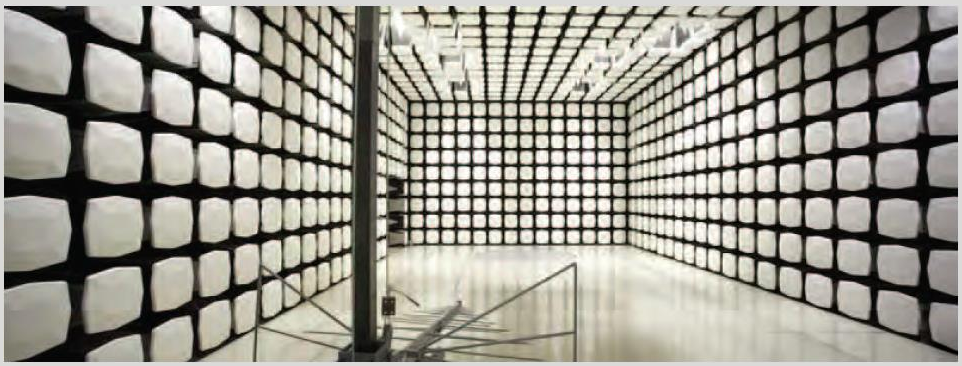
Schweitzer Engineering Laboratories, Inc.

SEL-RP50

FCC 15.247:2021

902 - 928 MHz Other Wideband (DTS) Transceiver

Report: SCHW0247.1, Issue Date: April 26, 2021



NVLAP LAB CODE: 200630-0

CERTIFICATE OF TEST

Last Date of Test: April 9, 2021
Schweitzer Engineering Laboratories, Inc.
EUT: SEL-RP50

Radio Equipment Testing

Standards

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

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	No	N/A	Not required because it does not connect to AC mains.
6.5, 6.6, 11.12.1, 11.13.2	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	N/A	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:

Kyle Holgate, Operations Manager

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

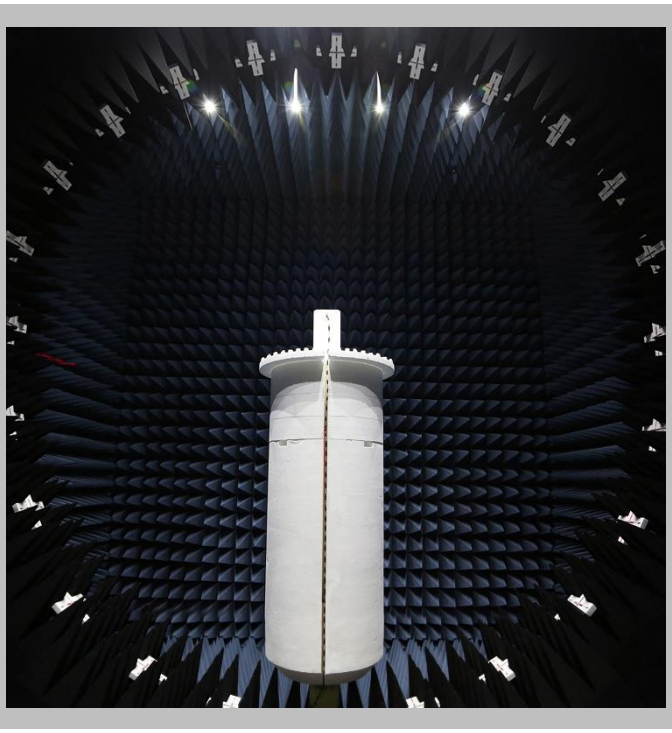
SCOPE

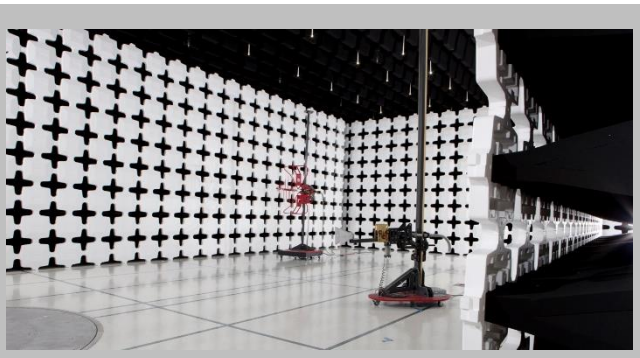
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

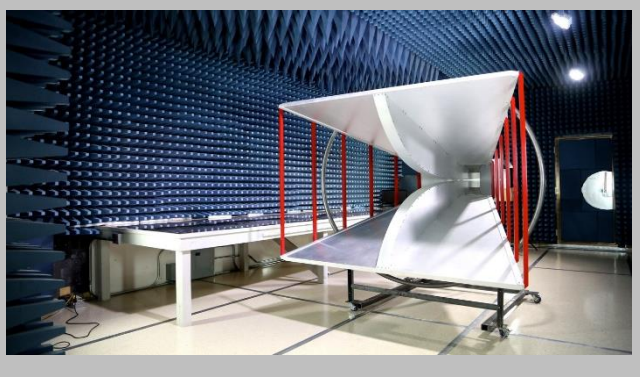
FACILITIES

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
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

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.

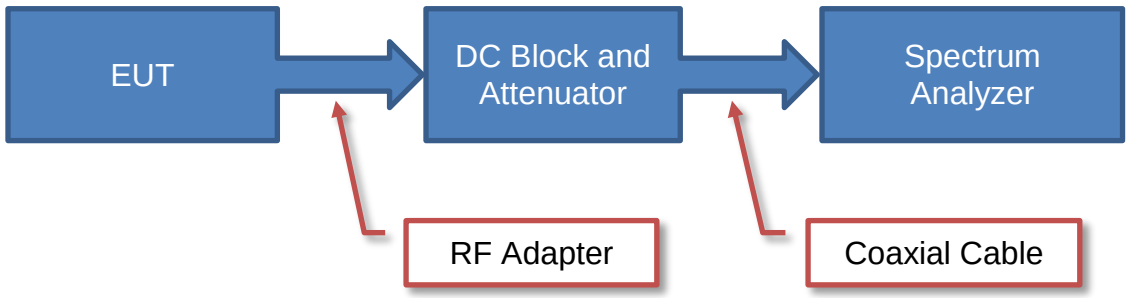
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific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

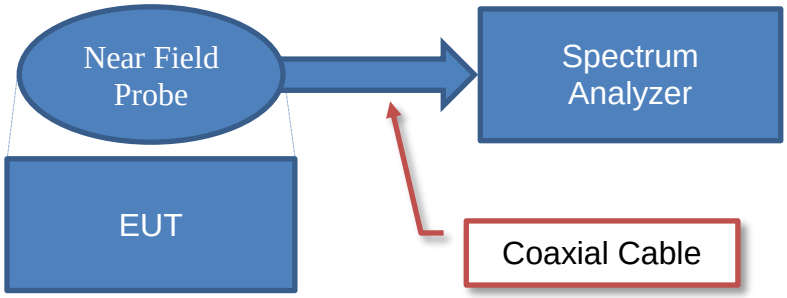
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

Test Setup Block Diagrams

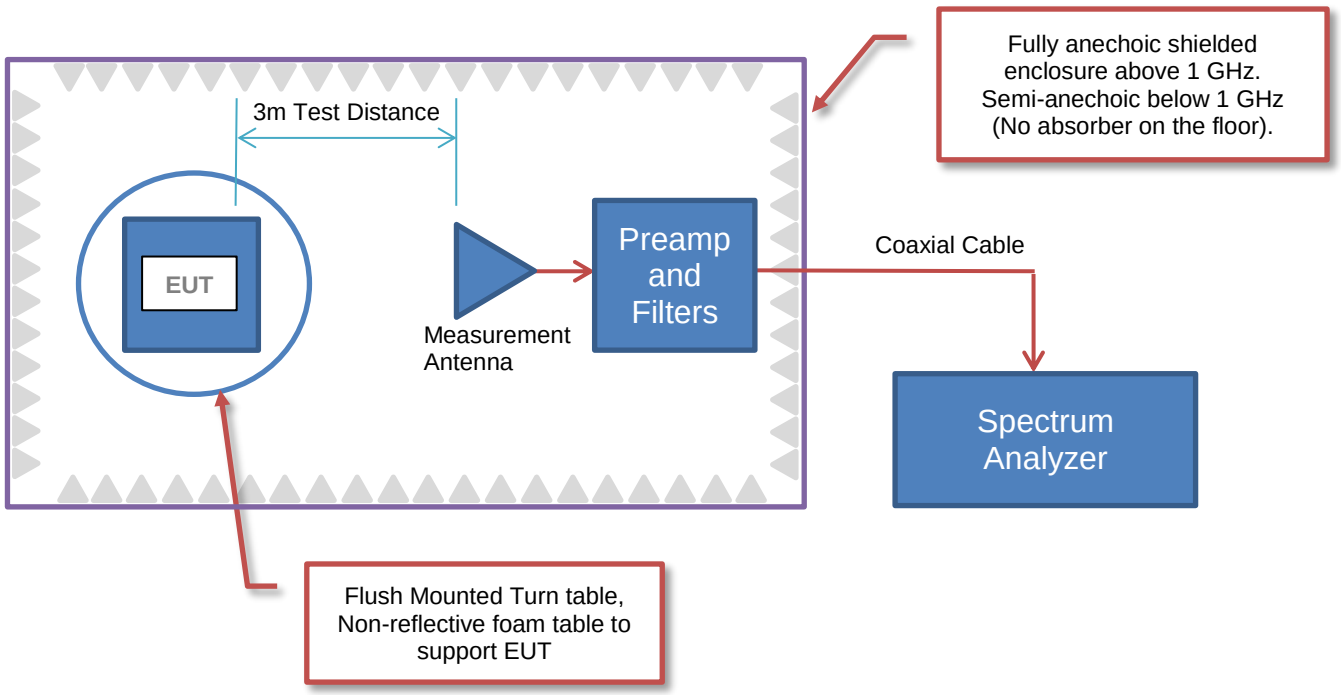
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



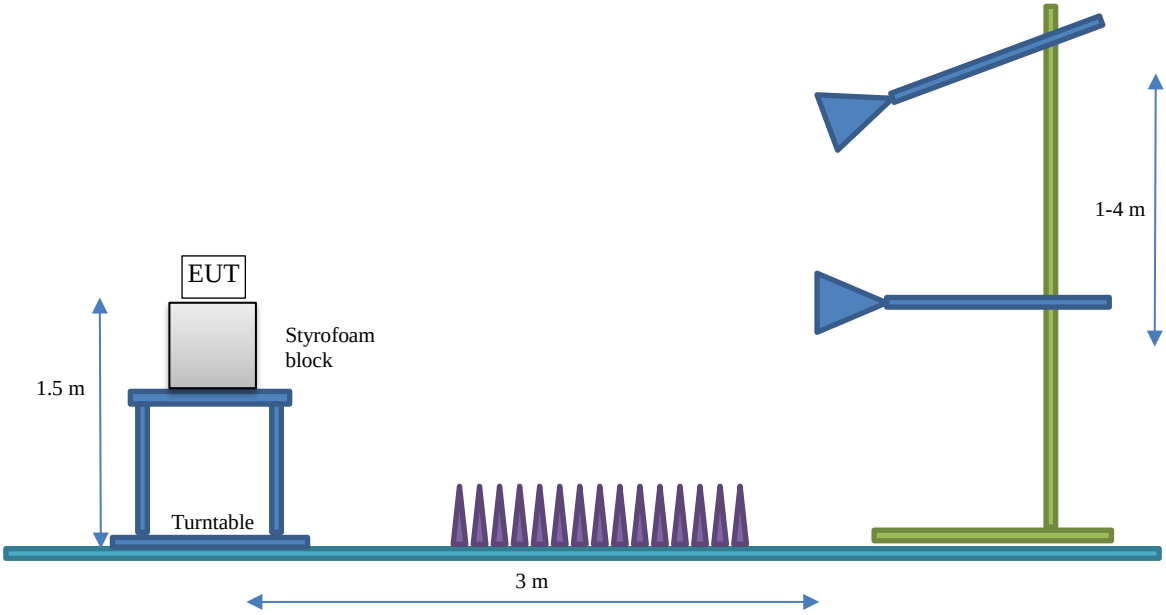
Spurious Radiated Emissions



Test Setup Block Diagrams

Bore Siting (>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:	Schweitzer Engineering Laboratories, Inc.
Address:	2350 NE Hopkins Court
City, State, Zip:	Pullman, WA 99163
Test Requested By:	Miralem Cosic
EUT:	SEL-RP50
First Date of Test:	March 11, 2021
Last Date of Test:	April 9, 2021
Receipt Date of Samples:	March 11, 2021
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
The SEL-RP50 works together with the SEL-FT50 and SEL-FR12 to form a system that provides a mechanism to speed up, thus enhance, protection of electrical utility distribution system.

Testing Objective:
Seeking to demonstrate compliance under FCC 15.247:2021 for operation in the 902 - 928 MHz Band.

CONFIGURATIONS

Configuration SCHW0247- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
900 MHz SEL-FT50 Repeater	Schweitzer Engineering Laboratories, Inc.	SEL-RP50	A12838995

Configuration SCHW0247- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
900 MHz SEL-FT50 Repeater	Schweitzer Engineering Laboratories, Inc.	SEL-RP50	A12839004

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
DC Power Supply	TDK Lambda	Z320-2-U	LOC-117B304-0002

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Power	No	3.0 m	No	900 MHz SEL-FT50 Repeater	DC Power Supply
AC Power	No	2.0 m	No	DC Power Supply	AC Mains

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2021-03-11	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	2021-03-11	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	2021-03-11	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	2021-03-11	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	2021-03-11	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	2021-03-11	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	2021-03-12	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT was taken home by the client before the next scheduled test.
8	2021-04-09	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	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)
Inverted F	Schweitzer Engineering Laboratories, Inc.	904 - 926	-4

No adjustable power settings were provided. The EUT was tested using power settings pre-defined by the manufacturer.

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2021.01.22.0

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. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

On, continuous transmit, DTS, 2-FSK, 300kbps, low channel 904 MHz, mid channel 917 MHz & high channel 926 MHz

POWER SETTINGS INVESTIGATED

9V Battery

CONFIGURATIONS INVESTIGATED

SCHW0247 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12400 MHz

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.	Cal. Due
Cable	None	Standard Gain Horns Cable	EVF	2020-11-18	2021-11-18
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-08001200-30-10P	PAO	2020-11-18	2021-11-18
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	NCR
Filter - High Pass	Micro-Tronics	HPM50108	HFV	2020-11-17	2021-11-17
Cable	N/A	Double Ridge Horn Cables	EVB	2020-11-17	2021-11-17
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	2020-11-17	2021-11-17
Antenna - Double Ridge	EMCO	3115	AHC	2020-07-01	2022-07-01
Filter - Low Pass	Micro-Tronics	LPM50004	LFD	2021-02-15	2022-02-15
Filter - Low Pass	Micro-Tronics	LPM50003	LFB	2021-02-15	2022-02-15
Attenuator	Coaxicom	3910-10	AWX	2021-02-15	2022-02-15
Attenuator	Coaxicom	3910-20	AXZ	2021-02-15	2022-02-15
Cable	N/A	Bilog Cables	EVA	2020-11-17	2021-11-17
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	2020-11-17	2021-11-17
Antenna - Biconilog	EMCO	3141	AXG	2019-07-23	2021-07-23
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	2020-06-25	2021-06-25

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*log(1/dc).

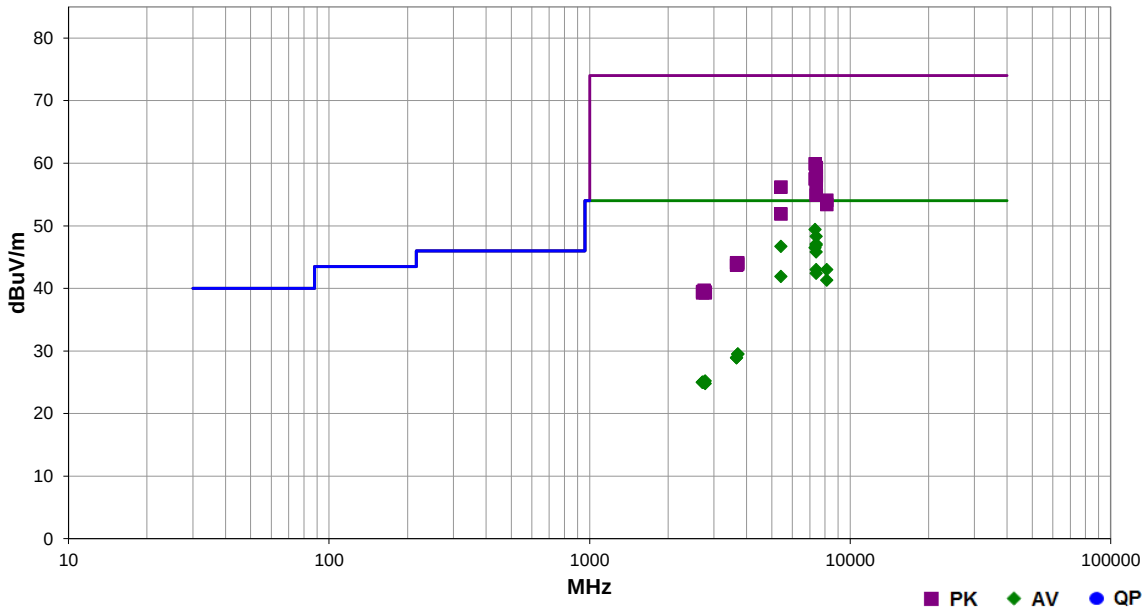
SPURIOUS RADIATED EMISSIONS

EmiR5 2021.01.08.0 PSA-ESCI 2021.01.22.0

Work Order:	SCHW0247	**Date:**	2021-03-12		
Project:	None	**Temperature:**	21.9 °C		
Job Site:	EV01	**Humidity:**	31.6% RH		
Serial Number:	A12838995	**Barometric Pres.:**	1030 mbar	**Tested by:**	Cole Ghizzone
EUT:	SEL-RP50				
Configuration:	1				
Customer:	Schweitzer Engineering Laboratories, Inc.				
Attendees:	Miralem Cosic				
EUT Power:	9V Battery				
Operating Mode:	On, continuous transmit, DTS, 2-FSK, 300kbps, low channel 904 MHz, mid channel 917 MHz & high channel 926 MHz				
Deviations:	None				
Comments:	None				

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

Run #	15	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



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
7337.750	37.6	11.8	2.33	211.0	3.0	0.0	Horz	AV	0.0	49.4	54.0	-4.6	Mid Channel, EUT On Side
7406.250	35.9	12.4	2.44	234.0	3.0	0.0	Horz	AV	0.0	48.3	54.0	-5.7	High Channel, EUT On Side
7406.258	34.7	12.4	2.34	261.0	3.0	0.0	Vert	AV	0.0	47.1	54.0	-6.9	High Channel, EUT Horizontal
7406.250	34.5	12.4	2.39	309.0	3.0	0.0	Horz	AV	0.0	46.9	54.0	-7.1	High Channel, EUT Horizontal
5425.307	39.5	7.2	1.46	212.0	3.0	0.0	Horz	AV	0.0	46.7	54.0	-7.3	Low Channel, EUT On Side
7334.258	34.7	11.8	1.69	317.0	3.0	0.0	Vert	AV	0.0	46.5	54.0	-7.5	Mid Channel, EUT Horizontal
7406.242	33.4	12.4	2.07	15.0	3.0	0.0	Vert	AV	0.0	45.8	54.0	-8.2	High Channel, EUT Vertical
7406.258	30.6	12.4	2.8	19.0	3.0	0.0	Horz	AV	0.0	43.0	54.0	-11.0	High Channel, EUT Vertical
8134.040	31.0	12.0	2.27	238.0	3.0	0.0	Horz	AV	0.0	43.0	54.0	-11.0	Low Channel, EUT On Side
7409.775	30.0	12.4	1.51	300.0	3.0	0.0	Vert	AV	0.0	42.4	54.0	-11.6	High Channel, EUT On Side
5425.307	34.7	7.2	1.5	268.0	3.0	0.0	Vert	AV	0.0	41.9	54.0	-12.1	Low Channel, EUT Horizontal
8134.027	29.3	12.0	2.16	252.0	3.0	0.0	Vert	AV	0.0	41.3	54.0	-12.7	Low Channel, EUT Horizontal
7334.200	48.1	11.8	2.33	211.0	3.0	0.0	Horz	PK	0.0	59.9	74.0	-14.1	Mid Channel, EUT On Side
7409.992	46.9	12.4	2.44	234.0	3.0	0.0	Horz	PK	0.0	59.3	74.0	-14.7	High Channel, EUT On Side
7406.250	45.7	12.4	2.34	261.0	3.0	0.0	Vert	PK	0.0	58.1	74.0	-15.9	High Channel, EUT Horizontal
7406.383	45.5	12.4	2.39	309.0	3.0	0.0	Horz	PK	0.0	57.9	74.0	-16.1	High Channel, EUT Horizontal
7338.225	45.7	11.8	1.69	317.0	3.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	Mid Channel, EUT Horizontal
7406.275	44.8	12.4	2.07	15.0	3.0	0.0	Vert	PK	0.0	57.2	74.0	-16.8	High Channel, EUT Vertical
5422.627	48.9	7.3	1.46	212.0	3.0	0.0	Horz	PK	0.0	56.2	74.0	-17.8	Low Channel, EUT On Side
7406.317	42.7	12.4	2.8	19.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	High Channel, EUT Vertical
7406.450	42.5	12.4	1.51	300.0	3.0	0.0	Vert	PK	0.0	54.9	74.0	-19.1	High Channel, EUT On Side
8137.573	42.1	12.0	2.27	238.0	3.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	Low Channel, EUT On Side

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
8137.347	41.4	12.0	2.16	252.0	3.0	0.0	Vert	PK	0.0	53.4	74.0	-20.6	Low Channel, EUT Horizontal
5425.347	44.7	7.2	1.5	268.0	3.0	0.0	Vert	PK	0.0	51.9	74.0	-22.1	Low Channel, EUT Horizontal
3706.417	25.6	3.9	1.5	55.0	3.0	0.0	Horz	AV	0.0	29.5	54.0	-24.5	High Channel, EUT On Side
3706.325	25.6	3.9	1.5	111.0	3.0	0.0	Vert	AV	0.0	29.5	54.0	-24.5	High Channel, EUT Horizontal
3667.142	25.4	3.5	1.5	78.0	3.0	0.0	Vert	AV	0.0	28.9	54.0	-25.1	Mid Channel, EUT Horizontal
3667.400	25.4	3.5	1.5	51.0	3.0	0.0	Horz	AV	0.0	28.9	54.0	-25.1	Mid Channel, EUT On Side
2778.625	27.7	-2.5	2.4	241.0	3.0	0.0	Horz	AV	0.0	25.2	54.0	-28.8	High Channel, EUT On Side
2751.650	27.7	-2.7	1.5	146.0	3.0	0.0	Vert	AV	0.0	25.0	54.0	-29.0	Mid Channel, EUT Horizontal
2751.667	27.7	-2.7	1.5	11.0	3.0	0.0	Horz	AV	0.0	25.0	54.0	-29.0	Mid Channel, EUT On Side
2711.573	27.9	-2.9	1.5	145.0	3.0	0.0	Horz	AV	0.0	25.0	54.0	-29.0	Low Channel, EUT On Side
2711.427	27.9	-2.9	1.5	236.0	3.0	0.0	Vert	AV	0.0	25.0	54.0	-29.0	Low Channel, EUT Horizontal
2778.600	27.3	-2.5	3.61	134.0	3.0	0.0	Vert	AV	0.0	24.8	54.0	-29.2	High Channel, EUT Horizontal
3705.483	40.2	3.9	1.5	55.0	3.0	0.0	Horz	PK	0.0	44.1	74.0	-29.9	High Channel, EUT On Side
3666.683	40.6	3.5	1.5	51.0	3.0	0.0	Horz	PK	0.0	44.1	74.0	-29.9	Mid Channel, EUT On Side
3701.558	40.1	3.8	1.5	111.0	3.0	0.0	Vert	PK	0.0	43.9	74.0	-30.1	High Channel, EUT Horizontal
3667.950	40.2	3.5	1.5	78.0	3.0	0.0	Vert	PK	0.0	43.7	74.0	-30.3	Mid Channel, EUT Horizontal
2752.308	42.4	-2.7	1.5	11.0	3.0	0.0	Horz	PK	0.0	39.7	74.0	-34.3	Mid Channel, EUT On Side
2714.347	42.4	-2.9	1.5	236.0	3.0	0.0	Vert	PK	0.0	39.5	74.0	-34.5	Low Channel, EUT Horizontal
2780.250	41.9	-2.5	3.61	134.0	3.0	0.0	Vert	PK	0.0	39.4	74.0	-34.6	High Channel, EUT Horizontal
2751.967	42.1	-2.7	1.5	146.0	3.0	0.0	Vert	PK	0.0	39.4	74.0	-34.6	Mid Channel, EUT Horizontal
2778.775	41.8	-2.5	2.4	241.0	3.0	0.0	Horz	PK	0.0	39.3	74.0	-34.7	High Channel, EUT On Side
2715.827	42.2	-2.9	1.5	145.0	3.0	0.0	Horz	PK	0.0	39.3	74.0	-34.7	Low Channel, EUT On Side

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

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
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16

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-1 in section 11.9.2.2.2 of ANSI C63.10:2013 was used to make the measurement.

The AVGSA-1 method was modified as the emissions bandwidth (B) was less than the available resolution bandwidth (RBw) of the spectrum analyzer. RBw was set wider than B. This follows the guidance of section 11.9.1.1 and is equivalent to a measurement with a power meter AVGPM per section 11.9.2.3.

OUTPUT POWER

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	SEL-RP50			Work Order:	SCHW0247
Serial Number:	A12839004			Date:	11-Mar-21
Customer:	Schweitzer Engineering Laboratories, Inc.			Temperature:	23.5 °C
Attendees:	Miralem Cosic			Humidity:	32.3% RH
Project:	None			Barometric Pres.:	1026 mbar
Tested by:	Jeff Alcoke	Power:	9V Battery	Job Site:	EV06

TEST SPECIFICATIONS	Test Method
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable.

DEVIATIONS FROM TEST STANDARD

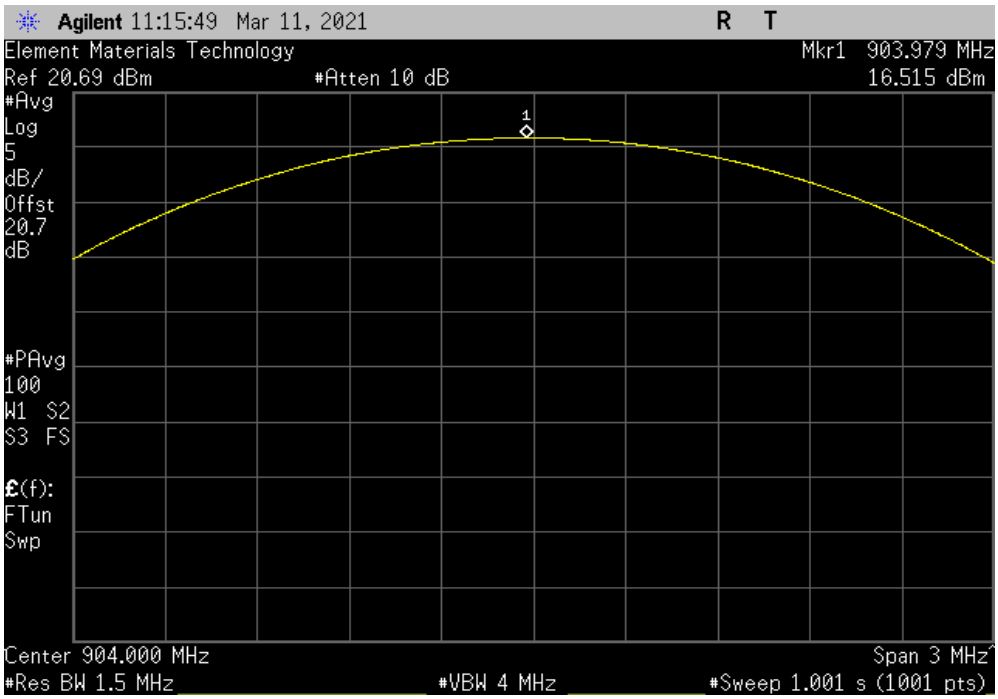
None

Configuration #	2	Signature

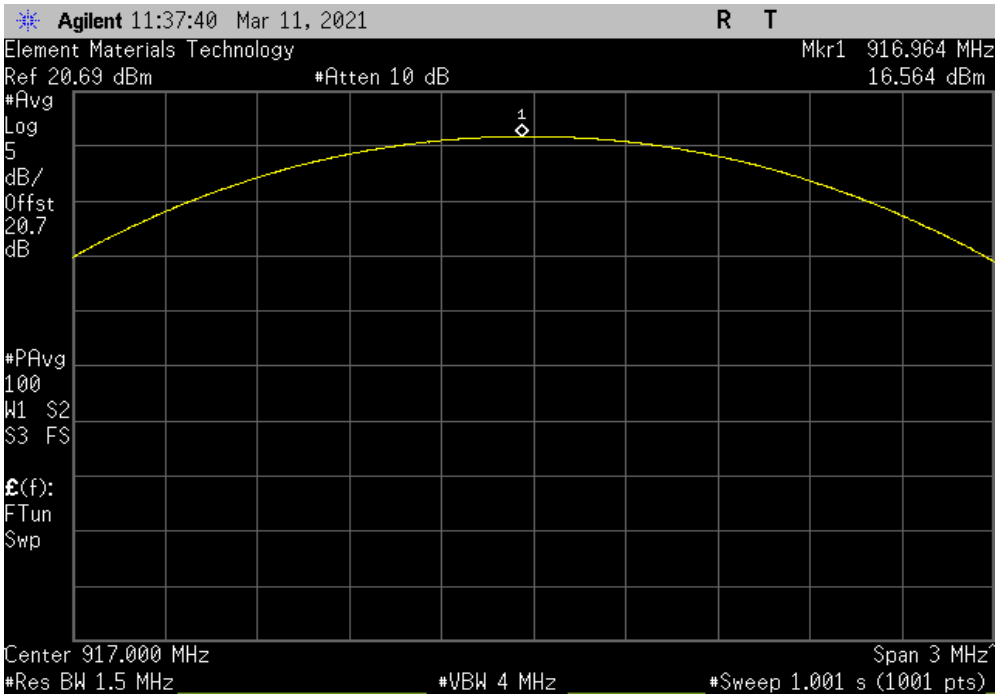
	Avg Cond Pwr (dBm)	Value (dBm)	Limit (dBm)	Results
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	16.515	16.5	30	Pass
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	16.564	16.6	30	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	16.515	16.5	30	Pass

OUTPUT POWER

900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz						
	Avg Cond Pwr (dBm)			Value (dBm)	Limit (dBm)	Results
	16.515			16.5	30	Pass

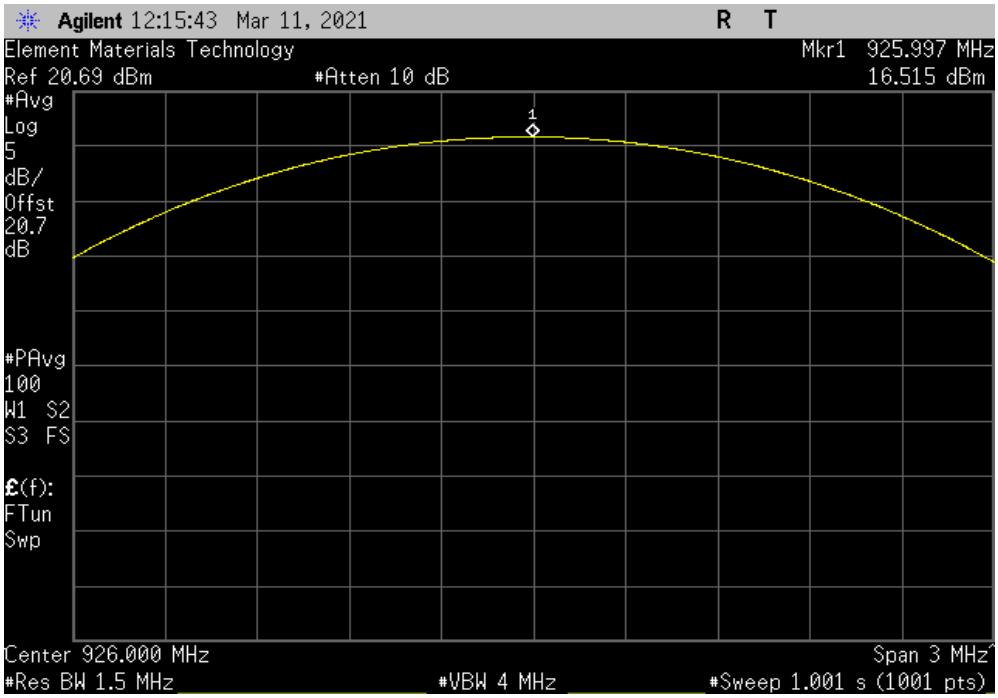


900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz						
	Avg Cond Pwr (dBm)			Value (dBm)	Limit (dBm)	Results
	16.564			16.6	30	Pass



OUTPUT POWER

900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz						
	Avg Cond Pwr (dBm)			Value (dBm)	Limit (dBm)	Results
	16.515			16.5	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

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
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16

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-1 in section 11.9.2.2.2 of ANSI C63.10:2013 was used to make the measurement.

The AVGSA-1 method was modified as the emissions bandwidth (B) was less than the available resolution bandwidth (RBW) of the spectrum analyzer. RBW was set wider than B. This follows the guidance of section 11.9.1.1 and is equivalent to a measurement with a power meter AVGPM per section 11.9.2.3.

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

EQUIVALENT ISOTROPIC RADIATED POWER

element

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	SEL-RP50			**Work Order:**	SCHW0247
Serial Number:	A12839004			**Date:**	11-Mar-21
Customer:	Schweitzer Engineering Laboratories, Inc.			**Temperature:**	23.5 °C
Attendees:	Miralem Cosic			**Humidity:**	32.3% RH
Project:	None			**Barometric Pres.:**	1026 mbar
Tested by:	Jeff Alcoke	**Power:**	9V Battery	**Job Site:**	EV06

TEST SPECIFICATIONS	Test Method
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable.

DEVIATIONS FROM TEST STANDARD

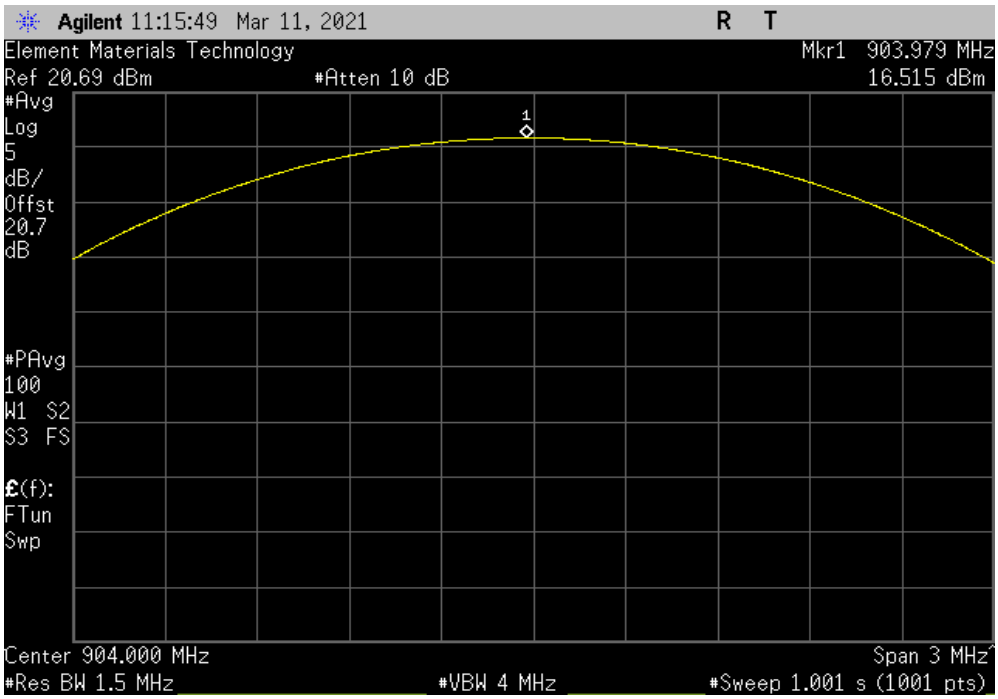
None

Configuration #	2	Signature

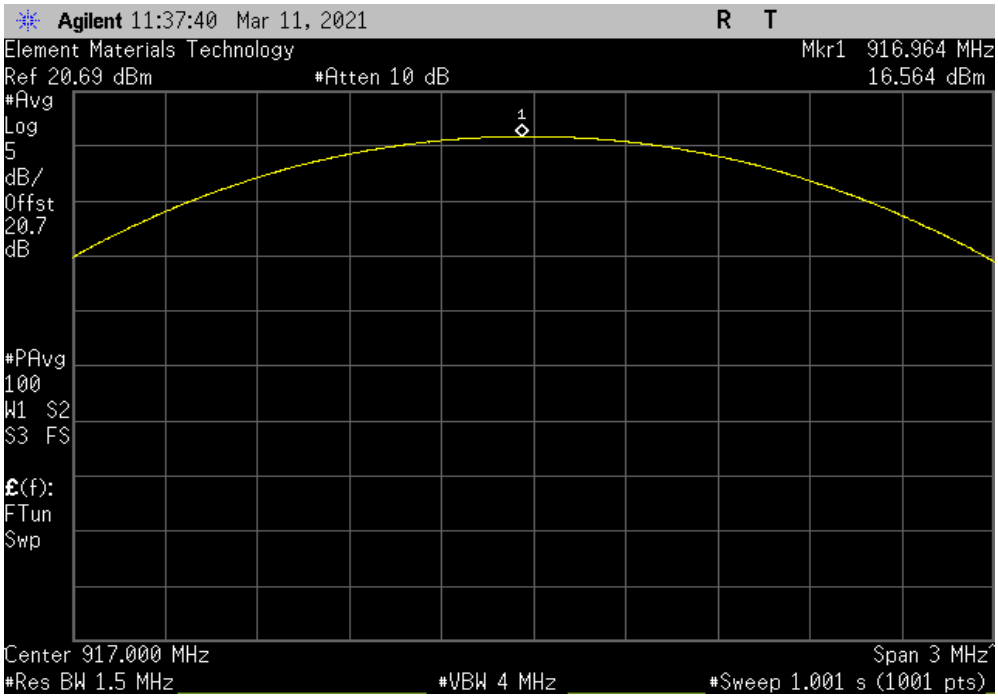
	Avg Cond Pwr (dBm)	Antenna Gain (dBi)	Value (dBm)	Limit (dBm)	Results
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	16.515	-4	12.5	36	Pass
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	16.564	-4	12.6	36	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	16.515	-4	12.5	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER

900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz						
	Avg Cond Pwr (dBm)		Antenna Gain (dBi)	Value (dBm)	Limit (dBm)	Results
	16.515		-4	12.5	36	Pass

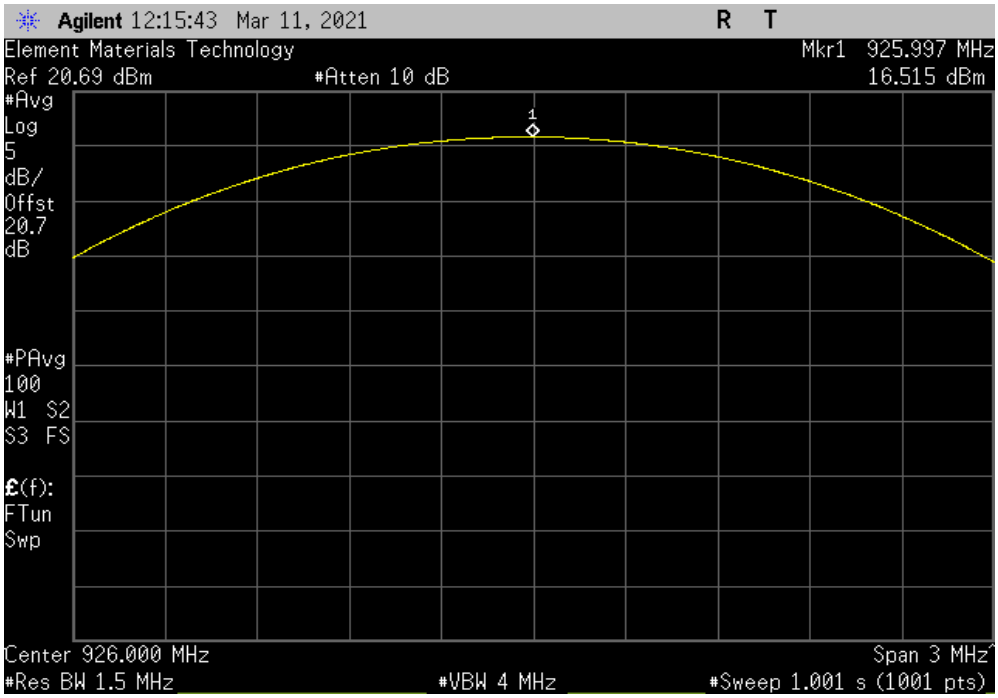


900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz						
	Avg Cond Pwr (dBm)		Antenna Gain (dBi)	Value (dBm)	Limit (dBm)	Results
	16.564		-4	12.6	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz						
	Avg Cond Pwr (dBm)		Antenna Gain (dBi)	Value (dBm)	Limit (dBm)	Results
	16.515		-4	12.5	36	Pass



BAND EDGE COMPLIANCE

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
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16

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.

Because Output Power was measured using an RMS detector, the attenuation requirement is for band edge is -30 dBc.

BAND EDGE COMPLIANCE

element

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	SEL-RP50			**Work Order:**	SCHW0247
Serial Number:	A12839004			**Date:**	11-Mar-21
Customer:	Schweitzer Engineering Laboratories, Inc.			**Temperature:**	23.6 °C
Attendees:	Miralem Cosic			**Humidity:**	32.1% RH
Project:	None			**Barometric Pres.:**	1026 mbar
Tested by:	Jeff Alcoke	**Power:**	9V Battery	**Job Site:**	EV06

TEST SPECIFICATIONS	Test Method
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable.

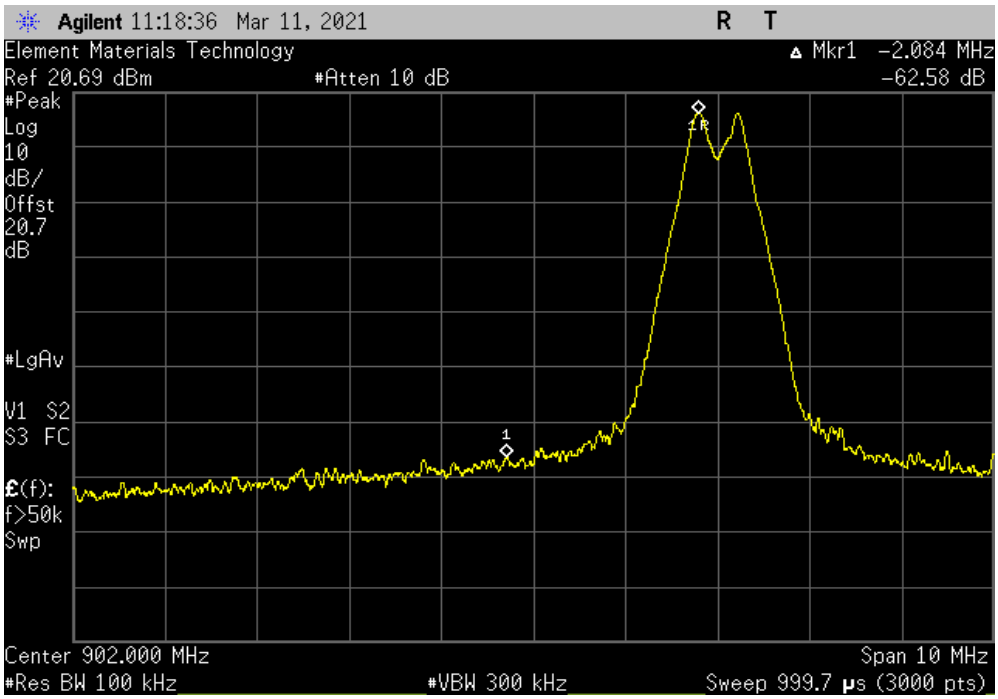
DEVIATIONS FROM TEST STANDARD

None

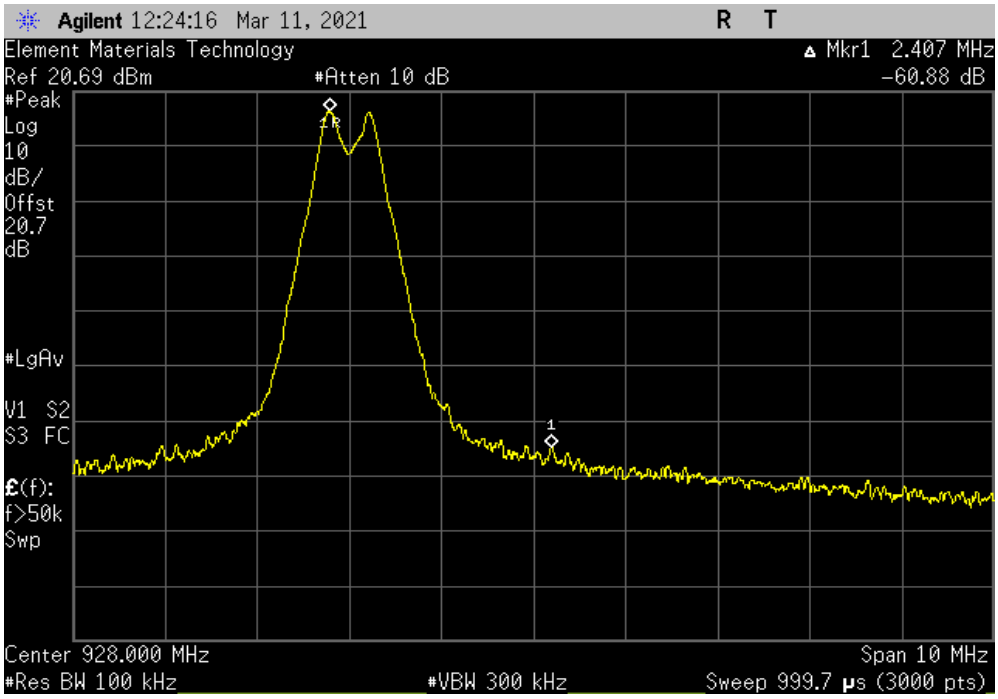
Configuration #	2	Signature

	Value (dBc)	Limit ≤ (dBc)	Result
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	-62.58	-30	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	-60.88	-30	Pass

900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-62.58	-30	Pass



900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-60.88	-30	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
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	2021-03-10	2022-03-10

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

element

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	**SEL-RP50**			**Work Order:**	**SCHW0247**
Serial Number:	**A12839004**			**Date:**	**9-Apr-21**
Customer:	**Schweitzer Engineering Laboratories, Inc.**			**Temperature:**	**23.4 °C**
Attendees:	**Miralem Cosic**			**Humidity:**	**32.3% RH**
Project:	**None**			**Barometric Pres.:**	**1026 mbar**
Tested by:	**Jeff Alcoke**	**Power:**	**9V Battery**	**Job Site:**	**EV06**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable. Spectrum analizer AFA was used for data collection on High Channel.

DEVIATIONS FROM TEST STANDARD

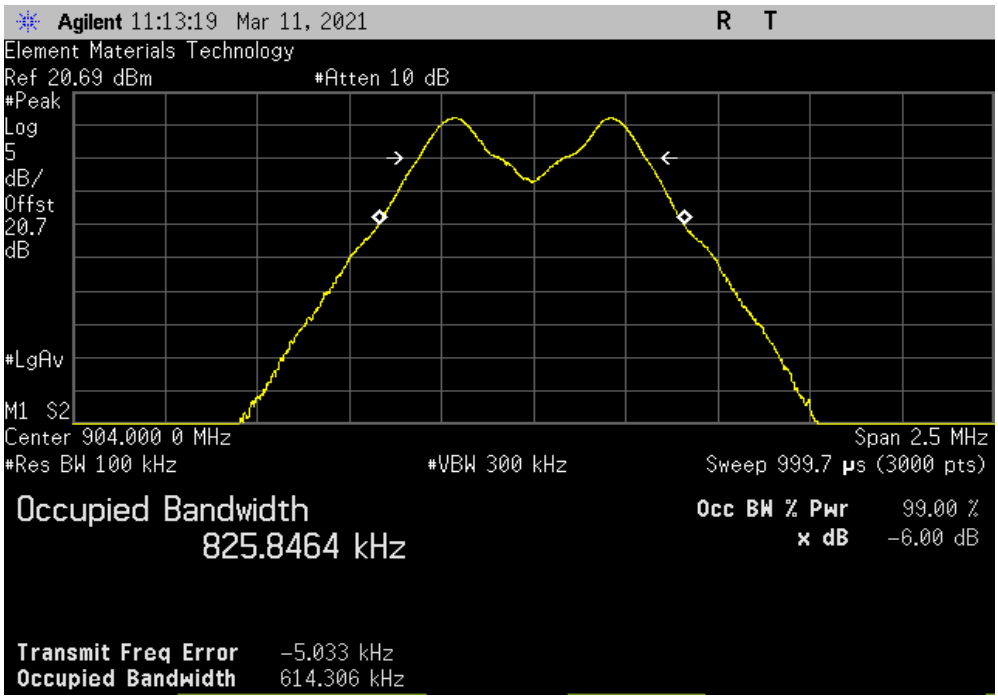
None

Configuration #	**2**	*Signature*

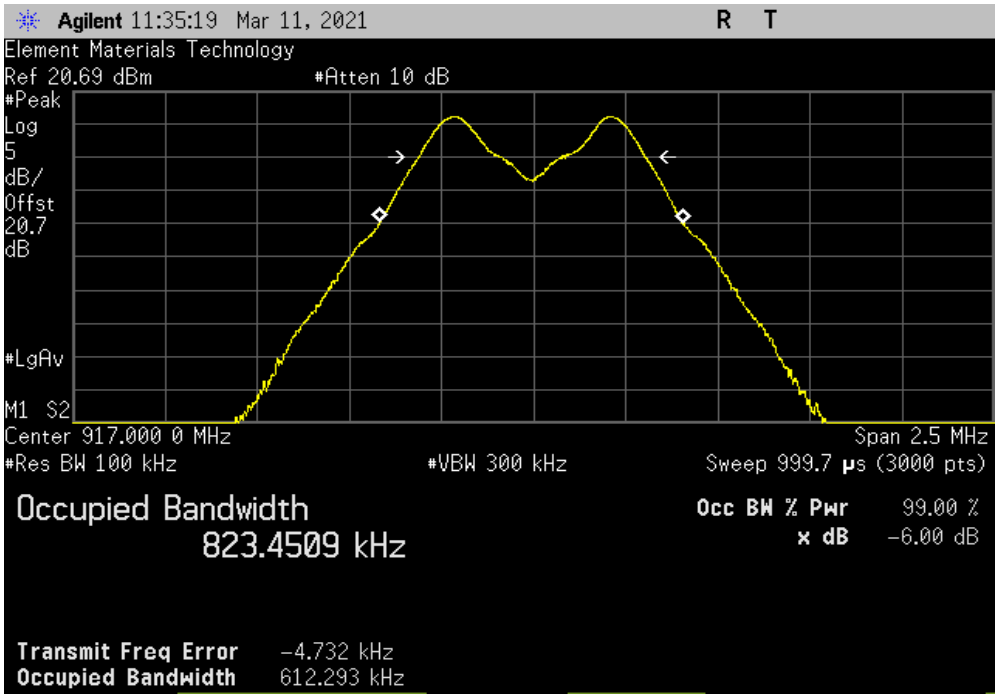
	Value	**Limit (≥)**	**Result**
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	614.306 kHz	500 kHz	Pass
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	612.293 kHz	500 kHz	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	619.485 kHz	500 kHz	Pass

OCCUPIED BANDWIDTH

900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz						
				Value	Limit (≥)	Result
				614.306 kHz	500 kHz	Pass

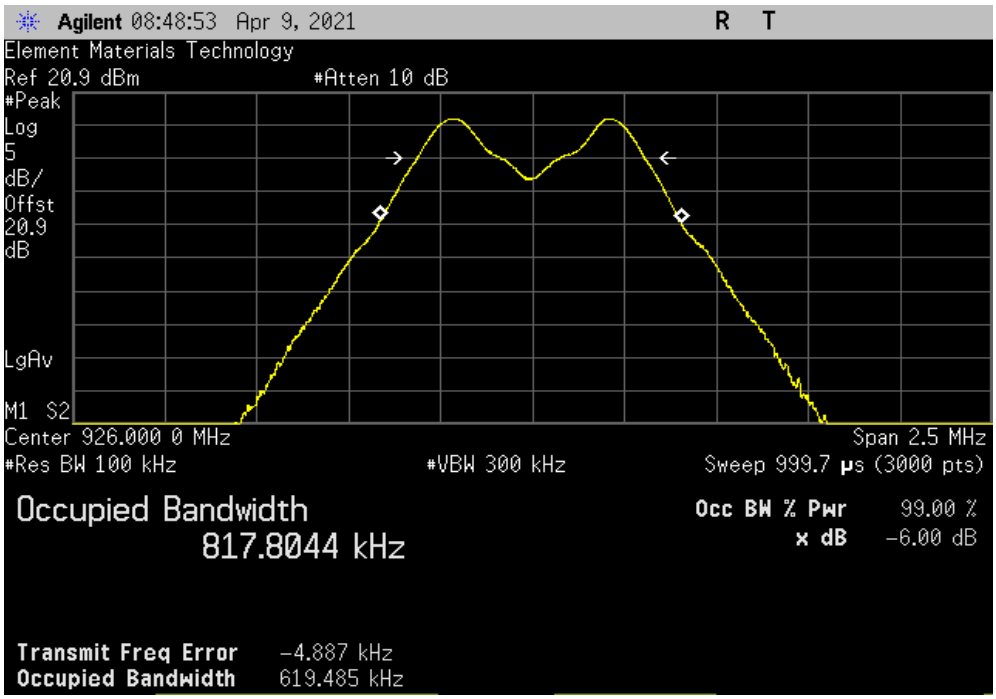


900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz						
				Value	Limit (≥)	Result
				612.293 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz						
				Value	Limit (≥)	Result
				619.485 kHz	500 kHz	Pass



SPURIOUS CONDUCTED EMISSIONS

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
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16

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

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	SEL-RP50			**Work Order:**	SCHW0247
Serial Number:	A12839004			**Date:**	11-Mar-21
Customer:	Schweitzer Engineering Laboratories, Inc.			**Temperature:**	23.4 °C
Attendees:	Miralem Cosic			**Humidity:**	32.2% RH
Project:	None			**Barometric Pres.:**	1026 mbar
Tested by:	Jeff Alcoke	**Power:**	9V Battery	**Job Site:**	EV06

TEST SPECIFICATIONS	Test Method
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable.

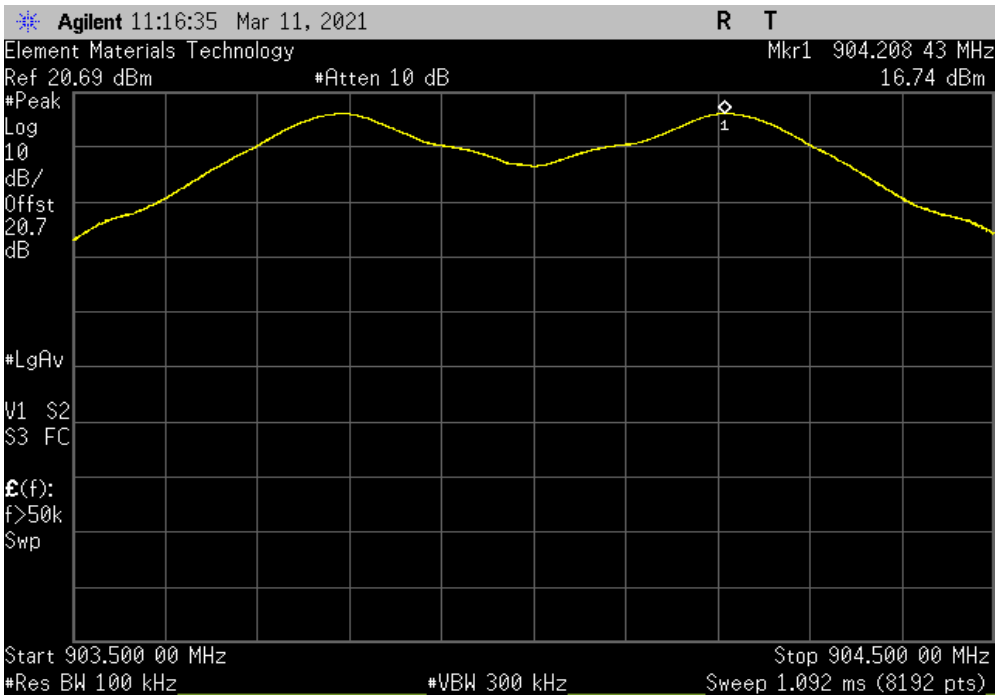
DEVIATIONS FROM TEST STANDARD

None

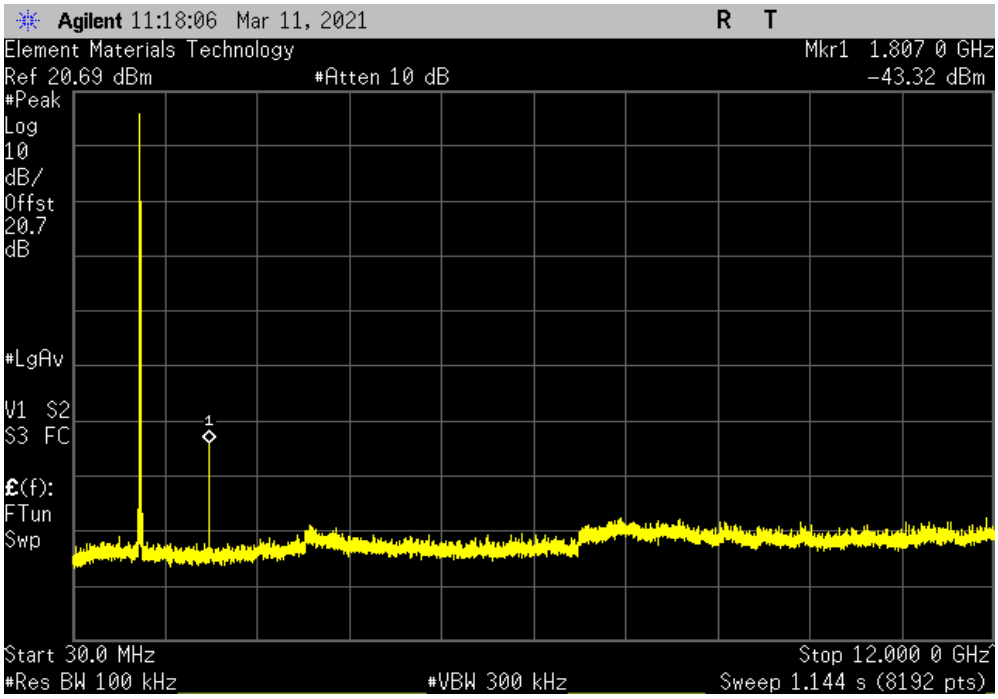
Configuration #	2	Signature

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	Fundamental	904.21	N/A	N/A	N/A
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	30 MHz - 12 GHz	1807	-60.06	-30	Pass
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	Fundamental	916.79	N/A	N/A	N/A
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	30 MHz - 12 GHz	1834.8	-61.05	-30	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	Fundamental	925.79	N/A	N/A	N/A
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	30 MHz - 12 GHz	1852.3	-62.43	-30	Pass

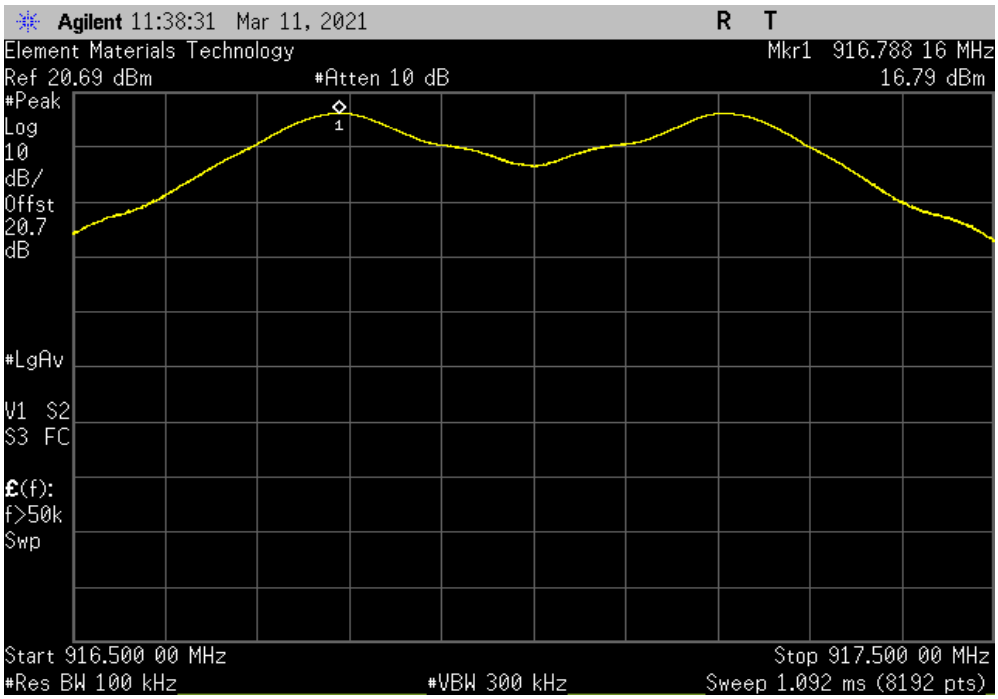
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	904.21	N/A	N/A	N/A



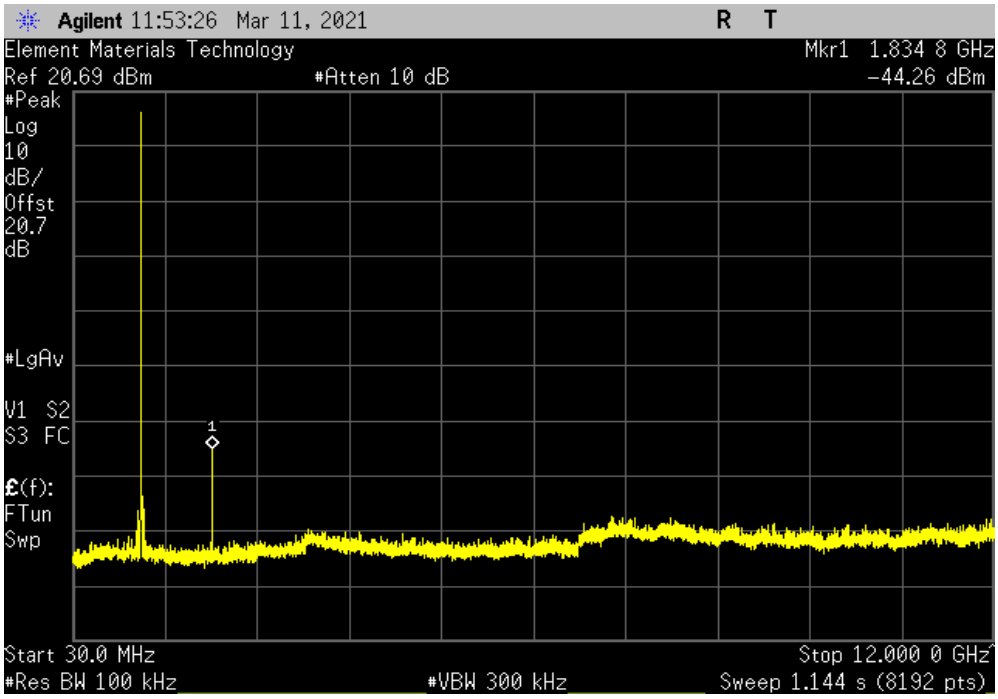
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12 GHz	1807	-60.06	-30	Pass



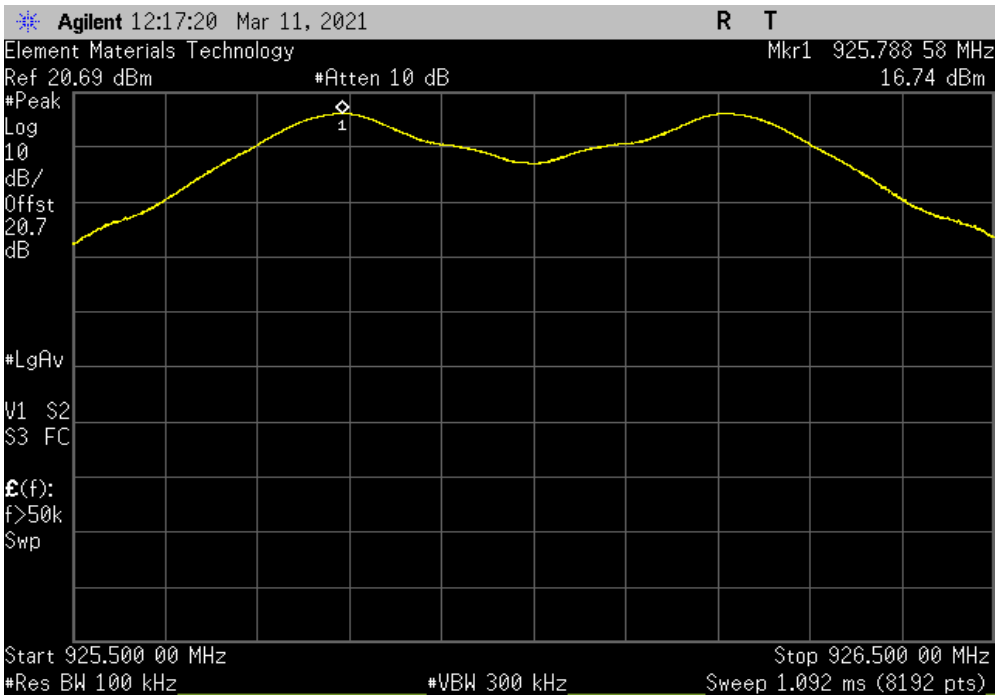
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	916.79	N/A	N/A	N/A



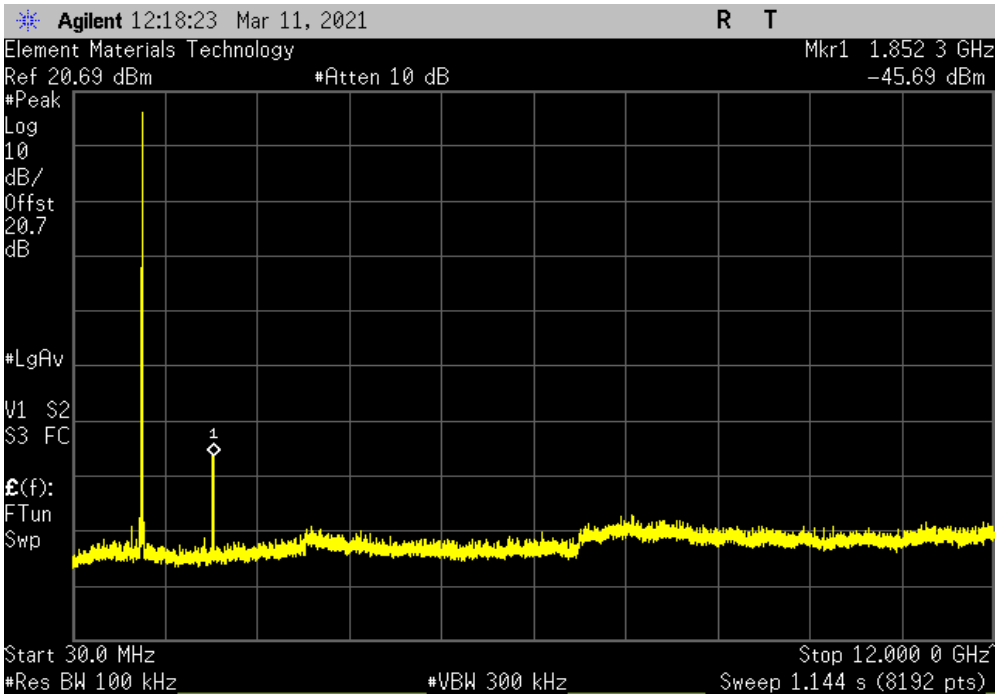
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12 GHz	1834.8	-61.05	-30	Pass



900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	925.79	N/A	N/A	N/A



900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12 GHz	1852.3	-62.43	-30	Pass



POWER SPECTRAL DENSITY

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
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	2020-03-13	2021-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2020-03-13	2021-03-13
Block - DC	Fairview Microwave	SD3379	AMW	2020-03-13	2021-03-13
Generator - Signal	Agilent	N5181A	TIG	2020-04-16	2023-04-16
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAW	2020-12-16	2021-12-16

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

element

TbtTx 2019.08.30.0 XMit 2020.12.30.0

EUT:	**SEL-RP50**			**Work Order:**	**SCHW0247**
Serial Number:	**A12839004**			**Date:**	**11-Mar-21**
Customer:	**Schweitzer Engineering Laboratories, Inc.**			**Temperature:**	**23.4 °C**
Attendees:	**Miralem Cosic**			**Humidity:**	**32.3% RH**
Project:	**None**			**Barometric Pres.:**	**1026 mbar**
Tested by:	**Jeff Alcoke**	**Power:**	**9V Battery**	**Job Site:**	**EV06**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC Block, 20 dB attenuator, and measurement cable.

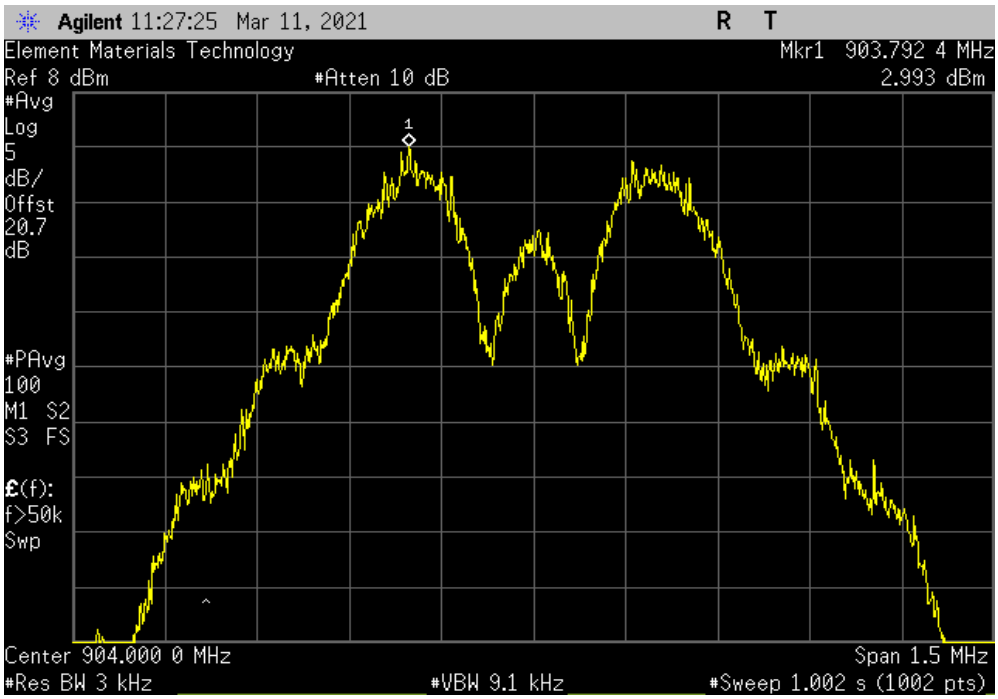
DEVIATIONS FROM TEST STANDARD

None

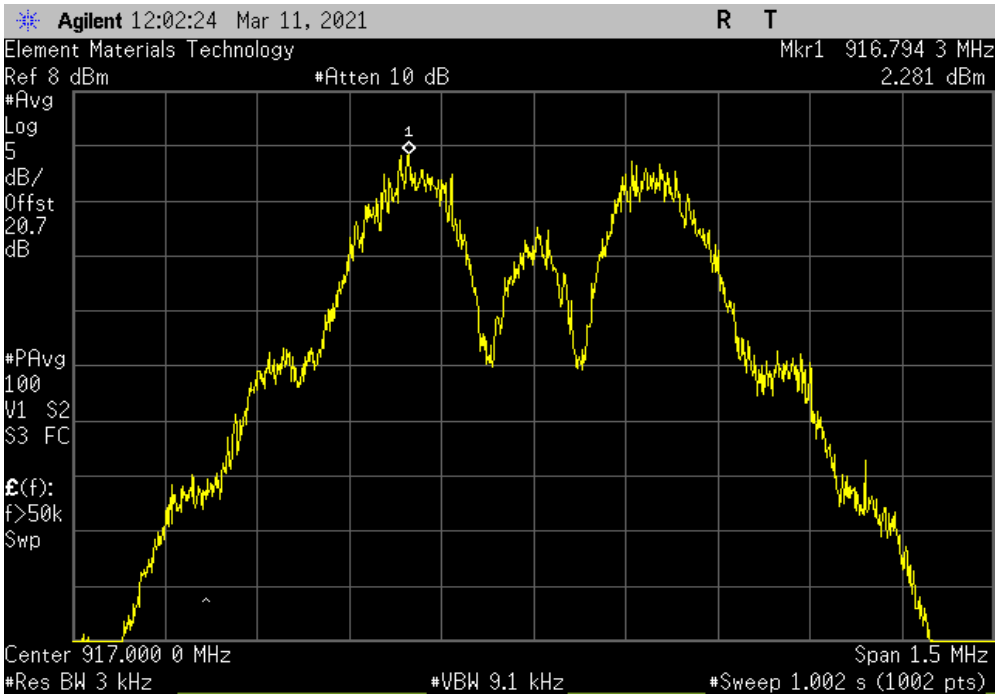
Configuration #	**2**	*Signature*

	Value dBm/3kHz	**Limit ≤ dBm/3kHz**	**Results**
900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz	2.993	8	Pass
900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz	2.281	8	Pass
900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz	2.87	8	Pass

900 MHz DTS, 2-FSK, 300 kbs, Low Channel, 904 MHz						
				Value dBm/3kHz	Limit ≤ dBm/3kHz	Results
				2.993	8	Pass

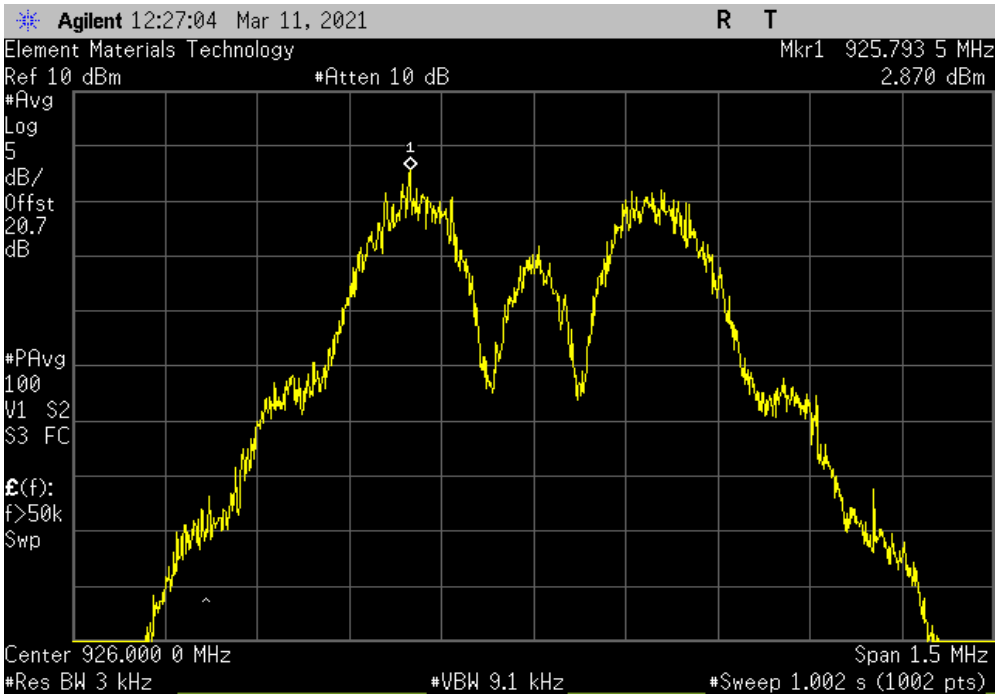


900 MHz DTS, 2-FSK, 300 kbs, Mid Channel, 917 MHz						
				Value dBm/3kHz	Limit ≤ dBm/3kHz	Results
				2.281	8	Pass



POWER SPECTRAL DENSITY

900 MHz DTS, 2-FSK, 300 kbs, High Channel, 926 MHz						
				Value dBm/3kHz	Limit ≤ dBm/3kHz	Results
				2.87	8	Pass



End of Test Report