Test Data for H25T99FG

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 $125 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 H25T99FG

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

(4) Emission: NBFM Voice – Designator: 16K0F3E

(5) Frequency Range: 148 –174 MHz

(6) Power: Single level of .25 Watts

(7) Maximum Power Rating of .30 Watts

(8) All stages including the final radio frequency amplifying device are powered by DC regulated supplies from a stand-alone battery source or external DC power.

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

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

(11) A drawing 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 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).

The RF power measured was 0.226 Watts at 360ma/1.5 VDC.

Thus the sample complies with §90.205(d).

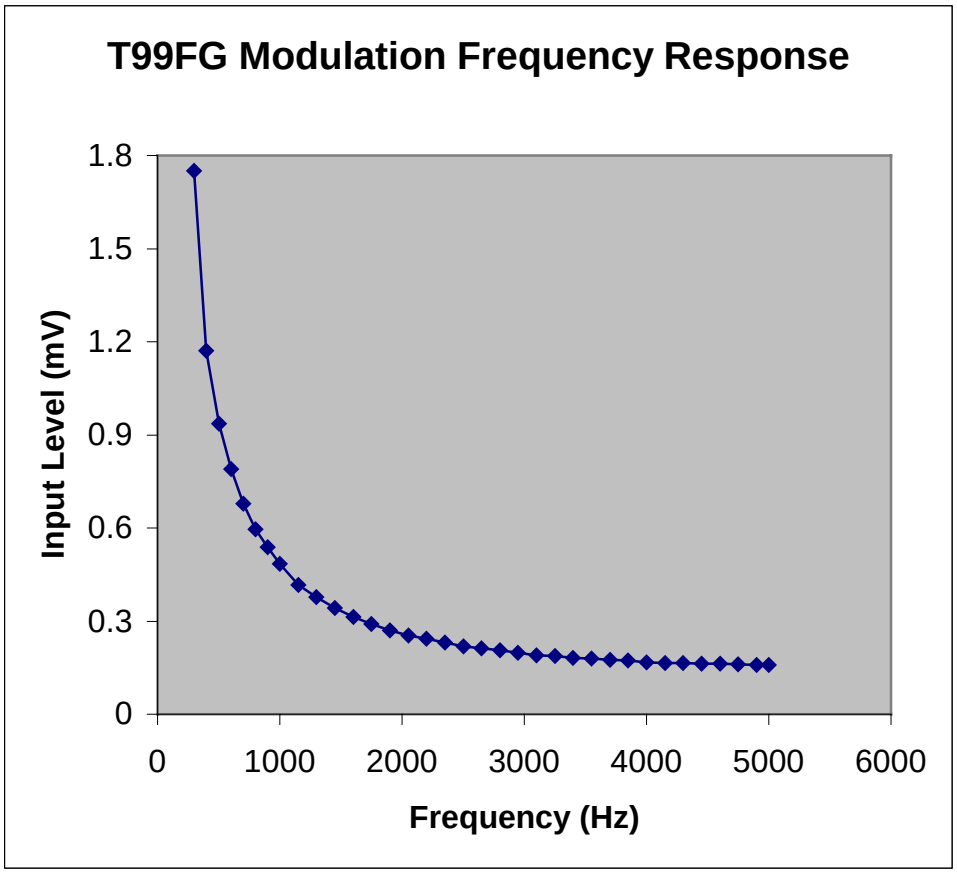
MODULATION CHARACTERISTICS 2.1047(a), 90.211(a)

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 1.0 kHz deviation (as measured with the Marconi Communications Test Set, model 2955) at the frequency of maximum response (5000 Hz) was used. The input level applied to the microphone terminals at this frequency was 158 mV. At each test frequency, the input audio level was adjusted to maintain the reference deviation. The AGC circuit *alone* in the T99FG does not allow the device to over-modulate at any realistic microphone audio frequency or level. The response of the low pass filter which follows pre-emphasis filter and the clipper diodes has a cutoff frequency of 40 kHz.

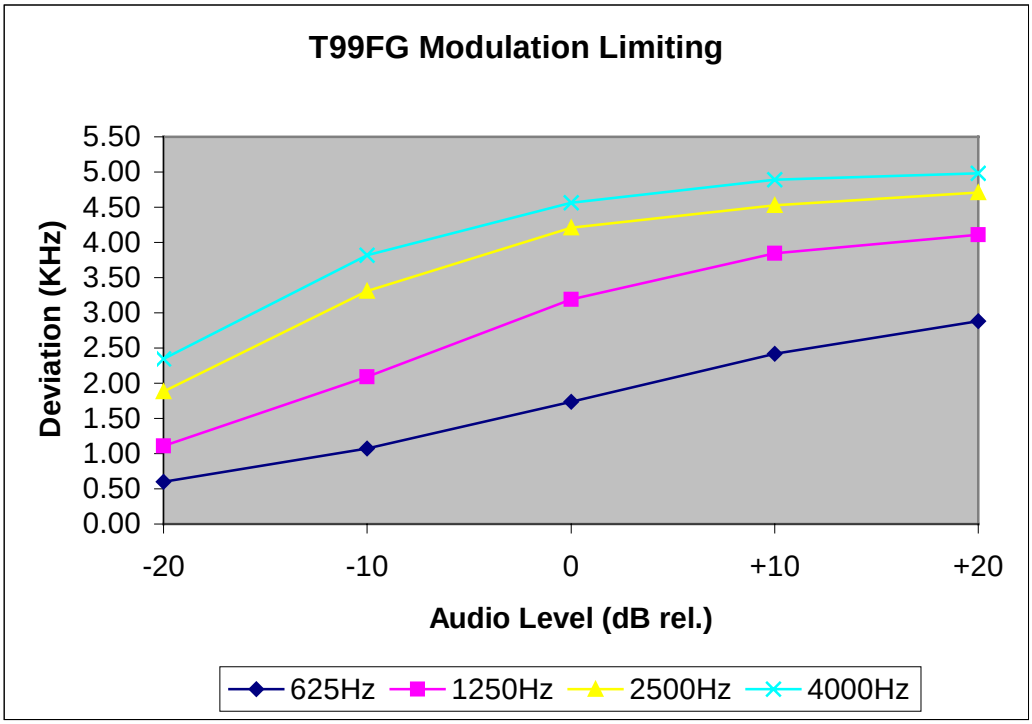
Freq (Hz)	Input Level (mV)	Freq (Hz)	Input Level (mV)
300	1.750	2650	0.212
400	1.171	2800	0.207
500	0.937	2950	0.197
600	0.789	3100	0.190
700	0.678	3250	0.187
800	0.596	3400	0.182
900	0.537	3550	0.180
1000	0.486	3700	0.175
1150	0.417	3850	0.173
1300	0.377	4000	0.168
1450	0.343	4150	0.165
1600	0.313	4300	0.165
1750	0.291	4450	0.163
1900	0.271	4600	0.163
2050	0.254	4750	0.160
2200	0.244	4900	0.158
2350	0.232	5000	0.158
2500	0.219		



Modulation Limiting

A family of curves showing the frequency deviation versus the modulation input level is included below. The information submitted shows the modulation limiting capability throughout the range of modulating frequencies and 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 HP 34401 Multimeter.

Audio Level		**Deviation (KHz) @**		
(dB rel.)	**625Hz**	**1250Hz**	**2500Hz**	**4000Hz**
-20	0.60	1.11	1.88	2.35
-10	1.07	2.09	3.31	3.82
0	1.74	3.19	4.21	4.56
+10	2.42	3.85	4.53	4.89
+20	2.88	4.11	4.71	4.98



OCCUPIED BANDWIDTH 2.1049, 90.211(a)

The next series of plots are taken from a Marconi 2390A 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 (2.5 kHz deviation). Audio levels were verified with a HP34401A multimeter. 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 90.210(b) states that for transmitters that are equipped with an audio low-pass filter, the power of any emission must be below the unmodulated carrier power (P) as follows:

1) 0n any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

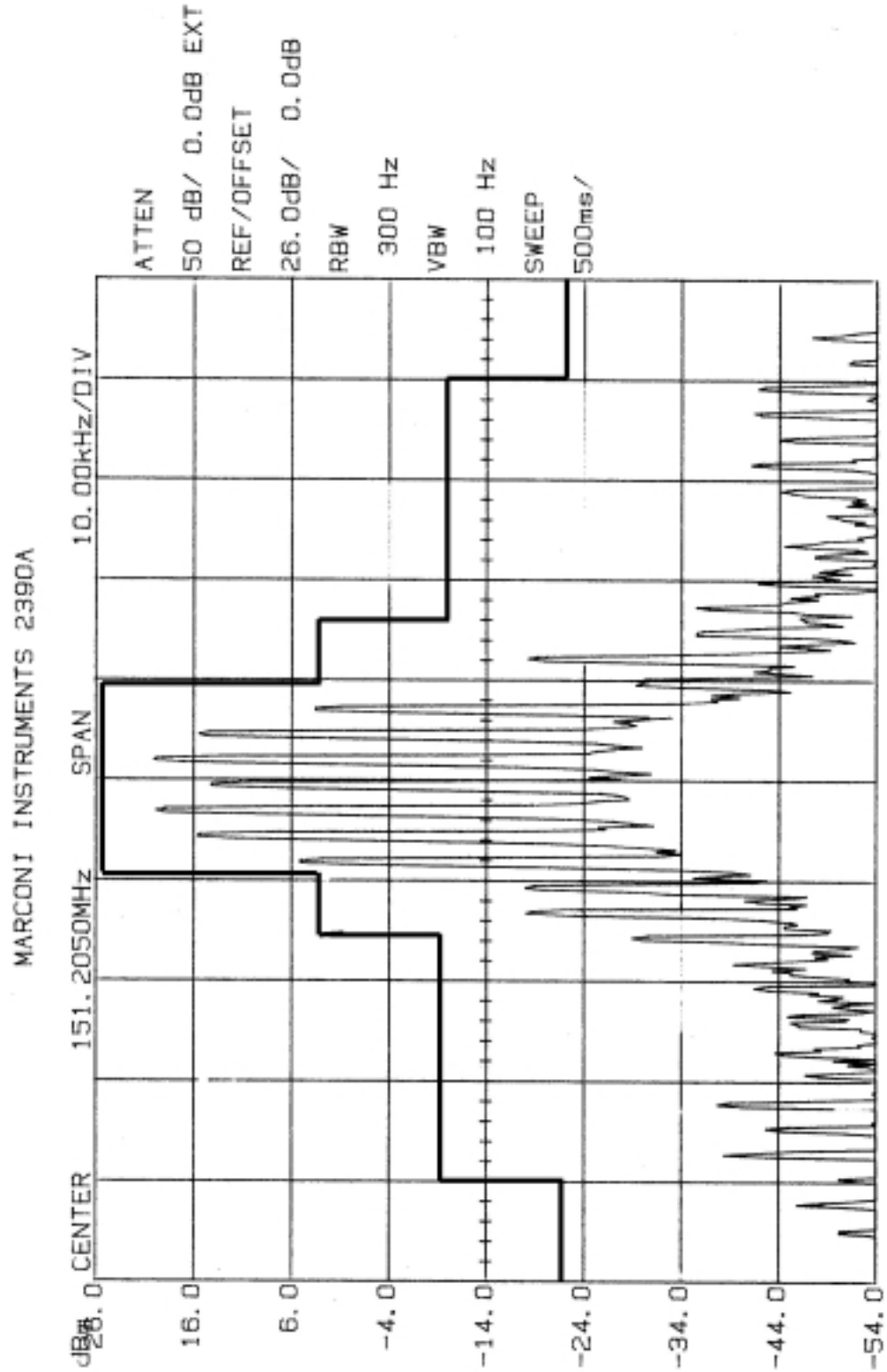
2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + log (P) dB.

The authorized bandwidth is 16 kHz; the assigned frequency of the sample is 151.205 MHz.

This mask is superimposed on the first spectral plot.

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


MARCONI INSTRUMENTS 2390A
CENTER 151.2050MHz SPAN 10.00kHz/DIV
ATTEN
50 dB/ 0.0dB EXT
REF/OFFSET
26.0dB/ 0.0dB
RBW
300 Hz
VBW
100 Hz
SWEEP
500ms/
dBm
26.0
16.0
6.0
-4.0
-14.0
-24.0
-34.0
-44.0
-54.0

SPURIOUS EMISSIONS AT ANTENNA TERMINALS 2.1053, 90.209

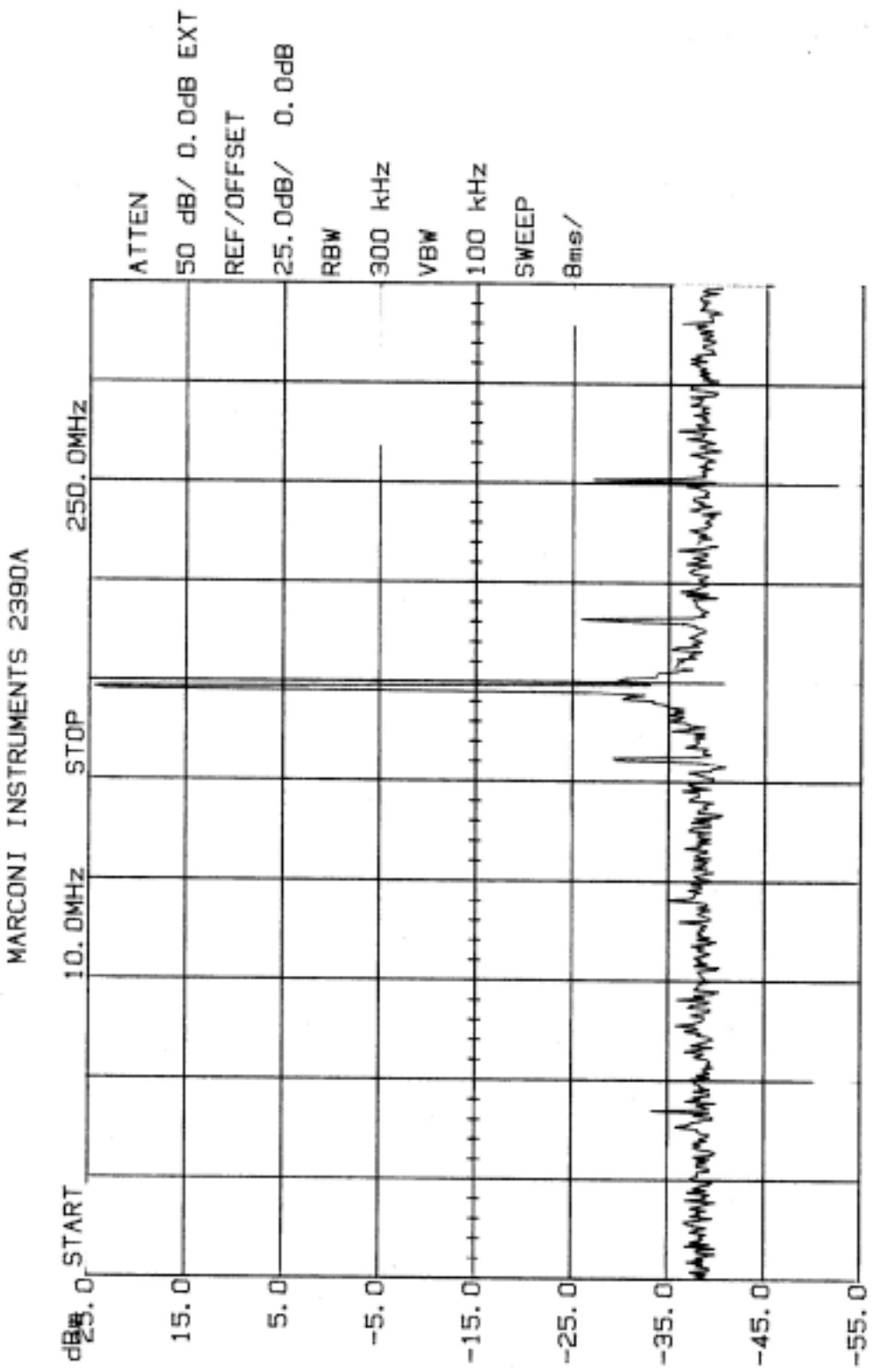
As required by §§2.1053 and 90.209, Emission Mask B, spurious emissions measurements at the antenna terminals were made using a Marconi 2390A spectrum analyzer. The transmitter was modulated by a Leader model LAG-125 audio generator with a sine wave at 2500 Hz at a level 16 dB above that required to produce 50% modulation (2.5 kHz deviation). Audio levels were verified with a HP 34401A multimeter. The transmitter output 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.

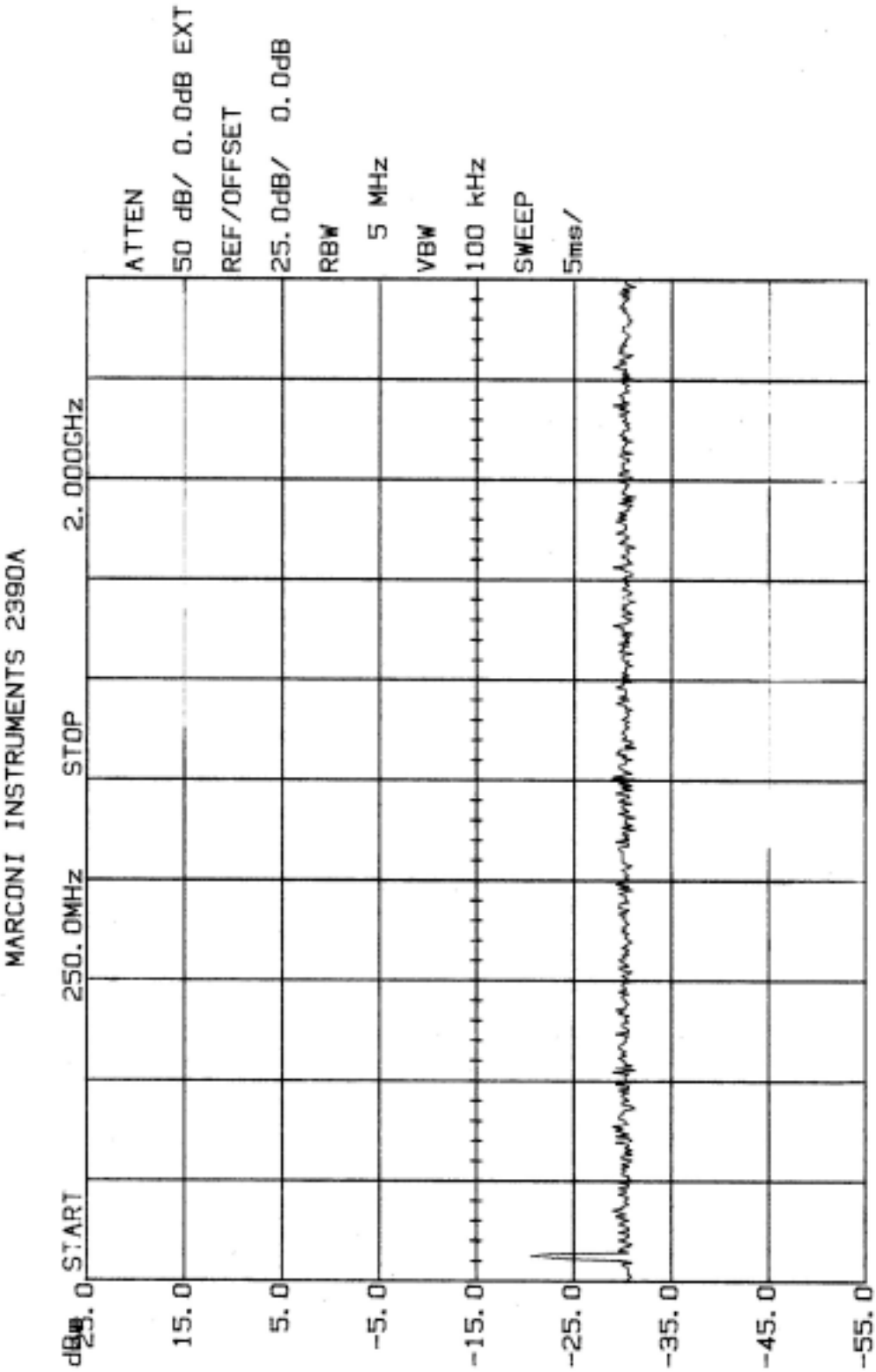
The spectrum was investigated over the range 9 kHz – 1.6 GHz per §2.1057(a)(1).

All emissions more than 250%, or 40 kHz in this case, removed from the center of the authorized bandwidth must be attenuated by at least 43 + 10 log (P) dB below the intentional carrier. Since the maximum measured unmodulated carrier power was 226 mW, this yields a minimum required attenuation of 36.5 dB.

The table below shows the magnitude of harmonic and other spurious emissions. All spurious emissions are attenuated below this level.

Thus the sample complies with 2.1053 and 90.209 Emission Mask B


MARCONI INSTRUMENTS 2390A
START
10.0MHz
STOP
250.0MHz
ATTEN
50 dB/ 0.0dB EXT
REF/OFFSET
25.0dB/ 0.0dB
RBW
300 kHz
VBW
100 kHz
SWEEP
8ms/
dBm
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
-45.0
-55.0


MARCONI INSTRUMENTS 2390A
START
250.0MHz
STOP
2.000GHz
ATTEN
50 dB/ 0.0dB EXT
REF/OFFSET
25.0dB/ 0.0dB
RBW
5 MHz
VBW
100 kHz
SWEEP
5ms/
dBm
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
-45.0
-55.0

Retlif Testing Laboratories
795 Marconi Avenue, Ronkonkoma, N.Y. 11779 (516) 737- 1500 - FAX 516-737-1497
(Branch Office)
101 New Boston Road, Goffstown, N.H. 03045 (603) 497-4600 - FAX (603) 497-5281

DATA PACKAGE
FOR

Audio Transmitter

Model No. T99FG

SHOWING TESTING TO FCC PART 2, PARA. 2.1053
AND FCC PART 90, PARA. 90.214

Customer Name: DTC Communications, Inc.

Customer P.O.: 44909

Data Package No.: R-3397N1

Package Date: February 8, 1999

Test Start Date: February 3, 1999

Test Finish Date: February 4, 1999

Test Technician(s): Mike Hippert, Tony Cricco

Test Engineer: John Monahan

Data Prepared By: Terra G. Tarango

Supervisor: Scott Wentworth

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

Test Conditions:	Standard temperature and Humidity External Power: 1.5 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 (43 + 10log P) dB or 80 dB, whichever is the lesser attenuation.
Test Result	Complies. The strongest spurious emission is at the third harmonic (453.6 MHz) with a level of 69.8 dBuV/m @ 3m. This is more than 14 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 .3W 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 .3)/3 = 1.28 V/m = 122.1 dBuV/m

Attenuation Requirement: §2.1053 requires that the spurious radiated emissions be attenuated at least 43 + 10 log (.3W) = 37.8 dB below the unmodulated carrier field strength.

Limit @ 3m = 122.1 – 37.8 = 84.3 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 = 120.0 – 37.8 = 82.2 dBuV

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

TEST METHOD: Radiated Emissions, 30 MHz to 1.6 GHz

CUSTOMER: DTC Communications, Inc. JOB No.: R-3397N1

TEST SAMPLE: Audio Transmitter

MODEL No.: T99FG SERIAL No.: n/a

TEST SPECIFICATION: FCC Part 2 - Field Strength of Spurious Emissions PARAGRAPH: 2.1053 (Formerly 2.993)

OPERATING MODE: Continuously Transmitting at 151.205MHz

TECHNICIAN: M. Hippert DATE: 2-4-99

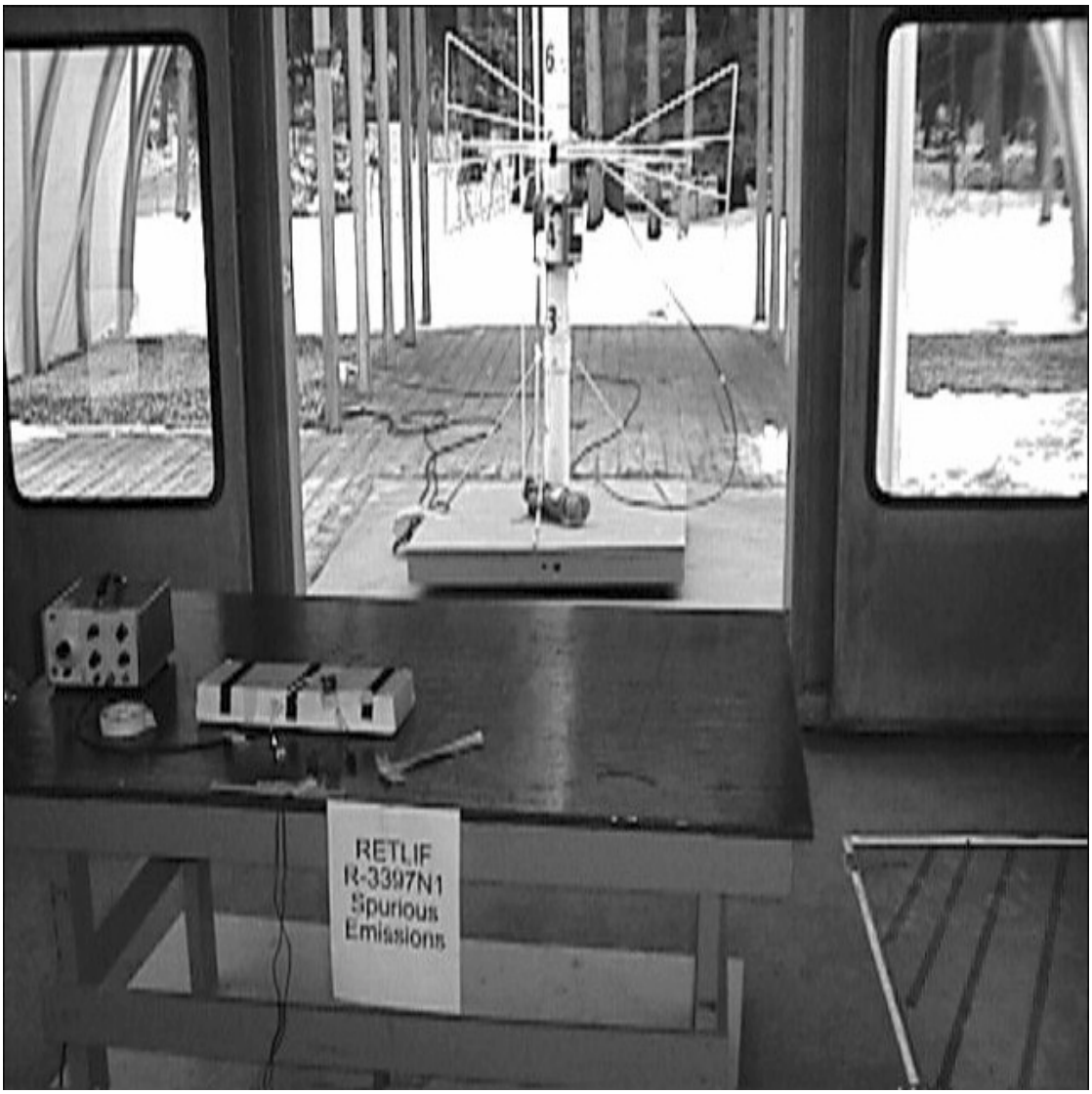
NOTES: Test Distance: 3 Meters

AXIS	TEST FREQUENCY	ANTENNA POSITION	TURNTABLE POSITION	METER READING	CORRECTION FACTOR	CORRECTED READING		LIMIT @ 3 METERS
X,Y	MHz	(HW) - HEIGHT	DEGREES	dBuV	dB	dBuV/m		dBuV/m
X	302.4	V 1m	135.0	67.2	-3.6	63.6		84.6
X	453.6	V 1m	315.0	69.0	0.8	69.8		
X	604.8	V 1m	0.0	59.1	6.3	65.4		
X	756.0	V 1m	315.0	50.0	9.0	59.0		
X	907.2	V 1m	315.0	39.5	12.8	52.3		
X	1058.4	V 1m	180.0	46.0	-4.9	41.1		
X	1209.6	V 1m	315.0	55.6	-1.6	54.0		
X	1360.8	V 1m	315.0	52.1	-0.8	51.3		
X	1512.1	V 1m	270.0	50.0	-0.3	49.7		
X	302.4	H 1m	0.0	63.9	-3.6	60.3		
X	453.6	H 1m	270.0	60.0	0.8	60.8		
X	604.8	H 1m	270.0	49.6	6.3	55.9		
X	756.0	H 1m	270.0	47.8	9.0	56.8		
X	907.2	H 1m	315.0	44.6	12.8	57.4		
X	1058.4	H 1m	135.0	46.8	-4.9	41.9		
X	1209.6	H 1m	180.0	56.4	-1.6	54.8		
X	1360.8	H 1m	45.0	60.0	-0.8	59.2		
X	1512.1	H 1m	180.0	55.6	-0.3	55.3		
Y	302.4	V 1m	180.0	61.1	-3.6	57.5		
Y	453.6	V 1m	270.0	56.0	0.8	56.8		
Y	604.8	V 1m	270.0	48.0	6.3	54.3		
Y	756.0	V 1m	270.0	50.0	9.0	59.0		
Y	907.2	V 1m	45.0	46.0	12.8	58.8		
Y	1058.4	V 1m	45.0	45.0	-4.9	40.1		
Y	1209.6	V 1m	0.0	58.0	-1.6	56.4		
Y	1360.8	V 1m	315.0	60.0	-0.8	59.2		
Y	1512.1	V 1m	135.0	53.0	-0.3	52.7		
Y	302.4	H 1m	45.0	58.0	-3.6	54.4		
Y	453.6	H 1m	225.0	59.0	0.8	59.8		
Y	604.8	H 1m	225.0	51.0	6.3	57.3		
Y	756.0	H 1m	90.0	45.0	9.0	54.0		
Y	907.2	H 1m	180.0	45.4	12.8	58.2		
Y	1058.4	H 1m	135.0	38.6	-4.9	33.7		
Y	1209.6	H 1m	270.0	50.0	-1.6	48.4		
Y	1360.8	H 1m	225.0	55.8	-0.8	55.0		
Y	1512.1	H 1m	180.0	53.0	-0.3	52.7		84.6

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

DATA SHEET 1 OF 1

R-3397N1


RETLIF
R-3397N1
Spurious
Emissions

FREQUENCY STABILITY 2.1055, 90.213, 90.214

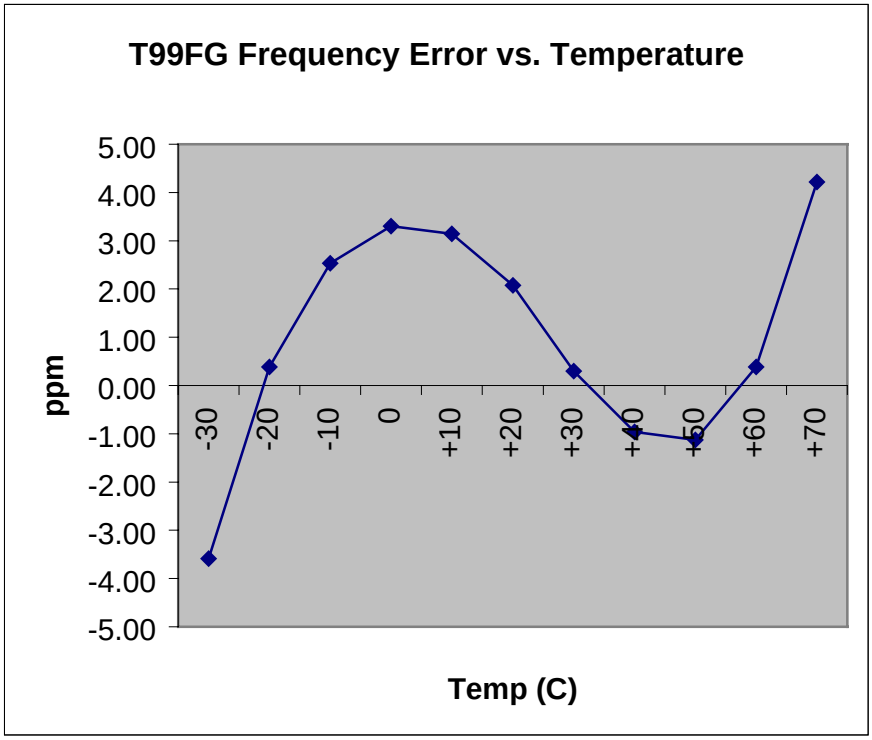
Frequency stability measurements were made over the temperature range of –30° C to +50° C and the variations of the primary DC voltage between 60% and more than 300% of the rated voltage (1.5 VDC). Frequency measurements were made using a direct (attenuated) connection to a Systron Donner model 6420 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.

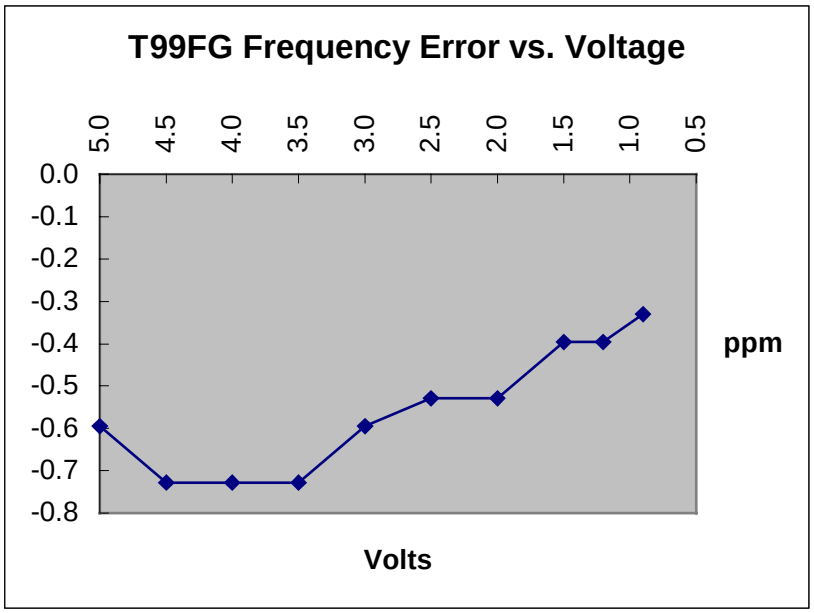
~~Temp (C)~~	~~Freq Error (Hz)~~	~~ppm~~
-30	-560	-3.59
-20	+60	0.38
-10	+395	2.53
0	+515	3.30
+10	+490	3.14
+20	+324	2.08
+30	+47	0.30
+40	-150	-0.96
+50	-176	-1.13
+60	+60	0.38
+70	+658	4.22



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

Nominal Frequency - 151.205MHz

Voltage	Frequency Error (Hz)	ppm
0.9	-50	-0.33
1.2	-60	-0.40
1.5	-60	-0.40
2.0	-80	-0.53
2.5	-80	-0.53
3.0	-90	-0.60
3.5	-110	-0.73
4.0	-110	-0.73
4.5	-110	-0.73
5.0	-90	-0.60



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

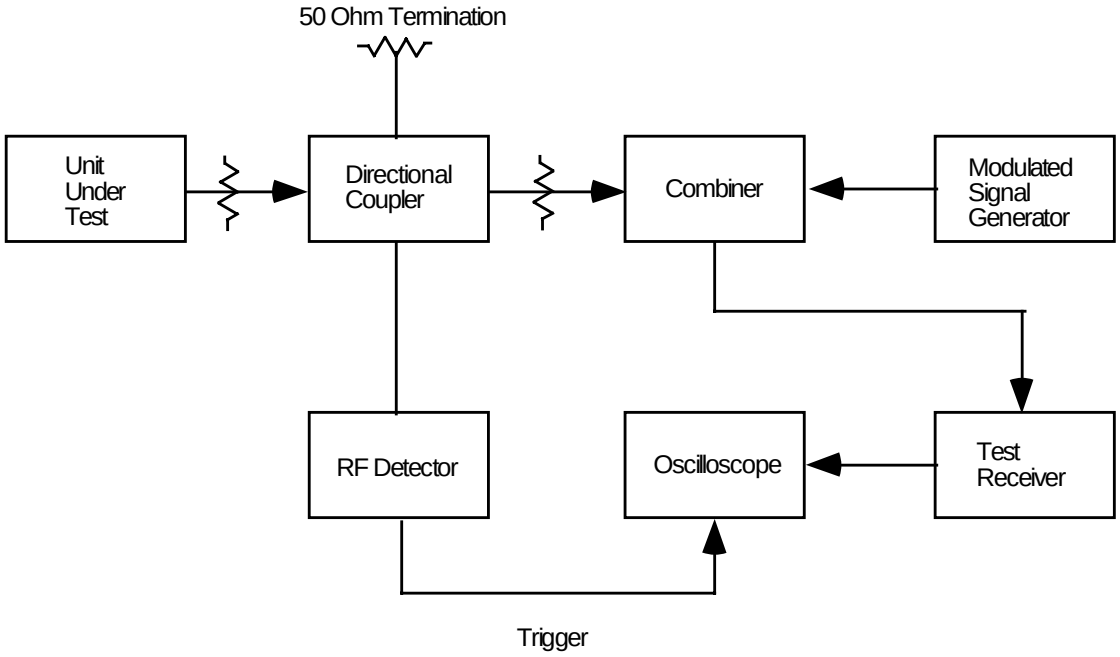
TRANSIENT FREQUENCY BEHAVIOR 90.214
(Performed by Retlif Testing Laboratories)

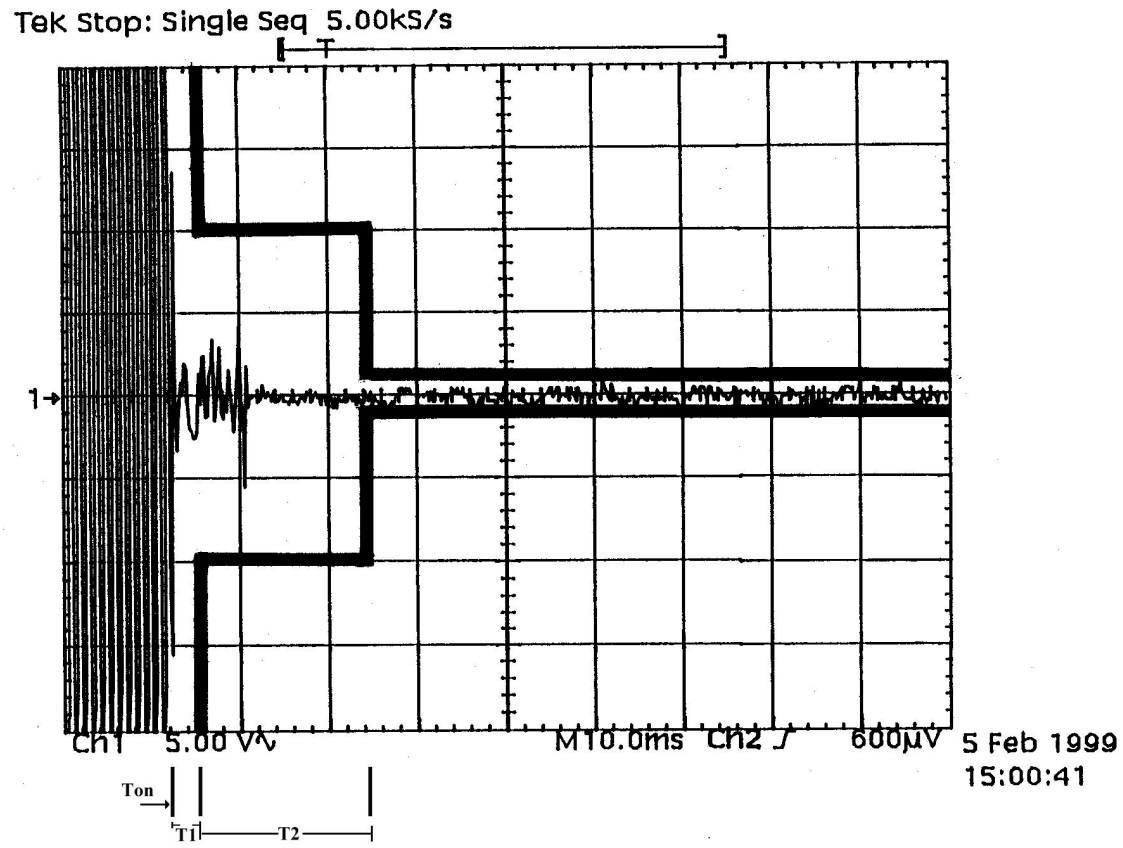
The transient frequency behavior test was carried out in accordance with TIA/EIA 603 §2.2.19 method of measurement §3.2.19 standard. This test measures the amount of time required for the unmodulated higher amplitude test sample to “capture” or “release” a weaker 25 kHz FM modulated test signal during 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

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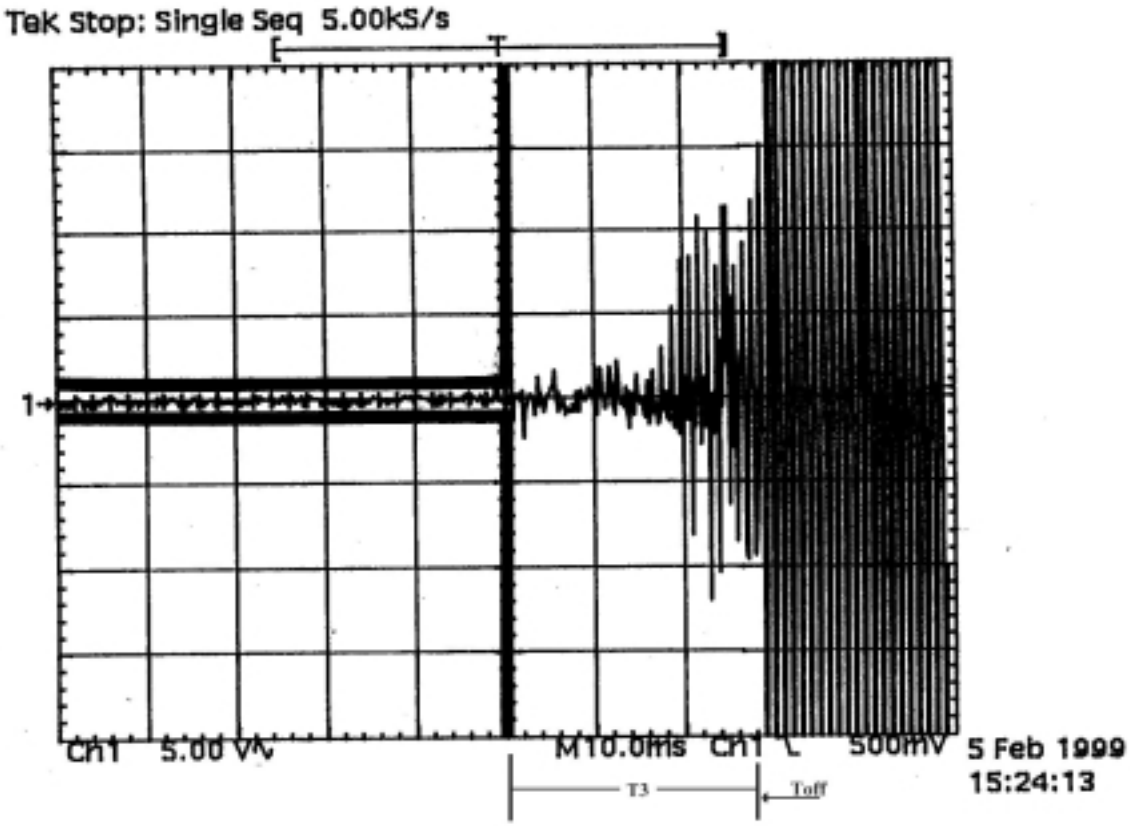
1→
Ch1 5.00 V
M10.0ms Ch2 ∫ 600µV
5 Feb 1999
15:00:41
Ton
T1
T2


Tek Stop: Single Seq 5.00kS/s
1→
Ch1 5.00 V
M10.0ms Ch1 ∫ 500mV
5 Feb 1999
15:24:13
T3
Toff

RETLIF TEST EQUIPMENT LIST

TYPE	MANUFACTURER	MODEL NO.
Interference Analyzer	Electro-Metrics	EMC-25
20dB Attenuator	Lucas Weinschel	2
0-11 dB step attenuator	Hewlett Packard	7470A
Power Divider	Weinschel Engineering	1506A
Oscilloscope	Tektronix	TDS-502A
RF Millivoltmeter	Boonton Electronics	92B
AM/FM Signal Generator	Marconi Instruments	2023
50 Ohm Termination	Tektronix	Term
Power Supply	B+K Precision