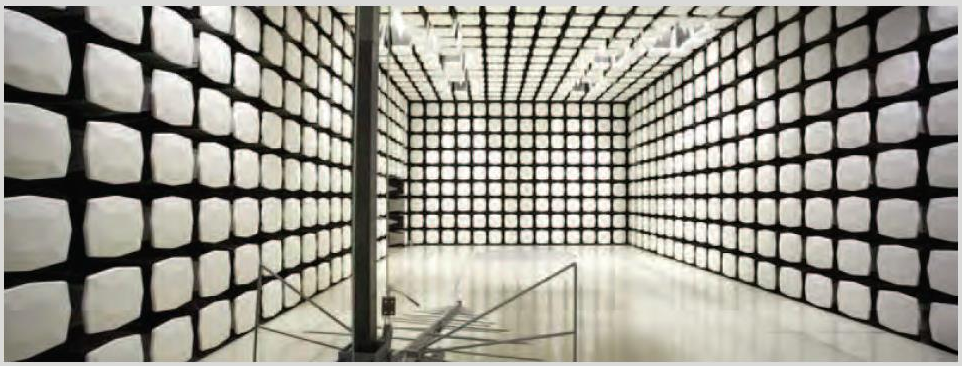
# CINCH Systems

**RF-SHK-433-CLR**

**FCC 15.231:2020**

**Low Power Radio**

**Report: CINC0052.3 Rev. 1, Issue Date: June 15, 2020**



NVLAP LAB CODE: 200881-0

# CERTIFICATE OF TEST

**Last Date of Test: June 1, 2020**
**CINCH Systems**
**EUT: RF-SHK-433-CLR**

## Radio Equipment Testing

### Standards

| Specification | Method |
|---|---|
| FCC 15.231:2020 | ANSI C63.10:2013 |

### Results

| Method Clause | Test Description | Applied | Results | Comments |
|---|---|---|---|---|
| 6.2 | Powerline Conducted Emissions (Transmitter) | 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 | N/A | |

### 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 | The calculation is missing the 100 ms divisor and so incomplete/inaccurate. Also the DCCF listed as “-19.3 dB” is inaccurate and should be “-20.7 dB”. | 2020-06-15 | 12, 13, 15, 16, 17, 21, 22, 23, and 24 |

# 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** – 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

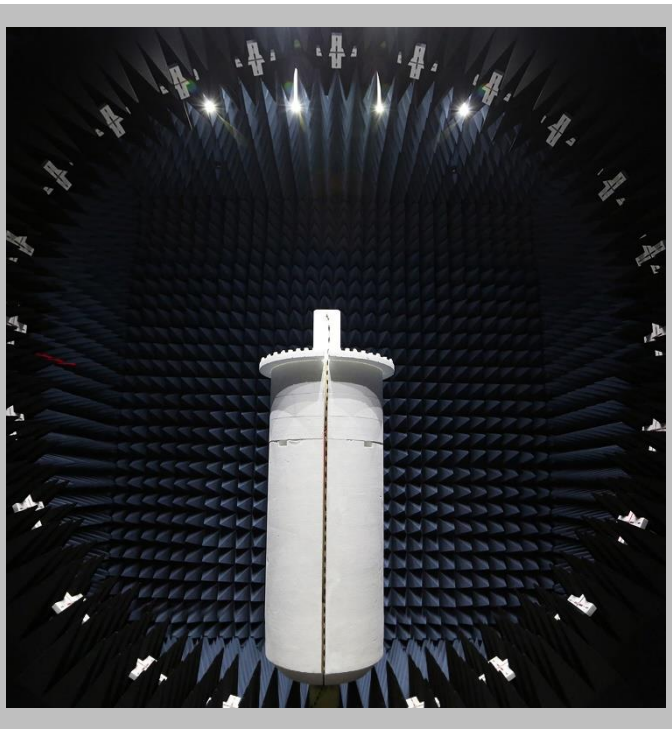
**MIC** – Recognized by MIC as a CAB for the acceptance of test data.

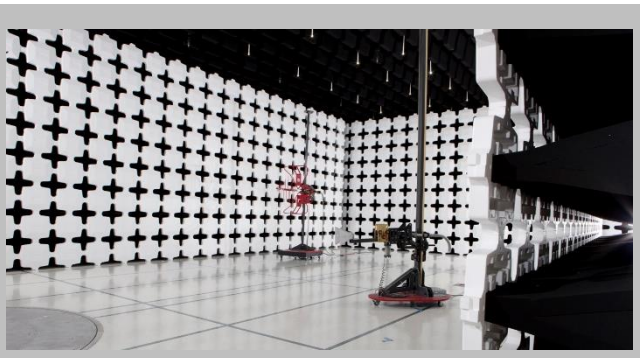
## SCOPE

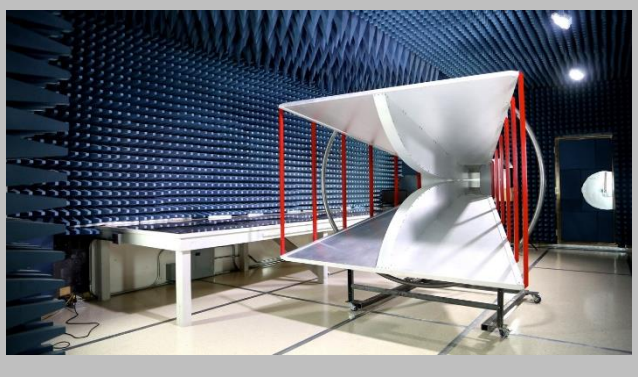
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

# FACILITIES

| California | Minnesota | Oregon | Texas | Washington |
|---|---|---|---|---|
| Labs OC01-17<br>41 Tesla<br>Irvine, CA 92618<br>(949) 861-8918 | Labs MN01-10<br>9349 W Broadway Ave.<br>Brooklyn Park, MN 55445<br>(612)-638-5136 | Labs EV01-12<br>6775 NE Evergreen Pkwy #400<br>Hillsboro, OR 97124<br>(503) 844-4066 | Labs TX01-09<br>3801 E Plano Pkwy<br>Plano, TX 75074<br>(469) 304-5255 | Labs NC01-05<br>19201 120th Ave NE<br>Bothell, WA 98011<br>(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.

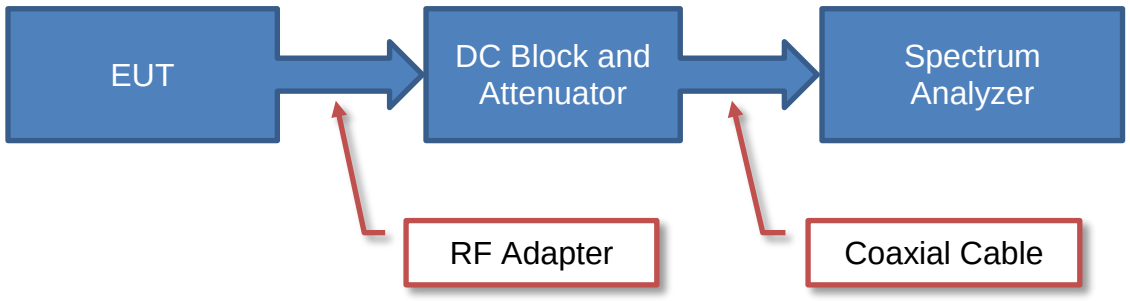
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable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

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

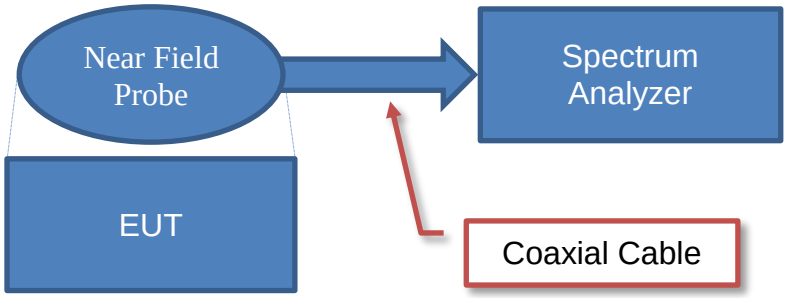
| Test | + MU | - MU |
|---|---|---|
| Frequency Accuracy | 0.0007% | -0.0007% |
| Amplitude Accuracy (dB) | 1.2 dB | -1.2 dB |
| Conducted Power (dB) | 1.2 dB | -1.2 dB |
| Radiated Power via Substitution (dB) | 0.7 dB | -0.7 dB |
| Temperature (degrees C) | 0.7°C | -0.7°C |
| Humidity (% RH) | 2.5%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

# Test Setup Block Diagrams

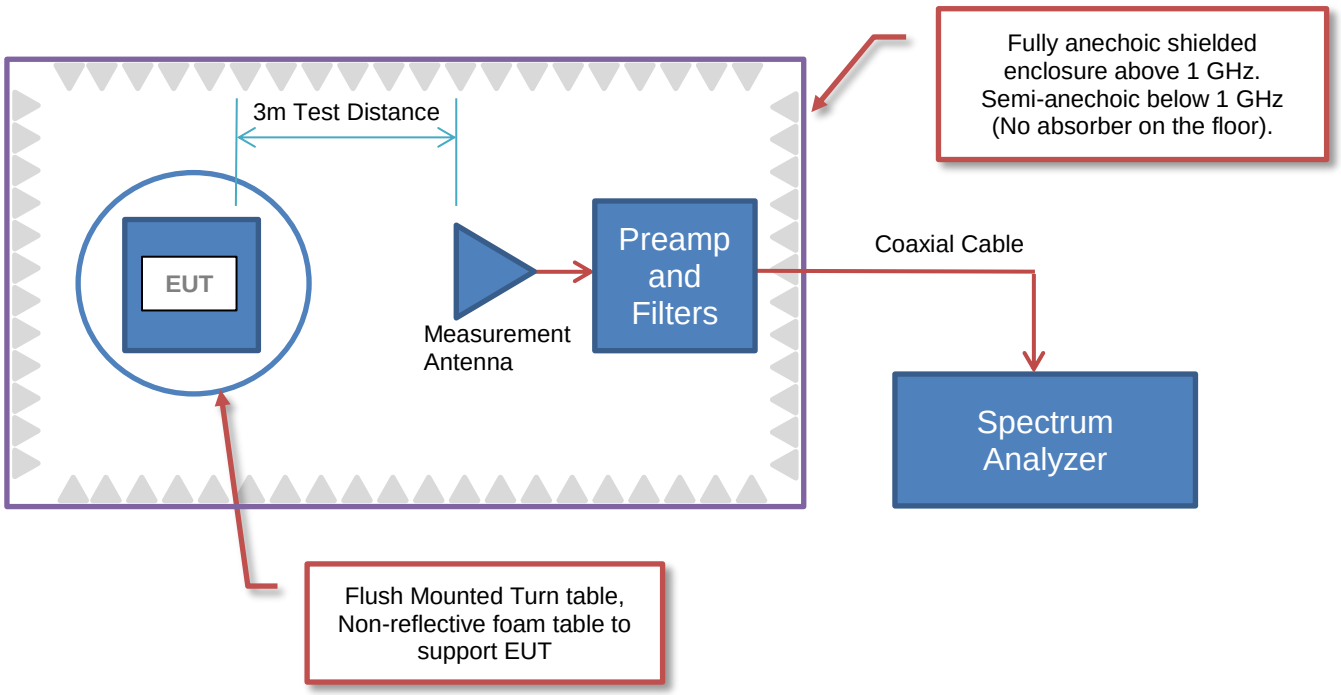
## Antenna Port Conducted Measurements




## Near Field Test Fixture Measurements




## Spurious Radiated Emissions



# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

| | |
|---|---|
| **Company Name:** | CINCH Systems |
| **Address:** | Suite 300 12075 43rd Street NE |
| **City, State, Zip:** | St. Michael, MN 55376 |
| **Test Requested By:** | Jibril Aga |
| **EUT:** | RF-SHK-433-CLR |
| **First Date of Test:** | April 13, 2020 |
| **Last Date of Test:** | June 1, 2020 |
| **Receipt Date of Samples:** | April 13, 2020 |
| **Equipment Design Stage:** | Production |
| **Equipment Condition:** | No Damage |
| **Purchase Authorization:** | Verified |

## Information Provided by the Party Requesting the Test

| **Functional Description of the EUT:** |
|---|
| Sensors containing periodic radio. |

| **Testing Objective:** |
|---|
| To demonstrate compliance to FCC 15.231 specifications. |

# CONFIGURATIONS

## Configuration CINC0052- 2

| EUT | | | |
|---|---|---|---|
| **Description** | **Manufacturer** | **Model/Part Number** | **Serial Number** |
| Shock Sensor | CINCH Systems | RF-SHK-433-CLR | 674434 |

## Configuration CINC0052- 6

| EUT | | | |
|---|---|---|---|
| **Description** | **Manufacturer** | **Model/Part Number** | **Serial Number** |
| Shock Sensor | CINCH Systems | RF-SHK-433-CLR | 966548 |

## Configuration CINC0052- 10

| EUT | | | |
|---|---|---|---|
| **Description** | **Manufacturer** | **Model/Part Number** | **Serial Number** |
| Shock Sensor | CINCH Systems | RF-SHK-433-CLR | 807945 |

# MODIFICATIONS

## Equipment Modifications

| Item | Date | Test | Modification | Note | Disposition of EUT |
|---|---|---|---|---|---|
| 1 | 2020-04-13 | 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 | 2020-04-13 | 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. |
| 3 | 2020-04-13 | 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. |
| 4 | 2020-06-01 | Duty Cycle | 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 2020.04.03.0

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**

Transmitting 433.95 MHz modulated

**POWER SETTINGS INVESTIGATED**

Battery

**CONFIGURATIONS INVESTIGATED**

CINC0052 - 6

**FREQUENCY RANGE INVESTIGATED**

| Start Frequency | 433 MHz | Stop Frequency | 435 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 |
|---|---|---|---|---|---|
| Antenna - Biconilog | ETS Lindgren | 3142D | AXO | 2019-09-03 | 24 mo |
| Cable | ESM Cable Corp. | Bilog Cables | MNH | 2019-10-18 | 12 mo |
| Analyzer - Spectrum Analyzer | Keysight | N9010A | AFN | 2019-12-23 | 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 modulated 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 = 0.1003 mSec
Pulsewidth of Type 2 Pulse = 0.2007 mSec
Number of Type 1 Pulses = 54
Number of Type 2 Pulses = 19

Duty Cycle Correction Factor = 20 log [((54)(0.1003) + (19)(0.2007)/100] = -20.7 dB

The duty cycle correction factor of -20.7 dB was added to the peak readings to mathematically derive the average levels.

# FIELD STRENGTH OF FUNDAMENTAL

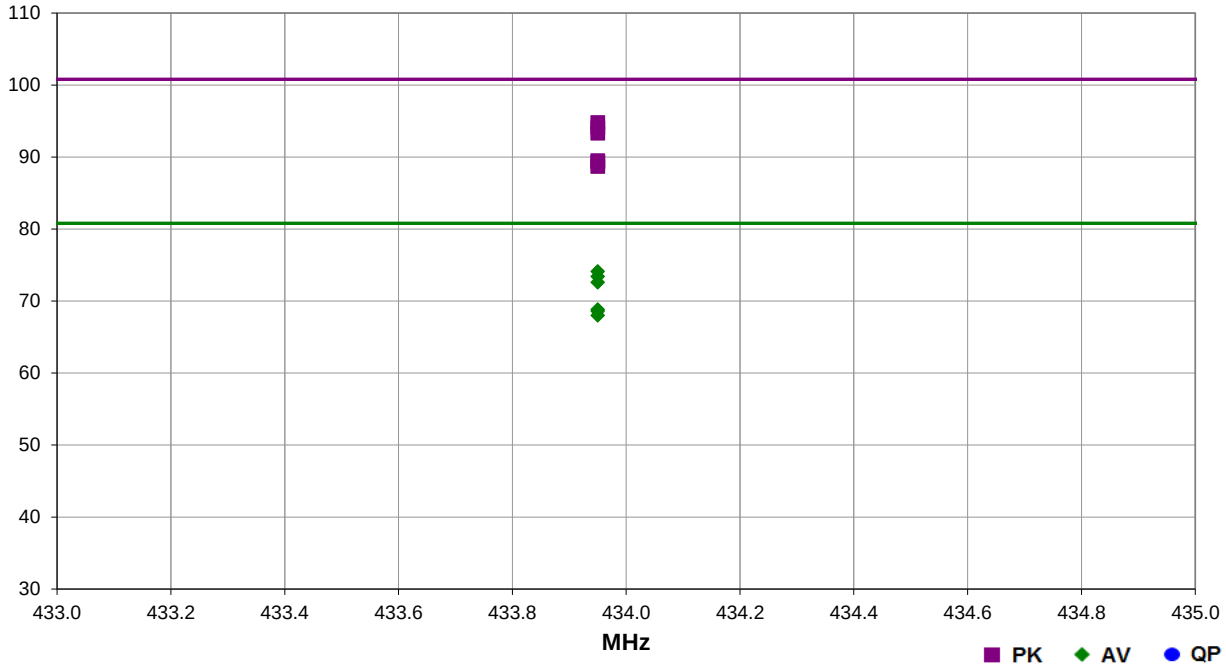
element

EmiR5 2019.08.15.1 PSA-ESCI 2020.04.03.0

| | | | | | |
|---|---|---|---|---|---|
| **Work Order:** | CINC0052 | **Date:** | 2020-04-13 | | |
| **Project:** | None | **Temperature:** | 20.9 °C | | |
| **Job Site:** | MN05 | **Humidity:** | 24.3% RH | | |
| **Serial Number:** | 966548 | **Barometric Pres.:** | 1017 mbar | **Tested by:** | Dustin Sparks |
| **EUT:** | RF-SHK-433-CLR | | | | |
| **Configuration:** | 6 | | | | |
| **Customer:** | CINCH Systems | | | | |
| **Attendees:** | Jibril Aga | | | | |
| **EUT Power:** | Battery | | | | |
| **Operating Mode:** | Transmitting 433.95 MHz modulated | | | | |
| **Deviations:** | None | | | | |
| **Comments:** | None | | | | |

| **Test Specifications** | **Test Method** |
|---|---|
| FCC 15.231:2020 | ANSI C63.10:2013 |

| **Run #** | 2 | **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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 433.950 | 71.0 | 23.8 | 1.5 | 90.0 | | 0.0 | Vert | PK | 0.0 | 94.8 | 100.8 | -6.0 | EUT on side |
| 433.950 | 71.0 | 23.8 | 1.5 | 90.0 | -20.7 | 0.0 | Vert | AV | 0.0 | 74.1 | 80.8 | -6.7 | EUT on side |
| 433.950 | 70.3 | 23.8 | 1.5 | 225.0 | | 0.0 | Vert | PK | 0.0 | 94.1 | 100.8 | -6.7 | EUT vertical |
| 433.950 | 70.3 | 23.8 | 1.5 | 225.0 | -20.7 | 0.0 | Vert | AV | 0.0 | 73.4 | 80.8 | -7.4 | EUT vertical |
| 433.950 | 69.5 | 23.8 | 1.0 | 37.1 | | 0.0 | Horz | PK | 0.0 | 93.3 | 100.8 | -7.5 | EUT horizontal |
| 433.950 | 69.5 | 23.8 | 1.0 | 37.1 | -20.7 | 0.0 | Horz | AV | 0.0 | 72.6 | 80.8 | -8.2 | EUT horizontal |
| 433.950 | 65.7 | 23.8 | 1.9 | 180.0 | | 0.0 | Horz | PK | 0.0 | 89.5 | 100.8 | -11.3 | EUT on side |
| 433.950 | 65.5 | 23.8 | 1.8 | 180.0 | | 0.0 | Horz | PK | 0.0 | 89.3 | 100.8 | -11.5 | EUT vertical |
| 433.950 | 65.7 | 23.8 | 1.9 | 180.0 | -20.7 | 0.0 | Horz | AV | 0.0 | 68.8 | 80.8 | -12.0 | EUT on side |
| 433.950 | 64.9 | 23.8 | 1.5 | 315.0 | | 0.0 | Vert | PK | 0.0 | 88.7 | 100.8 | -12.1 | EUT horizontal |
| 433.950 | 65.5 | 23.8 | 1.8 | 180.0 | -20.7 | 0.0 | Horz | AV | 0.0 | 68.6 | 80.8 | -12.2 | EUT vertical |
| 433.950 | 64.9 | 23.8 | 1.5 | 315.0 | -20.7 | 0.0 | Vert | AV | 0.0 | 68.0 | 80.8 | -12.8 | EUT horizontal |

# SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2020.04.03.0

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**

Transmitting 433.95 MHz modulated

**POWER SETTINGS INVESTIGATED**

Battery

**CONFIGURATIONS INVESTIGATED**

CINC0052 - 6

CINC0052 - 10

**FREQUENCY RANGE INVESTIGATED**

| Start Frequency | 30 MHz | Stop Frequency | 5000 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 |
|---|---|---|---|---|---|
| Attenuator | Fairview Microwave | SA18E-10 | TYA | 2019-09-17 | 12 mo |
| Filter - Low Pass | Micro-Tronics | LPM50003 | LFJ | 2019-09-17 | 12 mo |
| Amplifier - Pre-Amplifier | Miteq | AMF-3D-00100800-32-13P | AVT | 2020-01-17 | 12 mo |
| Cable | ESM Cable Corp. | Double Ridge Guide Horn Cables | MNI | 2019-09-17 | 12 mo |
| Antenna - Double Ridge | ETS-Lindgren | 3115 | AJQ | 2019-01-16 | 24 mo |
| Amplifier - Pre-Amplifier | Miteq | AM-1616-1000 | AVO | 2019-10-18 | 12 mo |
| Cable | ESM Cable Corp. | Bilog Cables | MNH | 2019-10-18 | 12 mo |
| Antenna - Biconilog | ETS Lindgren | 3142D | AXO | 2019-09-03 | 24 mo |
| Analyzer - Spectrum Analyzer | Keysight | N9010A | AFN | 2019-12-23 | 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 = 0.1003 mSec
Pulsewidth of Type 2 Pulse = 0.2007 mSec
Number of Type 1 Pulses = 54
Number of Type 2 Pulses = 19

Duty Cycle Correction Factor = 20 log [((54)(0.1003) + (19)(0.2007)/100] = -20.7 dB

The duty cycle correction factor of -20.7 dB was added to the peak readings to mathematically derive the average levels.

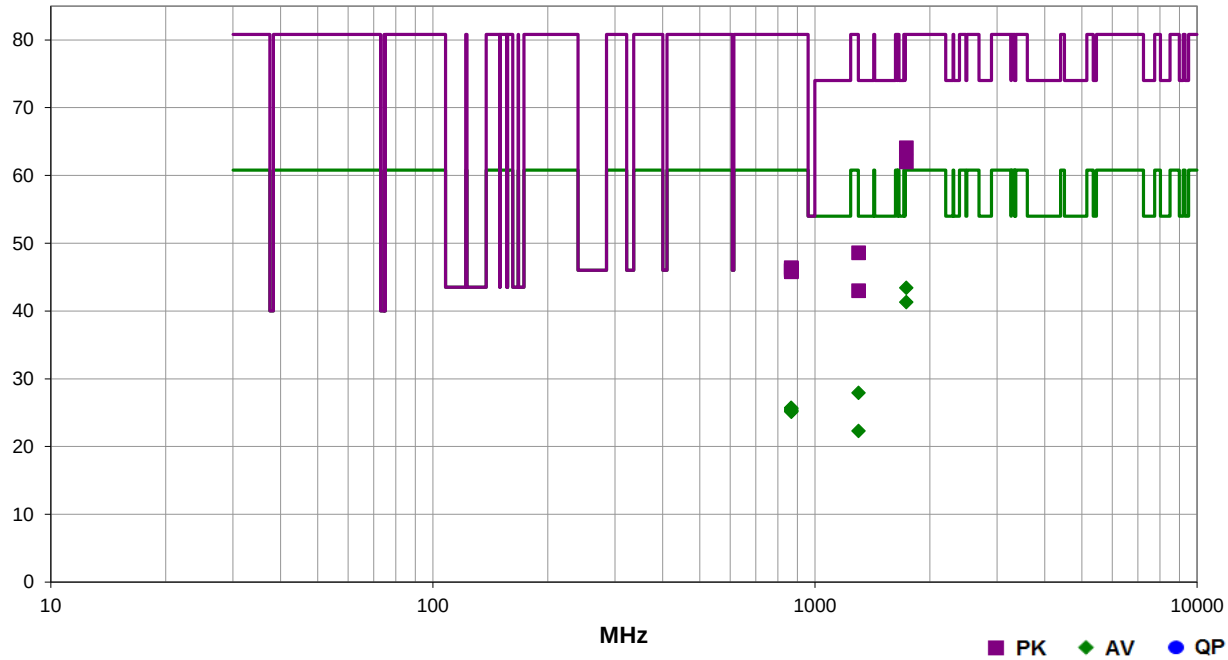
# SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2020.04.03.0

| | | | | | |
|---|---|---|---|---|---|
| **Work Order:** | CINC0052 | **Date:** | 2020-04-13 | | |
| **Project:** | None | **Temperature:** | 21.1 °C | | |
| **Job Site:** | MN05 | **Humidity:** | 25.3% RH | | |
| **Serial Number:** | 966548, 807945 | **Barometric Pres.:** | 1017 mbar | **Tested by:** | Dustin Sparks |
| **EUT:** | RF-SHK-433-CLR | | | | |
| **Configuration:** | 6, 10 | | | | |
| **Customer:** | CINCH Systems | | | | |
| **Attendees:** | Jibril Aga | | | | |
| **EUT Power:** | Battery | | | | |
| **Operating Mode:** | Transmitting 433.95 MHz modulated | | | | |
| **Deviations:** | None | | | | |
| **Comments:** | Configuration 6 (serial number 966548) used for measurements below 1 GHz. Configuration 10 (serial number 807945) used for measurements above 1 GHz. | | | | |

| **Test Specifications** | **Test Method** |
|---|---|
| FCC 15.231:2020 | ANSI C63.10:2013 |

| **Run #** | 12 | **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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1735.550 | 69.6 | -5.5 | 1.5 | 54.0 | | 0.0 | Vert | PK | 0.0 | 64.1 | 80.8 | -16.7 | EUT vertical |
| 1735.550 | 69.6 | -5.5 | 1.5 | 54.0 | -20.7 | 0.0 | Vert | AV | 0.0 | 43.4 | 60.8 | -17.4 | EUT vertical |
| 1735.758 | 67.5 | -5.5 | 1.5 | 221.0 | | 0.0 | Horz | PK | 0.0 | 62.0 | 80.8 | -18.8 | EUT horizontal |
| 1735.758 | 67.5 | -5.5 | 1.5 | 221.0 | -20.7 | 0.0 | Horz | AV | 0.0 | 41.3 | 60.8 | -19.5 | EUT horizontal |
| 1301.850 | 55.2 | -6.6 | 1.5 | 222.9 | | 0.0 | Vert | PK | 0.0 | 48.6 | 74.0 | -25.4 | EUT vertical |
| 1301.850 | 55.2 | -6.6 | 1.5 | 222.9 | -20.7 | 0.0 | Vert | AV | 0.0 | 27.9 | 54.0 | -26.1 | EUT vertical |
| 1301.850 | 49.6 | -6.6 | 1.5 | 0.0 | | 0.0 | Horz | PK | 0.0 | 43.0 | 74.0 | -31.0 | EUT horizontal |
| 1301.850 | 49.6 | -6.6 | 1.5 | 0.0 | -20.7 | 0.0 | Horz | AV | 0.0 | 22.3 | 54.0 | -31.7 | EUT horizontal |
| 867.660 | 23.8 | 12.6 | 2.0 | 225.0 | | 10.0 | Vert | PK | 0.0 | 46.4 | 80.8 | -34.4 | EUT vertical |
| 868.330 | 23.7 | 12.6 | 1.0 | 94.0 | | 10.0 | Vert | PK | 0.0 | 46.3 | 80.8 | -34.5 | EUT horizontal |
| 867.755 | 23.5 | 12.6 | 1.0 | 317.9 | | 10.0 | Horz | PK | 0.0 | 46.1 | 80.8 | -34.7 | EUT horizontal |
| 868.260 | 23.4 | 12.6 | 1.0 | 270.1 | | 10.0 | Horz | PK | 0.0 | 46.0 | 80.8 | -34.8 | EUT on side |
| 867.245 | 23.3 | 12.6 | 4.0 | 45.0 | | 10.0 | Vert | PK | 0.0 | 45.9 | 80.8 | -34.9 | EUT on side |
| 868.050 | 23.2 | 12.6 | 1.0 | 315.0 | | 10.0 | Horz | PK | 0.0 | 45.8 | 80.8 | -35.0 | EUT vertical |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 867.660 | 23.8 | 12.6 | 2.0 | 225.0 | -20.7 | 10.0 | Vert | AV | 0.0 | 25.7 | 60.8 | -35.1 | EUT vertical |
| 868.330 | 23.7 | 12.6 | 1.0 | 94.0 | -20.7 | 10.0 | Vert | AV | 0.0 | 25.6 | 60.8 | -35.2 | EUT horizontal |
| 867.755 | 23.5 | 12.6 | 1.0 | 317.9 | -20.7 | 10.0 | Horz | AV | 0.0 | 25.4 | 60.8 | -35.4 | EUT horizontal |
| 868.260 | 23.4 | 12.6 | 1.0 | 270.1 | -20.7 | 10.0 | Horz | AV | 0.0 | 25.3 | 60.8 | -35.5 | EUT on side |
| 867.245 | 23.3 | 12.6 | 4.0 | 45.0 | -20.7 | 10.0 | Vert | AV | 0.0 | 25.2 | 60.8 | -35.6 | EUT on side |
| 868.050 | 23.2 | 12.6 | 1.0 | 315.0 | -20.7 | 10.0 | Horz | AV | 0.0 | 25.1 | 60.8 | -35.7 | EUT vertical |

# OCCUPIED BANDWIDTH

XMit 2020.03.25.0

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

**TEST EQUIPMENT**

| Description | Manufacturer | Model | ID | Last Cal. | Cal. Due |
|---|---|---|---|---|---|
| Cable | ESM Cable Corp. | Bilog Cables | MNH | 18-Oct-19 | 18-Oct-20 |
| Antenna - Biconilog | ETS Lindgren | 3142D | AXO | 3-Sep-19 | 3-Sep-21 |
| Analyzer - Spectrum Analyzer | Keysight | N9010A | AFN | 23-Dec-19 | 23-Dec-20 |

**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. 0.0025*433.950 MHz = 1085 kHz

# OCCUPIED BANDWIDTH

XMit 2020.03.25.0

| | | | | | |
|---|---|---|---|---|---|
| **EUT:** | **RF-SHK-433-CLR** | | | **Work Order:** | **CINC0052** |
| **Serial Number:** | **966548** | | | **Date:** | **13-Apr-20** |
| **Customer:** | **CINCH Systems** | | | **Temperature:** | **21.1 °C** |
| **Attendees:** | **Jibril Aga** | | | **Humidity:** | **23.9% RH** |
| **Project:** | **None** | | | **Barometric Pres.:** | **1021 mbar** |
| **Tested by:** | **Dustin Sparks** | **Power:** | **Battery** | **Job Site:** | **MN05** |

| **TEST SPECIFICATIONS** | **Test Method** |
|---|---|
| **FCC 15.231:2020** | ANSI C63.10:2013 |
| | |

**COMMENTS**

**None**

**DEVIATIONS FROM TEST STANDARD**

**None**

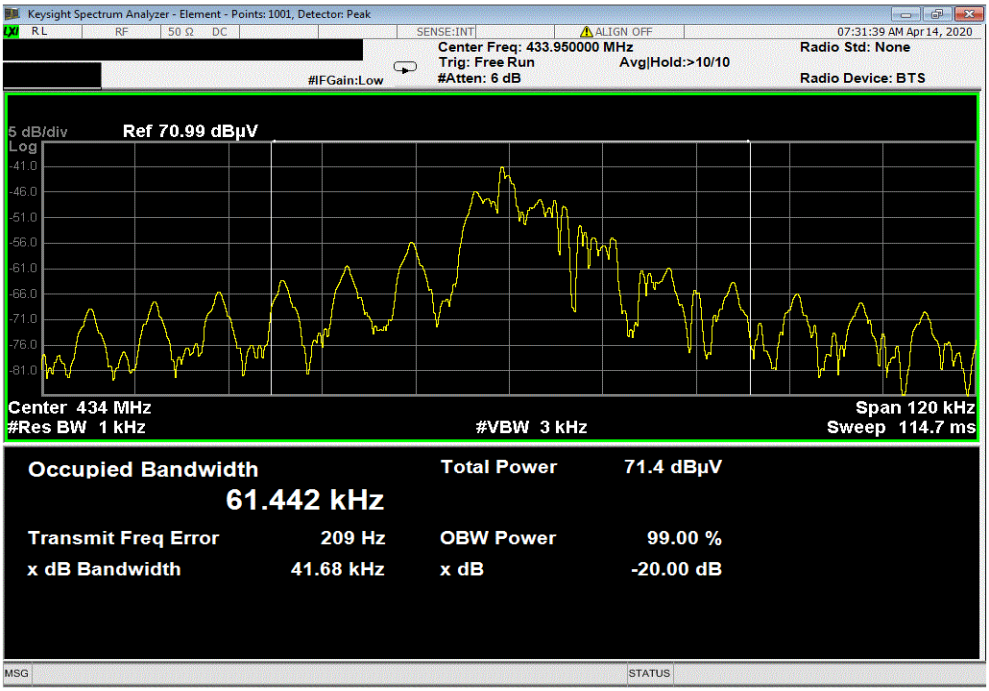
| **Configuration #** | **6** | *Signature* Dustin Sparks |
|---|---|---|

| | **Value (kHz)** | **Limit (≤ kHz)** | **Result** |
|---|---|---|---|
| 433.95 MHz | | | |
| Occupied Bandwidth | 41.68 | 1085 | Pass |

# OCCUPIED BANDWIDTH

XMit 2020.03.25.0

| 433.95 MHz, Occupied Bandwidth | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Value (kHz) | Limit (≤ kHz) | Result |
| | | | | 41.68 | 1085 | Pass |



# DUTY CYCLE

element

XMit 2020.03.25.0

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

**TEST EQUIPMENT**

| Description | Manufacturer | Model | ID | Last Cal. | Cal. Due |
|---|---|---|---|---|---|
| Cable | ESM Cable Corp. | Bilog Cables | MNH | 18-Oct-19 | 18-Oct-20 |
| Antenna - Biconilog | ETS Lindgren | 3142D | AXO | 3-Sep-19 | 3-Sep-21 |
| Analyzer - Spectrum Analyzer | Keysight | N9010A | AFN | 23-Dec-19 | 23-Dec-20 |

**TEST DESCRIPTION**

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 = **0.1003** mSec
Pulsewidth of Type 2 Pulse = **0.2007** mSec
Number of Type 1 Pulses = **54**
Number of Type 2 Pulses = **19**

Duty Cycle Correction Factor = 20 log [((54)(0.1003) + (19)(0.2007)/100] = **-20.7** dB

The duty cycle correction factor of **-20.7 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 2020.03.25.0

| | | | | | |
|---|---|---|---|---|---|
| **EUT:** | RF-SHK-433-CLR | | | **Work Order:** | CINC0052 |
| **Serial Number:** | 674434 | | | **Date:** | 1-Jun-20 |
| **Customer:** | CINCH Systems | | | **Temperature:** | 23.7 °C |
| **Attendees:** | Jibril Aga | | | **Humidity:** | 50.5% RH |
| **Project:** | None | | | **Barometric Pres.:** | 1021 mbar |
| **Tested by:** | Dustin Sparks | **Power:** | Battery | **Job Site:** | MN05 |

| TEST SPECIFICATIONS | Test Method |
|---|---|
| FCC 15.231:2020 | ANSI C63.10:2013 |
| | |

**COMMENTS**

None

**DEVIATIONS FROM TEST STANDARD**

None

| Configuration # | 2 | Signature |
|---|---|---|

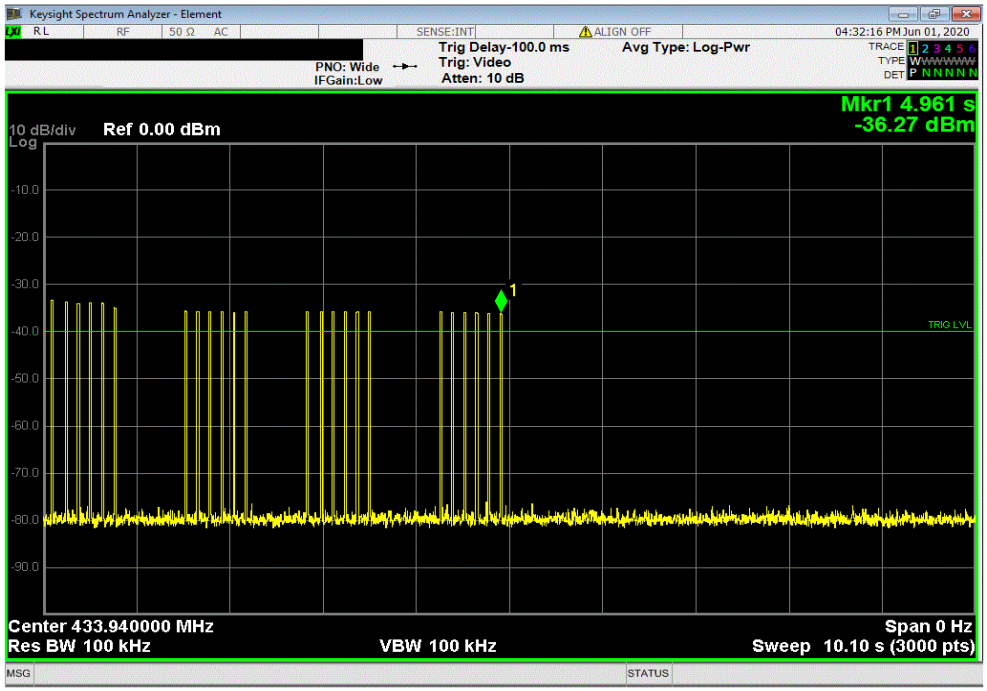
| | Type 1 Pulse Width (ms) | Type 1 Pulse Count | Type 2 Pulse Width (ms) | Type 2 Pulse Count | On Time in 100 ms | DCCF (dB) | Result |
|---|---|---|---|---|---|---|---|
| Sweep Time | | | | | | | |
| 10 s | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 2 s | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 100 ms | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 20 ms | 0.1003 | 54 | 0.2007 | 19 | 9.23 | -20.7 | N/A |

# DUTY CYCLE

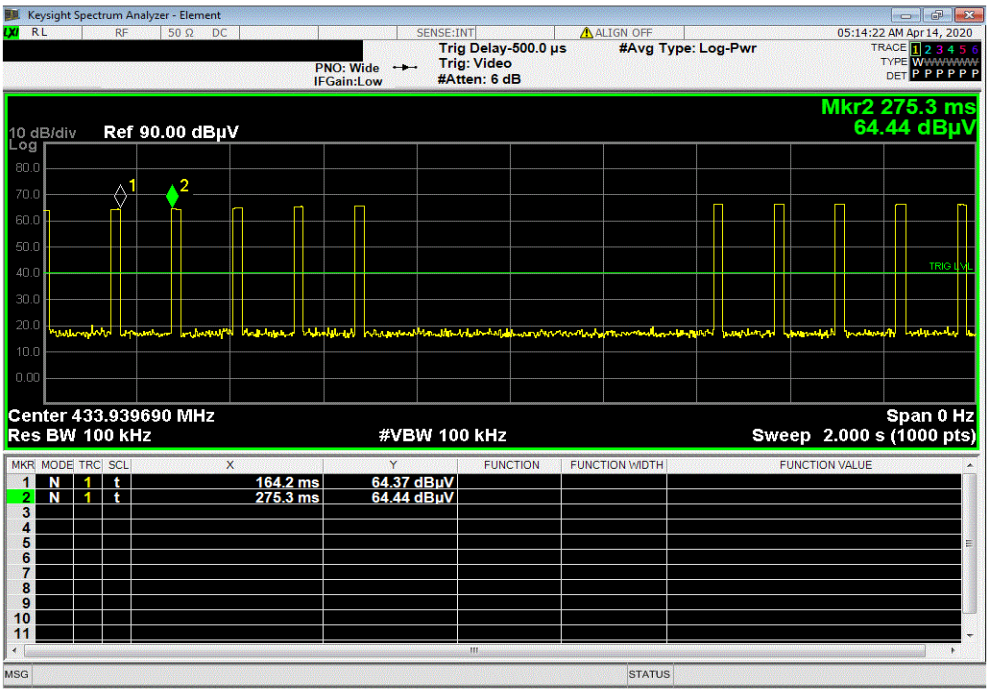
element

XMit 2020.03.25.0

| Sweep Time, 10 s | | | | | | |
|---|---|---|---|---|---|---|
| Type 1 Pulse Width (ms) | Type 1 Pulse Count | Type 2 Pulse Width (ms) | Type 2 Pulse Count | On Time in 100 ms | DCCF (dB) | Result |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A |




| Sweep Time, 2 s | | | | | | |
|---|---|---|---|---|---|---|
| Type 1 Pulse Width (ms) | Type 1 Pulse Count | Type 2 Pulse Width (ms) | Type 2 Pulse Count | On Time in 100 ms | DCCF (dB) | Result |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A |

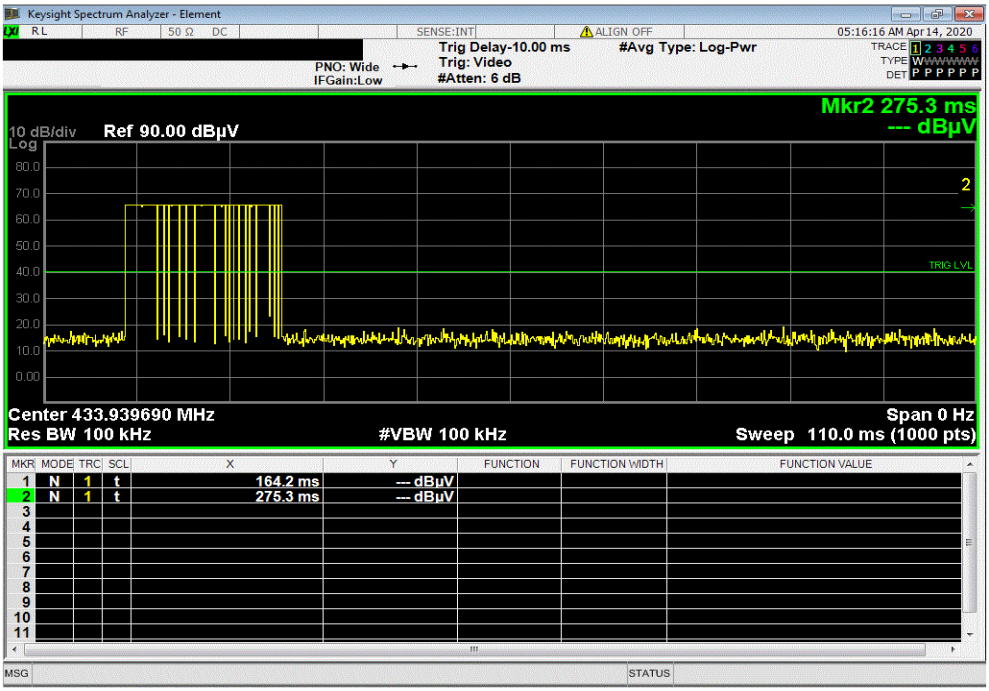


# DUTY CYCLE

element

XMit 2020.03.25.0

| Sweep Time, 100 ms | | | | | | |
|---|---|---|---|---|---|---|
| Type 1 Pulse Width (ms) | Type 1 Pulse Count | Type 2 Pulse Width (ms) | Type 2 Pulse Count | On Time in 100 ms | DCCF (dB) | Result |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A |




| Sweep Time, 20 ms | | | | | | |
|---|---|---|---|---|---|---|
| Type 1 Pulse Width (ms) | Type 1 Pulse Count | Type 2 Pulse Width (ms) | Type 2 Pulse Count | On Time in 100 ms | DCCF (dB) | Result |
| 0.1003 | 54 | 0.2007 | 19 | 9.23 | -20.7 | N/A |