

DNB ENGINEERING, INC.



A2LA # 0844-1



ELA #116

CERTIFICATION FOR INTENTIONAL RADIATOR

Per
Part 15 Subpart C
(CFR 47, 15.203, 15.231)

EUT: Transmitter
Model No. KF-100

PREPARED FOR APPLICANT:
LO JACK CORPORATION
333 Elm Street
Dedham, MA 02026

REPORT #16005-1FC
Test Date: Aug. 17-18, 2000

Prepared By:
DNB ENGINEERING, INC.
1100 East Chalk Creek Rd.
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Revision Letter	Number of Pages	Page No. of Rev.	Description	Date
A	28		Document Release	11/6/00

TRANSMITTAL SUMMARY

Unit tested:

Model #:

KF-100

FCC ID:

IDIKF100

Specifications:

ANSI C63.4 1992 and CFR 47 FCC part 15 Subpart C

Purpose of Report:

This report was prepared to document the status of the EUT with requirements of the standards listed above.

Requirements not applicable to EUT

Part 15.37 - Not applicable

Emergency Broadcast System - Not applicable

Spread Spectrum Exhibit - Not applicable

Scanning Receiver - Not applicable

Test Summary

The EUT's compliance status according to the tests performed is as follows.

CERTIFICATION OF TEST DATA - per 2.911(d)

This report, containing emissions test data and evaluations, has been prepared by an independent electromagnetic compatibility laboratory, DNB ENGINEERING Inc., in accordance with the applicable specifications and instructions required per the Introduction. DNB Engineering Inc. has been evaluated to do these tests by the American Association for Laboratory Accreditation, A2LA.



The data evaluation and equipment configuration presented herein are a true and accurate representation of the measurements of the test emissions characteristics as of the dates and at the times of the test under the conditions herein specified.

Equipment Tested:

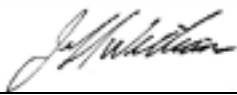
Model #: KF-100
FCC ID#: IDIKF100
Dates of Test: Aug. 17-18, 2000

Test Performed:

 11-6-00

Clay Allred Date
Test Engineer

Test Report Reviewed:

 11-6-2000

Jeff Williams Date
Documentation Supervisor

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1. INTRODUCTION

1.1 Administrative Data Per 2.1033(a) and 2.911(c)

1.1.1 Request for certification Per 2.1033(b)1:

Applicant: LO JACK CORPORATION
333 ELM STREET SUITE 200
DEDHAM, MA 02026

Contact: ROD DeMILLE
Phone: 781-326-4700

Dates of Test: Aug. 17-18, 2000

Equipment Under Test (EUT): KF-100
FCC ID: IDIKF100

1.2 Related Submittals/Grants

All Peripherals possess grants.

1.3 Purpose of Tests

The purpose of this series of tests was to demonstrate the Electromagnetic Compatibility (EMC) characteristics of the EUT. The following tests were performed:

REQUIREMENTS	STATUS
FCC part 15 Subpart C	
per 15.203 and 15.231	COMPLIANT

2. TEST DESCRIPTION

2.1 Test Configuration

Config- uration	Unit Name - Processor, Monitor, Printer, Cable, etc. (indent for features of a unit)	Style/Model/ Part No.	Serial Number	Obj. of test	VAC	Comments/ FCC ID#
A	KF-100			■		

- - Specific device(s) for which this test is being conducted.

2.2 Equipment Description

The KF-100 Key Fob is manufactured to be carried with the vehicle keys. A 3.6 volt lithium battery should be replaced in the FOB every eighteen months to assure maximum range and avoid the MS-100 from inadvertent triggering. The Key Fob emits an RF output every 75 seconds.

2.2.1 Mode of Operation

Lithium battery inserted into the KF-100.

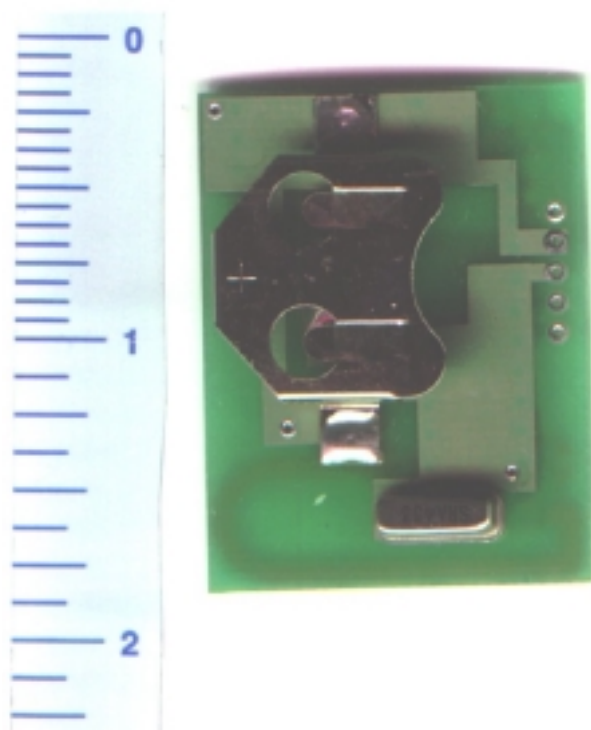
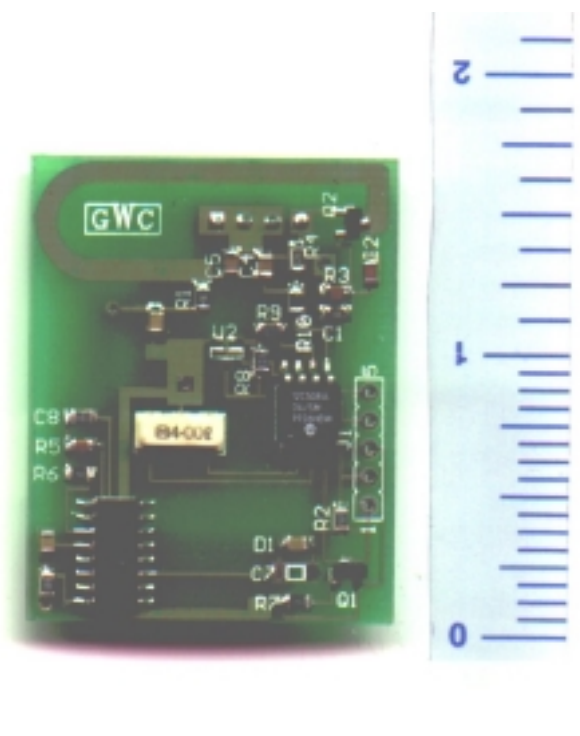
2.3 Antenna Requirement - per 15.203

The antenna is – Internally Fixed.

2.4 Circuit Description - per 2.1033(b)4

The Key Fob emits an RF Output every 75 seconds and when the signal is received by motion sensor the circuit is inactivated.

2.6 Photograph of EUT - per 2.1033(b)(7)



2.7 Photograph of EUT - per 2.1033(b)(7)

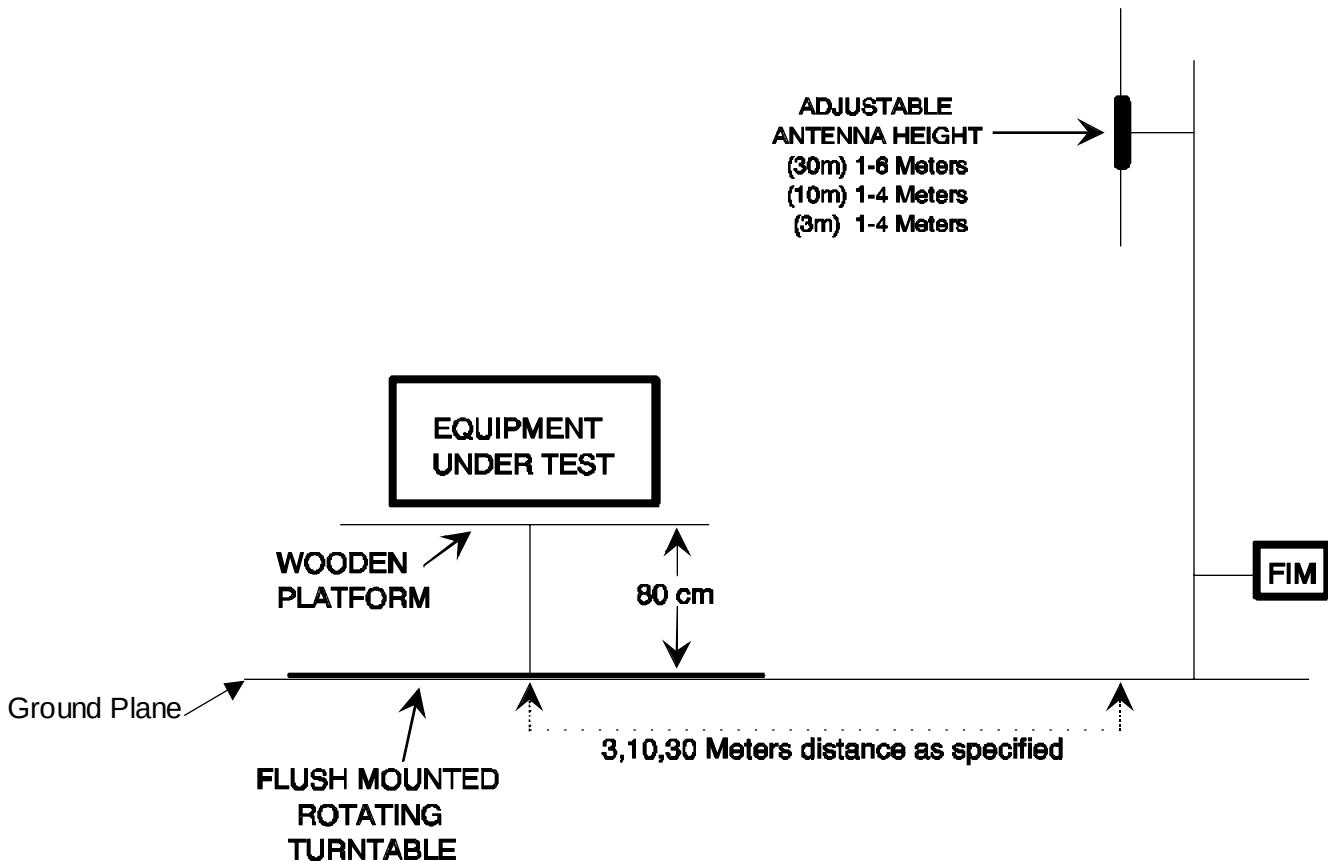


3. EMISSIONS FCC PART 15

3.1 Radiated Emissions Test Setup and Procedure - Per 2.1033(b)(6) Per 2.947(a)

The EUT was placed on a wooden table 1 meter wide and 1.5 meters long which rests on a flush mounted, steel-top turntable on the open area test site as shown in Section 3.1.1.1. The top of the table is 80 cm above the ground plane. The turntable can be rotated 360 degrees. Measuring antenna is set at the prescribed distance. Measurements are made with broadband antennas that have been correlated with tuned dipole antennas. The mast is 4.5 meters high and is self-supporting. The height of the antenna can be varied from 1 to 4 meters. Positioning of the antenna is controlled remotely.

3.1.1 Spurious Radiation Test Site Per 2.1033(b)6



Radiated Test Setup and Procedure - cont'd

The EUT is put into the operational test mode as stated in Section 2.2.1 is then started.

The spectrum analyzer is setup to store the peak emission over the frequency range of the antenna. Peak EUT and ambient emissions are stored while the turntable is rotated 360° . The Peak spectrum analyzer trace is then plotted with the addition of antenna and cable correction factors. The limit is plotted on the same graph. A receiver with CISPR Quasi Peak detector is then used on the frequencies identified as the highest with respect to the plotted limit. Ambients are noted on the graph along with EUT emissions. The highest emissions are maximized.

To maximize emissions levels, the turntable is rotated and the antenna is raised and lowered to determine the point of maximum emanations. The cables are then manipulated at that point to maximize emissions. Measurements are made with the antennas in each horizontal and vertical polarization. The data obtained from these tests is corrected with the proper cable, preamplifier and antenna factors. The results are then transcribed onto tables that show the maximum emission levels. The highest emissions are listed in a Radiated Emissions Summary table.

If no emissions can be found, the lowest harmonics of the EUT clocks within the bands of the standard are tuned into with the receiver. If no emissions are found, the noise floor will be entered to the table and noted. A minimum of six frequencies will be logged. Summary results will reflect only actual emissions from the EUT.

The field intensity measurements are made using standard techniques with a spectrum analyzer or EMI receiver as the calibrated Field Intensity Meter (FIM). Preamplifiers and filters are used when required.

When using the Hewlett Packard Model 8568B Spectrum Analyzer as the FIM, the Analyzer is calibrated to read signal level in dBm. Where:

$$0 \text{ dBm (50 ohms)} = 107 \text{ dBuV (50 ohms)}$$

The signal level (dBuV) = indicated signal level (dBm) + 107 dB. To obtain the signal level in dBuV/m it is necessary to add the antenna factor in dB.

3.1.2 Example Of Typical Calculation Per 2.1033(b)6

Measurement Distance = 3 Meter		
Rohde and Schwarz reading @ 60 MHz		49.0 dBuV
Antenna Factor	+7.5 dBuV	
Cable Loss	+2.0 dBuV	
Preamplifier	-25.5 dBuV	
	-16.0 dBuV	-16.0 dBuV
Field Strength dBuV/m at 3 Meter =		33.0 dBuV

The Following FCC limits for acceptance were used:

Limit 902 to 928 MHz (At the Carrier Frequency):

$$50,000 \mu\text{V/M} = 20 \log (50,000) \text{ dB}\mu\text{V/M} = 94.0 \text{ dB}\mu\text{V/M} @ 3 \text{ Meters}$$

Limit 88 to 216 MHz (Not at the Carrier Frequency):

$$150 \mu\text{V/M} = 20 \log (150) \text{ dB}\mu\text{V/M} = 43.5 \text{ dB}\mu\text{V/M} @ 3 \text{ Meters}$$

Limit 30 to 88 MHz:

$$100 \mu\text{V/M} = 20 \log (100) \text{ dB}\mu\text{V/M} = 40.0 \text{ dB}\mu\text{V/M} @ 3 \text{ Meters}$$

Limit >960 MHz:

$$500\mu\text{V/M} = 20 \log (500) \text{ dB}\mu\text{V/M} = 54.0 \text{ dB}\mu\text{V/M} @ 3 \text{ Meters}$$

3.1.3 Field Strength of Intentional Radiator Inside of Band per FCC part 15, Subpart C (15.249 (a)) at 3 meters

The EUT was compliant with CFR 47, 15.231 (a) field strength of intentional radiator.

LO JACK		EUT: KF-100		
Transmitter Field Strength	Frequency MHz	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Delta (dB)
	433.92	65.6	81.9	-16.3
	433.92	47.1	81.9	-34.8

- Frequencies relative to the Limit.
- Reference Appendix A for all data taken.

3.1.4 Emissions Radiated Outside of Band

Per FCC part 15, Subpart C (15.203 and 15.231 (c)) at 3 meters

The EUT was compliant with CFR 47, 15.231 (c) radiated emissions requirements.

Measurements of radiated emission data were taken at 433 MHz

Table 3.1.5(1)

LO JACK					EUT: KF-100				
Freq. (MHz)	Meas'd (dBuV)	Amp Factors (dB)	Cable Factors (dB)	Antenna Factors (dB)	50% Duty Cycle (dB)	Total Factors (dB)	Corrected signal (dBuV/m)	Limit (dBuV/m)	Delta (dB)
867.86	59.8	-51.0	10.8	24.5	-6	-15.7	44.1	61.0	-16.9
867.85	68.4	-51.0	10.8	24.5	-6	-15.7	52.7	61.0	-8.3
1302.00	49.0	-32.9	0.6	25.4	-6.0	-7.4	36.1	53.0	-16.9
1736.00	46.2	-32.5	0.7	27.2	-6.0	-5.2	35.6	53.0	-17.4
2170.00	50.7	-32.7	0.9	28.9	-6.0	-1.7	41.8	53.0	-11.2
2603.00	47.4	-30.7	1.2	29.9	-6.0	-0.4	41.8	53.0	

- Six highest frequencies relative to the Limit.
- Reference Appendix A for all data taken.

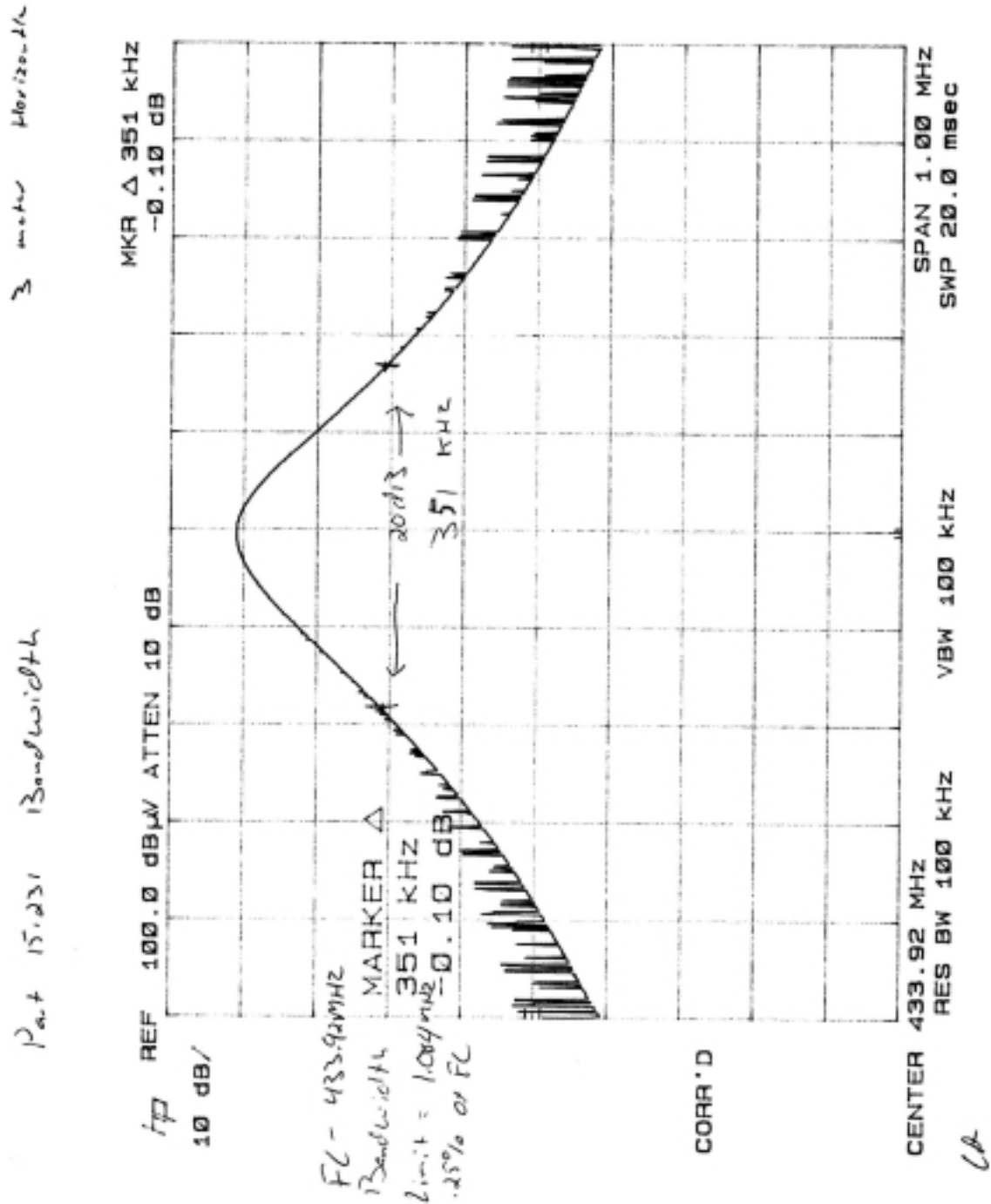
3.1.5 Occupied Bandwidth

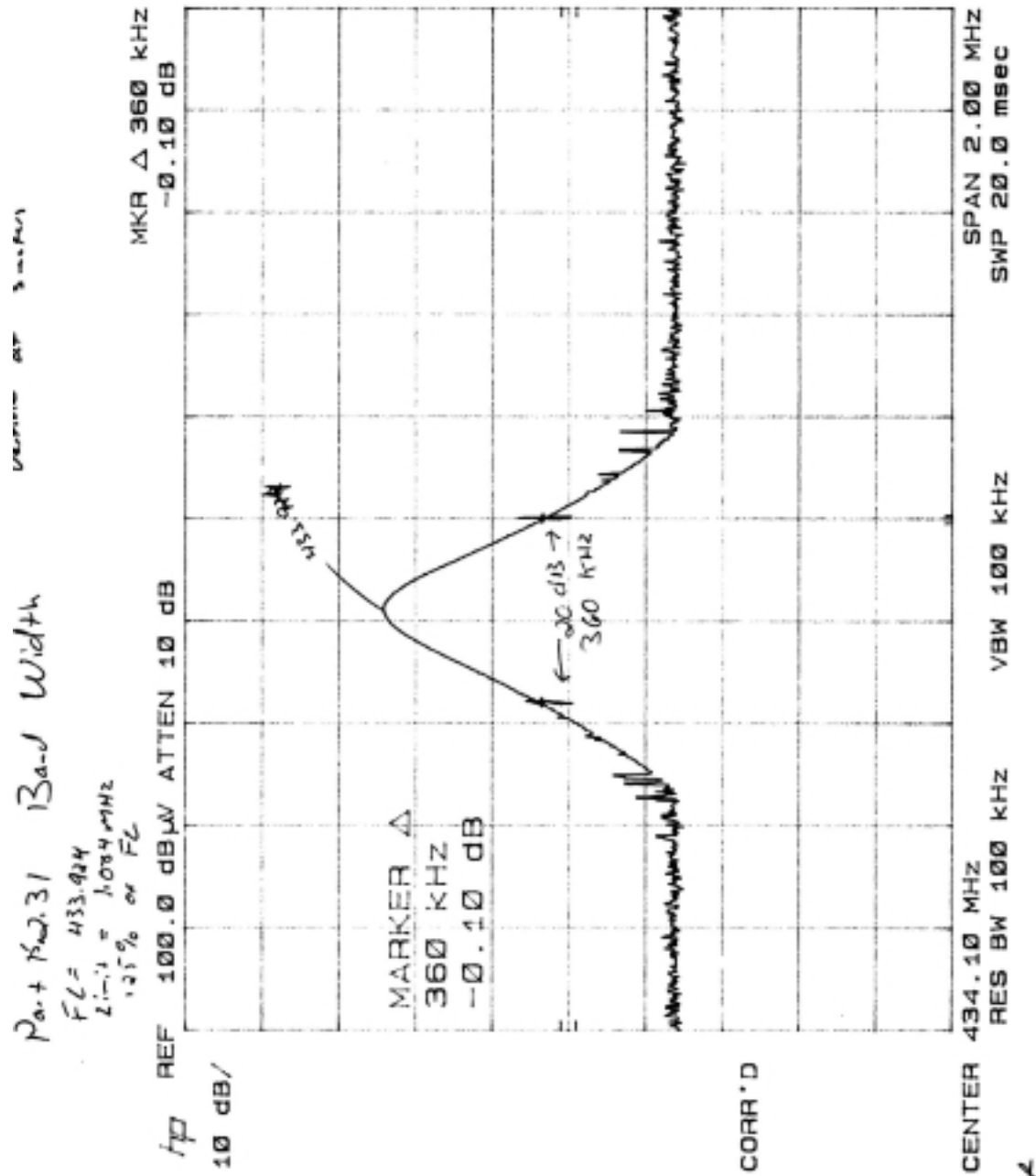
The occupied bandwidth at the transceiver's fundamental frequency output was measured using a HP 8568B spectrum analyzer. The spectrum analyzer was adjusted as follows:

Frequency: 433.9 MHz
Input Attenuation: 10. dB
Scan Width: .1.00 kHz/div
Vertical Scale: 10 dB/div

Resolution Bandwidth: 100 kHz
Reference Level: 100 dBuV
Detector: Peak
Max Hold Multiple Sweeps

3.1.6 Occupied Bandwidth Plot





3.1.7 Photograph of Radiated Test Setup - per 2.1033(b)(7)



4. LABELING REQUIREMENTS - PER 2.1033(B)(7)

Label will be constructed of 0.02 inch plastic attached as shown on the equipment with permanent adhesive.

All information on the label will be etched or screened. All methods will exceed the expected lifetime of the equipment.

The label will be large enough to allow all information to be readily legible.

4.1 Additional Label Required

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Shown above is a copy of the label with the Part 15.19 Compliance Statement, Location of required information is checked "below".

- ☐ The label will be placed in a conspicuous location on the device.
- ☒ The device is too small for a compliance label. Therefore the label will be placed in a prominent location in the Instruction Manual or other information supplied to the user.
- ☐ The device is too small for a compliance label. The label will be placed on the container in which the device will be marketed.

4.2 Label Placement and Contents

See Owners Manual

LO JACK CORPORATION

FCC ID: IDIKF100

6. OWNERS MANUAL

Pdf. File. See attachment that was electronically submitted

7. APPENDIX SECTION

7.1 APPENDIX A: TEST DATA

		EMI Datasheet (ITE Devices)	
5969 Robinson Avenue Riverside, CA 92503 (909) 637-2630 FAX (909) 637-2704		Date: September 13, 2000 Specification	
DNB Job Number: 16005-1 (Utah)		Serial Number: N/A	
Customer: Lojack		Serial Number: N/A	
Model Number: N/A		Serial Number: N/A	
Description: Transmitter		FCC Part 15.231 (e)	

EUT performed within the requirements of the applicable Standard(s)									
☒ YES					☐ NO				
Signed:									
Bcn = A.H. Systems SAS-200/540 Biconical Antenna S/N 138 (30-200 Mhz) Log = EMCO 3146 Log-Periodic Antenna S/N 1284 (200-1000 Mhz) DRG = Double Ridge Guide Horn Antenna S/N 2280 (1GHz - 18GHz) Def = Distance Correction Factor = 20*LOG ₁₀ (Test Distance/Specification Distance) *** = Readings taken with a res bandwidth of 10KHz do to nearby ambient signal					Cbl = Cable Loss Amp = Pre-amplifier Gain Pl = Antenna polarity V = Vertical H = Horizontal Hgt = Antenna height in meters xxx = 000 to 360 degrees Tbl = Table Position in degrees				

Harm	Freq	Meter	ACF	Cbl	Amp	50%	Corr	Lim dB	Delta	Antenna	Tbl	Pl	Hgt
3	1302	49.0	25.4	0.6	-32.9	-6	36.1	53	-16.9	DRG	90	H	1
4	1736	46.2	27.2	0.7	-32.5	-6	35.6	53	-17.4	DRG	90	H	1
5	2170	50.7	28.9	0.9	-32.7	-6	41.8	53	-11.2	DRG	90	H	1
6	2603	47.4	29.9	1.2	-30.7	-6	41.8	53	-11.2	DRG	90	H	1
3	1302	37.8	25.4	0.6	-32.9	-6	24.9	53	-28.1	DRG	90	V	1
4	1736	38.4	27.2	0.7	-32.5	-6	27.8	53	-25.2	DRG	90	V	1
5	2170	39.2	28.9	0.9	-32.7	-6	30.3	53	-22.7	DRG	90	V	1
6	2603	38.7	29.9	1.2	-30.7	-6	33.1	53	-19.9	DRG	90	V	1

NOTES: Worst case emissions were at 90 degrees on table and 1 meter antenna height

1.0 GHz to 10.0 GHz Emissions

Using an HP8566B with the Quasi-peak detector bypassed, an HP low noise preamplifier, and a high frequency antenna, signals between 1.0 GHz and 10 GHz were analyzed. The Spectrum Analyzer settings were as follows:

Start Frequency..... 1.00 GHz
Stop Frequency..... 10.0 GHz
Resolution Bandwidth 1 MHz
Video Bandwidth 3 MHz
Sweep Time 20 msec
Reference 0.0 dBm
RF Attenuation 10 dB

There we no signals measured between 1.0 GHz and 10.0 GHz down to the Spectrum analyzer's noise floor. The following data were measured at the highest level of the analyzer's noise floor:

7.2 APPENDIX B: UNCERTAINTY TOLERANCE

DNB Engineering's Inc. Utah Facility is within acceptable uncertainty tolerances per ANSI C63.4 (1992) sections 5.4.6.1 and 5.4.6.2 as well as CISPR 16-1(1993) Annex M, section M.2.

ANSI C63.4 (1992)

5.4.6.1 Site Attenuation. A measurement site shall be considered acceptable for radiated electromagnetic field measurements if the horizontal and vertical NSA derived from measurements, i.e., the "measured NSA," are within ± 4 dB of the theoretical NSA (5.4.6.3) for an ideal site.

5.4.6.1 NSA Tolerance. The ± 4 dB tolerance in 5.4.6.1 includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies. These errors are analyzed in ANSI C63.6-1988 [3], wherein it is shown that the performance of a well-built site contributes only 1 dB of the total allowable tolerance.

CISPR 16-1 (1993)

M.2 Error analysis

. . . The total estimated errors are the basis for the ± 4 dB site acceptability criterion consisting of approximately 3 dB measurement uncertainty and an additional allowable 1 dB for site imperfections.

7.3 APPENDIX C: TEST SITE CERTIFICATION, CHALK CREEK EMI SITE - per 2.948(a)

The DNB Engineering Inc. test facility is located in Chalk Creek Canyon near Coalville, Utah. Site characteristics were measured according to the procedures outlined in ANSI C63.4 (1992) "Characteristics of Open Field Test Site". The results of these characterizations indicate that the Chalk Creek site is an outstanding facility to perform accurate and repeatable EMI tests.

This facility has been FCC approved to perform class B certification testing since January, 1986. According to the FCC requirement to re-apply every three years, the facility was rectified. Certification was granted for the 3, 10, and 30 meter positions for both ranges. Facility approval was granted by the FCC Feb 2, 2003 under file number Registration number 90532.

In August of 1999, **The American Association for Laboratory Accreditation, A2LA**, granted accreditation to this facility. Standards for which accreditation were granted:
RF Emissions: ANSI C63.4 - 1992, FCC Part 15 subpart B and C, FCC Part 18
CISPR 11, CISPR 13, CISPR 14, CISPR 22, EN 55011, EN 55013, EN 55014, EN 55022, EN 60601-1-2, EN 50081-1, EN 50081-2, IEC 601-1-2; RF Immunity: EN 50082-1, EN 50082-2,
Radiated Susceptibility: EN 61000-4-3, ENV 50140, ENV 50204, IEC 1000-4-3, IEC 801-3, ESD: EN 61000-4-2, IEC 1000-4-2, IEC 801-2, EFT: EN 61000-4-4, IEC 1000-4-4, IEC 801-4, Surge: EN 61000-4-5, ENV 50142, IEC 1000-4-5, IEC 801-5, Injected RF Immunity: EN 61000-4-6, ENV 50141, IEC 1000-4-6, IEC 801-6 Magnetic EN 61000-4-8, Power Quality EN 61000-4-11, Harmonic EN 61000-3-2, Flicker EN 61000-3-3, Electric Strength Testing EN 60065(A1,A2,A3,), EN 61010-1, EN 60601-1-1, EN 60065, IEC 950, (Hi Pot) IEC 1010, IEC 601-1, IEC 65, IEC 335XX, Leakage EN 60950, EN 60601-1-1, Temperature Rise, Electric Strength Testing EN 60065(A1,A2,A3,), EN 61010-1, EN 60601-1-1, EN 60065, IEC 950, IEC 1010, IEC 601-1, IEC 65, IEC 335XX, Ground Bonding EN 61010-1, EN 60950, (A1,A2,A3,), EN 60601-1-1, EN 60065, IEC 1010, IEC 950, IEC 601-1, IEC 65, IEC 335XX, Humidity Conditioning EN 61010-1, EN 60950, (A1,A2,A3,), EN 60601-1-1, EN 60065, IEC 1010, IEC 950, IEC 601-1, IEC 65, IEC 335XX, Surges to Antenna or Mains EN 60065, IEC 65

In September 1994 the National Certified Testing/Competent/ Notified Body for Norway and Scandinavian Countries (NEMKO) approved this test facility. DNB now offers the testing required for the CE Mark. **NEMKO EMC Laboratory Authorization No.: ELA 131**. Standards for which accreditation was granted: RF Emission: EN 55011, EN 55022, EN 50081-1, EN 50081-2; RF Immunity: EN 50082-1, EN 50082-2

In September 1994, the New Zealand Ministry of Commerce certified that DNB ENGINEERING, INC. EMC facilities meet their laboratory approval criteria for EMC testing and placed DNB ENGINEERING on their list of Ministry-Approved laboratories.

In June of 1999, VCCI certified that the Chalk Creek facility was acceptable to perform EMI test according to VCCI requirements. The certificate number is **715**.

Ambient Emissions

Ambient emission measurements were made to determine the level of the ambient emanations at the DNB test facility. The results indicate that all ambient signals are below the FCC, and VCCI radiated emission limits or that each can easily be identified as an ambient signal.

7.4 APPENDIX D: EMC INSTRUMENTATION AND MEASUREMENT EQUIPMENT

All test equipment are calibrated by a certified metrology facility using standards traceable to NIST. Each instrument is calibrated annually or more frequently if required.

Equipment Used for Test Data

Radiated Emissions Equipment

Description	Manufacturer/Model	Asset #	Serial #	Calibration Due
Amplifier	HP/8447D	067	2727A06182	22FEB01
Amplifier	HP/8447D	065	2727A06180	22FEB01
Amplifier	HP/8447D	066	2727A06181	22FEB01
Amplifier	HP/8447D	068	2727A06184	22FEB01
Bi-con Antenna	SCH/BBA9106	187	6	15AUG01
Bi-con Antenna	SCH/BBA9106	186	7	25JUL01
Log P Antenna	SCH/UJALP9107	011	11	25JUL01
Log P Antenna	SCH/UHAL09107	010	10	15AUG01
Loop Antenna	R&S/HFH 2-Z2	173	880665/-40	10JUL01
QP Adapter	HP/85650 A	002	2043A00277	19OCT01
QP Adapter	HP/85650 A	001	2043A00124	19OCT01
Receiver	R&S/ESVP	078	879807/048	14SEP01
Receiver	R&S/ESVP	083	882402/005	2DEC00
Spectrum Analyzer	HP/8568B	003A	17221A00113	14NOV00
Spectrum Analyzer	HP/8566B	138A	2421A00516	25OCT01

7.5 APPENDIX E: INFORMATION SUPPLIED TO APPLICANT

INFORMATION PERTAINING TO EQUIPMENT MANUFACTURED AFTER COMPLIANCE TESTING

It is prudent that manufacturers have an established Quality Assurance program to spot check their products on a periodic basis, either based upon time or quantities produced. Obviously, a change in the engineering design should be sufficient justification for a re-test.

The Quality assurance test need not be formal Verification or Certification such as required during the initial production of the product. However, it should be sufficient in scope to assure that the EMI characteristics of the product have not changed to the degree that the product exceeds the FCC limits. If a new model of a product is produced, it must undergo full Verification or Certification testing and, in case of Certification, be filed with the FCC.

It is expected that the FCC will place greater emphasis and resources in spot checking commercially available products. If a product is found not to be compliant with the Limits specified in Part 15, Subpart B, the manufacturer will be subject to the appropriate penalties imposed by the Commission. The initial Certification or Verification is sufficient to justify initial production. The additional quality assurance testing performed is the manufacturer's responsibility to assure continued compliance.