MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Wayne Dalton Corporation**

MODEL: **Operator 31 372.5 MHz Transmitter**

FCC ID: **KJ8HHT-3725SW**

DATE: **July 14, 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:

United States Technologies, Inc.
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

TABLE OF CONTENTS

Letter of Confidentiality

SECTION 1

GENERAL INFORMATION

Product Description

SECTION 2

TESTS AND MEASUREMENTS

Configuration of Tested
Test Facility
Test Equipment
Modifications
Periodic Operation
Field Strength of Fundamental Emission
Field Strength of Spurious Emissions
20 dB Bandwidth of Fundamental Emission
Frequency Tolerance of Carrier Signal
Radiated Emissions
Power Line Conducted Emissions

SECTION 3

LABELING INFORMATION

SECTION 4

BLOCK DIAGRAM(S)

SECTION 5

PHOTOGRAPHS

SECTION 6

USER'S MANUAL

LIST OF FIGURES AND TABLES

FIGURES

Test Configuration
Photograph(s) for Spurious and Fundamental Emissions
Field Strength of Fundamental Emission
Field Strength of Spurious Emissions
Bandwidth of Fundamental Emission

TABLES

EUT And Peripherals
Test Instruments
Field Strength of Fundamental Emission
Field Strength of Spurious Emissions
Bandwidth of Fundamental Emission
Radiated Emissions
Power Line Conducted Emissions

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 at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

Modifications

No modifications were made to bring the EUT into compliance with FCC Part 15, Class B Requirements:

Test Equipment

Table 2 describes test equipment used to evaluate this product.

FIGURE 1

TEST CONFIGURATION

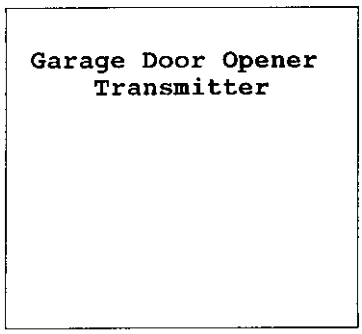


TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Garage Door Opener Transmitter Wayne Dalton Corporation (EUT)	Operator 31 372.5 MHz Transmitter	None	KJ8HHT-3725SW (Pending)	None

TABLE 2

TEST INSTRUMENTS

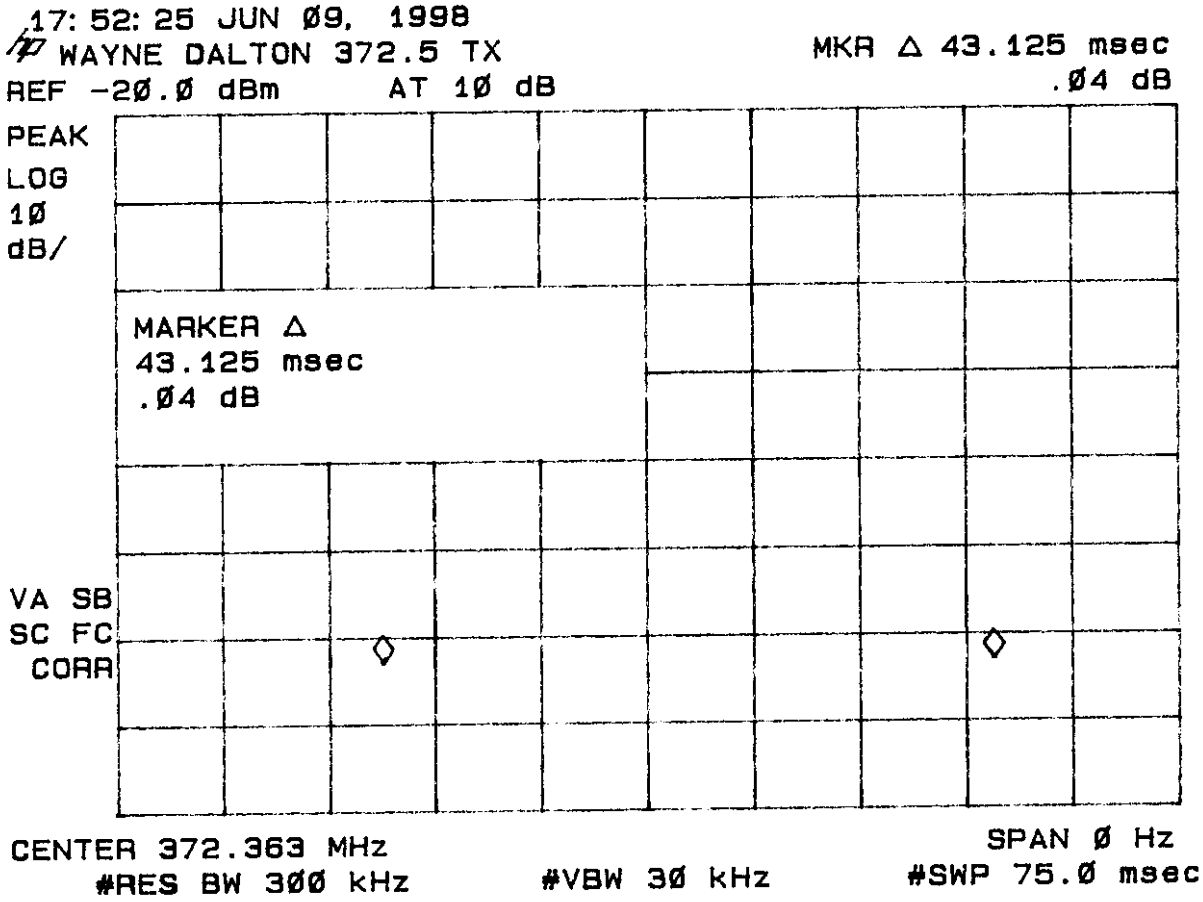
TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
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 43.125 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 (99.750 msec) never exceeds a series of 74* long (262.5 μs) and short (112.5 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 74 x 262.5 μs per 99.750 msec = 19% duty cycle. Figures 5a through 5f show the characteristics of the pulse train for one of these functions.

*- Note: 36.75 msec (data transmit time) / 562.5 μs (period of long pulse) = 65.3
4.875 msec (preamble transmit time) / 562.5 μs (period of long pulse) = 8.7
65.3 + 8.7 = 74 pulses

Duty Cycle Correction = 20 log(0.19) = -14.4 dB

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

TABLE 3

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 MHz Transmitter

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
372.4	-46.3	19.7	10,423.2	89,375

62.4

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-46.3 + 19.7 + 107)/20) = 10,423.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tested By: _____ Name: Erik Collins

TABLE 4

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 MHz Transmitter

FREQ. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 3m
372.5	-60.7	19.7	1,986.1	8,437.5

* Adjusted by duty cycle = 20 log(0.19) = -14.4 dB

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-60.7 + 19.7 + 107)/20) = 1,986.1
CONVERSION FROM dBm TO dBuV = 107 dB

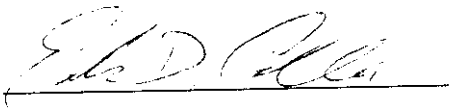
Tested By:  Name: Erik Collins

FIGURE 4

FIELD STRENGTH OF FUNDAMENTAL EMISSION 15.231(b)

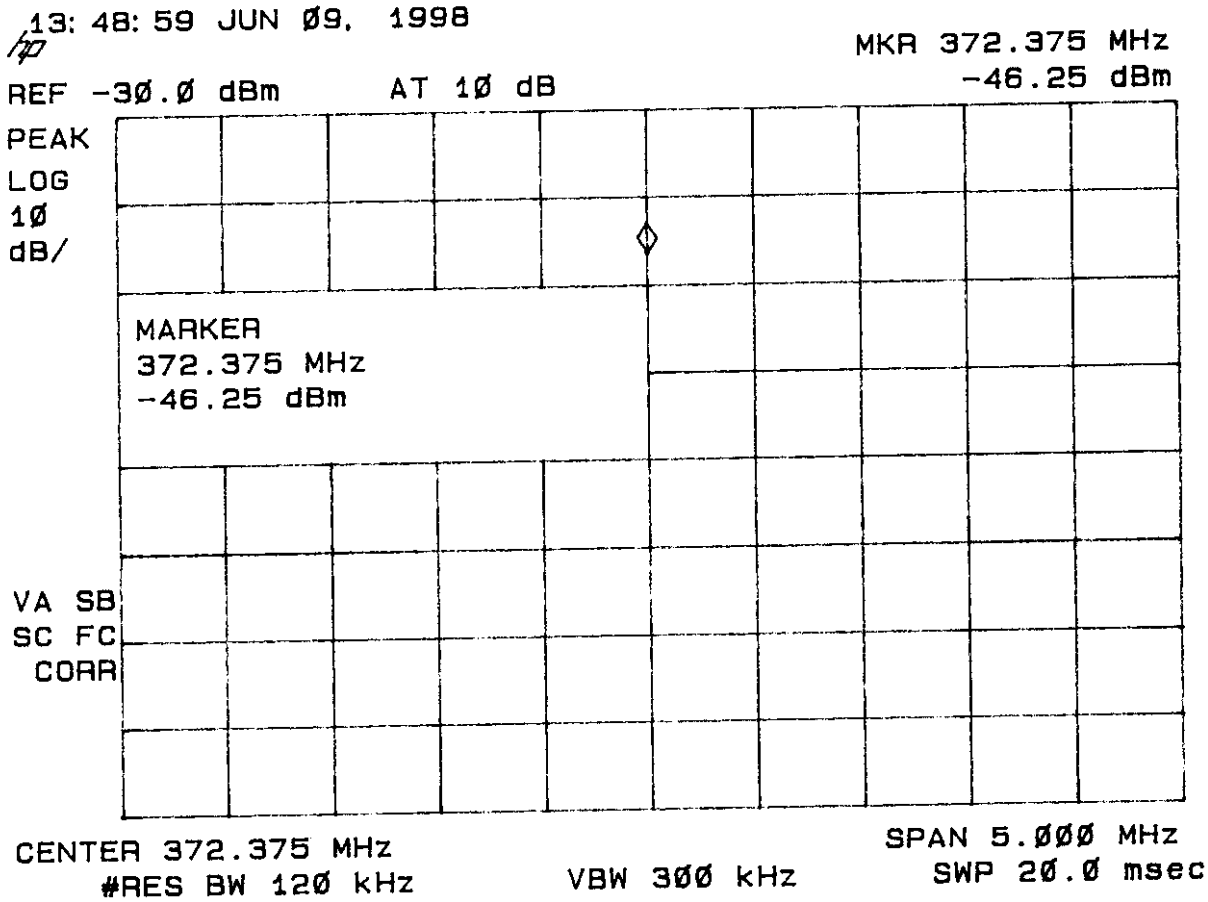


FIGURE 5a

DUTY CYCLE CHARACTERISTICS

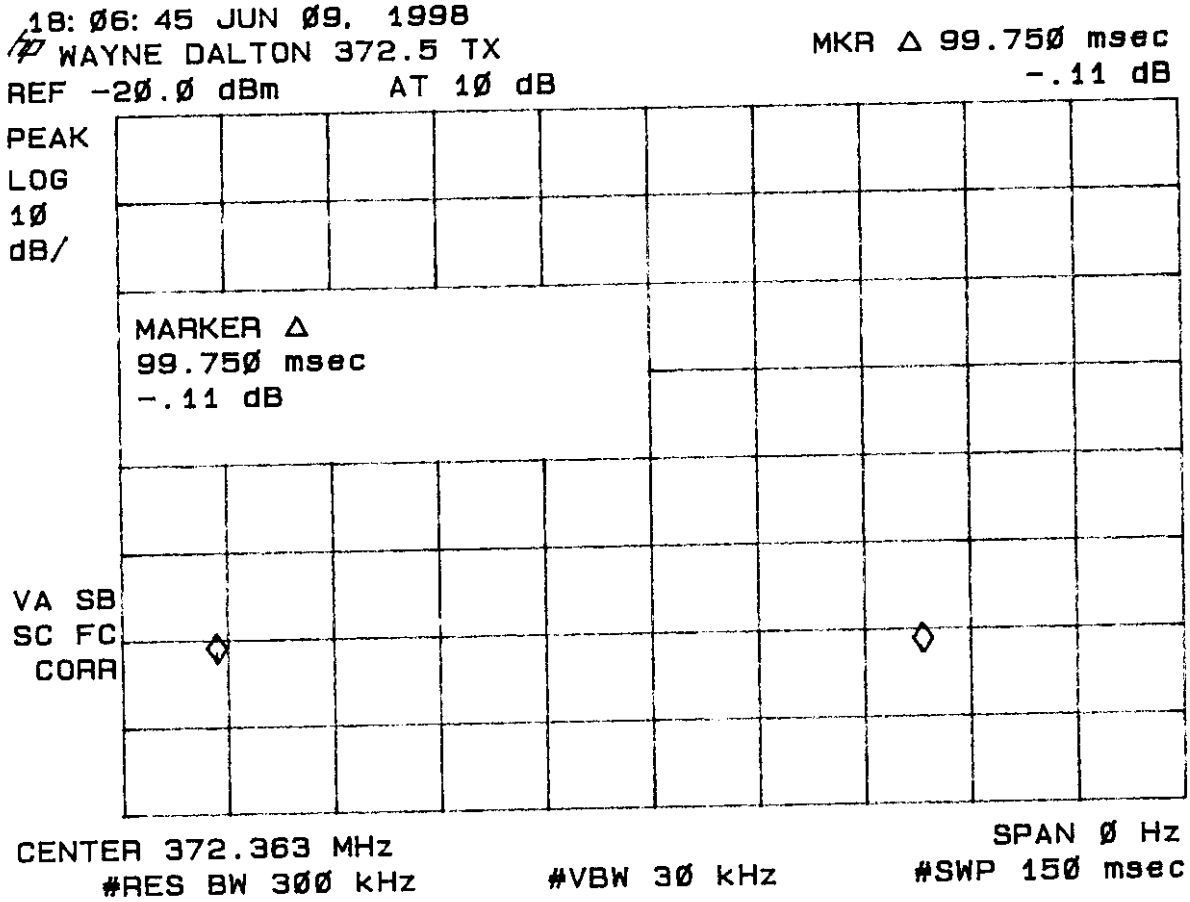


FIGURE 5b

DUTY CYCLE CHARACTERISTICS

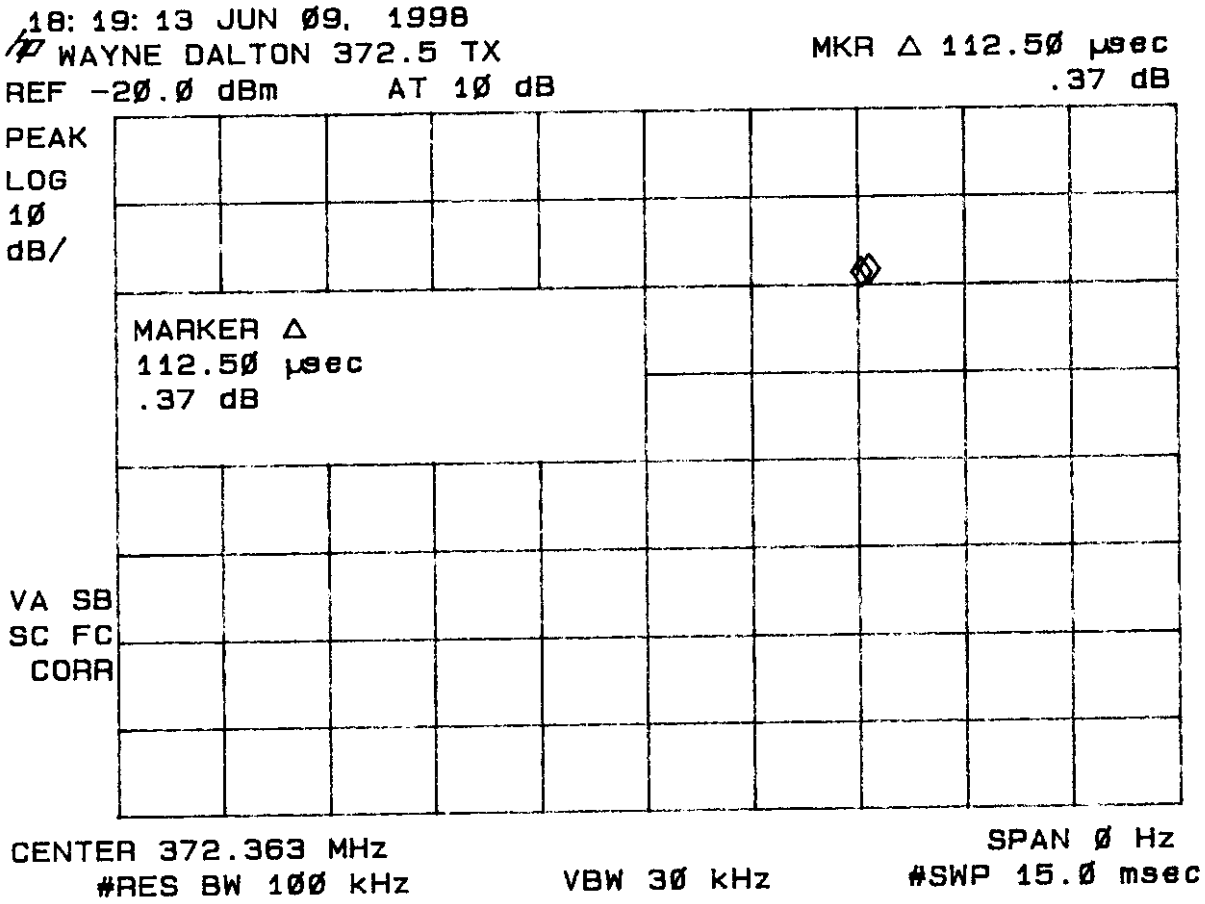


FIGURE 5c

DUTY CYCLE CHARACTERISTICS

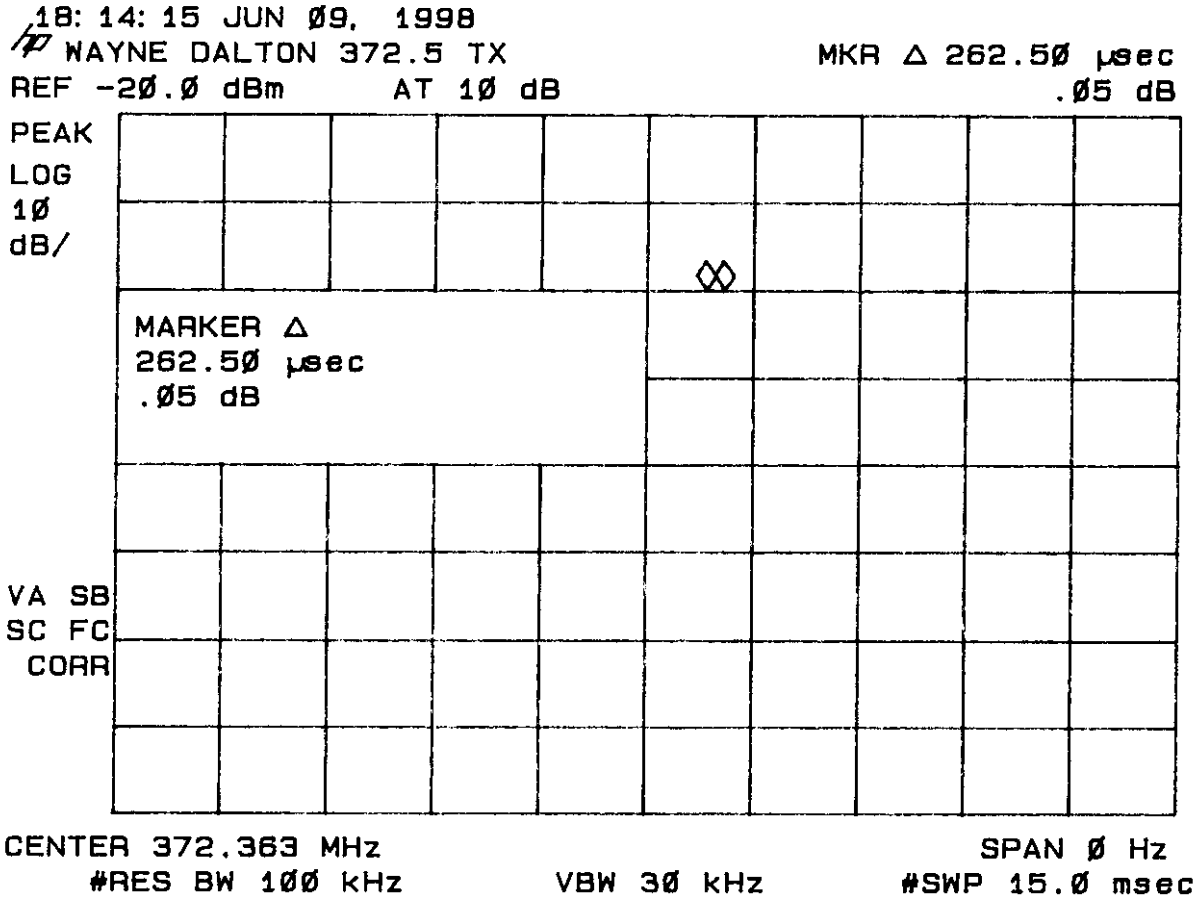


FIGURE 5d

DUTY CYCLE CHARACTERISTICS

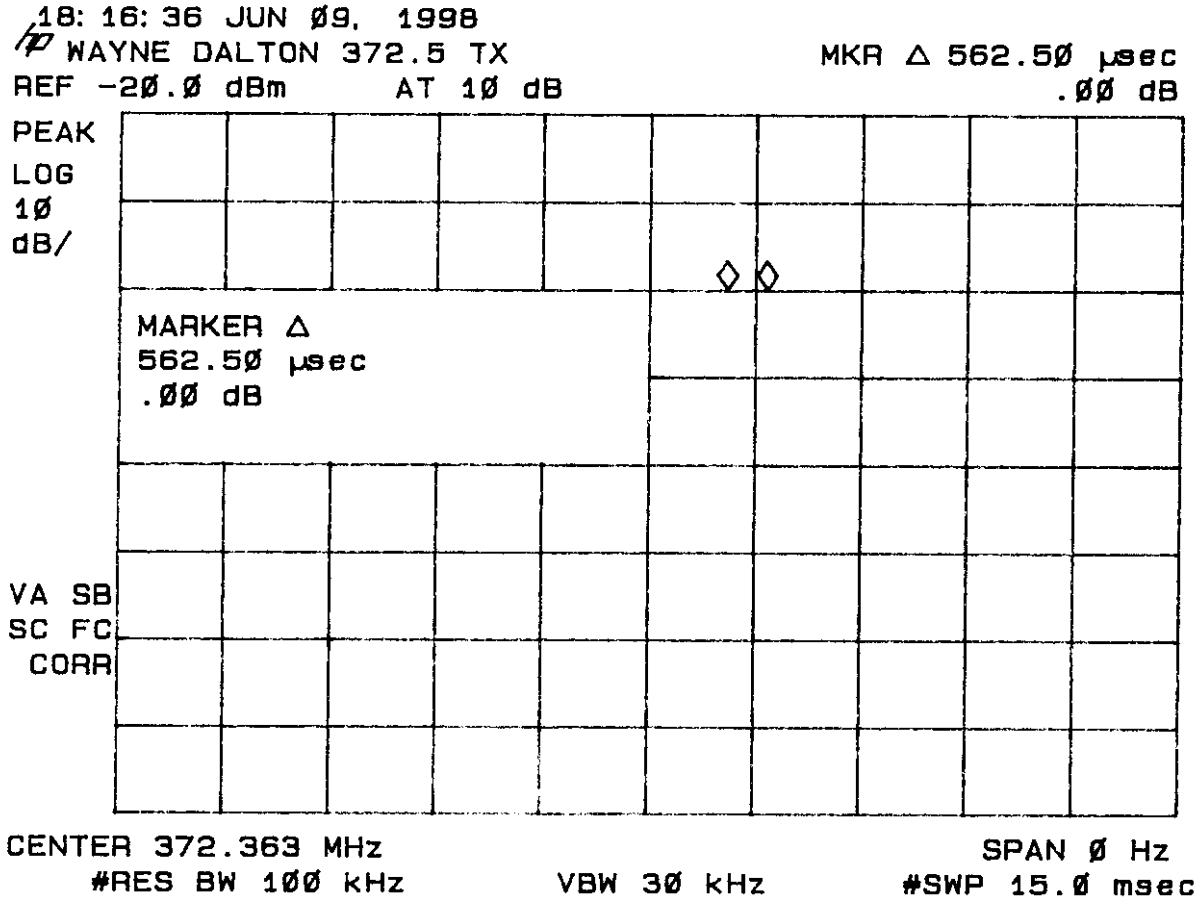


FIGURE 5e

DUTY CYCLE CHARACTERISTICS

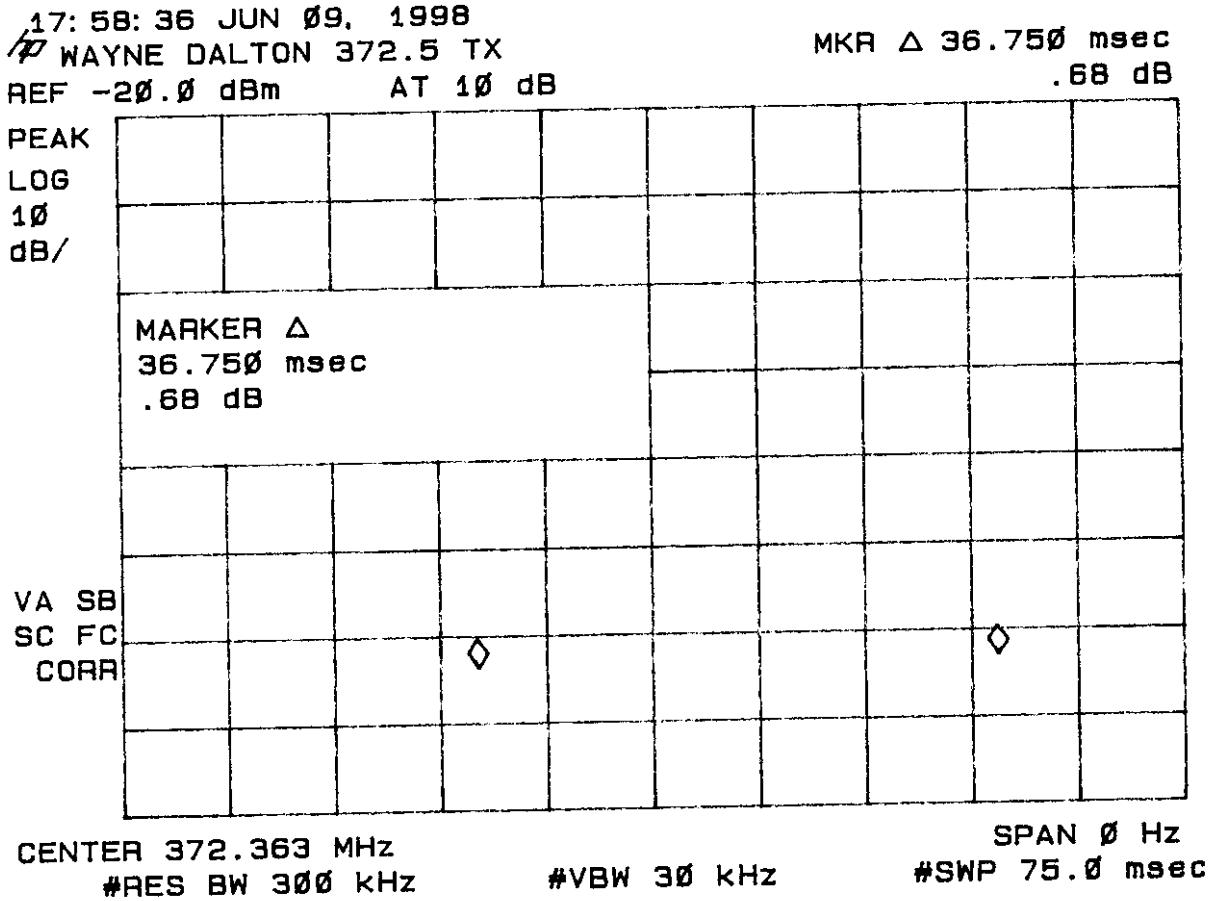
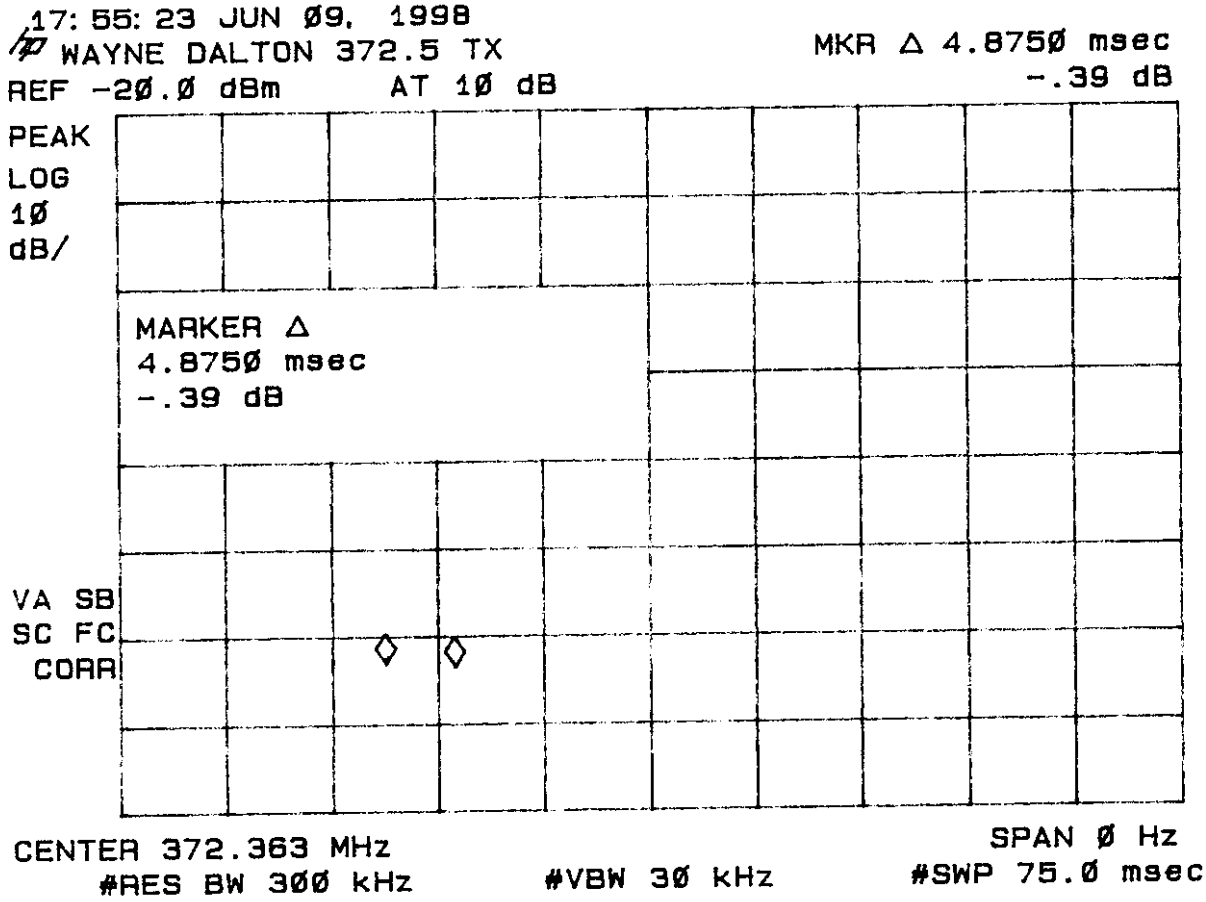


FIGURE 5f

DUTY CYCLE CHARACTERISTICS



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.

TABLE 5a

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 MHz Transmitter

FREQ. (MHz.)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
744.8	-82.8	26.6	347.9	8437.5
1117.13**	-47.2	-8.2	381.8	5000.0
1489.65**	-53.7	-6.2	226.4	5000.0
1861.95	-55.0	-3.5	265.4	8437.5
2234.43**	-51.9	-1.2	492.2	5000.0
2606.55	-54.1	.3	459.9	8437.5
297910	-56.1	.9	387.8	8437.5
3351.68**	-60.7	2.4	275.7	5000.0
3720.90**	-62.4	4.2	275.8	5000.0

** Denotes restricted band of operation

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-82.8 + 26.6 + 107)/20) = 347.9
CONVERSION FROM dBm TO dBuV = 107 dB

Tested By: _____ Name: Erik Collins

TABLE 5b

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 MHz Transmitter

FREQ. (MHz.)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 3m
744.8	-97.2	26.6	66.3	843.8
1117.13**	-61.6	-8.2	72.7	500.0
1489.65**	-68.1	-6.2	43.1	500.0
1861.95	-69.4	-3.5	50.6	843.8
2234.43**	-66.3	-1.2	93.8	500.0
2606.55	-68.5	.3	87.6	843.8
2979.10	-70.5	.9	73.9	843.8
3351.68**	-75.1	2.4	52.5	500.0
3720.90**	-76.8	4.2	52.6	500.0

* Adjusted by duty cycle = 20 log (0.19) =14.4 dB
** Denotes restricted band of operation

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-97.2 + 26.6 + 107)/20) = 66.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tested By: _____ Name: Erik Collins

FIGURE 6a

SPURIOUS EMISSIONS 15.231(b)

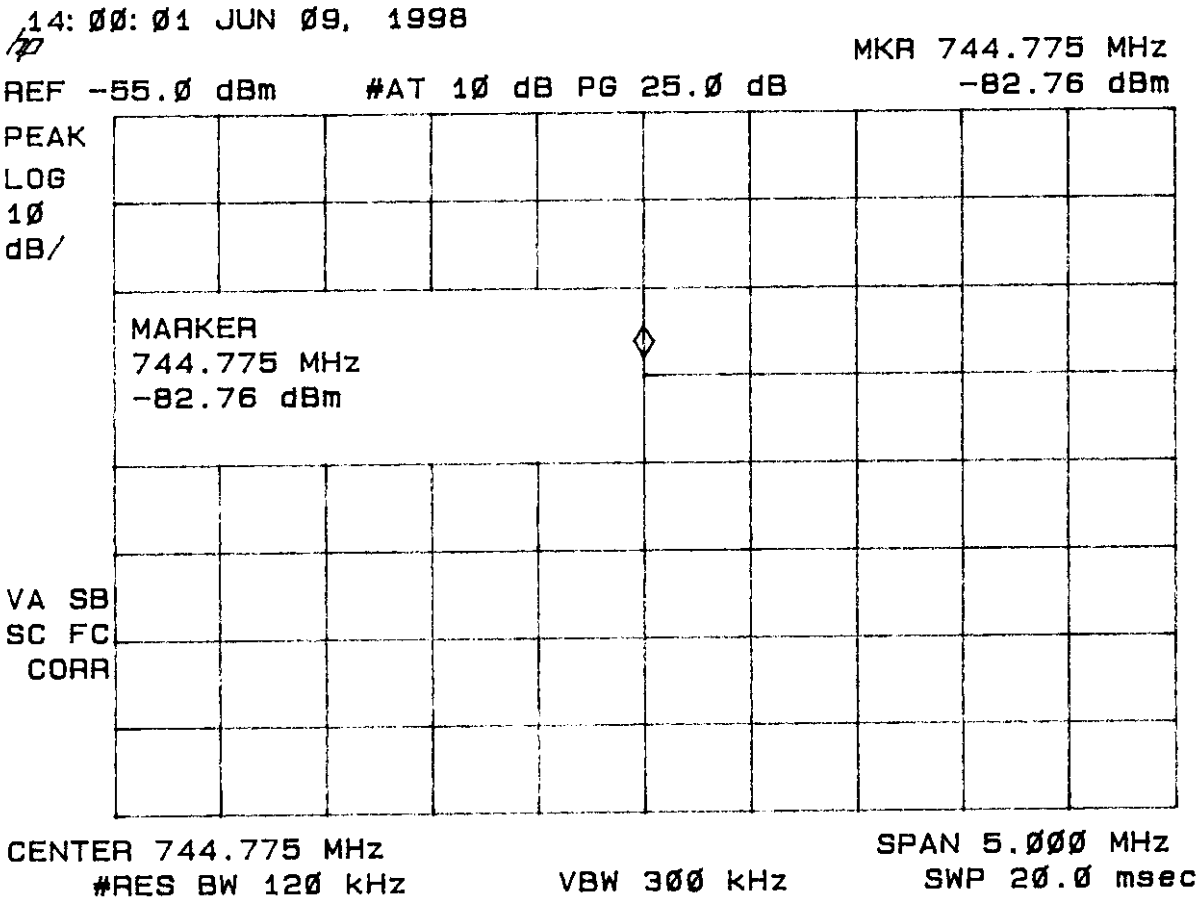


FIGURE 6b

SPURIOUS EMISSIONS 15.231(b)

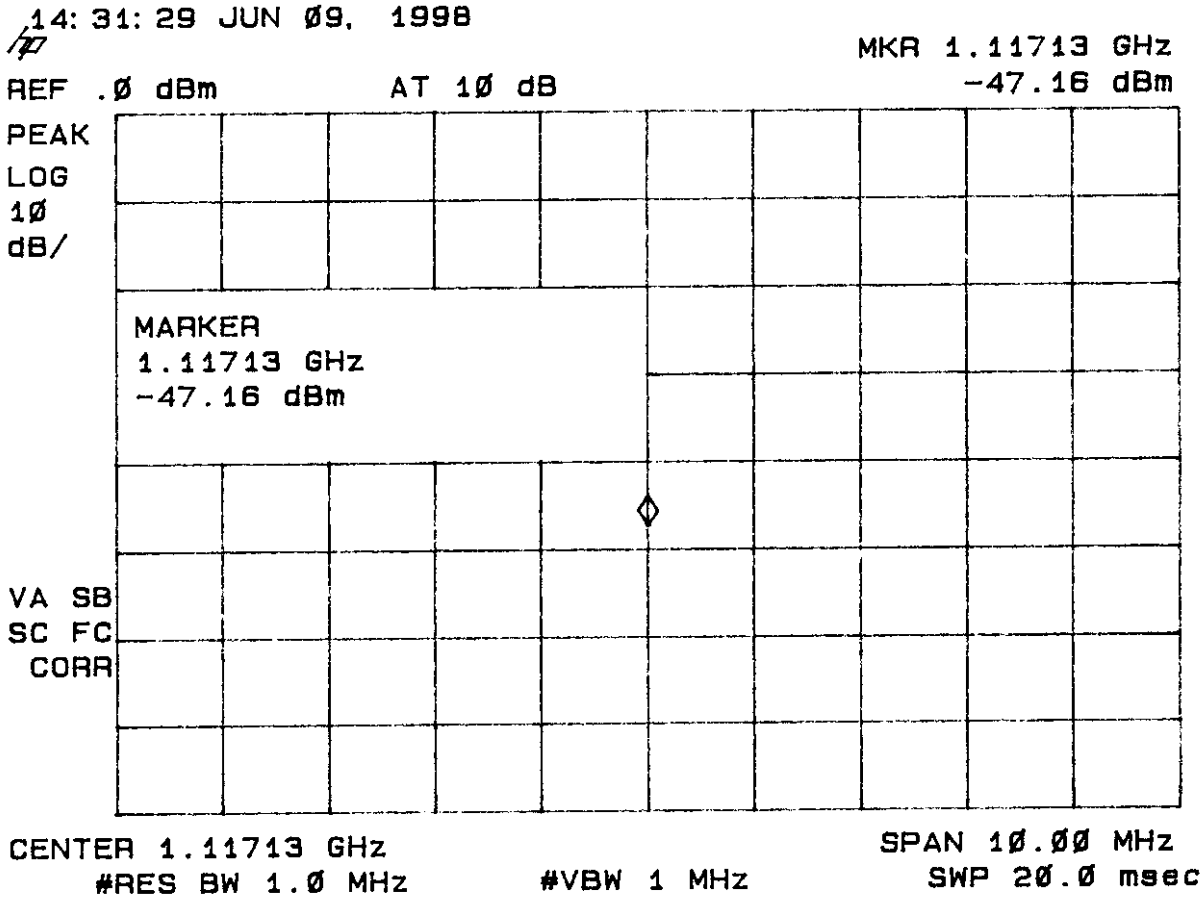


FIGURE 6c

SPURIOUS EMISSIONS 15.231(b)

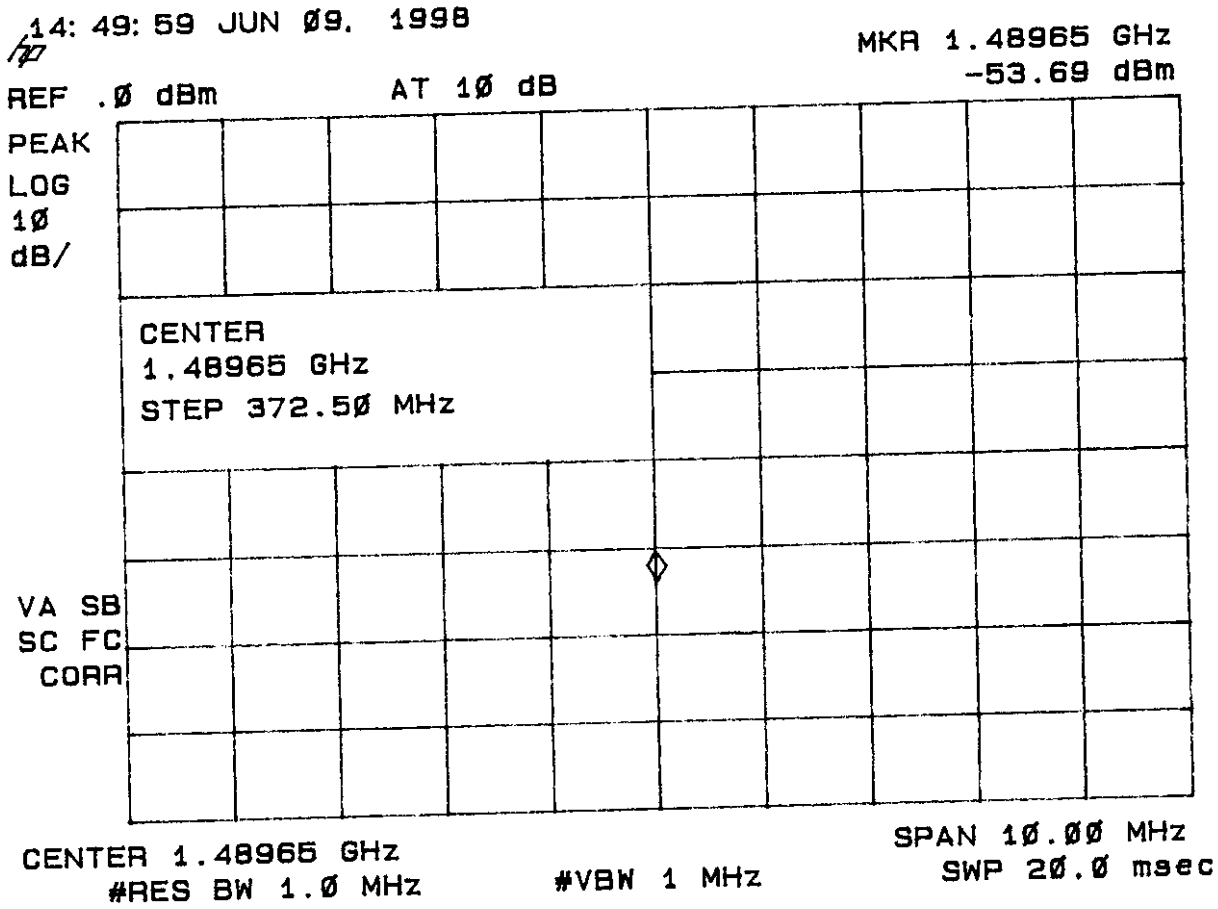


FIGURE 6d

SPURIOUS EMISSIONS 15.231(b)

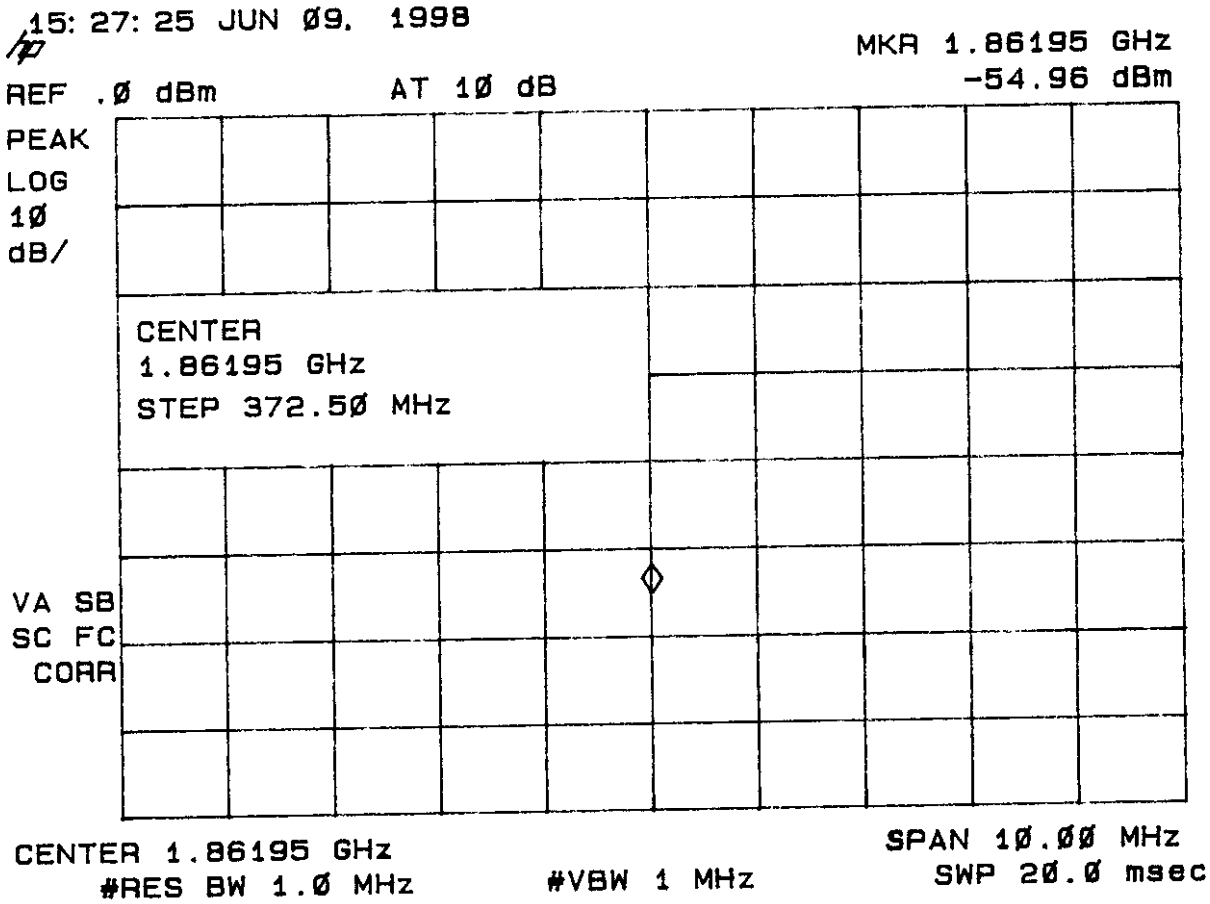


FIGURE 6e

SPURIOUS EMISSIONS 15.231(b)

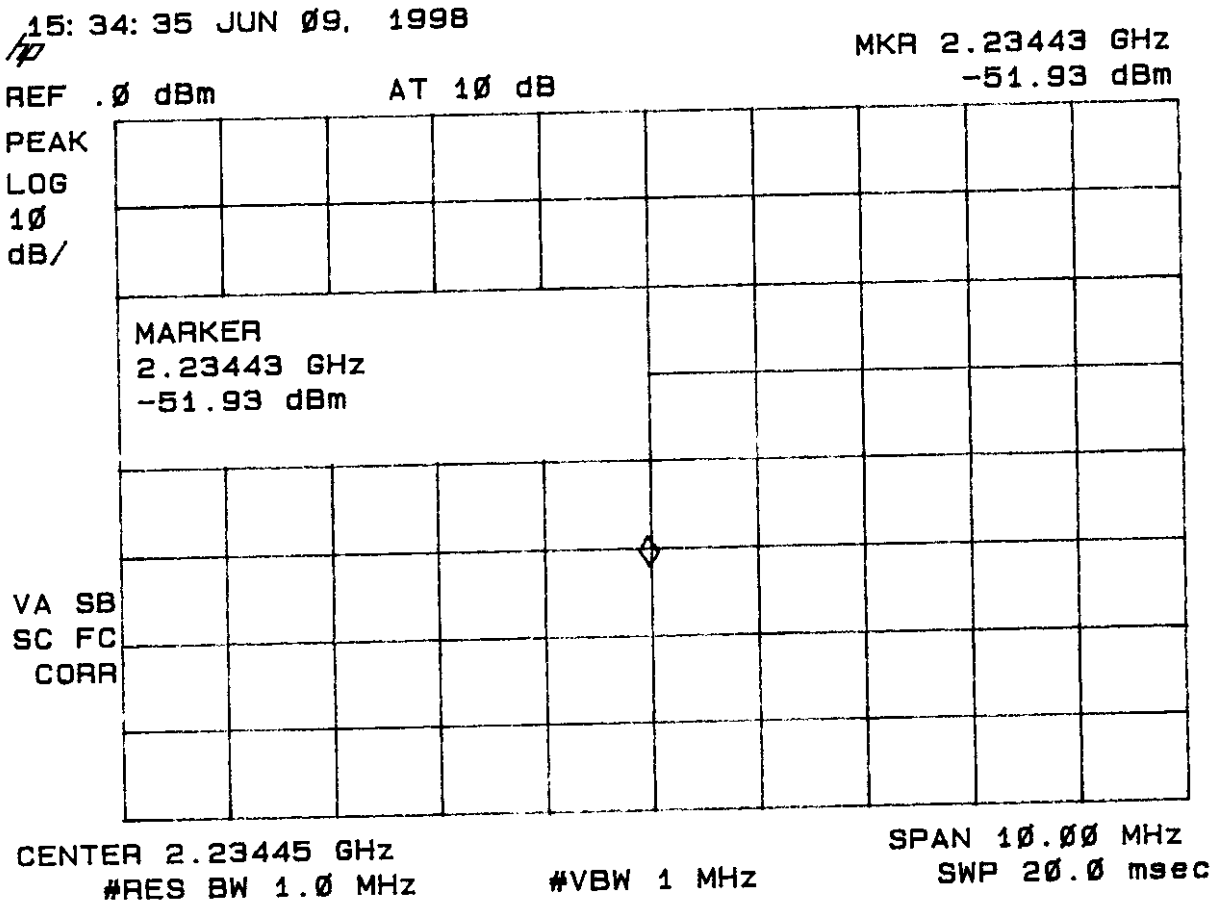


FIGURE 6f

SPURIOUS EMISSIONS 15.231(b)

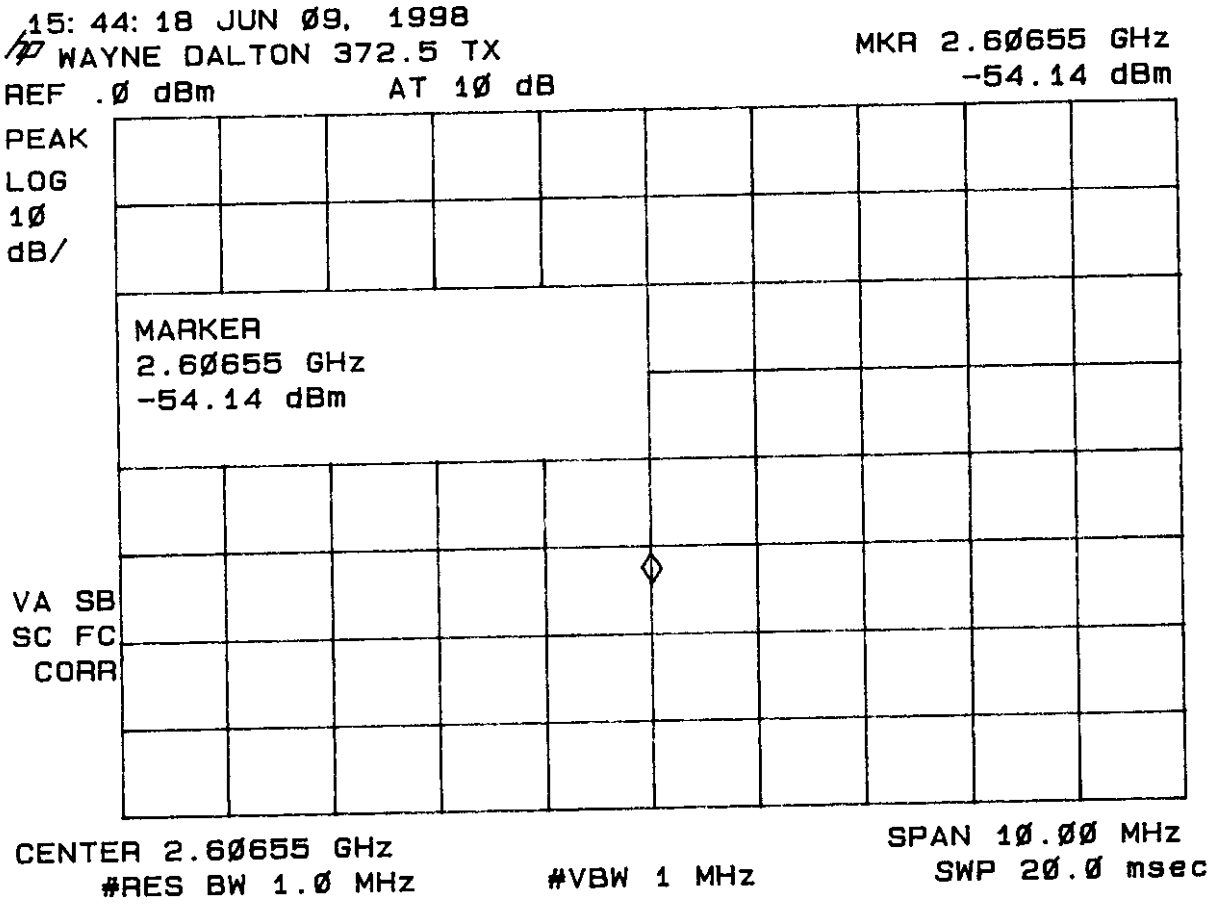


FIGURE 6g

SPURIOUS EMISSIONS 15.231(b)

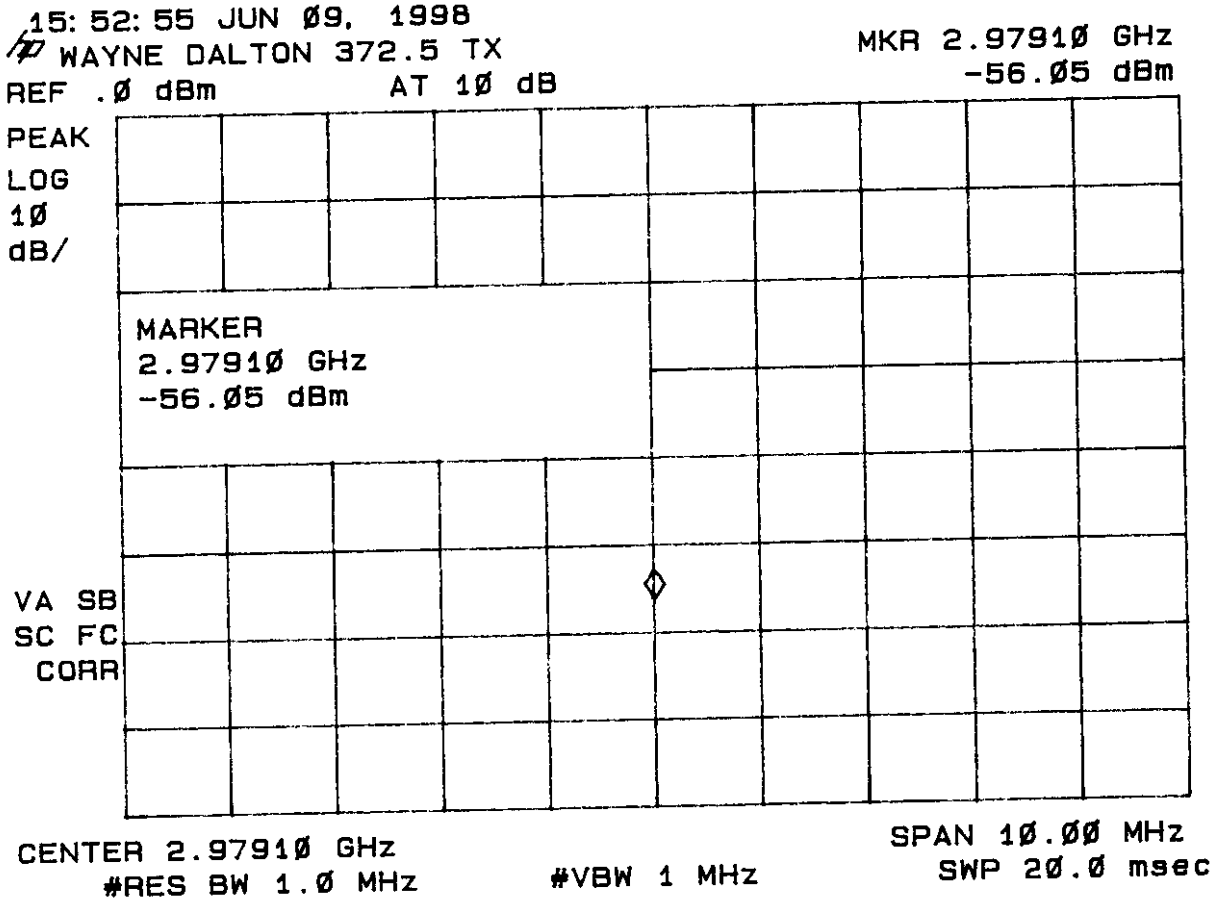


FIGURE 6h

SPURIOUS EMISSIONS 15.231(b)

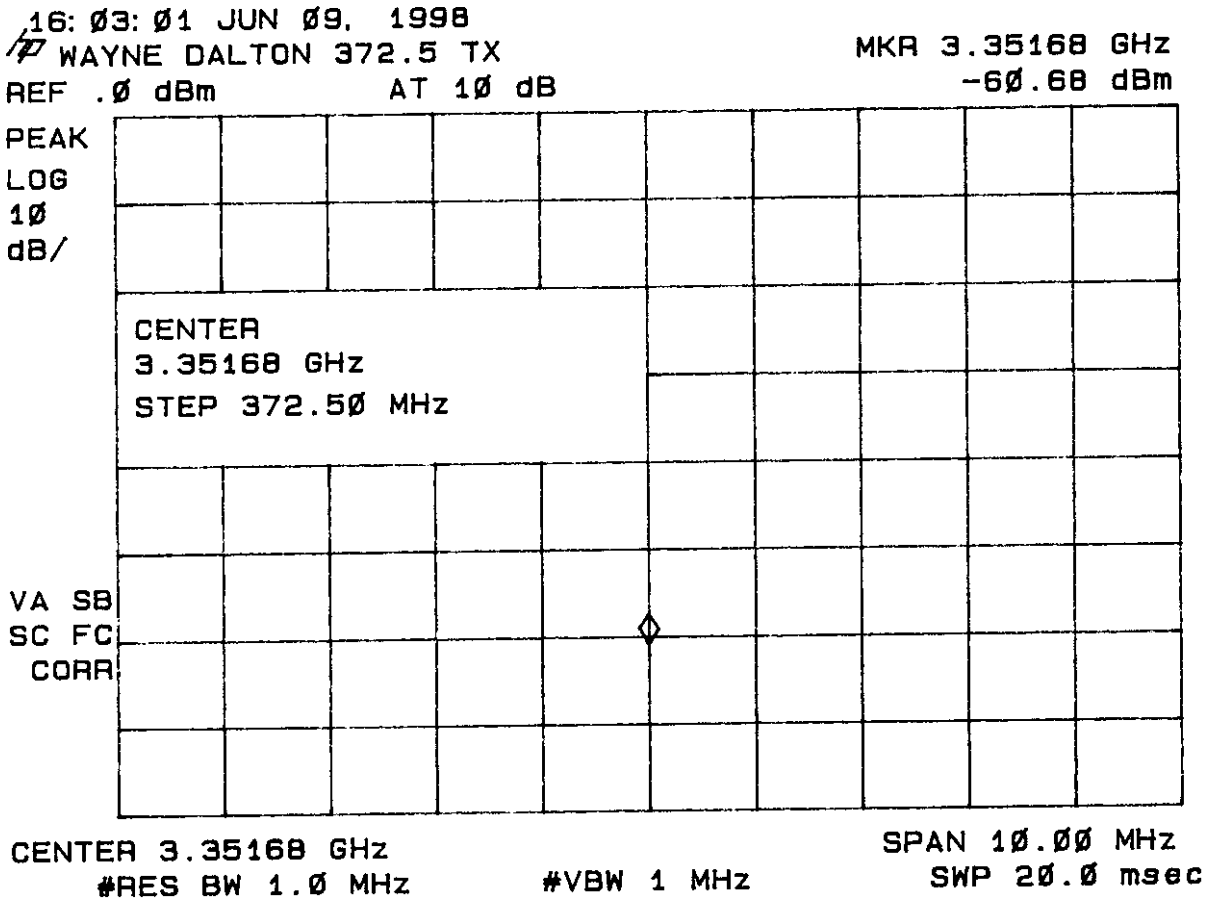
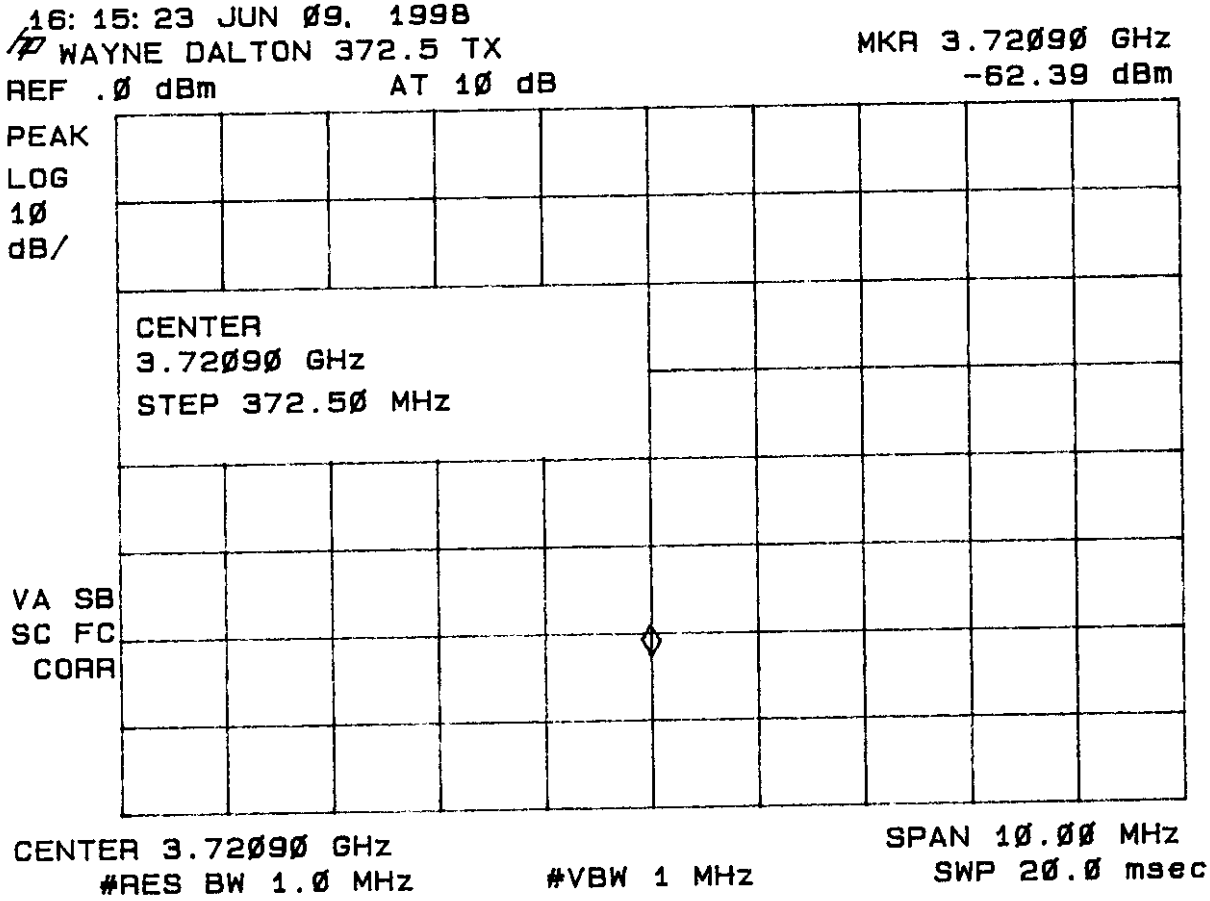


FIGURE 6i

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: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 MHz Transmitter

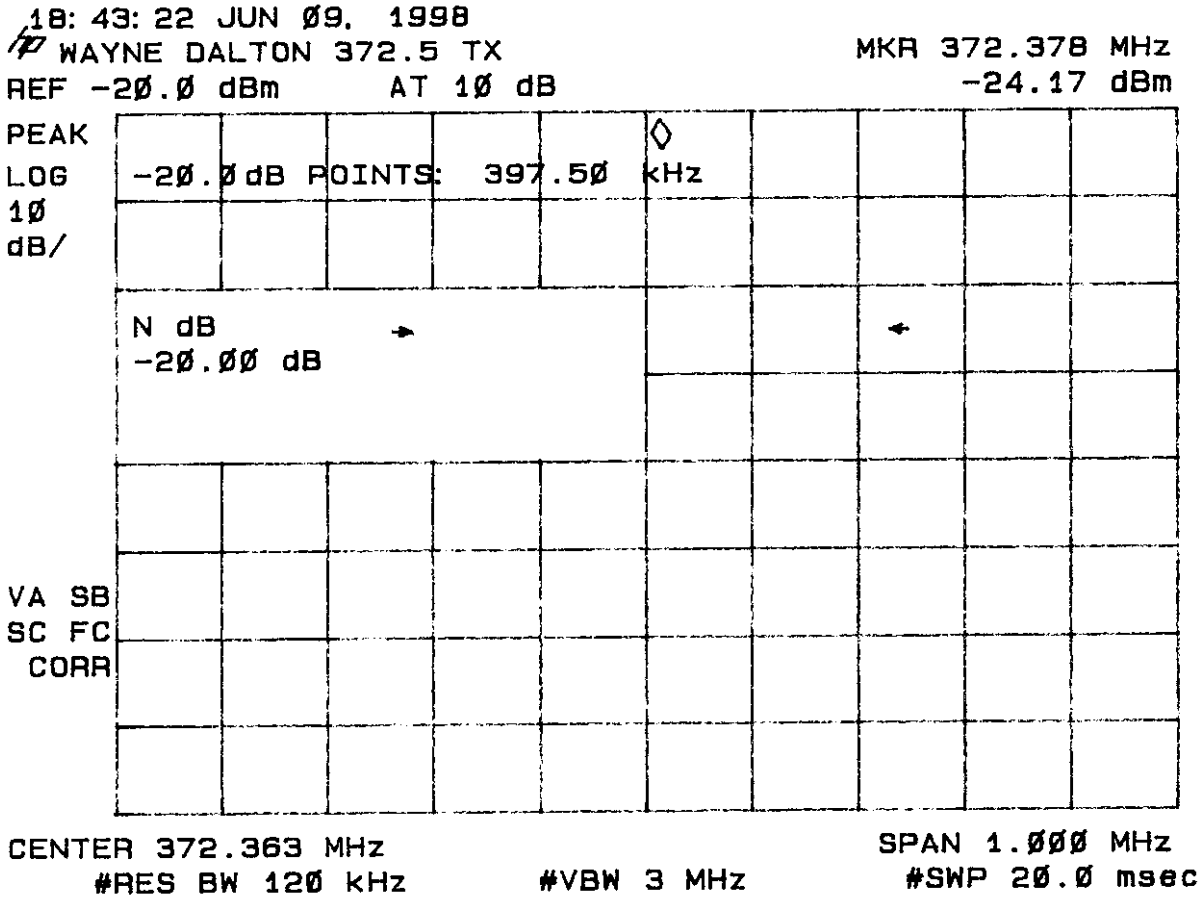
FREQUENCY (MHz)	20 dB BANDWIDTH (KHz)	FCC LIMITS (KHz)
372.5	397.5	931

FCC Limit = (0.25%) (Center Frequency) = (0.0025)(372.5) = 931 KHz

Tested 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: June 9, 1998
UST Project: 98-257
Customer: Wayne Dalton Corporation
Model: Operator 31 372.5 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				

Tested 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.

SECTION 4

BLOCK DIAGRAM(S)

SECTION 5

PHOTOGRAPHS

PHOTOS OF THE TESTED EUT

The following photos are attached:

Photo 1. EUT, Front View

Photo 2. EUT, Rear View

Photo 3. Internal View, Top Side

Photo 4. Internal View, Bottom Side