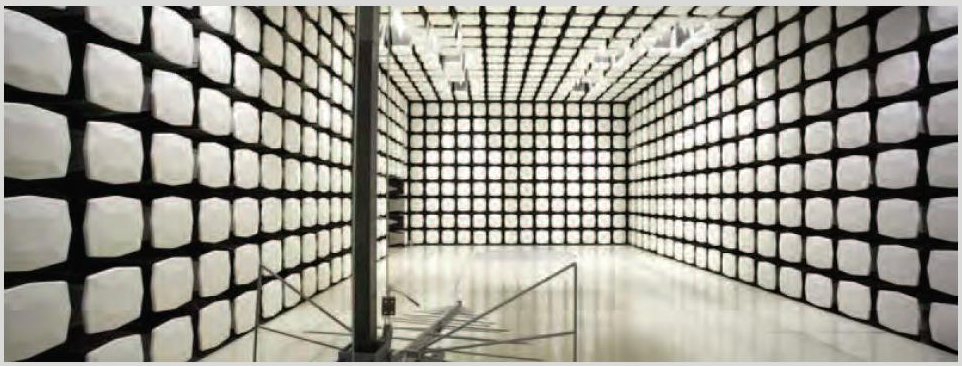
CINCH Systems

RF-ROR-433

FCC 15.231:2018
Low Power 433 MHz Periodic Transmitter

Report # CINC0021



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

2017-1-25

Last Date of Test: March 26, 2018
CINCH Systems
Model: RF-ROR-433

Radio Equipment Testing

Standards

Specification	Method
FCC 15.231:2018	ANSI C63.10:2013

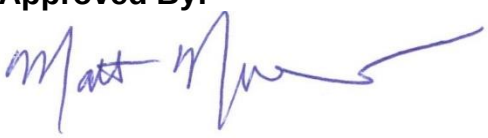
Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT.
6.5, 6.6	Field Strength of Fundamental	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
6.9.2	Occupied Bandwidth	Yes	Pass	
7.5	Duty Cycle	Yes	Pass	

Deviations From Test Standards

None

Approved By:



Matt Nuernberg, 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.

REVISION HISTORY

Revision Number	Description	Date	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

2018.2.20

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). Certification chambers and Open Area Test Sites are filed with ISED.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

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.

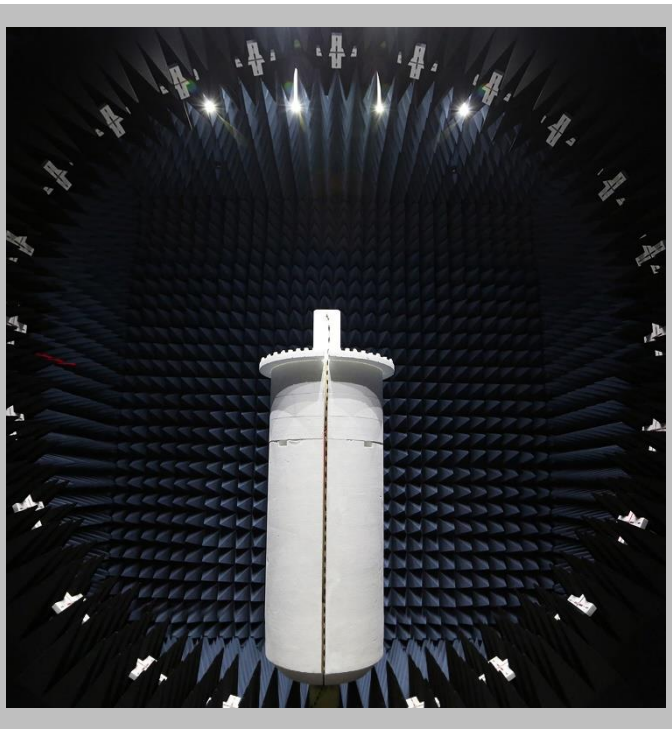
SCOPE

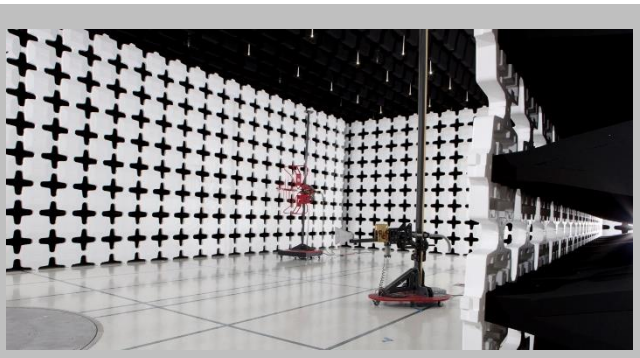
For details on the Scopes of our Accreditations, please visit:
http://portlandcustomer.element.com/ts/scope/scope.htm
http://gsi.nist.gov/global/docs/cabs/designations.html

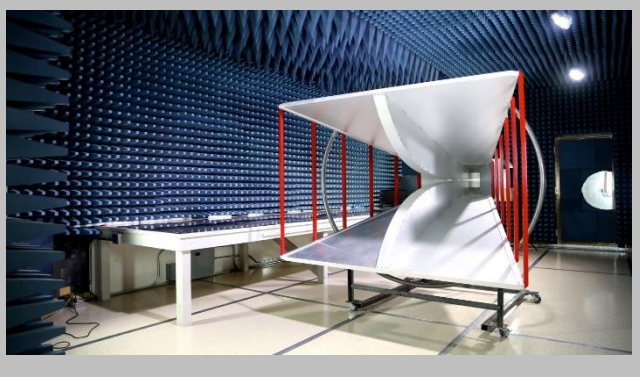
FACILITIES

2017.9.15

California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 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: 200761-0	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	N/A	2834D-1, 2834D-*2*	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157







EMISSIONS MEASUREMENTS

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 included as part of the applicable test description page. 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.

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

Measurements were made using the bandwidths and detectors specified. No video filter was used.

Sample Calculations

Radiated Emissions:

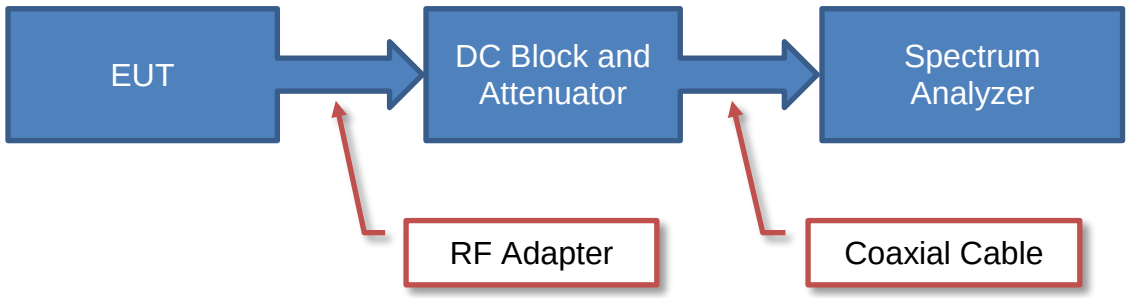
Field Strength		Measured Level		Antenna Factor		Cable Factor		Amplifier Gain		Distance Adjustment Factor		External Attenuation
33.5	=	42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0

Conducted Emissions:

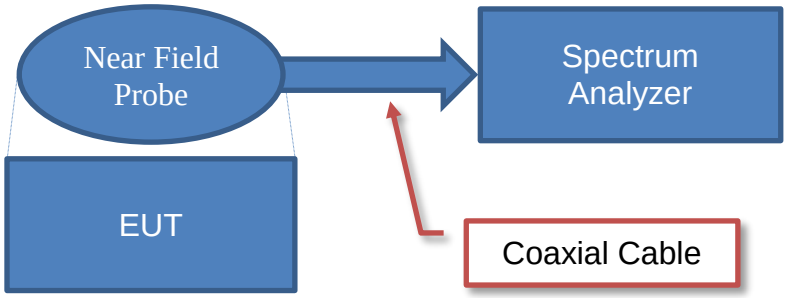
Adjusted Level		Measured Level		Transducer Factor		Cable Factor		External Attenuation
47.1	=	26.7	+	0.3	+	0.1	+	20.0

Test Setup Block Diagrams

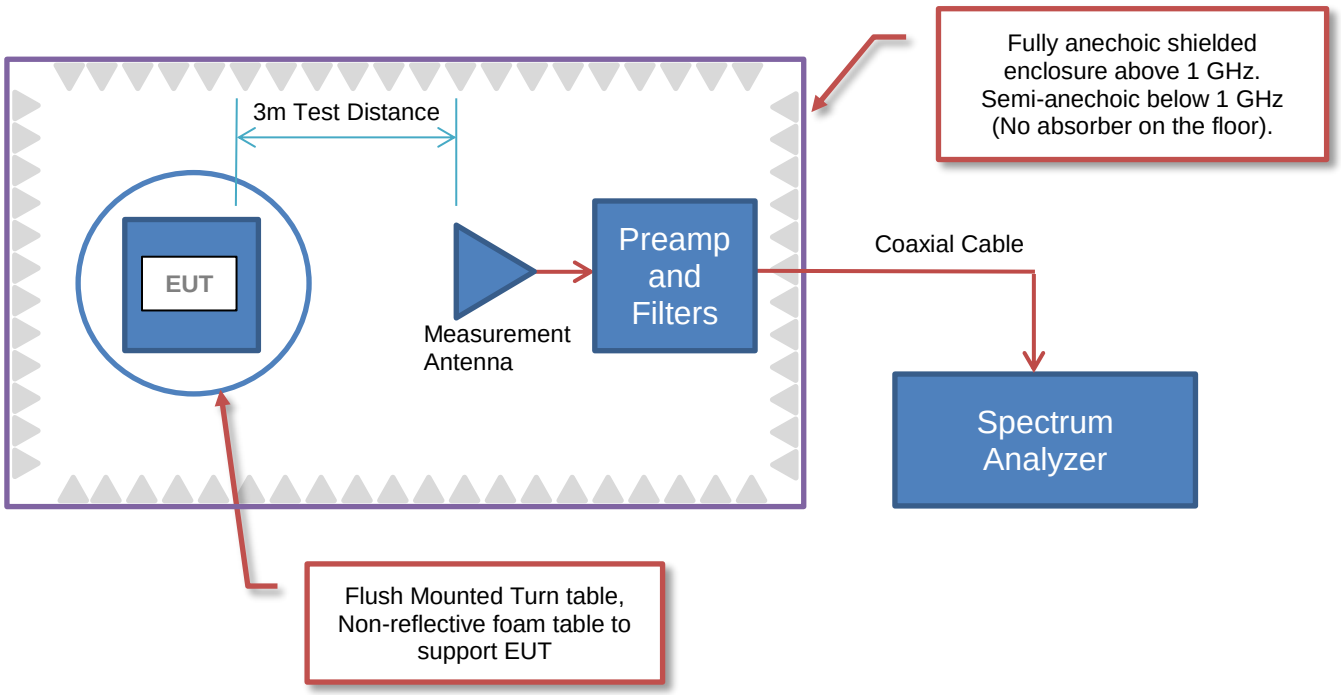
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	CINCH Systems
Address:	Suite 300 12075 43rd Street NE
City, State, Zip:	St. Michael, MN 55376
Test Requested By:	Jibril Aga
Model:	RF-ROR-433
First Date of Test:	March 26, 2018
Last Date of Test:	March 26, 2018
Receipt Date of Samples:	March 26, 2018
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Low power periodic transmitter which operates at 433 MHz utilizing OOK modulation.

Testing Objective:
To demonstrate compliance of the periodic radio to FCC 15.231(b) requirements.

CONFIGURATIONS

Configuration CINC0021- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
RF-ROR-433	CINCH Systems	RF-ROR-433	R4

Configuration CINC0021- 3

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
RF-ROR-433	CINCH Systems	RF-ROR-433	R1

MODIFICATIONS

2017-1-25

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	3/26/2018	Duty Cycle	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	3/26/2018	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.
3	3/26/2018	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	3/26/2018	Occupied Bandwidth	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

PSA-ESCI 2017.12.19

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

MODES OF OPERATION

Transmitting CW at 433.916 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

CINC0021 - 3

FREQUENCY RANGE INVESTIGATED

Start Frequency	430 MHz	Stop Frequency	440 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.	Interval
Cable	Element	Biconilog Cable	MNX	24-Feb-2018	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	15-Dec-2017	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	19-Jun-2017	12 mo

MEASUREMENT BANDWIDTHS

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

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was configured for continuous un-modulated CW operation at its single transmit frequency. The field strength of the transmit frequency was maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes (per ANSI C63.10:2013).

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. (Where T is the period of the pulse train.)

The measured values for the EUT’s pulse train are as follows:

Period = 100 mSec
Pulsewidth of Type 1 Pulse = 1.08 mSec
Pulsewidth of Type 2 Pulse = 0.12 mSec
Pulsewidth of Type 3 Pulse = 0.51 mSec
Number of Type 1 Pulses = 1
Number of Type 2 Pulses = 58
Number of Type 3 Pulses = 1

Duty Cycle = 20 log [((1.08)(1) + (0.12)(58) + (0.51)(1))/100] = -21.36 dB

The duty cycle correction factor of -21.36 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100kHz and a video bandwidth of 300kHz.

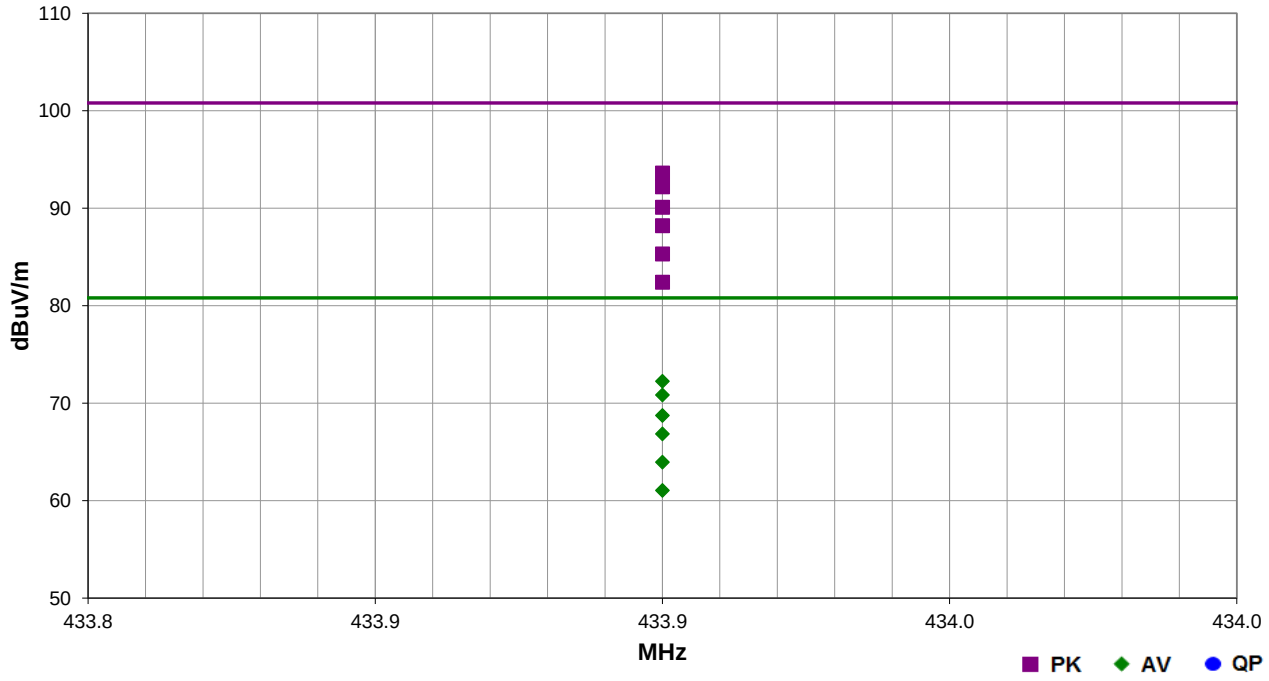
FIELD STRENGTH OF FUNDAMENTAL

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	CINC0021	**Date:**	26-Mar-2018		
Project:	None	**Temperature:**	22.9 °C		
Job Site:	MN05	**Humidity:**	19.9% RH		
Serial Number:	R1	**Barometric Pres.:**	1024 mbar	**Tested by:**	Kyle McMullan
EUT:	RF-ROR-433				
Configuration:	3				
Customer:	CINCH Systems				
Attendees:	Jibril Aga				
EUT Power:	Battery				
Operating Mode:	Transmitting CW at 433.916 MHz				
Deviations:	None				
Comments:	None				

Test Specifications	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

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



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
433.916	70.4	23.2	1.2	71.0		0.0	Vert	PK	0.0	93.6	100.8	-7.2	EUT Vert
433.916	70.4	23.2	1.2	71.0	-21.4	0.0	Vert	AV	0.0	72.2	80.8	-8.6	EUT Vert
433.916	69.0	23.2	1.1	246.0		0.0	Vert	PK	0.0	92.2	100.8	-8.6	EUT On Side
433.916	69.0	23.2	1.1	246.0	-21.4	0.0	Vert	AV	0.0	70.8	80.8	-10.0	EUT On Side
433.916	66.9	23.2	1.0	240.0		0.0	Horz	PK	0.0	90.1	100.8	-10.7	EUT Horz
433.916	66.9	23.2	1.0	240.0	-21.4	0.0	Horz	AV	0.0	68.7	80.8	-12.1	EUT Horz
433.916	65.0	23.2	1.0	154.0		0.0	Horz	PK	0.0	88.2	100.8	-12.6	EUT On Side
433.916	65.0	23.2	1.0	154.0	-21.4	0.0	Horz	AV	0.0	66.8	80.8	-14.0	EUT On Side
433.916	62.1	23.2	3.6	325.0		0.0	Horz	PK	0.0	85.3	100.8	-15.5	EUT Vert
433.916	62.1	23.2	3.6	325.0	-21.4	0.0	Horz	AV	0.0	63.9	80.8	-16.9	EUT Vert
433.916	59.2	23.2	1.1	92.0		0.0	Vert	PK	0.0	82.4	100.8	-18.4	EUT Horz
433.916	59.2	23.2	1.1	92.0	-21.4	0.0	Vert	AV	0.0	61.0	80.8	-19.8	EUT Horz

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2017.12.19

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

MODES OF OPERATION

Transmitting CW at 433.916 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

CINC0021 - 3

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	5 GHz

SAMPLE CALCULATIONS

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Attenuator	Coaxicom	3910-10	AWZ	24-Feb-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVX	24-Feb-2018	12 mo
Cable	Element	Double Ridge Guide Horn Cables	MNV	24-Feb-2018	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	14-Nov-2016	24 mo
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	24-Feb-2018	12 mo
Cable	Element	Biconilog Cable	MNX	24-Feb-2018	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	15-Dec-2017	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	19-Jun-2017	12 mo

MEASUREMENT BANDWIDTHS

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

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequency in each operational band 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, 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

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. Where T is the period of the pulse train.

The measured values for the EUT’s pulse train are as follows:

Period = 100 mSec
Pulsewidth of Type 1 Pulse = 1.08 mSec
Pulsewidth of Type 2 Pulse = 0.12 mSec
Pulsewidth of Type 3 Pulse = 0.51 mSec
Number of Type 1 Pulses = 1
Number of Type 2 Pulses = 58
Number of Type 3 Pulses = 1

Duty Cycle = 20 log [((1.08)(1) + (0.12)(58) + (0.51)(1))/100] = -21.36 dB

The duty cycle correction factor of -21.36 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100kHz and a video bandwidth of 300kHz for measurements at or below 1GHz. Above 1GHz, a resolution bandwidth of 1MHz and a video bandwidth of 3MHz was used.

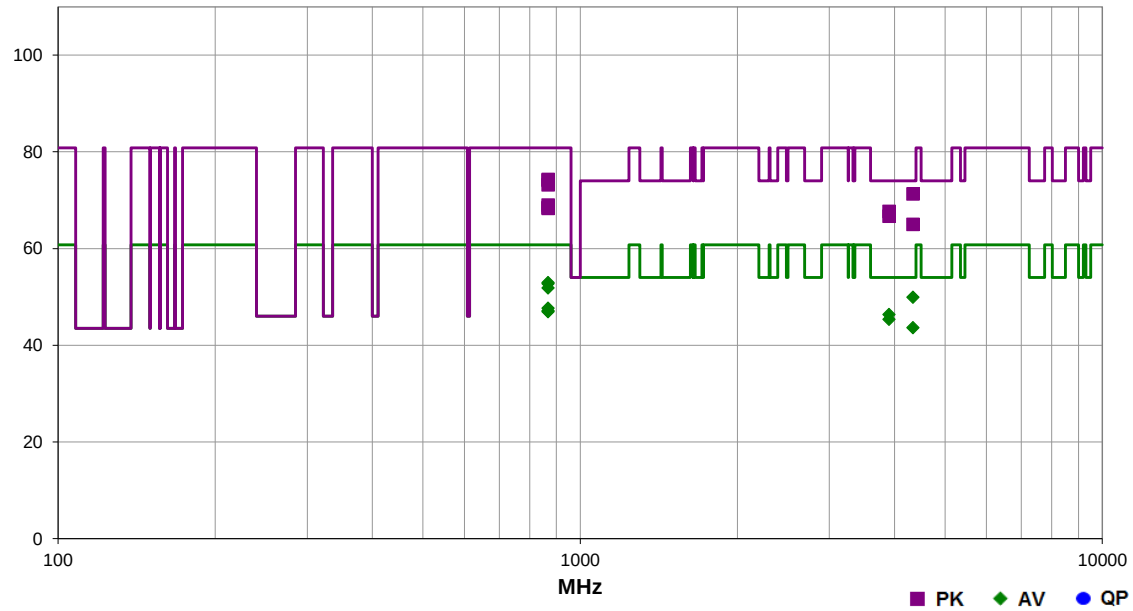
SPURIOUS RADIATED EMISSIONS

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	CINC0021	**Date:**	26-Mar-2018		
Project:	None	**Temperature:**	22.9 °C		
Job Site:	MN05	**Humidity:**	19.9% RH		
Serial Number:	R1	**Barometric Pres.:**	1024 mbar	**Tested by:**	Kyle McMullan
EUT:	RF-ROR-433				
Configuration:	3				
Customer:	CINCH Systems				
Attendees:	Jibril Aga				
EUT Power:	Battery				
Operating Mode:	Transmitting CW at 433.916 MHz				
Deviations:	None				
Comments:	None				

Test Specifications	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

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



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4339.177	58.6	2.7	2.1	180.0		10.0	Horz	PK	0.0	71.3	74.0	-2.7	EUT Horz
4339.177	58.6	2.7	2.1	180.0	-21.4	10.0	Horz	AV	0.0	49.9	54.0	-4.1	EUT Horz
3905.215	56.5	1.2	2.4	196.0		10.0	Horz	PK	0.0	67.7	74.0	-6.3	EUT Horz
867.833	51.8	12.5	1.0	191.0		10.0	Horz	PK	0.0	74.3	80.8	-6.5	EUT Horz
867.843	51.6	12.5	1.3	237.0		10.0	Vert	PK	0.0	74.1	80.8	-6.7	EUT Vert
3905.298	55.5	1.2	2.3	134.0		10.0	Vert	PK	0.0	66.7	74.0	-7.3	EUT Vert
867.833	50.7	12.5	1.0	321.0		10.0	Horz	PK	0.0	73.2	80.8	-7.6	EUT On Side
3905.215	56.5	1.2	2.4	196.0	-21.4	10.0	Horz	AV	0.0	46.3	54.0	-7.7	EUT Horz
867.833	51.8	12.5	1.0	191.0	-21.4	10.0	Horz	AV	0.0	52.9	60.8	-7.9	EUT Horz
867.843	51.6	12.5	1.3	237.0	-21.4	10.0	Vert	AV	0.0	52.7	60.8	-8.1	EUT Vert
3905.298	55.5	1.2	2.3	134.0	-21.4	10.0	Vert	AV	0.0	45.3	54.0	-8.7	EUT Vert
867.833	50.7	12.5	1.0	321.0	-21.4	10.0	Horz	AV	0.0	51.8	60.8	-9.0	EUT On Side
4339.110	52.3	2.7	1.1	45.0		10.0	Vert	PK	0.0	65.0	74.0	-9.0	EUT Vert
4339.110	52.3	2.7	1.1	45.0	-21.4	10.0	Vert	AV	0.0	43.6	54.0	-10.4	EUT Vert
867.828	46.5	12.5	1.0	194.0		10.0	Horz	PK	0.0	69.0	80.8	-11.8	EUT Vert
867.833	46.0	12.5	1.2	96.0		10.0	Vert	PK	0.0	68.5	80.8	-12.3	EUT On Side
867.838	45.8	12.5	1.6	110.0		10.0	Vert	PK	0.0	68.3	80.8	-12.5	EUT Horz
867.828	46.5	12.5	1.0	194.0	-21.4	10.0	Horz	AV	0.0	47.6	60.8	-13.2	EUT Vert
867.833	46.0	12.5	1.2	96.0	-21.4	10.0	Vert	AV	0.0	47.1	60.8	-13.7	EUT On Side
867.838	45.8	12.5	1.6	110.0	-21.4	10.0	Vert	AV	0.0	46.9	60.8	-13.9	EUT Horz

OCCUPIED BANDWIDTH

XMit 2017.12.13

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	Element	Biconilog Cable	MNX	24-Feb-18	24-Feb-19
Antenna - Biconilog	ETS Lindgren	3142D	AXO	15-Dec-17	15-Dec-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	19-Jun-17	19-Jun-18

TEST DESCRIPTION

The EUT was transmitting at its maximum data rate.

The 20 dB occupied bandwidth is required to be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

OCCUPIED BANDWIDTH

XMit 2017.12.13

EUT:	**RF-ROR-433**			**Work Order:**	**CINC0021**
Serial Number:	**R1**			**Date:**	**26-Mar-18**
Customer:	**CINCH Systems**			**Temperature:**	**22.9 °C**
Attendees:	**Jibril Aga**			**Humidity:**	**20.5% RH**
Project:	**None**			**Barometric Pres.:**	**1022 mbar**
Tested by:	**Kyle McMullan**	**Power:**	**Battery**	**Job Site:**	**MN09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.231:2018	**ANSI C63.10:2013**

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

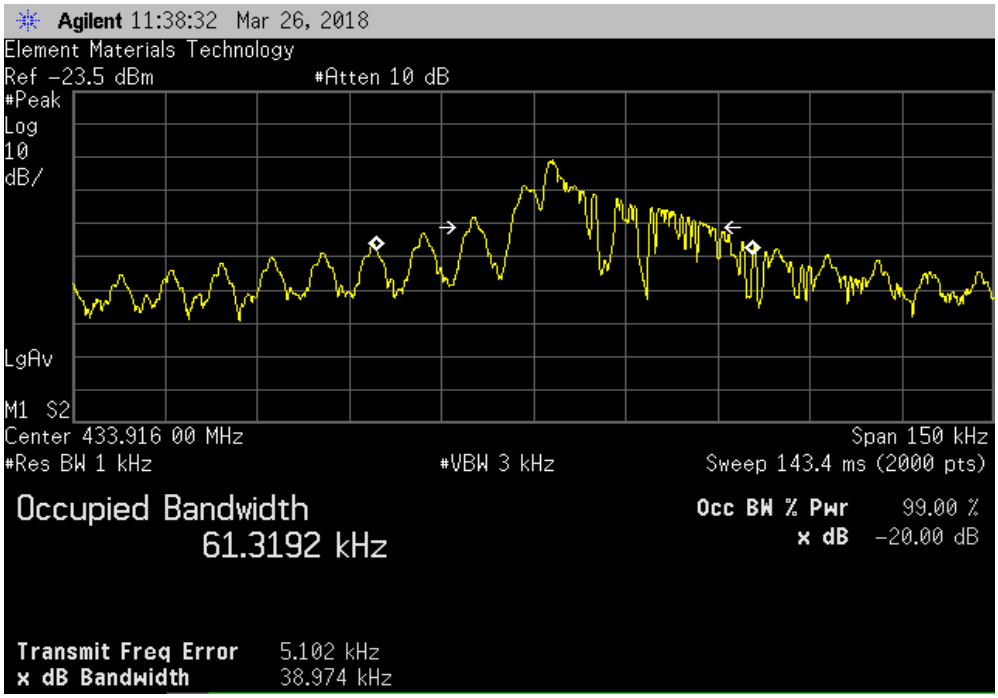
Configuration #	**3**	*Signature*

	Value	**Limit**	**Result**
Occupied Bandwidth			
433.916 MHz	38.974 kHz	1080 kHz	Pass

OCCUPIED BANDWIDTH

XMit 2017.12.13

Occupied Bandwidth, 433.916 MHz							
					Value	Limit	Result
					38.974 kHz	1080 kHz	Pass



DUTY CYCLE

XMit 2017.12.13

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
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	24-Feb-18	24-Feb-19
Cable	Element	Biconilog Cable	MNX	24-Feb-18	24-Feb-19
Antenna - Biconilog	ETS Lindgren	3142D	AXO	15-Dec-17	15-Dec-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	19-Jun-17	19-Jun-18

TEST DESCRIPTION

The measurement was made in a radiated configuration of the fundamental with the carrier fully maximized for its highest radiated power. For software controlled or pre-programmed devices, the manufacturer shall declare the duty cycle class or classes for the equipment under test. For manually operated or event dependant devices, with or without software controlled functions, the manufacturer shall declare whether the device once triggered, follows a pre-programmed cycle, or whether the transmission is constant until the trigger is released or manually reset. The manufacturer shall also give a description of the application for the device and include a typical usage pattern. The typical usage pattern as declared by the manufacturer shall be used to determine the duty cycle and hence the duty class.

Where an acknowledgement is required, the additional transmitter on-time shall be included and declared by the manufacturer.

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. (Where T is the period of the pulse train.)

The measured values for the EUT’s pulse train are as follows:

Period = **100** mSec
Pulsewidth of Type 1 Pulse = **1.08** mSec
Pulsewidth of Type 2 Pulse = **0.12** mSec
Pulsewidth of Type 3 Pulse = **0.51** mSec
Number of Type 1 Pulses = **1**
Number of Type 2 Pulses = **58**
Number of Type 3 Pulses = **1**

Duty Cycle = 20 log [((1.08)(1) + (0.12)(58) + (0.51)(1))/100] = -21.36 dB

The duty cycle correction factor of **-21.36 dB** was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100kHz and a video bandwidth of 300kHz.

DUTY CYCLE

XMit 2017.12.13

EUT:	RF-ROR-433			**Work Order:**	CINC0021
Serial Number:	R4			**Date:**	26-Mar-18
Customer:	CINCH Systems			**Temperature:**	22.8 °C
Attendees:	Jibril Aga			**Humidity:**	19.8% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN05

TEST SPECIFICATIONS	Test Method
FCC 15.231:2018	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

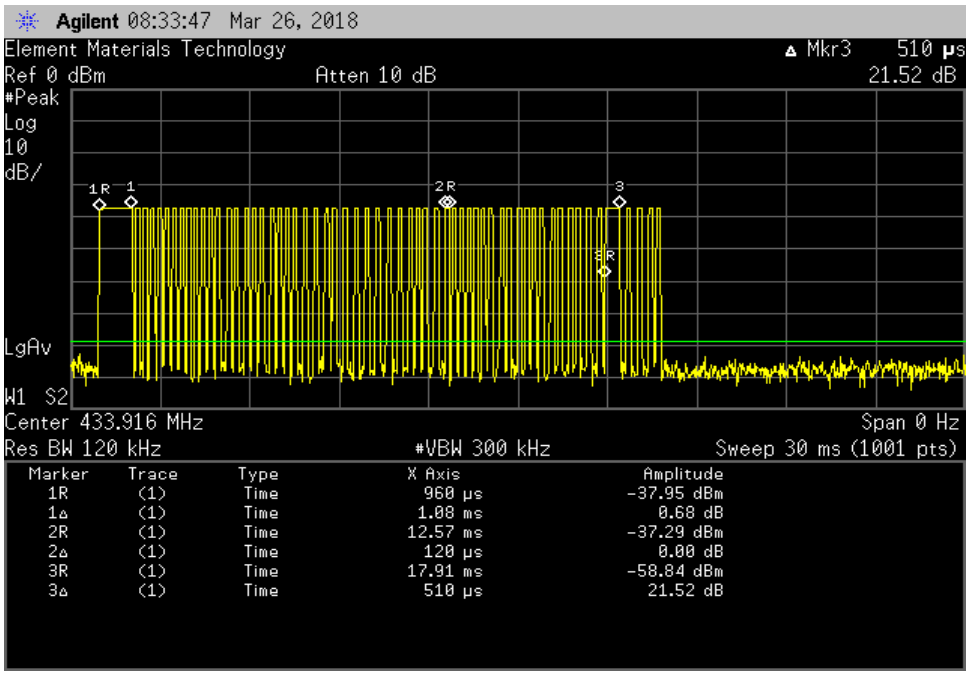
Configuration #	1	Signature

	Number of Type 1	Type 1 Pulse Length (ms)	Number of Type 2	Type 2 Pulse Length (ms)	Number of Type 3	Type 3 Pulse Length (ms)	DCCF (dB)
433.916 MHz Observation Time							
Observation Time 30 ms	1	1.08	58	0.12	1	0.51	-21.36
Observation Time 5 s	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Observation Time 10 s	N/A	N/A	N/A	N/A	N/A	N/A	N/A

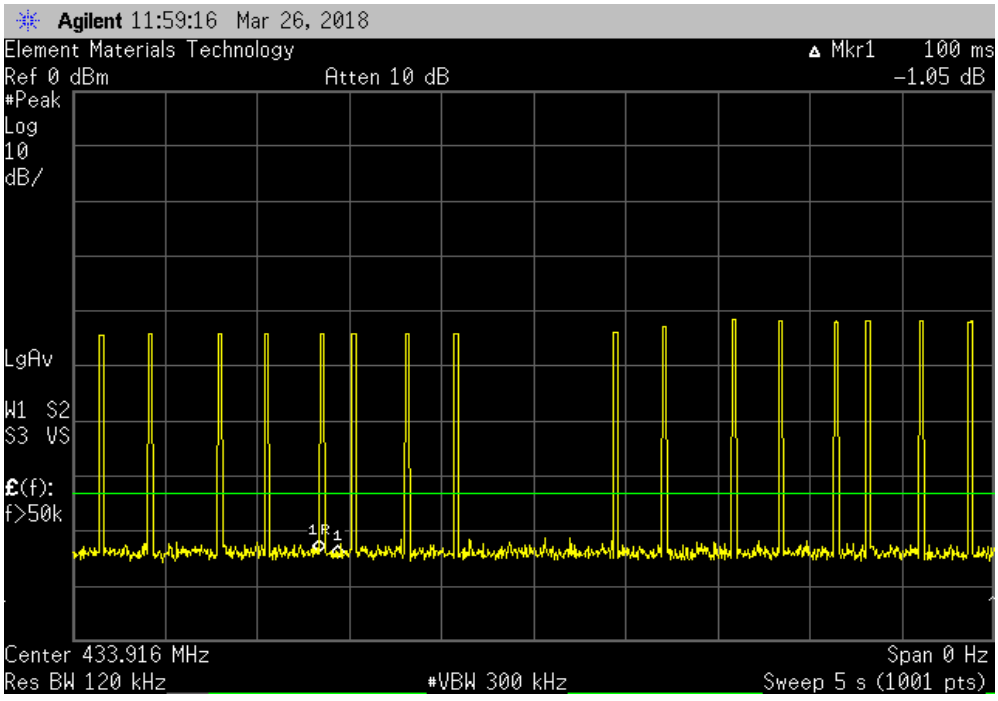
DUTY CYCLE

XMit 2017.12.13

433.916 MHz Observation Time, Observation Time 30 ms						
Number of Type 1	Type 1 Pulse Length (ms)	Number of Type 2	Type 2 Pulse Length (ms)	Number of Type 3	Type 3 Pulse Length (ms)	DCCF (dB)
1	1.08	58	0.12	1	0.51	-21.36



433.916 MHz Observation Time, Observation Time 5 s						
Number of Type 1	Type 1 Pulse Length (ms)	Number of Type 2	Type 2 Pulse Length (ms)	Number of Type 3	Type 3 Pulse Length (ms)	DCCF (dB)
N/A	N/A	N/A	N/A	N/A	N/A	N/A



DUTY CYCLE

XMit 2017.12.13

433.916 MHz Observation Time, Observation Time 10 s						
Number of Type 1	Type 1 Pulse Length (ms)	Number of Type 2	Type 2 Pulse Length (ms)	Number of Type 3	Type 3 Pulse Length (ms)	DCCF (dB)
N/A	N/A	N/A	N/A	N/A	N/A	N/A