MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Wayne Dalton Corporation**

MODEL: **Operator 31 384MHz Transmitter**

FCC ID: **KJ8HHT-384-LC**

DATE: **June 1, 1998**

This report concerns (check one): Original grant_X_

Class II change_____

Equipment type: **Low Power Transmitter**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_X_

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.__
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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Alpharetta, GA 30004

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Fax Number: (770) 740-1508

SECTION 2

TESTS AND MEASUREMENTS

TESTS AND MEASUREMENTS

Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

Since the EUT is a hand held device, it was placed into a continuous mode of transmit and rotated about all 3 axis to obtain worse case results. All testing was performed with the EUT lying face up, flat on the table.

Test Facility

Testing was performed at US Tech's measurement facility as described to the FCC and acknowledged in their letter marked 31040/SIT/USTECH.

Test Equipment

Table 2 describes test equipment used to evaluate this product.

Modifications

The following modifications were made by Wayne Dalton Corporation, to bring the EUT into compliance with FCC Part 15, Class B Requirements:

1. Changed R3 from 1.2Ω to 2.0KΩ
2. Changed C3 from 6.8pF to 4.7pF
3. Removed ground node from C1, C3, C5, C6, C7, R1, R3, added L3 to node and connect to ground

The above modifications will be implemented in all production models of this equipment.

Applicant: Wayne Dalton Corporation

Signature: _____ **Date:** June 1, 1998

Name: Yan Rodriguez **Position:** Project Manager, Electronics

FIGURE 1

TEST CONFIGURATION

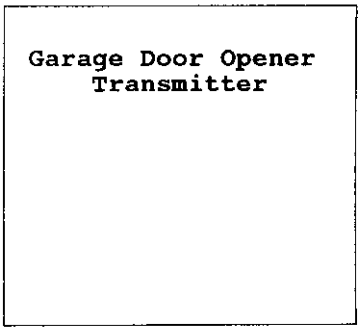


TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Garage Door Opener Transmitter Wayne Dalton Corporation (EUT)	Operator 31 384 Mhz Transmitter	None	KJ8HHT-384-LC (Pending)	None

TABLE 2

TEST INSTRUMENTS

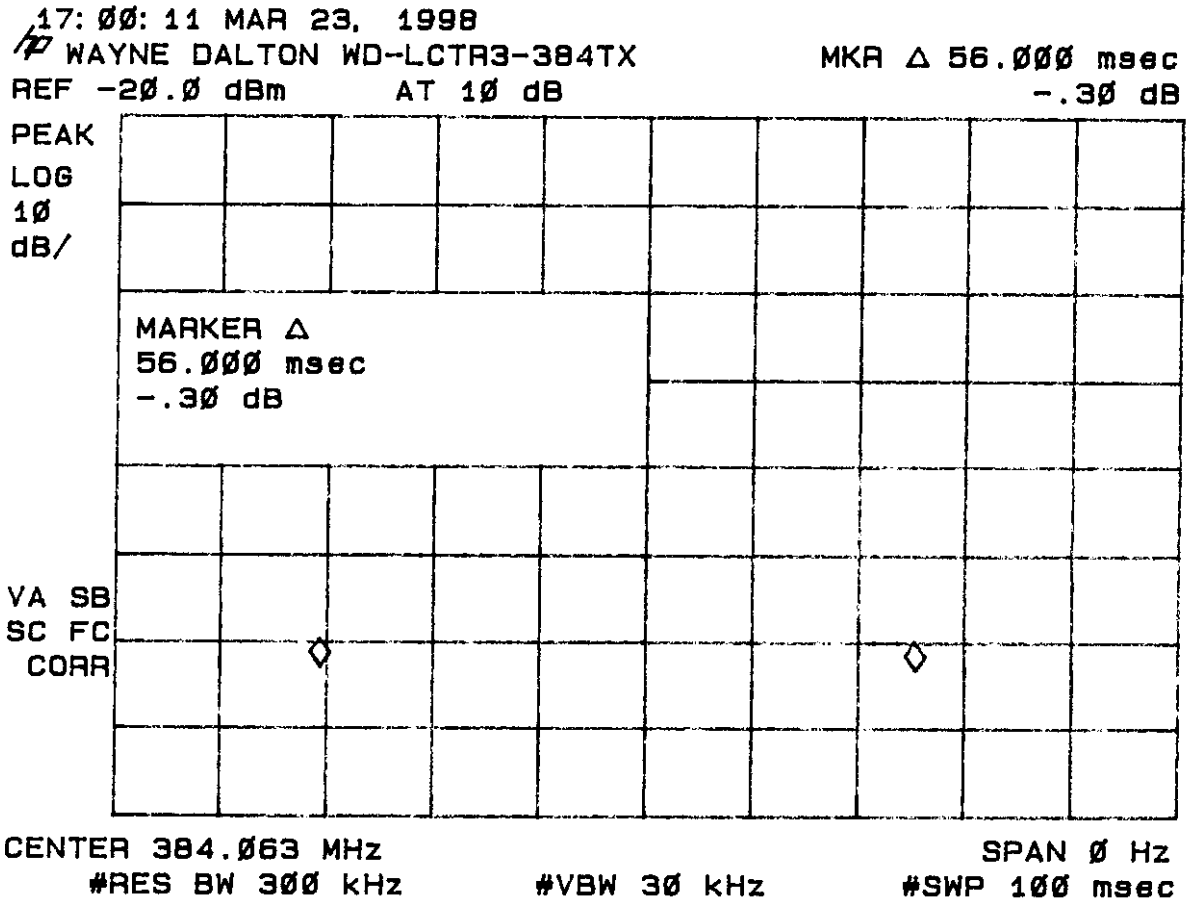
TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
HORN ANTENNA	EMCO	3115	3723
ROBERTS ANTENNAS	COMPLIANCE DESIGN	A100	167
BICONICAL ANTENNA	EMCO	3110	9307-1431
LOG PERIODIC ANTENNA	EMCO	3146	9110-3600
LISN	SOLAR ELE.	8012-50	N/A
THERMOMETER	FLUKE	52	5215250
MULTIMETER	FLUKE	85	53710469
FUNCTION GENERATOR	TEKTRONIX	CFG250	CFG250TW15059
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394
BILOG	CHASE	CBL6112A	2238

Periodic Operation (47 CFR 15.231(a1))

A transmitter manually activated must automatically deactivate within not more than 5 seconds of being released. The transmitter is a 3 button transmitter. The EUT continues to transmit while each button is being pressed. The EUT ceases transmission almost immediately upon being released and appears to finish the current packet being transmitted. Therefore the longest period of time the transmitter should take to deactivate is a packet length, or 56 msec as shown in Figure 3.

FIGURE 3

Periodic Operation 15.231(a)(c1)



Field Strength of Fundamental Emission (47 CFR 15.231b)

Measurements were made using a peak detector. Field strength of the peak fundamental emission is shown in Table 3 and Figure 4.

Duty Cycle Correction During 100 msec:

Each function key sends a different series of characters, but each packet period (131.25 msec) never exceeds a series of 76* long (487.5 μs) and short (225 μs) pulses. Assuming any combination of short or long pulses may be obtained due to encoding the worse case transmit duty cycle would be considered 76 x 487.5 μs = 37% duty cycle. Figures 5a through 5f show the characteristics of the pulse train for one of these functions.

*48 msec (data transmit time) / 712.50 msec (period of log pulse) = 67.4
5.875 msec (preamble transmit time) / 712.50 msec (period of log pulse) = 8.2
67.4 + 8.2 = 75.6 or 76 pulses

Duty Cycle Correction = 20 log(0.37) = -8.6dB

Field strength of the average fundamental emission is shown in Table 4.

TABLE 3

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
383.6	-40.3	20.6	23,173.9	89,167

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-40.3 + 20.6 + 107)/20) = 23,173.9
CONVERSION FROM dBm TO dBuV = 107 dB

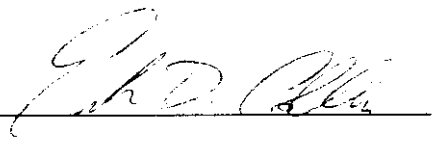
Results Reviewed By:  **Name: Erik Collins**

FIGURE 4

FIELD STRENGTH OF FUNDAMENTAL EMISSION 15.231(b)

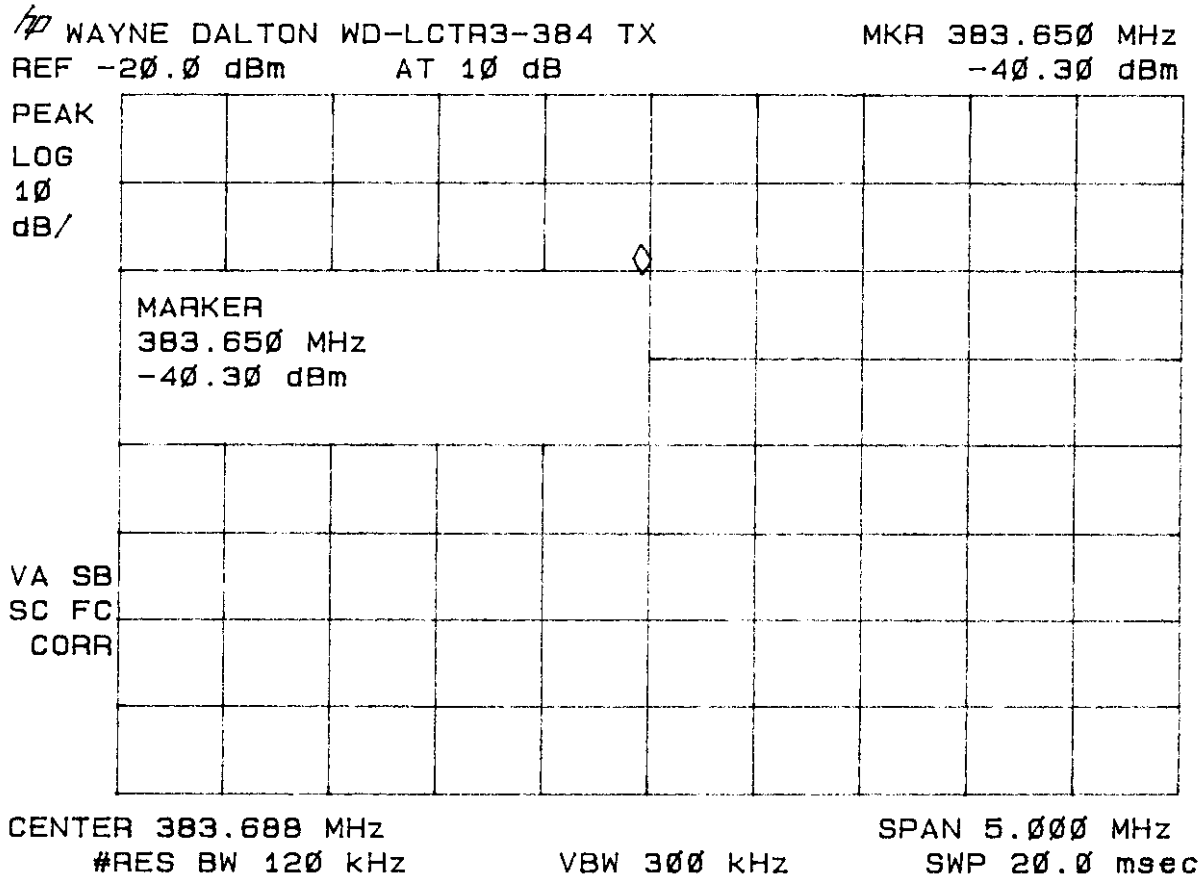


TABLE 4

FIELD STRENGTH OF FUNDAMENTAL EMISSION

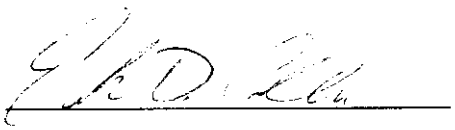
Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

FREQ. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 3m
383.6	-48.9	20.6	8,610	8,917

* Adjusted by duty cycle = 20 log(0.37) = -8.6 dB

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-48.9 + 20.6 + 107)/20) = 8,610
CONVERSION FROM dBm TO dBuV = 107 dB

Results Reviewed By:  Name: Erik Collins

Field Strength Of Spurious Emissions (47 CFR 15.231b)

Measurements were made using a peak detector. Field strength of Spurious Emissions are shown in Table 5 and Figures 6. For comparison to the average limits, duty cycle corrections were made as given in the previous section. Any emission less than 1000 MHz and falling within the restricted bands of 15.205 were not adjusted for averaging and the limits of 15.209 were applied.

FIGURE 5a

DUTY CYCLE CHARACTERISTICS

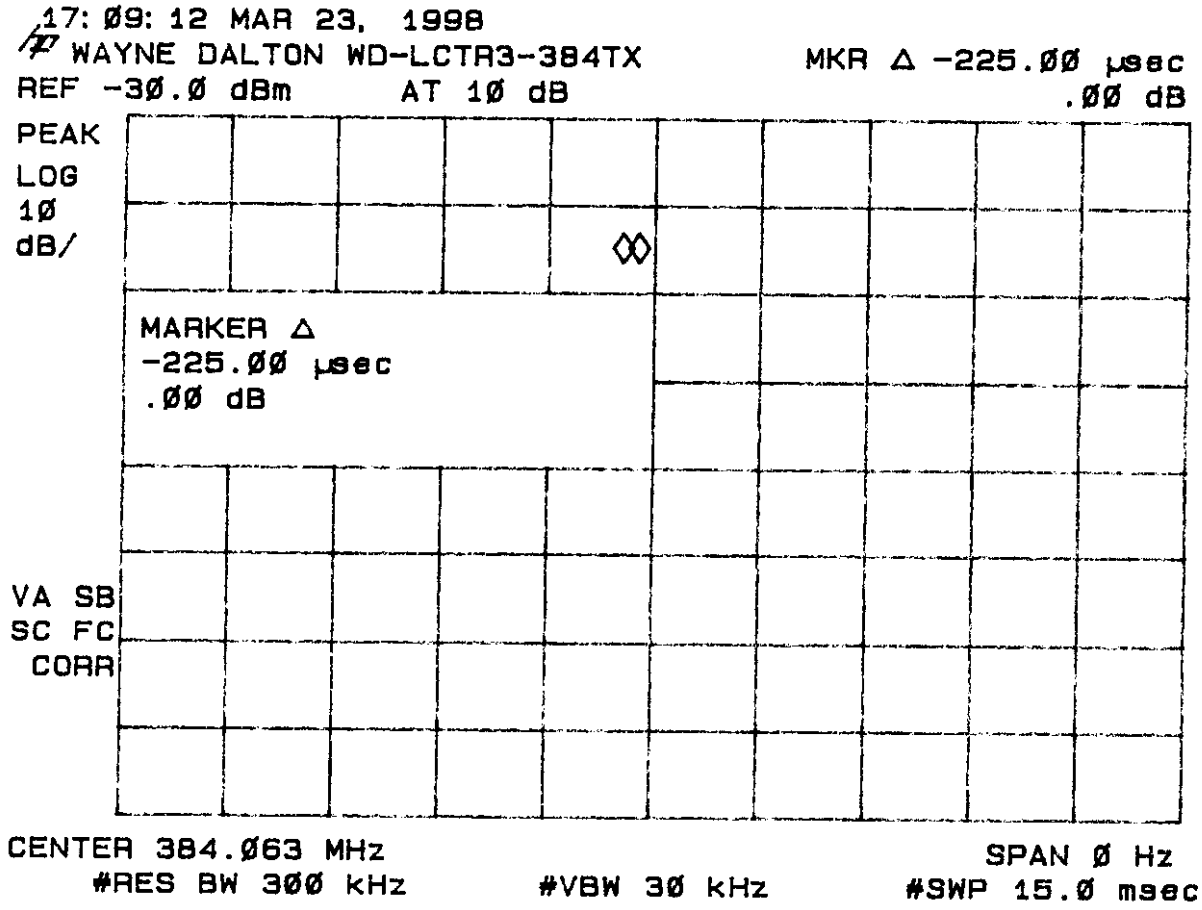


FIGURE 5b

DUTY CYCLE CHARACTERISTICS

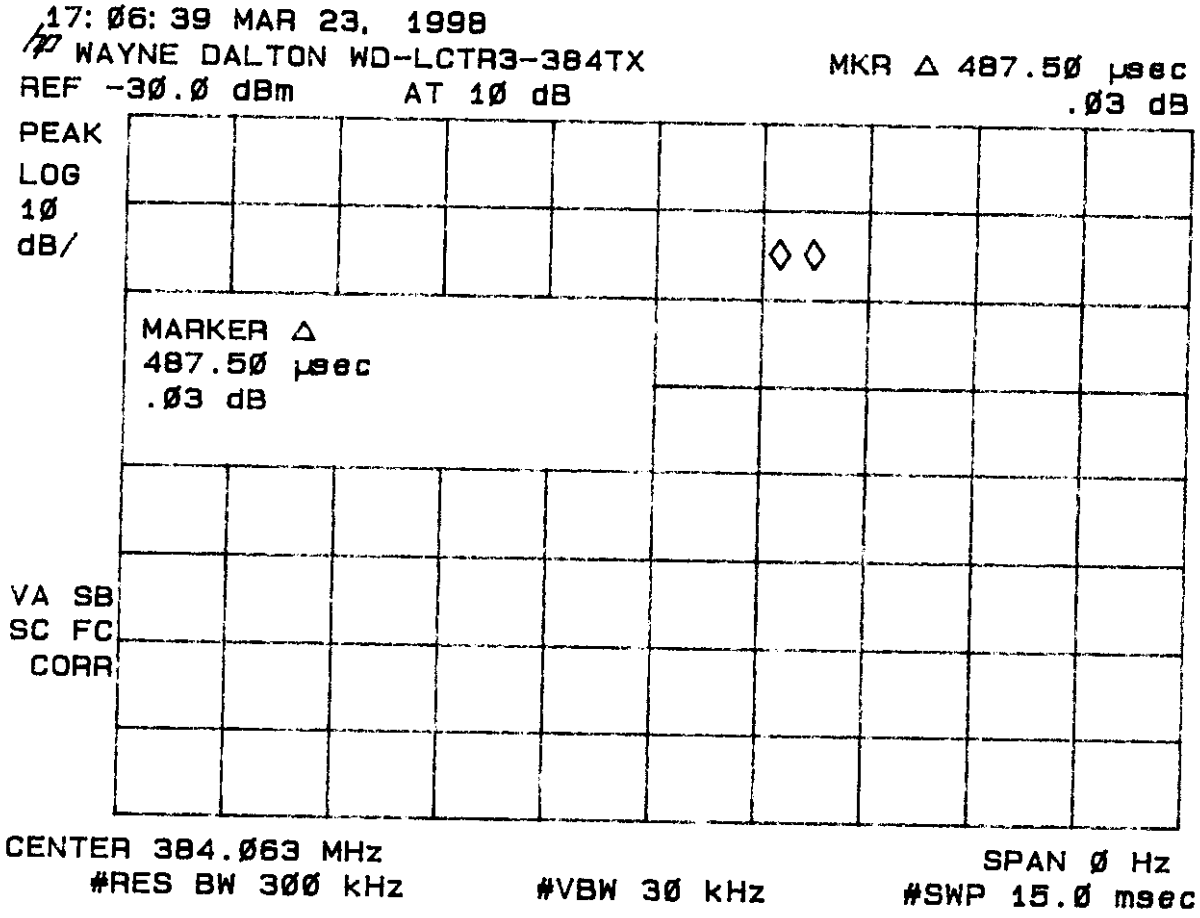


FIGURE 5c

DUTY CYCLE CHARACTERISTICS

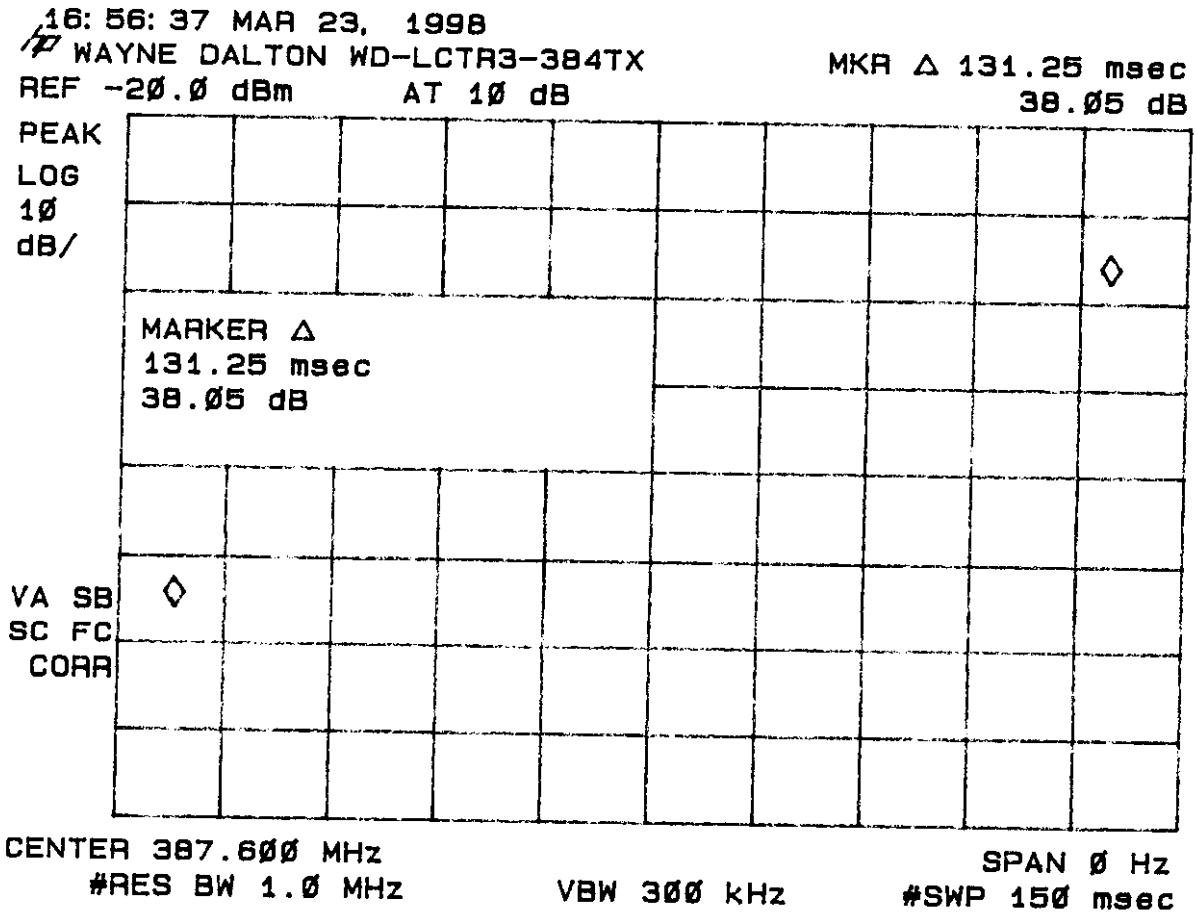


FIGURE 5d

DUTY CYCLE CHARACTERISTICS

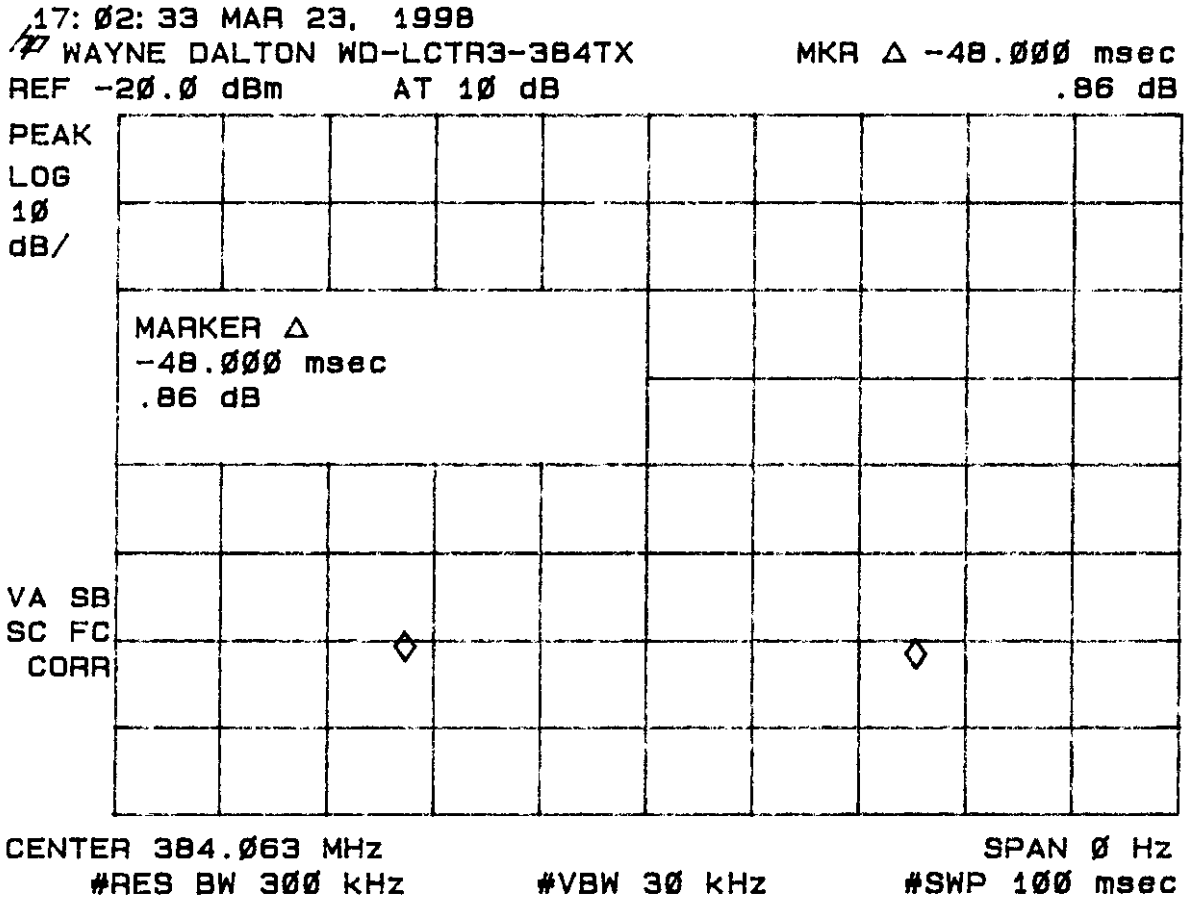


FIGURE 5e

DUTY CYCLE CHARACTERISTICS

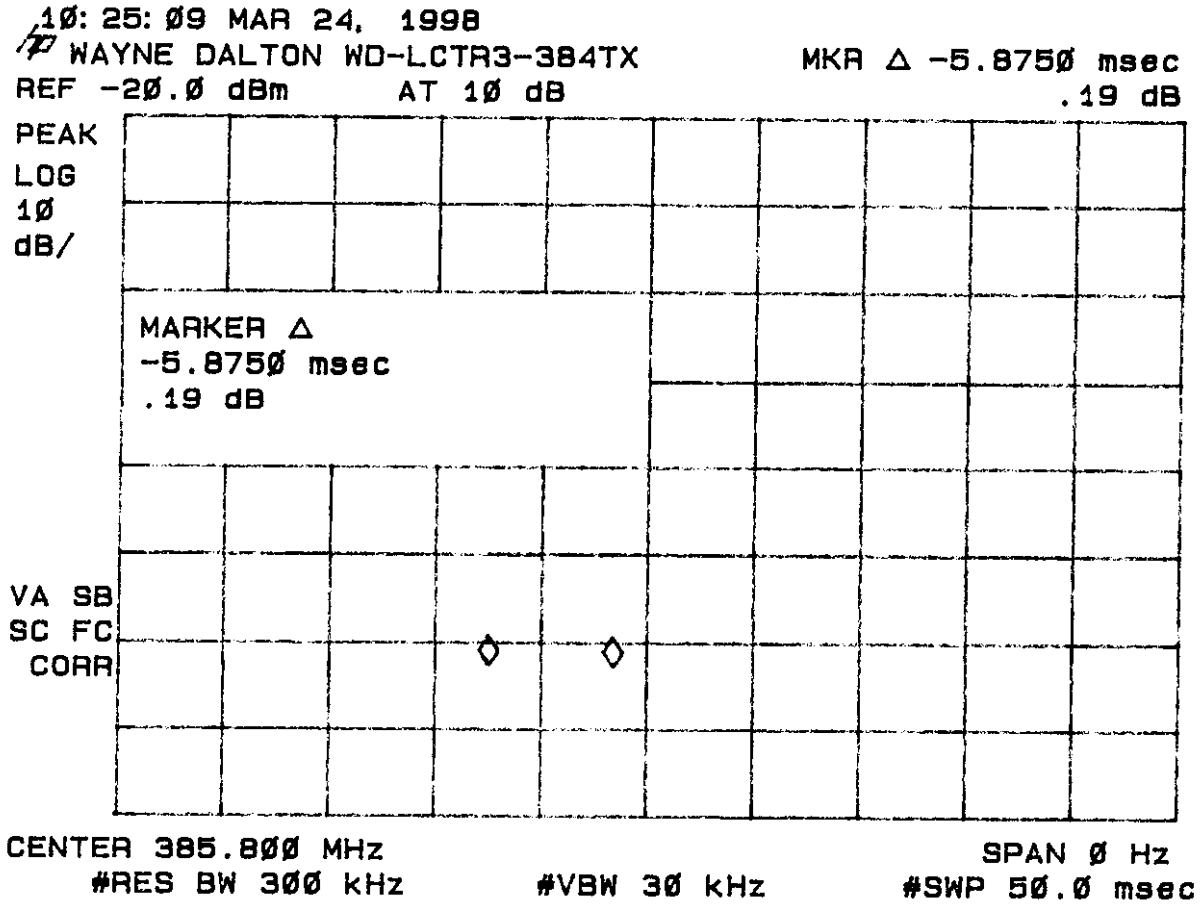


FIGURE 5f

DUTY CYCLE CHARACTERISTICS

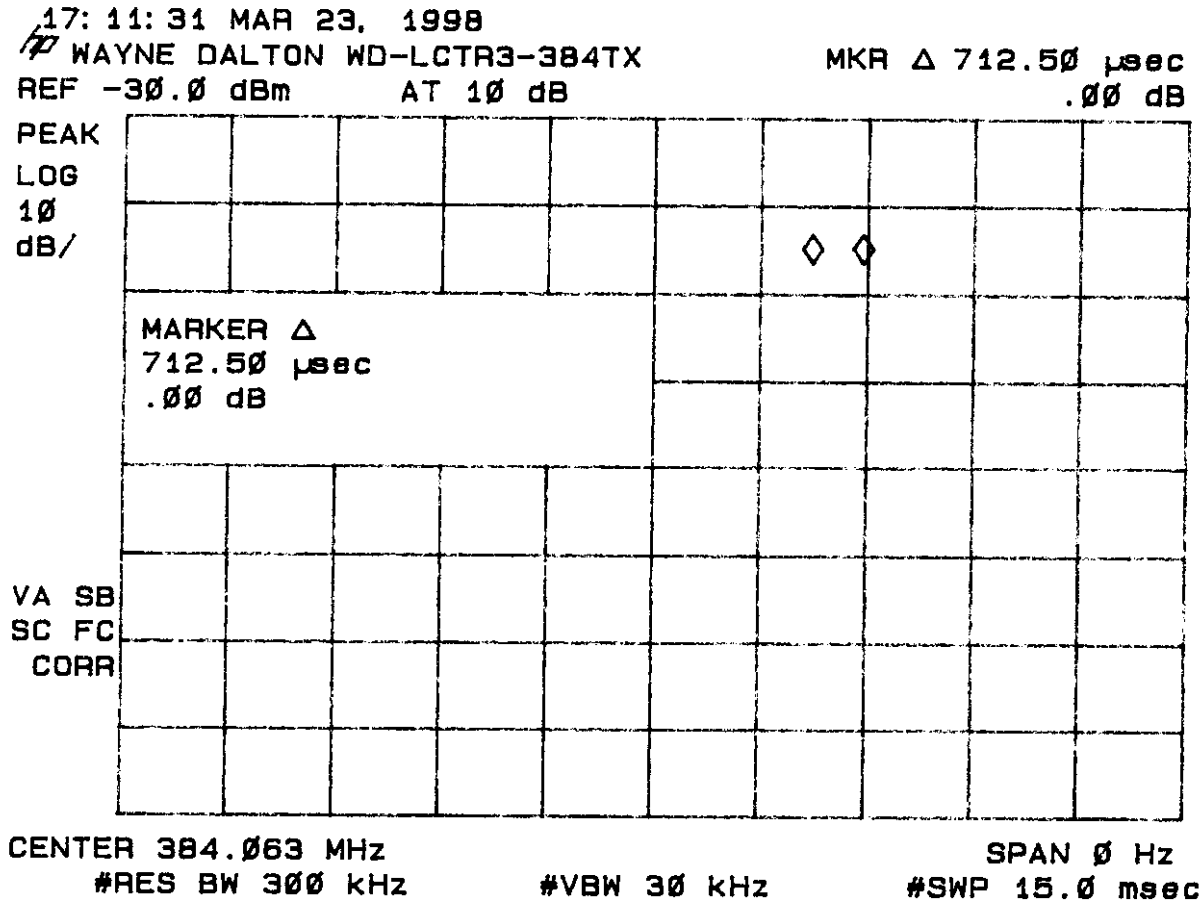


TABLE 5a

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

FREQ. (MHz.)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
765.3	-73.8	27.2	1047.9	8917
1150.68**	-41.7	-10.1	575.4	5000
1533.55**	-53.2	-6.9	221.3	5000
1917.73	-49.2	-4.3	473.2	8917
2301.28	-46.4	-.9	968.3	8917
2684.60**	-56.9	.4	337.0	5000
3068.18	-54.1	1.2	508.3	8917
3451.83	-49.8	2.9	1019.8	8917
3838.30**	-57.0	4.8	547.3	5000

** Denotes restricted band of operation

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-73.8 + 27.2 + 107)/20) = 1047.9
CONVERSION FROM dBm TO dBuV = 107 dB

Results Reviewed By: _____ Name: Erik Collins

TABLE 5b

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

FREQ. (MHz.)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 3m
765.3	-82.4	27.2	389.0	891.7
1150.68**	-50.3	-10.1	213.8	500.0
1533.55**	-61.8	-6.9	82.2	500.0
1917.73	-57.8	-4.3	175.8	891.7
2301.28	-55.0	-0.9	359.7	891.7
2684.60**	-65.5	.4	125.2	500.0
3068.18	-62.7	1.2	188.8	891.7
3451.83	-58.4	2.9	378.9	891.7
3838.30**	-65.6	4.8	203.3	500.0

*Adjustable duty cycle = 20 log (.37) = -8.6dB

** Denotes restricted band of operation

79
59
54

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-82.4 + 27.2 + 107)/20) = 389.0
CONVERSION FROM dBm TO dBuV = 107 dB

Results
Reviewed By: _____ Name: Erik Collins

FIGURE 6a

SPURIOUS EMISSIONS 15.231(b)

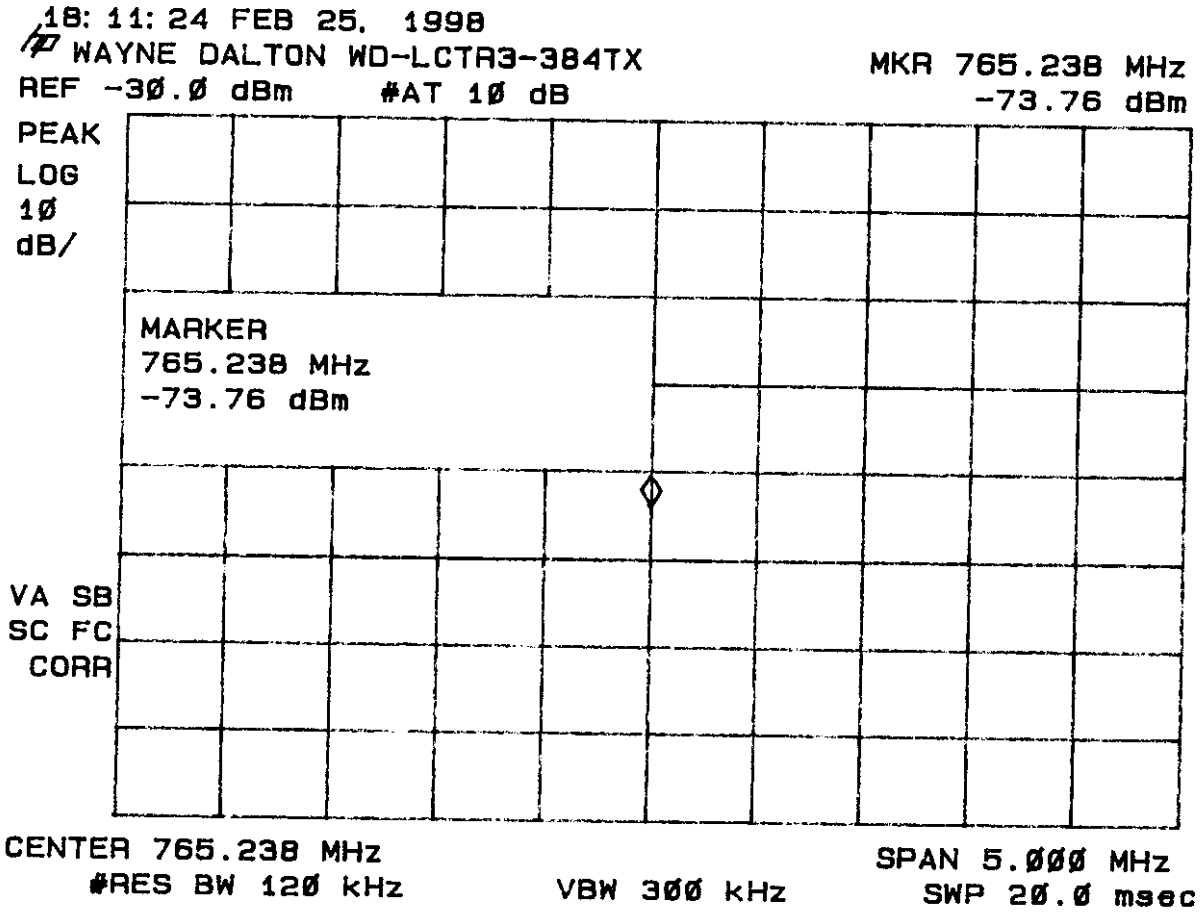


FIGURE 6b

SPURIOUS EMISSIONS 15.231(b)

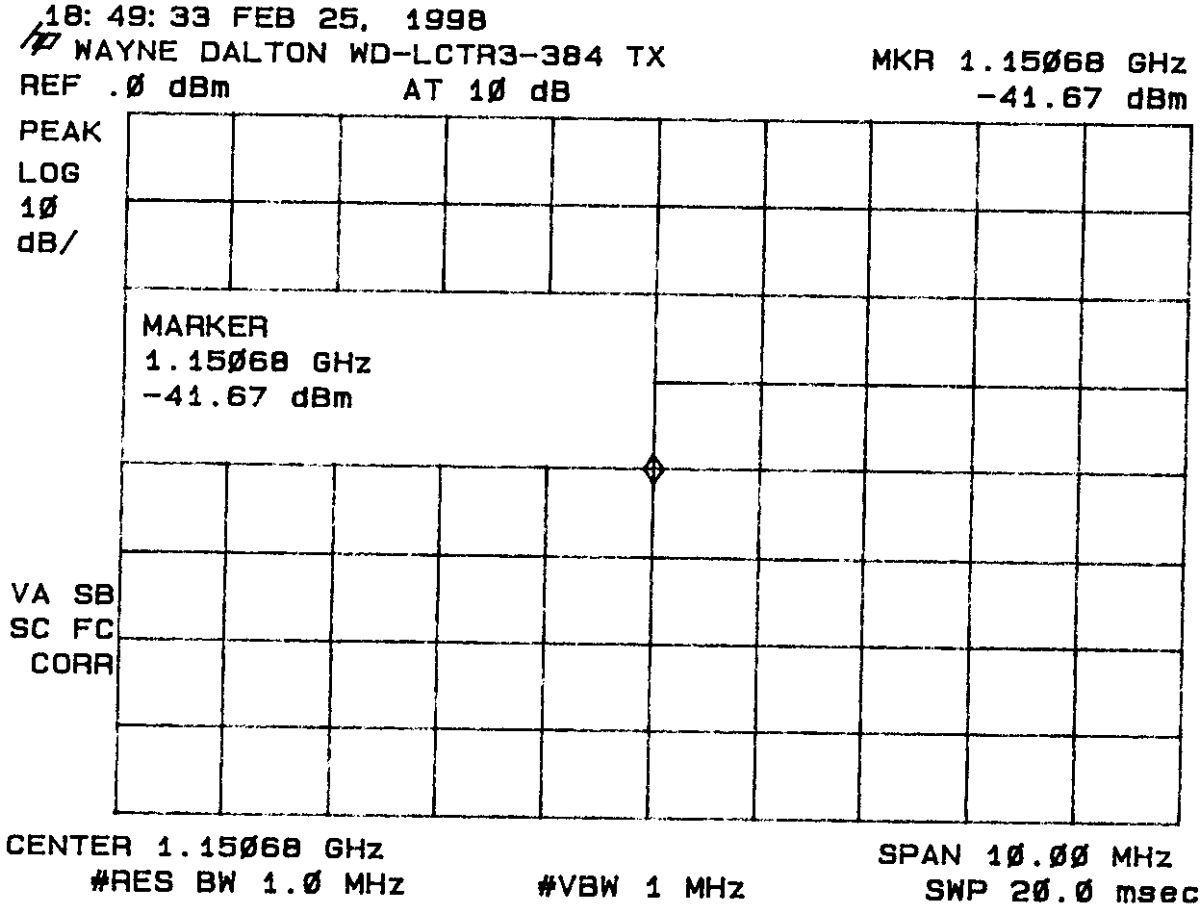


FIGURE 6c

SPURIOUS EMISSIONS 15.231(b)

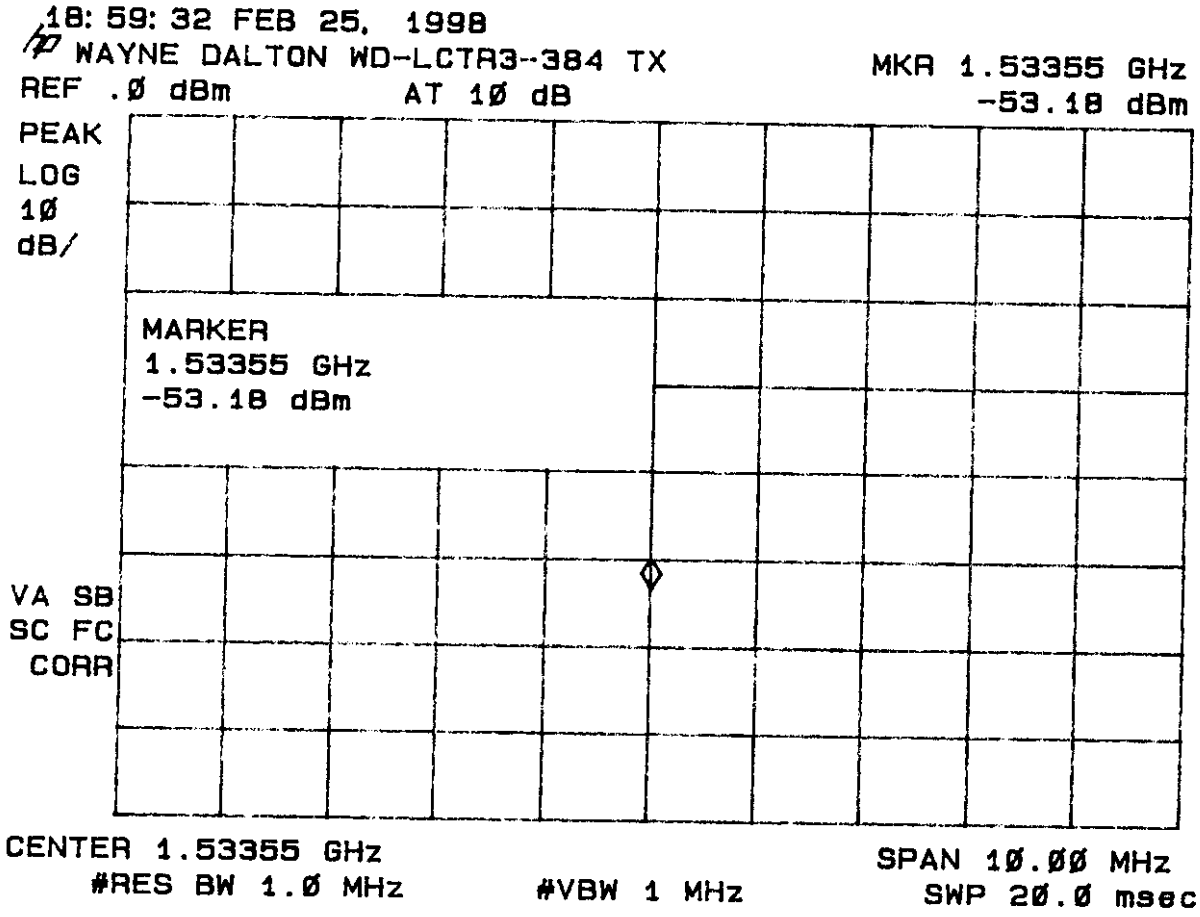


FIGURE 6d

SPURIOUS EMISSIONS 15.231(b)

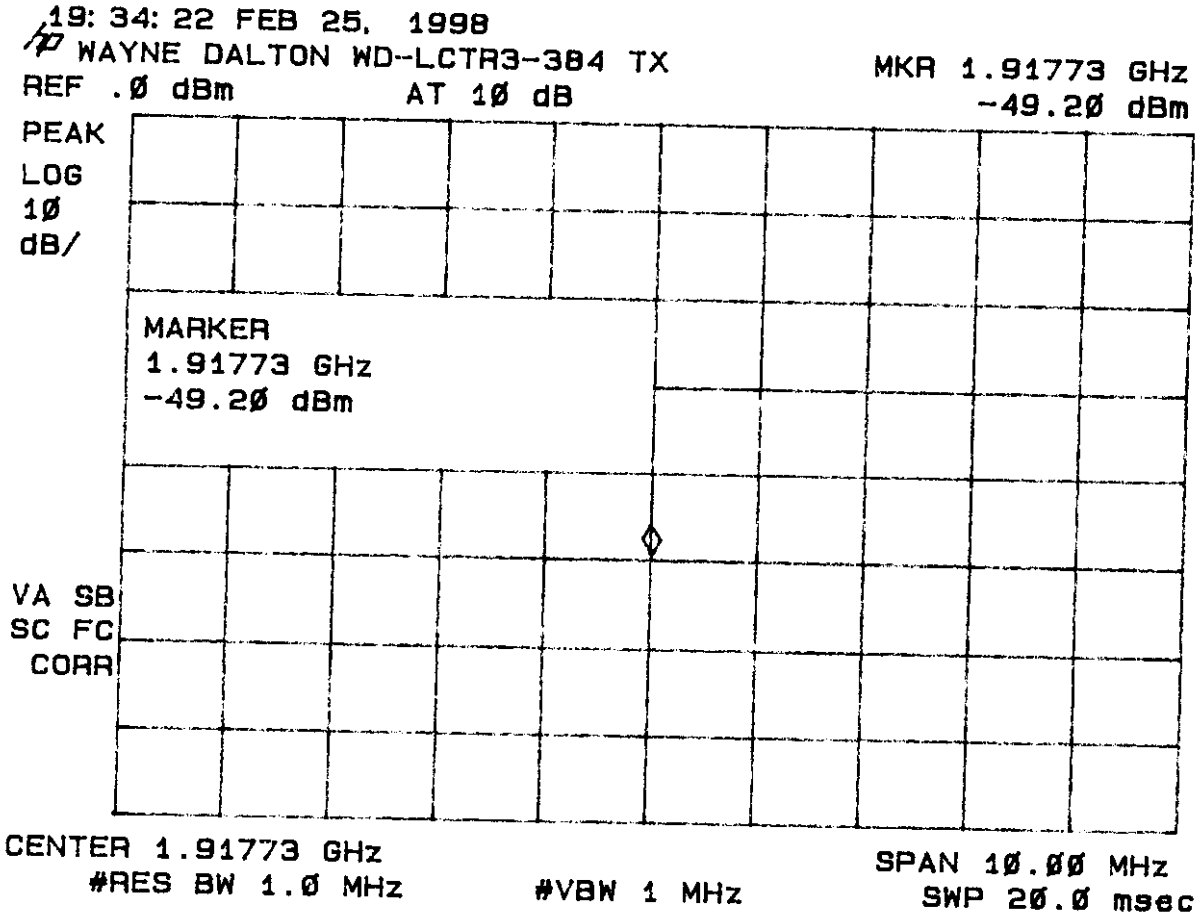


FIGURE 6e

SPURIOUS EMISSIONS 15.231(b)

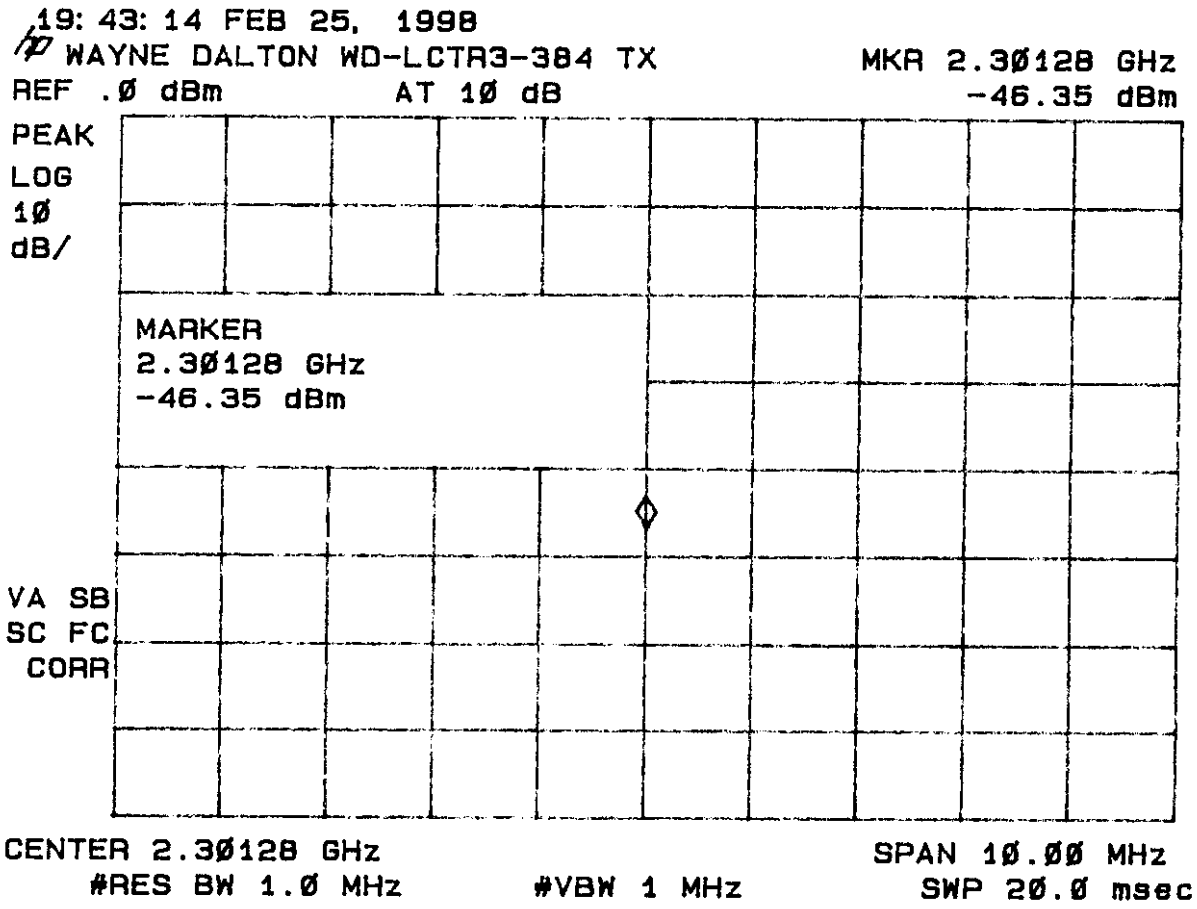


FIGURE 6f

SPURIOUS EMISSIONS 15.231(b)

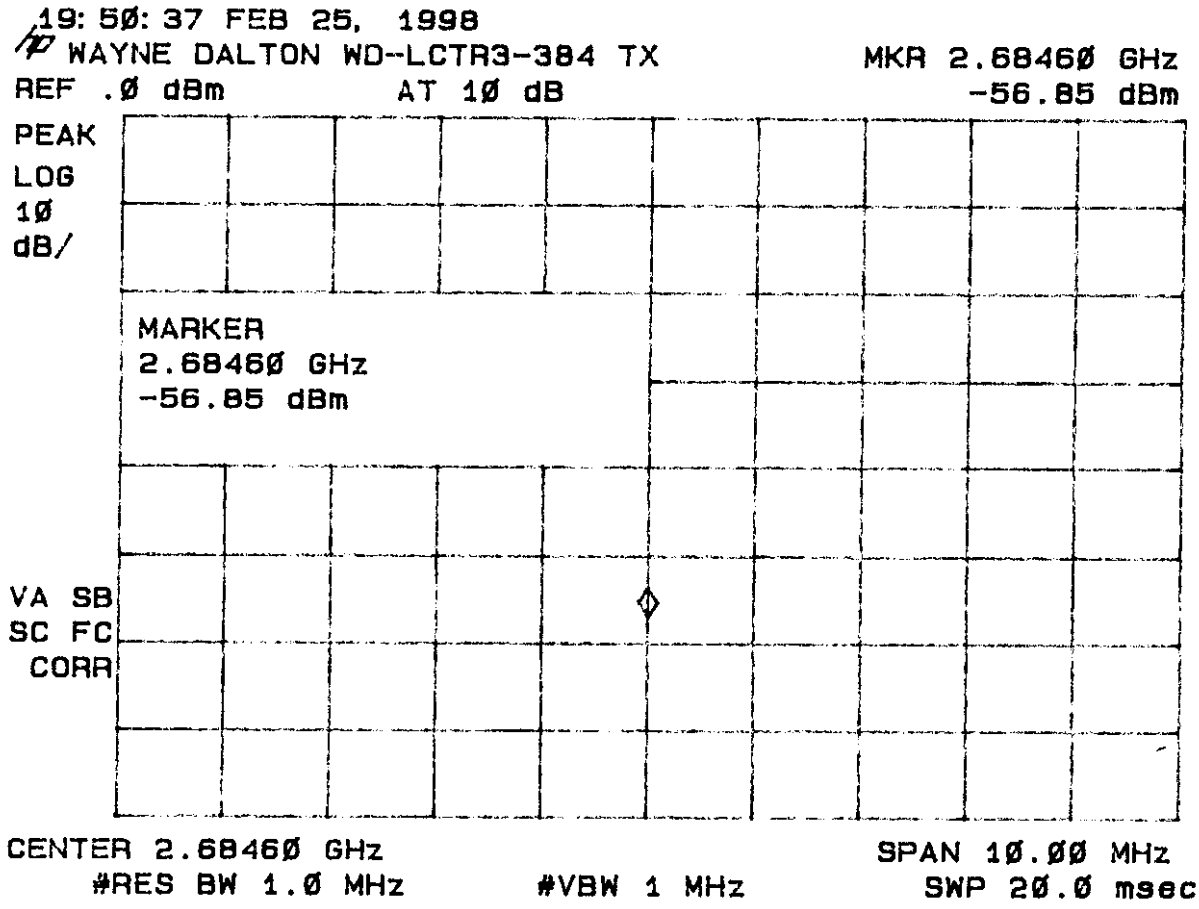


FIGURE 6g

SPURIOUS EMISSIONS 15.231(b)

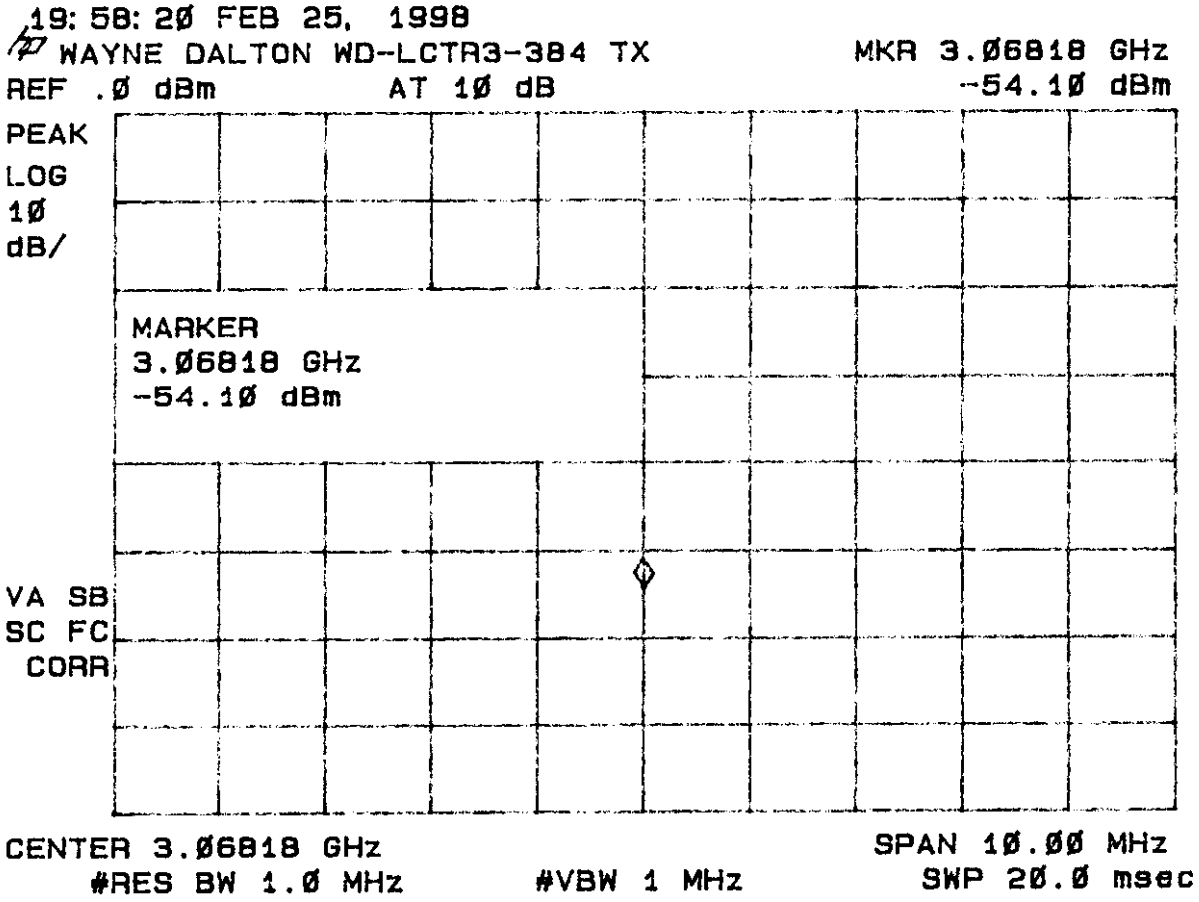


FIGURE 6h

SPURIOUS EMISSIONS 15.231(b)

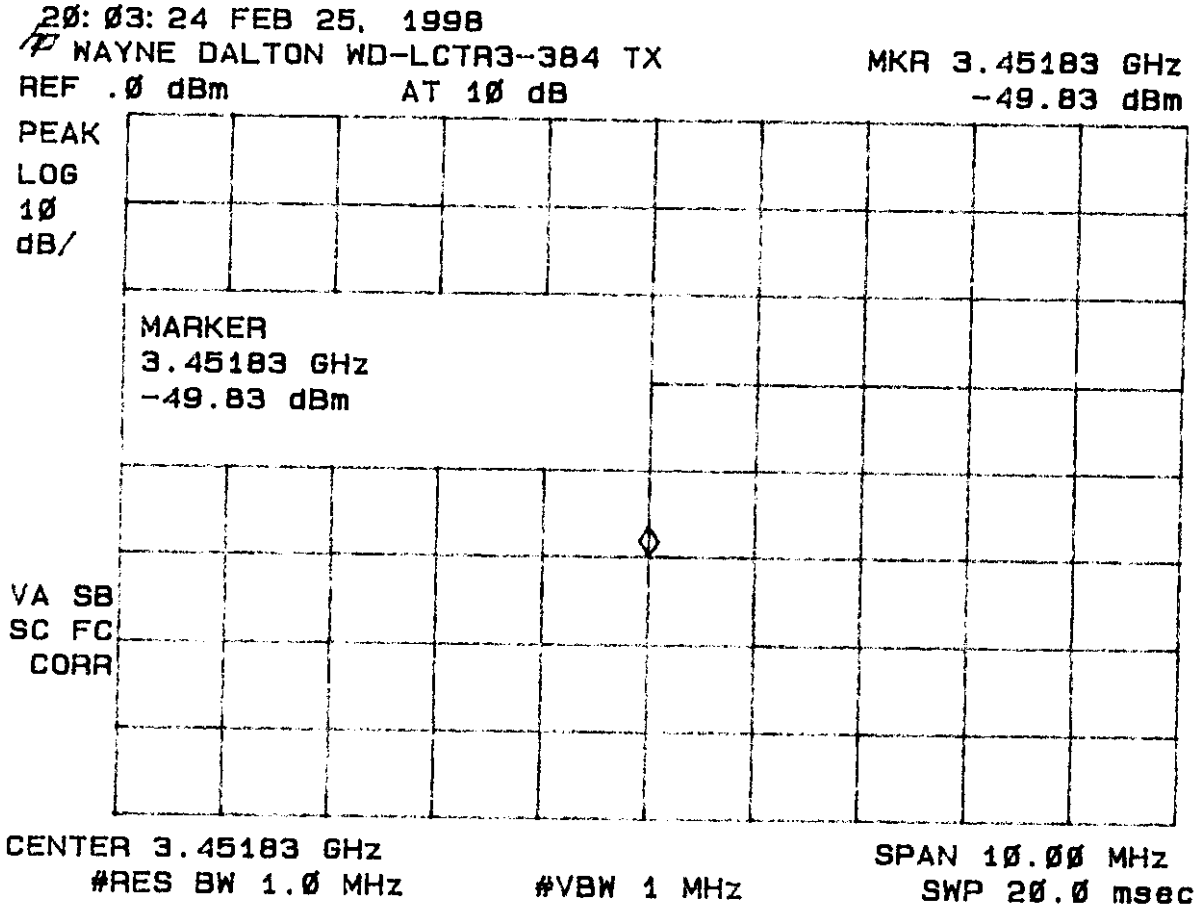
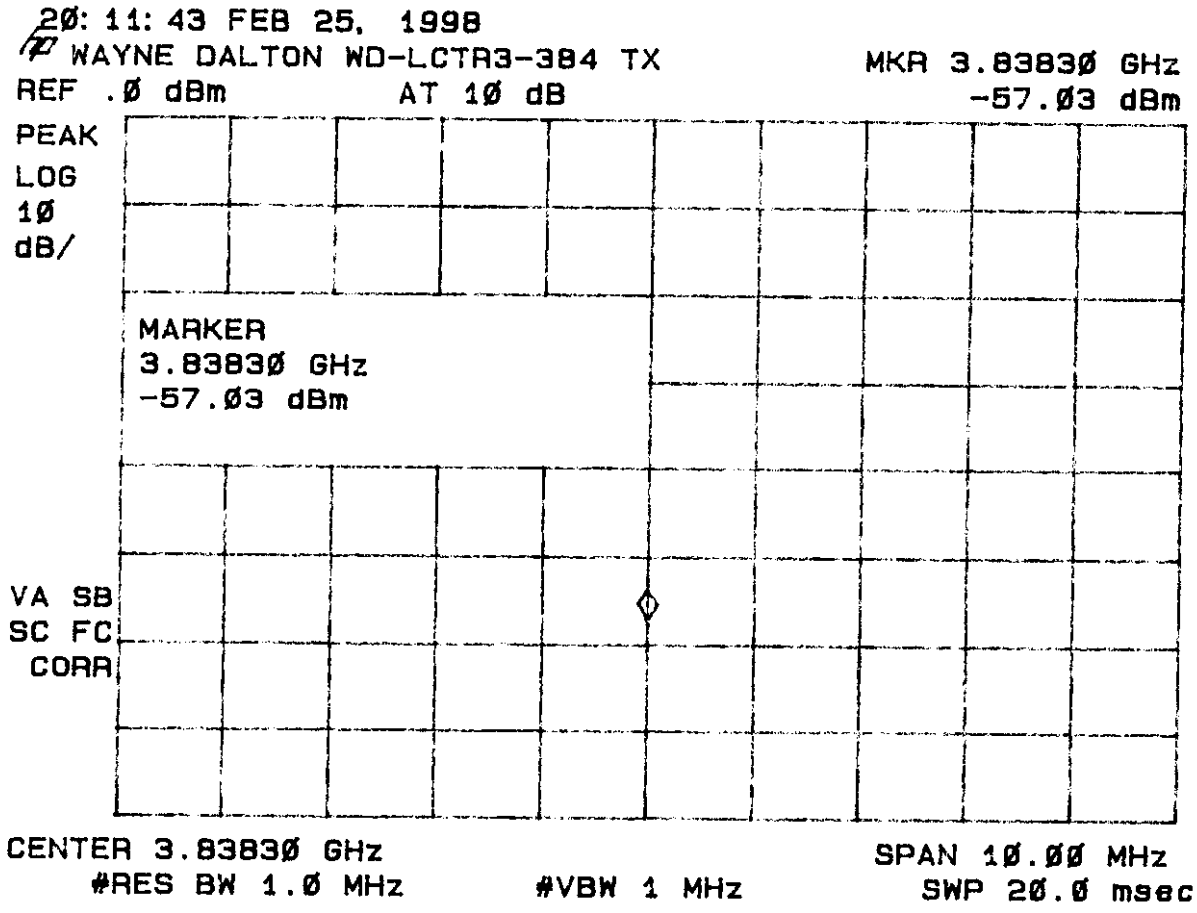


FIGURE 6i

SPURIOUS EMISSIONS 15.231(b)



20 dB Bandwidth of Fundamental Emission (47 CFR 15.231c)

The peak 20 dB bandwidth measurement of the fundamental emission is shown in Table 6 and Figure 7.

TABLE 6

20 dB BANDWIDTH OF FUNDAMENTAL EMISSION

Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

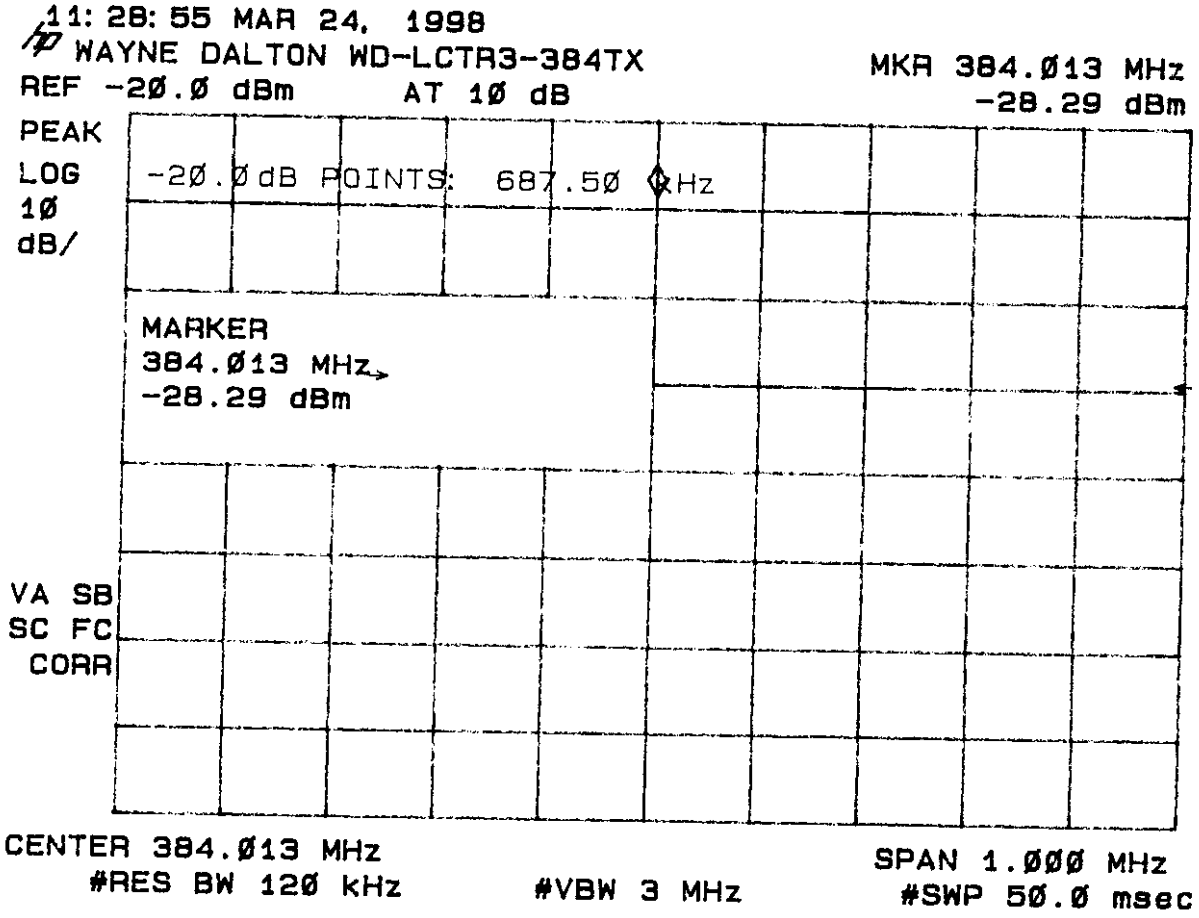
FREQUENCY (MHz)	20 dB BANDWIDTH (KHz)	FCC LIMITS (KHz)
384.0	687.5	960

FCC Limit = (0.25%) (Center Frequency) = (0.0025)(384.0) = 960 KHz

Results Reviewed By: _____ **Name:** Erik Collins

FIGURE 7

20 dB BANDWIDTH OF FUNDAMENTAL EMISSION 15.231(c)



Frequency Tolerance of Carrier Signal (47 CFR 15.231d)

The EUT does not operate in the 40.66 - 40.70 MHz band, therefore frequency tolerance measurements were deemed unnecessary.

Radiated Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 1000 MHz. Measurements were made with the analyzer's bandwidth set to 120 kHz. Emissions are shown in Table 7.

TABLE 7

CLASS B
RADIATED EMISSIONS

Test Date: February 25, 1998
UST Project: 98-062
Customer: Wayne Dalton Corporation
Model: Operator 31 384 MHz Transmitter

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	FCC LIMITS (uV/m) @ 3m
NO EMISSIONS DETECTED WITHIN 10 dB OF THE FCC LIMITS				

Results
Reviewed By: _____ Name: Erik Collins

Power Line Conducted Emissions (47 CFR 15.107a)

The EUT is operated by internal battery power only, therefore power line conducted emissions was deemed unnecessary.