



DATE: 09 February 2015

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Elpas Solutions Ltd.

Equipment under test:

ALC LF BUS Beacon

5-ALC11121-0 ; 5-ALC11122-0*;

5-ALC11123-0*; 5-ALC01121-0*;

5-ALC01122-0*;

5-ALC01123-0*;

* See customer's declaration on page 5

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

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This report relates only to items tested.



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1. General Information

1.1 Administrative Information

Manufacturer:	Elpas Solutions Ltd.
Manufacturer's Address:	23 Habarzel St., Tel-Aviv, 6971031, Israel Tel: +972-3-768-1400 Fax: +972-3-768-1415
Manufacturer's Representative:	Arick Elshtein
Equipment Under Test (E.U.T):	ALC LF BUS Beacon
Equipment Model No.:	5-ALC11121-0 ; 5-ALC11122-0*; 5ALC11123-0*; 5-ALC01121-0*; 5-ALC01122-0*; 5-ALC01123-0*
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	19.05.14
Start of Test:	19.05.14
End of Test:	22.01.15
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780 I.T.L (Product Testing) Ltd. 1 Bat Sheva Street, Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart C RSS-210, Issue 8, 2010

*See customer's Declaration on following page.



From Tyco Security Products

Elpas Solutions Ltd.
23 Habarzel Street
Tel-Aviv 69710, Israel

Tel: +972 3 768 1400
Fax: +972 3 768 1415
www.elpas.com

Date February 9, 2015

DECLARATION

I HEREBY DECLARE THE FOLLOWING AS IT RELATES TO THE BELOW
ELPAS BUS EXCITER ALC MODELS:

Elpas 2:

- 5-ALC01121-0 - LF Exciter 125 kHz Weigand indoor TX
- 5-ALC01122-0 - LF Exciter 125 kHz Weigand outdoor TX
- 5-ALC01123-0 - LF Exciter 125 kHz Weigand outdoor TX loop

Elpas 3:

- 5-ALC11121-0 - LF Exciter 125 kHz Weigand indoor TX
- 5-ALC11122-0 - LF Exciter 125 kHz Weigand outdoor TX
- 5-ALC11123-0 - LF Exciter 125 kHz Weigand outdoor TX loop

1. All models contain the identical 125 kHz transmitter.
2. All models contain the identical 433 MHz transmitter.
3. The 5-ALC01121-0 and 5-ALC11121 have an identical indoor enclosure and the 5-ALC01122-0, 5-ALC01123-0, 5-ALC11122-0 and 5-ALC11123-0 have an identical outdoor enclosure.
4. The 5-ALC01121-0, 5-ALC01122-0, 5-ALC11121-0, 5-ALC11122-0 have integral loop antennas.
5. The 5-ALC01123-0 and 5-ALC11123-0 have an external antenna which can vary from 10-80 meters in length. The 5-ALC11123-0 was tested using both a 10 meter and 80 meter antenna to cover the 10-80 meter length variations. The external 125 KHZ antenna does not affect the 433 MHz transmitter.
6. The 5-ALC01121-0 and 5-ALC11121-0 have a mechanical tamper switch and the 5-ALC01122-0, 5-ALC01123 -0, 5-ALC11122-0 and 5-ALC11123 -0 have an optical tamper sensor.
7. The Elpas 2 models have continuous transmission LF NRZ in ASK modulation with a 50% duty cycle.
8. The Elpas 3 models have LF Manchester transmission in GFSK transmission with a 0.0889 duty cycle.

Please relate to all of them (from a radio point of view) as the same product.

Reissued by:	
Tel-Aviv, Israel 9 February 2015	 Arick Eishtein Certification Manager



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.), Registration No. 90715 and FCC Designation No US1004.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025B-1, Site No. IC 4025A-1.

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

The Elpas ALC LF BUS Beacon is a fully supervised, 125 kHz emitter that adds instantaneous location, choke-point (a door or any other opening that controls ingress and egress from a protected area), awareness to RTLS security, and safety applications

The LF BUS Beacon generates a user-adjustable, elliptically shaped electromagnetic field up to 4m/13ft (perpendicular to the device) and 3.5m/11.5ft (parallel to the device) in radius that can be used to cover a single interior doorway. Optionally, up to four ALC LF BUS Beacons can be deployed in 'Primary-Secondary' (up to three secondary devices) star or daisy-chain topologies to cover large double-doors or architectural complex indoor entrance/exit areas. The DIP Switch setting determines which is primary and which is secondary.

The ALC LF BUS Beacon contains two general purpose analog inputs (IN1 and IN2) and two open collector outputs (OC1 and OC2). The device forces a choice between IN2 and OC2. The device also provides the choice of either two digital inputs or two 26-bit Wiegand device outputs. The DIP Switches setting determines these selections.

Note: An Elpas RS-485 BUS may contain up to fifteen Elpas BUS devices (such as RF or IR Readers, Elpas Display Panels, LF Beacons or other Primary BUS Beacons) which are wired together with Elpas RS-485 Junction Boxes (P/N:5-JBA10485).

1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2009 and RSS-Gen, Issue 4. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing November 21, 2012). Additionally, testing was also done 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 US1004.

I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.



1.6 Measurement Uncertainty

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) 0.15 – 30 MHz:

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

± 3.44 dB

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

2. System Test Configuration

2.1 Justification

Testing was done on the model 5-ALC11121-0 unit as representative of all models.

The EUT's was tested in three orthogonal orientations. The worst case orientation was the installation position.

Testing was performed at 433.42 MHz and 434.42 MHz.

Additionally, bandwidth testing was performed on the 5-ALC01121-0 for ASK modulation.

2.2 EUT Exercise Software

No exercise software was needed.

2.3 Special Accessories

No special accessories were needed.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance

2.5 Configuration of Tested System

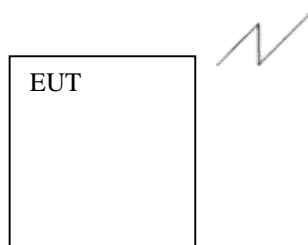


Figure 1. Configuration of Tested System

3. Conducted & Radiated Measurement Test Set-up Photo



Figure 2. Conducted Emission Test



Figure 3. Radiated Emission Test

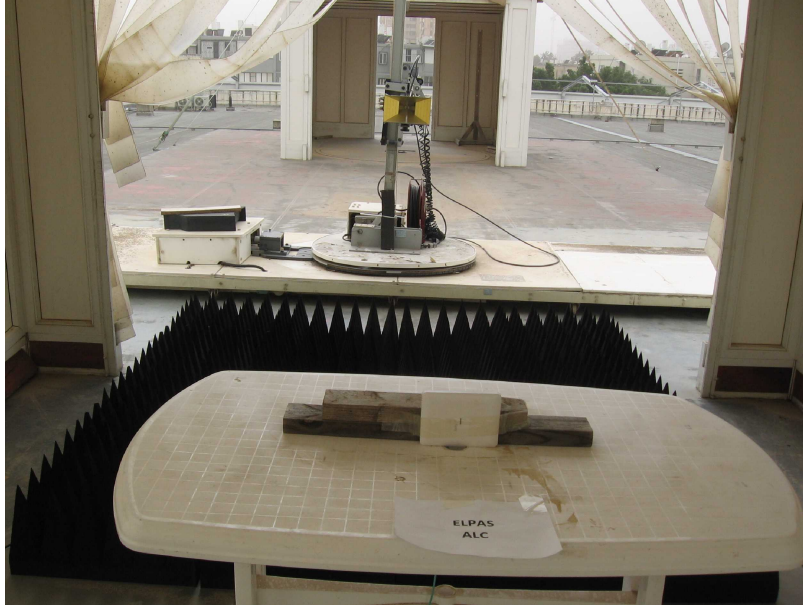


Figure 4. Radiated Emission Test



Figure 5. Radiated Emission Test



Figure 6. Radiated Emission Test



4. Conducted Emission From AC Mains

4.1 Test Specification

0.15 - 30 MHz, FCC Part 15, Subpart C, CLASS B

4.2 Test Procedure

The E.U.T operation mode and test setup are as described in Section 4.1. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room (see Section 3), with the E.U.T placed on a 0.4 meter high wooden table. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered 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 configuration tested is shown in the photograph,

Figure 2.

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

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.

4.3 Test Results

The E.U.T met the requirements of the FCC Part 15, Subpart C, Class B specifications.

The margin between the emission levels and the specification limit is, in the worst case, 0.72 dB for the phase line at 21.626 MHz and 1.38 dB at 21.498 MHz for the neutral line.

The details of the highest emissions are given in *Figure 7* to *Figure 10*.

TEST PERSONNEL:

Tester Signature: _____ 

Date: 15.02.15

Typed/Printed Name: M. Zohar



Conducted Emission

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Class B
Lead: Phase
Detectors: Quasi-peak, Average

EDIT PEAK LIST (Final Measurement Results)				
TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB	
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
2 Average	274 kHz	32.74	-18.24	
1 Quasi Peak	398 kHz	49.79	-8.09	
2 Average	406 kHz	35.37	-12.35	
2 Average	1.342 MHz	21.70	-24.29	
1 Quasi Peak	1.486 MHz	35.93	-20.06	
2 Average	2.002 MHz	24.92	-21.07	
1 Quasi Peak	2.266 MHz	35.27	-20.72	
2 Average	2.75 MHz	28.68	-17.31	
1 Quasi Peak	3.498 MHz	32.21	-23.78	
2 Average	3.878 MHz	24.12	-21.87	
1 Quasi Peak	7.874 MHz	42.12	-17.87	
2 Average	7.874 MHz	35.25	-14.74	
1 Quasi Peak	11.874 MHz	46.94	-13.05	
2 Average	11.874 MHz	39.82	-10.17	
1 Quasi Peak	17.25 MHz	55.10	-4.89	
2 Average	17.75 MHz	46.46	-3.53	
2 Average	21.626 MHz	49.27	-0.72	
1 Quasi Peak	21.75 MHz	57.15	-2.84	

Date: 22.JAN.2015 14:23:01

Figure 7. Detectors: Quasi-peak, Average

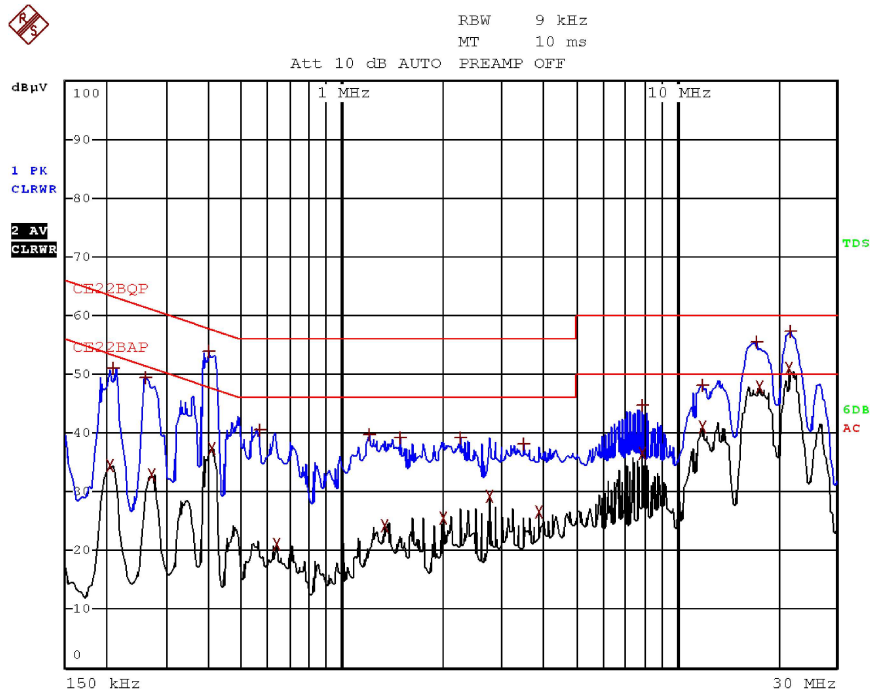
Note: DELTA LIMIT refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.



Conducted Emission

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Class B
Lead: Phase
Detectors: Quasi-peak, Average



Date: 22.JAN.2015 14:17:08

Figure 8 Detectors: Quasi-peak, Average



Conducted Emission

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Class B
Lead: Neutral
Detectors: Quasi-peak, Average

EDIT PEAK LIST (Final Measurement Results)				
TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
1	Quasi Peak	266 kHz	45.02	-16.21
1	Quasi Peak	402 kHz	48.36	-9.44
2	Average	414 kHz	34.04	-13.52
1	Quasi Peak	566 kHz	37.44	-18.55
2	Average	1.346 MHz	23.43	-22.56
2	Average	1.414 MHz	27.56	-18.43
1	Quasi Peak	1.558 MHz	38.83	-17.16
1	Quasi Peak	2.126 MHz	37.23	-18.76
2	Average	2.626 MHz	30.03	-15.96
1	Quasi Peak	3.75 MHz	34.92	-21.07
2	Average	4.122 MHz	26.89	-19.10
2	Average	7.75 MHz	37.27	-12.72
1	Quasi Peak	7.874 MHz	44.04	-15.95
1	Quasi Peak	11.874 MHz	48.70	-11.29
2	Average	12.126 MHz	40.59	-9.40
2	Average	16.874 MHz	48.39	-1.60
1	Quasi Peak	17.25 MHz	55.45	-4.54
2	Average	21.498 MHz	48.61	-1.38
1	Quasi Peak	21.75 MHz	57.06	-2.93

Date: 22.JAN.2015 14:28:57

Figure 9. Detectors: Quasi-peak, Average

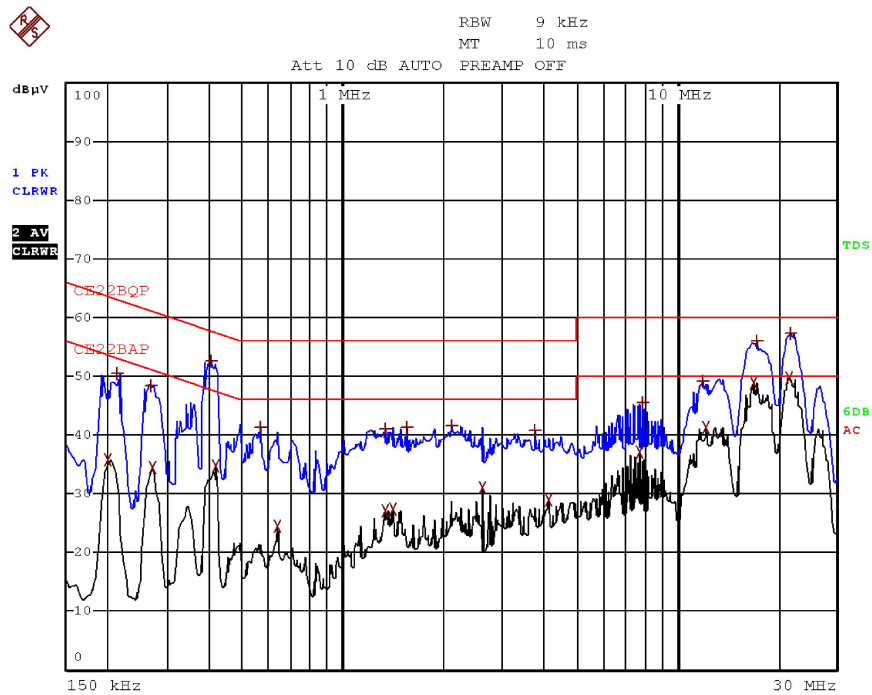
Note: DELTA LIMIT refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.



Conducted Emission

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

Specification: FCC Part 15, Subpart C, Class B
Lead: Neutral
Detectors: Quasi-peak, Average



Date: 22.JAN.2015 14:27:01

Figure 10 Detectors: Quasi-peak, Average



4.1 Test Instrumentation Used; Conducted Emission

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
LISN	Fischer	FCC-LISN-25A	127	June 23, 2014	1 year
Transient Limiter	HP	11947A	3107A03041	May 13, 2014	1 year
EMI Receiver	Rohde & Schwarz	ESCI7	100724	January 4, 2015	1 year

Figure 11 Test Equipment Used

5. Average Factor Calculation

1. Transmission pulse duration = N/A
2. Transmission pulse period = N/A
3. Burst duration = 0.975 msec
4. Time between bursts = 1.025 sec , >100ms
5. Average Factor = $20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$

$$\text{AverageFactor} = 20 \log \left[\frac{0.975}{100} \times 1 \right] = -40\text{dB}$$

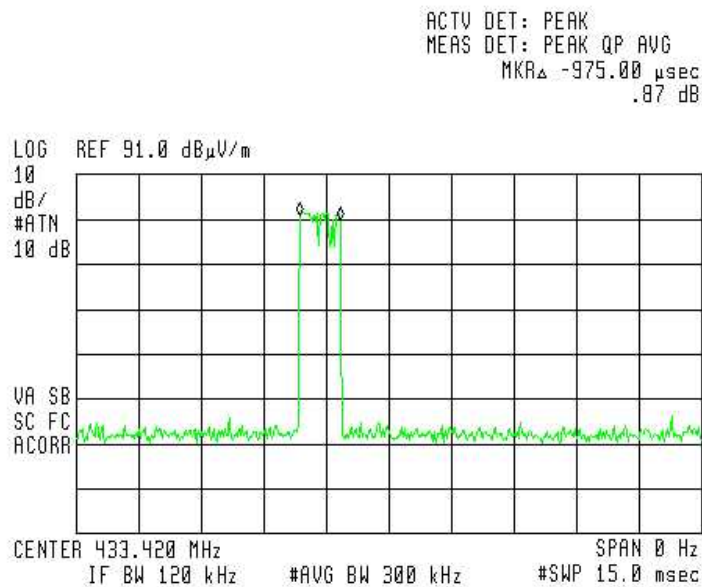


Figure 12. Burst duration = 0.975msec



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKRΔ -1.0250 sec
-.24 dB

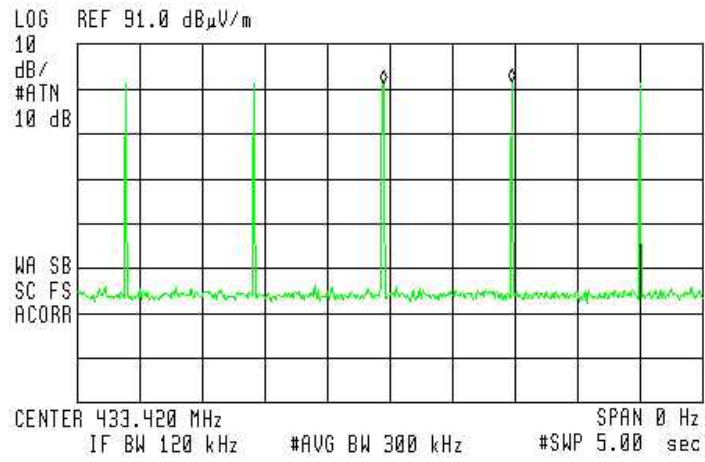


Figure 13. Time between bursts = 1.025sec, >100ms



5.1 Test Instrumentation Used; Average Factor Calculation

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A

Figure 14 Test Equipment Used



6. Periodic Operation

6.1 Specification

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

6.2 Requirements


Requirement	Rationale	Verdict
Continuous transmissions are not permitted.	N/A	Complies
A manually operated transmitter shall be deactivated within not more than 5 seconds after releasing the switch.	N/A	Complies
An automatically operated transmitter shall cease operation within 5 seconds after activation.	N/A	Complies
Periodic transmissions at regular predetermined intervals are not permitted.	N/A	Complies
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.	See plots in Figure 15 to Figure 16	Complies

6.3 Results

JUDGEMENT: Passed

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

TEST PERSONNEL:

Tester Signature:  _____

Date: 15.02.15

Typed/Printed Name: M. Zohar



Periodic Operation

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

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

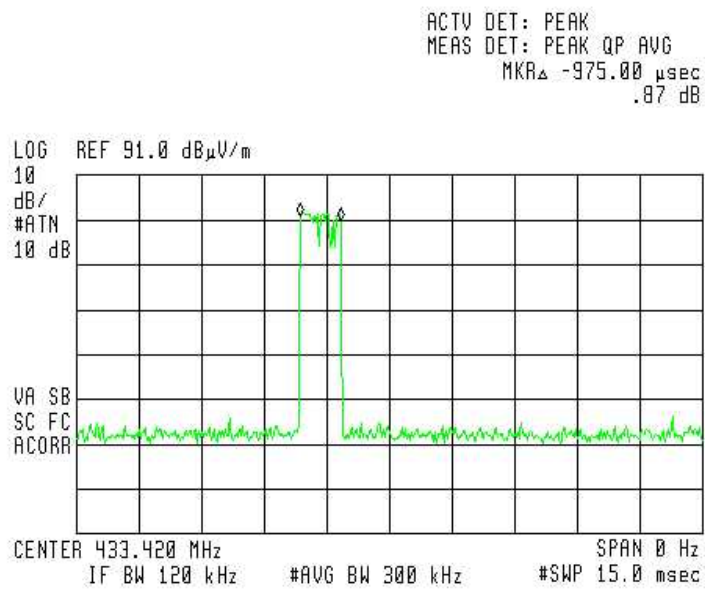
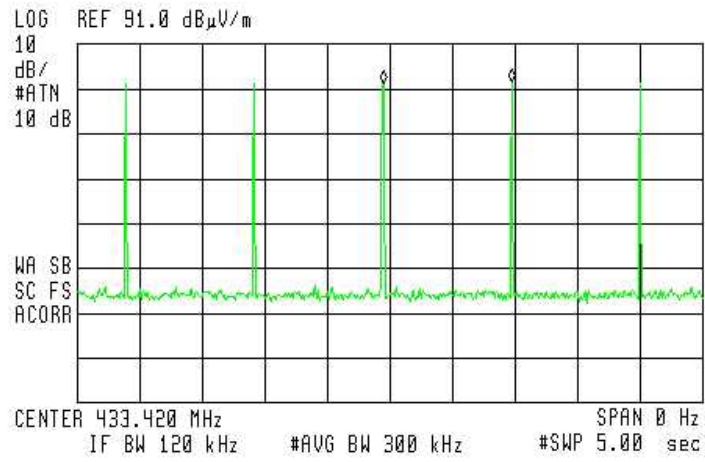


Figure 15. System Integrity Burst duration = 0.975msec



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKRΔ -1.0250 sec
-.24 dB



**Figure 16. Time between bursts = 1.025 sec., >100ms
System Integrity within 1 Hour (0.975 msec X 360 = 720 milliseconds)**



6.4 Test Instrumentation Used; Periodic Operation

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year

Figure 17 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

The E.U.T. operation mode and test set-up are as described in Section 3.

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.

The EMI receiver was set to the E.U.T. Fundamental Frequency and Peak Detection.

The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver.

The measurement was performed for vertical and horizontal polarizations of the test antenna.

The average result is:

Peak Level (dB μ V/m) + E.U.T. Duty Cycle Factor, in 100msec time window (dB)


7.3 Measured Data

JUDGEMENT: Passed by 35.6 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 19 to Figure 22.

TEST PERSONNEL:

Tester Signature: _____ 

Date: 15.02.15

Typed/Printed Name: M. Zohar



Field Strength of Fundamental

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

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

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters

Detector: Peak

Freq. (MHz)	Pol. V/H	Peak Reading (dBμV/m)	Average Factor (dB)	AVG Result (dBμV/m)	AVG Specification (dBμV/m)	Margin (dB)
433.42	H	80.3	-40.0	40.3	80.8	-40.5
433.42	V	82.2	-40.0	42.3	80.8	-38.5
434.42	H	81.0	-40.0	41.0	80.8	-39.8
434.42	V	85.2	-40.0	45.2	80.8	-35.6

Figure 18. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL. Detector: Peak

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." (dBμV/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor (dB) + Cable Loss.
4. "Average Factor = $20 \log [(burst\ duration/100msec)*Num\ of\ burst\ within\ 100msec]$ = $20 \log [(0.975/100)*1]$ = -40.0
5. "Average Result" (dBμV/m) = Peak Reading (dBμV/m) + D.C.F. (dB)



Field Strength of Fundamental

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

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

Antenna Polarization: Horizontal
Test Distance: 3 meters

Frequency: 433.42 MHz
Detector: Peak

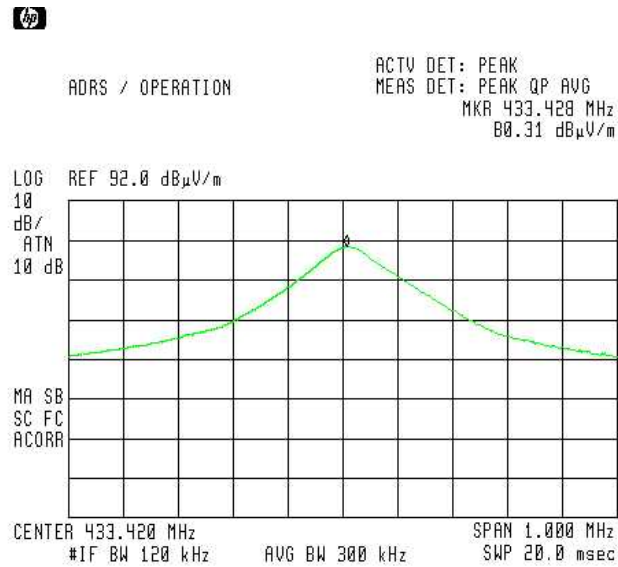


Figure 19. Field Strength of Fundamental (433.42 MHz) Antenna Polarization: HORIZONTAL.



Field Strength of Fundamental

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

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

Antenna Polarization: Vertical Frequency: 433.42 MHz
Test Distance: 3 meters Detector: Peak

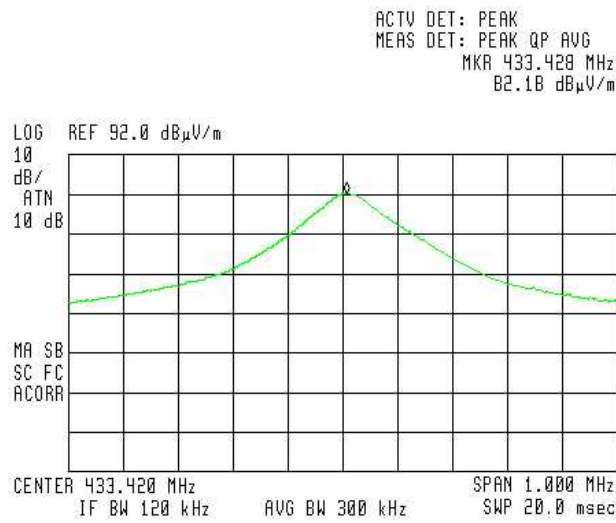


Figure 20. Field Strength of Fundamental (433.42 MHz) Antenna Polarization: VERTICAL.



Field Strength of Fundamental

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

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

Antenna Polarization: Horizontal
Test Distance: 3 meters

Frequency: 434.42 MHz
Detector: Peak

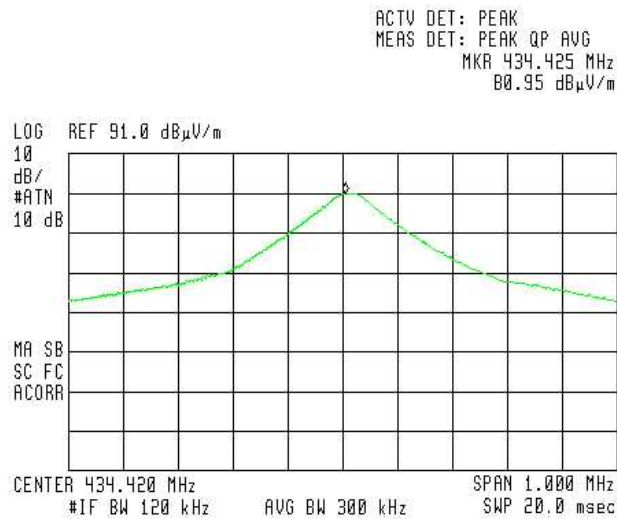


Figure 22. Field Strength of Fundamental (434.42 MHz) Antenna Polarization: HORIZONTAL.



7.4 Test Instrumentation Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	February 28, 2014	1 year
RF Section	HP	85420E	3705A00248	February 28, 2014	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG19982	N/A	N/A

Figure 23 Test Equipment Used



8. Radiated Emission, 9 kHz – 30 MHz

8.1 Test Specification

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

8.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

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 configuration tested is shown in Figure 3.1.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was operated at the frequency of 433.42/434.42 MHz. This frequency was measured using a peak detector.

8.3 Measured Data

JUDGEMENT: Passed

The EUT was tested and it met the requirements of the FCC Part 15, Subpart C specification.

No emissions were detected.

TEST PERSONNEL:

Tester Signature: _____

Date: 15.02.15

Typed/Printed Name: M. Zohar



8.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	February 28, 2014	1 year
RF Section	HP	85420E	3705A00248	February 28, 2014	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2013	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A

Figure 24 Test Equipment Used

8.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

- FS: Field Strength [dB μ v/m]
- RA: Receiver Amplitude [dB μ v]
- AF: Receiving Antenna Correction Factor [dB/m]
- CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB μ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB μ V

No external pre-amplifiers are used.



9. Radiated Emission 30 – 4500 MHz

9.1 Test Specification

30 - 4500 MHz, F.C.C., Part 15, Subpart C

9.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3. See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

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 configuration tested is shown in Figure 1.

The signals from the list of the highest emissions were verified and the list was updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 2.9 – 4.5GHz, a spectrum analyzer including a low noise amplifier was used. The test distance was 3 meters. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The emissions were measured at a distance of 3 meters.

Testing was done at two operational frequencies: 433.42 MHz and 434.42 MHz.



9.3 Test Data

JUDGEMENT: Passed by 50.6 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 50.6 dB in the worst case at the frequency of 1303.260 MHz, horizontal polarization.

TEST PERSONNEL:

Tester Signature: _____

Date: 15.02.15

Typed/Printed Name: M. Zohar



Radiated Emission

E.U.T Description ALC LF BUS Beacon
Type 5-ALC11121-0
Serial Number: Not designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 30 MHz to 4500 MHz
Antenna: 3 meters distance Detectors: Peak

Frequency (MHz)	Antenna Polarity (H/V)	Peak Reading (dB μ V/m)	Average Factor (dB μ V/m)	Average Result dB μ V/m)	Average Specification (dB μ V/m)	Margin (dB)
866.840	H	47.6	-40.0	7.6	60.8	-53.2
866.840	V	40.5	-40.0	0.5	60.8	-60.3
1300.270	V	50.0	-40.0	10.0	60.8	-50.8
1300.270	H	49.3	-40.0	9.3	60.8	-51.5

Figure 25. Radiated Emission 433.42 MHz Fundamental - Antenna Polarization: Horizontal/Vertical. Detectors Peak

Frequency (MHz)	Antenna Polarity (H/V)	Peak Reading (dB μ V/m)	Average Factor (dB μ V/m)	Average Result dB μ V/m)	Average Specification (dB μ V/m)	Margin (dB)
868.840	H	42.7	-40.0	2.7	60.8	-58.1
868.840	V	41.4	-40.0	1.4	60.8	-59.4
1303.260	V	49.9	-40.0	9.9	60.8	-50.9
1303.260	H	50.2	-40.0	10.2	60.8	-50.6

Figure 26. Radiated Emission 434.42 MHz Fundamental - Antenna Polarization: Horizontal/Vertical. Detectors: Peak

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)



9.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	February 28, 2014	1 year
RF Section	HP	85420E	3705A00248	February 28, 2014	1 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS- 0411N313	013	August 21, 2013	1 year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 14, 2012	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG19982	N/A	N/A

Figure 27 Test Equipment Used

10. 20 dB Bandwidth

10.1 Test procedure

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.

The EUT was set up as shown in Figure 1, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on the modulation envelope.

10.2 Results Table

E.U.T Description: ALC LF BUS Beacon
 Model: 5-ALC11121-0
 Serial Number: Not designated
 Specification: F.C.C. Part 15, Subpart C: (15.231(c))

Frequency	Bandwidth Reading (kHz)	Specification (1) (kHz)	Margin (kHz)
433.42	165.0	1083.55	-918.55
434.42	160.0	1083.55	-923.55

Figure 28. Test Results GFSK Modulation - 5-ALC11121-0

Frequency	Bandwidth Reading (kHz)	Specification (1) (kHz)	Margin (kHz)
433.92	158.0	1083.55	-925.55

Figure 29. Test Results ASK modulation - 5-ALC01121-0



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKRΔ -165 kHz
.10 dB

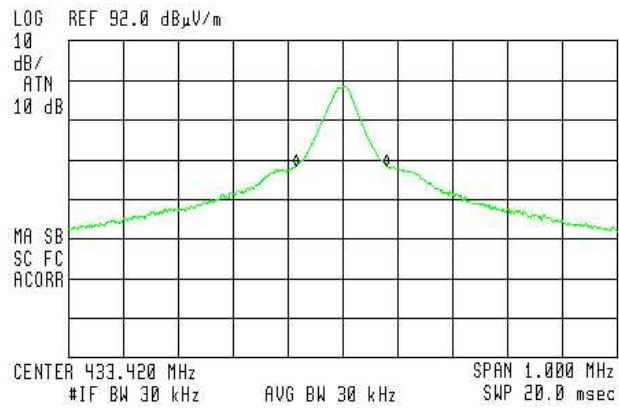


Figure 30. 433.42MHz GFSK Modulation



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKRΔ -160 kHz
.25 dB

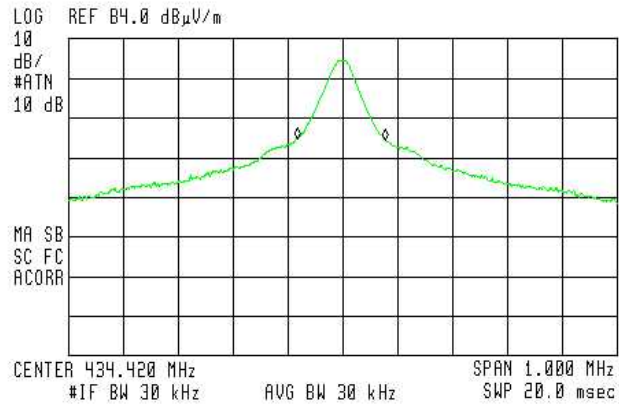


Figure 31. 434.42 MHz GFSK Modulation

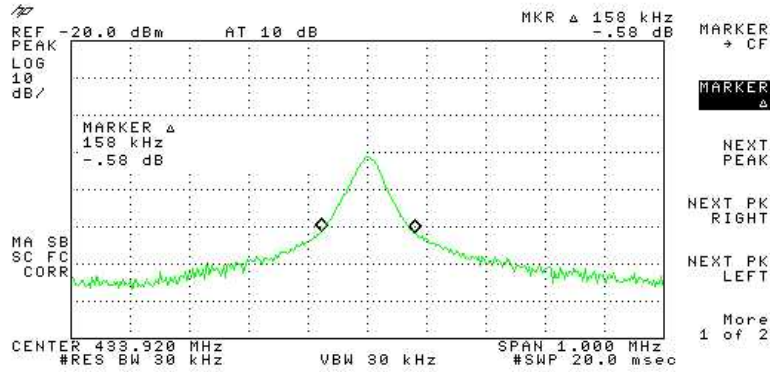


Figure 32. 433.92MHz ASK modulation

JUDGEMENT: Passed by 918.55 kHz

TEST PERSONNEL:

Tester Signature: _____

Date: 15.02.15

Typed/Printed Name: M. Zohar

(1) 0.25% of the E.U.T. fundamental frequency, Section 15.231(c).



10.3 Test Equipment Used; 20 dB Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	February 28, 2014	1 year
RF Section	HP	85420E	3705A00248	February 28, 2014	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG19982	N/A	N/A

Figure 33 Test Equipment Used



11. APPENDIX A - CORRECTION FACTORS

11.1 Correction factors for CABLE from EMI receiver to test antenna at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	7.3
20.0	0.6	1400.0	7.8
30.0	0.8	1600.0	8.4
40.0	0.9	1800.0	9.1
50.0	1.1	2000.0	9.9
60.0	1.2	2300.0	11.2
70.0	1.3	2600.0	12.2
80.0	1.4	2900.0	13.0
90.0	1.6		
100.0	1.7		
150.0	2.0		
200.0	2.3		
250.0	2.7		
300.0	3.1		
350.0	3.4		
400.0	3.7		
450.0	4.0		
500.0	4.3		
600.0	4.7		
700.0	5.3		
800.0	5.9		
900.0	6.3		
1000.0	6.7		

NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 27 meters.
3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".



11.2 Correction factors for CABLE
from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

- 1. The cable type is RG-8.*
- 2. The overall length of the cable is 10 meters.*



**11.3 Correction factors for CABLE
from spectrum analyzer
to test antenna above 2.9 GHz**

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

- 1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.*
- 2. The cable is used for measurements above 2.9 GHz.*
- 3. The overall length of the cable is 10 meters.*



**11.4 Correction factors for CABLE
from EMI receiver
to test antenna
at 10 meter range.**

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	9.8
20.0	0.8	1400.0	10.0
30.0	0.9	1600.0	11.3
40.0	1.2	1800.0	12.2
50.0	1.4	2000.0	13.1
60.0	1.6	2300.0	14.5
70.0	1.8	2600.0	15.9
80.0	1.9	2900.0	16.4
90.0	2.0		
100.0	2.1		
150.0	2.6		
200.0	3.2		
250.0	3.8		
300.0	4.2		
350.0	4.6		
400.0	5.1		
450.0	5.3		
500.0	5.6		
600.0	6.3		
700.0	7.0		
800.0	7.6		
900.0	8.0		
1000.0	8.7		

NOTES:

- 1. The cable type is RG-214.*
- 2. The overall length of the cable is 34 meters.*
- 3. The above data is located in file 34M10MO.CBL on the disk marked "Radiated Emissions Tests EMI Receiver".*



**11.5 Correction factors for LOG PERIODIC ANTENNA
Type LPD 2010/A
at 3 and 10 meter ranges.**

Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	12.5
400.0	15.4
500.0	16.1
600.0	19.2
700.0	19.4
800.0	19.9
900.0	21.2
1000.0	23.5

Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.8
400.0	15.3
500.0	15.6
600.0	18.7
700.0	19.1
800.0	20.2
900.0	21.1
1000.0	23.2

NOTES:

- 1. Antenna serial number is 1038.*
- 2. The above lists are located in file number 38M30.ANT for a 3 meter range, and file number 38M100.ANT for a 10 meter range.*
- 3. The files mentioned above are located on the disk marked "Radiated Emission Test EMI Receiver".*



11.6 Correction factors for Double-Ridged Waveguide Horn

**Model: 3115, S/N 29845
at 3 meter range.**

FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)	FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)
1.0	24.8	5.4	10.0	38.8	11.4
1.5	26.1	7.6	10.5	38.9	11.8
2.0	28.6	7.7	11.0	39.0	12.1
2.5	29.8	8.4	11.5	39.6	11.8
3.0	31.4	8.4	12.0	39.8	12.0
3.5	32.4	8.7	12.5	39.6	12.5
4.0	33.7	8.6	13.0	40.0	12.5
4.5	33.4	9.9	13.5	39.8	13.0
5.0	34.5	9.7	14.0	40.2	13.0
5.5	35.1	9.9	14.5	40.6	12.9
6.0	35.4	10.4	15.0	41.3	12.4
6.5	35.6	10.8	15.5	39.5	14.6
7.0	36.2	10.9	16.0	38.8	15.5
7.5	37.3	10.4	16.5	40.0	14.6
8.0	37.7	10.6	17.0	41.4	13.4
8.5	38.3	10.5	17.5	44.8	10.3
9.0	38.5	10.8	18.0	47.2	8.1
9.5	38.7	11.1			



11.7 Correction factors for

**Horn Antenna
Model: SWH-28
at 1 meter range.**

FREQUENCY (GHz)	APE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4



11.8 Correction factors for ACTIVE LOOP ANTENNA
Model 6502
S/N 9506-2950

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2



12. APPENDIX B – Comparison of Industry Canada Requirements With FCC Requirements

IC: 1467G-5ALC011210

FCC ID: O4X5-ALC01121-0

Test	FCC	IC
<input type="checkbox"/> Conducted Emission	15.207	RSS 210 Issue 8 Clause 2.5
<input type="checkbox"/> Radiated Emission	15.209	RSS 210 Issue 8 Clause 2.5
<input type="checkbox"/> Max power / Peak power	15.247(b)(3)	RSS 210 Issue 8 A8.4(4)
<input type="checkbox"/> 6dB BW	15.247(a)2	RSS 210 Issue 8 A8.2a
<input type="checkbox"/> Power density	15.247(e)	RSS 210 Issue 8 A8.2b
<input type="checkbox"/> Spurious radiated emission in the restricted band	15.205(c)	RSS 210 Issue 8 2.5 RSS Gen 7.2.2 (Table 1)
<input type="checkbox"/> Band edge spectrum	15.247(d)	RSS 210 Issue 8 A8.5
<input type="checkbox"/> RF Exposure Limits	1.1310	RSS 102 4.4