Test Data for H25LB1

I. INFORMATION REQUIRED UNDER PART 2

Para.

2.10033(a) N/A

2.10033(b) N/A

2.10033(c)(1) The full name and address of the applicant and manufacturer for certification is:

DTC Communications Inc.
75 Northeastern Blvd.
Nashua, NH 03062

(2) The FCC Identifier of the device is H25LB1

(3) A copy of the operating instructions is included in the EXHIBITS.

(4) Emission 1: NBFM Tone – Designator: 11K0F3W
Emission 2: Unmodulated Pulses – Designator: 6K00P0N

Emission 1 Single, multi-tone and DTMF modulated NBFM signals that are used for signaling purposes both aural and automatic. Functions include confidence tone, motion tone, low battery tone and alarm tone. Peak deviation is 2.75 kHz. Tone assignments are made in software before deployment.

Emission 2 is a series of four unmodulated 15 mS CW pulses; each separated by 15 mS, sent at a 1- second, 2- second or 4-second rep rate. This emission is used as a tracking signal.

(5) The table below describes the various tone types, which may be assigned.

Signal Name	Frequency / Freqs. (Hz)	Deviation (kHz)
Default High Tone	1800	2.75
Default Low Tone	600	2.75
DTMF 0	941 1336	2.75
DTMF 1	697 1209	2.75
DTMF 2	697 1336	2.75
DTMF 3	697 1477	2.75
DTMF 4	770 1209	2.75
DTMF 5	770 1336	2.75
DTMF 6	770 1477	2.75
DTMF 7	852 1209	2.75
DTMF 8	852 1336	2.75
DTMF 9	852 1477	2.75
DTMF A	697 1633	2.75
DTMF B	770 1633	2.75
DTMF C	852 1633	2.75
DTMF D	941 1633	2.75

DTMF #	941 1477	2.75
DTMF *	941 1209	2.75
OK (triple tone)	1209 1477 1633	2.75
Fault (triple tone)	1633 1477 1633	2.75
Note: triple tones are sequential		

Signal Duty Cycle Table

The table below describes the emissions duty cycles for the various signals:

Signal Name	Time On (sec)	Time Off (sec)	Duty Cycle (%)
Confidence	0.3	3.7	7
Motion	0.3	3.7	7
Low Battery	0.3	19.7	1.5
* Alarm	0.3	0.3	50
OK (triple tone)	1.1	Single Event	-
Fault (triple tone)	1.1	Single Event	-

* Alarm Event causes transmission until batteries are drained.

(6) Frequency Range: 148 –174 MHz

(7) Power: Single level of .025 Watts

(8) Maximum Power Rating of .050 Watts

(9) All stages except the final radio frequency amplifying device are powered by a DC regulated supply from a stand-alone battery source consisting of three coin cells.

(10) A tune-up procedure is included in the EXHIBITS.

(11) A Schematic Diagram is included in the EXHIBITS.

(12) A drawing of the equipment identification label is included in the EXHIBITS.

(13) Photographs showing the external and internal construction of the equipment is included in the EXHIBITS.

(14) N/A

(15) Test Data as required by (46)§§(47) 2.1046 through 2.1055, inclusive, is measured in accordance with the procedure setout in (48)§ 2.1041.

(16) N/A
(17) N/A
(18) N/A

II. TEST DATA

Data required by (46)§§(47) 2.1046 through 2.1055, inclusive, is measured in accordance with the procedures setout in (48)§ 2.1041.

RF POWER OUTPUT 2.1046(a), 2.1033(c)(8)

Power output measurements were made at the RF output terminals.
This test was done with an unmodulated carrier in accordance with §90.205(d).

The power output was measured with a Marconi Radio Communications Test Set, Model 2955.

The electrical characteristics of the RF load was 50 + j0 Ohms (50 ohms pure resistive).

Output power was 44.1 mW, measured at 8.0 VDC, representing nominal battery voltage.

The LB-1 is battery operated with three coin cells in series. Maximum possible voltage is limited to below 9 VDC due to series resistance in the cells. The following table shows power output over a wide range of input voltages.

LB-1 Output Power vs. Input Voltage

Input Voltage (Vdc)	Power Out (mW)
6.0	24.8
6.2	26.6
6.4	28.3
6.6	30.2
6.8	32.1
7.0	34
7.2	35.9
7.4	38.1
7.6	40
7.8	42.1
8.0	44.1
8.2	46.2
8.4	48.2
8.6	50.4
8.8	52.5
9.0	54.6
9.2	56.5

Thus the sample complies with §90.205(d).

MODULATION CHARACTERISTICS 2.1047(a)

Spectrum analyzer data is included which shows that the equipment will meet the modulation requirements under §90.217. This transmitter is equipped with an audio low pass filter circuit.

Frequency Response

This is a beacon transmitter with audible-band tones generated at fixed levels, thus producing a fixed peak deviation. Deviation was measured with the Marconi Communications Test Set, model 2955. The LB1 does have an active low pass filter, U1 a two-pole op-amp circuit. The low pass cutoff frequency is 2.5 kHz.

Modulation Limiting

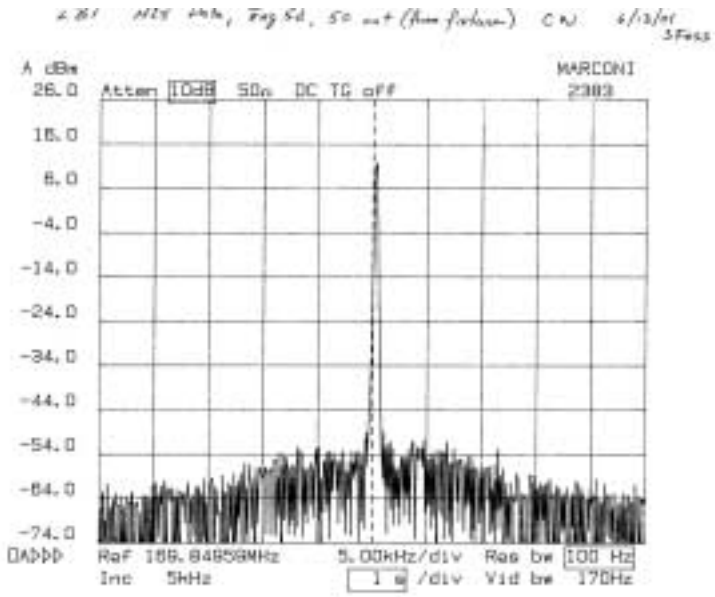
Modulation Limiting is not applicable, since the LB1 generates only fixed level tones or unmodulated pulses.

OCCUPIED BANDWIDTH 2.1049, 90.217

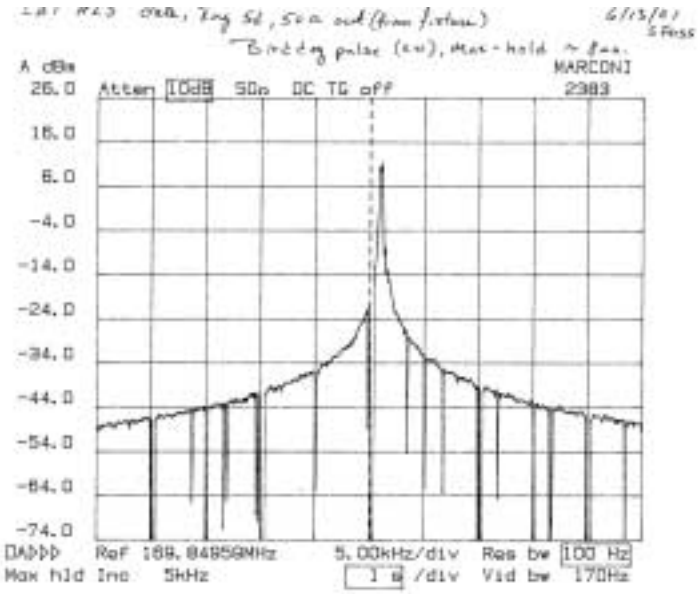
The next series of plots are taken from a Marconi 2390A spectrum analyzer. The transmitter was self-modulated with internal circuitry. The transmitter output was connected to the input of the spectrum analyzer via a 9 inch test pigtail made of RG-188 coaxial cable, terminated with a BNC connector and a JFW model 50FH-020-10, 50-ohm, 20 dB attenuator. This test pigtail was soldered to the antenna output terminals of the board sample.

Power was supplied to the test sample via a HP E3610A Power Supply and test leads.

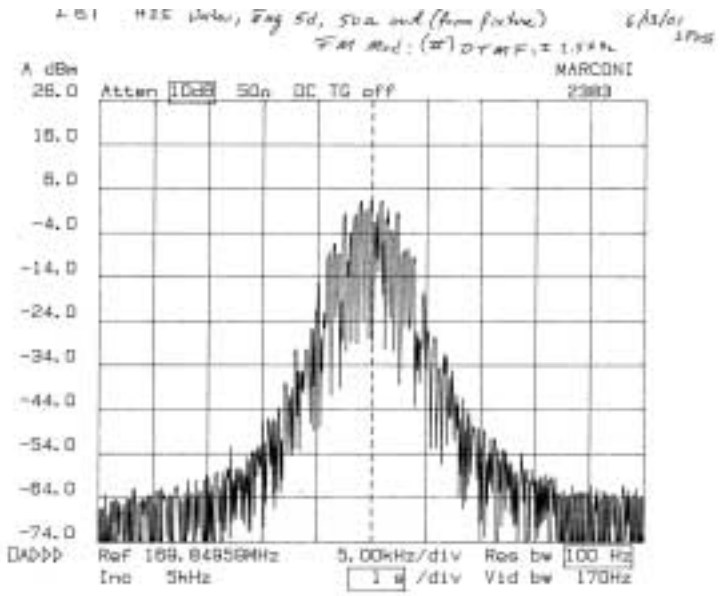
Paragraph 90.217(b) states that: For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.



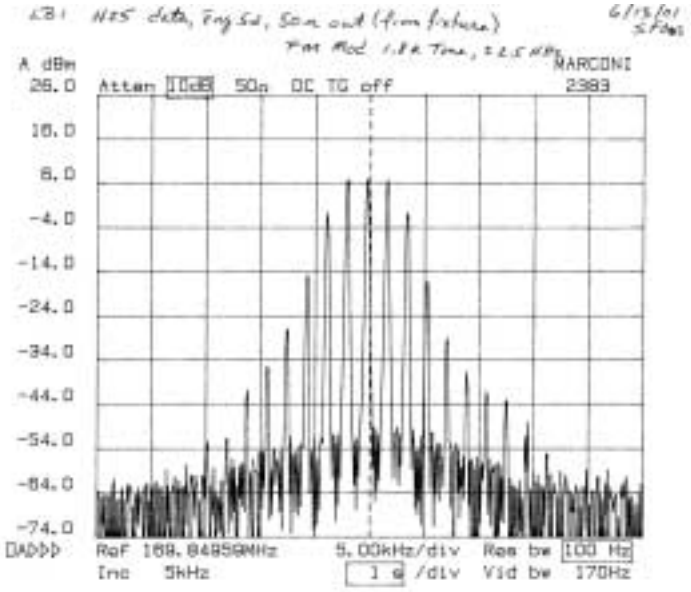
UNMODULATED



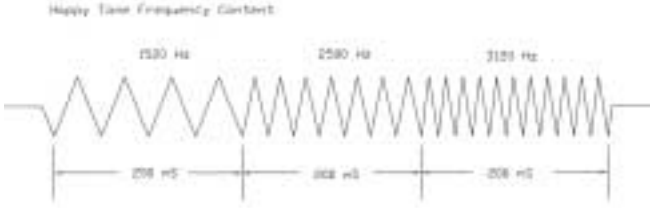
MODULATED WITH UNMODULATED PULSED OUTPUT



MODULATED WITH DTMF TONE



MODULATED WITH 1 kHz. TONE



TYPICAL THREE TONE MODULATED INTELLIGENCE

The authorized bandwidth is 12.5 kHz; the assigned frequency of the sample is 169.850 MHz.

All emissions are below the required limits. Thus, the sample complies with 90.217.

SPURIOUS EMISSIONS AT ANTENNA TERMINALS 2.1053, 90.217

The LB-1 has an integral antenna, which is a primary contributor to its harmonic and spurious suppression. Conducted measurements at the antenna terminals are not applicable to this device. Refer to the data in the FIELD STRENGTH OF SPURIOUS RADIATION section.

As required by §§2.1053 and 90.217
pectrum investigated: 9 kHz – 1.6 GHz per §2.1057(a)(1).

90.217 (b) states that equipment operating under Subpart B or C at an output power of less than 120 mW are exempt from the technical requirements set out in this Subpart, but instead must comply with the following:

For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

FIELD STRENGTH OF SPURIOUS RADIATION 2.1053 and 90.217
(Performed by Retlif Testing Laboratories)

Test Conditions:	Standard temperature and Humidity Internal Power: 8.0 VDC via coin cells and the LB-1's integral antenna. Motion Mode
Test Equipment	See Retlif Test Instruments List
Minimum Standard	§2.1053 The power of any emission shall be attenuated below the carrier power (P) by at least (50 + 10log P) dB or 36.9 dB, whichever is the lesser attenuation.
Test Result	Complies. The strongest spurious emission is at the third harmonic (509.55 MHz) with a level of 51.18 dBuV/m @ 3m. This is more than 33 dB below the limit.

Calculation of Radiated Power Limit below 1000 MHz

The emissions limit is expressed in terms of equivalent power that would have to be fed into a dipole antenna in order to produce the same electric field strength.

Based on the maximum rated output power of .05W and the formula E = SQRT (30GPt)/R

Where:
E = Electric Field Intensity in V/m
G = Antenna Gain = 1.64
Pt = Power in Watts
R = Distance from test sample to antenna in Meters = 3

E = SQRT (49.2 X .05)/3 = 0.52 V/m = 114.3 dBuV/m

Attenuation Requirement: §2.1053 requires that the spurious radiated emissions be attenuated at least 50 + 10 log (.05W) = 36.9 dB below the unmodulated carrier field strength.

Limit @ 3m = 114.3 – 36.9 = 77.3 dBuV

Calculation of radiated Power Limit above 1000 MHz

For all emissions above 1000 MHz, the source of the emission is assumed to be isotropic. Therefore the antenna gain G = 1 and the limit is reduced slightly to:

Limit @ 3m = 112.2 – 36.9 = 75.3 dBuV

Retlif Testing Laboratories
101 New Boston Road, Goffstown, NH 03045
603-497-4600 - Fax: 603-497-5281

CORPORATE OFFICE
795 Marconi Avenue
Ronkonkoma, NY 11779
516-737-1500 Fax 516-737-1497
(A NY Corporation)

BRANCH LABORATORY
11 Harts Lane, Suite H
East Brunswick, NJ 08816
732-257-0800 Fax 732-257-6663
(A NJ L.L.C.)

ENGINEERING OFFICE
27777 Franklin Road
Southfield, MI 48034
248-213-0265 Fax 248-213-0257

DATA PACKAGE
FOR

Letter Beacon Transmitter

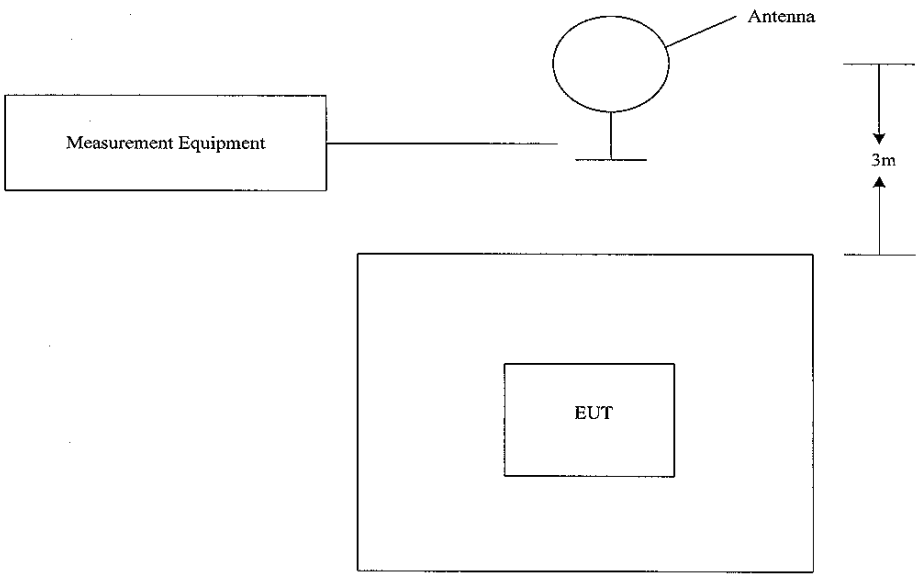
Model No. LB-1
Serial No. ENG5d

SHOWING COMPLIANCE WITH RADIATED EMISSIONS

Customer Name:	DTC Communications, Inc.
Customer P.O.:	71015
Data Package No.:	R-3755N
Package Date:	March 14, 2001
Test Start Date:	March 8, 2001
Test Finish Date:	March 9, 2001
Test Technician(s):	Tim Firkowski
Test Engineer:	John Monahan
Data Prepared By:	Amanda Lackey
Supervisor:	Scott Wentworth

TEST SETUP PHOTOGRAPH
SPURIOUS RADIATED EMISSIONS

SPURIOUS EMISSIONS AND RECEIVER SPURIOUS
RADIATION GENERAL TEST SETUP



Standard OATS Site

EQUIPMENT LIST

Spurious Radiated Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	7/10/00	7/10/01
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/9/00	3/9/01

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

Test Method:	Spurious Radiated Emissions 30 MHz to 1.7 GHz		
Customer:	DTC Communications, Inc.	**Job No:**	R-3755N
Test Sample:	Letter Beacon Transmitter		
Model No:	LB-1	**Serial No:**	ENG5d
Test Specification:	FCC Part 2 & 90 Paragraph: 2.1053 & 90.210		
Operating Mode:	Continuously Transmitting		
Technician:	T. Firkowski	**Date:**	3/9/01
Notes:	Detector Function: Peak Test Distance = 3m Harmonic Limit per Emission Mask D of paragraph 90.210		

Test Frequency	Harmonic Frequency	Ant Position/ EUT axis	Meter Reading	Correction Factor	Corrected Reading					Limit at 3 Meters
MHz	MHz		dBuV	dB	dBuV/m					dBuV/m
169.85										
-	339.70	H/Z	25.75	23.04	48.79					84.40
-	509.55	V/X	23.26	27.92	51.18					I
-	679.40	-	-	-	-					I
-	849.25	-	-	-	-					I
-	1019.10	-	-	-	-					I
-	1188.95	-	-	-	-					I
-	1358.80	-	-	-	-					I
-	1528.65	-	-	-	-					I
-	1698.50	-	-	-	-					84.40

EUT emissions observed throughout the given frequency spectrum were recorded. Emssions levels closest to the limit are listed on this data sheet.

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

Effective Radiated Power

DTC Communications, Inc. — Model No: R-3805N

Letter Beacon Transmitter

LB-1 — Serial No: ENG56

FCC Part 2 & 90

Paragraph: 2.1053 & 90.210

Operating Mode: Continuously Transmitting

Technician: T. Firkowski — Date: 6/26/01

Notes: Detector Function: Peak — Test Distance = 3m

Transmit Frequency	Harmonic Frequency	Ant Position/ EUT Axis	Reference Level	Signal Gen Level	Reference Ant Gain	Cable Factor	Corrected Reading			
MHz	MHz		dBuV	dBm	dBi	dB	dBm			
169.85	-	H/X	76.50	-7.70	1.64	1.65	-4.41			
-	339.70	V/Y	32.80	-43.00	1.64	2.42	-38.94			
-	509.55	V/X	21.20	-44.00	1.64	2.84	-39.52			

PRELIMINARY TEST DATA
PENDING RETLIF, INC.
ENGINEERING REVIEW

EUT emissions observed throughout the given frequency spectrum were recorded. Emissions levels closest to the limit are listed on this data sheet.

FREQUENCY STABILITY 2.1055, 90.213, 90.214

Frequency stability measurements were made over the temperature range of –30° C to +50° C and the variations of the primary DC voltage –40% to +10% of the rated voltage (4.5 VDC). Frequency measurements were made using a direct (attenuated) connection to a Systron Donner model 6420 frequency counter with a frequency accuracy of better than 0.1 ppm.

Power variations were accomplished with a variable regulated DC supply, an HP 3610A. Environmental conditions were accomplished with an environmental chamber the Associated Systems BK-1101.The temperature was first lowered to -30° C and then increased in 10° C increments.

At each temperature, short- term transient effects were monitored and no adverse effects were noted. The frequency was recorded fifteen seconds after the turn on of the transmitter.

The table below shows the frequency vs. temperature data.

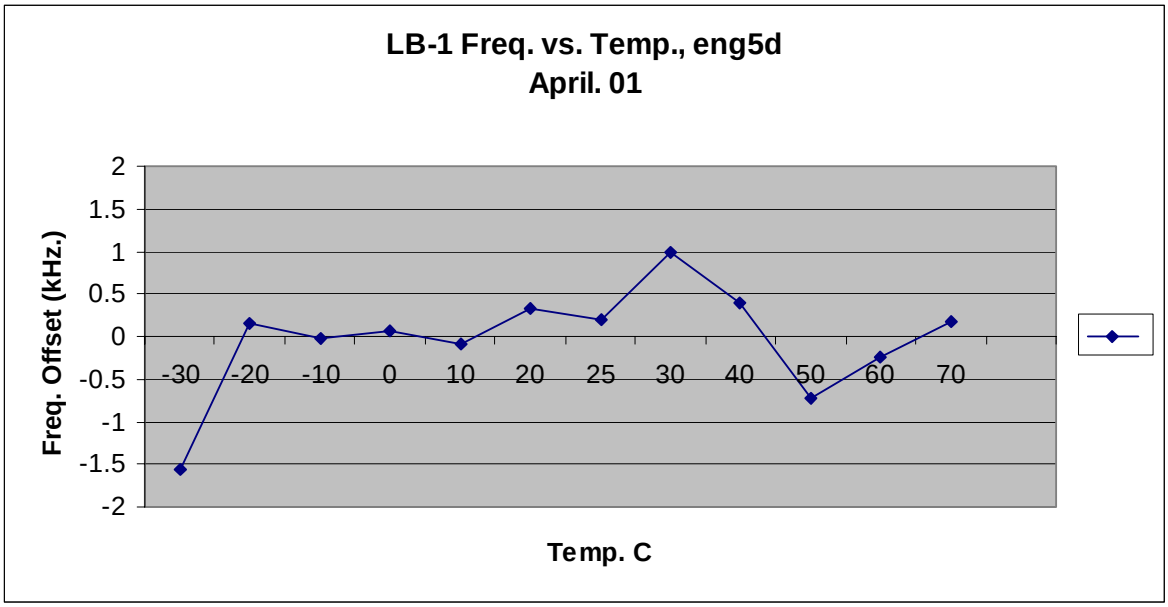
LB-1 Oscillator Measurements

April 6, 2001

Frequency offset vs. temp.
Operating freq. : 169850000 Hz.

Unit No. ENG5D

Temp (°C)	Offset (kHz.)	Offset (ppm)
-30	-1.55	-9.12
-20	0.147	0.865
-10	-0.016	-.009
0	0.072	0.423
10	-0.088	-0.518
20	0.338	1.98
25	0.188	1.10
30	1	5.88
40	0.387	2.27
50	-0.727	-4.28
60	-0.244	-1.43
70	0.168	0.989



The data show that the LB-1 has a frequency drift over temperature of less than -1.55 and + 1 kHz which is - 9.1 ppm / + 5.8 ppm which is less than the limit of +/- 50 ppm.

The table below shows frequency variations vs. power supply input voltage data.

LB-1 frequency vs. input voltage

Input Voltage (Volts)	Output Freq. Offset (Hz.)	Offset (ppm)
5.0	60	0.350
5.5	52	0.300
6.0	32	0.188
6.5	34	0.200
7.0	12	0.070
7.5	51	0.300
8.0	51	0.300
8.5	1	0.005
9.0	0	0.0
9.5	58	0.341
10.0	145	0.853
10.5	112	0.659
11.0	205	1.20

The data show that the LB-1 has a frequency drift over temperature of less than +0.350 ppm which is which is less than the limit of +/- 50 ppm.

DTC TEST INSTRUMENTS

Type	Manufacturer	Model No.
Radio Test Set	Marconi Instruments	2955
Spectrum Analyzer	Marconi Instruments	2390A
Multimeter	Hewlett Packard	34401A
Dc Power Supply	Hewlett Packard	E3610A
Audio Generator	Leader	LAG-12S
Temperature Chamber	Associated Systems	BK-1101
Frequency Counter	Systron Donner	6420
Attenuator Pad 20 dB	JFW	50FH-020

APPENDIX – Excerpt from 47CFR PART 90

90.217 EXEMPTION FROM TECHNICAL STANDARDS.

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 milliwatts are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

(b) For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

(c) For equipment designed to operate with a 6.25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 12.5 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carriers.

(d) Transmitters may be operated in the continuous carrier transmit mode.

End of Report