Test Data for H25T2001S

I. INFORMATION REQUIRED UNDER PART 2

Para.

2.10033(a) This Application for Certification is filed on form 731 with all questions answered. Confidentiality is being requested for the schematic. An application fee of $475 and a request for confidentiality fee of $135 has been sent.

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 H25T2001S

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

(4) Emission: NBFM Voice – Designator: 11K2F3E
Emissions calculation is included in the EXHIBITS.

(5) Frequency Range: 150 –174 MHz

(6) Power: Two power levels: 500 mW at 130 mA; 6 VDC
and 1.0 W at 240 mA; 9 VDC

(7) Maximum Power Rating of 1.25 Watts

(8) All stages are powered by 3.5 VDC regulated supplies with the exception of the final amplifier device, which is connected to the battery source.

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

(10) A schematic diagram is included in the EXHIBITS.

(11) A drawing and photo of the equipment identification label is included in the EXHIBITS.

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

(13) N/A

(14) Test Data as required by (46)§§(47) 2.1046 through 2.1057, inclusive, is measured in accordance with the procedure setout in (48)§ 2.1041.

(15) N/A

(16) N/A

(17) N/A

II. TEST DATA

Data required by (46)§§(47) 2.1046 through 2.1057, inclusive, is measured in accordance with the procedures setout in (48)§ 2.1041.

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

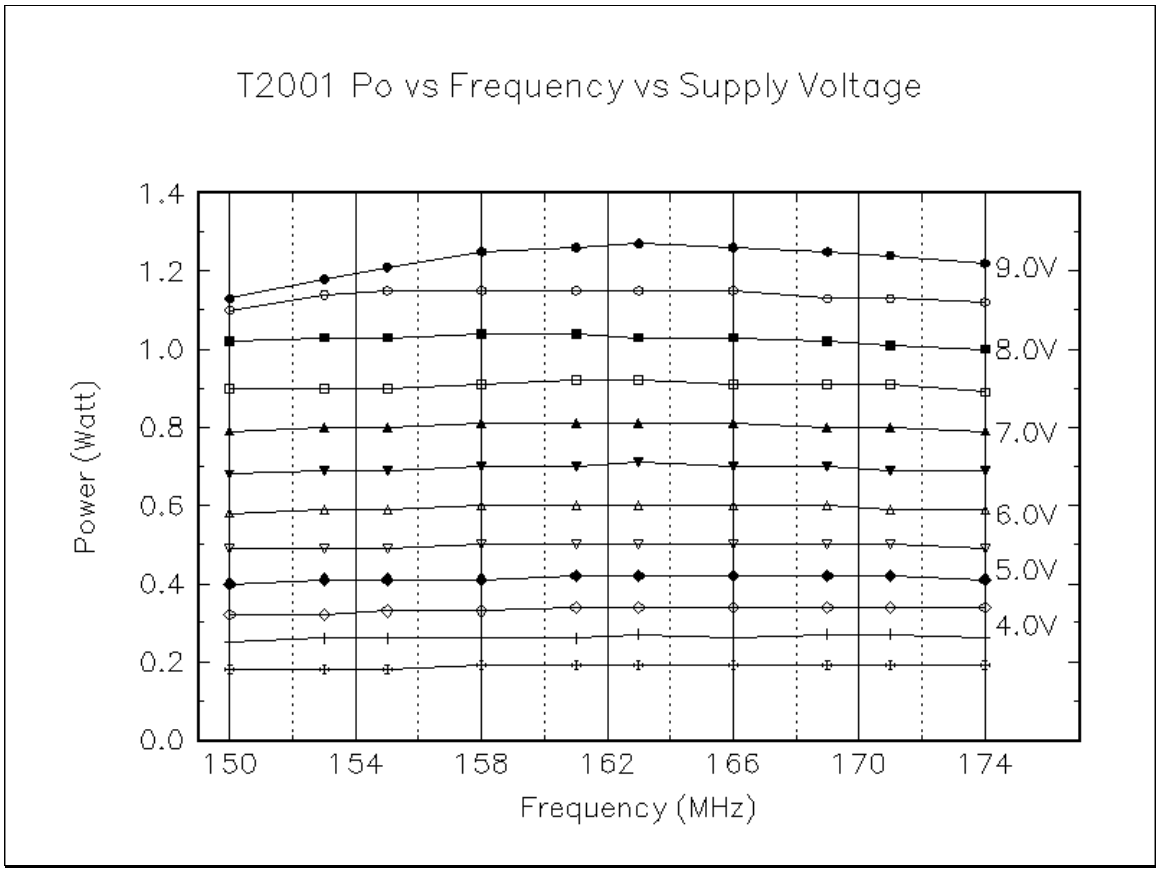
Power output measurements were made at the RF output connector.
This test was done with an unmodulated carrier in accordance with §90.205(d).

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).

The RF power measured mid-band was 590 mW at 6.0 VDC and 1.22 Watts at 9.0 VDC.

Thus the sample complies with §90.205(d).

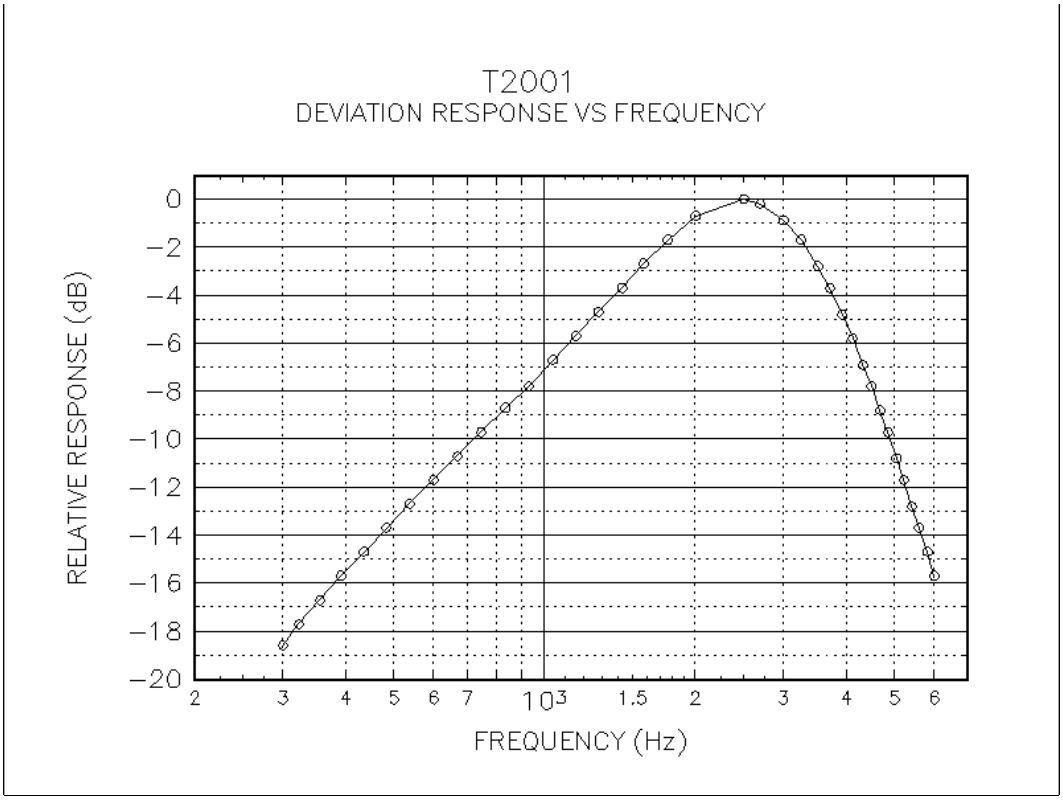


MODULATION CHARACTERISTICS 2.1047(a), 90.211(a)

Spectrum analyzer data is included which shows that the equipment will meet the modulation requirements under §90.211(a). This transmitter is equipped with an audio low pass filter circuit.

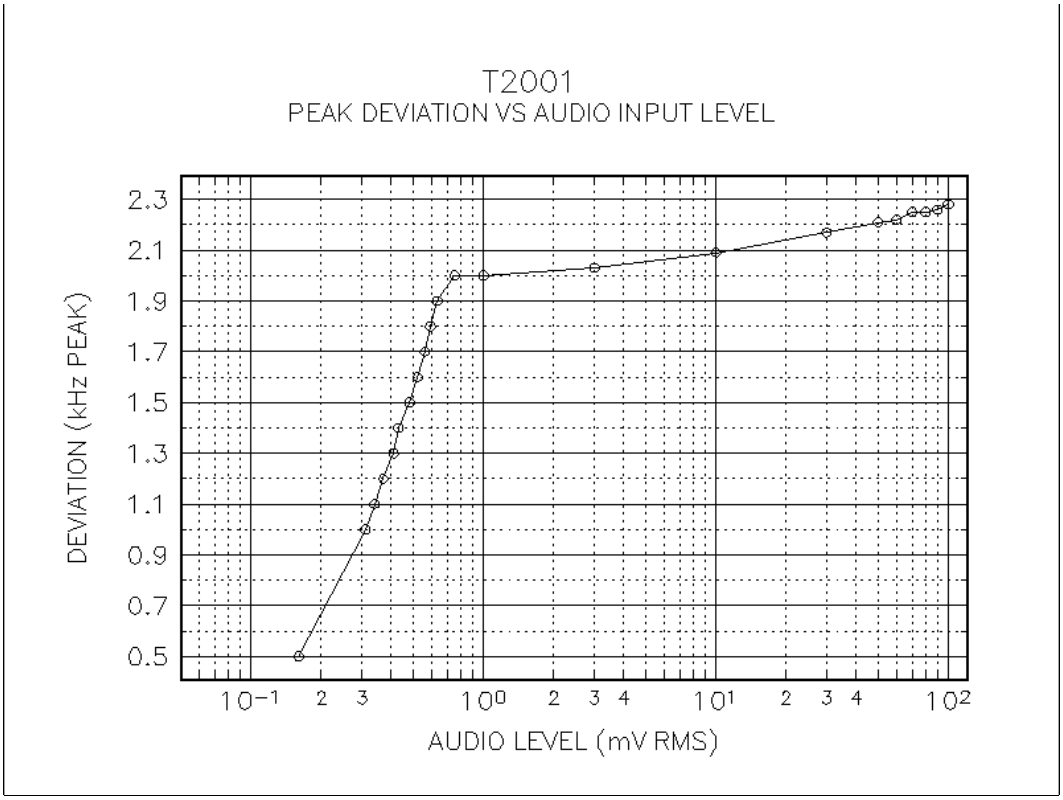
Frequency Response

Measurement data showing the frequency response of the transmitter is tabulated and graphed below. A reference level of 1.25 kHz deviation (as measured with the Marconi Communications Test Set, model 2955) at the frequency of maximum response (2500 Hz) was used. At each test frequency, the input audio level was adjusted to maintain the reference deviation.



Modulation Limiting

Curves showing frequency deviation versus the microphone input levels are shown below, tested at the frequency of maximum deviation (2.5 kHz). The information submitted shows the modulation limiting capability throughout the range of input signals employed. A Leader model LAG-125 Audio Generator was used to generate the modulation, and a Marconi Communications Test Set, model 2955 was used to measure modulation. Audio levels were verified with a HP34401 meter.



OCCUPIED BANDWIDTH 2.1049, 90.211(a)

The next series of plots are taken from a Marconi 2383 spectrum analyzer. The transmitter was modulated by a Leader model LAG-125 audio generator with a sine wave at 2500 Hz at a level 16 dB above that required to produce 50% modulation (1.25 kHz deviation). Audio levels were verified with a HP34401A multimeter. The transmitter output connector 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.

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

Paragraph 90.210(d) states that for transmitters that are designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1) 0n any frequency removed from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

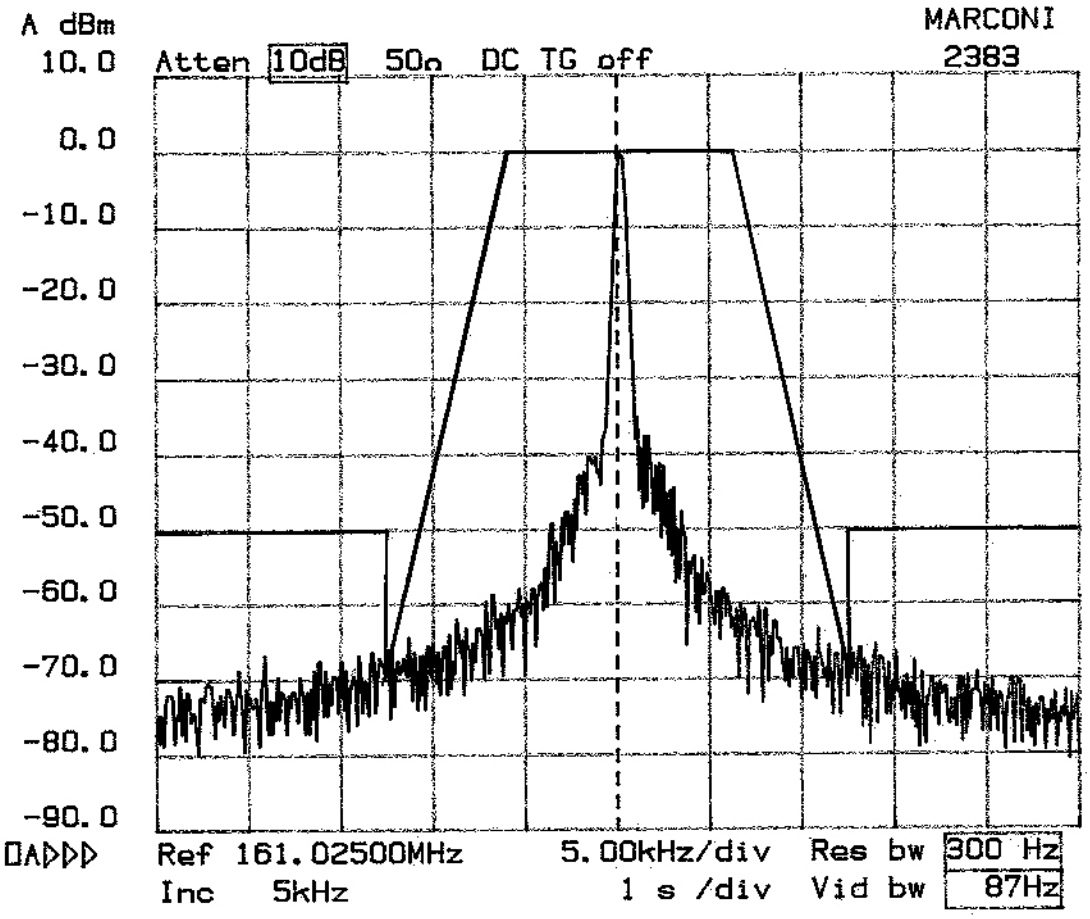
2) 0n any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.25 (fd – 2.88 kHz) dB.

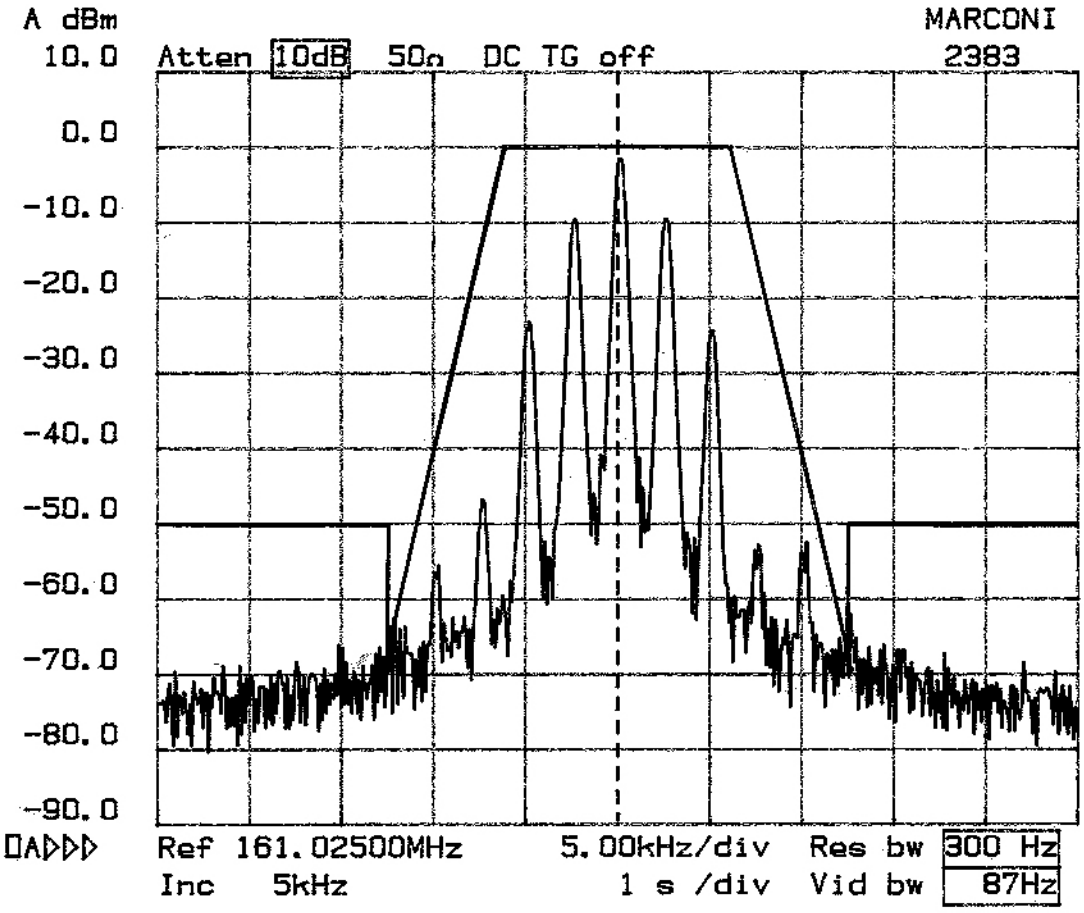
3) 0n any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50+ log(P) or 70 dB, whichever is the lesser attenuation.

The authorized bandwidth is 12.5 kHz; the frequency of the sample was set for 161.025 MHz.

The first plot shows the unmodulated carrier. The second plot shows the modulated carrier. The mask is superimposed on both spectral plots.

All emissions are below the required limits. Thus, the sample complies with 90.211(a).





SPURIOUS EMISSIONS AT ANTENNA TERMINALS 2.1053, 90.209

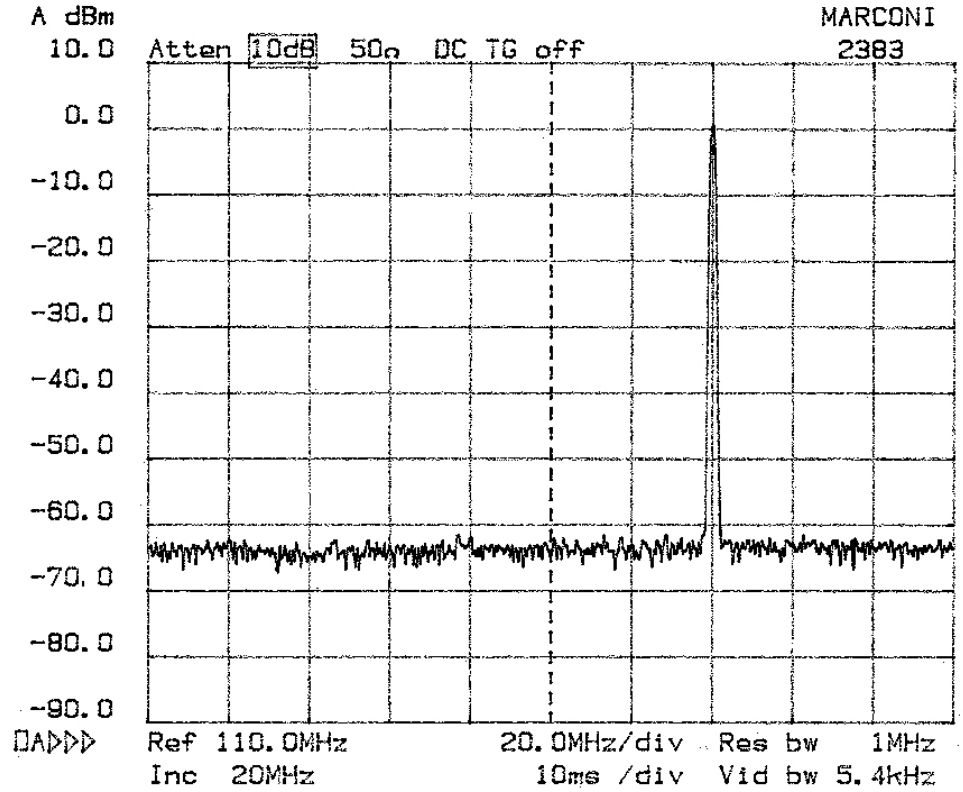
As required by §§2.1053 and 90.209, Emission Mask D, spurious emissions measurements at the antenna terminals were made using a Marconi 2383 spectrum analyzer. The transmitter was modulated by a Leader model LAG-125 audio generator with a sine wave at 2500 Hz at a level 16 dB above that required to produce 50% modulation (1.25 kHz deviation). Audio levels were verified with a HP 34401A multimeter. The transmitter output connector was connected to a JFW model 50FH-020-10, 50-ohm, 20dB attenuator at the input of the spectrum analyzer, via a 9-inch test cable made of RG-188 coax.

The spectrum was investigated over the range 9 kHz – 1.75 GHz per §2.1057(a)(1).

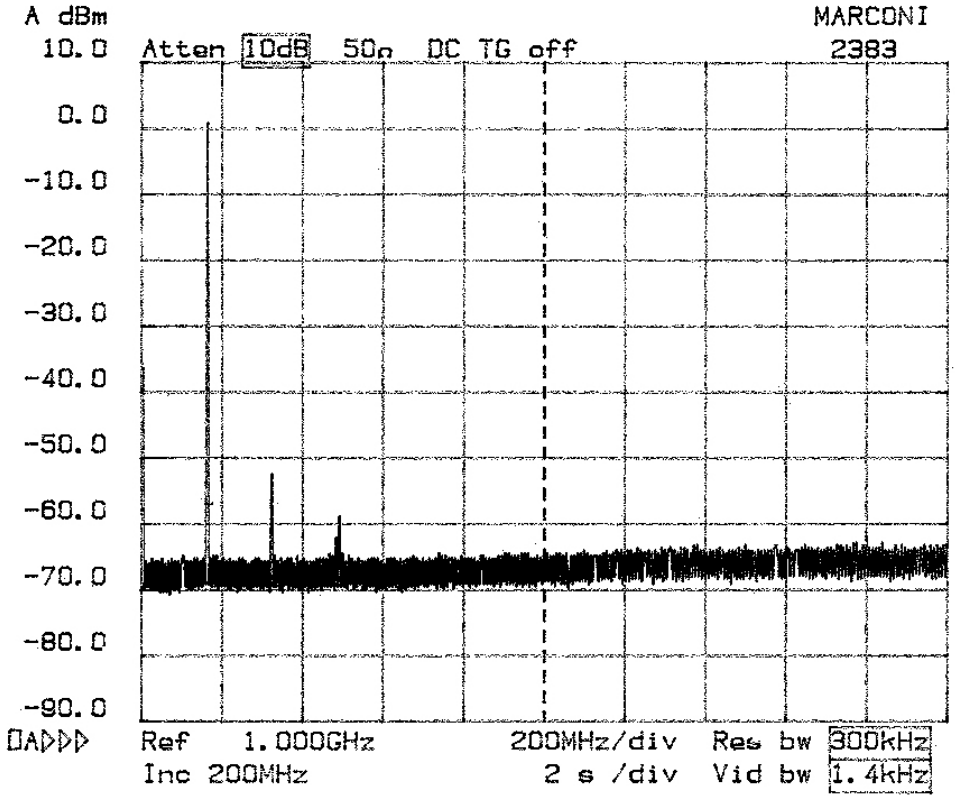
All emissions more than 250%, removed from the center of the authorized bandwidth must be attenuated by at least 50 + 10 log (P) dB below the intentional carrier. Since the maximum measured unmodulated carrier power was 1220 mW, this yields a minimum required attenuation of 50.86 dBc.

All spurious emissions are attenuated below this level. The two significant spurs are the second harmonic at –53 dBc and the third at –59 dBc.

Thus the sample complies with 2.1053 and 90.209 Emission Mask D.
This plot shows the 160 MHz carrier in a span of 10 MHz – 220 MHz



This plot shows a scan from 0 to 2 GHz. Note the second and third harmonics



FIELD STRENGTH OF SPURIOUS RADIATION 2.1053 and 90.209
(Performed by Retlif Testing Laboratories)

Test Conditions:	Standard temperature and Humidity External Power: 9 VDC via test leads and HP E3610 Power Supply 9 Inch Pigtail made of RG-188 coax with BNC connector and 50 Ohm termination, soldered to the antenna terminals of the test sample.
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 70 dB, whichever is the lesser attenuation.

Theoretical 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 1.25W 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 1.25)/3 = 4.51 V/m = 133.11 dBuV/m

Attenuation Requirement: §2.1053 requires that the spurious radiated emissions be attenuated at least 50 + 10 log (1.25W) = 50.86 dB below the unmodulated carrier field strength.

Limit @ 3m = 133.11 – 50.86 dB = 82.2 dBuV/m

Theoretical 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 = 130.9 – 50.86 dB = 80.1 dBuV/m

Retlif Laboratories measured the actual peak power and calculated the actual limit to be:

–20 dBm + 107 dB = 87dBuV/m

The difference between theoretical and actual limits is due to the T-2001's antenna efficiency.

Test Result	Complies. The strongest spurious emission is at the second harmonic of the third test frequency with a level of 66.1 dBuV/m @ 3m. This is more than 20 dB below the limit.

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 732-257-6553
(A NJ L.L.C.)

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

June 26, 2000

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

Attention: Mr. Mike Murphy

Dear Sir:

Enclosed you will find Data Package R-3644N covering the testing of the Audio Transmitter, Model No. T2001, Serial No. FCC01 to the requirements of FCC Parts 2 & 90. This testing was performed against Purchase Order Number 47588.

Test setup photographs and drawings, equipment lists, and test data are included for each test method performed on the above test sample.

Thank you for this opportunity to be of service to you. Should you have any questions concerning this data or the actual testing of your unit, please do not hesitate to contact us.

Sincerely,

RETLIF TESTING LABORATORIES

Amanda M. Lackey
Publications

Enc. (as stated)

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 732-257-0803
(A NJ L.L.C.)

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

DATA PACKAGE FOR

Audio Transmitter

Model No. T2001
Serial No. FCC01

SHOWING COMPLIANCE WITH RADIATED EMISSIONS

Customer Name:	DTC Communications, Inc
Customer P.O.:	47588
Data Package No.:	R-3644N
Package Date:	June 26, 2000
Test Start Date:	June 15, 2000
Test Finish Date:	June 16, 2000
Test Technician(s):	Tim Firkowski
Test Engineer:	John Monahan
Data Prepared By:	Amanda Lackey
Supervisor:	Scott Wentworth

TEST SETUP PHOTOGRAPH

EQUIPMENT LIST

Spurious Radiated Emissions

EN	Type	Manufacturer	Description.	Model No.	Cal Date	Due Date
296	Spectrum Analyzer	Advantest	10 kHz - 3.6 GHz	R-4131B	7/19/99	7/19/00
3116	Pre-Amplifier	Miteq	0.1 GHz - 18 GHz	AFS42-35	1/4/00	1/4/01
3117	Power Supply	B&K Precision	0-30 Vdc, 3.0 A	1630	2/23/00	2/23/01
3258	Double Ridge Guide	EMCO	1 - 18 GHz	3115	4/6/00	4/6/01
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	6/16/99	6/16/00
4921	Graphics Plotter	Hewlett Packard	N/A	7550A	4/25/00	4/25/01
4986	EMC Analyzer	Electro-Metrics	9 kHz - 1 GHz	EMC-30C	2/14/00	2/14/01

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

TEST METHOD:	Spurious Radiated Emissions
CUSTOMER:	DTC Communications, Inc. — JOB No: R-3644N
TEST SAMPLE:	Audio Transmitter
MODEL No.:	T2001 — SERIAL No.: FCC01
TEST SPECIFICATION:	FCC Part 2 & 90 — PARAGRAPH: 2.1053 & 90.210
OPERATING MODE:	Continuously transmitting
TECHNICIAN:	T. Firkowski — DATE: 6/15/00
NOTES:	Detector Function: Peak Test Distance = 3m. Harmonic Limit per Emission Mask D of paragraph 90.210

TEST FREQUENCY	HARMONIC FREQUENCY	ANTENNA POSITION	TURNTABLE POSITION	METER READING	CORRECTION FACTOR	CORRECTED READING		LIMIT @ 3 METERS
MHz	MHz	(H/V) - HEIGHT	DEGREES	dBuV	dB	dBuV/m		dBuV/m
150.06	-	V-1m	90	92.0	14.3	106.3		-
-	300.13	V-1m	90	39.0	21.3	60.3		87.0
-	450.11	V-1m	90	32.0	25.5	57.5		|
-	600.14	V-1m	90	29.0	30.9	59.9		|
-	750.13	V-1m	90	13.0	33.4	46.4		|
-	900.06	V-1m	90	18.0	36.9	54.9		|
-	1050.22	V-1m	0	57.2	-13.7	43.5		|
-	1200.20	V-1m	0	41.6	-13.7	27.9		|
-	1350.34	V-1m	0	43.0	-11.1	31.9		|
-	1500.35	V-1m	0	47.8	-11.1	36.7		87.0

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

TEST METHOD: Spurious Radiated Emissions

CUSTOMER: DTC Communications, Inc. JOB No: R-3644N -

TEST SAMPLE: Audio Transmitter

MODEL No.: T2001 SERIAL No.: FCC01

TEST SPECIFICATION: FCC Part 2 & 90 PARAGRAPH: 2.1053 & 90.210

OPERATING MODE: Continuously transmitting

TECHNICIAN: T. Firkowski DATE: 6/15/00

NOTES: Detector Function: Peak Test Distance = 3m.
Harmonic Limit per Emission Mask D of paragraph 90.210

TEST FREQUENCY	HARMONIC FREQUENCY	ANTENNA POSITION	TURNTABLE POSITION	METER READING	CORRECTION FACTOR	CORRECTED READING		LIMIT @ 3 METERS
MHz	MHz	(H/V) - HEIGHT	DEGREES	dBuV	dB	dBuV/m		dBuV/m
161.05	-	V-1m	90	93.0	14.7	107.7		-
-	322.13	V-1m	90	43.0	22.8	65.8		87.0
-	483.09	V-1m	90	32.0	26.8	58.8			
-	644.12	V-1m	90	20.0	32.1	52.1			
-	805.11	V-1m	90	13.0	34.5	47.5			
-	966.06	V-1m	90	13.0	38.2	51.2			
-	1127.17	V-1m	0	47.4	-13.7	33.7			
-	1288.2	-	-	-	-	-			
-	1449.31	V-1m	0	48.0	-11.1	36.9			
-	1610.25	-	-	-	-	-		87.0	

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

TEST METHOD:	Spurious Radiated Emissions
CUSTOMER:	DTC Communications, Inc. JOB No.: R-3644N
TEST SAMPLE:	Audio Transmitter
MODEL No.:	T2001 SERIAL No.: FCC01
TEST SPECIFICATION:	FCC Part 2 & 90 PARAGRAPH: 2.1053 & 90.210
OPERATING MODE:	Continuously transmitting
TECHNICIAN:	T. Firkowski DATE: 6/15/00
NOTES:	Detector Function: Peak Test Distance = 3m. Harmonic Limit per Emission Mask D of paragraph 90.210

TEST FREQUENCY	HARMONIC FREQUENCY	ANTENNA POSITION	TURNTABLE POSITION	METER READING	CORRECTION FACTOR	CORRECTED READING		LIMIT @ 3 METERS
MHz	MHz	(H/V) - HEIGHT	DEGREES	dBuV	dB	dBuV/m		dBuV/m
174.01	-	V-1m	45	95.0	15.4	110.4		
-	348.13	V-1m	45	43.0	23.1	66.1		87.0
-	522.47	V-1m	45	25.0	28.6	53.6		
-	696.10	V-1m	45	14.0	33.3	47.3		
-	870.14	V-1m	45	14.0	36.6	50.6		
-	1044.22	V-1m	45	61.2	-13.7	47.5		
-	1218.18	-	-	-	-	-		
-	1392.28	V-1m	0	47.0	-11.1	35.9		
-	1566.33	V-1m	0	44.2	-11.1	33.1		
-	1740.31	V-1m	0	48.4	-11.1	37.3		87.0

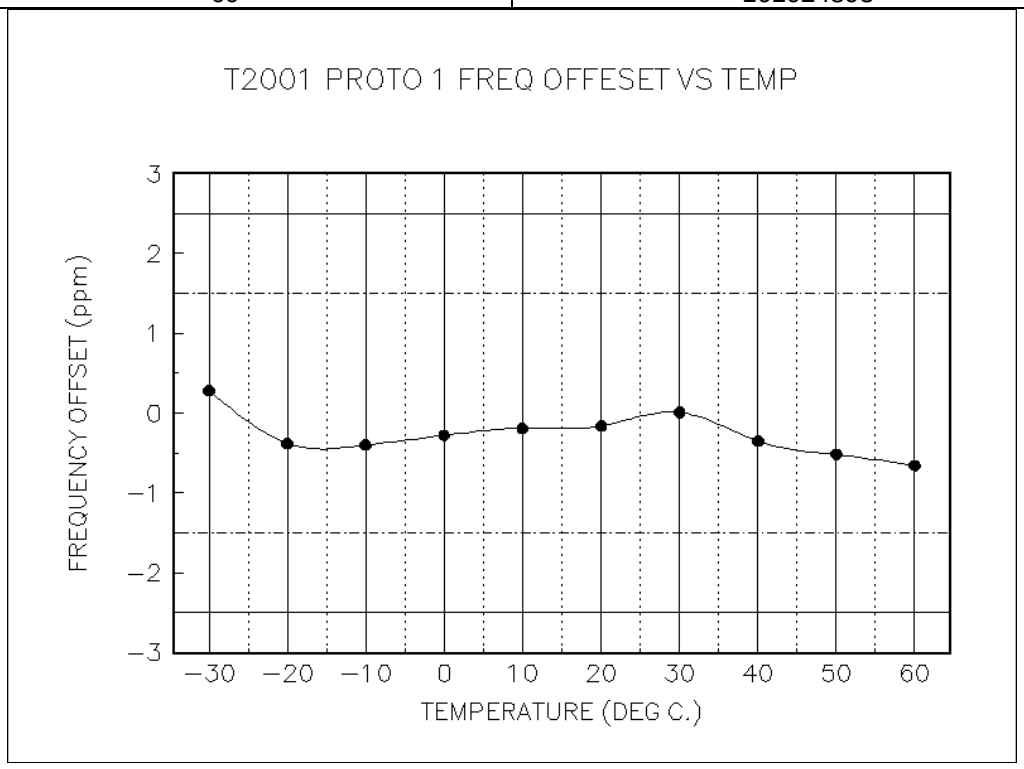
FREQUENCY STABILITY 2.1055, 90.213, 90.214

Frequency stability measurements were made over the temperature range of –30° C to +60° C. Variations of the primary DC voltage were varied by more than 40 % lower and 10% higher than the rated voltage range (6-9 VDC). Frequency measurements were made using a direct (20 dB 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 O.K. Industries PS732. 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.

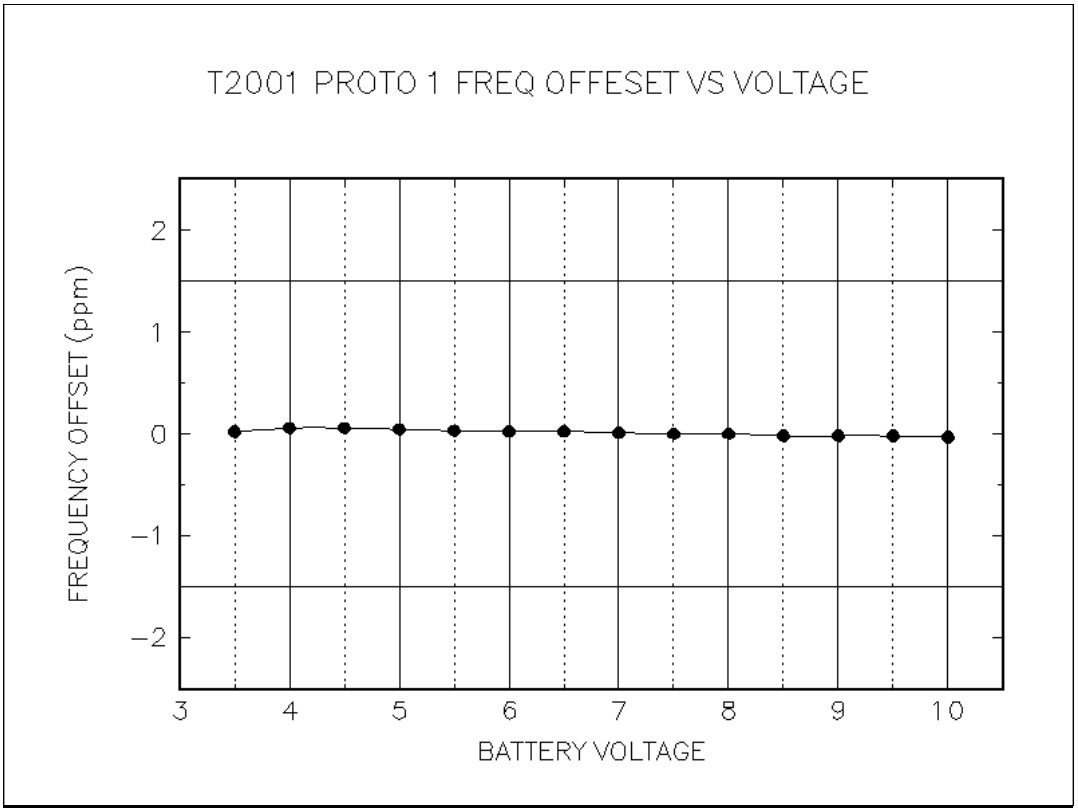
The table below shows the frequency vs. temperature data.

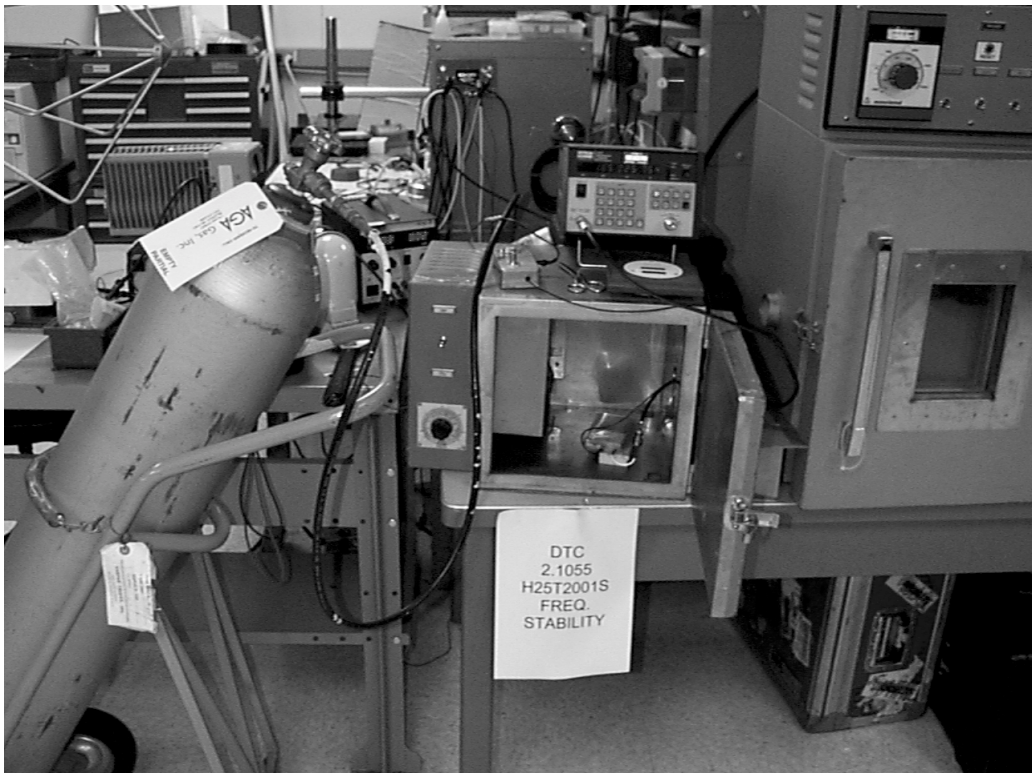
Temperature (Degrees C)	Frequency (Hz)
-30	161025045
-20	161024939
-10	161024936
0	161024955
+10	161024970
+20	161024974
+30	161025001
+40	161024943
+50	161024916
+60	161024893



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

Power Supply Voltage	Frequency (Hz)
3.5	161024964
4.0	161024970
4.5	161024970
5.0	161024968
5.5	161024966
6.0	161024965
6.5	161024965
7.0	161024962
7.5	161024962
8.0	161024961
8.5	161024958
9.0	161024958
9.5	161024956
10.0	161024975





DTC TEST INSTRUMENTS

Type	Manufacturer	Model No.
Radio Test Set	Marconi Instruments	2955
Spectrum Analyzer	Marconi Instruments	2383
Multimeter	Hewlett Packard	34401A
DC Power Supply	O.K Industries	PS732
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

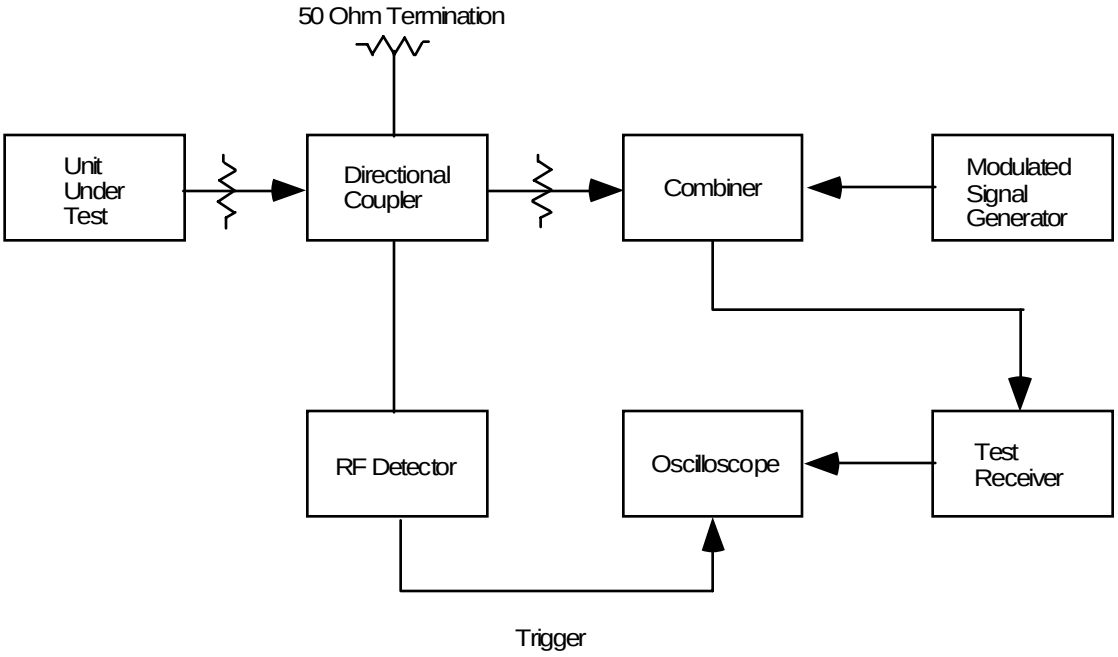
TRANSIENT FREQUENCY BEHAVIOR 90.214
(Performed by Retlif Testing Laboratories)

The transient frequency behavior test was carried out in accordance with TIA/EIA 603 §2.2.19 method of measurement §3.2.19 standard. This test measures the amount of time required for the unmodulated higher amplitude test sample to "capture" or "release" a weaker 25 kHz FM modulated test signal during key-up and key-down. This is an indirect method of measuring the time that it takes for a transmitter to come on-channel and allows transition effects to be recorded. The device was powered up and down manually with a test lead and the power supply positive terminal. A fast responding diode detector acts as a trigger signal for the oscilloscope.

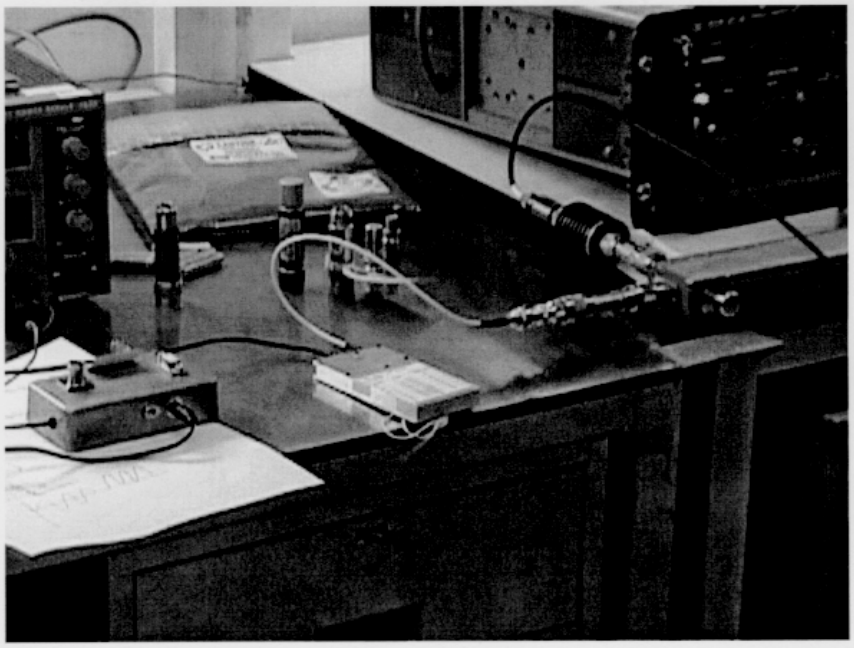
As shown in the oscilloscope plots, three time periods are observed. The t_1, t_2, t_3 mask limits are superimposed on the data runs. These plots indicate the t_{on} and t_{off} points and the related frequency displacement. The frequency difference remained within the limits of 90.213 between t_2 and t_3. The test sample comes on-frequency smoothly and remains within the limits of the mask.

BLOCK DIAGRAM

Transient Frequency Behavior 90.214



TEST SETUP PHOTOGRAPH
TRANSIENT FREQUENCY BEHAVIOR



Retlif Testing Laboratories

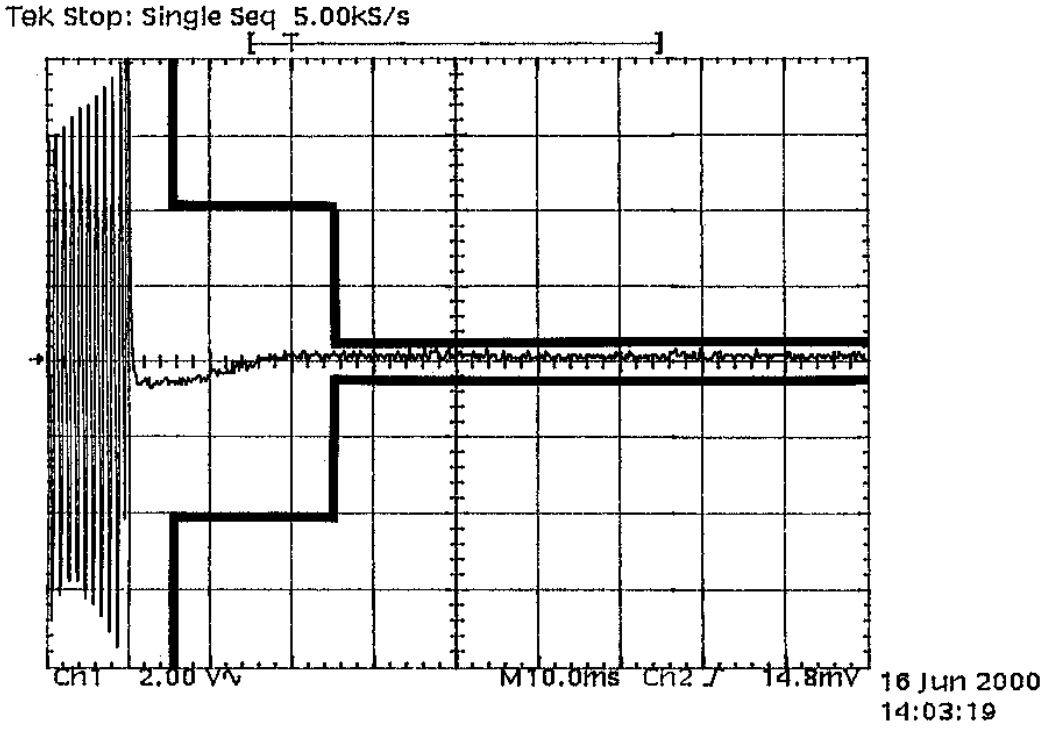
DATA PACKAGE No. R-3644N

EQUIPMENT LIST

Transient Frequency Behavior

EN	Type	Manufacturer	Description.	Model No.	Cal Date	Due Date
073	Interference Analyzer	Electro-Metrics	10 kHz - 1 GHz	EMC-25	3/31/00	3/31/01
3117	Power Supply	B&K Precision	0-30 Vdc, 3.0 A	1630	2/23/00	2/23/01
3233	Graphics Plotter	Hewlett Packard	N/A	7470A	4/11/00	4/11/01
3250	Signal Generator	Hewlett Packard	500 KHz - 1 GHz	8640B-OPT-32	8/17/99	8/17/00
4001	Oscilloscope	Tektronix	N/A	TDS 520A	3/14/00	3/14/01
4004	RF Millivoltmeter	Boonton Electronics	10 KHz - 1.2 GHz	92B	10/5/99	10/5/00
4910	Tee Adapter	Bruel and Kjaer	10 kHz - 1 GHz	91-14A	10/25/99	10/25/00
4935	Attenuator	JFW Inc.	DC - 2 GHz	50FH-006-30N	2/11/00	2/11/01
4962	Attenuator	Narda	DC - 18 GHz	757C-20dB	9/2/99	9/2/00

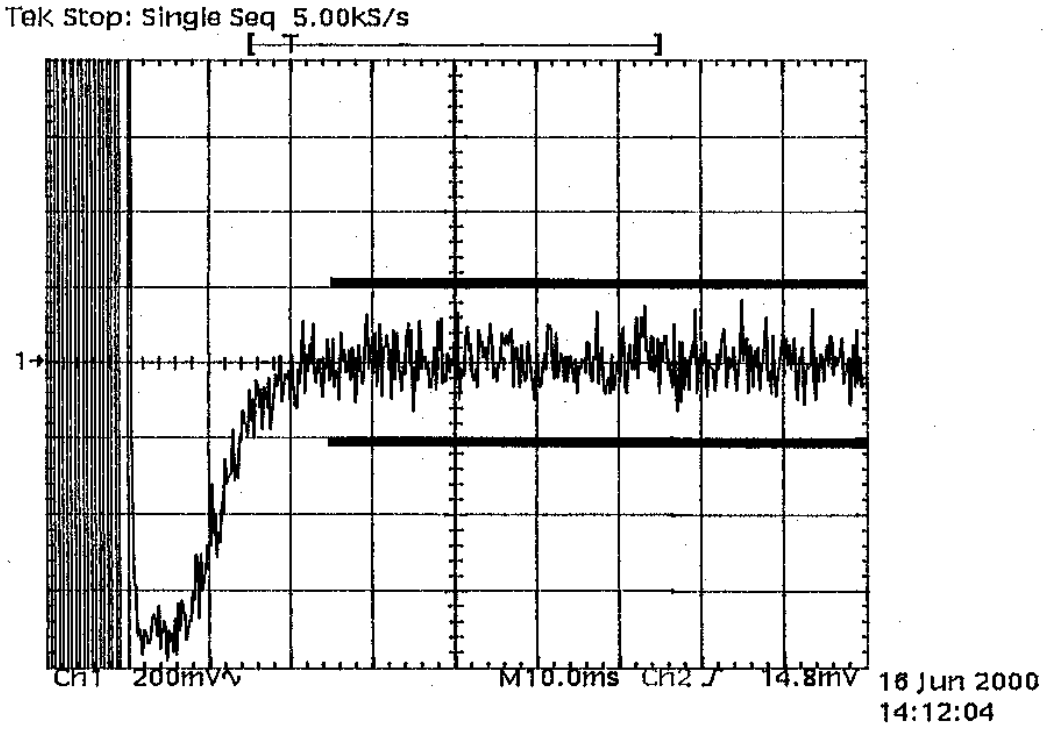
RETLIF TESTING LABORATORIES



Test Method	Transient Frequency Behavior		
Customer	DTC Communications, Inc.	Job No.	R-3644N
Test Sample	Audio Transmitter		
Model No.	T2001	Serial No.	FCC01
Test Specification	FCC Part 90	Paragraph	90.214
Operating Mode	Switching from off to on		
Technician	T. Firkowski	Date	6/16/00
Notes			

Sheet 1 of 3

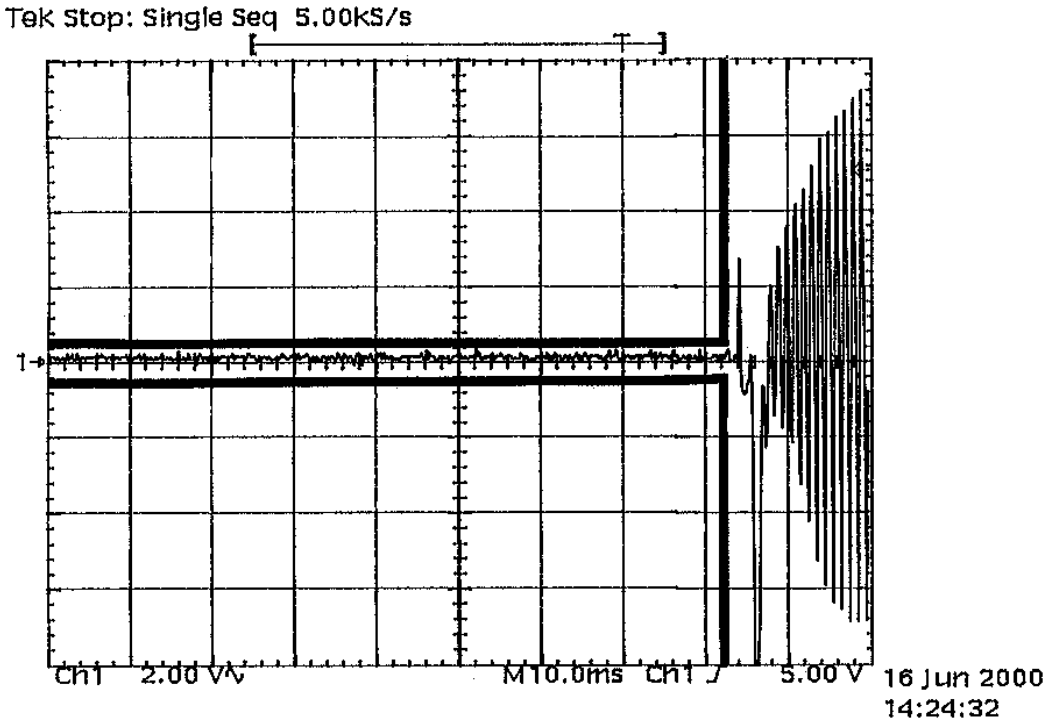
RETLIF TESTING LABORATORIES



Test Method	Transient Frequency Tolerance		
Customer	DTC Communications, Inc.	Job No.	R-3644N
Test Sample	Audio Transmitter		
Model No.	T2001	Serial No.	FCC01
Test Specification	FCC Part 90	Paragraph	90.214
Operating Mode	Switching from off to on		
Technician	T. Firkowski	Date	6/16/00
Notes			

Sheet 2 of 3

RETLIF TESTING LABORATORIES



Test Method	Transient Frequency Behavior		
Customer	DTC Communications, Inc.	Job No.	R-3644N
Test Sample	Audio Transmitter		
Model No.	T2001	Serial No.	FCC01
Test Specification	FCC Part 90	Paragraph	90.214
Operating Mode	Switching from on to off		
Technician	T. Firkowski	Date	6/16/00
Notes			

Sheet 3 of 3

END OF REPORT