Report on the Radio Testing

For

Lodar Ltd

on

P121

Report No. TRA-034693-47-05B

26 November 2018

Report Number: TRA-034693-47-05B
Issue: A

REPORT ON THE RADIO TESTING OF A
Lodar Ltd
P121
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.231

TEST DATE: 2018/10/23 to 2018/10/30

Written by: Steve Garwell cn=Steve Garwell, o=Element Material Technology, ou, email=steve.garwell@element.com, c=GB I am the author of this document 2018.12.21 09:37:07 Z

Daniel Moncayola / Steven Garwell
Radio Test Engineer

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John Charters
Department Manager - Radio

Date: 26 November 2018

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	26 November 2018	Original

2 Summary

TEST REPORT NUMBER:	TRA-034693-47-05B
WORKS ORDER NUMBER:	TRA-034693-12
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J.
TEST SPECIFICATION:	47CFR15.231
EQUIPMENT UNDER TEST (EUT):	P121
FCC IDENTIFIER:	M2H-P121
MANUFACTURER/AGENT:	Lodar Ltd
ADDRESS:	60 Sandwell Street Walsall West Midlands WS1 3EB United Kingdom
CLIENT CONTACT:	Callum Bassie ☎ 01922 728352 ✉ callum@lodar.com
ORDER NUMBER:	12630
SERIAL NUMBER:	000010, 000011
TEST DATE:	2018/10/23 to 2018/10/30
TESTED BY:	Daniel Moncayola / Steven Garwell Element

2.1 Test Summary

Test Method and Description	*Requirement Clause 47CFR15*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions	15.231(b)	☒	*PASS*
AC power line conducted emissions	15.207	☐	*Note 1*
Occupied bandwidth	15.215(c) 15.231(c)	☐	*PASS*
Field strength of fundamental	15.231(b)	☒	*PASS*
Calculation of duty correction	15.35(c)	☒	*PASS*
Periodic operation	15.231(a)	☒	*PASS*

Notes:

Note 1: Not applicable the EUT is battery operated

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-034693-47-05B presents the results of the Radio testing on a Lodar Ltd, P121 to specification 47CFR15 Radio Frequency Devices: Category I Equipment.

The testing was carried out for Lodar Ltd by Element, at the address detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element North West
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

The test site requirements of ANSI C63.4-2014 are met up to 1 GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment Under Test

7.1 EUT Identification

- Name: P121
- Serial Number: 000010
- Model Number: TX5008
- Software Revision: V1.1
- Build Level / Revision Number: P121 V2

- Name: P121
- Serial Number: 000011
- Model Number: TX5008
- Software Revision: V1.1
- Build Level / Revision Number: P121 V2

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Not Applicable – No support/monitoring equipment required.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Transmit tests was as follows:-

The device was supplied with test firmware programmed for both modulated and unmodulated operation on the required frequency.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	433.05 MHz / 434.79 MHz
Modulation type:	2-FSK
Occupied channel bandwidth:	40 kHz
Channel spacing:	NARROWBAND
Nominal Supply Voltage:	3.2 V dc
Duty cycle:	< 30%

7.4.2 Antennas

Type:	Printed Antenna
Gain:	< 1 dBi

7.5 EUT Description

The EUT is a radio operated remote control for controlling heavy plant machinery.

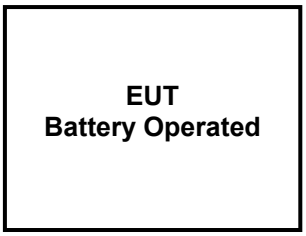
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

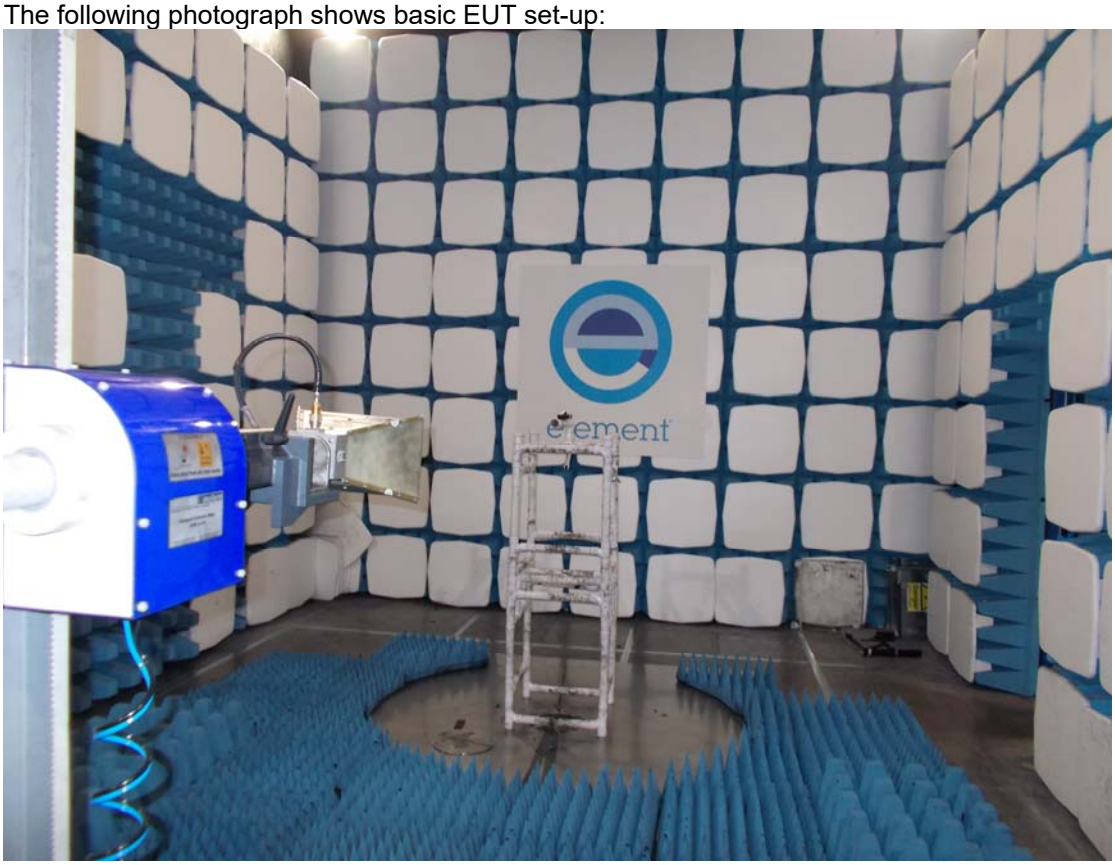
9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 3 V dc from alkaline batteries.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

	Category	***Nominal***	***Variation***
☐	Mains	110 V ac +/-2 %	85 % and 115 %
☒	Battery	New battery	N/A

11 Radiated emissions

11.1 Definitions

Out-of-band emissions
Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

Spurious emissions
Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequency Measured:	433.05 MHz / 434.79 MHz
EUT Channel Bandwidths:	40 kHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 43 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	3 V dc (as declared)

11.3 Test Limit

In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:.

Fundamental Frequency (MHz)	*Field Strength Of Fundamental (µV/m)*	*Field Strength Of Spurious Emissions (µV/m)*
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750	125 to 375
174-260	3,750	375
260-470	3,750 to 12,500	375 to 1,250
Above 470	12,500	1,250

The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in § 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of § 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in § 15.209, whichever limit permits a higher field strength.

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

Frequency (MHz)	*Field Strength (µV/m at 3 m)*
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

n.b. per FCC 47CFR15.35(b) peak limit is 20 dB above average.

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

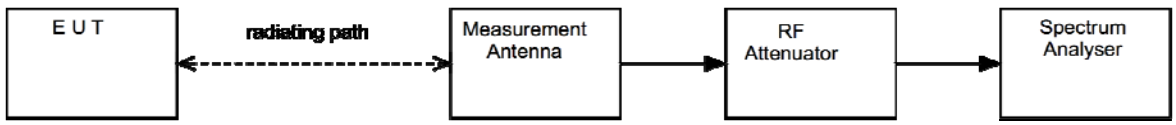
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

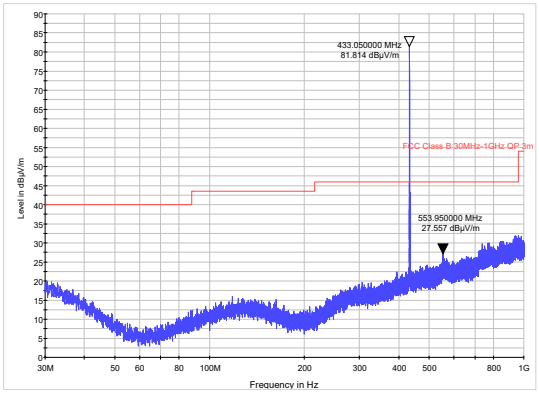
Figure i Test Setup



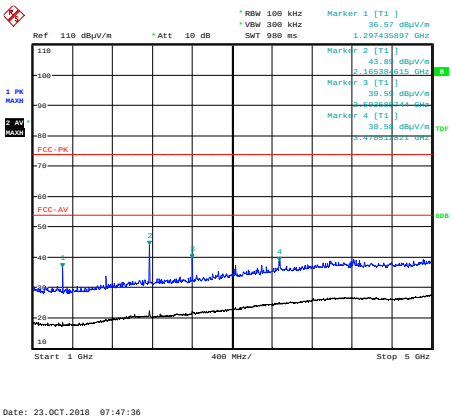
11.5 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2019-05-22
Pre Amp	Agilent	8449B	L572	2019-10-12
1-18GHz Horn	EMCO	3115	L139	2019-09-25
1-18GHz Horn	EMCO	3115	U223	2019-10-25
Receiver	R&S	ESVS10	L317	2019-03-22
Bilog	Chase	CBL611/A	U573	2019-08-02
Log Periodic Ant	Chase	UPA6108	L203	2020-06-11

11.6 Test Results

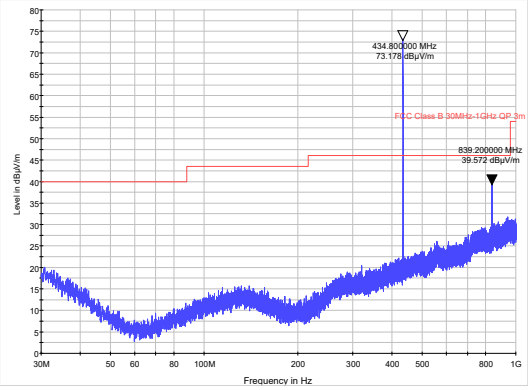


30 MHz to 1 GHz

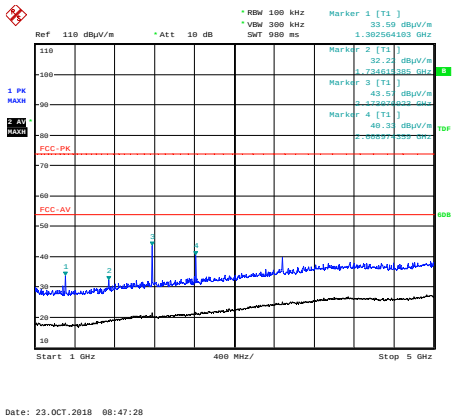


1 GHz to 5 GHz

Frequency 433.05 MHz:										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
QP	866.10	39.20	4.01	29.40	28.10	0.00	0.00	44.51	168.07	200
Pk	1299.15	51.94	2.50	24.80	37.42	0.00	0.00	41.82	123.31	500
Av	1299.15	44.72	2.50	24.80	37.42	0.00	0.00	34.60	53.70	500
Pk	2598.30	50.61	3.70	28.90	36.50	0.00	0.00	46.71	216.52	500
Av	2598.30	42.84	3.70	28.90	36.50	0.00	0.00	38.94	88.51	500



30 MHz to 1 GHz



1 GHz to 5 GHz

Frequency 434.79 MHz:										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
QP	869.58	38.20	4.02	29.40	28.10	0.00	0.00	43.52	149.97	200
Pk	1304.37	51.67	2.50	24.80	37.41	0.00	0.00	41.56	119.67	500
Av	1304.37	43.70	2.50	24.80	37.41	0.00	0.00	33.59	47.81	500
Pk	2173.95	56.19	3.30	27.90	36.50	0.00	0.00	50.89	350.35	500
Av	2173.95	52.67	3.30	27.90	36.50	0.00	0.00	47.37	233.61	500

12 Occupied Bandwidth

12.1 Definitions

Occupied bandwidth
The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the emitted power. This is also known as the *99 % emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

20 dB bandwidth
The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	433.05 MHz / 434.79 MHz
EUT Channel Bandwidths:	33 kHz
EUT Test Modulations:	2-FSK
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	500 Hz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3 kHz
Measurement Span: (requirement 2 to 5 times OBW)	75 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 43 % RH	20 % RH to 75 % RH (as declared)
Supply: 6 V dc	6 V dc (as declared)

12.3 Test Limit

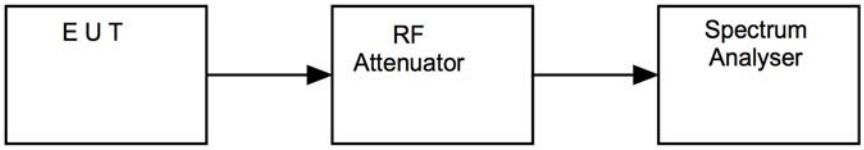
The 99% bandwidth of momentarily operated devices shall be less or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the 99% bandwidth shall be less or equal to 0.5% of the centre frequency.

12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iii Test Setup

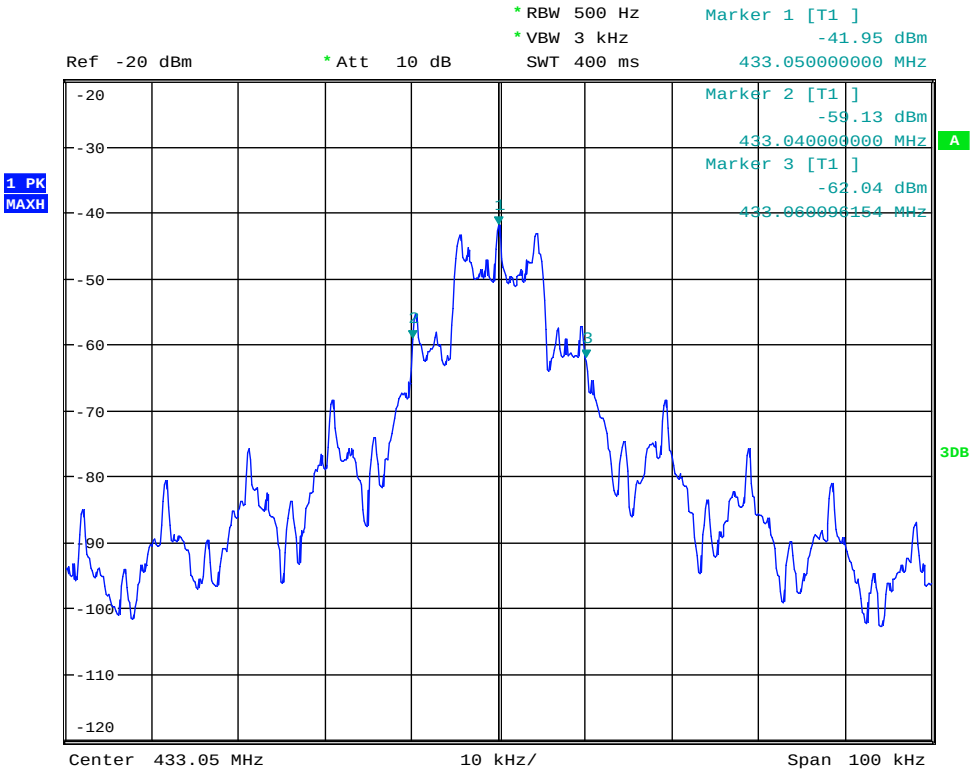


12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	FSU50	U544	2019-05-22

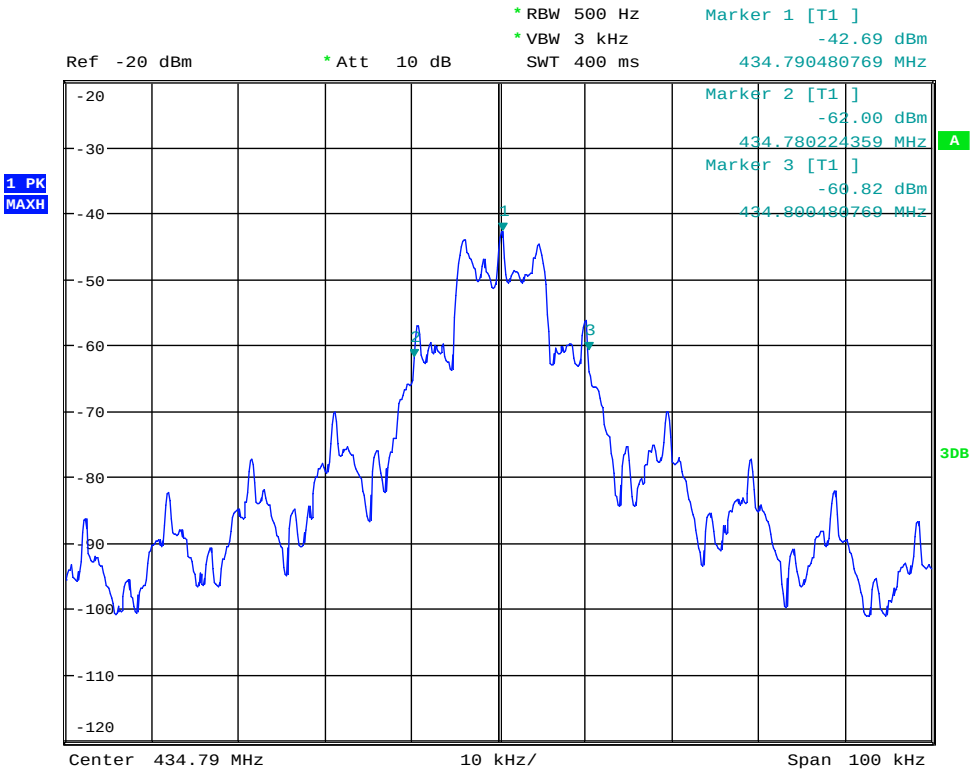
12.6 Test Results

Frequency 433.05 MHz:					
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***20 dB Bandwidth (kHz)***	***Limit (MHz)***	***Result***
433.05	433.040000	433.0600062	20.006154	1.08	PASS



Date: 26.OCT.2018 17:48:16

Frequency 434.79 MHz:					
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**20 dB Bandwidth (kHz)**	**Limit (MHz)**	**Result**
434.79	434.7802244	434.8004808	20.256401	1.09	PASS



Date: 26.OCT.2018 17:37:42

13 Transmitter output power (fundamental radiated emission)

13.1 Definition

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Frequency Measured:	433.05 MHz / 434.79 MHz
EUT Channel Bandwidths:	40 kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	1 MHz
Measurement Detector:	Up to 1 GHz: Quasi-peak Above 1 GHz: Average RMS and Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 43 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

The field strength measured at 3 meters shall not exceed the limits in the following table:

Fundamental frequency (MHz)	***Field strength (µV/m at 3 m)***
40.66-40.70	2,250
70-130	1,250
130-174	1,250 to 3,750
174-260	3,750
260-470	3,750 to 12,500
Above 470	12,500

Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in § 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of § 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

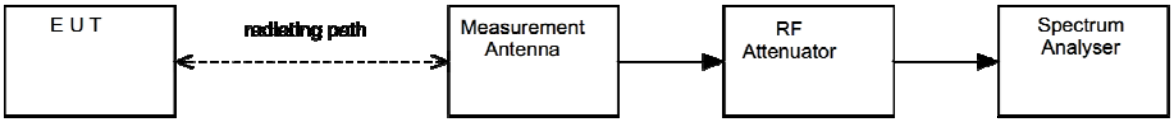
n.b. per FCC 47CFR15.249(e) peak limit is 20 dB above average.

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iv Test Setup



13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	FSU50	U544	2019-05-22
Bilog	Chase	CBL611/A	U573	2019-08-02

13.6 Test Results

Detector	*Freq. (MHz)*	*Meas'd Emission (dBµV)*	*Cable Loss (dB)*	*Antenna Factor (dB/m)*	*Pre-amp Gain (dB)*	*Duty Cycle Corr'n (dB)*	*Distance Extrap'n Factor (dB)*	*Field Strength (dBµV/m)*	*Field Strength (µV/m)*	*Limit (µV/m)*
Pk	433.05	63.05	2.83	22.86	N/A	0.00	0.00	88.74	27352.69	109622.0
Av	433.05	N/A	N/A	N/A	N/A	-10.4	N/A	78.34	8260.38	10962.20

Detector	*Freq. (MHz)*	*Meas'd Emission (dBµV)*	*Cable Loss (dB)*	*Antenna Factor (dB/m)*	*Pre-amp Gain (dB)*	*Duty Cycle Corr'n (dB)*	*Distance Extrap'n Factor (dB)*	*Field Strength (dBµV/m)*	*Field Strength (µV/m)*	*Limit (µV/m)*
Pk	434.79	64.04	2.85	22.90	N/A	0.00	0.00	89.79	30867.40	110347.0
Av	434.79	N/A	N/A	N/A	N/A	-10.4	N/A	79.39	9231.81	11034.70

14 Duty Cycle

14.1 Definition

The ratio of the sum of all pulse durations to the total period, during a specified period of operation. The duty cycle is determined on the basis of one complete pulse train for pulse trains not exceeding 100 milliseconds. Where the pulse train exceeds 100 milliseconds, the duty cycle is determined on the basis of the 100 millisecond interval with the highest average value of emission.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.5
EUT Frequency Measured:	434.79 MHz
EUT Channel loading:	30%
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 32 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	3 V dc (as declared)

14.3 Test Limit

N/A.
Note, the maximum duty cycle correction factor which may be used is 20dB.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vii, the duty of the EUT was calculated from the sum of total on and off times over the observation period.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, bandwidths, data rates and power settings were used to observe the worst-case configuration.

[1] Single antenna output devices

Duty was measured at the antenna port / at a distance of 3 m.

[2] Multiple antenna output devices

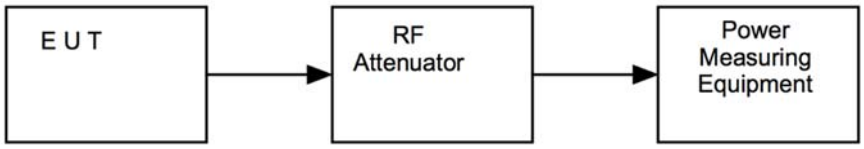
Duty was measured as the combination of all ports simultaneously / at a distance of 3 m.

The duty cycle correction factor, DC, is used to adjust peak emissions (voltage) to give an average value and is calculated by:

$$DC = 20 \log (\text{duty ratio})$$

Where, duty ratio is total on-time divided by total off-time in the worst-case pulse train or 100 ms, whichever is longer.

Figure vii Test Setup

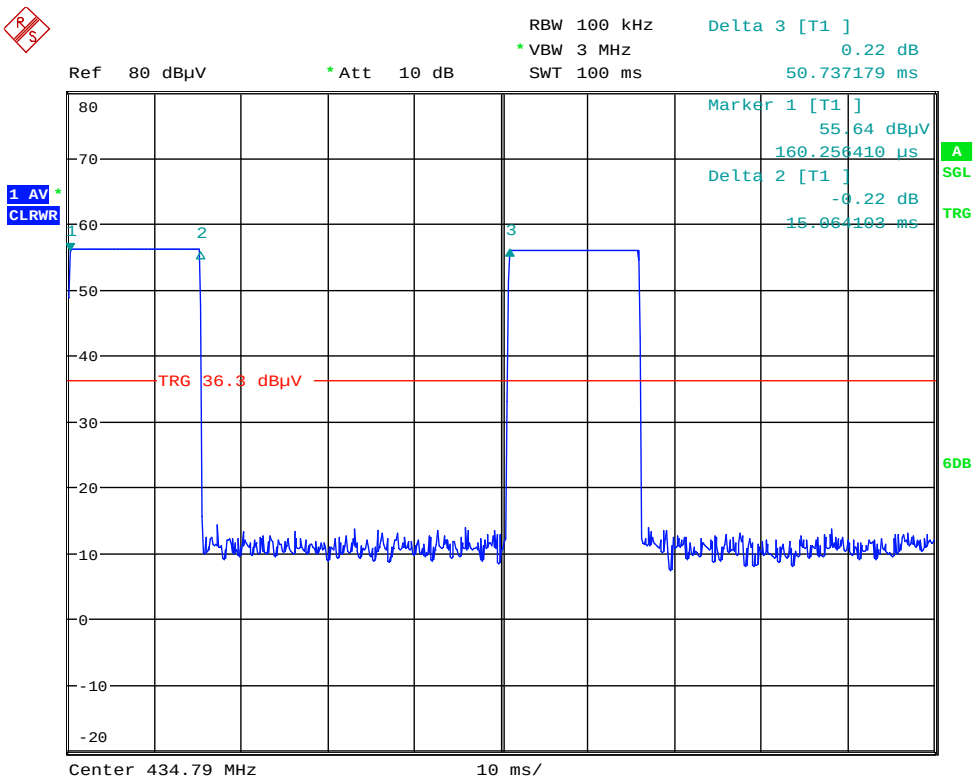


14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU50	R&S	Spectrum Analyser	U544	2019-05-22

14.6 Test Results

Frequency 434.79 MHz:						
Test Environment		Single Channel TxOn time (ms)	Total TxOn time (ms)	Observation period (ms)	Duty (%)	Calculated Factor (dB)
$V_{nominal}$	$T_{nominal}$	15.06	30.13	100	30	-10.4



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15 Periodic Operation

15.1 Definition

Measurement of the time period a device transmits for after a specified trigger.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.4
EUT Frequency Measured:	433.05 MHz
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 32 % RH	20 % RH to 75 % RH (as declared)
Supply: 6 V dc	6 V dc (as declared)

15.3 Test Limit

Devices shall comply with the following for momentary operation:

A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released

A transmitter that has been activated automatically shall cease transmission within 5 seconds of activation.

Periodic transmissions at regular, predetermined intervals are not permitted, except as specified in §Section A.1.4. However, polling or supervision transmissions that determine system integrity of transmitters used in security or safety applications are permitted, provided the total duration of transmission does not exceed 2 seconds per hour for each transmitter.

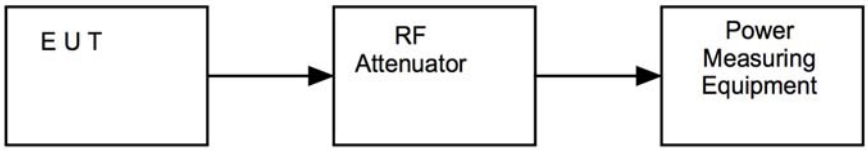
Intentional radiators used for radio control during emergencies involving fire, security of goods (e.g. burglar alarms), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure viii, the Unit was triggered manually and the measurement instrumentation set to trigger on release of the manual operation.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, bandwidths, data rates and power settings were used to observe the worst-case configuration.

Figure viil Test Setup

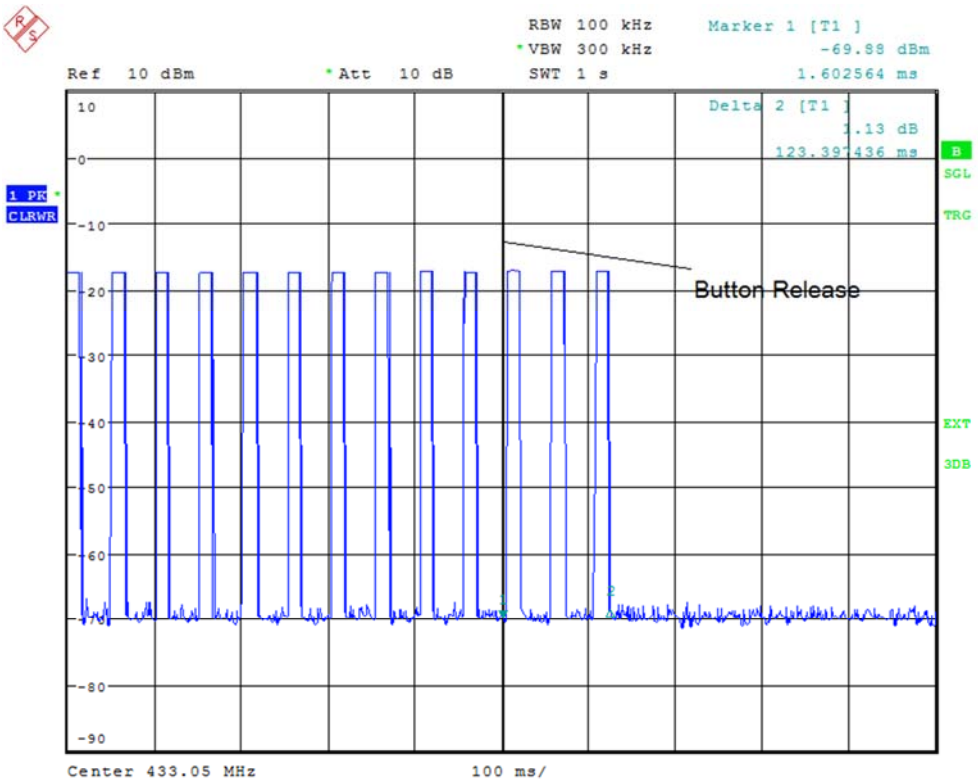


15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU50	R&S	Spectrum Analyser	U544	2019-05-22

Test Results

Frequency 433.05 MHz:			
Activation	***Transmit time (ms)***	***Limit (s)***	***Results***
Manual	123.40	5	Pass
Automatic	Not applicable (no Automatic transmissions)		



16 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

[1] Carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**
Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

[2] Spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[3] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[4] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113 ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265 ppm**

[6] Duty cycle

Uncertainty in test result = **7.98 %**