

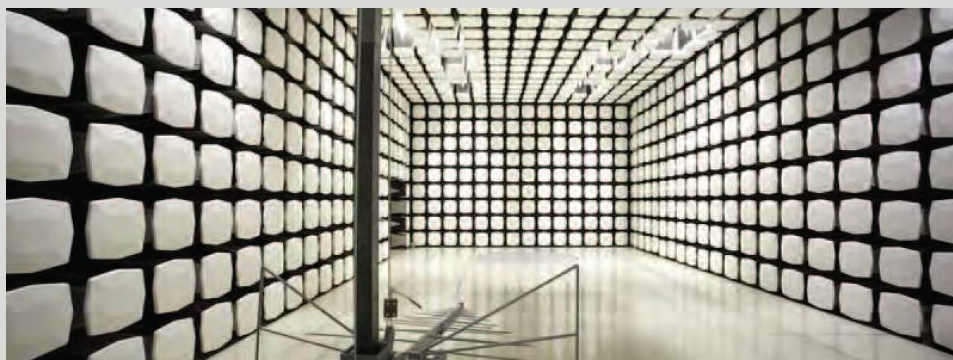


## **CINCH Systems**

**RF-WIN-WATER-319**

**FCC 15.231:2017  
Periodic Transmitter**

**Report # CINC0011.1**



NVLAP Lab Code: 200881-0



*This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America. This Report shall not be reproduced, except in full without written approval of the laboratory.*



# CERTIFICATE OF TEST

Last Date of Test: September 5, 2017

CINCH Systems

Model: RF-WIN-WATER-319

## Radio Equipment Testing

### Standards

| Specification   | Method           |
|-----------------|------------------|
| FCC 15.231:2017 | 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



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## 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

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## 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.

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## European Union

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

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## Australia/New Zealand

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

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## Korea

**MSIP / RRA** - Recognized by KCC's RRA as a CAB for the acceptance of test data.

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## Japan

**VCCI** - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

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## 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.

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## Singapore

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

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## Israel

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

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## Hong Kong

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

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## Vietnam

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

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## 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>

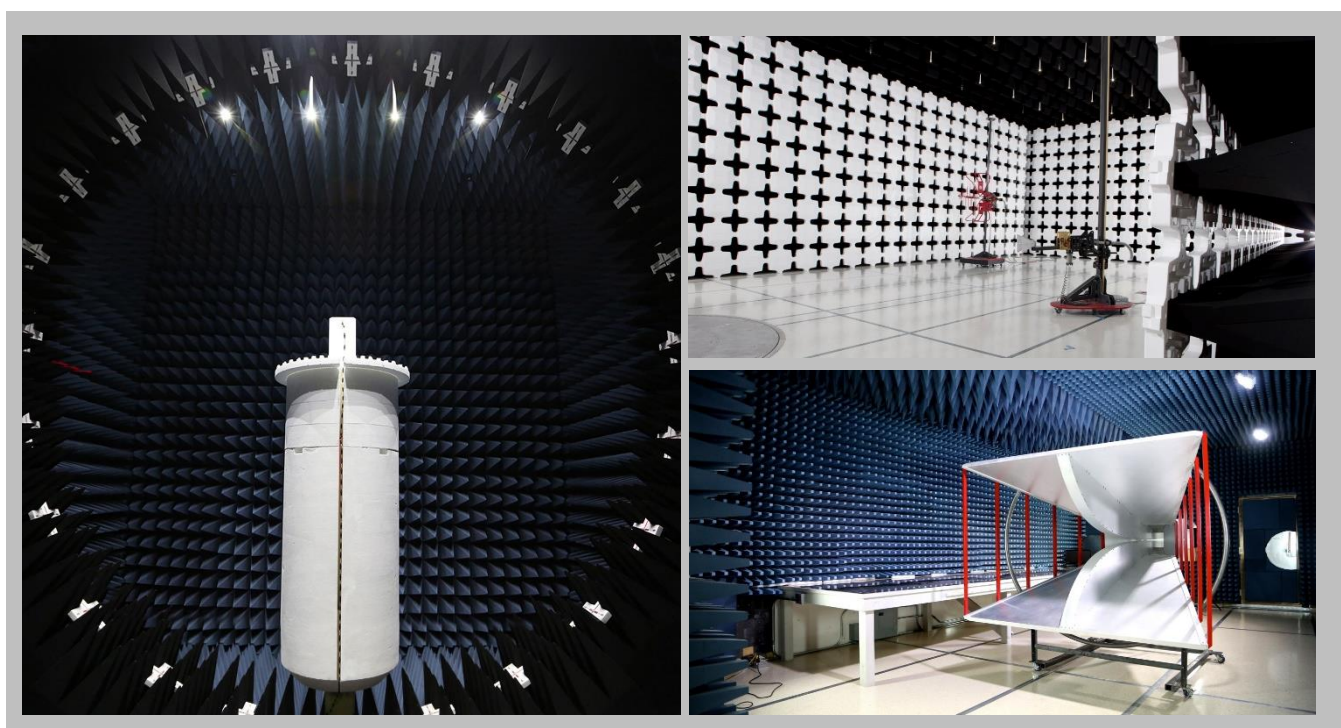
# FACILITIES



2017.7.25



|                                                                                     |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>California</b><br>Labs OC01-13<br>41 Tesla<br>Irvine, CA 92618<br>(949) 861-8918 | <b>Minnesota</b><br>Labs MN01-08, MN10<br>9349 W Broadway Ave.<br>Brooklyn Park, MN 55445<br>(612)-638-5136 | <b>New York</b><br>Labs NY01-04<br>4939 Jordan Rd.<br>Elbridge, NY 13060<br>(315) 554-8214 | <b>Oregon</b><br>Labs EV01-12<br>22975 NW Evergreen Pkwy<br>Hillsboro, OR 97124<br>(503) 844-4066 | <b>Texas</b><br>Labs TX01-09<br>3801 E Plano Pkwy<br>Plano, TX 75074<br>(469) 304-5255 | <b>Washington</b><br>Labs NC01-05<br>19201 120 <sup>th</sup> Ave NE<br>Bothell, WA 98011<br>(425)984-6600 |
| <b>NVLAP</b>                                                                        |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
| 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                                                                                  |
| <b>Innovation, Science and Economic Development Canada</b>                          |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
| 2834B-1, 2834B-3                                                                    | 2834E-1, 2834E-3                                                                                            | N/A                                                                                        | 2834D-1, 2834D-2                                                                                  | 2834G-1                                                                                | 2834F-1                                                                                                   |
| <b>BSMI</b>                                                                         |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
| SL2-IN-E-1154R                                                                      | SL2-IN-E-1152R                                                                                              | N/A                                                                                        | SL2-IN-E-1017                                                                                     | SL2-IN-E-1158R                                                                         | SL2-IN-E-1153R                                                                                            |
| <b>VCCI</b>                                                                         |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
| A-0029                                                                              | A-0109                                                                                                      | N/A                                                                                        | A-0108                                                                                            | A-0201                                                                                 | A-0110                                                                                                    |
| <b>Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA</b>     |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                           |
| US0158                                                                              | US0175                                                                                                      | N/A                                                                                        | US0017                                                                                            | US0191                                                                                 | US0157                                                                                                    |



# MEASUREMENT UNCERTAINTY



## Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

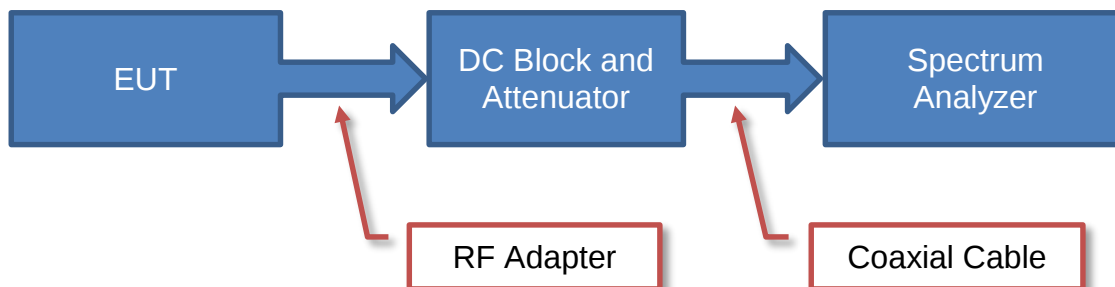
A measurement uncertainty estimation has been performed for each test per our internal quality document WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. Our measurement 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.

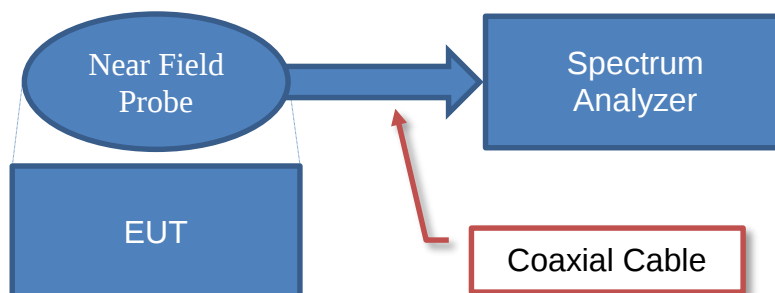
| Test                                  | + MU    | - MU     |
|---------------------------------------|---------|----------|
| Frequency Accuracy (Hz)               | 0.0007% | -0.0007% |
| Amplitude Accuracy (dB)               | 1.2 dB  | -1.2 dB  |
| Conducted Power (dB)                  | 0.3 dB  | -0.3 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) | 2.4 dB  | -2.4 dB  |

# Test Setup Block Diagrams

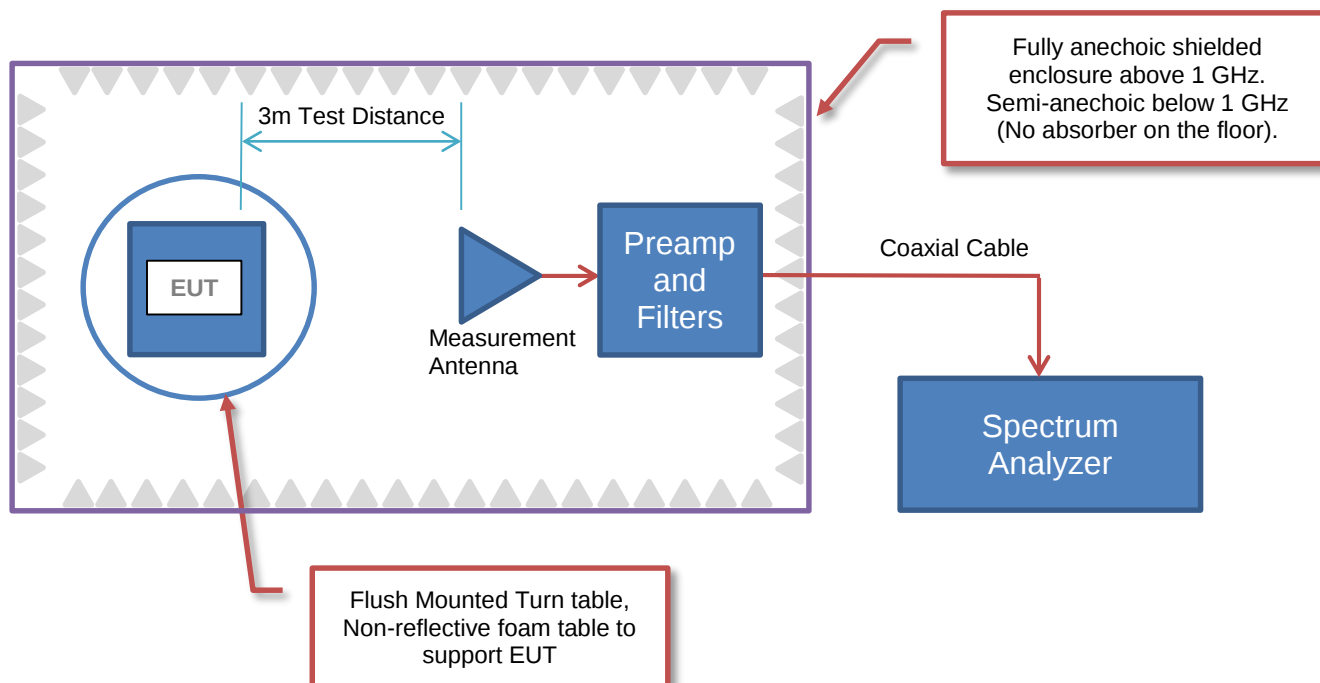
## Antenna Port Conducted Measurements



## Near Field Test Fixture Measurements



## Spurious Radiated Emissions





# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

|                                 |                                |
|---------------------------------|--------------------------------|
| <b>Company Name:</b>            | CINCH Systems                  |
| <b>Address:</b>                 | Suite 300 12075 43rd Street NE |
| <b>City, State, Zip:</b>        | St. Michael, MN 55376          |
| <b>Test Requested By:</b>       | Jibril Aga                     |
| <b>Model:</b>                   | RF-WIN-WATER-319               |
| <b>First Date of Test:</b>      | September 5, 2017              |
| <b>Last Date of Test:</b>       | September 5, 2017              |
| <b>Receipt Date of Samples:</b> | September 5, 2017              |
| <b>Equipment Design Stage:</b>  | Production                     |
| <b>Equipment Condition:</b>     | No Damage                      |
| <b>Purchase Authorization:</b>  | Verified                       |

## Information Provided by the Party Requesting the Test

### Functional Description of the EUT:

Water flood detection sensor containing a low power transmitter which operates at 319.5 MHz utilizing AM modulation (OOK)

### Testing Objective:

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

# CONFIGURATIONS



## Configuration CINC0011- 1

| Software/Firmware Running during test |         |
|---------------------------------------|---------|
| Description                           | Version |
| Firmware                              | V1.2    |

| EUT              |               |                   |               |
|------------------|---------------|-------------------|---------------|
| Description      | Manufacturer  | Model/Part Number | Serial Number |
| RF-WIN-WATER-319 | CINCH Systems | 319               | 12345         |
| Water Sensor     | CINCH Systems | 319               | 12345         |

| Cables       |        |            |         |                  |              |
|--------------|--------|------------|---------|------------------|--------------|
| Cable Type   | Shield | Length (m) | Ferrite | Connection 1     | Connection 2 |
| Sensor Cable | No     | 1.7m       | No      | RF-WIN-WATER-319 | Water Sensor |

# MODIFICATIONS



## Equipment Modifications

| Item | Date     | Test                          | Modification                         | Note                                                                | Disposition of EUT                          |
|------|----------|-------------------------------|--------------------------------------|---------------------------------------------------------------------|---------------------------------------------|
| 1    | 9/5/2017 | 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    | 9/5/2017 | 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    | 9/5/2017 | 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    | 9/5/2017 | Spurious Radiated Emissions   | 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 2017.06.01

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

Tx unmodulated at 319.5 MHz

## POWER SETTINGS INVESTIGATED

Battery

## CONFIGURATIONS INVESTIGATED

CINC0011 - 1

## FREQUENCY RANGE INVESTIGATED

Start Frequency 319 MHz Stop Frequency 320 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 | 2/16/2017  | 12 mo    |
| Analyzer - Spectrum Analyzer | Keysight     | N9010A (EXA)    | AFQ | 12/22/2016 | 12 mo    |
| Antenna - Biconilog          | ETS Lindgren | 3142D           | AXO | 12/11/2015 | 24 mo    |

## MEASUREMENT BANDWIDTHS

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

# FIELD STRENGTH OF FUNDAMENTAL



PSA-ESCI 2017.06.01

## 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" =  $N1L1 + N2L2 + \dots$

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 =  $(N1L1 + N2L2 + \dots)/100\text{mS}$  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 = 0.160 mSec

Pulsewidth of Type 2 Pulse = 0.480 mSec

Number of Type 1 Pulses = 56

Number of Type 2 Pulses = 1

$$20 \log [(56)(0.160) + (1)(0.480)] = -20.5 \text{ dB}$$

The duty cycle correction factor of -20.5 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



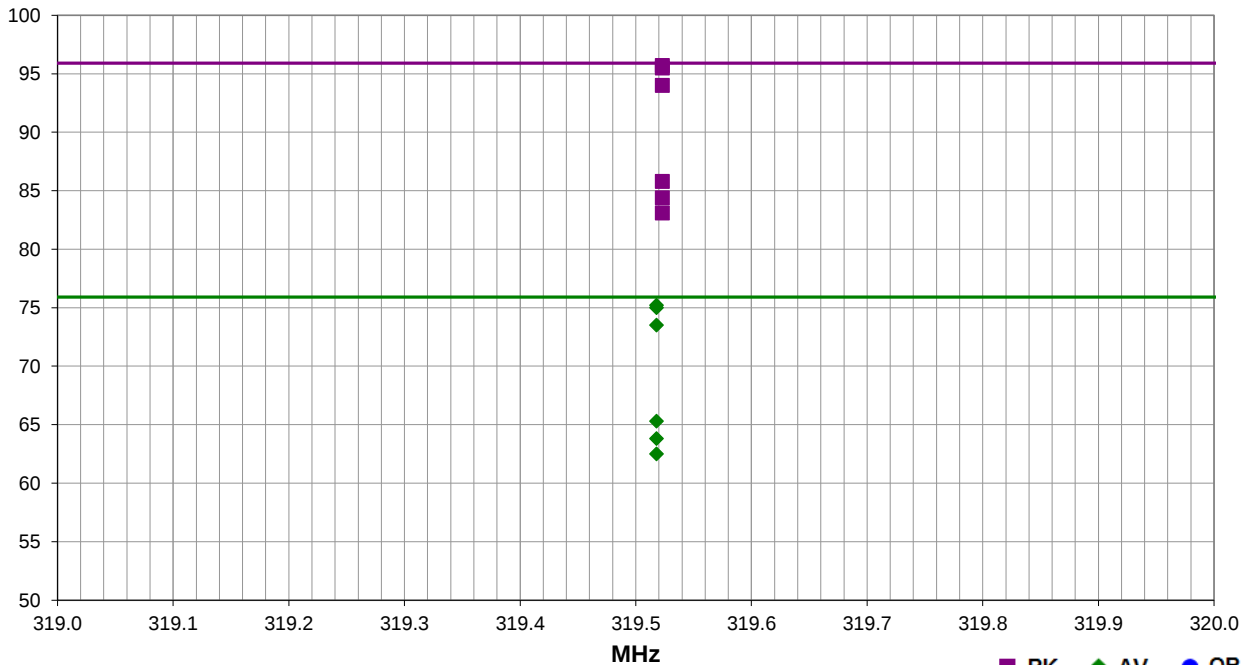
EmiRS 2017.07.11

PSA-ESCI 2017.06.01

|                 |                             |                   |           |                                                                                    |
|-----------------|-----------------------------|-------------------|-----------|------------------------------------------------------------------------------------|
| Work Order:     | CINC0011                    | Date:             | 09/05/17  |  |
| Project:        | None                        | Temperature:      | 22.5 °C   |                                                                                    |
| Job Site:       | MN09                        | Humidity:         | 52.8% RH  |                                                                                    |
| Serial Number:  | 12345                       | Barometric Pres.: | 1018 mbar | Tested by: Kyle McMullan                                                           |
| EUT:            | RF-WIN-WATER-319            |                   |           |                                                                                    |
| Configuration:  | 1                           |                   |           |                                                                                    |
| Customer:       | CINCH Systems               |                   |           |                                                                                    |
| Attendees:      | Jibril Aga                  |                   |           |                                                                                    |
| EUT Power:      | Battery                     |                   |           |                                                                                    |
| Operating Mode: | Tx unmodulated at 319.5 MHz |                   |           |                                                                                    |
| Deviations:     | None                        |                   |           |                                                                                    |
| Comments:       | None                        |                   |           |                                                                                    |

|                     |                 |             |                  |
|---------------------|-----------------|-------------|------------------|
| Test Specifications | FCC 15.231:2017 | Test Method | ANSI C63.10:2013 |
|---------------------|-----------------|-------------|------------------|

|       |   |                   |   |                   |           |         |      |
|-------|---|-------------------|---|-------------------|-----------|---------|------|
| Run # | 6 | 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    |
|------------|------------------|-------------|-------------------------|-------------------|-----------------------------------|---------------------------|--------------------------|----------|--------------------------|-------------------|----------------------|------------------------|-------------|
| 319.523    | 76.2             | 19.5        | 1.0                     | 332.0             | 0.0                               | 0.0                       | Horz                     | PK       | 0.0                      | 95.7              | 95.9                 | -0.2                   | EUT Vert    |
| 319.523    | 76.0             | 19.5        | 1.0                     | 0.0               | 0.0                               | 0.0                       | Horz                     | PK       | 0.0                      | 95.5              | 95.9                 | -0.4                   | EUT Horz    |
| 319.518    | 76.2             | 19.5        | 1.0                     | 332.0             | -20.5                             | 0.0                       | Horz                     | AV       | 0.0                      | 75.2              | 75.9                 | -0.7                   | EUT Vert    |
| 319.518    | 76.0             | 19.5        | 1.0                     | 0.0               | -20.5                             | 0.0                       | Horz                     | AV       | 0.0                      | 75.0              | 75.9                 | -0.9                   | EUT Horz    |
| 319.523    | 74.5             | 19.5        | 1.0                     | 340.0             | 0.0                               | 0.0                       | Horz                     | PK       | 0.0                      | 94.0              | 95.9                 | -1.9                   | EUT On Side |
| 319.518    | 74.5             | 19.5        | 1.0                     | 340.0             | -20.5                             | 0.0                       | Horz                     | AV       | 0.0                      | 73.5              | 75.9                 | -2.4                   | EUT On Side |
| 319.523    | 66.3             | 19.5        | 3.0                     | 61.0              | 0.0                               | 0.0                       | Vert                     | PK       | 0.0                      | 85.8              | 95.9                 | -10.1                  | EUT Vert    |
| 319.518    | 66.3             | 19.5        | 3.0                     | 61.0              | -20.5                             | 0.0                       | Vert                     | AV       | 0.0                      | 65.3              | 75.9                 | -10.6                  | EUT Vert    |
| 319.523    | 64.9             | 19.5        | 3.1                     | 73.0              | 0.0                               | 0.0                       | Vert                     | PK       | 0.0                      | 84.4              | 95.9                 | -11.5                  | EUT Horz    |
| 319.518    | 64.8             | 19.5        | 3.1                     | 73.0              | -20.5                             | 0.0                       | Vert                     | AV       | 0.0                      | 63.8              | 75.9                 | -12.1                  | EUT Horz    |
| 319.523    | 63.6             | 19.5        | 3.1                     | 58.0              | 0.0                               | 0.0                       | Vert                     | PK       | 0.0                      | 83.1              | 95.9                 | -12.8                  | EUT On Side |
| 319.518    | 63.5             | 19.5        | 3.1                     | 58.0              | -20.5                             | 0.0                       | Vert                     | AV       | 0.0                      | 62.5              | 75.9                 | -13.4                  | EUT On Side |

# SPURIOUS RADIATED EMISSIONS



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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

Tx unmodulated at 319.5 MHz

## POWER SETTINGS INVESTIGATED

Battery

## CONFIGURATIONS INVESTIGATED

CINC0011 - 1

## FREQUENCY RANGE INVESTIGATED

|                 |        |                |          |
|-----------------|--------|----------------|----------|
| Start Frequency | 30 MHz | Stop Frequency | 4000 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 |
|------------------------------|---------------|--------------------------------|-----|------------|----------|
| Amplifier - Pre-Amplifier    | Miteq         | AMF-3D-00100800-32-13P         | AVX | 2/23/2017  | 12 mo    |
| Cable                        | Element       | Double Ridge Guide Horn Cables | MNV | 2/16/2017  | 12 mo    |
| Antenna - Double Ridge       | ETS-Lindgren  | 3115                           | AJQ | 11/14/2016 | 24 mo    |
| Amplifier - Pre-Amplifier    | Miteq         | AM-1064-9079 and SA18E-10      | AOO | 2/24/2017  | 12 mo    |
| Cable                        | Element       | Biconilog Cable                | MNX | 2/16/2017  | 12 mo    |
| Antenna - Biconilog          | ETS Lindgren  | 3142D                          | AXO | 12/11/2015 | 24 mo    |
| Filter - High Pass           | Micro-Tronics | HPM50108                       | LFM | 9/22/2016  | 12 mo    |
| Filter - Low Pass            | Micro-Tronics | LPM50004                       | LFK | 9/22/2016  | 12 mo    |
| Analyzer - Spectrum Analyzer | Keysight      | N9010A (EXA)                   | AFQ | 12/22/2016 | 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             |

# SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2017.06.01

## 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" =  $N1L1 + N2L2 + \dots$

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 =  $(N1L1 + N2L2 + \dots)/100\text{mS}$  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 = 0.160 mSec  
Pulsewidth of Type 2 Pulse = 0.480 mSec  
Number of Type 1 Pulses = 56  
Number of Type 2 Pulses = 1

$20 \log [(56)(0.160) + (1)(0.480)] = -20.5 \text{ dB}$

The duty cycle correction factor of -20.5 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



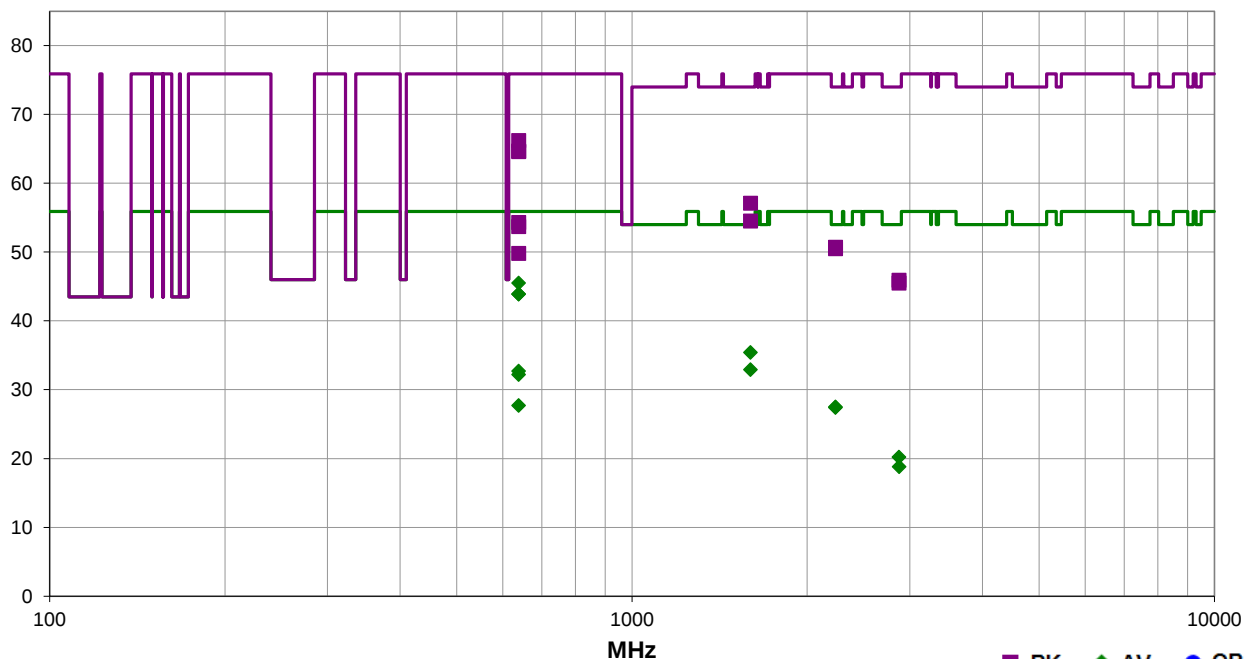
EniRS 2017.07.11

PSA-ESCI 2017.06.01

|                 |                             |                   |           |                                                                                    |
|-----------------|-----------------------------|-------------------|-----------|------------------------------------------------------------------------------------|
| Work Order:     | CINC0011                    | Date:             | 09/05/17  |  |
| Project:        | None                        | Temperature:      | 22.5 °C   |                                                                                    |
| Job Site:       | MN09                        | Humidity:         | 52.8% RH  |                                                                                    |
| Serial Number:  | 12345                       | Barometric Pres.: | 1018 mbar | Tested by: Kyle McMullan                                                           |
| EUT:            | RF-WIN-WATER-319            |                   |           |                                                                                    |
| Configuration:  | 1                           |                   |           |                                                                                    |
| Customer:       | CINCH Systems               |                   |           |                                                                                    |
| Attendees:      | Jibril Aga                  |                   |           |                                                                                    |
| EUT Power:      | Battery                     |                   |           |                                                                                    |
| Operating Mode: | Tx unmodulated at 319.5 MHz |                   |           |                                                                                    |
| Deviations:     | None                        |                   |           |                                                                                    |
| Comments:       | None                        |                   |           |                                                                                    |

|                     |                 |             |                  |
|---------------------|-----------------|-------------|------------------|
| Test Specifications | FCC 15.231:2017 | Test Method | ANSI C63.10:2013 |
|---------------------|-----------------|-------------|------------------|

|       |   |                   |   |                   |           |         |      |
|-------|---|-------------------|---|-------------------|-----------|---------|------|
| Run # | 7 | 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    |
|------------|------------------|-------------|-------------------------|-------------------|-----------------------------------|---------------------------|--------------------------|----------|--------------------------|-------------------|----------------------|------------------------|-------------|
| 639.036    | 48.4             | 7.8         | 1.0                     | 334.0             | 0.0                               | 10.0                      | Horz                     | PK       | 0.0                      | 66.2              | 75.9                 | -9.7                   | EUT Vert    |
| 639.031    | 48.2             | 7.8         | 1.0                     | 334.0             | -20.5                             | 10.0                      | Horz                     | AV       | 0.0                      | 45.5              | 55.9                 | -10.4                  | EUT Vert    |
| 639.036    | 46.9             | 7.8         | 1.0                     | 351.0             | 0.0                               | 10.0                      | Horz                     | PK       | 0.0                      | 64.7              | 75.9                 | -11.2                  | EUT Horz    |
| 639.041    | 46.8             | 7.8         | 1.0                     | 157.0             | 0.0                               | 10.0                      | Horz                     | PK       | 0.0                      | 64.6              | 75.9                 | -11.3                  | EUT On Side |
| 639.031    | 46.6             | 7.8         | 1.0                     | 157.0             | -20.5                             | 10.0                      | Horz                     | AV       | 0.0                      | 43.9              | 55.9                 | -12.0                  | EUT On Side |
| 639.031    | 46.6             | 7.8         | 1.0                     | 351.0             | -20.5                             | 10.0                      | Horz                     | AV       | 0.0                      | 43.9              | 55.9                 | -12.0                  | EUT Horz    |
| 1597.715   | 62.9             | -5.8        | 1.0                     | 143.0             | 0.0                               | 0.0                       | Horz                     | PK       | 0.0                      | 57.1              | 74.0                 | -16.9                  | EUT Vert    |
| 1597.573   | 61.7             | -5.8        | 1.0                     | 143.0             | -20.5                             | 0.0                       | Horz                     | AV       | 0.0                      | 35.4              | 54.0                 | -18.6                  | EUT Vert    |
| 1597.607   | 60.3             | -5.8        | 1.0                     | 110.0             | 0.0                               | 0.0                       | Vert                     | PK       | 0.0                      | 54.5              | 74.0                 | -19.5                  | EUT On Side |
| 1597.582   | 59.2             | -5.8        | 1.0                     | 110.0             | -20.5                             | 0.0                       | Vert                     | AV       | 0.0                      | 32.9              | 54.0                 | -21.1                  | EUT On Side |
| 639.036    | 36.5             | 7.8         | 1.0                     | 306.0             | 0.0                               | 10.0                      | Vert                     | PK       | 0.0                      | 54.3              | 75.9                 | -21.6                  | EUT On Side |
| 639.041    | 35.9             | 7.8         | 1.0                     | 95.0              | 0.0                               | 10.0                      | Vert                     | PK       | 0.0                      | 53.7              | 75.9                 | -22.2                  | EUT Vert    |
| 639.031    | 35.4             | 7.8         | 1.0                     | 306.0             | -20.5                             | 10.0                      | Vert                     | AV       | 0.0                      | 32.7              | 55.9                 | -23.2                  | EUT On Side |

| Freq<br>(MHz) | Amplitude<br>(dBuV) | Factor<br>(dB) | Antenna Height<br>(meters) | Azimuth<br>(degrees) | Duty Cycle<br>Correction<br>Factor<br>(dB) | External<br>Attenuation<br>(dB) | Polarity/<br>Transducer<br>Type | Detector | Distance<br>Adjustment<br>(dB) | Adjusted<br>(dBuV/m) | Spec. Limit<br>(dBuV/m) | Compared to<br>Spec.<br>(dB) | Comments    |
|---------------|---------------------|----------------|----------------------------|----------------------|--------------------------------------------|---------------------------------|---------------------------------|----------|--------------------------------|----------------------|-------------------------|------------------------------|-------------|
| 2236.727      | 53.6                | -2.9           | 1.1                        | 229.0                | 0.0                                        | 0.0                             | Vert                            | PK       | 0.0                            | 50.7                 | 74.0                    | -23.3                        | EUT On Side |
| 2236.593      | 53.4                | -2.9           | 3.5                        | 185.0                | 0.0                                        | 0.0                             | Horz                            | PK       | 0.0                            | 50.5                 | 74.0                    | -23.5                        | EUT Vert    |
| 639.031       | 34.9                | 7.8            | 1.0                        | 95.0                 | -20.5                                      | 10.0                            | Vert                            | AV       | 0.0                            | 32.2                 | 55.9                    | -23.7                        | EUT Vert    |
| 639.031       | 32.0                | 7.8            | 1.1                        | 172.0                | 0.0                                        | 10.0                            | Vert                            | PK       | 0.0                            | 49.8                 | 75.9                    | -26.1                        | EUT Horz    |
| 2236.618      | 50.9                | -2.9           | 1.1                        | 229.0                | -20.5                                      | 0.0                             | Vert                            | AV       | 0.0                            | 27.5                 | 54.0                    | -26.5                        | EUT On Side |
| 2236.593      | 50.8                | -2.9           | 3.5                        | 185.0                | -20.5                                      | 0.0                             | Horz                            | AV       | 0.0                            | 27.4                 | 54.0                    | -26.6                        | EUT Vert    |
| 2875.645      | 47.5                | -1.6           | 1.0                        | 122.0                | 0.0                                        | 0.0                             | Horz                            | PK       | 0.0                            | 45.9                 | 74.0                    | -28.1                        | EUT Vert    |
| 639.036       | 30.4                | 7.8            | 1.1                        | 172.0                | -20.5                                      | 10.0                            | Vert                            | AV       | 0.0                            | 27.7                 | 55.9                    | -28.2                        | EUT Horz    |
| 2875.653      | 47.1                | -1.6           | 1.0                        | 58.0                 | 0.0                                        | 0.0                             | Vert                            | PK       | 0.0                            | 45.5                 | 74.0                    | -28.5                        | EUT On Side |
| 2875.645      | 42.3                | -1.6           | 1.0                        | 122.0                | -20.5                                      | 0.0                             | Horz                            | AV       | 0.0                            | 20.2                 | 54.0                    | -33.8                        | EUT Vert    |
| 2875.662      | 40.9                | -1.6           | 1.0                        | 58.0                 | -20.5                                      | 0.0                             | Vert                            | AV       | 0.0                            | 18.8                 | 54.0                    | -35.2                        | EUT On Side |

# OCCUPIED BANDWIDTH



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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 | 2/16/2017  | 2/16/2018  |
| Antenna - Biconilog          | ETS Lindgren | 3142D           | AXO | 12/11/2015 | 12/11/2017 |
| Analyzer - Spectrum Analyzer | Keysight     | N9010A (EXA)    | AFQ | 12/22/2016 | 12/22/2017 |

## TEST DESCRIPTION

The measurement was made in a radiated configuration of the fundamental with the carrier fully maximized for its highest radiated power. 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



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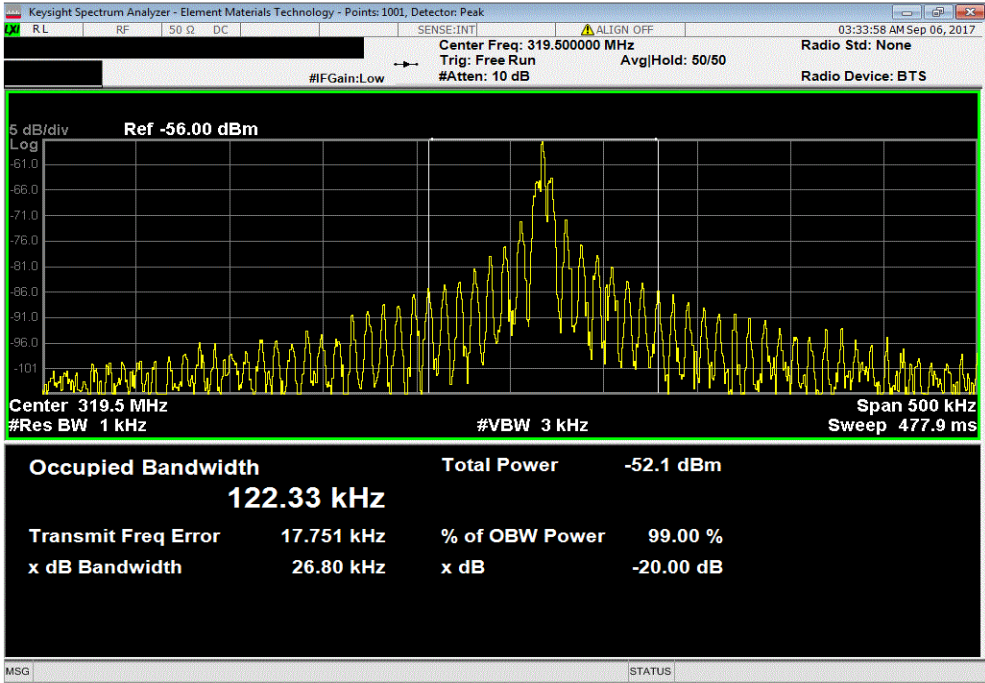
|                               |   |                                |             |
|-------------------------------|---|--------------------------------|-------------|
| EUT: RF-WIN-WATER-319         |   | Work Order: CINC0011           |             |
| Serial Number: 12345          |   | Date: 09/05/17                 |             |
| Customer: CINCH Systems       |   | Temperature: 22.3 °C           |             |
| Attendees: Jibril Aga         |   | Humidity: 40.4% RH             |             |
| Project: None                 |   | Barometric Pres.: 1019 mbar    |             |
| Tested by: Kyle McMullan      |   | Power: Battery                 |             |
|                               |   | Job Site: MN09                 |             |
| TEST SPECIFICATIONS           |   | Test Method                    |             |
| FCC 15.231:2017               |   | ANSI C63.10:2013               |             |
| COMMENTS                      |   |                                |             |
| None                          |   |                                |             |
| DEVIATIONS FROM TEST STANDARD |   |                                |             |
| None                          |   |                                |             |
| Configuration #               | 1 | Signature <i>Kyle McMullan</i> |             |
|                               |   | 20dB OB (kHz)                  | Limit (kHz) |
| 319.5MHz                      |   | 26.8                           | 798         |
|                               |   |                                | Result      |
|                               |   |                                | Pass        |

OCCUPIED BANDWIDTH



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|          |  |  |  |               |             |        |
|----------|--|--|--|---------------|-------------|--------|
| 319.5MHz |  |  |  |               |             |        |
|          |  |  |  | 20dB OB (kHz) | Limit (kHz) | Result |
|          |  |  |  | 26.8          | 798         | Pass   |



# DUTY CYCLE



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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   |
|------------------------------|---------------|-----------------|-----|------------|------------|
| Filter - Low Pass            | Micro-Tronics | LPM50004        | LFK | 9/22/2016  | 9/22/2017  |
| Cable                        | Element       | Biconilog Cable | MNX | 2/16/2017  | 2/16/2018  |
| Antenna - Biconilog          | ETS Lindgren  | 3142D           | AXO | 12/11/2015 | 12/11/2017 |
| Analyzer - Spectrum Analyzer | Keysight      | N9010A (EXA)    | AFQ | 12/22/2016 | 12/22/2017 |

## 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" =  $N1L1 + N2L2 + \dots$

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 =  $(N1L1 + N2L2 + \dots)/100\text{mS}$  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 = 0.160 mSec

Pulsewidth of Type 2 Pulse = 0.480 mSec

Number of Type 1 Pulses = 56

Number of Type 2 Pulses = 1

Duty Cycle =  $20 \log [(56)(0.160) + (1)(0.480)] = -20.5 \text{ dB}$

The duty cycle correction factor of -20.5 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



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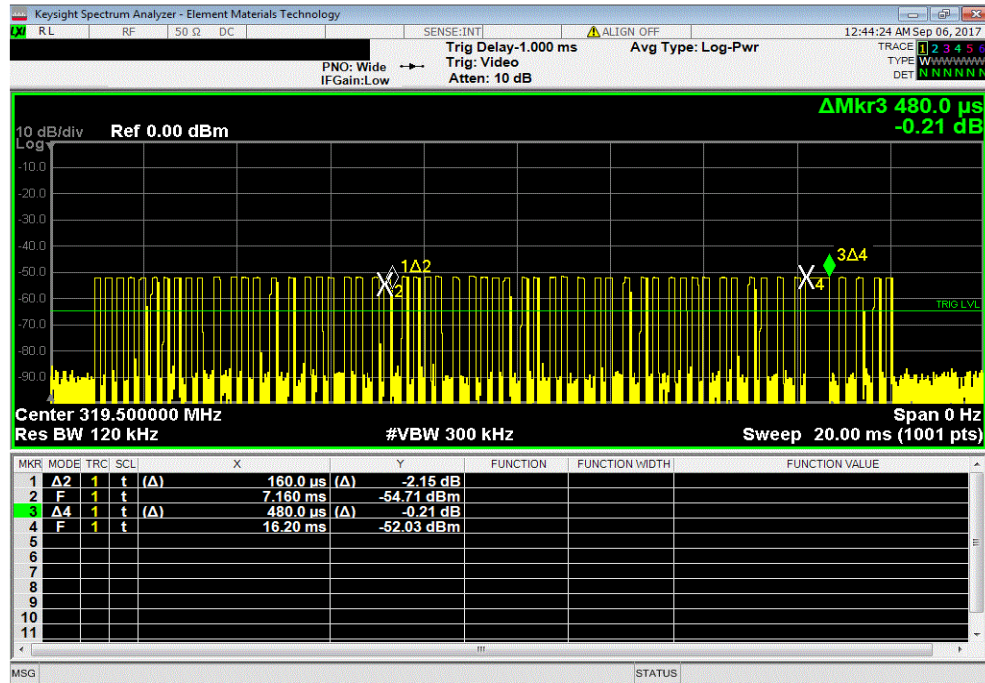
|                               |   |                                |                        |
|-------------------------------|---|--------------------------------|------------------------|
| EUT: RF-WIN-WATER-319         |   | Work Order: CINC0011           |                        |
| Serial Number: 12345          |   | Date: 09/05/17                 |                        |
| Customer: CINCH Systems       |   | Temperature: 22.3 °C           |                        |
| Attendees: Jibril Aga         |   | Humidity: 45.3% RH             |                        |
| Project: None                 |   | Barometric Pres.: 1019 mbar    |                        |
| Tested by: Kyle McMullan      |   | Power: Battery                 |                        |
| Job Site: MN09                |   |                                |                        |
| TEST SPECIFICATIONS           |   |                                |                        |
| FCC 15.231:2017               |   | Test Method                    |                        |
|                               |   | ANSI C63.10:2013               |                        |
| COMMENTS                      |   |                                |                        |
| None                          |   |                                |                        |
| DEVIATIONS FROM TEST STANDARD |   |                                |                        |
| None                          |   |                                |                        |
| Configuration #               | 1 | Signature <i>Kyle McMullan</i> |                        |
|                               |   | Length of Type 1 Pulse (ms)    | Number of Type 1 Pulse |
| 319.5MHz, 20ms                |   | 0.16                           | 56                     |
| 319.5MHz, 1s                  |   | N/A                            | N/A                    |
| 319.5MHz, 10s                 |   | N/A                            | N/A                    |
|                               |   | Length of Type 2 Pulse (ms)    | Number of Type 2 Pulse |
|                               |   | 0.48                           | 1                      |
|                               |   | N/A                            | N/A                    |
|                               |   | N/A                            | N/A                    |
|                               |   | DCCF                           | Limit                  |
|                               |   | -20.5                          | N/A                    |
|                               |   | N/A                            | N/A                    |
|                               |   | N/A                            | N/A                    |
|                               |   | Result                         |                        |
|                               |   | N/A                            |                        |
|                               |   | N/A                            |                        |
|                               |   | N/A                            |                        |

# DUTY CYCLE

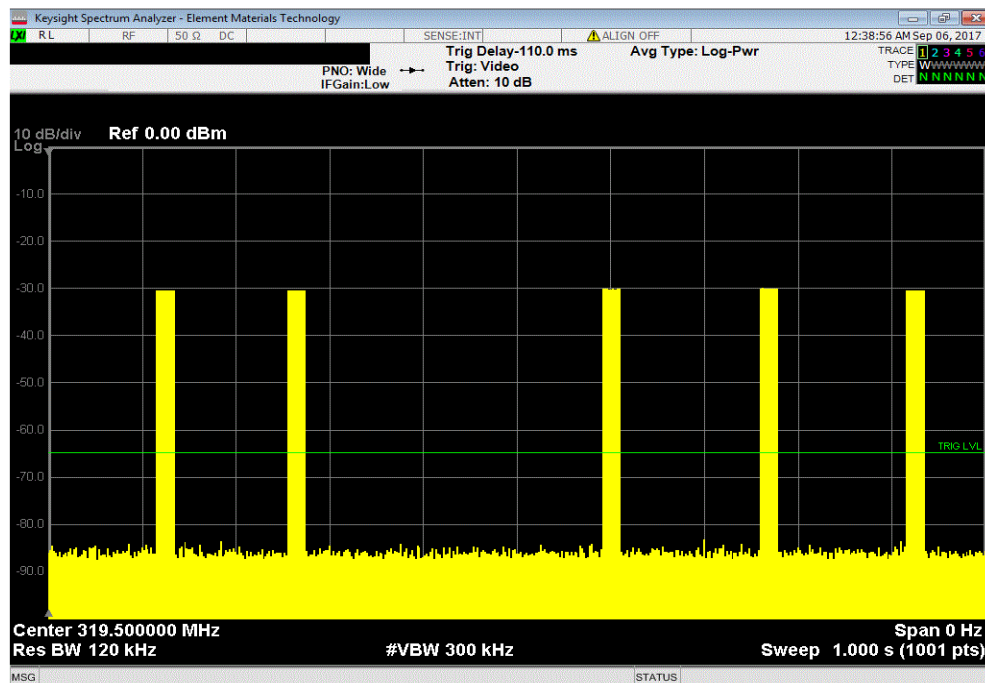


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| 319.5MHz, 20ms                 |                           |                                |                           |       |       |        |
|--------------------------------|---------------------------|--------------------------------|---------------------------|-------|-------|--------|
| Length of Type<br>1 Pulse (ms) | Number of<br>Type 1 Pulse | Length of Type<br>2 Pulse (ms) | Number of<br>Type 2 Pulse | DCCF  | Limit | Result |
| 0.16                           | 56                        | 0.48                           | 1                         | -20.5 | N/A   | N/A    |



| 319.5MHz, 1s                   |                           |                                |                           |      |       |        |
|--------------------------------|---------------------------|--------------------------------|---------------------------|------|-------|--------|
| Length of Type<br>1 Pulse (ms) | Number of<br>Type 1 Pulse | Length of Type<br>2 Pulse (ms) | Number of<br>Type 2 Pulse | DCCF | Limit | Result |
| N/A                            | N/A                       | N/A                            | N/A                       | N/A  | N/A   | N/A    |



DUTY CYCLE



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| 319.5MHz, 10s               |                        |                             |                        |      |       |        |
|-----------------------------|------------------------|-----------------------------|------------------------|------|-------|--------|
| Length of Type 1 Pulse (ms) | Number of Type 1 Pulse | Length of Type 2 Pulse (ms) | Number of Type 2 Pulse | DCCF | Limit | Result |
| N/A                         | N/A                    | N/A                         | N/A                    | N/A  | N/A   | N/A    |

