



DATE: 27 November 2017

I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report
for
ArrowSpot Systems LTD

Equipment under test:

ArrowTrack 3G-433

ARS-AD000

Tested by:

M. Zohar

Approved by:

D. Shidowsky

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This report relates only to items tested.



Measurement/Technical Report for ArrowSpot Systems LTD

ArrowTrack 3G-433

ARS-AD000

FCC ID: 2ANZWARRTRACK3G433

This report concerns:	Original Grant: <input checked="" type="checkbox"/> X
	Class I Change: <input type="checkbox"/>
	Class II Change: <input type="checkbox"/>
Equipment type:	DSR Part 15 Security/Remote Control Transmitter
Limits used:	47CFR15 Section 15.231 (a-d)

Measurement procedure used is ANSI C63.10-2013.

Application for Certification	Applicant for this device:
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1. General Information

1.1 Administrative Information

Manufacturer: ArrowSpot Systems LTD

Manufacturer's Address: 3 Hakerem St
Kfar Hess, 4069200, Israel
Tel: +972-72-250-2230
Fax: +972-72-250-2231

Manufacturer's Representative: Ran Grinshtain

Equipment Under Test (E.U.T): ArrowTrack 3G-433

Equipment Model No.: ARS-AD000

Equipment Serial No.: GDC20500EVK

Date of Receipt of E.U.T: October 17, 2017

Start of Test: October 17, 2017

End of Test: November 27, 2017

Test Laboratory Location: I.T.L (Product Testing) Ltd.
1 Batsheva St.,
Lod
ISRAEL 7120101

Test Specifications: FCC Part 15, Subpart C, Section 231(a-d)



1.2 ***List of Accreditations***

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



1.3 Product Description

ArrowTrack 3G-433 is a dedicated monitoring device, which easily connects to a reefer's sea container. The device is connect to the reefer's controller and send in real time information over the cellular network and throw the RF. The information includes: Temperature, Umiddity, Power ON/OFF, location Etc.

Model name	Arrow Track 3G-433 W/O Sensor
Working voltage	3.6VDC rechargeable via 24VAC (via AC generator)
Mode of operation	Transceiver
Modulation	GFSK
Assigned Frequency Range	Above 70MHz
Operating Frequency Range	433.1-434.1MHz
Transmit power	~10 mW
Antenna Gain	+0.5dB
Modulation BW	250.0kHz

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 Measurement Uncertainty

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):
± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):
±5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):
±5.51 dB



2. System Test Configuration

2.1 Justification

The E.U.T contains 433.6MHz transceiver

The evaluation was done in installation position orientation

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

No special accessories were needed to achieve compliance.

2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System



Figure 1. Configuration of Tested System

3. Test Set-Up Photos



Figure 2. Conducted Emission From AC Mains

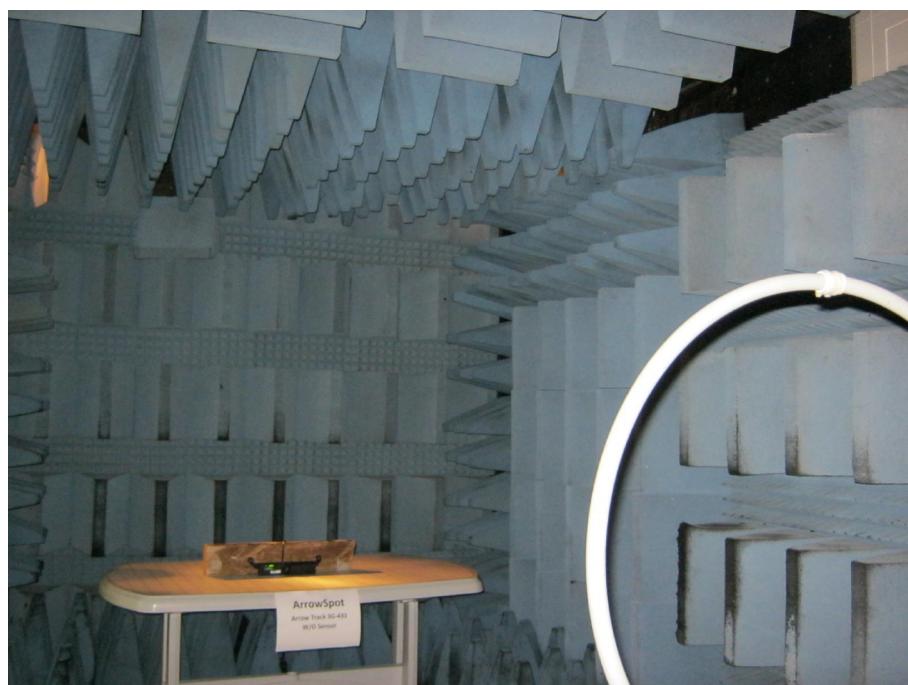


Figure 3. Radiated Emission Test 0.009-30.0MHz



Figure 4. Radiated Emission Test 30.0-200MHz

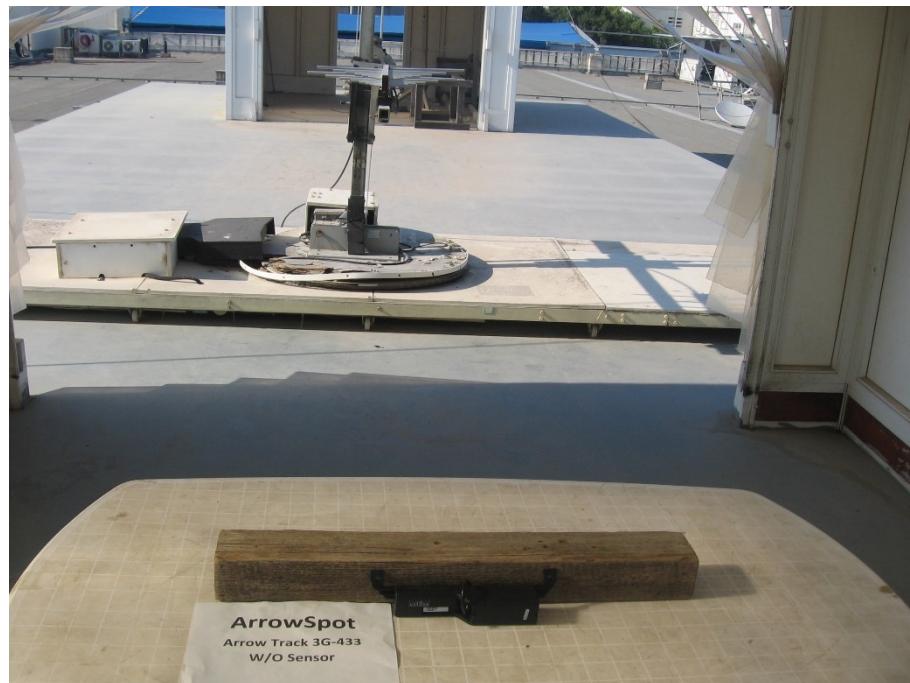


Figure 5. Radiated Emission Test 200-1000.0MHz



Figure 6. Radiated Emission Test 1.0-5.0GHz

4. Average Factor Calculation

1. Transmission pulse duration = N/A
2. Transmission pulse period = N/A
3. Burst duration in 100msec = 11.0msec

4. Average Factor = $20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$

$$\text{AverageFactor} = 20 \log \left[1 \times \frac{11}{100} \times 1 \right] = -19.1 \text{dB}$$

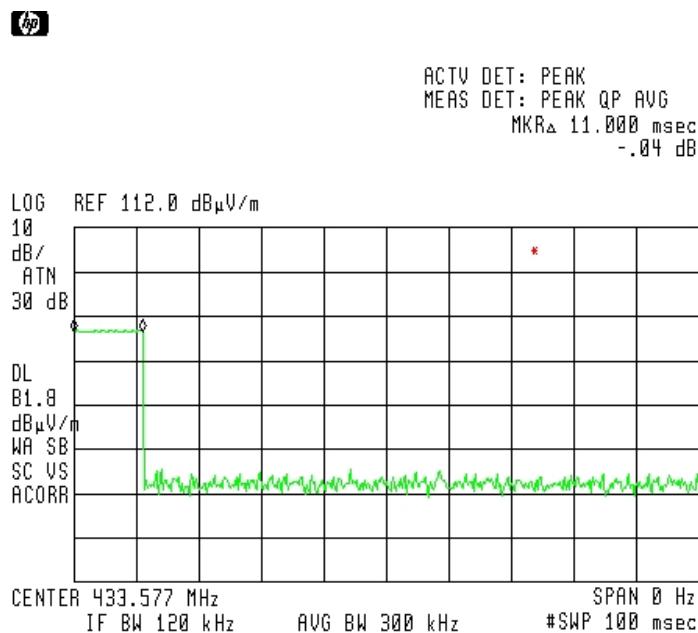


Figure 7. Burst duration = 11.0msec

4.1 Test Instrumentation Used; Average Factor Calculation

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
Log periodic antenna	EMCO	3146	9505-4081	May 15, 2107	May 15, 2018

Figure 8. Test Equipment Used



5. Conducted Emission From AC Mains

5.1 Test Specification

FCC Part 15, Subpart C, Section 15.207

RSS Gen, Issue 4, Clause 8.8

5.2 Test Procedure

(Temperature (20°C)/ Humidity (56%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 μ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission..

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

5.3 Test limit

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.



5.4 **Test Results**

JUDGEMENT: Passed by 26.0 dB

The margin between the emission levels and the specification limit is, in the worst case, 26.0 dB for the phase line at 2.57 MHz and 26.5 dB at 0.43 MHz for the neutral line.

The EUT met the F.C.C. Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 9* to *Figure 12*.



Conducted Emission

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: : Peak, Quasi-peak, Average
Power Operation 24VAC

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP	Trace2:	CE22BAP	Trace3:

TRACE	FREQUENCY	LEVEL dB μ V	DELTA	LIMIT dB
1	Quasi Peak 154 kHz	17.96	-47.81	
2	Average 250 kHz	7.39	-44.36	
1	Quasi Peak 430 kHz	30.24	-27.00	
2	Average 430 kHz	20.39	-26.85	
1	Quasi Peak 434 kHz	18.30	-38.87	
2	Average 434 kHz	14.19	-32.98	
1	Quasi Peak 858 kHz	18.58	-37.41	
2	Average 890 kHz	10.74	-35.25	
1	Quasi Peak 1.286 MHz	15.66	-40.33	
2	Average 1.286 MHz	13.52	-32.47	
1	Quasi Peak 2.57 MHz	16.50	-39.49	
2	Average 2.57 MHz	20.01	-25.98	
1	Quasi Peak 4.718 MHz	15.62	-40.37	
2	Average 4.718 MHz	10.46	-35.53	
1	Quasi Peak 9.43 MHz	14.89	-45.10	
2	Average 9.43 MHz	11.41	-38.58	
1	Quasi Peak 14.574 MHz	17.36	-42.63	
2	Average 14.574 MHz	10.70	-39.29	
2	Average 23.582 MHz	14.31	-35.68	
1	Quasi Peak 23.586 MHz	14.22	-45.77	

Figure 9. Detectors: Peak, Quasi-peak, Average

Note: *QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.*

Conducted Emission

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: Peak, Quasi-peak, Average
Power Operation 24VAC

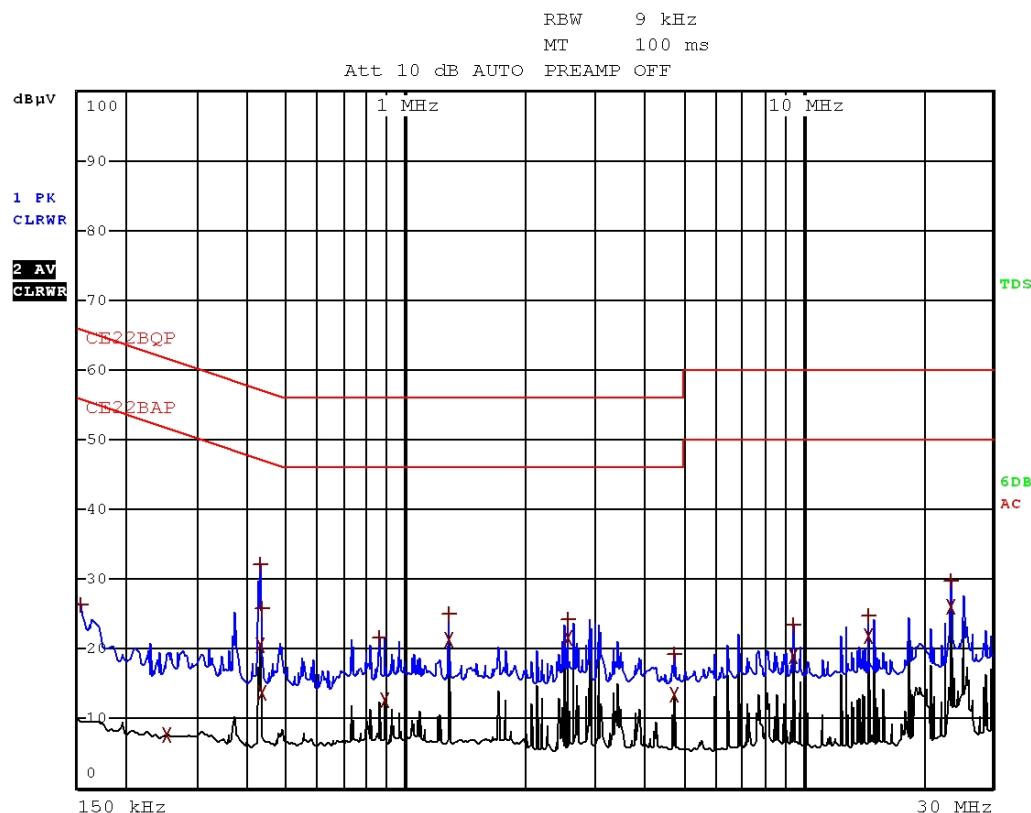


Figure 10. Detectors: Peak, Quasi-peak, Average



Conducted Emission

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation 24VAC

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP	Trace2:	CE22BAF	Trace3:
TRACE	FREQUENCY	LEVEL dB μ V	DELTA LIMIT dB	
1	Quasi Peak 154 kHz	17.17	-48.60	
2	Average 254 kHz	7.27	-44.34	
1	Quasi Peak 430 kHz	30.70	-26.54	
2	Average 430 kHz	12.06	-35.19	
1	Quasi Peak 434 kHz	13.25	-43.91	
2	Average 434 kHz	8.31	-38.85	
1	Quasi Peak 858 kHz	18.73	-37.27	
2	Average 858 kHz	11.88	-34.11	
1	Quasi Peak 1.286 MHz	15.95	-40.05	
2	Average 1.286 MHz	11.46	-34.53	
1	Quasi Peak 2.574 MHz	22.19	-33.80	
2	Average 3.002 MHz	11.60	-34.39	
2	Average 3.786 MHz	9.14	-36.85	
1	Quasi Peak 4.218 MHz	9.90	-46.09	
1	Quasi Peak 7.29 MHz	19.89	-40.10	
2	Average 7.29 MHz	10.31	-39.68	
2	Average 13.294 MHz	10.36	-39.64	
1	Quasi Peak 14.578 MHz	15.80	-44.19	
1	Quasi Peak 19.726 MHz	25.38	-34.61	
2	Average 19.726 MHz	22.28	-27.71	

Figure 11. Detectors: Peak, Quasi-peak, Average

Note: *QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.*



Conducted Emission

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation 24VAC

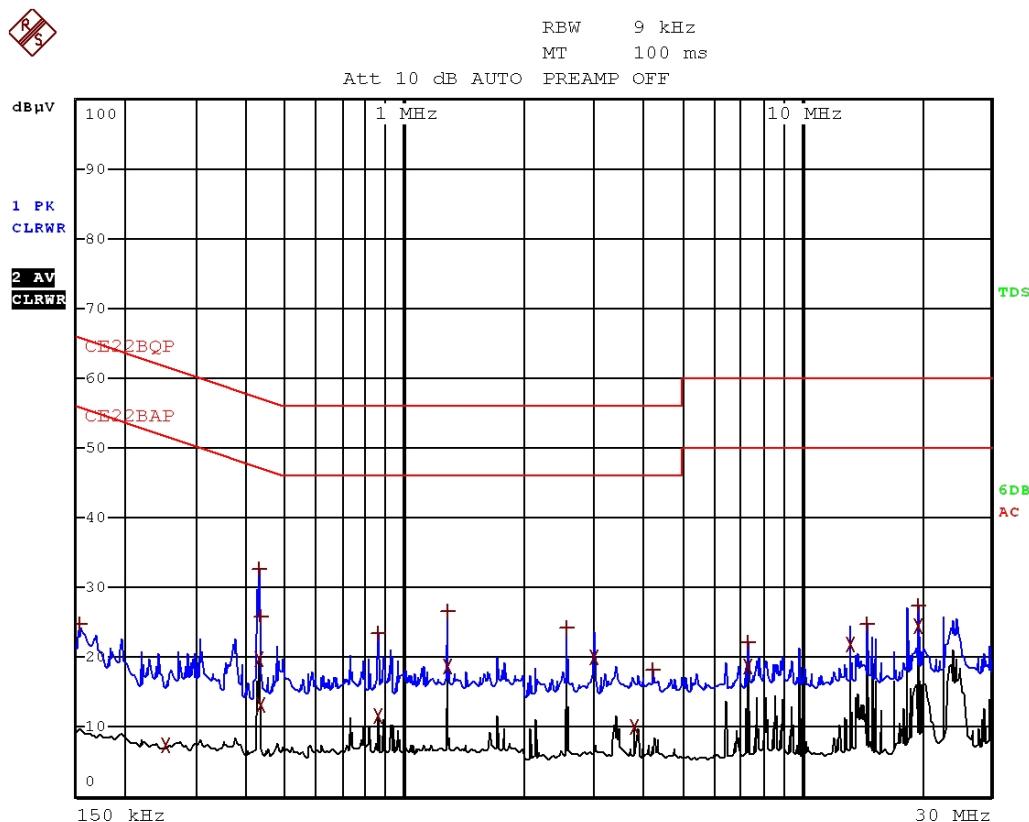


Figure 12 Detectors: Peak, Quasi-peak, Average



5.5 Test Equipment Used; Conducted Emission

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
LISN	Fischer	FCC-LISN-25A	127	July 20, 2017	July 20, 2018
Transient Limiter	HP	11947A	3107A03041	June 29, 2017	June 29, 2018
EMI Receiver	Rohde & Schwarz	ESCI7	100724	February 28, 2017	February 28, 2018

Figure 13. Test Equipment Used



6. Periodic Operation

6.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231(a)

6.2 Test Procedure

(Temperature (21°C)/ Humidity (52%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report

6.3 Test Requirements and verdicts

Requirement	Rationale	Verdict
1. A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	N/A	Complies
2. An automatically operated transmitter shall cease operation within 5 seconds after activation.	See Figure 14	Complies
3. Periodic transmissions at regular predetermined intervals are not permitted.	N/A	Complies
4. Polling or supervised transmissions to determine system integrity of transmitter used in security or safety applications shall not exceed more than 2 seconds per hour.	N/A	Complies
5. Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition	N/A	Complies
6. Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.	N/A	Complies

6.4 Test Results

JUDGEMENT: Passed

The EUT met the FCC Part 15, Subpart C, Section 15.231(a) specification requirements.

Periodic Operation

E.U.T Description ArrowTrack 3G-433
 Type ARS-AD000
 Serial Number: GDC20500EVK

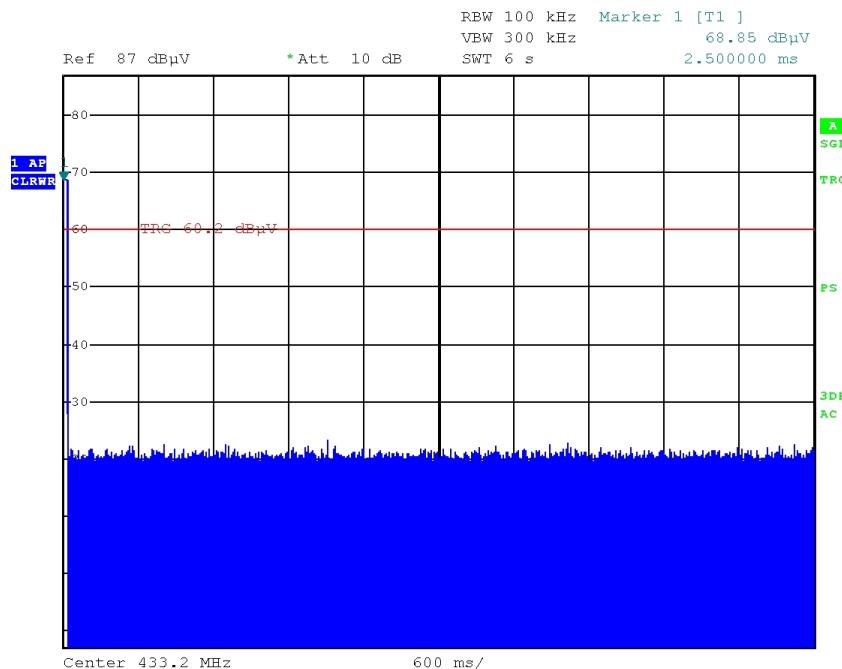


Figure 14. Automatic Transmission

6.5 *Test Instrumentation Used; Periodic Operation*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 2, 2017	March 2, 2018
Log periodic antenna	EMCO	3146	9505-4081	May 15, 2107	May 15, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 15. Test Equipment Used



7. Field Strength of Fundamental

7.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231(b)

7.2 Test Procedure

(Temperature (26°C)/ Humidity (54%RH))

The E.U.T was tested in the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

7.3 Test Limit

The field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental@3m (μ V/m)	Field strength of fundamental@3m (dB μ V/m)
40.66-40.70	2,250	67.0
70-130	1,250	61.9
130-174	¹ 1,250 to 3,750	¹ 61.9 to 71.5
174-260	3,750	71.5
260-470	¹ 3,750 to 12,500	¹ 71.5 to 81.9
Above 470	12,500	81.9

¹ Linear interpolations

* The limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions

** If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply

7.4 Test Results

JUDGEMENT: Passed by 4.6 dB

The EUT met the FCC Part 15, Subpart C, Section 15.231(b) specification requirements.

The details of the highest emissions are given in *Figure 16 to Figure 18*.



Field Strength of Fundamental

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: F.C.C., Part 15, Subpart C, 15.231(b)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detector: Peak

Freq.	Pol.	Peak Reading	Average Factor	Average Result	Peak limit	Average limit	Peak Margin	Average Margin
(MHz)	(V/H)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB)
433.6	H	95.3	-19.1	76.2	100.8	80.8	-5.5	-4.6
433.6	V	89.1	-19.1	70.0	100.8	80.8	-11.7	-10.8

Figure 16. Field Strength of Fundamental - Average/Peak Results

Notes:

1. *Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.*
2. *“Peak Reading” (dB μ V/m) included the “Correction Factors”.*
3. *“Correction Factors” (dB) = Test Antenna Correction Factor (dB) + Cable Loss.*
4. *“Average Result” (dB μ V/m)=Peak Reading (dB μ V/m) + Average Factor (dB).*



Field Strength of Fundamental

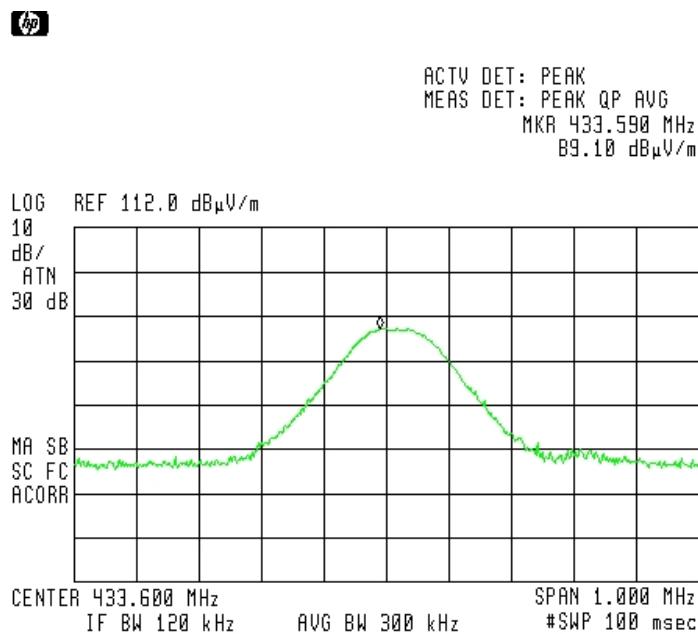


Figure 17. Field Strength of Fundamental – Vertical

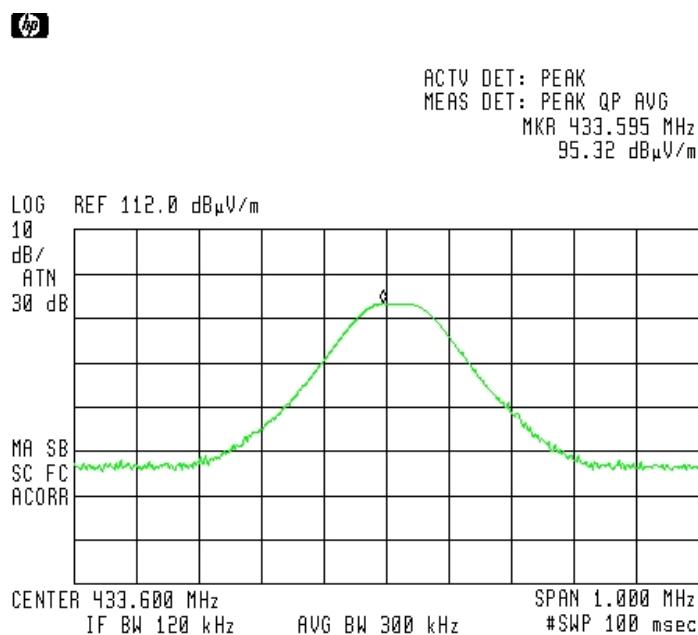


Figure 18. Field Strength of Fundamental - Horizontal



7.5 ***Test Instrumentation Used; Field Strength of Fundamental***

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
Log periodic antenna	EMCO	3146	9505-4081	May 15, 2017	May 15, 2018

Figure 19. Test Equipment Used



8. Field Strength of Spurious Emissions

8.1 ***Test Specification***

F.C.C., Part 15, Subpart C, Section 15.231(b)

8.2 ***Test Procedure***

(Temperature (21°C)/ Humidity (52%RH))

For measurements between 0.009MHz-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1.0GHz-5.0GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1.0GHz -5.0GHz was scanned

8.3 ***Test Limit***

Spurious emissions shall be attenuated to the average limits shown in next table or to the general limits shown in §15.209, whichever limit permits a higher field strength:



Fundamental frequency (MHz)	Field strength of spurious emissions@3m (μ V/m)	Field strength of spurious emissions@3m (dB μ V/m)
40.66-40.70	225	47.0
70-130	125	41.9
130-174	¹ 125 to 375	¹ 41.9 to 51.5
174-260	375	51.5
260-470	¹ 375 to 1,250	¹ 51.5 to 61.9
Above 470	1,250	61.9

¹ Linear interpolations

* The limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions

** If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength (dB μ V/m)	Field strength* (dB μ V/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

- The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

8.4 Test Results

JUDGEMENT: Passed by 12.6 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C specification.

The margin between the emission level and the specification limit was 12.6 dB in the worst case at the frequency of 4333.6 MHz, vertical polarization.

For additional information see *Figure 20*.



Radiated Emission

E.U.T Description ArrowTrack 3G-433
Type ARS-AD000
Serial Number: GDC20500EVK

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical/Horizontal
Antenna: 3 meters distance

Frequency range: 0.009MHz to 5GHz
Detectors: Peak

Freq. (MHz)	Pol. (V/H)	Peak Reading (dB μ V/m)	Average Factor (dB)	Average Result (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak Margin (dB)	Average Margin (dB)
867.2	H	46.4	-19.1	27.3	74.0	54.0	-27.6	-26.7
867.2	V	46.2	-19.1	27.1	74.0	54.0	-27.8	-26.9
1300.8	H	49.0	-19.1	29.9	74.0	54.0	-25.0	-24.1
1300.8	V	49.7	-19.1	30.6	74.0	54.0	-24.3	-23.4
3035.2	H	60.1	-19.1	41.0	74.0	54.0	-13.9	-13.0
3035.2	V	60.0	-19.1	40.9	74.0	54.0	-14.0	-13.1
4336.0	H	60.2	-19.1	41.1	74.0	54.0	-13.8	-12.9
4333.6	V	60.5	-19.1	41.4	74.0	54.0	-13.5	-12.6

Figure 20. Spurious Radiated Emission Results

Notes:

1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. "Peak Reading" (dB μ V/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor (dB) + Cable Loss.
4. "Average Result" (dB μ V/m) = Peak Reading (dB μ V/m) + Average Factor (dB).



8.5 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 28, 2017	February 28, 2018
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
Biconical Antenna	EMCO	3110B	9912-3337	May 15, 2017	May 15, 2018
Log Periodic Antenna	EMCO	3146	9505-4081	May 15, 2017	May 15, 2018
Horn Antenna	ETS	3115	29845	May 19, 2015	May 19, 2018
Active Loop Antenna	EMCO	6502	9506-2950	October 15, 2017	October 15, 2018
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 28, 2017	February 28, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 21. Test Equipment Used



9. 20dB Bandwidth

9.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231(c)

9.2 Test Procedure

(Temperature (21°C)/ Humidity (50%RH))

The transmitter unit operated with normal modulation. The spectrum analyzer was set to 30 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit was measured and recorded. The BW was measured at 20 dBc points.

9.3 Test Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

9.4 Test Results

Specification: F.C.C. Part 15, Subpart C: (15.231(c))

Bandwidth Reading (kHz)	Specification (kHz)	Margin (kHz)
158.8	<1082	923.2

Figure 22. 20dB Bandwidth Test Results

JUDGEMENT: Passed by 923.2 kHz

For additional information, see *Figure 23*.

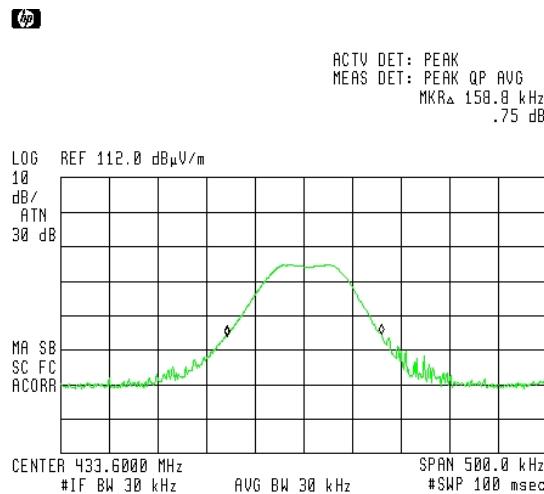


Figure 23. 20dB Bandwidth Results

9.5 Test Equipment Used; 20dB Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
Log Periodic Antenna	EMCO	3146	9505-4081	May 15, 2017	May 15, 2018

Figure 24. Test Equipment Used



10. Antenna Information

Antenna Gain – 0.5dBi



AN1603-433
Multilayer Chip Antenna for
433MHz Wireless Communication



11. APPENDIX A - CORRECTION FACTORS

11.1 *Correction factors for RF OATS Cable 35m ITL #1879*

Frequency (MHz)	Cable loss (dB)
30.0	1.1
50.0	1.1
100.0	1.7
150.0	2.1
200.0	2.5
250.0	2.7
300.0	2.9
350.0	3.1
400.0	3.5
450.0	3.7
500.0	3.9
550.0	4.0
600.0	4.2
650.0	4.4
700.0	4.9
750.0	5.0
800.0	5.0
850.0	4.9
900.0	5.0
950.0	5.1
1000.0	5.4



11.2 Correction factors for Biconical Antenna – ITL # 1356

**Model: EMCO 3110B
Serial No.:9912-3337**

Frequency	ITL 1356 AF
[MHz]	[dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17



11.3 Correction factors for LogPeriodic Antenna

ITL # 1349

Model: EMCO 3146

Serial No.:9505-4081

Frequency [MHz]	ITL 1349 AF [dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22



11.4 Correction factors for Active Loop Antenna
Model 6502 S/N 9506-2950
ITL # 1075

f(MHz)	MAF(dBs/m)	AF(dB/m)
0.01	-33.1	18.4
0.02	-37.2	14.3
0.03	-38.2	13.3
0.05	-39.8	11.7
0.1	-40.1	11.4
0.2	-40.3	11.2
0.3	-40.3	11.2
0.5	-40.3	11.2
0.7	-40.3	11.2
1	-40.1	11.4
2	-40	11.5
3	-40	11.5
4	-40.1	11.4
5	-40.2	11.3
6	-40.4	11.1
7	-40.4	11.1
8	-40.4	11.1
9	-40.5	11
10	-40.5	11
20	-41.5	10
30	-43.5	8



**11.5 Correction factors for
Horn ANTENNA**

Double -Ridged Waveguide

Model: 3115

Serial number: 29845

3 meter range; ITL # 1352

FREQUENCY (GHz)	AFE (dB/m)
0.75	25
1.0	23.5
1.5	26.0
2.0	29.0
2.5	27.5
3.0	30.0
3.5	31.5
4.0	32.5
4.5	32.5
5.0	33.0
5.5	35.0
6.0	36.5
6.5	36.5
7.0	37.5
7.5	37.5
8.0	37.5
8.5	38.0
9.0	37.5

FREQUENCY (GHz)	AFE (dB/m)
9.5	38
10.0	38.5
10.5	38.5
11.0	38.5
11.5	38.5
12.0	38.0
12.5	38.5
13.0	40.0
13.5	41.0
14.0	40.0
14.5	39.0
15.0	38.0
15.5	37.5
16.0	37.5
16.5	39.0
17.0	40.0
17.5	42.0
18.0	42.5



11.6 Correction factor for RF CABLE for Semi Anechoic Chamber

ITL # 1841

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

NOTES:

1. The cable is manufactured by Commscope
2. The cable type is 0623 WBC-400, serial # G020132 and 10m long