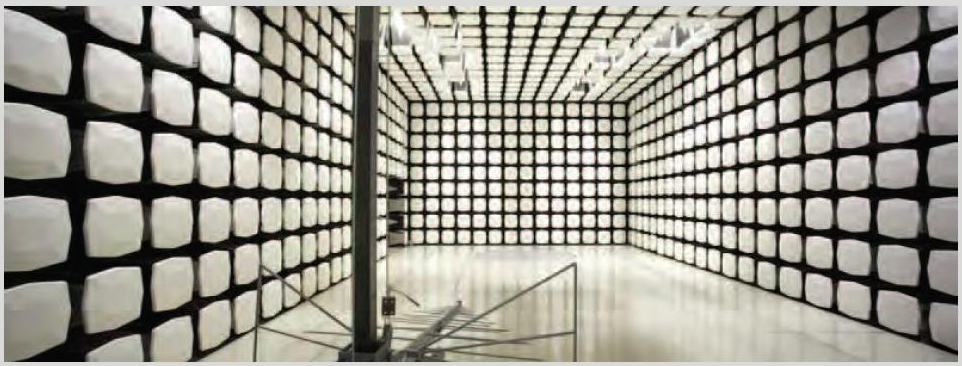
MSA Innovation, LLC

io4

FCC 15.225:2021

13.56 MHz Radio

Report: MSAS0022.12 Rev. 2, Issue Date: March 18, 2022



CERT #3310.05

CERTIFICATE OF TEST

Last Date of Test: December 17, 2021
MSA Innovation, LLC
EUT: io4

Radio Equipment Testing

Standards

Specification	Method
FCC 15.225:2021	ANSI C63.10:2013

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required, radio is not operational during charge mode.
6.4	Field Strength of Fundamental	Yes	Pass	
6.4	Field Strength of Spurious Emissions (Less Than 30 MHz)	Yes	Pass	
6.5	Field Strength of Spurious Emissions (Greater Than 30 MHz)	Yes	Pass	
6.8	Frequency Stability	Yes	Pass	
6.9.2	Occupied Bandwidth	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
01	Added antenna information and power settings table	2022-03-14	11
	Listed EUT software or firmware	2022-03-14	12
	Corrected frequency scale	2022-03-14	19 and 26
	Corrected limits	2022-03-14	22, 24, 26
	Distance adjustment applied to top data point	2022-03-14	23
	Corrected data off the bottom of the graph	2022-03-14	24
02	Removed ANSI C63.4 from Certificate of Test	2022-03-18	2
	Replaced gain, added mod type	2022-03-18	11
	Updated standard and date	2022-03-18	21-26
	Removed photos	2022-03-18	N/A
	Recalculated frequency stability	2022-03-18	32, 38

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 - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

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

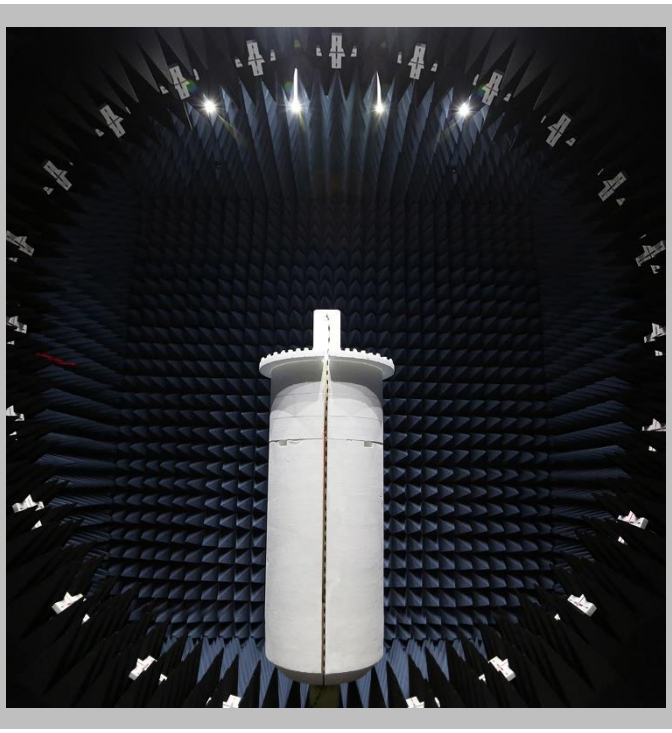
For details on the Scopes of our Accreditations, please visit:

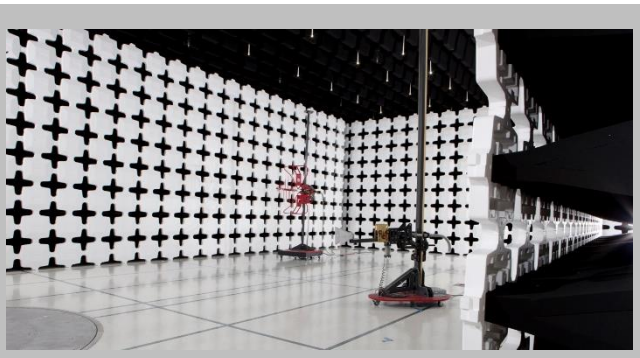
California Minnesota Oregon Texas Washington

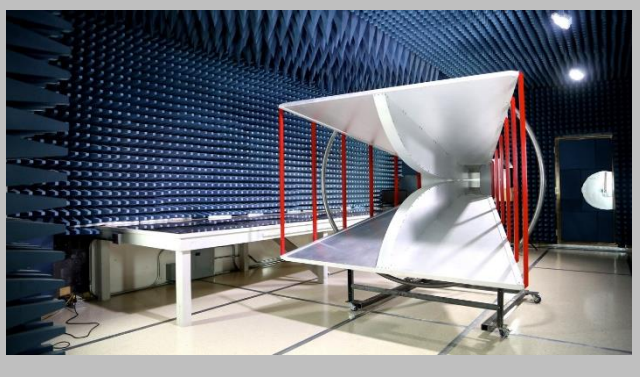
FACILITIES

element
2020.12.15

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
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

element
TMU.2015.07.10

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)	3.2 dB	-3.2 dB

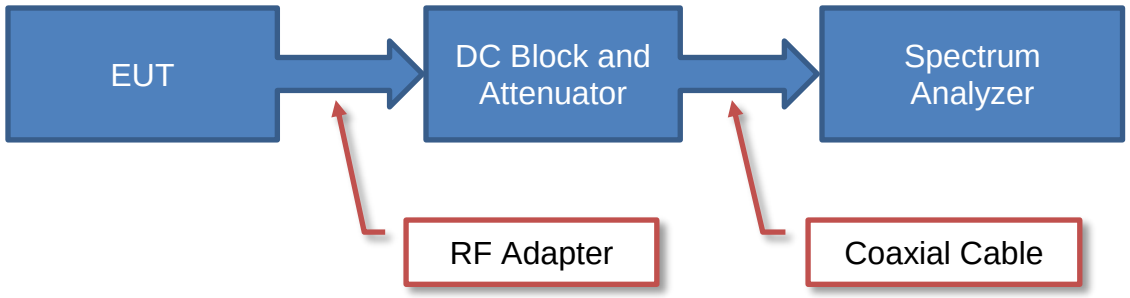
TEST SETUP BLOCK DIAGRAMS

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

Unless otherwise stated, measurements were made using the bandwidths and detectors specified. No video filter was used.

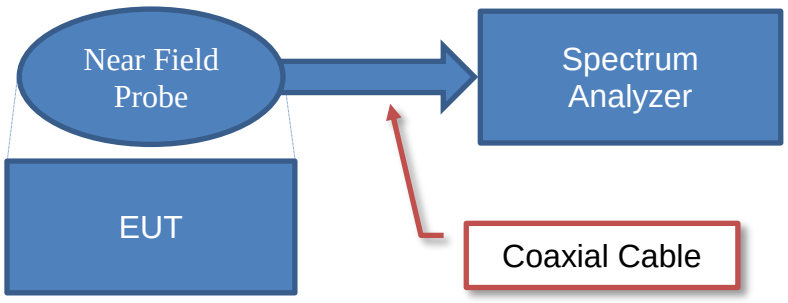
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

Near Field Test Fixture Measurements

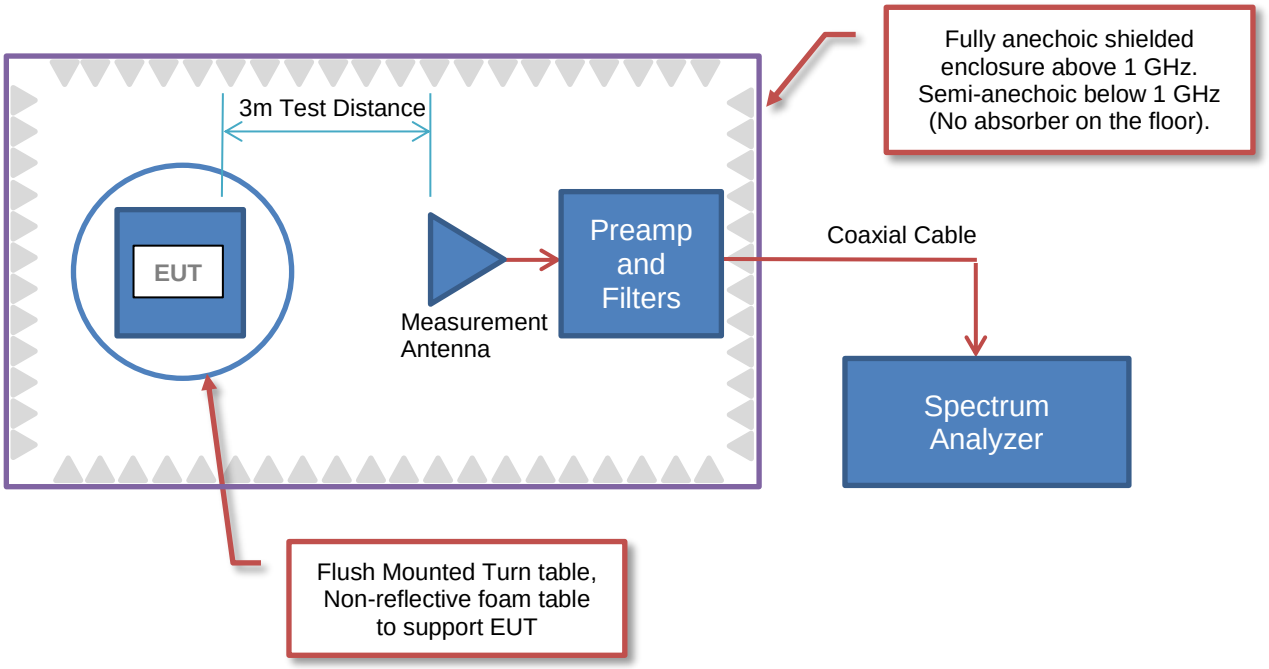


Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

Measured Level (Amplitude)		Factor: Antenna Factor		Factor: Cable Factor		Factor: Amplifier Gain		Distance Adjustment Factor		External Attenuation		Field Strength
42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0	=	**33.5**

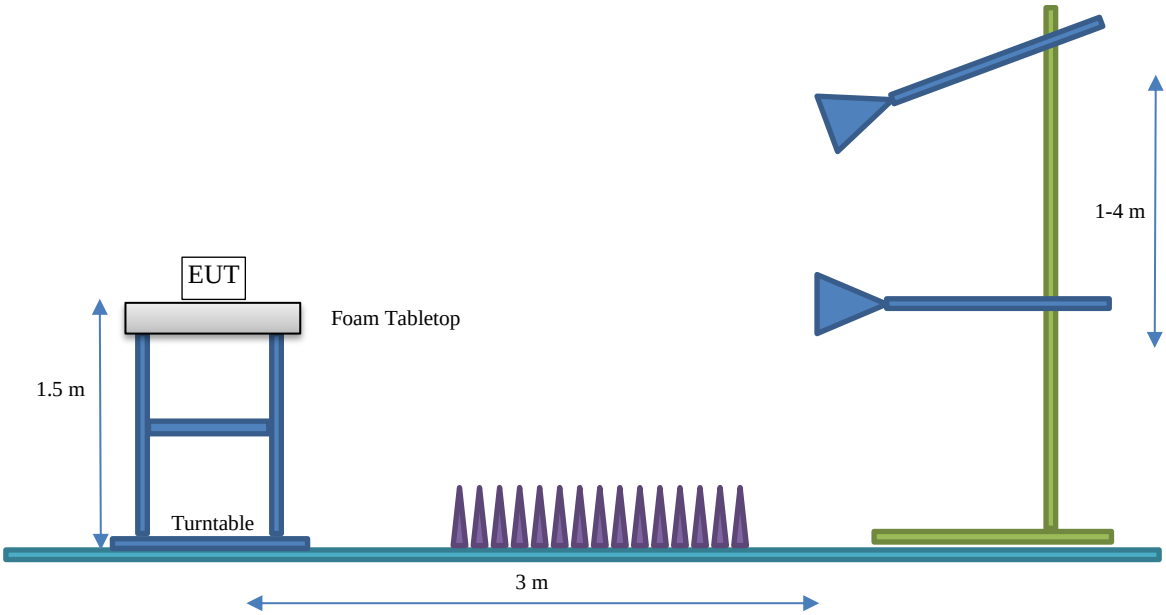
Conducted Emissions:

Measured Level (Amplitude)		Factor: Transducer Factor		Factor: Cable Factor		External Attenuation		Adjusted Level
26.7	+	0.3	+	0.1	+	20.0	=	**47.1**

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. Above 1 GHz, when required by the measurement standard, the antenna is pointed for both azimuth and elevation to maintain the receive antenna within the cone of radiation from the EUT. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	MSA Innovation, LLC
Address:	1100 Cranberry Woods Road
City, State, Zip:	Cranberry Township, PA 16066
Test Requested By:	Dustin Morris
EUT:	io4
First Date of Test:	December 6, 2021
Last Date of Test:	December 17, 2021
Receipt Date of Samples:	November 30, 2021
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Multigas Detector (LEL, O2, CO, H2S) with Bluetooth, Cellular, GNSS and HF RFID

Testing Objective:
To demonstrate compliance to FCC Part 15.225 specifications.

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

Type	Provided by:	Frequency Range (MHz)	Antenna Description
Custom coil	MSA Safety	13.56	6 turn, 1.874" x 0.641" coil

POWER SETTINGS

Radio	Modulation	Channel	Power Setting (dBm)
RFID	ASK	13.56 MHz	+7

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CONFIGURATIONS

Configuration MSAS0022- 4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Multigas Detector	MSA Innovation, LLC	io4 (410 variant)	5710

Configuration MSAS0022- 5

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Multigas Detector	MSA Innovation, LLC	io4 (412 variant)	9485

Configuration MSAS0022- 6

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Multigas Detector	MSA Innovation, LLC	io4 (412 variant)	3511

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2021-12-06	Field Strength of Fundamental	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	2021-12-06	Field Strength of Spurious Emissions (Less Than 30 MHz)	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	2021-12-07	Field Strength of Spurious Emissions (Greater Than 30 MHz)	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	2021-12-17	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	2021-12-17	Frequency Stability	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	2021-12-17	Frequency Stability (Extreme Voltage)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was continuously transmitting while set to the channel specified.

The fundamental carrier of the EUT was maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A calibrated active loop antenna was used for this test in order to provide sufficient measurement sensitivity. The reference point of the loop antenna was maintained at 1m above the ground plane during the testing.

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

As outlined in 15.209(e), 15.31(f)(2), and RSS-GEN, 6.5, measurements may be performed at a distance closer than what is specified with the limit. The limit at the specified distance is shown on the data sheet. Measurements are made at a closer distance and the data is adjusted using a distance correction factor of 40dB/decade for comparison to the limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Amplifier - Pre-Amplifier	Miteq	AM-1551	PAC	2021-06-17	2022-06-17
Receiver	Rohde & Schwarz	ESR26	ARP	2021-04-08	2022-04-08
Antenna - Loop	ETS Lindgren	6502	AOB	2021-06-01	2023-06-01
Cable	ESM Cable Corp.	Antenna Loop Cable	MNE	2021-02-17	2022-02-17

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	1.8 dB	-1.8 dB

FREQUENCY RANGE INVESTIGATED

9 kHz TO 30 MHz

POWER INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

MSAS0022-4
MSAS0022-5

MODES INVESTIGATED

Transmitting at 13.56 MHz, Modulated

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	5678	Date:	2021-12-06
Customer:	MSA Innovation, LLC	Temperature:	23.6°C
Attendees:	Dustin Morris	Relative Humidity:	18.9%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	7	Test Distance (m):	3	Ant. Height(s) (m):	1(m)

COMMENTS

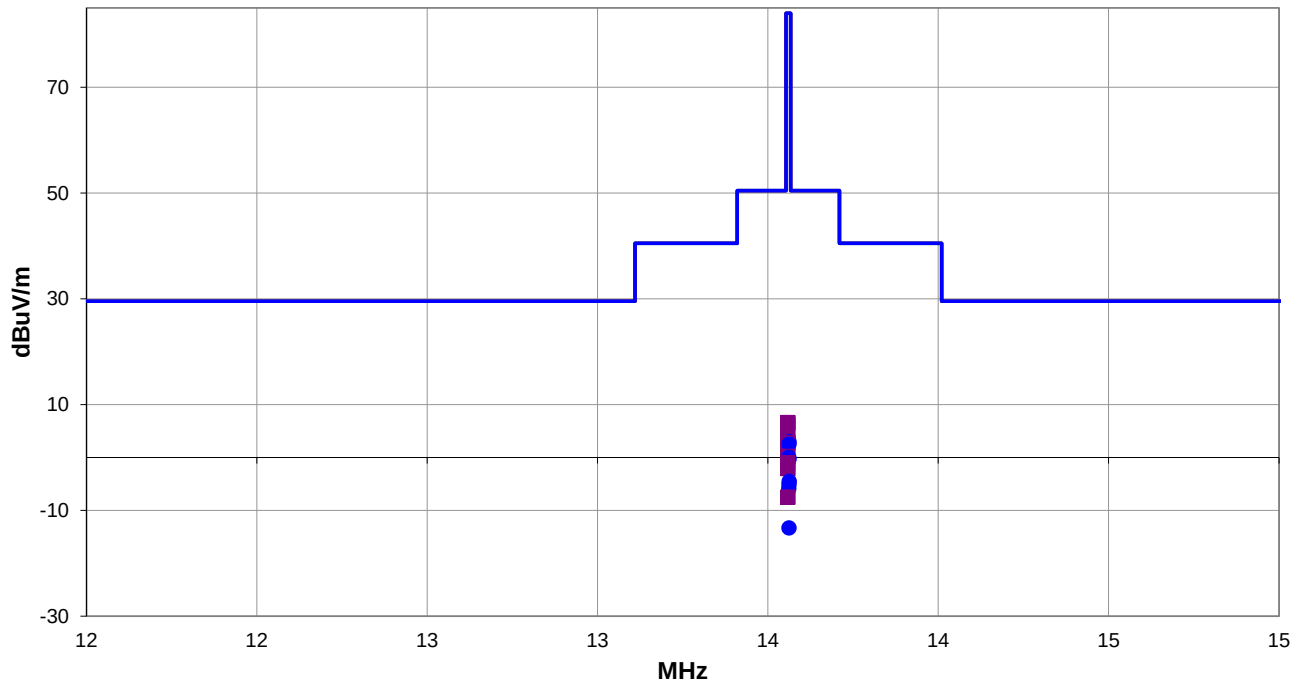
EUT horz, receive antenna(RA) parallel to EUT

EUT OPERATING MODES

Transmitting at 13.56 MHz. Modulated.

DEVIATIONS FROM TEST STANDARD

None



Run #: 7 ■ PK ◆ AV ● QP

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #7

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
13.559	35.6	11.0	1.0	62.0	3.0	0.0	Horz	PK	-40.0	6.6	84.0	-77.4	EUT on side, RA par to EUT
13.559	35.2	11.0	1.0	74.0	3.0	0.0	Horz	PK	-40.0	6.2	84.0	-77.8	EUT vert, RA par to EUT
13.559	32.4	11.0	1.0	199.0	3.0	0.0	Horz	PK	-40.0	3.4	84.0	-80.6	EUT on side, RA perp to EUT
13.562	32.0	11.0	1.0	62.0	3.0	0.0	Horz	QP	-40.0	3.0	84.0	-81.0	EUT on side, RA par to EUT
13.559	31.8	11.0	1.0	357.0	3.0	0.0	Horz	PK	-40.0	2.8	84.0	-81.2	EUT vert, RA perp to EUT
13.562	31.5	11.0	1.0	74.0	3.0	0.0	Horz	QP	-40.0	2.5	84.0	-81.5	EUT vert, RA par to EUT
13.559	29.2	11.0	1.0	354.0	3.0	0.0	Horz	PK	-40.0	0.2	84.0	-83.8	EUT on side, RA par to gnd
13.561	29.0	11.0	1.0	357.0	3.0	0.0	Horz	QP	-40.0	0.0	84.0	-84.0	EUT vert, RA perp to EUT
13.562	28.7	11.0	1.0	199.0	3.0	0.0	Horz	QP	-40.0	-0.3	84.0	-84.3	EUT on side, RA perp to EUT
13.558	28.0	11.0	1.0	271.0	3.0	0.0	Horz	PK	-40.0	-1.0	84.0	-85.0	EUT horz, RA par to gnd
13.559	26.9	11.0	1.0	332.0	3.0	0.0	Horz	PK	-40.0	-2.1	84.0	-86.1	EUT horz, RA par to EUT
13.562	24.5	11.0	1.0	354.0	3.0	0.0	Horz	QP	-40.0	-4.5	84.0	-88.5	EUT on side, RA par to gnd
13.562	23.9	11.0	1.0	271.0	3.0	0.0	Horz	QP	-40.0	-5.1	84.0	-89.1	EUT horz, RA par to gnd
13.562	23.1	11.0	1.0	332.0	3.0	0.0	Horz	QP	-40.0	-5.9	84.0	-89.9	EUT horz, RA par to EUT
13.559	21.5	11.0	1.0	262.0	3.0	0.0	Horz	PK	-40.0	-7.5	84.0	-91.5	EUT horz, RA perp to EUT
13.562	15.7	11.0	1.0	262.0	3.0	0.0	Horz	QP	-40.0	-13.3	84.0	-97.3	EUT horz, RA perp to EUT

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	5678	Date:	2021-12-06
Customer:	MSA Innovation, LLC	Temperature:	23.6°C
Attendees:	Dustin Morris	Relative Humidity:	18.9%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	15	Test Distance (m):	3	Ant. Height(s) (m):	1(m)

COMMENTS

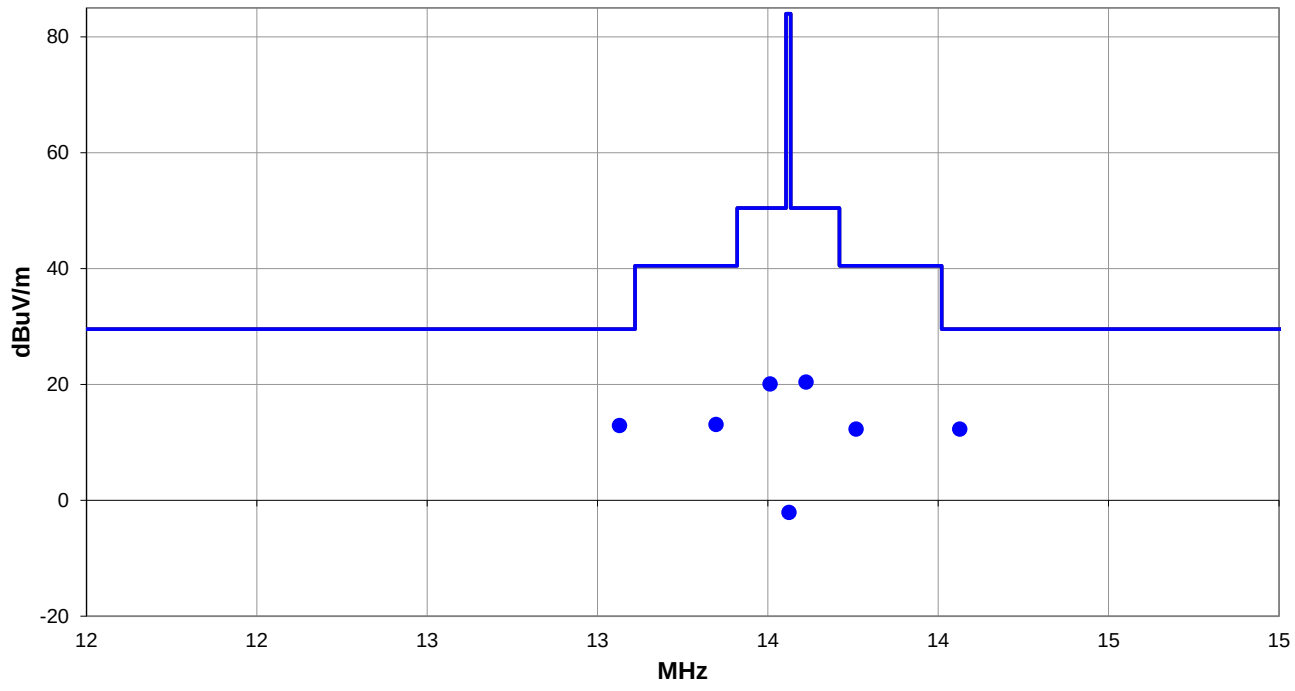
EUT vert, receive antenna(RA) parallel to ground

EUT OPERATING MODES

Transmitting at 13.56 MHz, Modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 15 ■ PK ◆ AV ● QP

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #15

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
13.065	1.8	11.1	1.0	301.0	3.0	0.0	para to eut	QP	0.0	12.9	29.5	-16.6	EUT on side
14.063	1.3	11.0	1.0	206.0	3.0	0.0	para to eut	QP	0.0	12.3	29.5	-17.2	EUT on side
27.514	1.3	9.5	1.0	317.0	3.0	0.0	para to eut	QP	0.0	10.8	29.5	-18.7	EUT on side
13.348	2.0	11.1	1.0	300.0	3.0	0.0	para to eut	QP	0.0	13.1	40.5	-27.4	EUT on side
13.759	1.3	11.0	1.0	29.0	3.0	0.0	para to eut	QP	0.0	12.3	40.5	-28.2	EUT on side
13.612	9.4	11.0	1.0	270.0	3.0	0.0	para to eut	QP	0.0	20.4	50.5	-30.1	EUT on side
13.506	9.1	11.0	1.0	73.0	3.0	0.0	para to eut	QP	0.0	20.1	50.5	-30.4	EUT on side
13.562	26.9	11.0	1.0	105.0	3.0	0.0	para to grnd	QP	-40.0	-2.1	84.0	-86.1	EUT vert, RA par to gnd

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	9485	Date:	2021-12-06
Customer:	MSA Innovation, LLC	Temperature:	23.7°C
Attendees:	Dustin Morris	Relative Humidity:	18.6%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	23	Test Distance (m):	10	Ant. Height(s) (m):	1(m)

COMMENTS

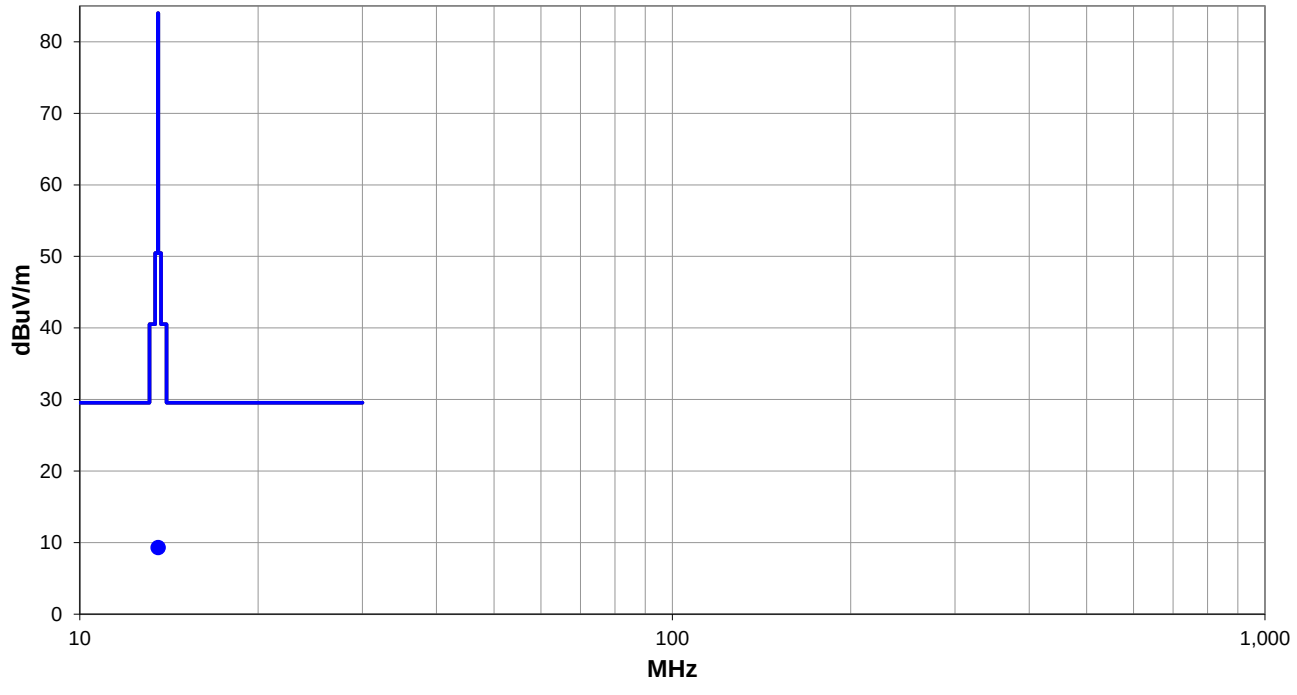
None

EUT OPERATING MODES

Transmitting at 13.56 MHz, Modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 23 ■ PK ◆ AV ● QP

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #23

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
13.560	7.8	11.0	1.0	44.0	10.0	0.0	para to EUT	QP	-9.5	9.3	84.0	-74.7	EUT on side

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was continuously transmitting while set to the channel specified.

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). An active loop antenna was 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

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

As outlined in 15.209(e), 15.31(f)(2), and RSS-GEN, 6.5, measurements may be performed at a distance closer than what is specified with the limit. The limit at the specified distance is shown on the data sheet. Measurements are made at a closer distance and the data is adjusted using a distance correction factor of 40dB/decade for comparison to the limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	ESM Cable Corp.	Antenna Loop Cable	MNE	2021-02-17	2022-02-17
Amplifier - Pre-Amplifier	Miteq	AM-1551	PAC	2021-06-17	2022-06-17
Receiver	Rohde & Schwarz	ESR26	ARP	2021-04-08	2022-04-08
Antenna - Loop	ETS Lindgren	6502	AOB	2021-06-01	2023-06-01

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	1.8 dB	-1.8 dB

FREQUENCY RANGE INVESTIGATED

9 kHz TO 30 MHz

POWER INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

MSAS0022-4

MODES INVESTIGATED

Transmitting at 13.56 MHz. Modulated.

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	5678	Date:	2021-12-06
Customer:	MSA Safety	Temperature:	23.6°C
Attendees:	Dustin Morris	Relative Humidity:	18.9%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	15	Test Distance (m):	3	Ant. Height(s) (m):	1(m)

COMMENTS

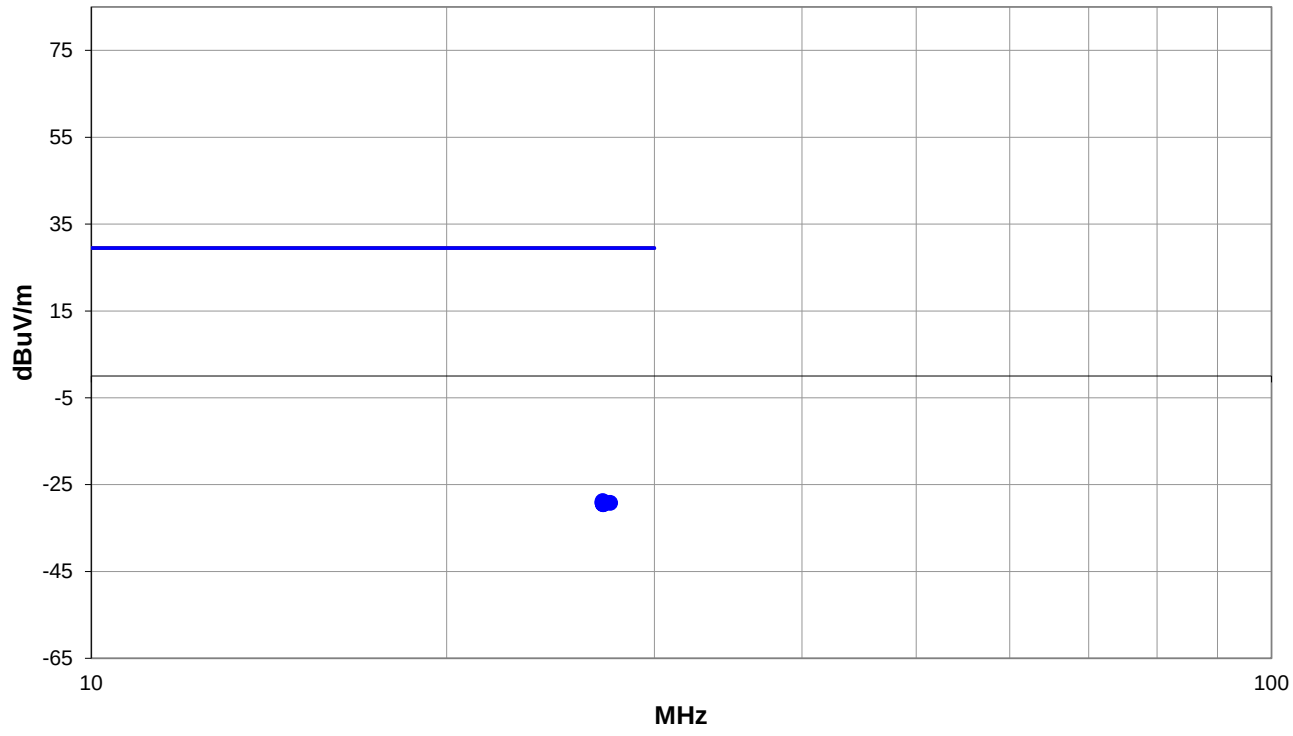
EUT vert, receive antenna(RA) parallel to ground

EUT OPERATING MODES

Transmitting at 13.56 MHz, modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 15 ■ PK ◆ AV ● QP

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #15

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
27.119	1.7	9.5	1.0	278.0	3.0	0.0	para to EUT	QP	-40.0	-28.8	29.5	-58.3	EUT vert
27.121	1.4	9.5	1.0	357.0	3.0	0.0	para to EUT	QP	-40.0	-29.1	29.5	-58.6	EUT vert
27.514	1.3	9.5	1.0	317.0	3.0	0.0	para to eut	QP	-40.0	-29.2	29.5	-58.7	EUT on side
27.116	1.3	9.5	1.0	140.0	3.0	0.0	perp to EUT	QP	-40.0	-29.2	29.5	-58.7	EUT on side
27.143	1.2	9.5	1.0	257.0	3.0	0.0	para to grnd	QP	-40.0	-29.3	29.5	-58.8	EUT vert
27.128	1.1	9.5	1.0	78.0	3.0	0.0	para to grnd	QP	-40.0	-29.4	29.5	-58.9	EUT on side
27.144	1.1	9.5	1.0	358.0	3.0	0.0	perp to grnd	QP	-40.0	-29.4	29.5	-58.9	EUT horz
27.128	1.0	9.5	1.0	209.0	3.0	0.0	perp to EUT	QP	-40.0	-29.5	29.5	-59.0	EUT horz
27.155	1.0	9.5	1.0	210.0	3.0	0.0	para to EUT	QP	-40.0	-29.5	29.5	-59.0	EUT horz

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	9485	Date:	2021-12-06
Customer:	MSA Safety	Temperature:	23.7°C
Attendees:	Dustin Morris	Relative Humidity:	18.6%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	22	Test Distance (m):	3	Ant. Height(s) (m):	1(m)

COMMENTS

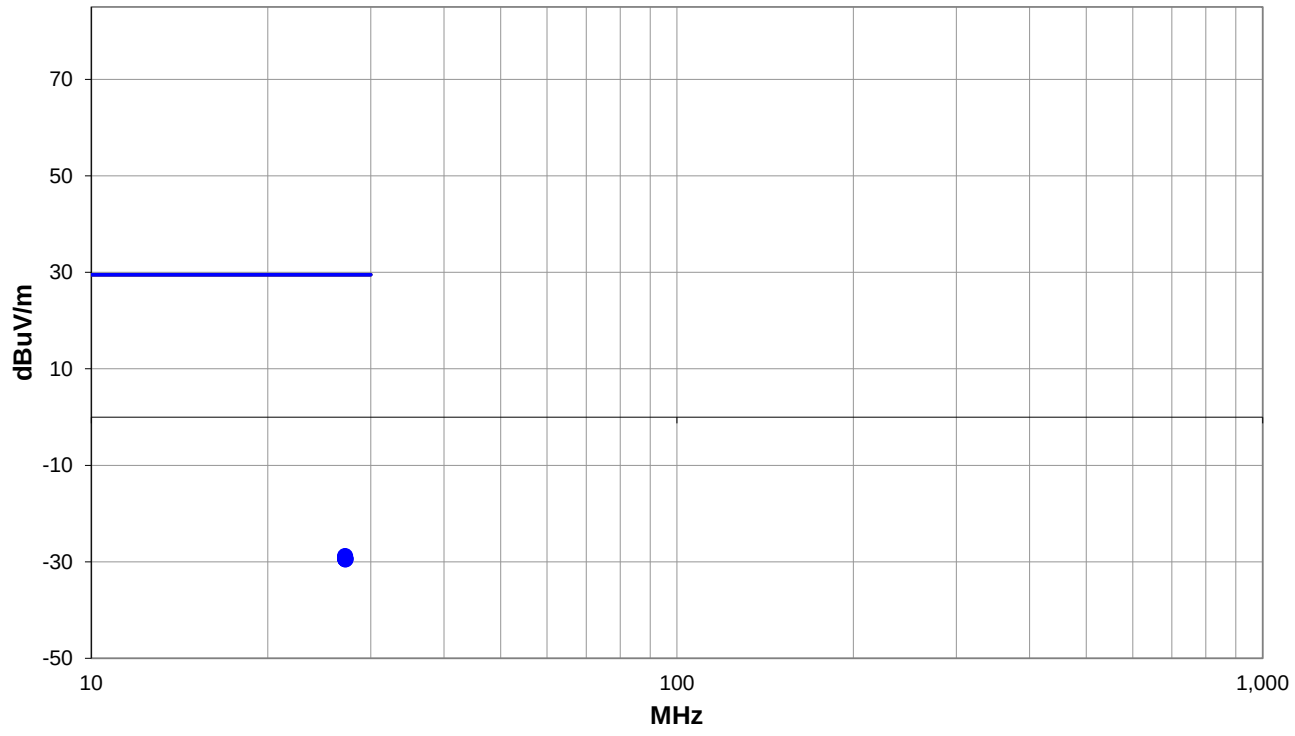
None

EUT OPERATING MODES

Transmitting at 13.56 MHz, modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 22 ■ PK ◆ AV ● QP

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #22

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
27.119	1.7	9.5	1.0	278.0	3.0	0.0	para to EUT	QP	-40.0	-28.8	29.5	-58.3	EUT vert
27.121	1.4	9.5	1.0	357.0	3.0	0.0	para to EUT	QP	-40.0	-29.1	29.5	-58.6	EUT vert
27.116	1.3	9.5	1.0	140.0	3.0	0.0	perp to EUT	QP	-40.0	-29.2	29.5	-58.7	EUT on side
27.143	1.2	9.5	1.0	257.0	3.0	0.0	para to grnd	QP	-40.0	-29.3	29.5	-58.8	EUT vert
27.128	1.1	9.5	1.0	78.0	3.0	0.0	para to grnd	QP	-40.0	-29.4	29.5	-58.9	EUT on side
27.144	1.1	9.5	1.0	358.0	3.0	0.0	perp to grnd	QP	-40.0	-29.4	29.5	-58.9	EUT horz
27.128	1.0	9.5	1.0	209.0	3.0	0.0	perp to EUT	QP	-40.0	-29.5	29.5	-59.0	EUT horz
27.155	1.0	9.5	1.0	210.0	3.0	0.0	para to EUT	QP	-40.0	-29.5	29.5	-59.0	EUT horz

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	9485	Date:	2021-12-06
Customer:	MSA Safety	Temperature:	23.7°C
Attendees:	Dustin Morris	Relative Humidity:	18.6%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Alexis Converse, Kyle McMullan	Job Site:	MN04
Power:	Battery	Configuration:	MSAS0022-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	23	Test Distance (m):	10	Ant. Height(s) (m):	1(m)

COMMENTS

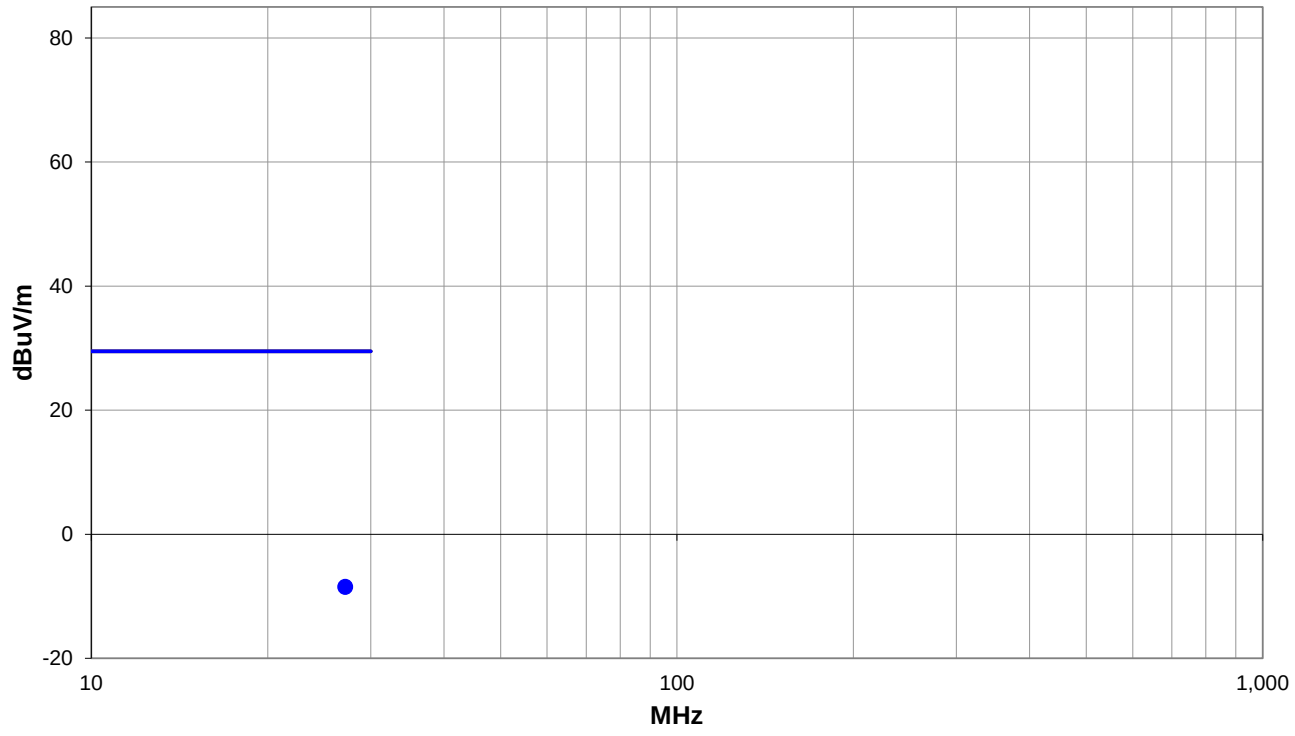
None

EUT OPERATING MODES

Transmitting at 13.56 MHz, modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 23 ■ PK ◆ AV ● QP

FIELD STRENGTH OF SPURIOUS EMISSIONS (BELOW 30MHZ)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #23

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
27.125	1.1	9.5	1.0	349.0	10.0	0.0	para to EUT	QP	-40.0	-29.4	29.5	-58.9	EUT on side

CONCLUSION
Pass

Tested By

FIELD STRENGTH OF SPURIOUS EMISSIONS (GREATER THAN 30 MHz)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was transmitting while set at the operating channel.

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, 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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Antenna - Biconilog	Ametek	CBL 6141B	AYS	2021-03-09	2023-03-09
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	2021-05-21	2022-05-21
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2021-10-13	2022-10-13
Cable	ESM Cable Corp.	Bilog Cables	MNH	2021-10-13	2022-10-13

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	4.6 dB	-4.6 dB

FREQUENCY RANGE INVESTIGATED

30 MHz TO 140 MHz

POWER INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

MSAS0022-4

MODES INVESTIGATED

Transmitting at 13.56 MHz, modulated

FIELD STRENGTH OF SPURIOUS EMISSIONS (GREATER THAN 30 MHz)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

EUT:	io4	Work Order:	MSAS0022
Serial Number:	9485	Date:	2021-12-07
Customer:	MSA Innovation, LLC	Temperature:	24°C
Attendees:	Dustin Morris	Relative Humidity:	15.9%
Customer Project:	None	Bar. Pressure (PMSL):	1022 mb
Tested By:	Alexis Converse	Job Site:	MN05
Power:	Battery	Configuration:	MSAS0022-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.225:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	98	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

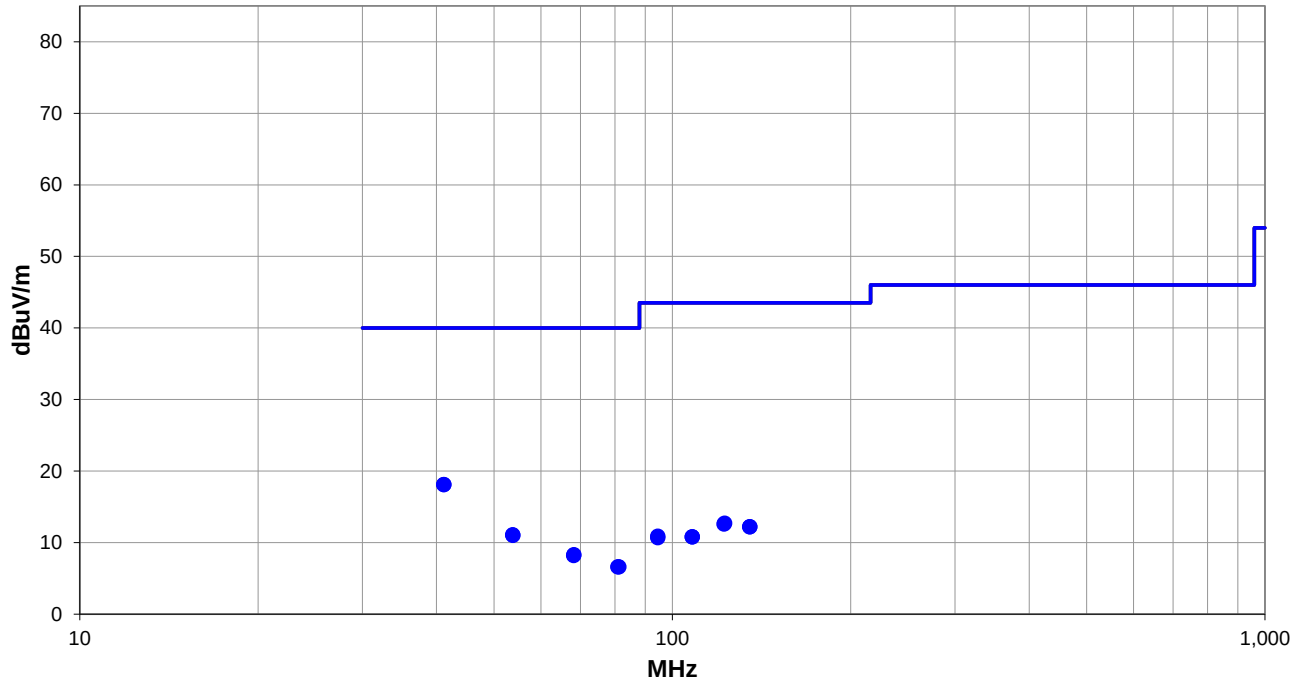
EUT on side

EUT OPERATING MODES

Transmitting at 13.56 MHz, modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 98 ■ PK ◆ AV ● QP

FIELD STRENGTH OF SPURIOUS EMISSIONS (GREATER THAN 30 MHz)

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.03.17.0

RESULTS - Run #98

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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)
41.160	17.7	0.4	1.0	37.0	3.0	0.0	Horz	QP	0.0	18.1	40.0	-21.9
41.142	17.7	0.4	3.05	243.0	3.0	0.0	Vert	QP	0.0	18.1	40.0	-21.9
53.757	16.4	-5.3	1.0	270.0	3.0	0.0	Horz	QP	0.0	11.1	40.0	-28.9
53.828	16.4	-5.4	1.54	106.9	3.0	0.0	Vert	QP	0.0	11.0	40.0	-29.0
122.481	17.7	-5.0	1.0	195.0	3.0	0.0	Vert	QP	0.0	12.7	43.5	-30.8
122.263	17.6	-5.0	1.0	66.0	3.0	0.0	Horz	QP	0.0	12.6	43.5	-30.9
135.088	16.8	-4.6	2.35	130.0	3.0	0.0	Horz	QP	0.0	12.2	43.5	-31.3
135.145	16.8	-4.6	1.0	11.0	3.0	0.0	Vert	QP	0.0	12.2	43.5	-31.3
68.176	17.7	-9.4	1.0	109.0	3.0	0.0	Vert	QP	0.0	8.3	40.0	-31.7
68.163	17.6	-9.4	3.37	274.0	3.0	0.0	Horz	QP	0.0	8.2	40.0	-31.8
94.506	19.2	-8.3	1.62	99.9	3.0	0.0	Horz	QP	0.0	10.9	43.5	-32.6
108.001	16.7	-5.9	1.0	289.9	3.0	0.0	Horz	QP	0.0	10.8	43.5	-32.7
108.008	16.7	-5.9	3.31	268.0	3.0	0.0	Vert	QP	0.0	10.8	43.5	-32.7
94.496	19.1	-8.4	1.42	23.9	3.0	0.0	Vert	QP	0.0	10.7	43.5	-32.8
80.931	16.4	-9.8	3.45	217.9	3.0	0.0	Horz	QP	0.0	6.6	40.0	-33.4
81.236	16.4	-9.8	1.0	34.9	3.0	0.0	Vert	QP	0.0	6.6	40.0	-33.4

CONCLUSION

Pass

Tested By

FREQUENCY STABILITY

XMit 2020.12.30.0

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
Probe - Near Field Set	ETS Lindgren	7405	IPO	NCR	NCR
Thermometer	Omega Engineering, Inc.	HH311	DUB	2020-10-05	2023-10-05
Chamber - Temperature/Humidity	Cincinnati Sub Zero (CSZ)	ZPH-32-3.5-SCT/AC	TBF	NCR	NCR
Meter - Multimeter	Fluke	115	MBE	2020-02-26	2023-02-26
Block - DC	Fairview Microwave	SD3379	AMZ	2021-11-05	2022-11-05
Attenuator	S.M. Electronics	SA26B-20	RFW	2021-02-05	2022-02-05
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2021-09-12	2022-09-12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	2021-05-18	2022-05-18

TEST DESCRIPTION

The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made on the single transmit frequency as called out on the data sheets. Testing was done while the EUT was continuously polling.

The primary supply voltage was varied from full battery voltage to minimum operating voltage at ambient temperature. Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range of -20 ° to +50° C and at 10°C intervals.

The requirement of a frequency tolerance of ±0.01% is equivalent to 100 ppm
The formula to check for compliance is:

ppm = (Measured Frequency / Measured Nominal Frequency - 1) * 1,000,000

FREQUENCY STABILITY

element

TbtTx 2021.10.29.2 XMit 2020.12.30.0

EUT:	io4			**Work Order:**	MSAS0022
Serial Number:	5710			**Date:**	17-Dec-21
Customer:	MSA Innovation, LLC			**Temperature:**	23.0 °C
Attendees:	Dustin Morris			**Humidity:**	21.0% RH
Project:	None			**Barometric Pres.:**	1017.1 mbar
Tested by:	Andrew Rogstad	**Power:**	4.1 VDC Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	**Test Method**
FCC 15.225:2021	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

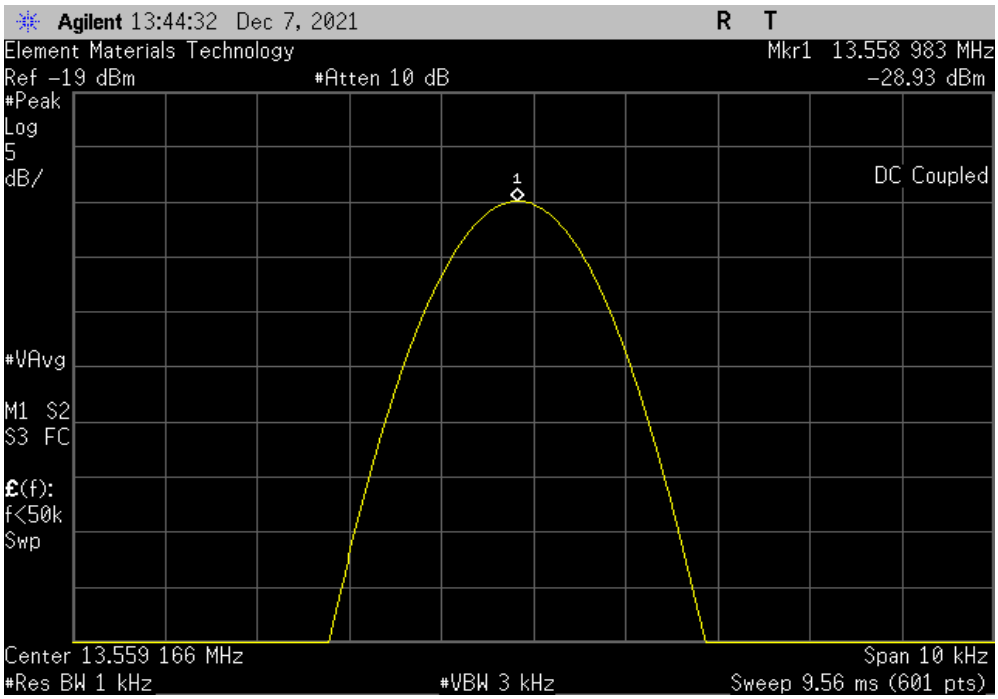
None

Configuration #	4	*Signature* Andrew Rogstad

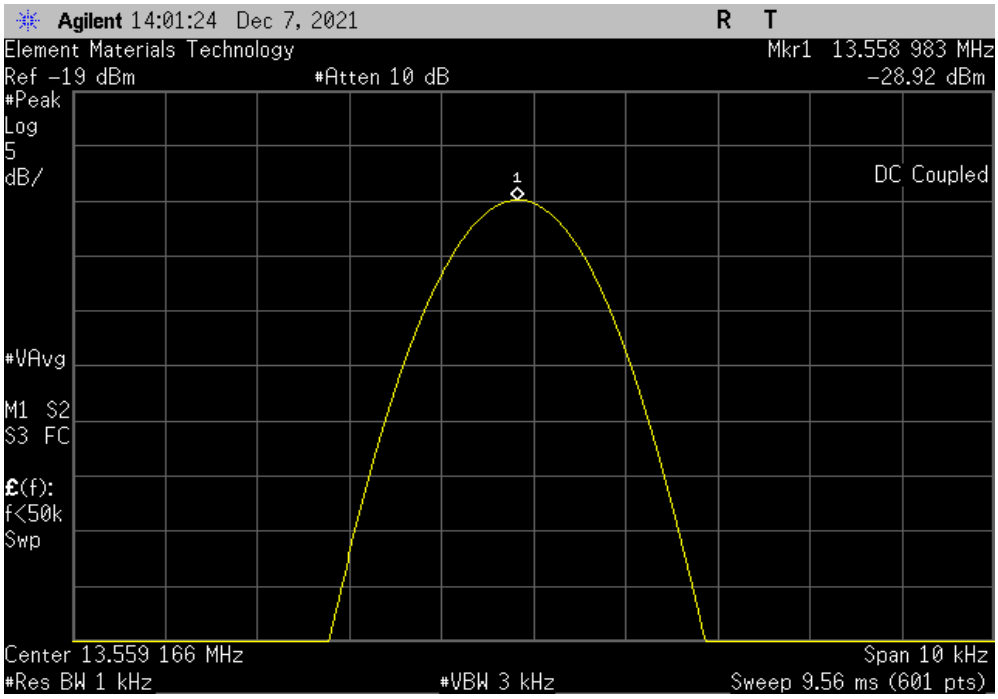
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
13.56 MHz, CW					
50°C	13.558983	13.559049	4.9	100	Pass
40°C	13.558983	13.559049	4.9	100	Pass
30°C	13.559015	13.559049	2.5	100	Pass
20°C	13.559049	13.559049	0	100	Pass
10°C	13.559099	13.559049	3.7	100	Pass
0°C	13.559132	13.559049	6.1	100	Pass
-10°C	13.559149	13.559049	7.4	100	Pass
-20°C	13.559165	13.559049	8.6	100	Pass

FREQUENCY STABILITY

13.56 MHz, CW, 50°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.558983	13.559049	4.9	100	Pass

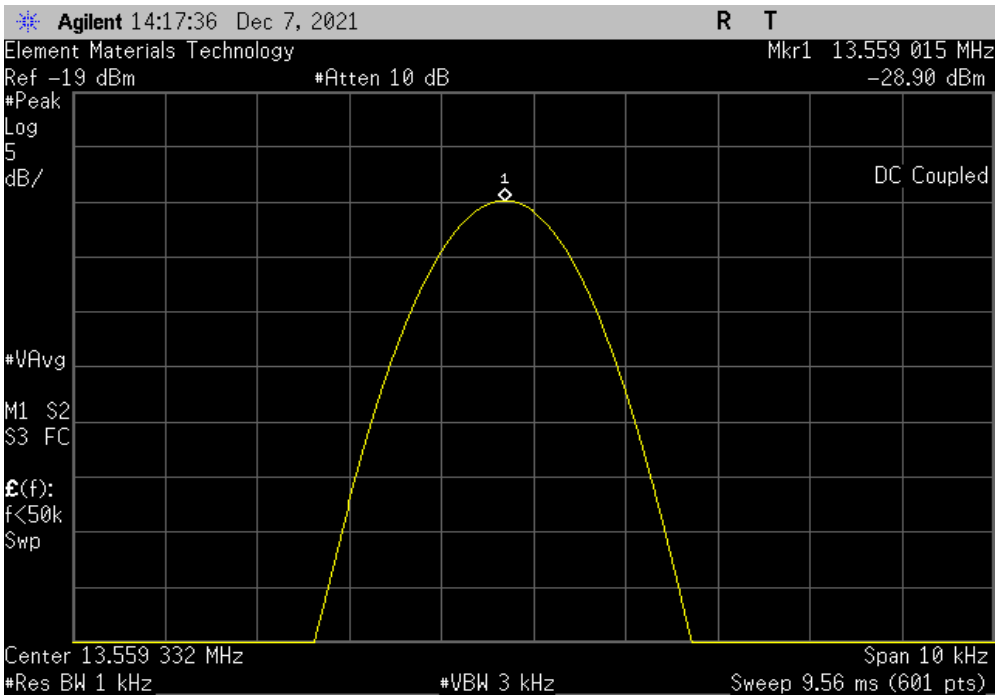


13.56 MHz, CW, 40°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.558983	13.559049	4.9	100	Pass

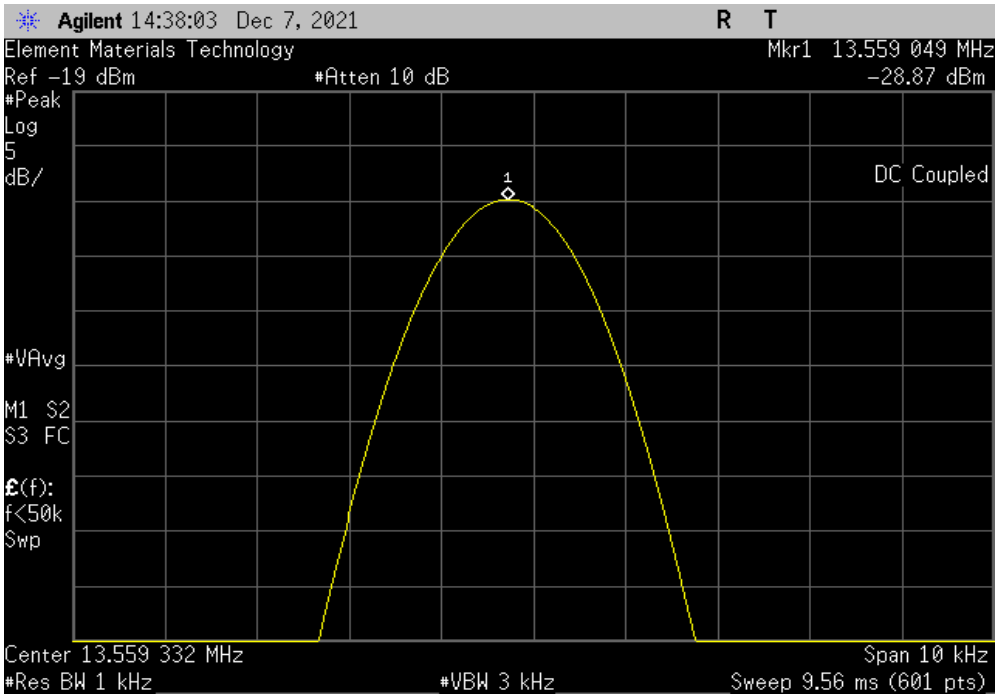


FREQUENCY STABILITY

13.56 MHz, CW, 30°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559015	13.559049	2.5	100	Pass

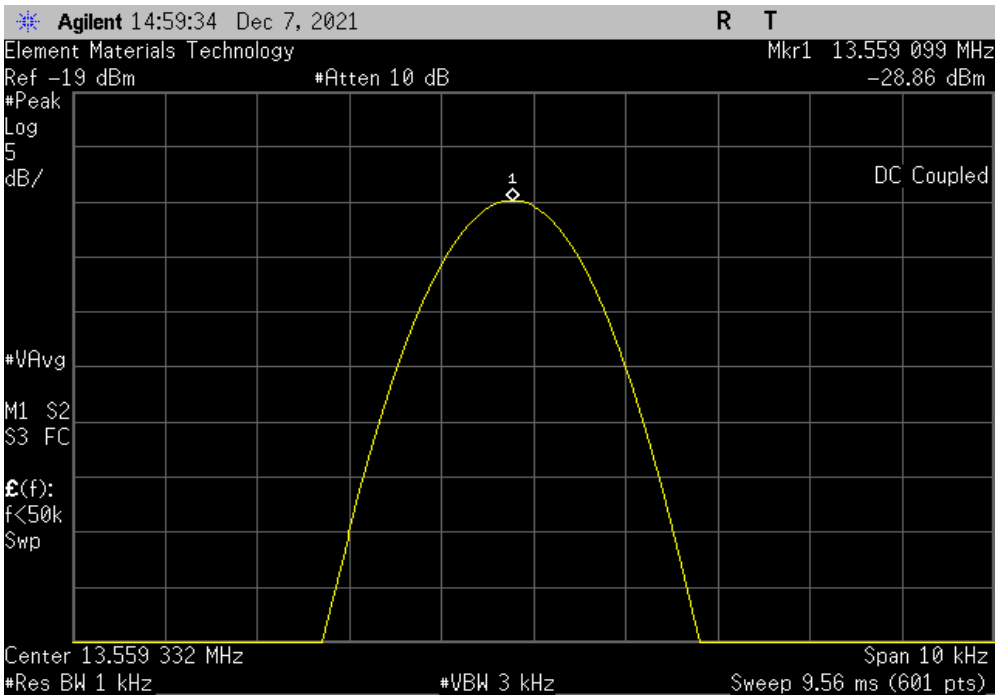


13.56 MHz, CW, 20°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559049	13.559049	0	100	Pass

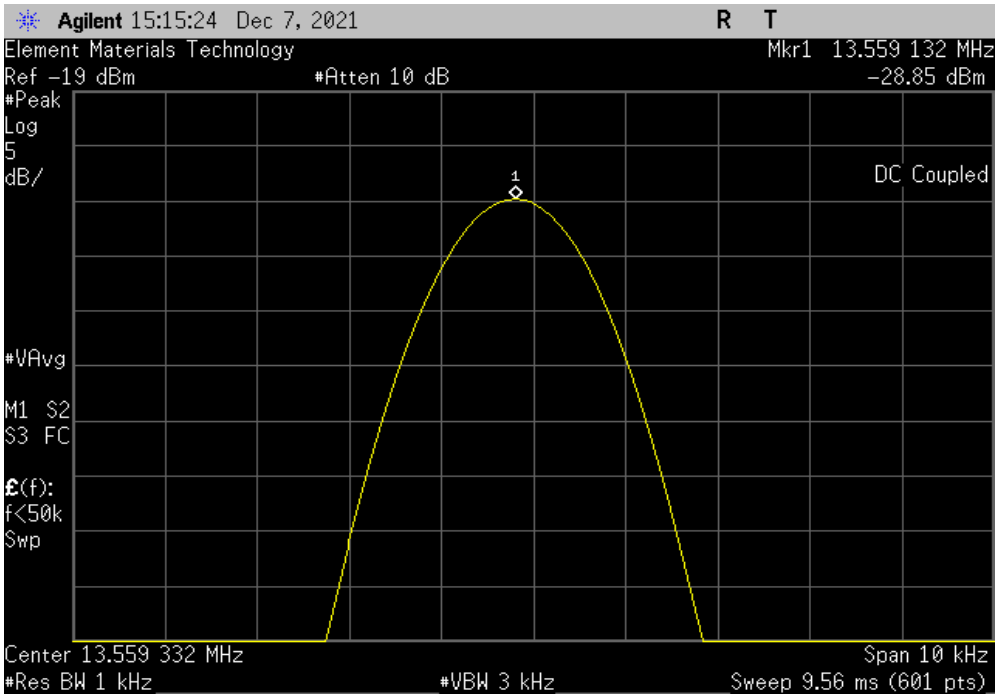


FREQUENCY STABILITY

13.56 MHz, CW, 10°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559099	13.559049	3.7	100	Pass

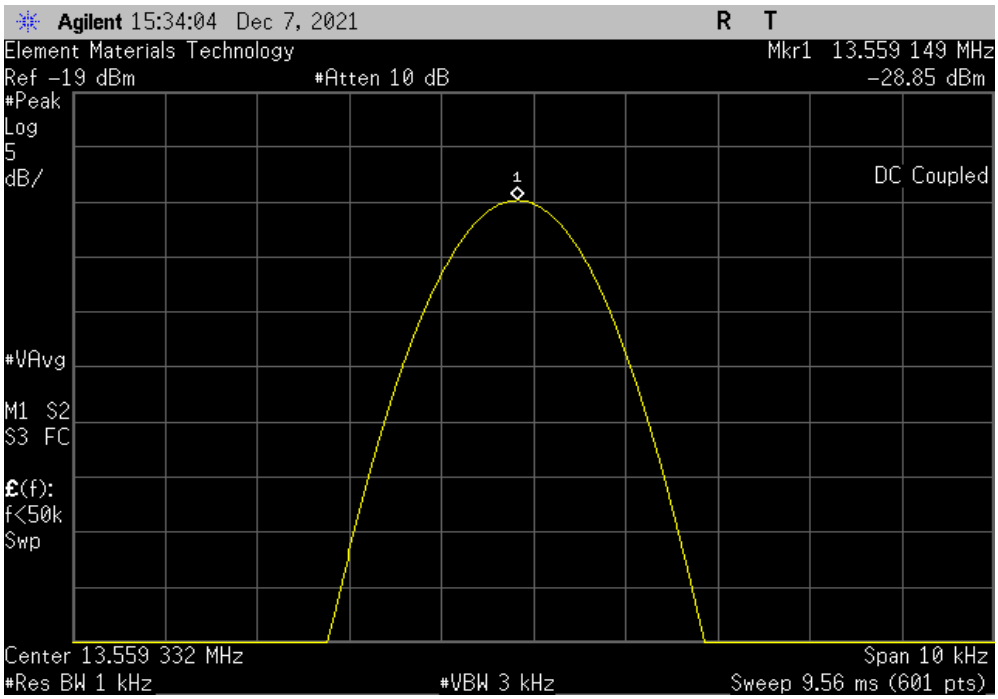


13.56 MHz, CW, 0°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559132	13.559049	6.1	100	Pass

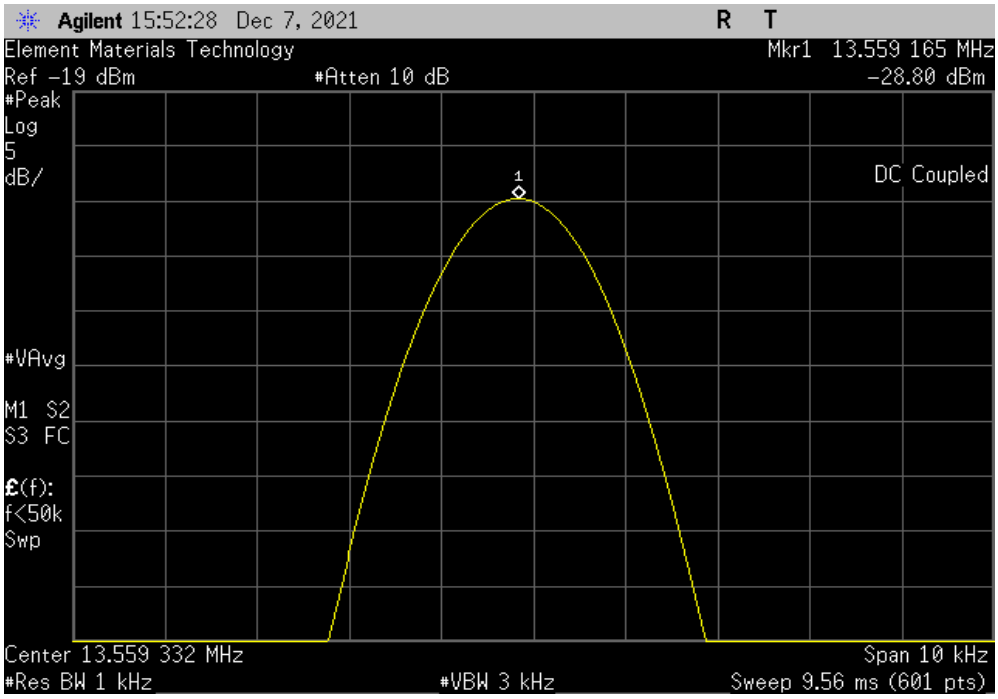


FREQUENCY STABILITY

13.56 MHz, CW, -10°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559149	13.559049	7.4	100	Pass



13.56 MHz, CW, -20°C						
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559165	13.559049	8.6	100	Pass



FREQUENCY STABILITY (EXTREME VOLTAGE)

XMit 2020.12.30.0

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
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Meter - Multimeter	Fluke	115	MBE	2020-02-26	2023-02-26
Probe - Near Field Set	ETS Lindgren	7405	IPO	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMZ	2021-11-05	2022-11-05
Attenuator	S.M. Electronics	SA26B-20	RFW	2021-02-05	2022-02-05
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2021-09-12	2022-09-12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	2021-05-18	2022-05-18

TEST DESCRIPTION

The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made on the single transmit frequency as called out on the data sheets. Testing was done while the EUT was continuously polling.

The primary supply voltage was varied from 85 % to 115% of the nominal voltage while at ambient temperature. Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range of -20 ° to +50° C and at 10°C intervals.

The requirement of a frequency tolerance of ±0.01% is equivalent to 100 ppm
The formula to check for compliance is:

ppm = (Measured Frequency / Measured Nominal Frequency - 1) * 1,000,000

FREQUENCY STABILITY (EXTREME VOLTAGE)

element

TbtTx 2021.10.29.2 XMit 2020.12.30.0

EUT:	io4			**Work Order:**	MSAS0022
Serial Number:	5710			**Date:**	17-Dec-21
Customer:	MSA Innovation, LLC			**Temperature:**	23.0 °C
Attendees:	Dustin Morris			**Humidity:**	21.0% RH
Project:	None			**Barometric Pres.:**	1017.1 mbar
Tested by:	Andrew Rogstad	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.225:2021	ANSI C63.10:2013

COMMENTS

Configuration 4 was tested on 12/14/2021 for the Battery End-Point Voltage. Configuration 6 was tested on 12/17/2021 (23.6°C, 21.2% RH, 1025.6 mb) for the Fully Charged Battery Voltage.

DEVIATIONS FROM TEST STANDARD

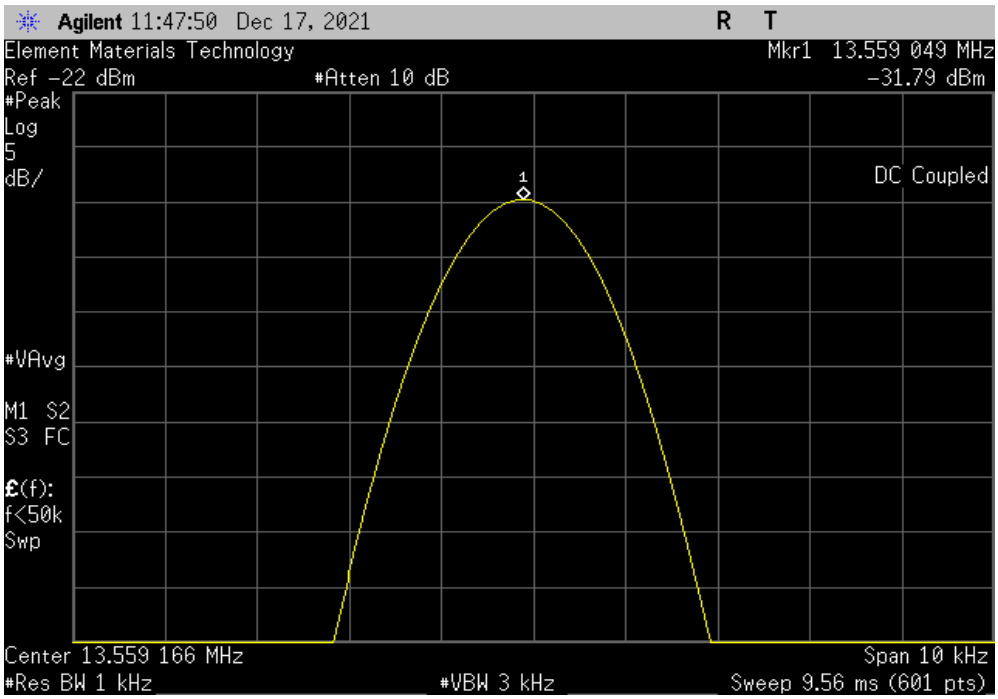
None

Configuration #	4, 6	Signature

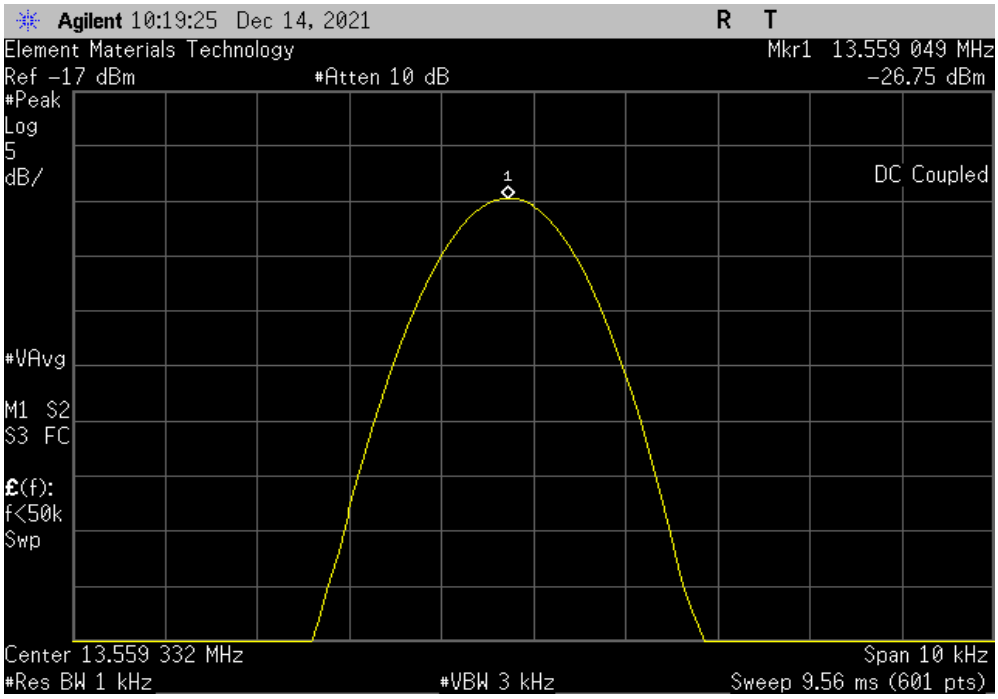
		Measured Value (MHz)	Nominal Value (MHz)	Error (ppm)	Limit (ppm)	Results
13.56 MHz, CW						
	20°C					
	Fully Charged Battery Voltage	13.559049	13.559049	0	100	Pass
	Battery End-Point Voltage	13.559049	13.559049	0	100	Pass

FREQUENCY STABILITY (EXTREME VOLTAGE)

13.56 MHz, CW, 20°C, Fully Charged Battery Voltage						
		Measured Value (MHz)	Nominal Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559049	13.559049	0.0	100	Pass



13.56 MHz, CW, 20°C, Battery End-Point Voltage						
		Measured Value (MHz)	Nominal Value (MHz)	Error (ppm)	Limit (ppm)	Results
		13.559049	13.559049	0.0	100	Pass



OCCUPIED BANDWIDTH

XMit 2020.12.30.0

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
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2020-12-27	2021-12-27
Probe - Near Field Set	ETS Lindgren	7405	IPO	NCR	NCR
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2021-09-12	2022-09-12

TEST DESCRIPTION

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

The 20dB occupied bandwidth was measured using 10 kHz resolution bandwidth and 30 kHz video bandwidth.

OCCUPIED BANDWIDTH

element

TbtTx 2021.10.29.2 XMit 2020.12.30.0

EUT:	io4			**Work Order:**	MSAS0022
Serial Number:	3511			**Date:**	17-Dec-21
Customer:	MSA Innovation, LLC			**Temperature:**	23.1 °C
Attendees:	Dustin Morris			**Humidity:**	21.9% RH
Project:	None			**Barometric Pres.:**	1026 mbar
Tested by:	Andrew Rogstad	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.225:2021	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

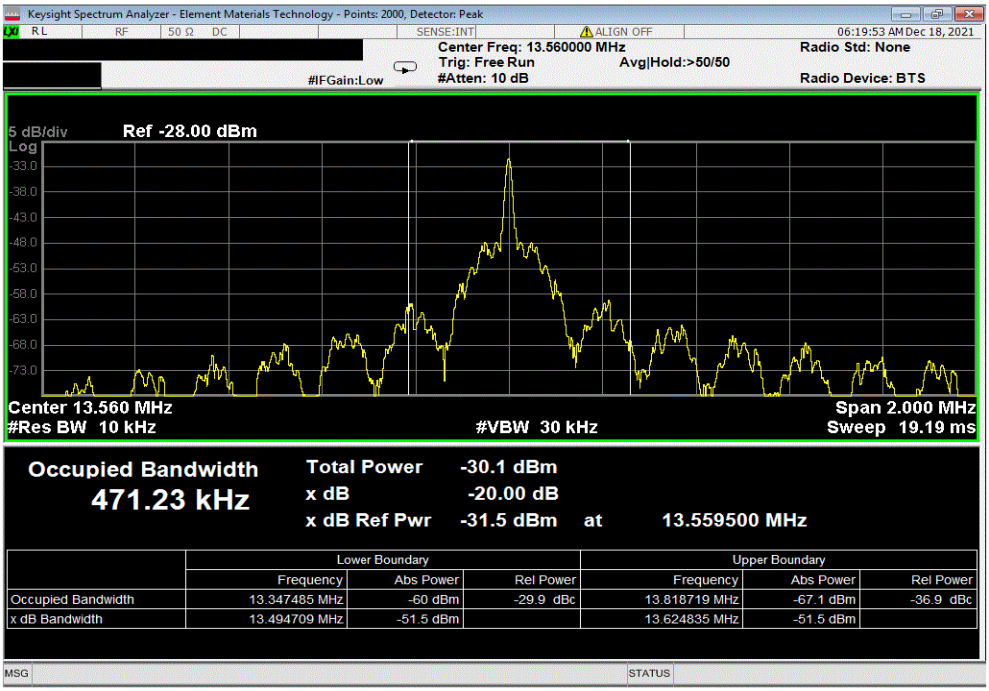
None

Configuration #	6	Signature

	Lower Value (MHz)	Lower Limit (MHz)	Upper Value (MHz)	Upper Limit (MHz)	Result
13.56 MHz, Modulated					
Occupied Bandwidth (20 dB)	13.495	≥13.110	13.625	≤14.010	Pass

OCCUPIED BANDWIDTH

13.56 MHz, Modulated, Occupied Bandwidth (20 dB)						
		Lower Value (MHz)	Lower Limit (MHz)	Upper Value (MHz)	Upper Limit (MHz)	Result
		13.495	≥13.110	13.625	≤14.010	Pass



End of Test Report