7	20.2	41.9	50.0	-8.1
10.338	21.2	20.2	41.4	50.0	-8.6
10.398	21.0	20.2	41.2	50.0	-8.8
10.270	20.9	20.2	41.1	50.0	-8.9
10.776	20.0	20.2	40.2	50.0	-9.8
11.214	18.5	20.2	38.7	50.0	-11.3

CONCLUSION

Pass



Tested By

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting LORA at Low, Mid, High Channel @ 903, 917, 927 MHz

POWER SETTINGS INVESTIGATED

USB via 110VAC/60Hz

CONFIGURATIONS INVESTIGATED

MLTI0031-1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12400
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SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
High Pass Filter	Micro-Tronics	HPM50111	HHX	8/18/2014	12 mo
Low Pass Filter	Micro-Tronics	LPM50004	HHV	8/18/2014	12 mo
Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	PAK	10/27/2014	12 mo
Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	PAL	10/27/2015	12 mo
TX02 Cable	NWEMC	8-18GHz	TXD	10/27/2016	12mo
Pre-Amplifier	Miteq	JSDQK42-18004000-60-5P	PAM	11/21/2014	12 mo
Cable	NWEMC	18-40GHz	TXE	11/21/2014	12 mo
Antenna, Double Ridge Guide Horn	A.H. Systems, Inc.	SAS-574	AXW	4/23/2014	36 mo
Antenna, Horn	ETS Lindgren	3160-08	AJG	NCR	0 mo
Antenna, Horn	ETS Lindgren	3160-07	AJF	NCR	0 mo
Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	9/22/2014	12 mo
TX02 Cable	NWEMC	1-8.2 GHz	TXC	9/22/2014	12 mo
Antenna, Horn	ETS Lindgren	3115	AJL	9/15/2014	24 mo
Pre-Amplifier	Miteq	AM-1551	PAH	9/13/2014	12 mo
TX02 Cable	N/A	RE 9kHz - 1GHz	TXB	9/22/2014	12 mo
Attenuator	Fairview Microwave	SA18H-20	TKQ	12/8/2014	0 mo
Antenna, Biconilog	ETS Lindgren	3143B	AYF	4/7/2014	36 mo
Spectrum Analyzer	Agilent	N9010A	AFL	6/20/2014	12 mo

MEASUREMENT BANDWIDTHS

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

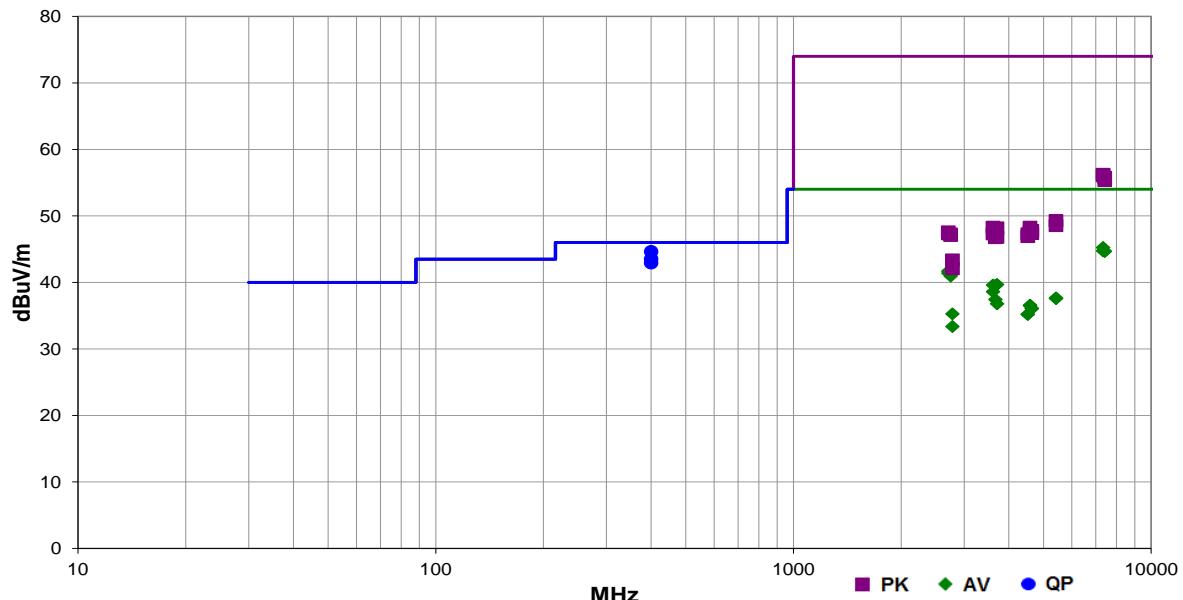
TEST DESCRIPTION

The highest gain of each type of antenna to be used with the EUT was tested. The EUT was configured for low, mid, and high band transmit frequencies. For each configuration, the spectrum was scanned throughout the specified range. In addition, measurements were made in the restricted bands to verify compliance. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and the EUT antenna in three orthogonal axis, and adjusting measurement antenna height and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

Work Order:	MLTI0031	Date:	02/26/15	
Project:	None	Temperature:	23.3 °C	
Job Site:	TX02	Humidity:	22.9% RH	
Serial Number:	None	Barometric Pres.:	1028 mbar	Tested by: Jonathan Kiefer
EUT:	MTAC-Lora			
Configuration:	1			
Customer:	Multi-Tech Systems			
Attendees:	Bud			
EUT Power:	USB via 110VAC/60Hz			
Operating Mode:	Transmitting LORA at Low, Mid, High Channel @ 903, 917, 927 MHz			
Deviations:	None			
Comments:	PK and AVG (RMS).			

Test Specifications	Test Method
FCC 15.247:2015	ANSI C63.10:2009

Run #	7	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7336.075	31.9	13.4	3.0	181.0	3.0	0.0	Vert	AV	0.0	45.3	54.0	-8.7	LORA, Mid Ch, EUT Horizontal
7336.017	31.4	13.4	4.0	310.9	3.0	0.0	Horz	AV	0.0	44.8	54.0	-9.2	LORA, Mid Ch, EUT Horizontal
7416.025	31.3	13.4	1.8	309.9	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	LORA, High Ch, EUT Horizontal
7416.100	31.3	13.4	2.1	15.0	3.0	0.0	Vert	AV	0.0	44.7	54.0	-9.3	LORA, High Ch, EUT Horizontal
3707.975	35.5	4.2	2.1	295.0	3.0	0.0	Horz	AV	0.0	39.7	54.0	-14.3	LORA, High Ch, EUT Horizontal
3612.175	36.5	3.1	2.5	246.0	3.0	0.0	Horz	AV	0.0	39.6	54.0	-14.4	LORA, Low Ch, EUT Horizontal
3668.025	35.8	3.7	1.8	273.9	3.0	0.0	Horz	AV	0.0	39.5	54.0	-14.5	LORA, Mid Ch, EUT Horizontal
3612.108	35.5	3.1	1.8	196.9	3.0	0.0	Vert	AV	0.0	38.6	54.0	-15.4	LORA, Low Ch, EUT Horizontal
5418.867	28.6	9.1	1.8	22.9	3.0	0.0	Horz	AV	0.0	37.7	54.0	-16.3	LORA, Low Ch, EUT Horizontal
5419.250	28.5	9.1	1.1	280.9	3.0	0.0	Vert	AV	0.0	37.6	54.0	-16.4	LORA, Low Ch, EUT Horizontal
3667.975	33.7	3.7	1.5	199.0	3.0	0.0	Vert	AV	0.0	37.4	54.0	-16.6	LORA, Mid Ch, EUT Horizontal
3708.067	32.6	4.2	1.8	79.0	3.0	0.0	Vert	AV	0.0	36.8	54.0	-17.2	LORA, High Ch, EUT Horizontal
4584.992	29.5	7.1	1.8	210.0	3.0	0.0	Vert	AV	0.0	36.6	54.0	-17.4	LORA, Mid Ch, EUT Horizontal
4584.858	29.4	7.1	3.4	135.9	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5	LORA, Mid Ch, EUT Horizontal
7336.017	42.9	13.4	3.0	181.0	3.0	0.0	Vert	PK	0.0	56.3	74.0	-17.7	LORA, Mid Ch, EUT Horizontal
4637.500	28.8	7.3	1.8	10.9	3.0	0.0	Horz	AV	0.0	36.1	54.0	-17.9	LORA, High Ch, EUT Horizontal
4637.425	28.8	7.3	1.8	198.0	3.0	0.0	Vert	AV	0.0	36.1	54.0	-17.9	LORA, High Ch, EUT Horizontal
7335.975	42.7	13.4	4.0	310.9	3.0	0.0	Horz	PK	0.0	56.1	74.0	-17.9	LORA, Mid Ch, EUT Horizontal
7415.617	42.4	13.4	2.1	15.0	3.0	0.0	Vert	PK	0.0	55.8	74.0	-18.2	LORA, High Ch, EUT Horizontal
7415.917	42.0	13.4	1.8	309.9	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	LORA, High Ch, EUT Horizontal
4517.458	28.4	6.8	3.4	104.0	3.0	0.0	Horz	AV	0.0	35.2	54.0	-18.8	LORA, Low Ch, EUT Horizontal
4516.617	28.4	6.8	4.0	32.0	3.0	0.0	Vert	AV	0.0	35.2	54.0	-18.8	LORA, Low Ch, EUT Horizontal
5416.533	40.2	9.1	1.1	280.9	3.0	0.0	Vert	PK	0.0	49.3	74.0	-24.7	LORA, Low Ch, EUT Horizontal
5417.450	39.5	9.1	1.8	22.9	3.0	0.0	Horz	PK	0.0	48.6	74.0	-25.4	LORA, Low Ch, EUT Horizontal
3612.008	45.2	3.1	2.5	246.0	3.0	0.0	Horz	PK	0.0	48.3	74.0	-25.7	LORA, Low Ch, EUT Horizontal

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4584.717	41.2	7.1	1.8	210.0	3.0	0.0	Vert	PK	0.0	48.3	74.0	-25.7	LORA, Mid Ch, EUT Horizontal
3707.967	44.0	4.2	2.1	295.0	3.0	0.0	Horz	PK	0.0	48.2	74.0	-25.8	LORA, High Ch, EUT Horizontal
4635.933	40.5	7.3	1.8	10.9	3.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	LORA, High Ch, EUT Horizontal
4584.875	40.6	7.1	3.4	135.9	3.0	0.0	Horz	PK	0.0	47.7	74.0	-26.3	LORA, Mid Ch, EUT Horizontal
3667.925	43.8	3.7	1.8	273.9	3.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	LORA, Mid Ch, EUT Horizontal
4635.975	40.1	7.3	1.8	198.0	3.0	0.0	Vert	PK	0.0	47.4	74.0	-26.6	LORA, High Ch, EUT Horizontal
4516.842	40.5	6.8	4.0	32.0	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	LORA, Low Ch, EUT Horizontal
3612.025	44.2	3.1	1.8	196.9	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	LORA, Low Ch, EUT Horizontal
4517.050	40.1	6.8	3.4	104.0	3.0	0.0	Horz	PK	0.0	46.9	74.0	-27.1	LORA, Low Ch, EUT Horizontal
3708.292	42.6	4.2	1.8	79.0	3.0	0.0	Vert	PK	0.0	46.8	74.0	-27.2	LORA, High Ch, EUT Horizontal
3668.367	43.0	3.7	1.5	199.0	3.0	0.0	Vert	PK	0.0	46.7	74.0	-27.3	LORA, Mid Ch, EUT Horizontal
2709.000	45.1	-3.4	2.7	96.0	3.0	0.0	Vert	AV	0.0	41.7	54.0	-12.3	LORA, Low Ch, EUT Vertical
2750.908	44.7	-3.1	3.2	123.0	3.0	0.0	Vert	AV	0.0	41.6	54.0	-12.4	LORA, Mid Ch, EUT Vertical
2708.950	44.8	-3.4	1.9	255.9	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	LORA, Low Ch, EUT Vertical
2751.000	44.1	-3.1	2.3	180.0	3.0	0.0	Horz	AV	0.0	41.0	54.0	-13.0	LORA, Mid Ch, EUT Vertical
2781.508	38.3	-3.0	3.3	211.0	3.0	0.0	Horz	AV	0.0	35.3	54.0	-18.7	LORA, High Ch, EUT Vertical
2781.508	36.4	-3.0	3.0	111.9	3.0	0.0	Vert	AV	0.0	33.4	54.0	-20.6	LORA, High Ch, EUT Vertical
2708.942	51.0	-3.4	1.9	255.9	3.0	0.0	Horz	PK	0.0	47.6	74.0	-26.4	LORA, Low Ch, EUT Vertical
2709.292	50.7	-3.4	2.7	96.0	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	LORA, Low Ch, EUT Vertical
2751.000	50.4	-3.1	3.2	123.0	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	LORA, Mid Ch, EUT Vertical
2750.858	50.2	-3.1	2.3	180.0	3.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	LORA, Mid Ch, EUT Vertical
2781.625	46.4	-3.0	3.3	211.0	3.0	0.0	Horz	PK	0.0	43.4	74.0	-30.6	LORA, High Ch, EUT Vertical
2781.633	45.1	-3.0	3.0	111.9	3.0	0.0	Vert	PK	0.0	42.1	74.0	-31.9	LORA, High Ch, EUT Vertical
400.002	64.3	-19.7	1.0	90.0	3.0	0.0	Vert	QP	0.0	44.6	46.0	-1.4	LORA, High Ch, EUT Vertical
400.002	63.2	-19.7	1.0	324.0	3.0	0.0	Vert	QP	0.0	43.5	46.0	-2.5	LORA, Mid Ch, EUT Vertical
400.003	62.6	-19.7	1.0	315.0	3.0	0.0	Vert	QP	0.0	42.9	46.0	-3.1	LORA, Low Ch, EUT Vertical

BAND EDGE COMPLIANCE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet.

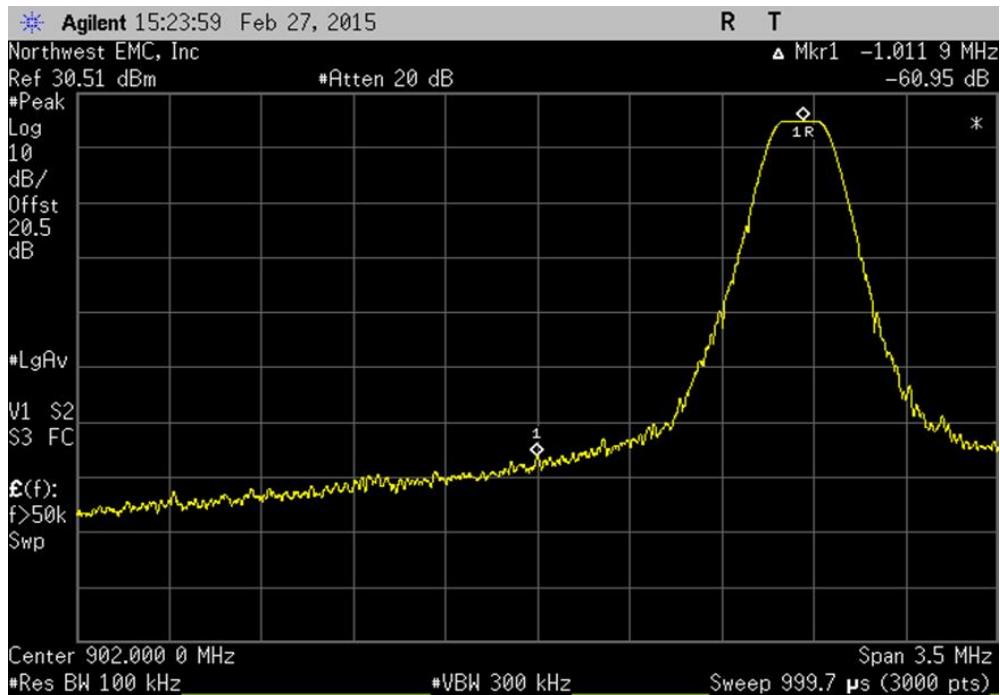
The spectrum was scanned below the lower band edge and above the higher band edge.

BAND EDGE COMPLIANCE

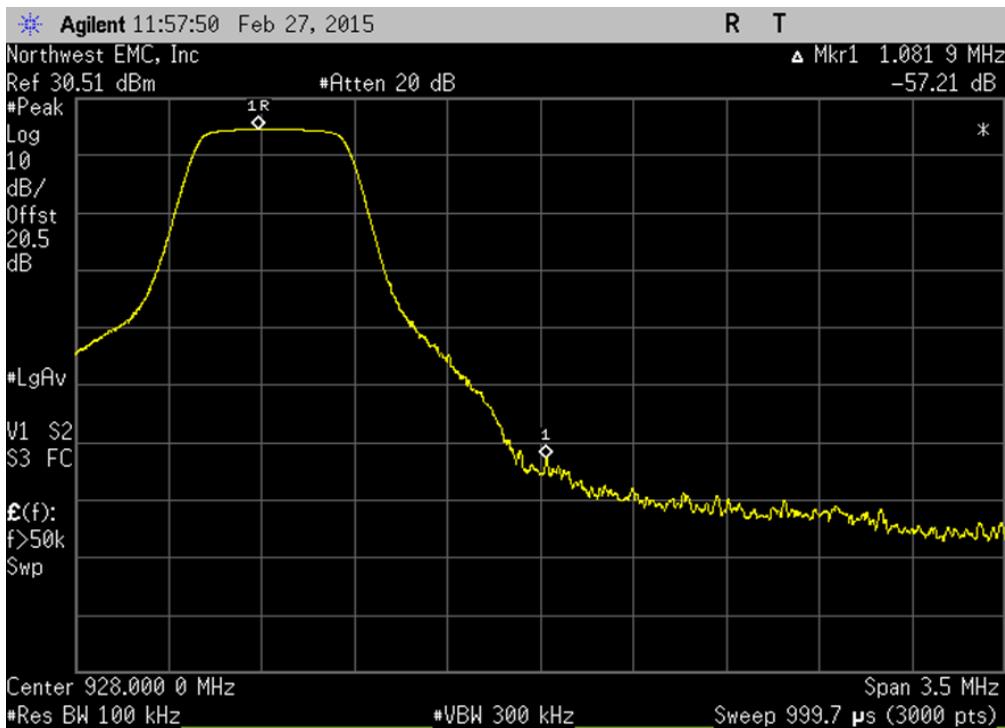
EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	02/27/15
Customer:	Multi-Tech Systems	Temperature:	25°C
Attendees:	Bud Sundeen	Humidity:	31%
Project:	None	Barometric Pres.:	1020 mb
Tested by:	Jonathan Kiefer	Job Site:	TX09
Power: USB via 110VAC/60Hz		Test Method:	
TEST SPECIFICATIONS		ANSI C63.10:2009	
FCC 15.247:2015			
COMMENTS			
Transmitting Lora at Low, High Channel @ 903, 927 MHz.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature	
		Value (dBc)	Limit ≤ (dBc)
Lora SF7		-60.95	-20
Low Channel, 903 MHz		-57.21	-20
High Channel, 927 MHz			Pass

BAND EDGE COMPLIANCE

Lora SF7, Low Channel, 903 MHz				Value (dBc)	Limit ≤ (dBc)	Result
				-60.95	-20	Pass



Lora SF7, High Channel, 927 MHz				Value (dBc)	Limit ≤ (dBc)	Result
				-57.21	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

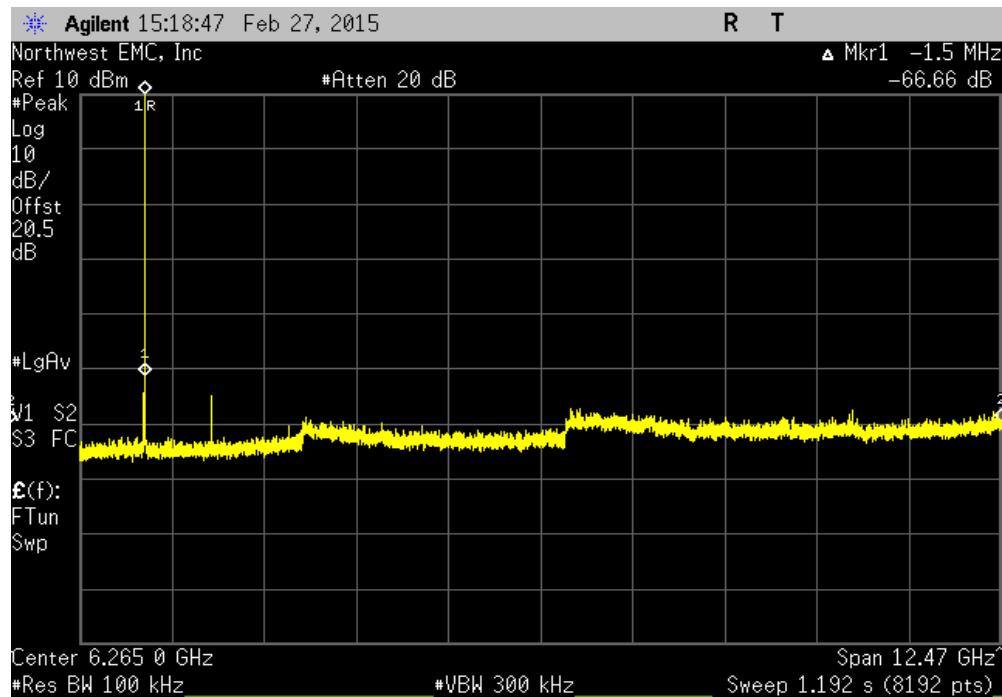
The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

SPURIOUS CONDUCTED EMISSIONS

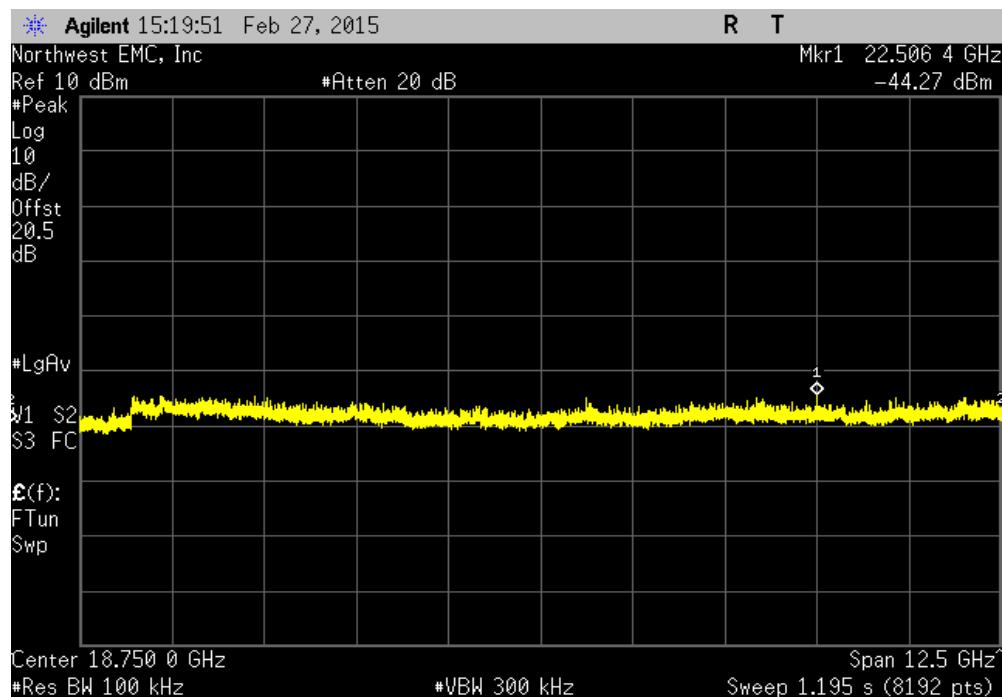
EUT:	MTAC-Lora	Work Order:	MLTI0031																														
Serial Number:	None	Date:	02/27/15																														
Customer:	Multi-Tech Systems	Temperature:	25°C																														
Attendees:	Bud Sundeen	Humidity:	31%																														
Project:	None	Barometric Pres.:	1020 mb																														
Tested by:	Jonathan Kiefer	Power:	USB via 110VAC/60Hz																														
TEST SPECIFICATIONS		Test Method	ANSI C63.10:2009																														
FCC 15.247:2015																																	
COMMENTS																																	
Transmitting Lora at Low, Mid, High Channel @ 903, 917, 927 MHz.																																	
DEVIATIONS FROM TEST STANDARD																																	
None																																	
Configuration #	1	Signature																															
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 15%;">Frequency Range</th> <th style="text-align: center; width: 15%;">Value (dBc)</th> <th style="text-align: center; width: 15%;">Limit ≤ (dBc)</th> <th style="text-align: center; width: 15%;">Result</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">30 MHz - 12.5 GHz</td> <td style="text-align: center;">-66.66</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">12.5 GHz - 25 GHz</td> <td style="text-align: center;">-69.72</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">30 MHz - 12.5 GHz</td> <td style="text-align: center;">-70.75</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">12.5 GHz - 25 GHz</td> <td style="text-align: center;">-68.8</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">30 MHz - 12.5 GHz</td> <td style="text-align: center;">-66.82</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">12.5 GHz - 25 GHz</td> <td style="text-align: center;">-68.29</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">Pass</td> </tr> </tbody> </table>				Frequency Range	Value (dBc)	Limit ≤ (dBc)	Result	30 MHz - 12.5 GHz	-66.66	-20	Pass	12.5 GHz - 25 GHz	-69.72	-20	Pass	30 MHz - 12.5 GHz	-70.75	-20	Pass	12.5 GHz - 25 GHz	-68.8	-20	Pass	30 MHz - 12.5 GHz	-66.82	-20	Pass	12.5 GHz - 25 GHz	-68.29	-20	Pass		
Frequency Range	Value (dBc)	Limit ≤ (dBc)	Result																														
30 MHz - 12.5 GHz	-66.66	-20	Pass																														
12.5 GHz - 25 GHz	-69.72	-20	Pass																														
30 MHz - 12.5 GHz	-70.75	-20	Pass																														
12.5 GHz - 25 GHz	-68.8	-20	Pass																														
30 MHz - 12.5 GHz	-66.82	-20	Pass																														
12.5 GHz - 25 GHz	-68.29	-20	Pass																														
Lora SF7																																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 25%;">Low Channel, 903 MHz</td> <td style="width: 25%;">30 MHz - 12.5 GHz</td> <td style="width: 25%;">-66.66</td> <td style="width: 25%;">-20</td> <td style="width: 25%;">Pass</td> </tr> <tr> <td>Low Channel, 903 MHz</td> <td>12.5 GHz - 25 GHz</td> <td>-69.72</td> <td>-20</td> <td>Pass</td> </tr> <tr> <td>Mid Channel, 917 MHz</td> <td>30 MHz - 12.5 GHz</td> <td>-70.75</td> <td>-20</td> <td>Pass</td> </tr> <tr> <td>Mid Channel, 917 MHz</td> <td>12.5 GHz - 25 GHz</td> <td>-68.8</td> <td>-20</td> <td>Pass</td> </tr> <tr> <td>High Channel, 927 MHz</td> <td>30 MHz - 12.5 GHz</td> <td>-66.82</td> <td>-20</td> <td>Pass</td> </tr> <tr> <td>High Channel, 927 MHz</td> <td>12.5 GHz - 25 GHz</td> <td>-68.29</td> <td>-20</td> <td>Pass</td> </tr> </tbody> </table>				Low Channel, 903 MHz	30 MHz - 12.5 GHz	-66.66	-20	Pass	Low Channel, 903 MHz	12.5 GHz - 25 GHz	-69.72	-20	Pass	Mid Channel, 917 MHz	30 MHz - 12.5 GHz	-70.75	-20	Pass	Mid Channel, 917 MHz	12.5 GHz - 25 GHz	-68.8	-20	Pass	High Channel, 927 MHz	30 MHz - 12.5 GHz	-66.82	-20	Pass	High Channel, 927 MHz	12.5 GHz - 25 GHz	-68.29	-20	Pass
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High Channel, 927 MHz	12.5 GHz - 25 GHz	-68.29	-20	Pass																													

SPURIOUS CONDUCTED EMISSIONS

Lora SF7, Low Channel, 903 MHz				
Frequency Range		Value (dBc)	Limit \leq (dBc)	Result
30 MHz - 12.5 GHz		-66.66	-20	Pass

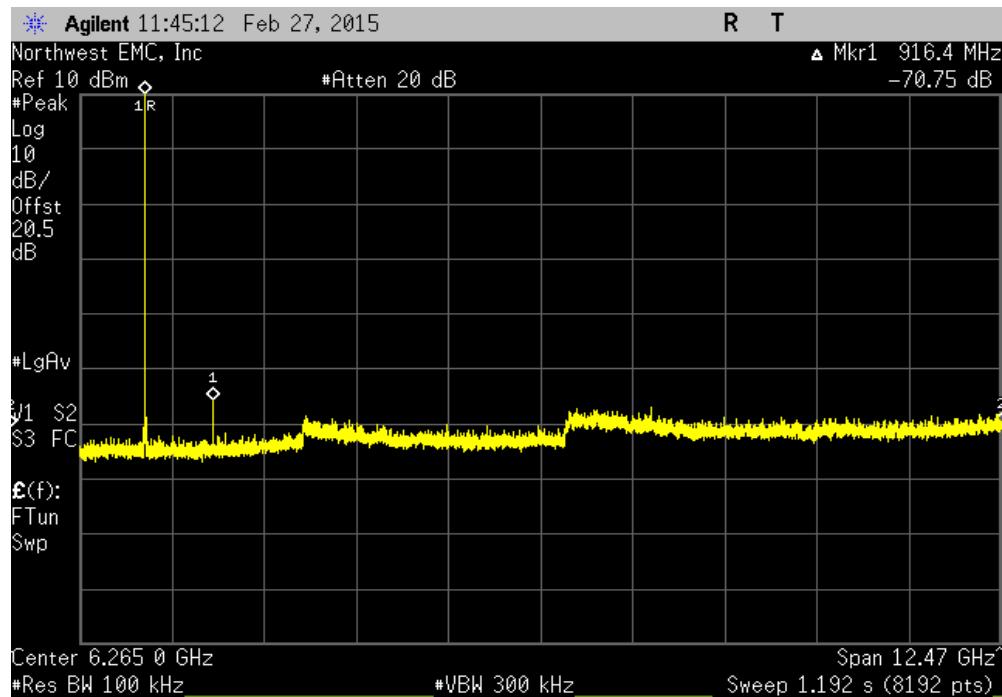


Lora SF7, Low Channel, 903 MHz				
Frequency Range		Value (dBc)	Limit \leq (dBc)	Result
12.5 GHz - 25 GHz		-69.72	-20	Pass



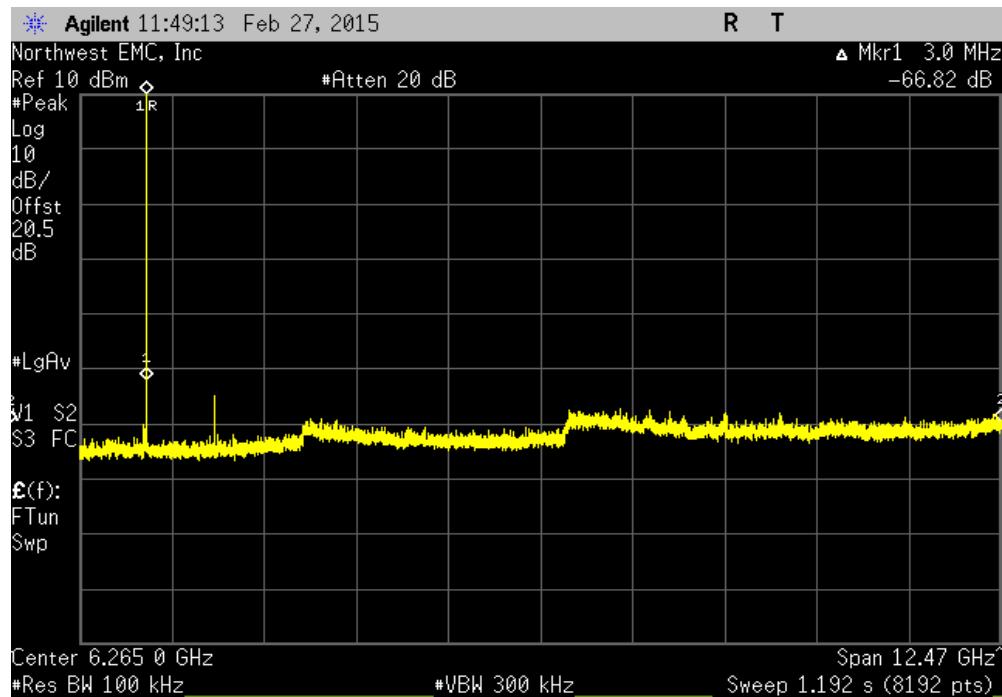
SPURIOUS CONDUCTED EMISSIONS

Lora SF7, Mid Channel, 917 MHz				
Frequency Range	Value (dBc)	Limit \leq (dBc)	Result	
30 MHz - 12.5 GHz	-70.75	-20	Pass	

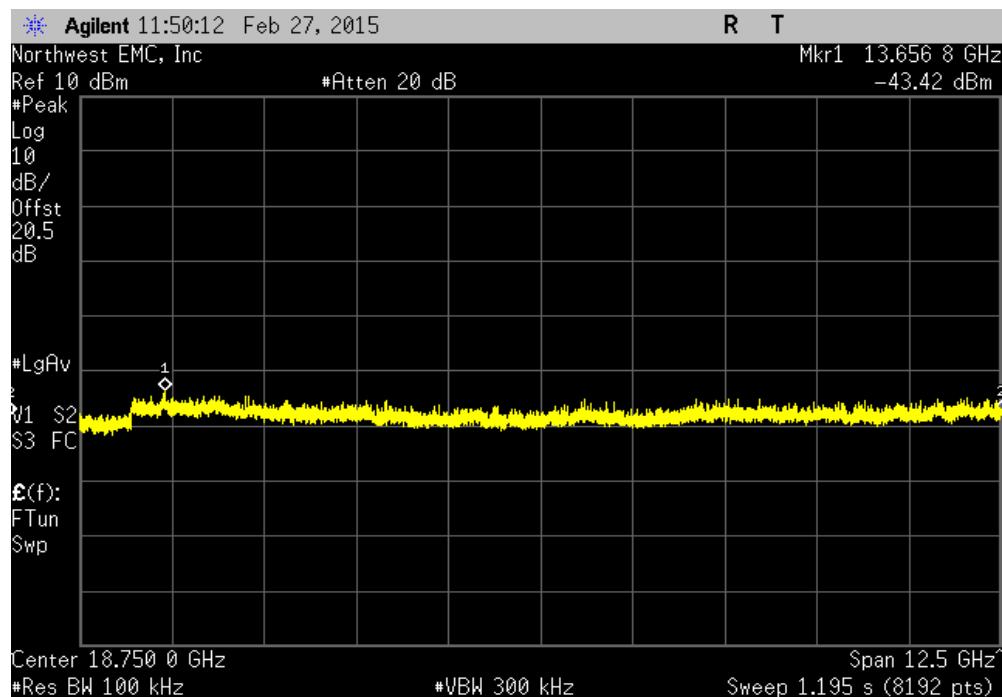


SPURIOUS CONDUCTED EMISSIONS

Lora SF7, High Channel, 927 MHz				
Frequency Range		Value (dBc)	Limit \leq (dBc)	Result
30 MHz - 12.5 GHz		-66.82	-20	Pass



Lora SF7, High Channel, 927 MHz				
Frequency Range		Value (dBc)	Limit \leq (dBc)	Result
12.5 GHz - 25 GHz		-68.29	-20	Pass



OCCUPIED BANDWIDTH

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.9% (approximate 26 dB) emission bandwidth (EBW) was also measured at the same time.

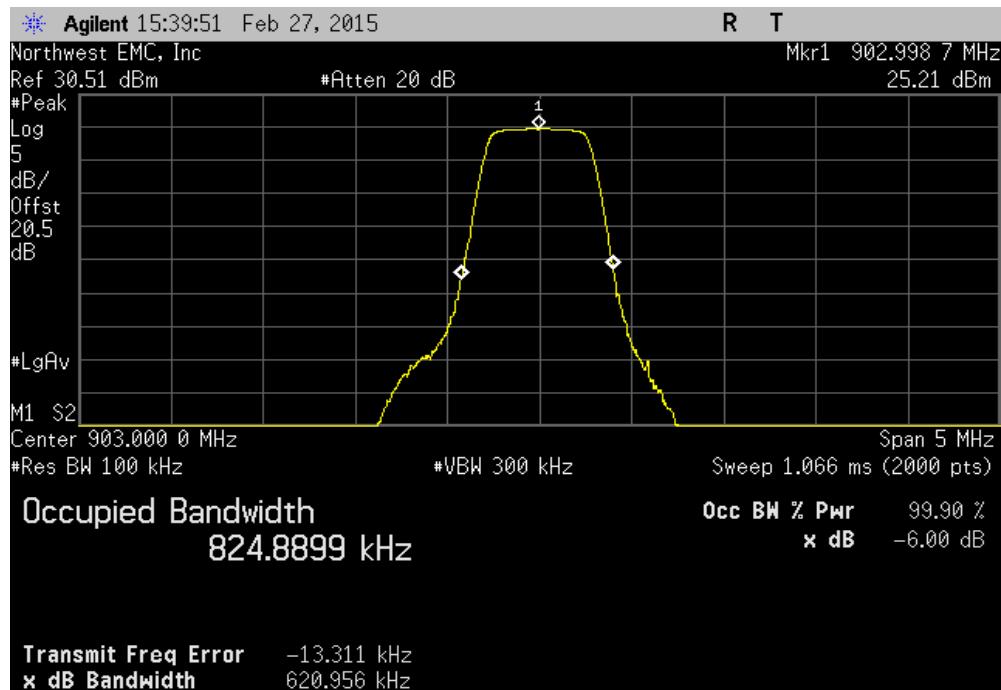
The EUT was set to the channels and modes listed in the datasheet. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer.

OCCUPIED BANDWIDTH

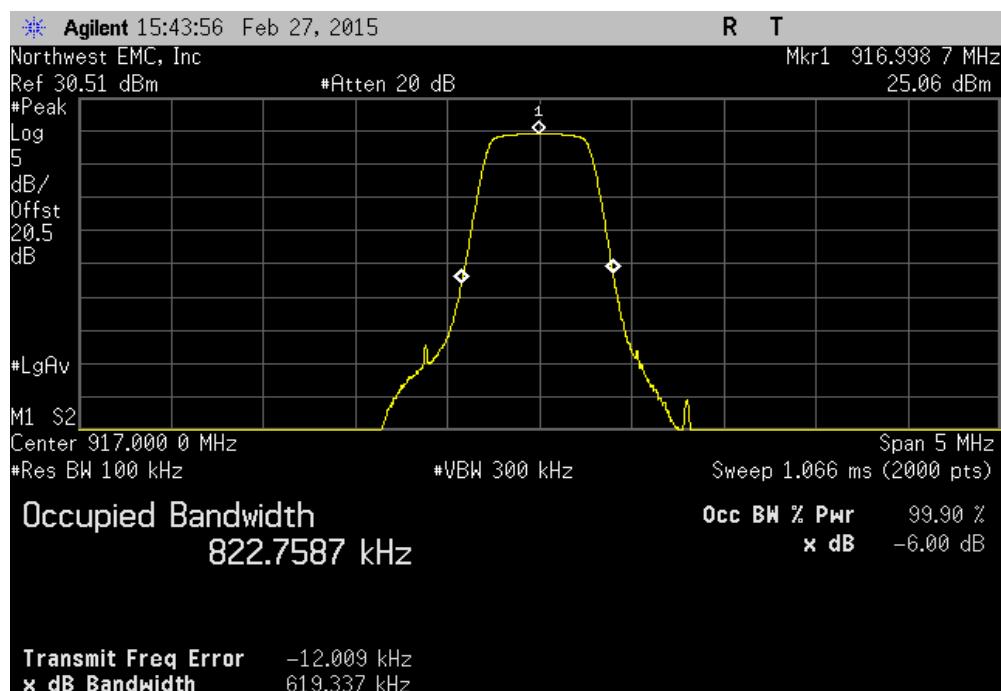
EUT:	MTAC-Lora	Work Order:	MLTI0031	
Serial Number:	None	Date:	02/27/15	
Customer:	Multi-Tech Systems	Temperature:	25°C	
Attendees:	Bud Sundeen	Humidity:	31%	
Project:	None	Barometric Pres.:	1020 mb	
Tested by:	Jonathan Kiefer	Job Site:	TX09	
TEST SPECIFICATIONS		Test Method		
FCC 15.247:2015		ANSI C63.10:2009		
COMMENTS				
Transmitting Lora at Low, Mid, High Channel @ 903, 917, 927 MHz.				
DEVIATIONS FROM TEST STANDARD				
None				
Configuration #	1	Signature		
Lora SF7		Value (kHz)	Lower Limit (kHz)	Result
Low Channel, 903 MHz		620.956	500	Pass
Mid Channel, 917 MHz		619.337	500	Pass
High Channel, 927 MHz		612.419	500	Pass

OCCUPIED BANDWIDTH

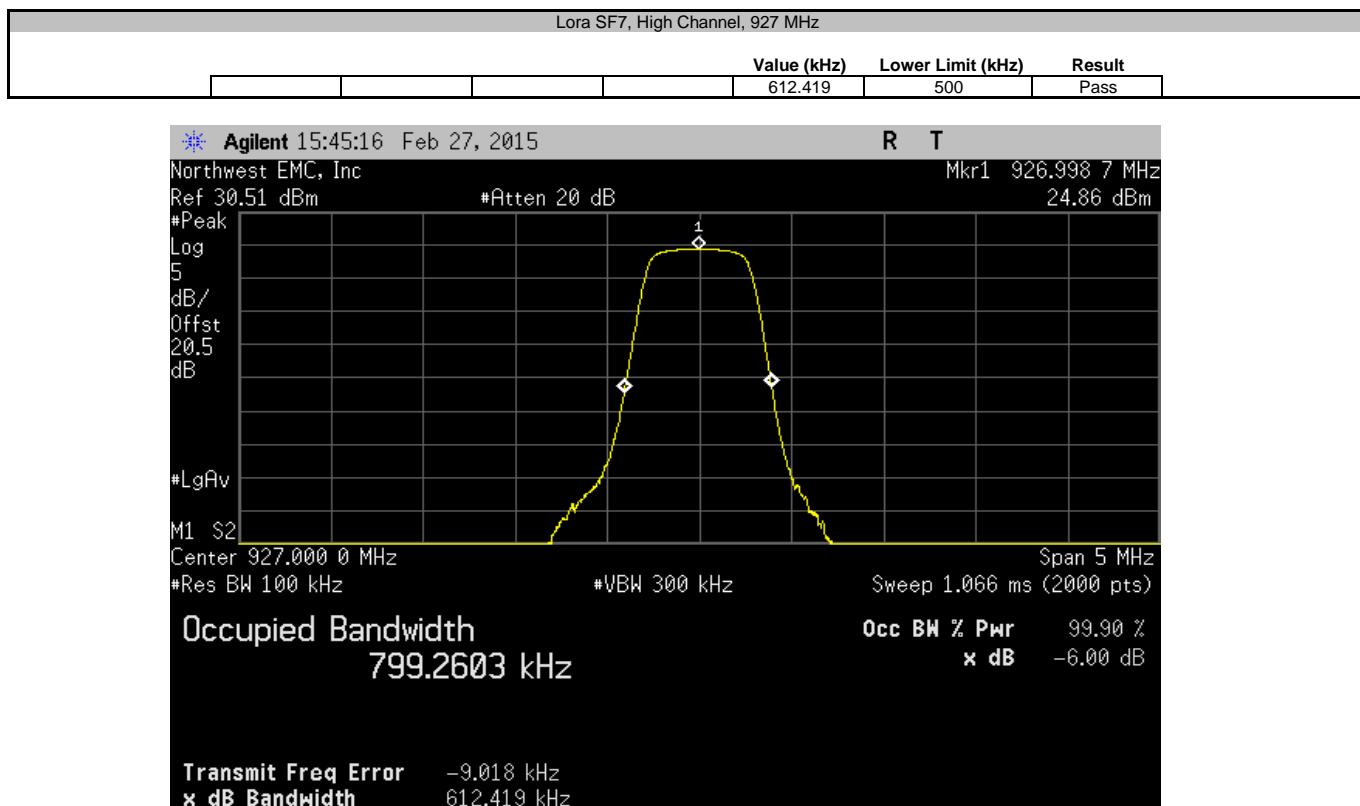
Lora SF7, Low Channel, 903 MHz				Value (kHz)	Lower Limit (kHz)	Result
				620.956	500	Pass



Lora SF7, Mid Channel, 917 MHz				Value (kHz)	Lower Limit (kHz)	Result
				619.337	500	Pass



OCCUPIED BANDWIDTH



OUTPUT POWER

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used. The reference level offset on the spectrum analyzer was adjusted to compensate for cable loss and the external attenuation used between the RF output and the spectrum analyzer input.

Prior to measuring peak transmit power the DTS bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method found in KDB 558074 DTS D01 Measurement Section 9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

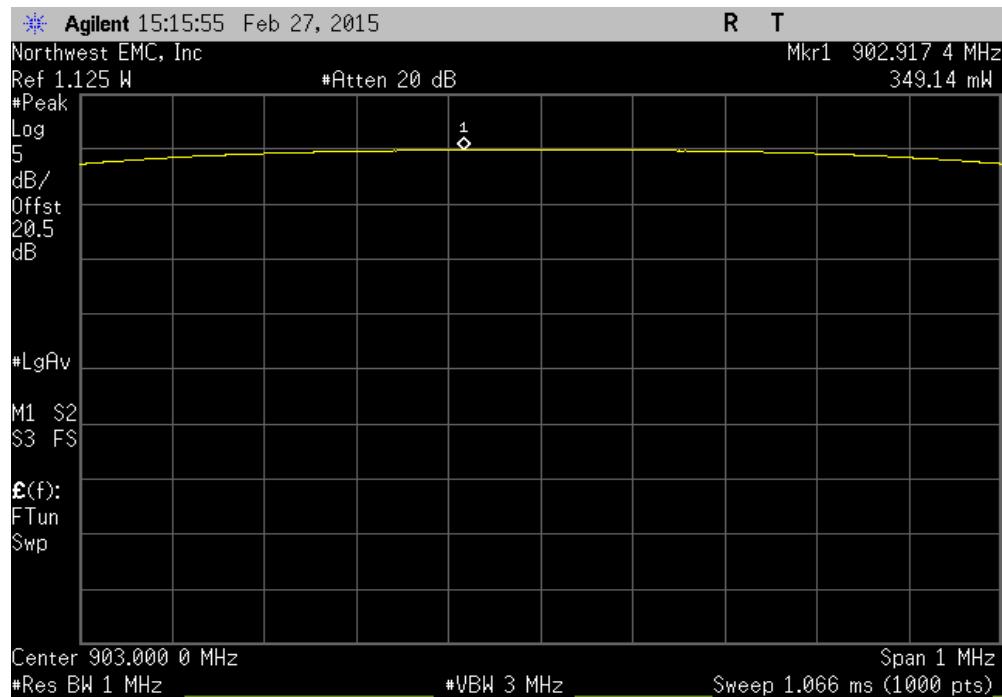
De Facto EIRP Limit: Per 47 CFR 15.247 (b)(1-3), the EUT meets the de facto EIRP limit of +36 dBm.

OUTPUT POWER

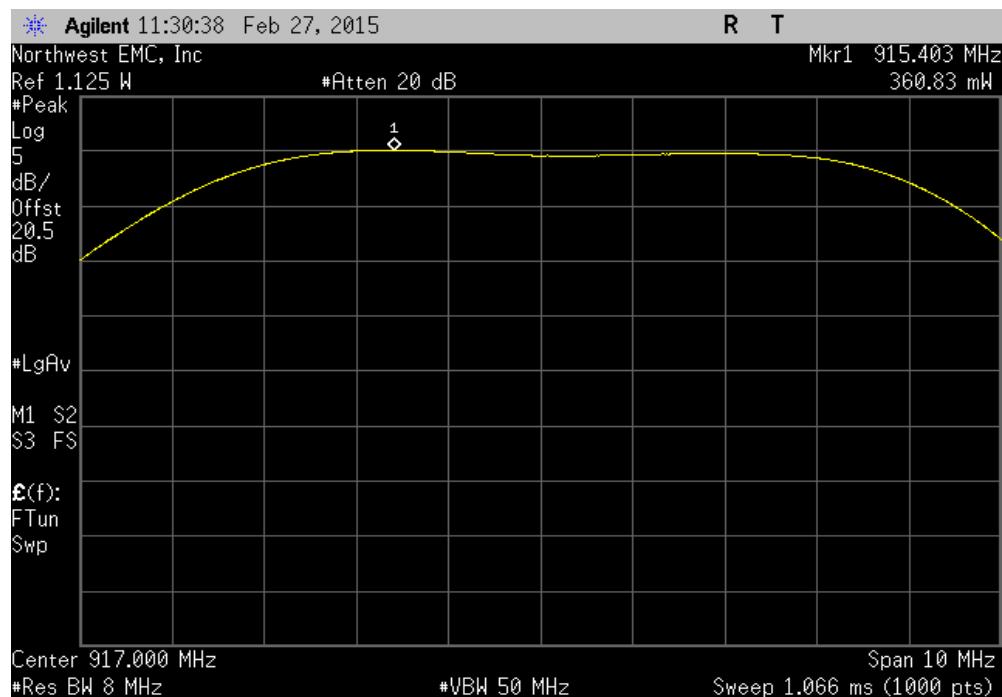
EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	02/27/15
Customer:	Multi-Tech Systems	Temperature:	25°C
Attendees:	Bud Sundeen	Humidity:	31%
Project:	None	Barometric Pres.:	1020 mb
Tested by:	Jonathan Kiefer	Job Site:	TX09
Power: USB via 110VAC/60Hz		Test Method:	
TEST SPECIFICATIONS		ANSI C63.10:2009	
FCC 15.247:2015			
COMMENTS			
Transmitting Lora at Low, Mid, High Channel @ 903, 917, 927 MHz.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature	
			Value
			Limit (<)
			Result
Lora SF7			
Low Channel, 903 MHz Mid Channel, 917 MHz High Channel, 927 MHz			
349.14 mW 1 W Pass 360.828 mW 1 W Pass 350.187 mW 1 W Pass			

OUTPUT POWER

Lora SF7, Low Channel, 903 MHz			Value	Limit	Result
			349.14 mW	(<) 1 W	Pass

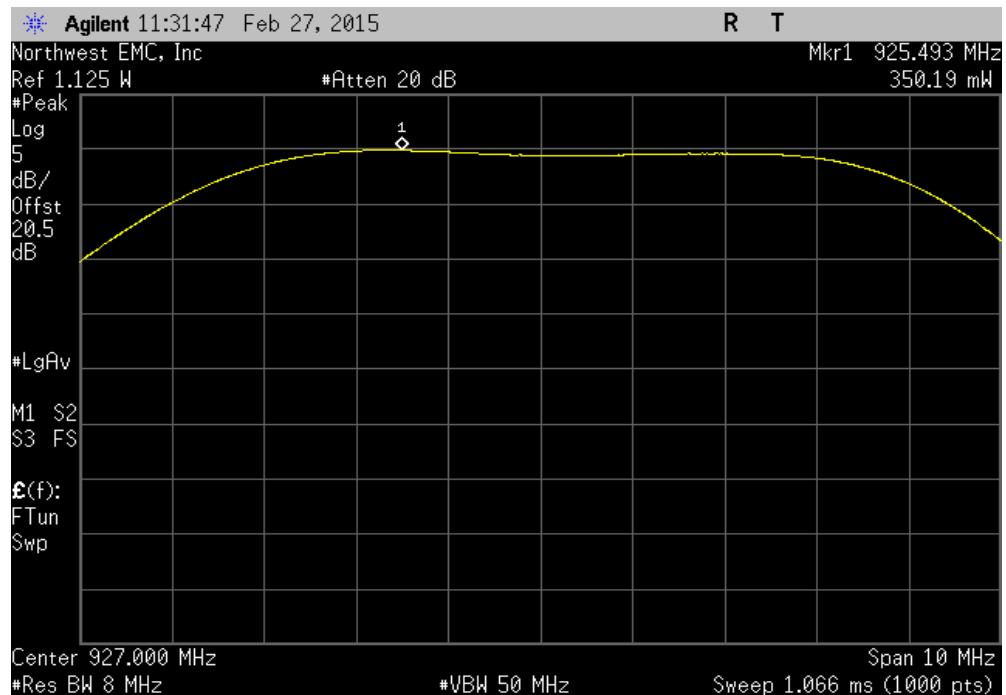


Lora SF7, Mid Channel, 917 MHz			Value	Limit	Result
			360.828 mW	(<) 1 W	Pass



OUTPUT POWER

Lora SF7, High Channel, 927 MHz			Value	Limit (<)	Result
			350.187 mW	1 W	Pass



POWER SPECTRAL DENSITY

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

The maximum power spectral density measurements were measured with the EUT set to the required transmit frequencies in each band. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the lowest, middle, and maximum data rate for each modulation type available. A duty cycle of >98% was used.

Per the procedure outlined in section 10.3 in the KDB 558074 D01 v03r02 document, a power spectral density measurement using the AVGPSD-1 method was used on each channel.

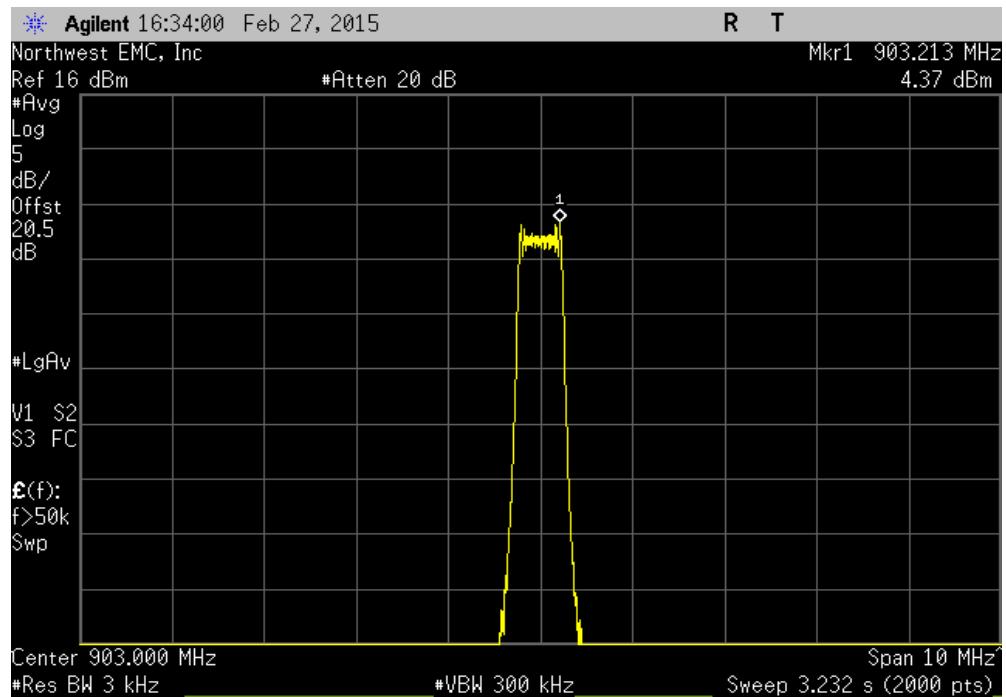
- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Detector = power averaging (RMS)
- f) Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.

POWER SPECTRAL DENSITY

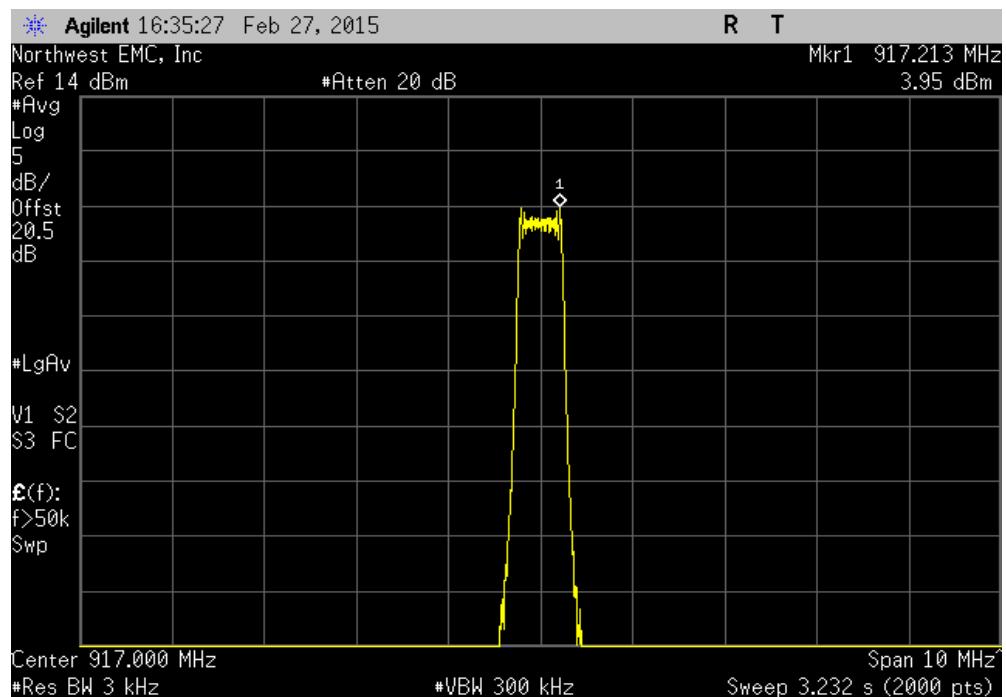
EUT:	MTAC-Lora	Work Order:	MLTI0031	
Serial Number:	None	Date:	02/27/15	
Customer:	Multi-Tech Systems	Temperature:	25°C	
Attendees:	Bud Sundeen	Humidity:	31%	
Project:	None	Barometric Pres.:	1020 mb	
Tested by:	Jonathan Kiefer	Job Site:	TX09	
Power: USB via 110VAC/60Hz		Test Method:		
TEST SPECIFICATIONS		ANSI C63.10:2009		
FCC 15.247:2015				
COMMENTS				
Transmitting Lora at Low, Mid, High Channel @ 903, 917, 927 MHz.				
DEVIATIONS FROM TEST STANDARD				
None				
Configuration #	1	Signature		
		Value dBm/3kHz	Limit dBm/3kHz	Results
Lora SF7				
Low Channel, 903 MHz 4.37 8 Pass				
Mid Channel, 917 MHz 3.947 8 Pass				
High Channel, 927 MHz 3.541 8 Pass				

POWER SPECTRAL DENSITY

Lora SF7, Low Channel, 903 MHz			Value dBm/3kHz	Limit dBm/3kHz	Results
	4.37			8	Pass

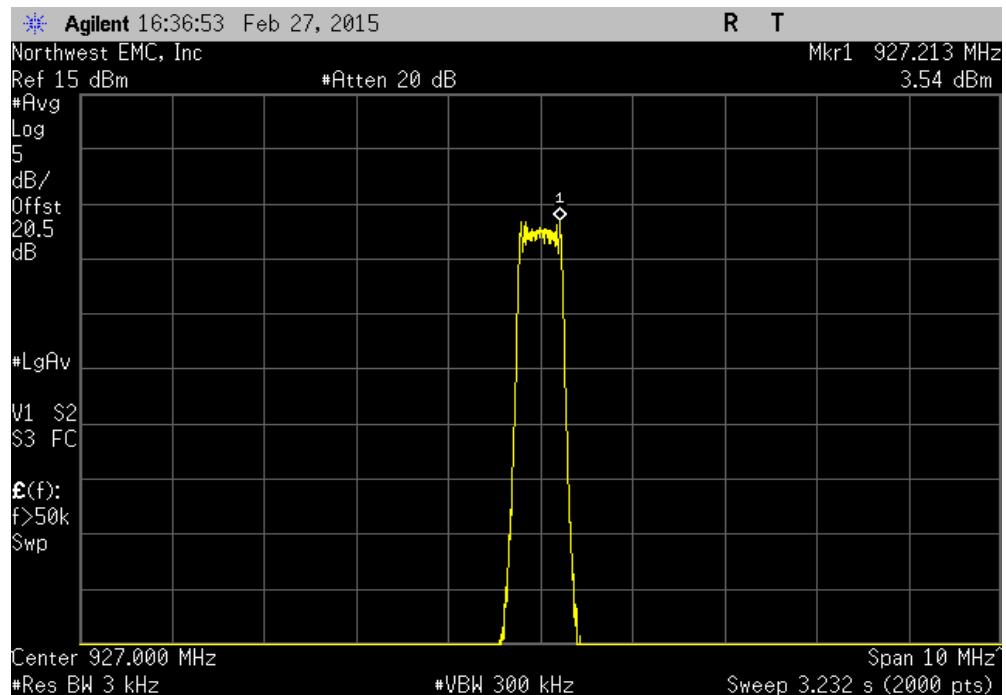


Lora SF7, Mid Channel, 917 MHz			Value dBm/3kHz	Limit dBm/3kHz	Results
	3.947			8	Pass



POWER SPECTRAL DENSITY

Lora SF7, High Channel, 927 MHz			Value	Limit	Results
	dBm/3kHz		dBm/3kHz		
	3.541		8	Pass	



DUTY CYCLE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mos)
Spectrum Analyzer	Agilent	E4440A	AFD	7/14/2014	12
20 dB Attenuator	Fairview Microwave	SA4018-20	TQY	2/27/2015	12
DC Block	Fairview Microwave	SD 3379	AMM	2/27/2015	12
Signal Generator, 40 GHz	Agilent	N5173B	TIW	7/15/2014	36

TEST DESCRIPTION

The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

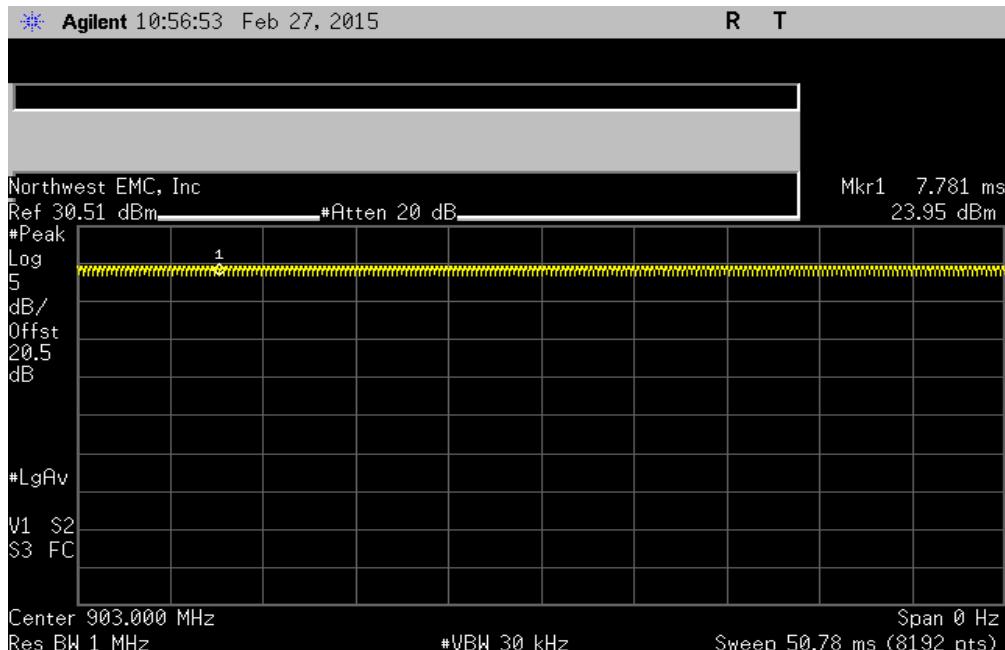
If the transmit duty cycle < 98 percent, burst gating was used during some of the other tests in this report to only measure during the burst duration.

DUTY CYCLE

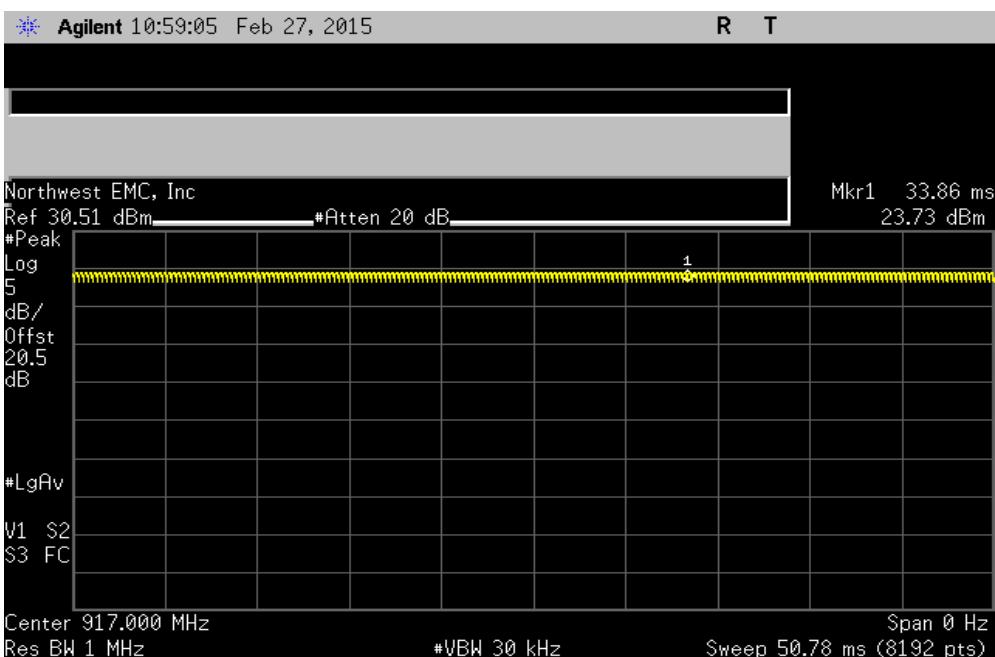
EUT:	MTAC-Lora	Work Order:	MLTI0031
Serial Number:	None	Date:	02/27/15
Customer:	Multi-Tech Systems	Temperature:	25°C
Attendees:	Bud Sundeen	Humidity:	31%
Project:	None	Barometric Pres.:	1020 mb
Tested by:	Jonathan Kiefer	Power:	USB via 110VAC/60Hz
TEST SPECIFICATIONS		Test Method	ANSI C63.10:2009
FCC 15.247:2015			
COMMENTS			
Transmitting Lora at Low, Mid, High Channel @ 903, 917, 927 MHz.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value (%)	Limit (%)
Lora SF7		100	100
Low Channel		100	100
Mid Channel		100	100
High Channel		100	Pass

DUTY CYCLE

Lora SF7, Low Channel, 903 MHz		
	Value (%)	Limit (%)
	100	100



Lora SF7, Mid Channel, 917 MHz		
	Value (%)	Limit (%)
	100	100



DUTY CYCLE

Lora SF7, High Channel, 927 MHz		
	Value (%)	Limit (%)
	100	100

