



Multi-Tech Systems, Inc.

**MTCDTIP2-LNA3-B11UKP-L1L
MTCDTIP2-EN-B11UKP-L1L**

FCC 15.247:2021

902 - 928 MHz Other Wideband (DTS) Transceiver

Report: MLTI0180.6, Issue Date: July 26, 2021



NVLAP LAB CODE: 200881-0



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CERTIFICATE OF TEST



Last Date of Test: February 11, 2021
Multi-Tech Systems, Inc.
EUT: MTCDTIP2-LNA3-B11UKP-L1L

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2021 FCC 15.247:2021	ANSI C63.10:2013, KDB 558074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	Yes	Pass	
6.5, 6.6, 11.12.1, 11.13.2	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	NA	Characterization of radio operation.
7.8.2	Carrier Frequency Separation	No	N/A	Not required for DTS devices.
7.8.3	Number of Hopping Frequencies	No	N/A	Not required for DTS devices.
7.8.4	Dwell Time	No	N/A	Not required for DTS devices.
11.9.1.1	Output Power	Yes	Pass	
11.9.1.1	Equivalent Isotropic Radiated Power	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
7.8.6	Band Edge Compliance - Hopping Mode	No	N/A	Not required for DTS devices.
11.8.2	Occupied Bandwidth	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Eric Brandon, Department 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. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	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 Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

Australia/New Zealand

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

Korea

MSIT / 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.

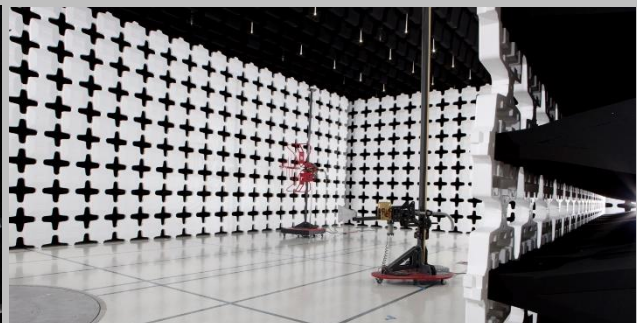
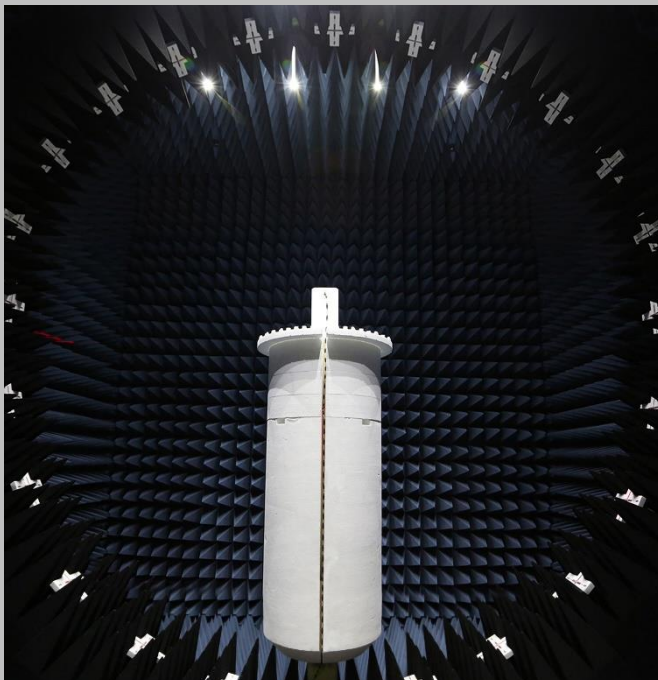
SCOPE

For details on the Scopes of our Accreditations, please visit:
<https://www.nwemc.com/emc-testing-accreditations>

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



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.

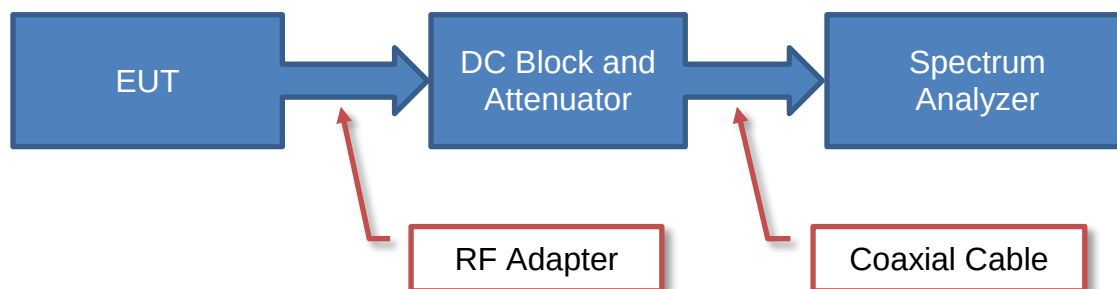
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific value may also be found in the applicable test description section. 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.

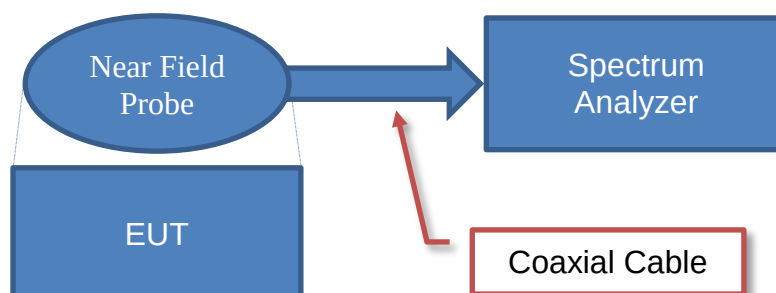
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.6 dB	-2.6 dB

Test Setup Block Diagrams

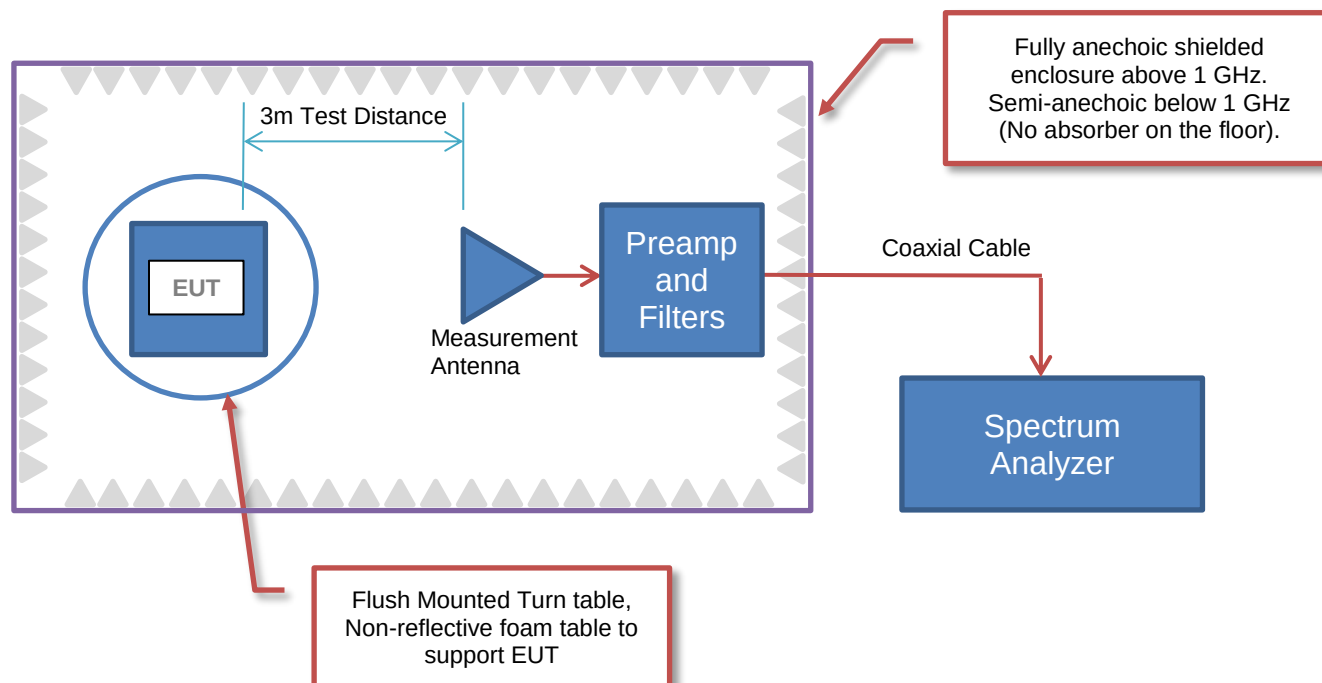
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Multi-Tech Systems, Inc.
Address:	2205 Woodale Drive
City, State, Zip:	Saint Paul, MN 55112
Test Requested By:	Jim Asp
EUT:	MTCDTIP2-LNA3-B11UKP-L1L MTCDTIP2-EN-B11UKP-L1L
First Date of Test:	January 4, 2021
Last Date of Test:	February 11, 2021
Receipt Date of Samples:	December 11, 2020
Equipment Design Stage:	Preproduction
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

The Conduit® IP67 Base Station is a ruggedized IoT gateway solution, specifically designed for outdoor LoRa® public or private network deployments. The highly scalable and certified Conduit IP67 gateway is capable of resisting the harshest environmental factors including moisture, dust, wind, rain, snow and extreme heat. The device supports LoRaWAN® applications in virtually any environment. Leveraging the Conduit, this device can support thousands of LoRaWAN-certified end nodes, including the mDot™*. This flexible solution provides durable, low-power, low-power, wide area network connectivity in support of M2M and IoT applications for both LoRa service providers and individual enterprises wanting to expand their LoRa network coverage.

Bundled for easy deployment, the solution includes a Conduit with a LoRa mCard™, IP67 enclosure and LoRa antenna to improve outdoor range. It also provides a choice of cellular 3G, 4G-LTE or Ethernet backhaul options. The LoRa transceiver can be deployed as part of an existing telecommunications tower, individual stand or wall mount.

Model Equivalency Statement:

MTCDTIP2-LNA3-B11UKP-L1L	915 external Lora Antenna, LNA3 Cell,mlinux
MTCDTIP2-EN-B11UKP-L1L	915 External Lora Antenna, no cell,mlinux

Testing Objective:

Seeking to demonstrate compliance under FCC 15.247:2020 for operation in the 902 - 928 MHz Band.

CONFIGURATIONS

Configuration MLTI0180- 11

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
MTCDTIP2-LNA3-B11UKP-L1L (external 915 Lora Antenna)	Multi-Tech Systems, Inc.	70006807L	0205123980-0008

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Lenovo	ThinkPad T430	PB7Z4FB
AC/DC Adapter (Laptop)	Lenovo	ADLX90NLT2A	11S45N0307Z1ZLZ437C86U

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Cable	No	1.8m	No	Gigabit PoE+ Injector	AC Mains
Ethernet Cable (TE)	No	1.8m	No	Gigabit PoE+ Injector	Laptop
Ethernet	No	1.8m	No	EUT Family	Gigabit PoE+ Injector
AC Cable (Laptop)	No	1.8m	No	AC Mains	AC/DC Adapter (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	AC/DC Adapter (Laptop)	Laptop

CONFIGURATIONS

Configuration MLTI0180- 14

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
MTCDTIP2-LNA3-B11UKP-L1L (external 915 Lora Antenna)	Multi-Tech Systems, Inc.	70006807L	0205123980-0008
L-Com External Antenna	L-Com	HGV-906U	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Gigabit PoE+ Injector	Trendnet	TPE-115Gi/A	IT0E5I2208642

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Lenovo	ThinkPad T430	PB7Z4FB
AC/DC Adapter (Laptop)	Lenovo	ADLX90NLT2A	11S45N0307Z1ZLZ437C86U

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Cable	No	1.8m	No	Gigabit PoE+ Injector	AC Mains
Ethernet	No	1.8m	No	EUT Family	Gigabit PoE+ Injector
Ethernet	No	>3m	No	Gigabit PoE+ Injector	Laptop
AC Cable (Laptop)	No	1.8m	No	AC Mains	AC/DC Adapter (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	AC/DC Adapter (Laptop)	Laptop

CONFIGURATIONS



Configuration MLTI0180- 17

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
MTCDTIP2-LNA3-B11UKP-L1L (external 915 Lora Antenna)	Multi-Tech Systems, Inc.	70006807L	0205123980-0008
L-Com External Antenna	L-Com	HGV-906U	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Gigabit PoE+ Injector	Intellinet	560566/Rev.1	1019692032000059

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Lenovo	ThinkPad T430	PB7Z4FB
AC/DC Adapter (Laptop)	Lenovo	ADLX90NLT2A	11S45N0307Z1ZLZ437C86U

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Cable	No	1.8m	No	Gigabit PoE+ Injector	AC Mains
Ethernet	No	1.8m	No	EUT Family	Gigabit PoE+ Injector
Ethernet	No	>3m	No	Gigabit PoE+ Injector	Laptop
AC Cable (Laptop)	No	1.8m	No	AC Mains	AC/DC Adapter (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	AC/DC Adapter (Laptop)	Laptop

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2021-01-04	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2021-01-04	Equivalent Isotropic Radiated Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2021-01-04	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2021-01-04	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2021-01-04	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2021-01-04	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2021-01-08	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2021-02-11	Powerline Conducted Emissions (Transmitter)	Modified from delivered configuration.	Clients added a ground strap from the circuit board ground to the sim card board ground. Approved by Jim Asp.	Scheduled testing was completed.

POWER SETTINGS AND ANTENNAS



The power settings, antenna gain value(s) and cable loss (if applicable) used for the testing contained in this report were provided by the customer and will affect the validity of the results. Element assumes no responsibility for the accuracy of this information.

ANTENNA GAIN (dBi)

Type	Provided by:	Frequency Range (MHz)	Gain (dBi)
HGV-906U	L-Com	824-960	6

The EUT was tested using the power settings provided by the manufacturer:

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types	Position (if multiple channels)	Power Setting
Single Data Rate / Modulation	Low Channel (923.3 MHz)	Mix 13, PA 3, Dig 0
	Mid Channel (925.1 MHz)	Mix 13, PA 3, Dig 0
	High Channel (927.5 MHz)	Mix 13, PA 3, Dig 0

POWERLINE CONDUCTED EMISSIONS

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Gauss Instruments	TDEMI 30M	ARK	2020-10-27	2021-10-27
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2020-03-11	2021-03-11
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2020-03-15	2021-03-15
LISN	Solar Electronics	9252-50-R-24-BNC	LIO	2020-09-28	2021-09-28

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.6 dB	-2.6 dB

CONFIGURATIONS INVESTIGATED

MLTI0180-17

MODES INVESTIGATED

LoRa Transmitting: Mid Channel 925.1 MHz

POWERLINE CONDUCTED EMISSIONS



WTD.2020.12.03.1
EmiRS 2021.01.08.0, PSA-ESCI
2021.01.22.0

EUT:	MTCDTIP2-LNA3-B11UKP-L1L	Work Order:	MLTI0180
Serial Number:	0205123980-0008	Date:	2021-02-11
Customer:	Multi-Tech Systems, Inc.	Temperature:	22°C
Attendees:	Jim Asp	Relative Humidity:	12.8%
Customer Project:	None	Bar. Pressure:	1039.2 mb
Tested By:	Andrew Rogstad	Job Site:	MN03
Power:	54VDC via PoE	Configuration:	MLTI0180-17

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	27	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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COMMENTS

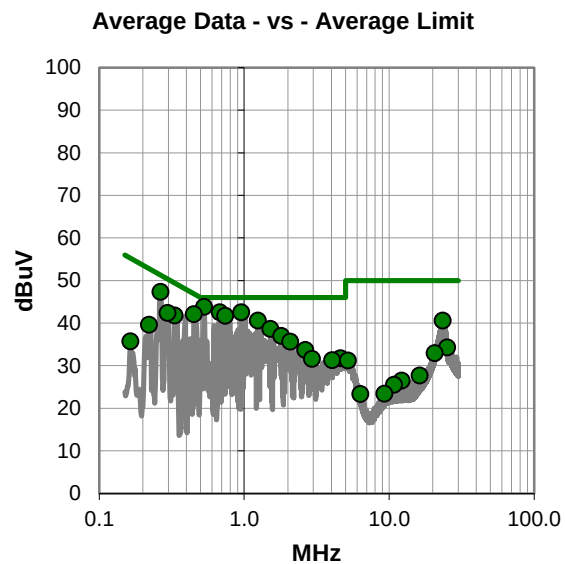
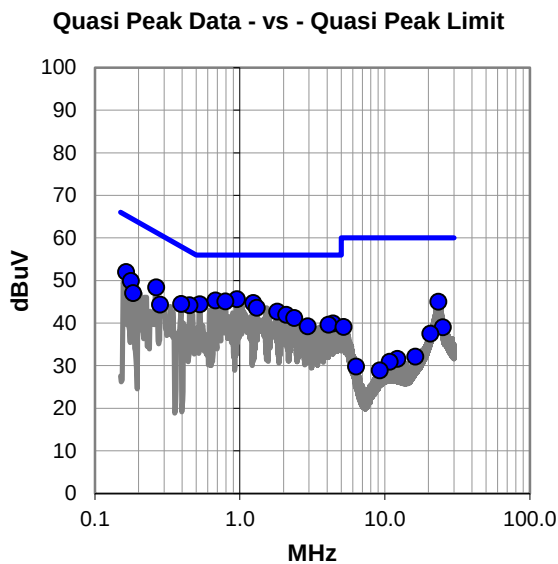
54VDC provided by power over Ethernet adapter supplied with 120VAC/60Hz.

EUT OPERATING MODES

LoRa Transmitting: Mid Channel 925.1 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS



WTD, 2020.12.03.1
EmiR5 2021.01.08.0, PSA-ESCI
2021.01.22.0

RESULTS - Run #27

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.957	25.1	20.5	45.6	56.0	-10.4
0.678	24.8	20.5	45.3	56.0	-10.7
0.795	24.6	20.5	45.1	56.0	-10.9
1.241	24.2	20.5	44.7	56.0	-11.3
0.530	23.9	20.5	44.4	56.0	-11.6
1.312	23.1	20.5	43.6	56.0	-12.4
0.450	23.7	20.5	44.2	56.9	-12.7
0.265	27.7	20.7	48.4	61.3	-12.9
0.165	31.1	20.9	52.0	65.2	-13.2
1.812	22.1	20.6	42.7	56.0	-13.3
0.394	24.0	20.5	44.5	58.0	-13.5
2.096	21.3	20.6	41.9	56.0	-14.1
0.177	29.1	20.8	49.9	64.6	-14.7
2.374	20.6	20.6	41.2	56.0	-14.8
23.481	23.7	21.3	45.0	60.0	-15.0
4.391	19.2	20.7	39.9	56.0	-16.1
4.084	18.9	20.7	39.6	56.0	-16.4
0.281	23.8	20.5	44.3	60.8	-16.5
2.935	18.6	20.6	39.2	56.0	-16.8
0.183	26.3	20.7	47.0	64.3	-17.3
5.204	18.4	20.7	39.1	60.0	-20.9
25.154	17.7	21.3	39.0	60.0	-21.0
20.598	16.3	21.2	37.5	60.0	-22.5
16.226	11.0	21.1	32.1	60.0	-27.9
12.196	10.6	21.0	31.6	60.0	-28.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.530	23.3	20.5	43.8	46.0	-2.2
0.678	22.0	20.5	42.5	46.0	-3.5
0.957	22.0	20.5	42.5	46.0	-3.5
0.265	26.6	20.7	47.3	51.3	-4.0
0.740	21.2	20.5	41.7	46.0	-4.3
0.450	21.6	20.5	42.1	46.9	-4.8
1.243	20.1	20.5	40.6	46.0	-5.4
1.520	18.1	20.5	38.6	46.0	-7.4
0.331	21.3	20.5	41.8	49.4	-7.6
0.296	21.9	20.5	42.4	50.4	-8.0
1.808	16.4	20.6	37.0	46.0	-9.0
23.481	19.3	21.3	40.6	50.0	-9.4
2.084	15.0	20.6	35.6	46.0	-10.4
2.647	13.1	20.6	33.7	46.0	-12.3
0.221	18.9	20.7	39.6	52.8	-13.2
4.620	11.0	20.7	31.7	46.0	-14.3
2.937	11.0	20.6	31.6	46.0	-14.4
4.057	10.6	20.7	31.3	46.0	-14.7
25.154	13.0	21.3	34.3	50.0	-15.7
20.644	11.7	21.2	32.9	50.0	-17.1
5.204	10.5	20.7	31.2	50.0	-18.8
0.165	14.8	20.9	35.7	55.2	-19.5
16.226	6.6	21.1	27.7	50.0	-22.3
12.198	5.5	21.0	26.5	50.0	-23.5
10.795	4.6	20.9	25.5	50.0	-24.5

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS



WTD.2020.12.03.1
EmiRS 2021.01.08.0, PSA-ESCI
2021.01.22.0

EUT:	MTCDTIP2-LNA3-B11UKP-L1L	Work Order:	MLTI0180
Serial Number:	0205123980-0008	Date:	2021-02-11
Customer:	Multi-Tech Systems, Inc.	Temperature:	22°C
Attendees:	Jim Asp	Relative Humidity:	12.8%
Customer Project:	None	Bar. Pressure:	1039.2 mb
Tested By:	Andrew Rogstad	Job Site:	MN03
Power:	54VDC via PoE	Configuration:	MLTI0180-17

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	28	Line:	High Line	Add. Ext. Attenuation (dB):	0
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COMMENTS

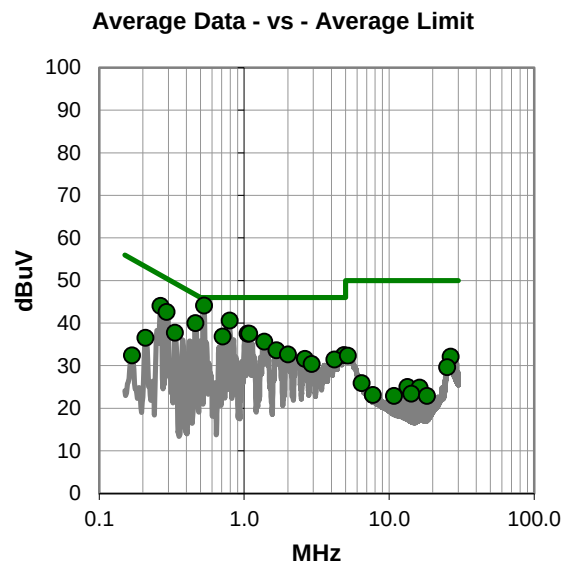
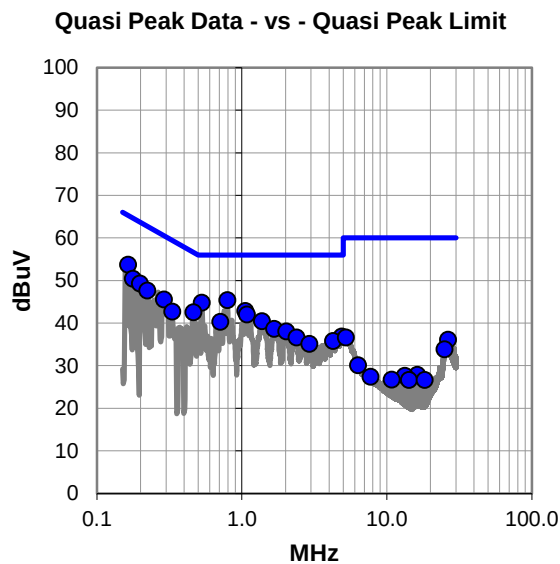
54VDC provided by power over Ethernet adapter supplied with 120VAC/60Hz.

EUT OPERATING MODES

LoRa Transmitting: Mid Channel 925.1 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS



WTD, 2020.12.03.1
EmiR5 2021.01.08.0, PSA-ESCI
2021.01.22.0

RESULTS - Run #28

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.795	24.9	20.5	45.4	56.0	-10.6
0.530	24.3	20.5	44.8	56.0	-11.2
0.165	32.8	20.9	53.7	65.2	-11.5
1.059	22.3	20.5	42.8	56.0	-13.2
1.087	21.5	20.5	42.0	56.0	-14.0
0.465	22.0	20.5	42.5	56.6	-14.1
0.177	29.6	20.8	50.4	64.6	-14.2
0.198	28.6	20.7	49.3	63.7	-14.4
0.290	25.0	20.5	45.5	60.5	-15.0
0.223	26.9	20.7	47.6	62.7	-15.1
1.381	19.9	20.5	40.4	56.0	-15.6
0.711	19.8	20.5	40.3	56.0	-15.7
0.331	22.2	20.5	42.7	59.4	-16.7
1.671	18.1	20.5	38.6	56.0	-17.4
2.032	17.4	20.6	38.0	56.0	-18.0
4.893	16.1	20.7	36.8	56.0	-19.2
2.384	16.0	20.6	36.6	56.0	-19.4
4.266	15.1	20.7	35.8	56.0	-20.2
2.922	14.5	20.6	35.1	56.0	-20.9
5.231	15.9	20.7	36.6	60.0	-23.4
26.487	14.8	21.3	36.1	60.0	-23.9
25.112	12.5	21.3	33.8	60.0	-26.2
6.335	9.4	20.7	30.1	60.0	-29.9
16.228	6.7	21.1	27.8	60.0	-32.2
13.358	6.6	21.0	27.6	60.0	-32.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.530	23.6	20.5	44.1	46.0	-1.9
0.795	20.1	20.5	40.6	46.0	-5.4
0.461	19.5	20.5	40.0	46.7	-6.7
0.265	23.3	20.7	44.0	51.3	-7.3
0.292	22.1	20.5	42.6	50.5	-7.9
1.057	17.0	20.5	37.5	46.0	-8.5
1.087	17.0	20.5	37.5	46.0	-8.5
0.711	16.3	20.5	36.8	46.0	-9.2
1.379	15.1	20.5	35.6	46.0	-10.4
0.334	17.2	20.5	37.7	49.4	-11.7
1.671	13.1	20.5	33.6	46.0	-12.4
2.004	12.0	20.6	32.6	46.0	-13.4
4.896	11.8	20.7	32.5	46.0	-13.5
2.632	11.0	20.6	31.6	46.0	-14.4
4.190	10.7	20.7	31.4	46.0	-14.6
2.926	9.8	20.6	30.4	46.0	-15.6
0.208	15.8	20.7	36.5	53.3	-16.8
5.202	11.6	20.7	32.3	50.0	-17.7
26.608	10.8	21.3	32.1	50.0	-17.9
25.144	8.3	21.3	29.6	50.0	-20.4
0.169	11.6	20.8	32.4	55.0	-22.6
6.456	5.2	20.7	25.9	50.0	-24.1
13.419	4.0	21.0	25.0	50.0	-25.0
16.228	3.7	21.1	24.8	50.0	-25.2
14.274	2.4	21.0	23.4	50.0	-26.6

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2020.06.24.2

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

Lora Radio: Transmitting High Ch 927.5 MHz, Mid Ch 925.1 MHz, Low Ch 923.3 MHz

POWER SETTINGS INVESTIGATED

54VDC via PoE

CONFIGURATIONS INVESTIGATED

MLTI0180 - 14

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12400 MHz
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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
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	2020-12-27	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFK	2020-09-24	12 mo
Filter - Low Pass	Micro-Tronics	LPM50003	LFJ	2020-09-24	12 mo
Filter - Band Pass/Notch	K&L Microwave	3TNF-500/1000-N/N	HGS	2020-06-30	12 mo
Attenuator	Fairview Microwave	SA18E-10	TYA	2020-09-14	12 mo
Attenuator	Fairview Microwave	SA18E-20	TWZ	2020-09-14	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	2020-01-17	12 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	2020-03-10	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	2020-01-17	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	2020-09-14	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	2019-01-16	24 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2020-10-06	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	2020-10-06	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	2019-09-03	24 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 antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These "pre-scans" are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector

PK = Peak Detector

AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements within 2 MHz of the allowable band may have been taken using the integration method from ANSI C63.10 clause 11.13.3. This procedure uses the channel power feature of the spectrum analyzer to integrate the power of the emission within a 1 MHz bandwidth.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of $10 \cdot \log(1/dc)$.

SPURIOUS RADIATED EMISSIONS

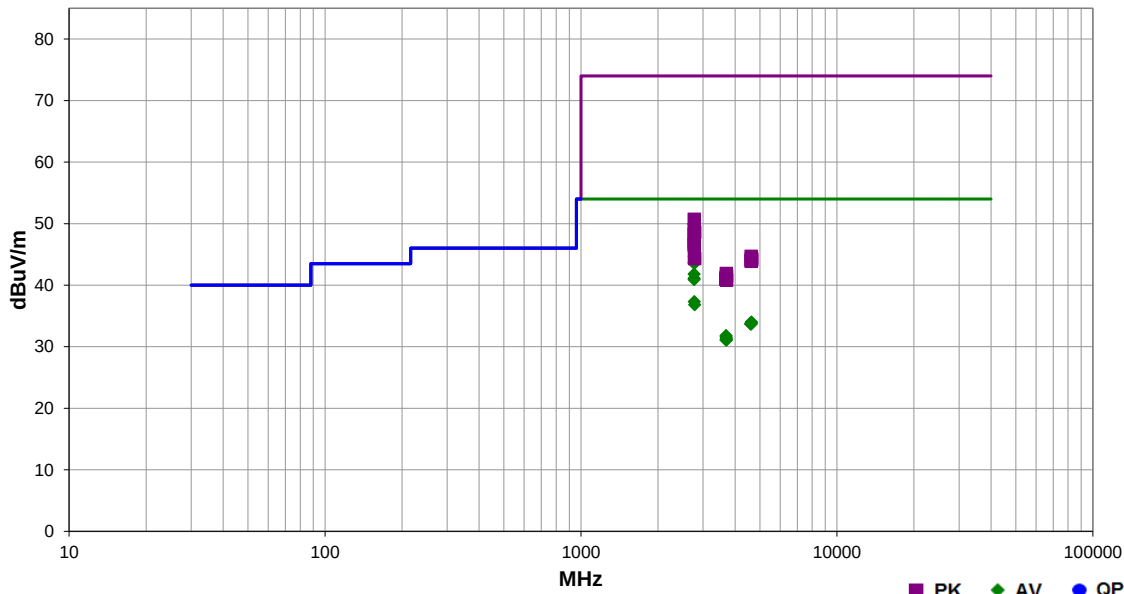


EmiRS 2020.12.09.0 PSA-ESCI 2020.06.24.2

Work Order:	MLTI0180	Date:	2021-01-08		
Project:	None	Temperature:	22.4 °C		
Job Site:	MN05	Humidity:	23.3% RH		
Serial Number:	0205123980-0008	Barometric Pres.:	1031 mbar	Tested by:	Chris Patterson
EUT:	MTCDTIP2-LNA3-B11UKP-L1L				
Configuration:	14				
Customer:	Multi-Tech Systems, Inc.				
Attendees:	Jim Asp				
EUT Power:	54VDC via PoE				
Operating Mode:	Lora Radio: Transmitting High Ch 927.5 MHz, Mid Ch 925.1 MHz, Low Ch 923.3 MHz				
Deviations:	None				
Comments:	EUT position listed in comments. Bandwidth was set to 500 kHz.				

Test Specifications	Test Method
FCC 15.247:2021	ANSI C63.10:2013

Run #	27	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
2769.942	51.5	-4.3	3.6	227.0	3.0	0.0	Vert	AV	0.0	47.2	54.0	-6.8	EUT Horz, Low Ch
2769.817	49.0	-4.3	1.1	353.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	EUT Vert, Low Ch
2769.900	48.0	-4.3	1.5	253.0	3.0	0.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT On Side, Low Ch
2782.500	47.9	-4.2	2.6	351.9	3.0	0.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT Vert, High Ch
2775.383	47.7	-4.2	1.1	358.0	3.0	0.0	Horz	AV	0.0	43.5	54.0	-10.5	EUT Vert, Mid Ch
2769.858	46.1	-4.3	1.6	55.9	3.0	0.0	Vert	AV	0.0	41.8	54.0	-12.2	EUT Vert, Low Ch
2769.817	45.4	-4.3	1.5	296.0	3.0	0.0	Vert	AV	0.0	41.1	54.0	-12.9	EUT On Side, Low Ch
2770.025	45.2	-4.3	1.5	171.0	3.0	0.0	Horz	AV	0.0	40.9	54.0	-13.1	EUT Horz, Low Ch
2775.342	41.5	-4.2	1.5	254.9	3.0	0.0	Vert	AV	0.0	37.3	54.0	-16.7	EUT Horz, Mid Ch
2782.417	41.0	-4.2	1.4	58.0	3.0	0.0	Vert	AV	0.0	36.8	54.0	-17.2	EUT Horz, High Ch
4637.292	30.9	3.1	2.5	185.0	3.0	0.0	Horz	AV	0.0	34.0	54.0	-20.0	EUT Vert, High Ch
4638.792	30.8	3.1	1.5	168.9	3.0	0.0	Vert	AV	0.0	33.9	54.0	-20.1	EUT Horz, High Ch
4611.917	30.8	2.9	1.5	181.0	3.0	0.0	Vert	AV	0.0	33.7	54.0	-20.3	EUT Horz, Low Ch
4614.042	30.8	2.9	1.5	222.9	3.0	0.0	Horz	AV	0.0	33.7	54.0	-20.3	EUT Vert, Low Ch
4613.458	30.8	2.9	1.5	318.9	3.0	0.0	Horz	AV	0.0	33.7	54.0	-20.3	EUT Vert, Mid Ch
4625.542	30.7	3.0	1.5	185.9	3.0	0.0	Vert	AV	0.0	33.7	54.0	-20.3	EUT Horz, Mid Ch
3693.158	32.2	-0.4	1.9	228.9	3.0	0.0	Horz	AV	0.0	31.8	54.0	-22.2	EUT Vert, Low Ch
3693.200	32.0	-0.4	1.5	196.0	3.0	0.0	Vert	AV	0.0	31.6	54.0	-22.4	EUT Horz, Low Ch
3700.108	31.8	-0.4	1.5	227.0	3.0	0.0	Horz	AV	0.0	31.4	54.0	-22.6	EUT Vert, Mid Ch
3695.983	31.5	-0.4	1.5	62.0	3.0	0.0	Vert	AV	0.0	31.1	54.0	-22.9	EUT Horz, Mid Ch
3698.167	31.5	-0.4	3.1	42.9	3.0	0.0	Vert	AV	0.0	31.1	54.0	-22.9	EUT Horz, High Ch
3697.583	31.5	-0.4	1.5	181.0	3.0	0.0	Horz	AV	0.0	31.1	54.0	-22.9	EUT Vert, High Ch
2769.942	55.0	-4.3	3.6	227.0	3.0	0.0	Vert	PK	0.0	50.7	74.0	-23.3	EUT Horz, Low Ch

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
2769.608	53.4	-4.3	1.1	353.0	3.0	0.0	Horz	PK	0.0	49.1	74.0	-24.9	EUT Vert, Low Ch
2782.167	52.8	-4.2	2.6	351.9	3.0	0.0	Horz	PK	0.0	48.6	74.0	-25.4	EUT Vert, High Ch
2770.192	52.7	-4.3	1.5	253.0	3.0	0.0	Horz	PK	0.0	48.4	74.0	-25.6	EUT On Side, Low Ch
2774.925	52.4	-4.2	1.1	358.0	3.0	0.0	Horz	PK	0.0	48.2	74.0	-25.8	EUT Vert, Mid Ch
2769.692	51.3	-4.3	1.6	55.9	3.0	0.0	Vert	PK	0.0	47.0	74.0	-27.0	EUT Vert, Low Ch
2769.983	50.8	-4.3	1.5	296.0	3.0	0.0	Vert	PK	0.0	46.5	74.0	-27.5	EUT On Side, Low Ch
2769.692	50.8	-4.3	1.5	171.0	3.0	0.0	Horz	PK	0.0	46.5	74.0	-27.5	EUT Horz, Low Ch
4622.708	41.7	3.0	1.5	318.9	3.0	0.0	Horz	PK	0.0	44.7	74.0	-29.3	EUT Vert, Mid Ch
2775.175	48.6	-4.2	1.5	254.9	3.0	0.0	Vert	PK	0.0	44.4	74.0	-29.6	EUT Horz, Mid Ch
4639.917	41.3	3.1	1.5	168.9	3.0	0.0	Vert	PK	0.0	44.4	74.0	-29.6	EUT Horz, High Ch
2782.208	48.5	-4.2	1.4	58.0	3.0	0.0	Vert	PK	0.0	44.3	74.0	-29.7	EUT Horz, High Ch
4627.167	41.2	3.0	1.5	181.0	3.0	0.0	Vert	PK	0.0	44.2	74.0	-29.8	EUT Horz, Low Ch
4649.417	41.0	3.1	2.5	185.0	3.0	0.0	Horz	PK	0.0	44.1	74.0	-29.9	EUT Vert, High Ch
4617.250	41.1	2.9	1.5	185.9	3.0	0.0	Vert	PK	0.0	44.0	74.0	-30.0	EUT Horz, Mid Ch
4623.000	40.9	3.0	1.5	222.9	3.0	0.0	Horz	PK	0.0	43.9	74.0	-30.1	EUT Vert, Low Ch
3695.358	42.3	-0.4	1.5	227.0	3.0	0.0	Horz	PK	0.0	41.9	74.0	-32.1	EUT Vert, Mid Ch
3709.292	41.9	-0.4	1.5	181.0	3.0	0.0	Horz	PK	0.0	41.5	74.0	-32.5	EUT Vert, High Ch
3693.742	41.7	-0.4	1.9	228.9	3.0	0.0	Horz	PK	0.0	41.3	74.0	-32.7	EUT Vert, Low Ch
3688.483	41.8	-0.5	1.5	62.0	3.0	0.0	Vert	PK	0.0	41.3	74.0	-32.7	EUT Horz, Mid Ch
3684.242	41.6	-0.6	1.5	196.0	3.0	0.0	Vert	PK	0.0	41.0	74.0	-33.0	EUT Horz, Low Ch
3706.167	41.2	-0.4	3.1	42.9	3.0	0.0	Vert	PK	0.0	40.8	74.0	-33.2	EUT Horz, High Ch

DUTY CYCLE



TEST DESCRIPTION

The Duty Cycle (x) were 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.

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

The EUT operates at 100% Duty Cycle.

OUTPUT POWER



XMR 2020.03.25.0

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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

Prior to measuring output power; the emission 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 AVGSA-2 in section 11.9.2.2.4 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging across ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding $[10 \log (1 / D)]$, where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

OUTPUT POWER



TSTx 2019.08.30.0 XMR 2020.03.25.0

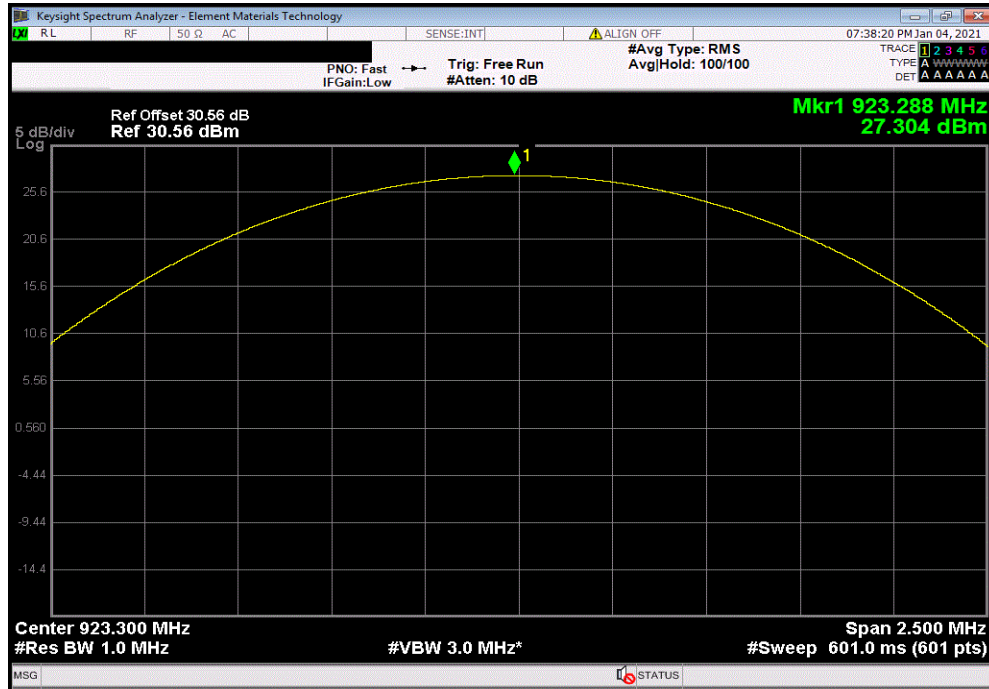
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180			
Serial Number: 0205123980-0008		Date: 4-Jan-21			
Customer: Multi-Tech Systems, Inc.		Temperature: 22.3 °C			
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.9% RH			
Project: None		Barometric Pres.: 1013 mbar			
Tested by: Dustin Sparks	Power: 54VDC via PoE	Job Site: MN08			
TEST SPECIFICATIONS					
FCC 15.247:2021		Test Method: ANSI C63.10:2013			
COMMENTS					
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	11	Signature <i>Dustin Sparks</i>			
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)		
915 MHz LoRa		Out Pwr (dBm)	Limit (dBm)		
			Result		
Low Channel (923.3 MHz)	27.304	0	27.3	30	Pass
Mid Channel (925.1 MHz)	27.039	0	27	30	Pass
High Channel (927.5 MHz)	26.353	0	26.4	30	Pass

OUTPUT POWER

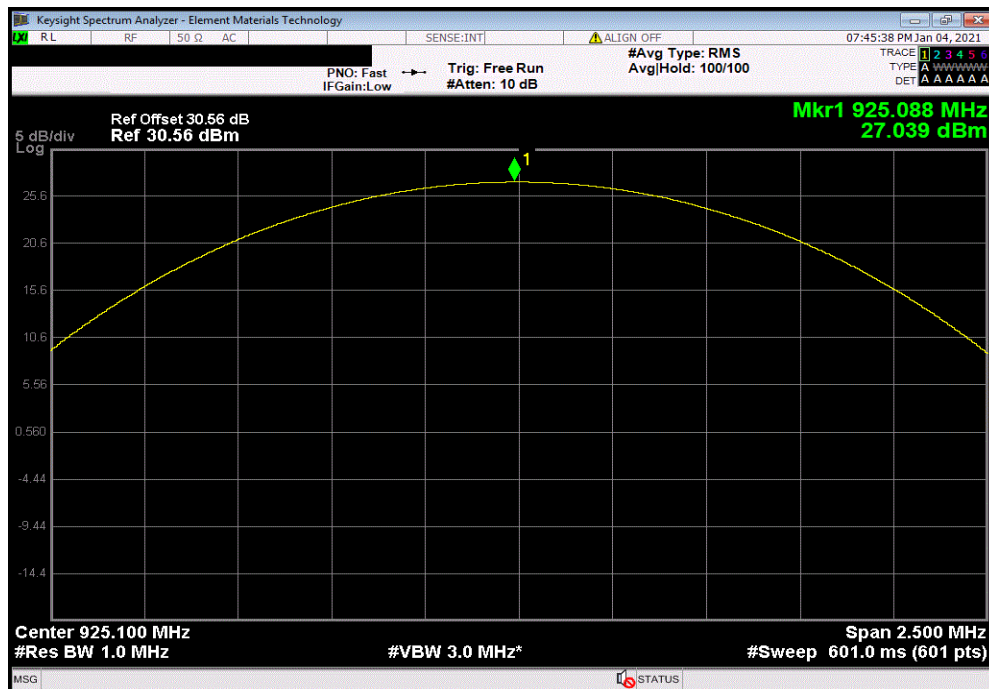


TM1Tx 2019.08.30.0 XM1 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result		
27.304	0	27.3	30	Pass		



915 MHz LoRa, Mid Channel (925.1 MHz)						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result		
27.039	0	27	30	Pass		

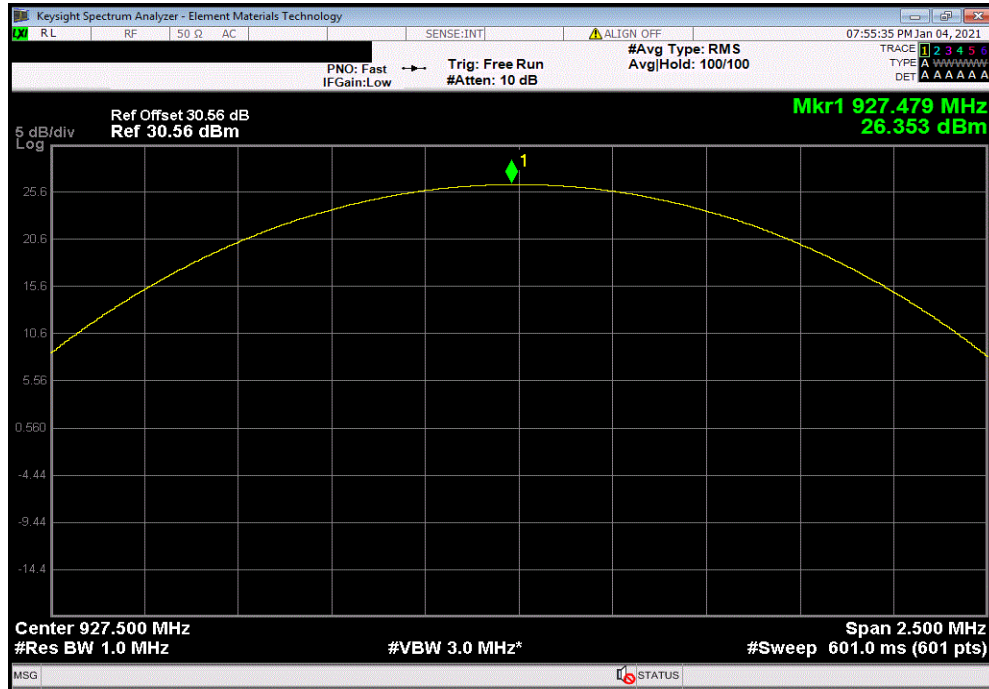


OUTPUT POWER



TM1Tx 2019.08.30.0 XM1 2020.03.25.0

915 MHz LoRa, High Channel (927.5 MHz)						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	26.353	0	26.4	30	Pass	



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



XMIT 2020.03.25.0

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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

Prior to measuring output power; the emission 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 AVGSA-2 in section 11.9.2.2.4 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging across ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding $[10 \log (1 / D)]$, where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

Equivalent Isotropic Radiated Power (EIRP) = Max Measured Power + Antenna gain (dBi)

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



TSTx 2019.08.30.0 XMR 2020.03.25.0

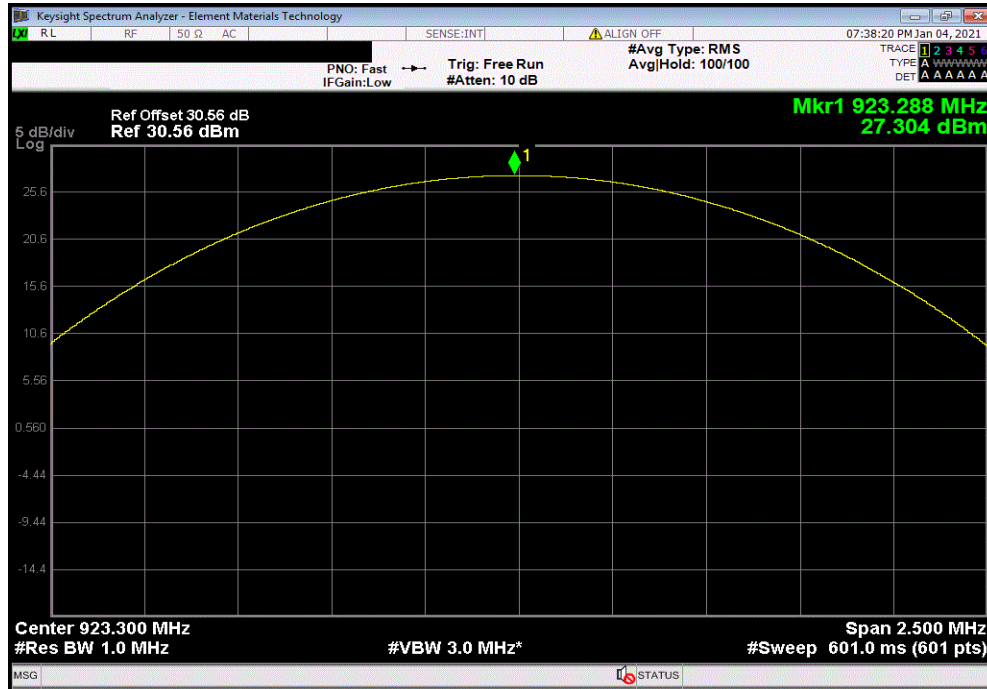
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180	
Serial Number: 0205123980-0008		Date: 4-Jan-21	
Customer: Multi-Tech Systems, Inc.		Temperature: 22.3 °C	
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.8% RH	
Project: None		Barometric Pres.: 1013 mbar	
Tested by: Dustin Sparks		Power: 54VDC via PoE	
		Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.247:2021		Test Method	
		ANSI C63.10:2013	
COMMENTS			
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	11	Signature <i>Dustin Sparks</i>	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Antenna Gain (dBi)
		EIRP (dBm)	EIRP Limit (dBm)
			Result
915 MHz LoRa			
	Low Channel (923.3 MHz)	27.304	0
	Mid Channel (925.1 MHz)	27.039	0
	High Channel (927.5 MHz)	26.353	0

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

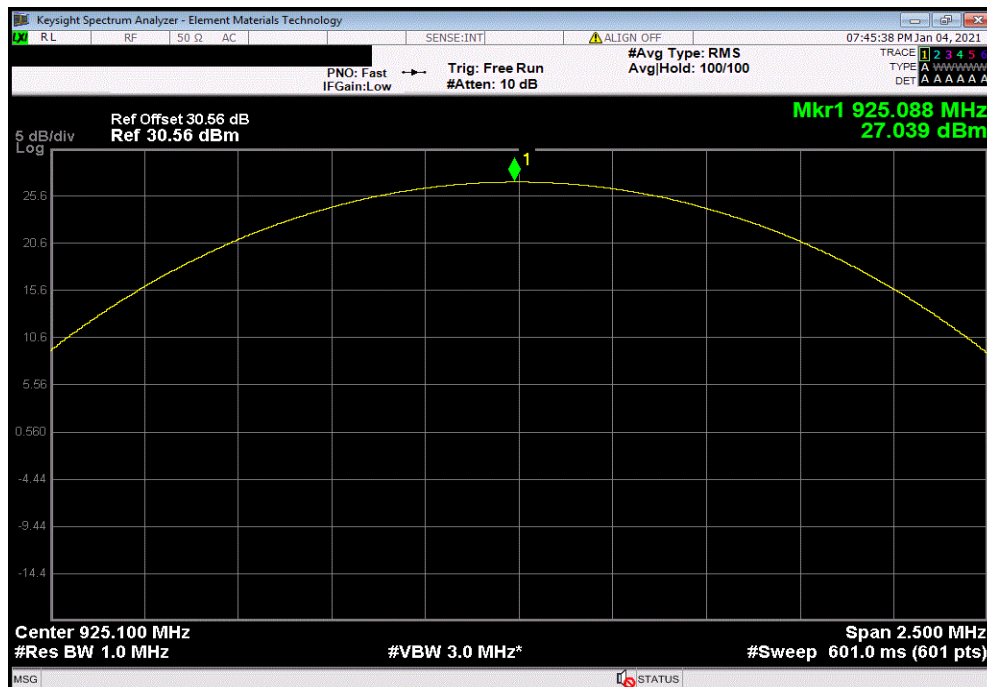


TM1Tx 2019.08.30.0 XM1 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
27.304	0	27.3	6	33.3	36	Pass



915 MHz LoRa, Mid Channel (925.1 MHz)						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
27.039	0	27	6	33	36	Pass

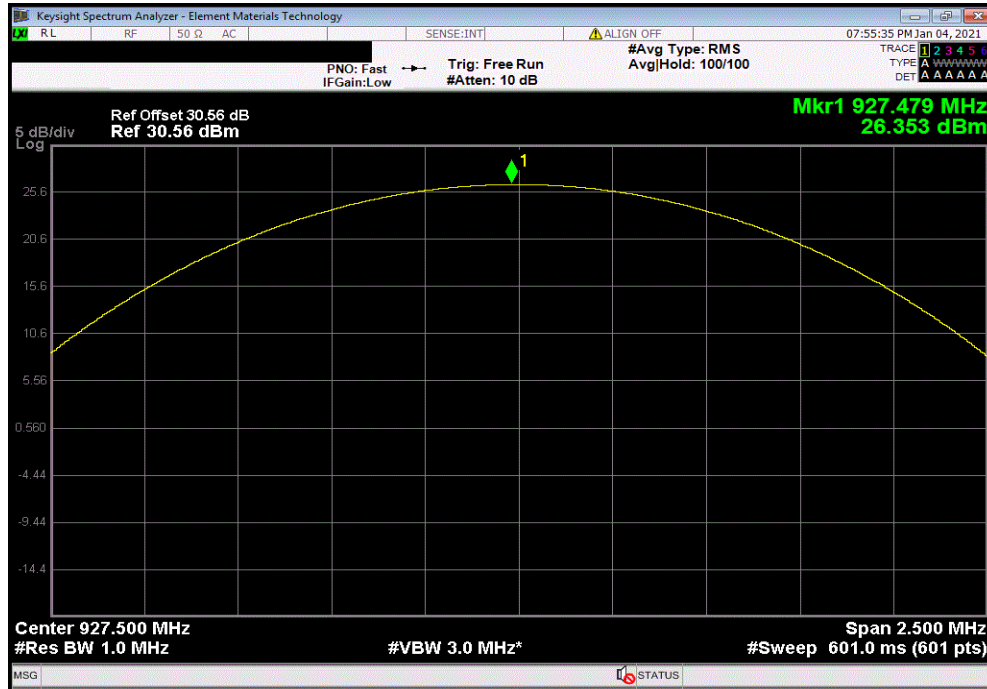


EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



TbTx 2019.08.30.0 XMt 2020.03.25.0

915 MHz LoRa, High Channel (927.5 MHz)						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
26.353	0	26.4	6	32.4	36	Pass



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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

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 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.

An RMS detector was used to match the method called out for Output Power. Because the reference level was taken with an RMS detector, the attenuation requirement is -30 dBc.

BAND EDGE COMPLIANCE



TSTx 2019.08.30.0 XMR 2020.03.25.0

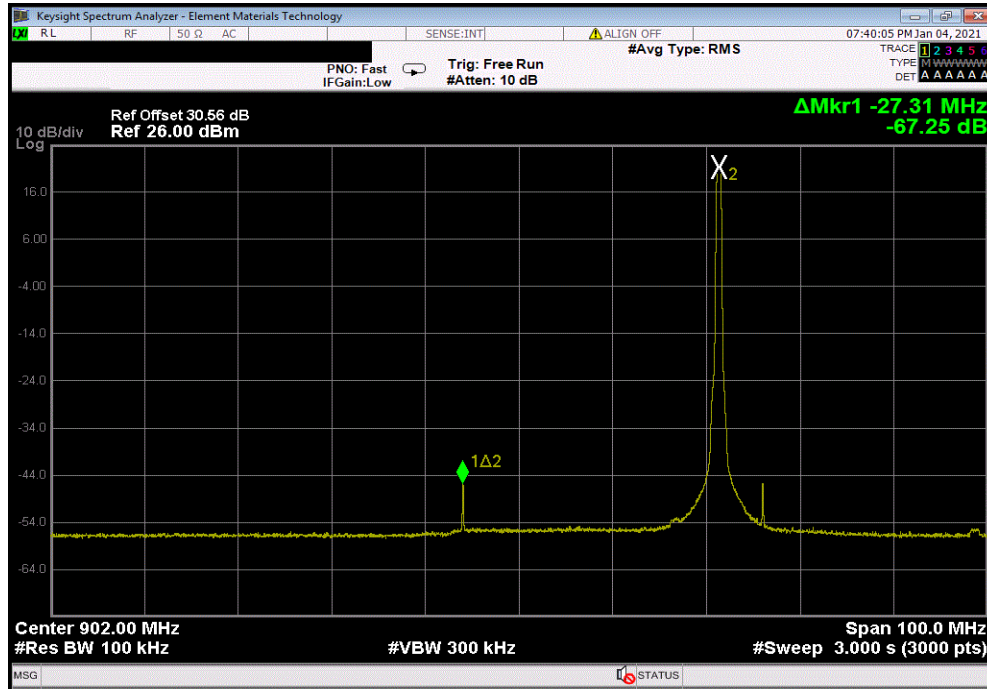
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180	
Serial Number: 0205123980-0008		Date: 4-Jan-21	
Customer: Multi-Tech Systems, Inc.		Temperature: 22.3 °C	
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.7% RH	
Project: None		Barometric Pres.: 1013 mbar	
Tested by: Dustin Sparks	Power: 54VDC via PoE	Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.247:2021		Test Method: ANSI C63.10:2013	
COMMENTS			
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	11	Signature <i>Dustin Sparks</i>	
		Value (dBc)	Limit ≤ (dBc) Result
915 MHz LoRa			
Low Channel (923.3 MHz)		-67.26	-30 Pass
High Channel (927.5 MHz)		-46.93	-30 Pass

BAND EDGE COMPLIANCE

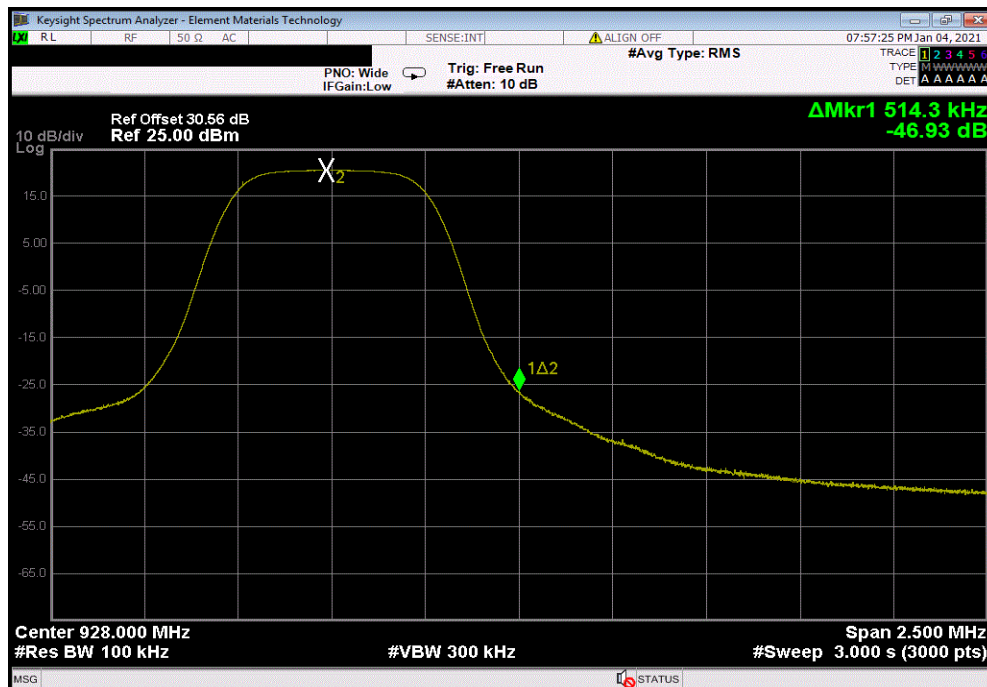


TM1Tx 2019.08.30.0 XM1 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
				Value (dBc)	Limit ≤ (dBc)	Result
				-67.26	-30	Pass



915 MHz LoRa, High Channel (927.5 MHz)						
				Value (dBc)	Limit ≤ (dBc)	Result
				-46.93	-30	Pass



OCCUPIED BANDWIDTH



XMIT 2020.03.25.0

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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The EUT was set to the channels and modes listed in the datasheet.

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.

OCCUPIED BANDWIDTH



TbTx 2019.08.30.0 XMt 2020.03.25.0

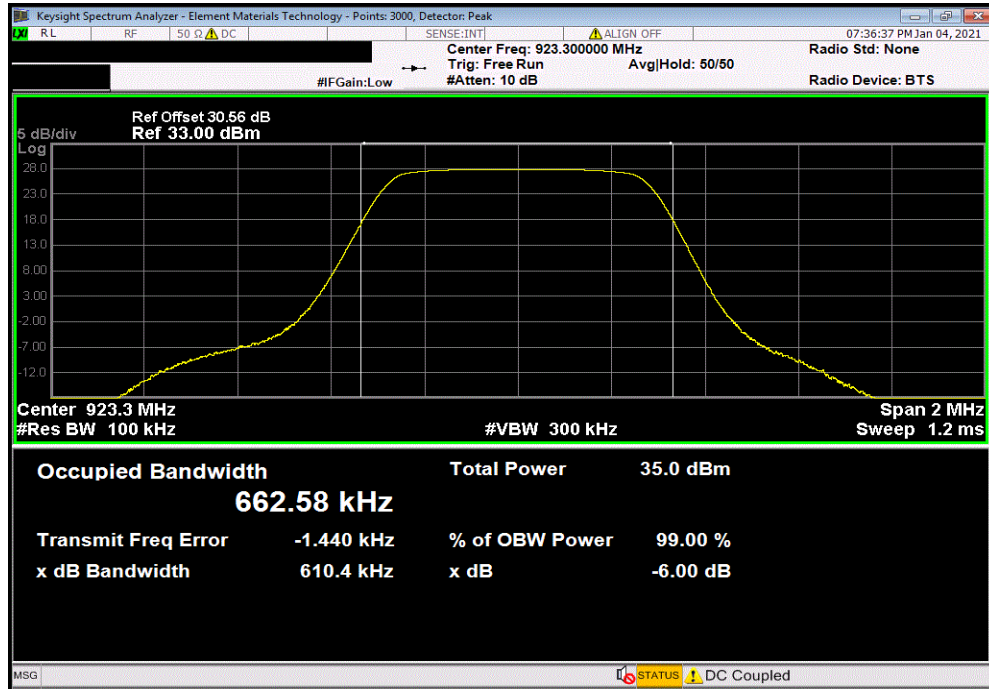
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180	
Serial Number: 0205123980-0008		Date: 4-Jan-21	
Customer: Multi-Tech Systems, Inc.		Temperature: 22.3 °C	
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.8% RH	
Project: None		Barometric Pres.: 1013 mbar	
Tested by: Dustin Sparks	Power: 54VDC via PoE	Job Site: MN08	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2021		ANSI C63.10:2013	
COMMENTS			
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	11	Signature <i>Dustin Sparks</i>	
		Value	Limit (>)
915 MHz LoRa			Result
Low Channel (923.3 MHz)		610.41 kHz	500 kHz Pass
Mid Channel (925.1 MHz)		604.624 kHz	500 kHz Pass
High Channel (927.5 MHz)		596.164 kHz	500 kHz Pass

OCCUPIED BANDWIDTH

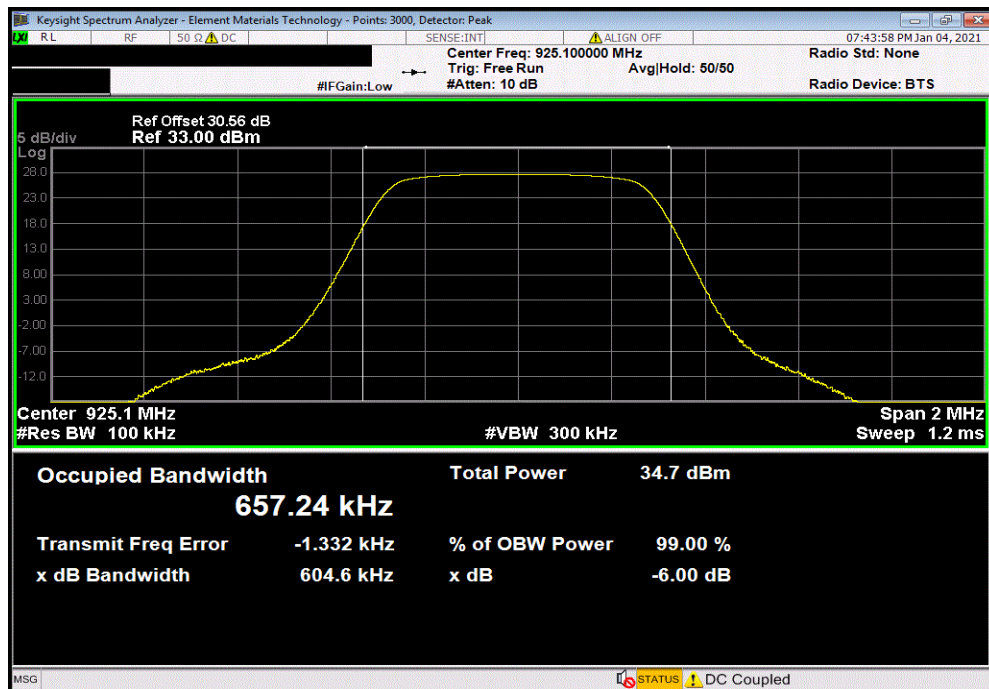


TbTx 2019.08.30.0 XbTx 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
				Value	Limit (>)	Result
				610.41 kHz	500 kHz	Pass



915 MHz LoRa, Mid Channel (925.1 MHz)						
				Value	Limit (>)	Result
				604.624 kHz	500 kHz	Pass

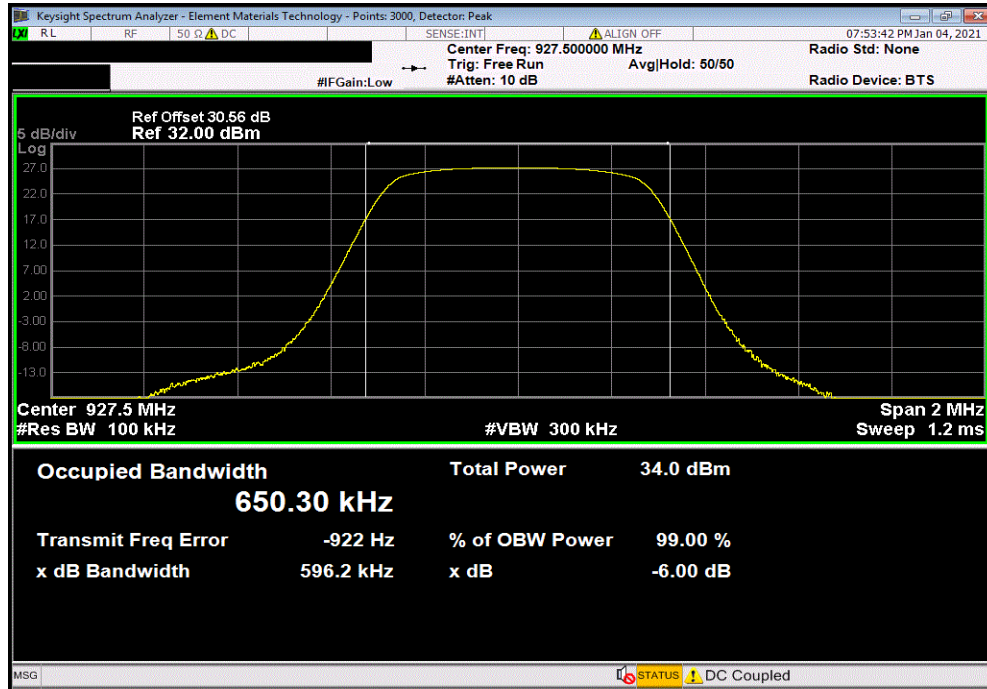


OCCUPIED BANDWIDTH



TbTx 2019.08.30.0 XMR 2020.03.25.0

915 MHz LoRa, High Channel (927.5 MHz)						
Value				Limit	Result	
596.164 kHz				(>) 500 kHz	Pass	



SPURIOUS CONDUCTED EMISSIONS



XMIT 2020.03.25.0

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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. 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.

Because an RMS detector was used to measure Output Power, the attenuation requirement is -30 dBc.

SPURIOUS CONDUCTED EMISSIONS



TSTx 2019.08.30.0 XMR 2020.03.25.0

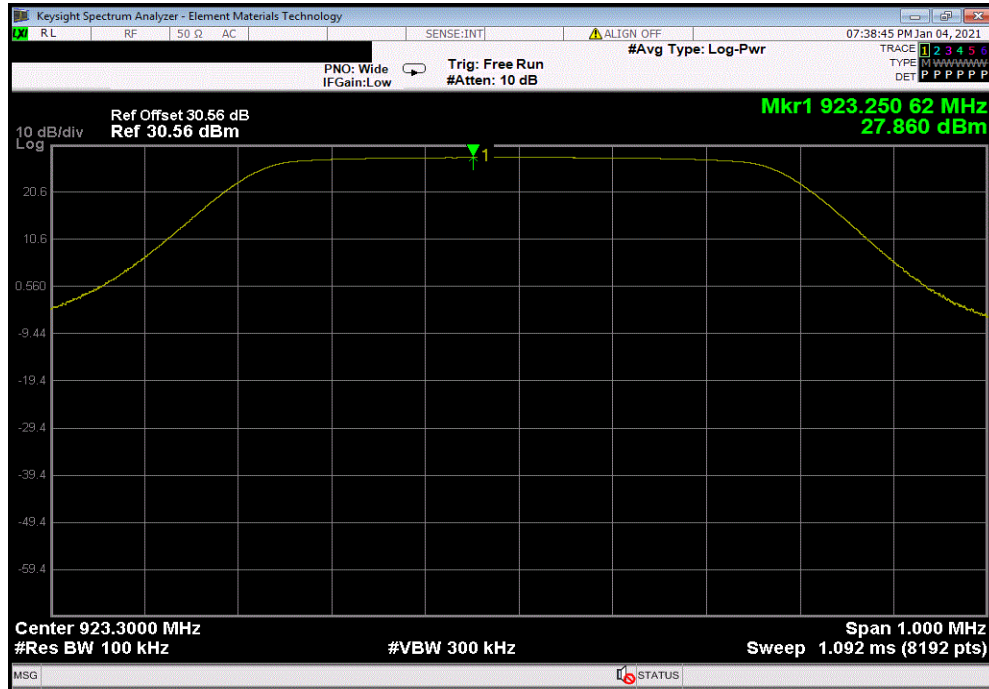
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180	
Serial Number: 0205123980-0008		Date: 4-Jan-21	
Customer: Multi-Tech Systems, Inc.		Temperature: 22.4 °C	
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.7% RH	
Project: None		Barometric Pres.: 1013 mbar	
Tested by: Dustin Sparks	Power: 54VDC via PoE	Job Site: MN08	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2021		ANSI C63.10:2013	
COMMENTS			
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	11	Signature <i>Dustin Sparks</i>	
		Frequency Range	Measured Freq (MHz)
			Max Value (dBc)
			Limit ≤ (dBc)
			Result
915 MHz LoRa			
	Low Channel (923.3 MHz)	Fundamental	923.25
	Low Channel (923.3 MHz)	30 MHz - 10 GHz	5818.95
	Mid Channel (925.1 MHz)	Fundamental	925.05
	Mid Channel (925.1 MHz)	30 MHz - 10 GHz	5874.94
	High Channel (927.5 MHz)	Fundamental	927.45
	High Channel (927.5 MHz)	30 MHz - 10 GHz	929.5
			N/A
			-68.73
			-30
			N/A
			-67.88
			-30
			N/A
			-65.95
			-30
			N/A
			Pass

SPURIOUS CONDUCTED EMISSIONS

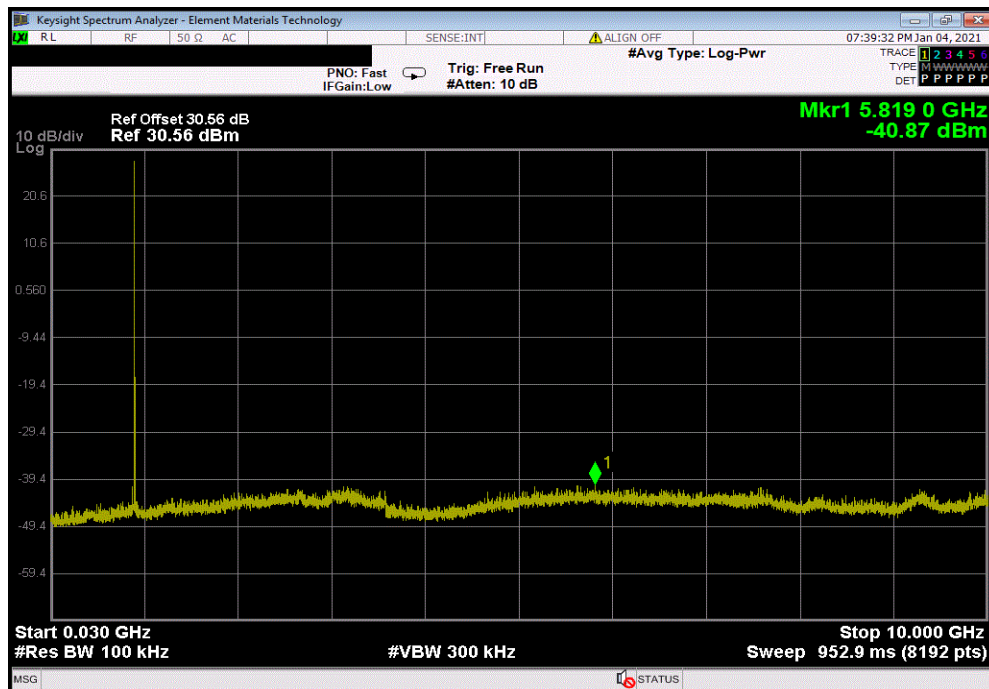


TM1Tx 2019.08.30.0 XM1 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	923.25	N/A	N/A	N/A		



915 MHz LoRa, Low Channel (923.3 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 10 GHz	5818.95	-68.73	-30	Pass		

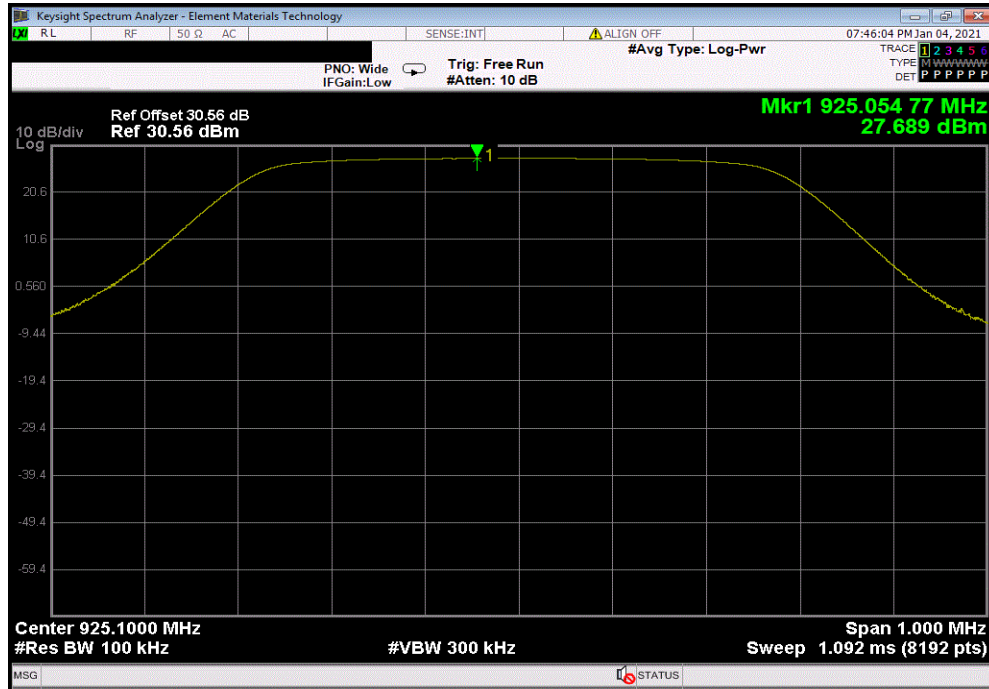


SPURIOUS CONDUCTED EMISSIONS

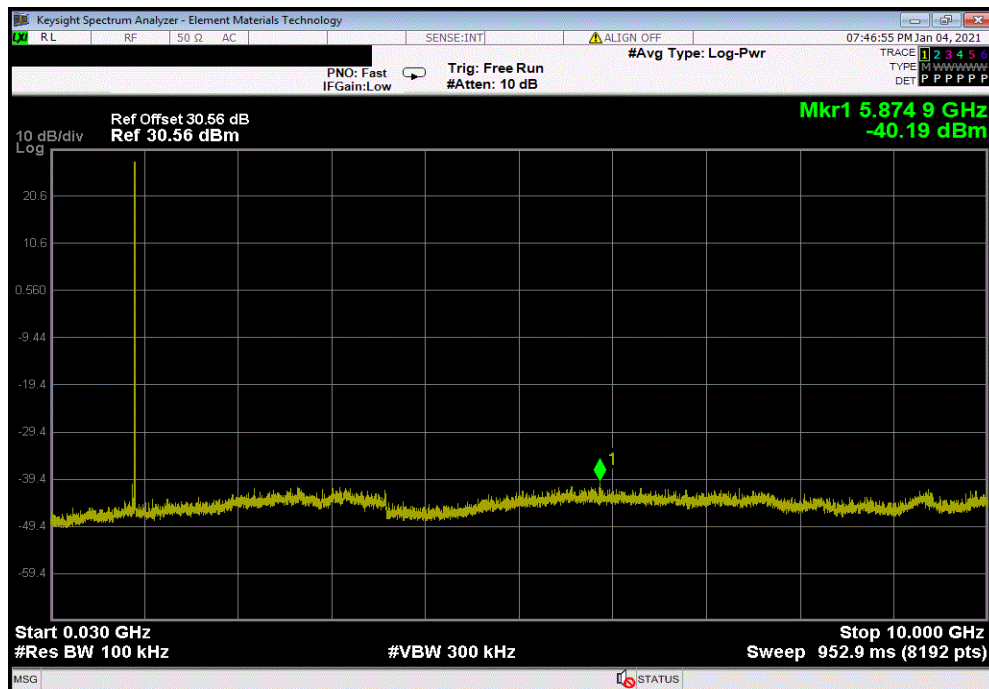


TbTtX 2019.08.30.0 XMt 2020.03.25.0

915 MHz LoRa, Mid Channel (925.1 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	925.05	N/A	N/A	N/A		



915 MHz LoRa, Mid Channel (925.1 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 10 GHz	5874.94	-67.88	-30	Pass		

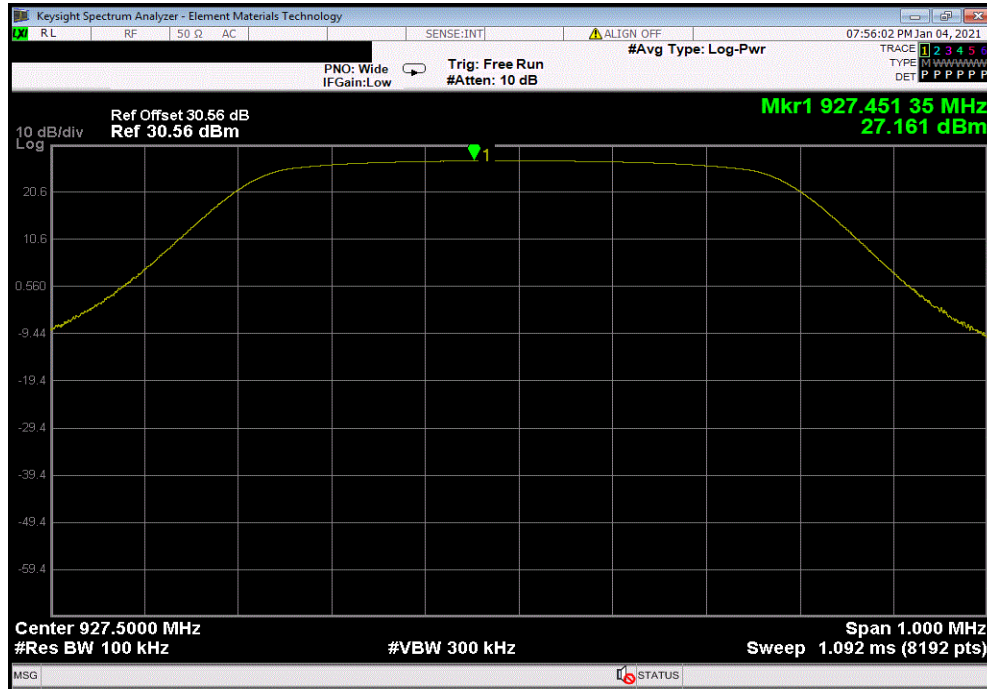


SPURIOUS CONDUCTED EMISSIONS

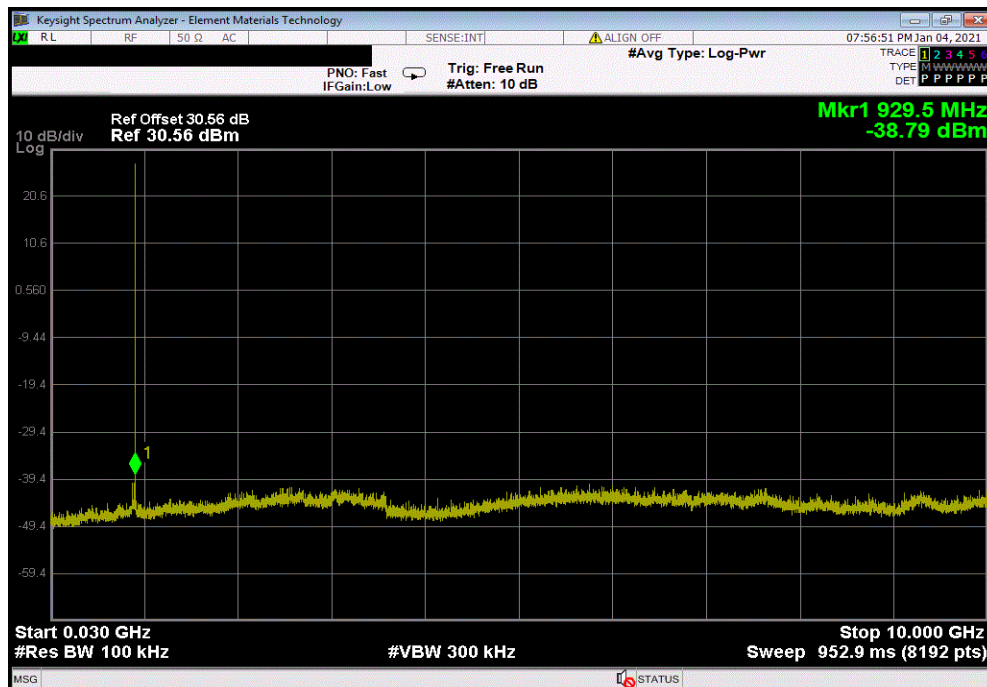


TM19 2019.08.30.0 XM18 2020.03.25.0

915 MHz LoRa, High Channel (927.5 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	927.45	N/A	N/A	N/A		



915 MHz LoRa, High Channel (927.5 MHz)						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 10 GHz	929.5	-65.95	-30	Pass		



POWER SPECTRAL DENSITY



XMIT 2020.03.25.0

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.	Cal. Due
Generator - Signal	Keysight	N5182B	TFX	28-Apr-20	28-Apr-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	14-Sep-20	14-Sep-21
Attenuator	Fairview Microwave	SA18S5W-20	RFX	3-Jun-20	3-Jun-21
Attenuator	INMET	64671 6A-10dB	AUI	5-Aug-20	5-Aug-21
Block - DC	Fairview Microwave	SD3379	AMZ	4-Nov-20	4-Nov-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The power spectral density was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method AVGPSD-1 in section 11.10.3 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging and RMS detection across the full power of the burst. This method is allowed as the same method has been used to determine the conducted output power.

POWER SPECTRAL DENSITY



TSTx 2019.08.30.0 XMR 2020.03.25.0

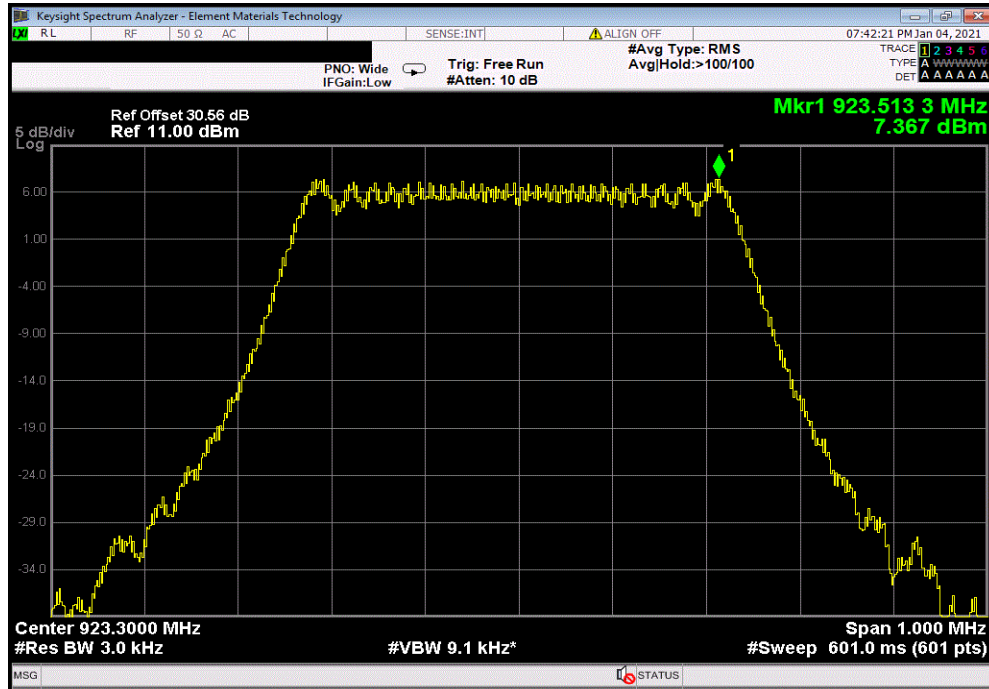
EUT: MTCDTIP2-LNA3-B11UKP-L1L		Work Order: MLTI0180	
Serial Number: 0205123980-0008		Date: 4-Jan-21	
Customer: Multi-Tech Systems, Inc.		Temperature: 22.3 °C	
Attendees: Jim Asp, Brent Nielsen		Humidity: 26.7% RH	
Project: None		Barometric Pres.: 1013 mbar	
Tested by: Dustin Sparks	Power: 54VDC via PoE	Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.247:2021		Test Method	
		ANSI C63.10:2013	
COMMENTS			
Power over Ethernet (PoE) adapter powered with 120VAC/60Hz. Reference level offset includes measurement cable, attenuator, and DC block.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	11	Signature <i>Dustin Sparks</i>	
		Value	Limit
		dBm/3kHz	dBm/3kHz
915 MHz LoRa			Results
Low Channel (923.3 MHz)		7.368	8 Pass
Mid Channel (925.1 MHz)		7.023	8 Pass
High Channel (927.5 MHz)		6.417	8 Pass

POWER SPECTRAL DENSITY

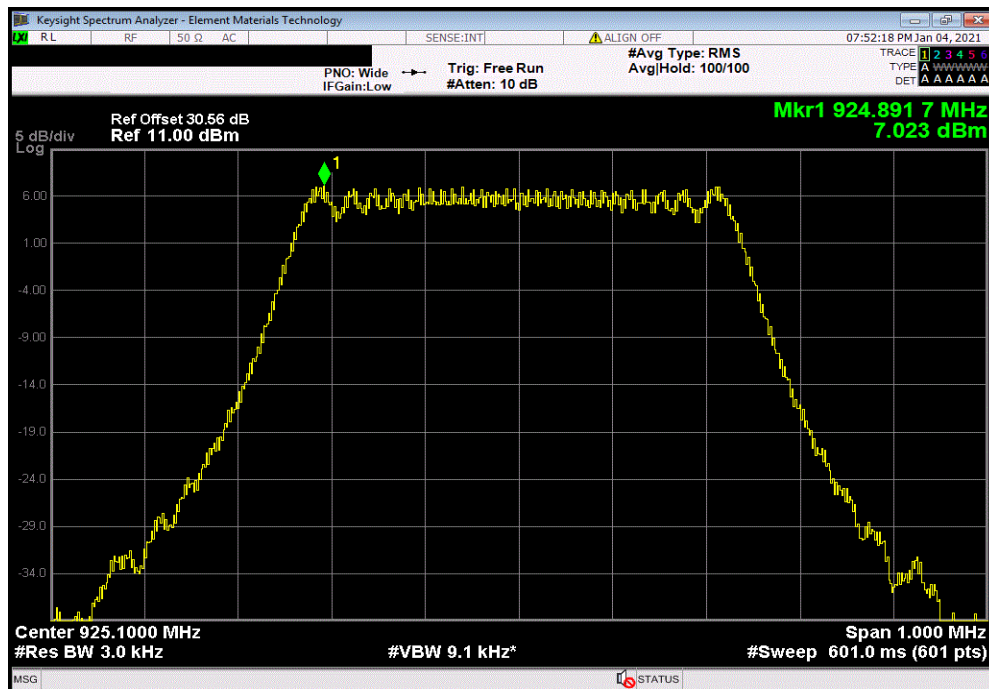


TIMTx 2019.08.30.0 XMR 2020.03.25.0

915 MHz LoRa, Low Channel (923.3 MHz)						
				Value	Limit	Results
				dBm/3kHz	dBm/3kHz	
				7.368	8	Pass



915 MHz LoRa, Mid Channel (925.1 MHz)						
				Value	Limit	Results
				dBm/3kHz	dBm/3kHz	
				7.023	8	Pass



POWER SPECTRAL DENSITY



TbTx 2019.08.30.0 XMR 2020.03.25.0

915 MHz LoRa, High Channel (927.5 MHz)						
				Value	Limit	Results
				dBm/3kHz	dBm/3kHz	
				6.417	8	Pass

