



QUALIFICATION TEST REPORT

EMISSIONS -FCC Part 15

Test Report Number: ZSI 9902 1701a Date of Issue: 3/23/99
Model No: REMOTE RF Date of Test Article Receipt: 3/2/99
Type of product: Part 15 Intentional Radiator

Manufacturer: Yamaha Corporation of America

Address:

Test Results: ☒ Complies ☐ Does Not Comply

R. Barry Wallen Lab Director

Michael E. Mussler Compliance Engineer

TEST REPORT

Disclaimers:

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Criterion Technology reports apply only to the specific Equipment Under Test (EUT) sample(s) tested under the test conditions described in this report. If the manufacturer intends to use this report as a document demonstrating compliance of this model, additional models of this product must have electrical and mechanical characteristics identical to the device tested for this report. Criterion Technology shall have no liability for any deductions, inferences, or generalizations drawn by the client or others from Criterion Technology issued reports.

Total liability is limited to the amount invoiced for the testing of this EUT and the contents of this report are not warranted.

Compliance with the appropriate governmental standards is the responsibility of the manufacturer. Any questions regarding this report should be directed to:

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Criterion Technology has been accredited by the following groups: NVLAP, VCCI, BCIQ, NMI (EU Competent Body Accreditation) and Industry Canada.

All Criterion Technology instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 9001, ISO Guide 25, ANSI/NCSL Z540-I-1994 and are traceable to national standards.

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Section 1 Executive Summary

The test article was in compliance with all the test standards listed below.

FCC Part 15 Subpart A	General
FCC Part 15 Subpart C	Intentional Radiators, 15.231

All test methods were performed in accordance with the standards listed above.

Section 2 Emissions Test Standards

The emissions tests were performed according to following standards:

FCC Part 15, Subpart C, Paragraph 15.231

Other:

Part 2.1 FCC Part 15 Subpart C –Intentional Radiated Fields

Measurement or *radiated emissions (electric field)* in the frequency range of 30 MHz-1000 MHz were tested in a horizontal and vertical polarization as indicated below:

Environmental conditions in the lab:

Date(s) of Test: mm/dd/yy 3/2/99
 Temperature: 71°F
 Rel. Humidity: 15%
 Test Voltage [] 120 V, 60Hz [X] 9.0 VDC*, Hz

*Battery Powered

Test location:

[X] Criterion Technology Open Area Test Site
 [] Pre-Scan In Semi-Anechoic Chamber
 [] Not applicable

Test distance (antenna - EUT):

[] 1 meter [] Preliminary Measurement [] Final Measurement
 [X] 3 meters [X] Preliminary Measurement [X] Final Measurement, f > 1000 MHz
 [X] 10 meters [X] Preliminary Measurement [X] Final Measurement, f < 1000 MHz
 [] 30 meters [] Preliminary Measurement [] Final Measurement
 [] Not applicable

Test instruments:**Calibration Due Date**

[X] Hewlett Packard Spectrum Analyzer, Model 8566B	7/12/99
[X] Hewlett Packard Quasi Peak Adapter, Model 85650A	12/17/99
[] Hewlett Packard Tracking Generator, Model 85645A	5/22/99
[] Rohde and Schwarz Receiver, Model, ESHS-30	8/26/99
[X] Rohde and Schwarz Model Receiver, ESVS-30	9/1/99
[X] Chase, BiLog Antenna, Model 1121	5/30/99
[X] Antenna Research, Model 1181A (sn: 1056)	4/15/99
[X] Amp3 and High Freq. Cable Set	9/30/99
[X] Mini Circuits Pre-Amp, Amp 2	6/2/99
[] EMCO Loop Antenna, Model 6502	10/7/99
[] Not Applicable	

Test accessories:

[] Other
 [X] Not applicable

Results**Radiated Emissions (Electric Field)**

The requirements are [X] PASS [] FAIL [] N/A

Min. limit margin 0.34 dB at 1315.2150 MHz

Max. limit exceeding dB at MHz

Emission Bandwidth (Re. Part 15, Paragraph 15.231(c))

The requirements are [X] PASS [] FAIL [] N/A

Maximum Bandwidth Permitted: 1.089 MHz, Measured Bandwidth: 20 KHz

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Transmission Duration Following Release of Transmit Switch (Re. Part 15, Paragraph 15.231(a)(1))
The requirements are ☒ PASS ☐ FAIL ☐ N/A

Time Limit: 5 seconds Measured Duration: 0.180 seconds

Remarks: Reference Section 4 for Data Sheets

A CISPR Quasi Peak detector was used for measurements from 30 MHz to 1000 MHz. Measurements below 1000 Mhz were made at a distance of 10 meters from the EUT. Measurements above 1000 MHz were made at a distance of 3 meters from the EUT using an average detector.

The transmitter was set to transmit at three different frequencies for the emissions test. The frequencies selected represented the low, mid and high frequencies within the operating passband of the transmitter.

The limits were calculated from CFR47 Part 15.231(b) and 15.205.

Section 3 Test Setup Photographs







Section 4 Original Test Data / Plots

Radiated Emissions

Part 4.1 Radiated Emissions Data, 30 MHz to 1000 MHz

Criterion Technology

Wed Mar 24 17:19:07 1999

EUT: UHF Transmitter, Serial: 002

Manufacturer: Mfr: Yamaha Corp. of America

Tester: MEM

Special ID: ZSI Q438

EUT Level: Production Level Rev. 2

EUT Information: Battery Powered Transmitter Located on Tabletop with Filter Mods

Test information: Continuous Transmit, 10m, Battery Power, FCC 15.231

Table 1: Scan List, sorted by margin to limit SPCL, -30.0dB filter

<u>Freq, MHz</u>	<u>Value</u>	<u>Sts</u>	<u>SPCL</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Comment</u>
432.3957	63.69	m	-6.62	69	230	H	Transmit, Low Fo
435.6000	63.52	m	-6.90	70	312	H	mid Fo
876.8000	44.27	m	-7.21	77	102	H	2 x high Fo
40.0084	22.22	q	-7.32	269	162	V	.
48.0000	22.12	q	-7.42	269	162	V	12. ck
438.4036	63.00	m	-7.51	71	185	H	high Fo
871.2000	42.24	m	-9.24	44	100	H	2 x Mid. Fo
864.8101	37.99	m	-13.49	318	103	H	2 x Transmit Low
120.0055	10.80	q	-20.68	180	400	H	12. ck
72.0000	10.77	q	-20.71	269	162	V	12. ck
73.8114	10.64	q	-20.84	269	162	V	amb?

Table 2: Scan List for SPCL, sorted by Frequency, -30.0dB filter

<u>Freq, MHz</u>	<u>Value</u>	<u>Sts</u>	<u>SPCL</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Comment</u>
40.0084	22.22	q	-7.32	269	162	V	.
48.0000	22.12	q	-7.42	269	162	V	12. ck
72.0000	10.77	q	-20.71	269	162	V	12. ck
73.8114	10.64	q	-20.84	269	162	V	amb?
120.0055	10.80	q	-20.68	180	400	H	12. ck
432.3957	63.69	m	-6.62	69	230	H	Transmit, Low Fo
435.6000	63.52	m	-6.90	70	312	H	mid Fo
438.4036	63.00	m	-7.51	71	185	H	high Fo
864.8101	37.99	m	-13.49	318	103	H	2 x Transmit Low
871.2000	42.24	m	-9.24	44	100	H	2 x Mid. Fo
876.8000	44.27	m	-7.21	77	102	H	2 x high Fo

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Table 3: Complete Scan List Sorted by Frequency

Freq, MHz	I-val	Final	Sts	TT	Hght	Az	Time	Comment
40.0084	31.89	22.22	q	269	162	V	Tue Mar 02 21:14:49 1999	.
48.0000	36.01	22.12	q	269	162	V	Tue Mar 02 21:14:51 1999	12. ck
72.0000	27.10	10.77	q	269	162	V	Tue Mar 02 21:14:56 1999	12. ck
73.8114	26.89	10.64	q	269	162	V	Tue Mar 02 21:14:58 1999	amb?
120.0055	21.73	10.80	q	180	400	H	Tue Mar 02 21:10:07 1999	12. ck
432.3957	68.53	63.69	m	69	230	H	Tue Mar 02 21:33:32 1999	Transmit, Low Fo
435.6000	68.27	63.52	m	70	312	H	Tue Mar 02 21:44:14 1999	mid Fo
438.4036	67.66	63.00	m	71	185	H	Tue Mar 02 21:21:43 1999	high Fo
864.8101	36.42	37.99	m	318	103	H	Tue Mar 02 21:38:38 1999	2 x Transmit Low
871.2000	40.68	42.24	m	44	100	H	Tue Mar 02 21:50:19 1999	2 x Mid. Fo
876.8000	42.70	44.27	m	77	102	H	Tue Mar 02 21:27:16 1999	2 x high Fo

Part 4.2 Radiated Emissions Data, 1000 MHz to 5000 MHz

Criterion Technology

Tue Mar 02 20:16:10 1999

EUT: UHF Transmitter, Serial No.: 002

Manufacturer: Yamaha Corp. of America, with added filtering

Tester: MEM

Special ID: ZSI Q437

EUT Level: Production Level Rev. 2

EUT Information: Battery Powered Transmitter located on Tabletop

Test information: Normal Operation except Continuous Transmit, 3m, Battery Pwr., FCC 15.231

Table 4: Scan List, sorted by margin to limit SPCL, -15.0dB filter

<u>Freq. MHz</u>	<u>Value</u>	<u>Sts</u>	<u>SPCL</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Comment</u>
1315.2150	61.60	m	-0.34	297	100	V	3 fo high
1297.1913	60.91	m	-1.03	262	100	V	3 fo low
1306.8240	58.98	m	-2.96	230	101	V	3 fo mid
2192.0251	58.58	m	-3.36	71	123	V	5 fo high
1753.6311	55.67	m	-6.27	169	109	V	4 fo high
2162.0270	55.63	m	-6.31	73	118	V	5 fo low
2178.0171	55.16	m	-6.78	120	114	V	5 fo mid
3068.8371	54.46	m	-7.48	298	141	V	7 fo high
1742.4231	53.90	m	-8.04	156	111	V	4 fo mid
1729.6202	51.15	m	-10.79	158	100	V	4 fo low
3049.2381	50.57	m	-11.37	298	144	V	7 fo mid
2630.4371	50.00	m	-11.94	202	104	H	6 fo high
2613.6441	49.28	m	-12.66	15	117	H	6 fo mid
4384.0599	49.21	m	-12.73	333	112	V	10 fo high
4356.0539	49.19	m	-12.75	334	112	V	10 fo mid
3507.2491	49.05	m	-12.89	66	102	V	8 fo high
3484.8411	48.94	m	-13.00	67	124	V	8 fo mid
3459.2336	47.68	m	-14.26	64	125	V	8 fo high
4324.0510	47.59	m	-14.35	335	111	V	10 fo low
2594.4330	47.13	m	-14.81	23	124	H	6 fo low
3920.4501	47.03	m	-14.91	296	107	V	9 fo mid

Table 5: Scan List for SPCL, sorted by Frequency, -15.0dB filter

<u>Freq. MHz</u>	<u>Value</u>	<u>Sts</u>	<u>SPCL</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Comment</u>
1297.1913	60.91	m	-1.03	262	100	V	3 fo low
1306.8240	58.98	m	-2.96	230	101	V	3 fo mid
1315.2150	61.60	m	-0.34	297	100	V	3 fo high

Table 5: Scan List for SPCL, sorted by Frequency, -15.0dB filter

<u>Freq, MHz</u>	<u>Value</u>	<u>Sts</u>	<u>SPCL</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Comment</u>
1729.6202	51.15	m	-10.79	158	100	V	4 fo low
1742.4231	53.90	m	-8.04	156	111	V	4 fo mid
1753.6311	55.67	m	-6.27	169	109	V	4 fo high
2162.0270	55.63	m	-6.31	73	118	V	5 fo low
2178.0171	55.16	m	-6.78	120	114	V	5 fo mid
2192.0251	58.58	m	-3.36	71	123	V	5 fo high
2594.4330	47.13	m	-14.81	23	124	H	6 fo low
2613.6441	49.28	m	-12.66	15	117	H	6 fo mid
2630.4371	50.00	m	-11.94	202	104	H	6 fo high
3049.2381	50.57	m	-11.37	298	144	V	7 fo mid
3068.8371	54.46	m	-7.48	298	141	V	7 fo high
3459.2336	47.68	m	-14.26	64	125	V	8 fo high
3484.8411	48.94	m	-13.00	67	124	V	8 fo mid
3507.2491	49.05	m	-12.89	66	102	V	8 fo high
3920.4501	47.03	m	-14.91	296	107	V	9 fo mid
4324.0510	47.59	m	-14.35	335	111	V	10 fo low
4356.0539	49.19	m	-12.75	334	112	V	10 fo mid
4384.0599	49.21	m	-12.73	333	112	V	10 fo high

Table 6: Complete Scan List Sorted by Frequency

<u>Freq, MHz</u>	<u>I-val</u>	<u>Final</u>	<u>Sts</u>	<u>TT</u>	<u>Hght</u>	<u>Az</u>	<u>Time</u>	<u>Comment</u>
1297.1913	74.87	60.91	m	262	100	V	Tue Mar 02 17:26:16 1999	3 fo low
1306.8240	72.84	58.98	m	230	101	V	Tue Mar 02 18:05:01 1999	3 fo mid
1315.2150	75.38	61.60	m	297	100	V	Tue Mar 02 18:35:55 1999	3 fo high
1729.6202	61.21	51.15	m	158	100	V	Tue Mar 02 17:31:35 1999	4 fo low
1742.4231	63.84	53.90	m	156	111	V	Tue Mar 02 18:06:48 1999	4 fo mid
1753.6311	65.50	55.67	m	169	109	V	Tue Mar 02 18:41:20 1999	4 fo high
2162.0270	56.28	55.63	m	73	118	V	Tue Mar 02 17:35:52 1999	5 fo low
2178.0171	56.62	55.16	m	120	114	V	Tue Mar 02 18:10:34 1999	5 fo mid
2192.0251	60.76	58.58	m	71	123	V	Tue Mar 02 18:44:41 1999	5 fo high
2594.4330	52.68	47.13	m	23	124	H	Tue Mar 02 17:40:00 1999	6 fo low
2613.6441	54.75	49.28	m	15	117	H	Tue Mar 02 18:13:10 1999	6 fo mid
2630.4371	55.43	50.00	m	202	104	H	Tue Mar 02 18:50:45 1999	6 fo high
3026.8360	46.69	41.95	m	16	120	V	Tue Mar 02 17:43:47 1999	7 fo low
3049.2381	55.28	50.57	m	298	144	V	Tue Mar 02 18:15:56 1999	7 fo mid
3068.8371	59.15	54.46	m	298	141	V	Tue Mar 02 18:53:55 1999	7 fo high
3459.2336	52.32	47.68	m	64	125	V	Tue Mar 02 17:47:46 1999	8 fo high
3484.8411	53.52	48.94	m	67	124	V	Tue Mar 02 18:19:31 1999	8 fo mid
3507.2491	53.57	49.05	m	66	102	V	Tue Mar 02 18:56:15 1999	8 fo high
3891.6480	48.34	45.01	m	306	108	V	Tue Mar 02 17:53:29 1999	9 fo low
3920.4501	50.34	47.03	m	296	107	V	Tue Mar 02 18:23:42 1999	9 fo mid
3945.6491	47.32	44.11	m	291	126	V	Tue Mar 02 18:58:42 1999	9 fo high

TEST REPORT

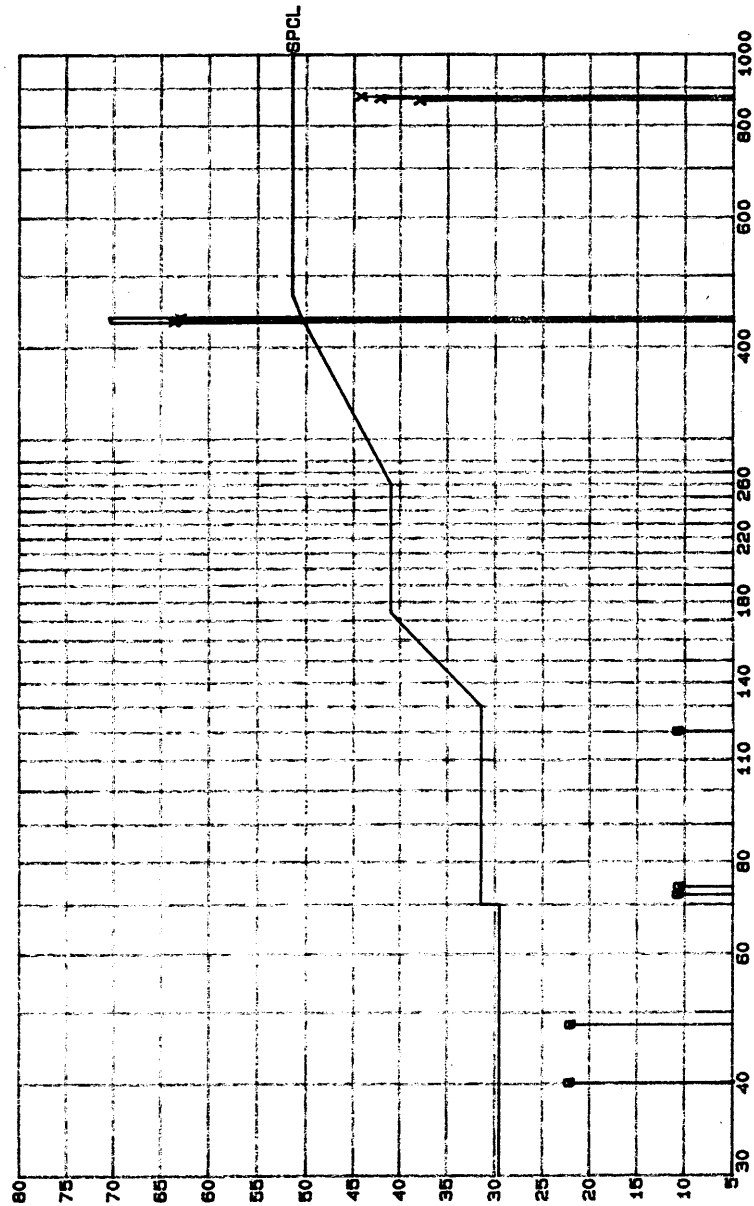
Table 6: Complete Scan List Sorted by Frequency

Freq, MHz	I-val	Final	Sts	TT	Hght	Az	Time	Comment
4324.0510	48.92	47.59	m	335	111	V	Tue Mar 02 17:59:00 1999	10 fo low
4356.0539	50.39	49.19	m	334	112	V	Tue Mar 02 18:28:53 1999	10 fo mid
4384.0599	50.27	49.21	m	333	112	V	Tue Mar 02 19:01:50 1999	10 fo high

Part 4.3 Radiated Emissions Plot, 30 MHz to 1000 MHz

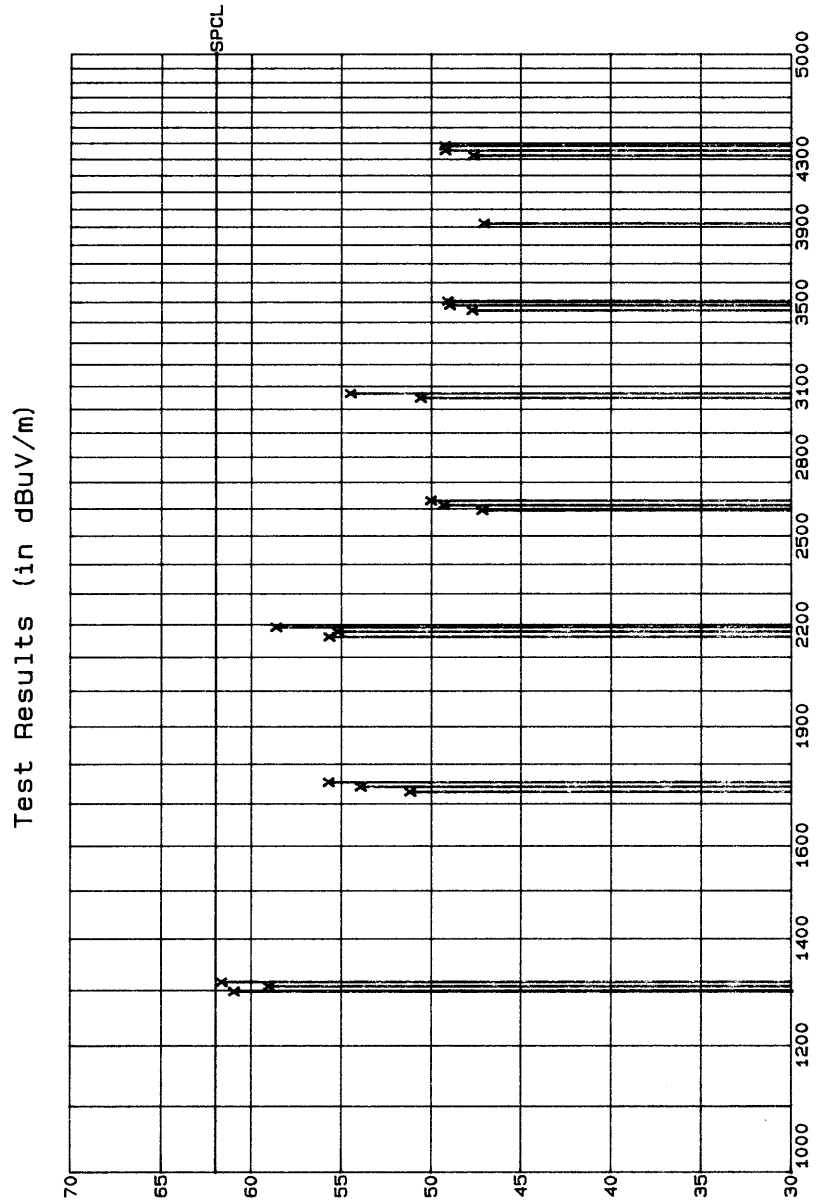
Intelliistor OATS
 Date: Wed Mar 24 17:18:49 1999
 EUT: UHF Transmitter, Serial: 002
 Manufacturer: Mfgr: Yamaha Corp. of America
 Tester: MEM SPID: ZSI Q438
 EUT Level: Production Level Rev. 2
 EUT Information: Battery Powered Transmitter Located on Tabletop with Filter Mode
 Test Information: Continuous Transmit, 10m, Battery Power, FCC 15.231

Test Results (in dBuV/m)

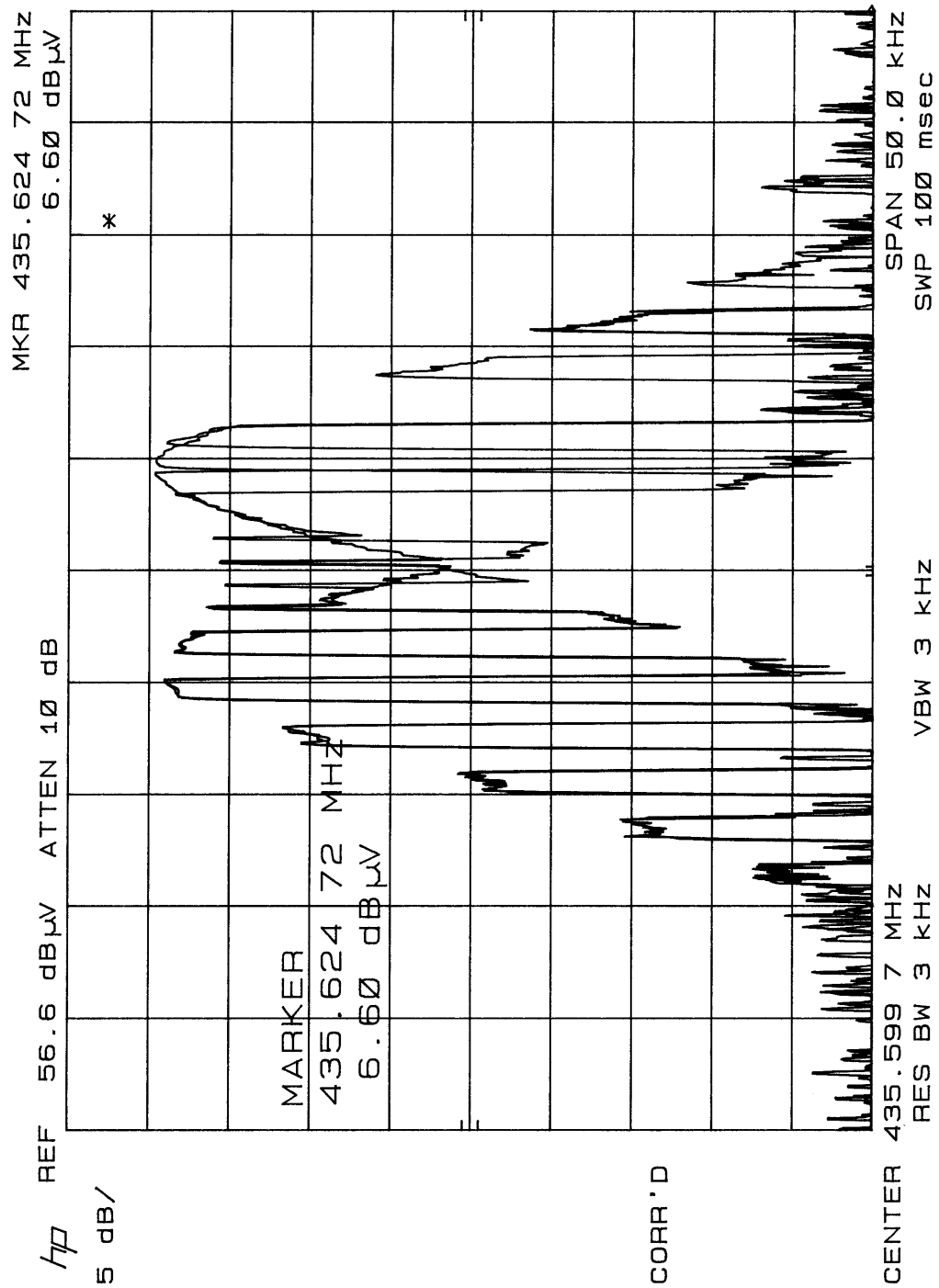


Part 4.4 Radiated Emissions Plot, 1000 MHz to 5000 MHz

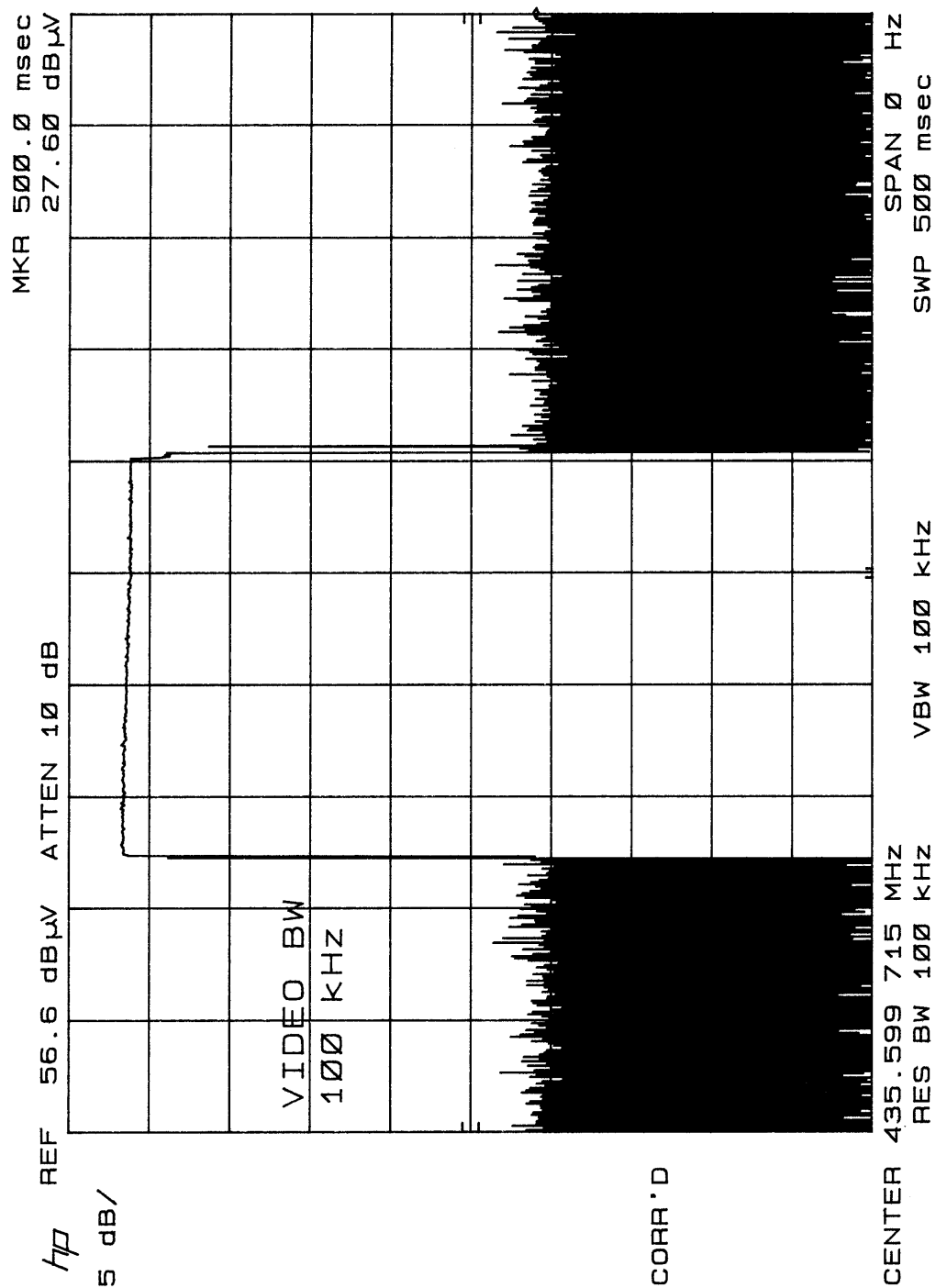
Intellistor OATS
Date: Tue Mar 02 20:15:54 1999
EUT: UHF Transmitter, Serial No.: 002
Manufacturer: Yamaha Corp. of America, with added filtering
Tester: MEM SPiD: ZSI Q437
EUT Level: Production Level Rev. 2
EUT Information: Battery Powered Transmitter located on Tabletop
Test Information: Normal Operation except Continuous Transmit, 3m, Battery Pwr., FCC 15.231



Part 4.5 Emission Bandwidth Plot, 435.6 MHz



Part 4.6 Transmission Duration Plot



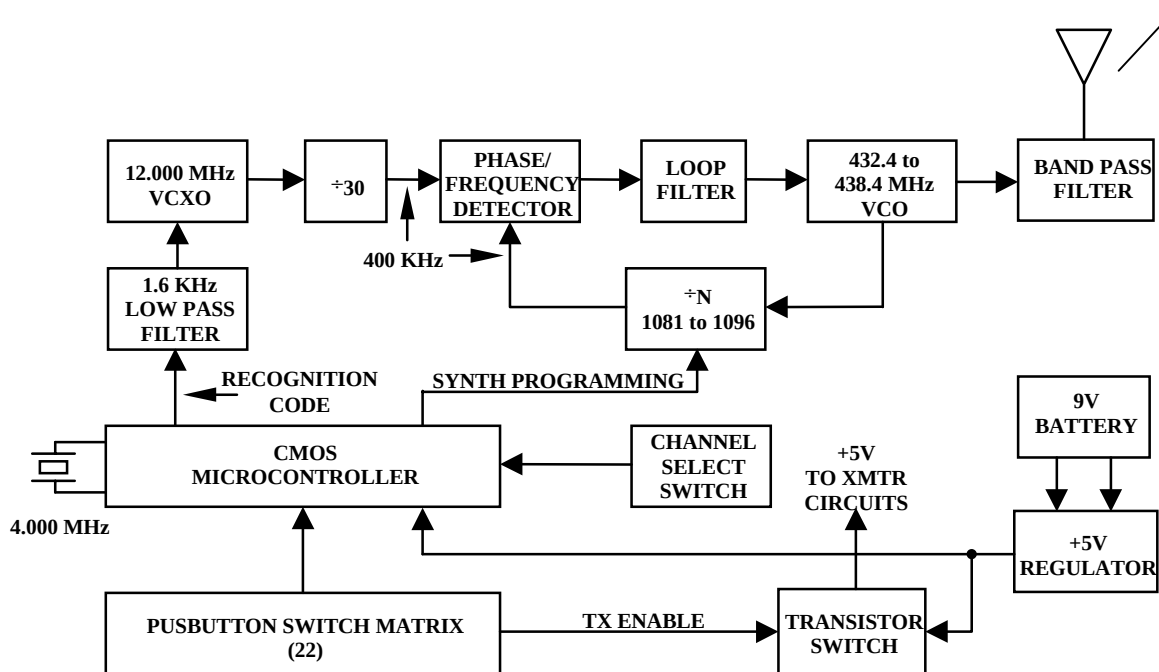
Section 5 Product Information Forms

Remote RF Transmitter Circuit Description

The Remote RF Transmitter operates on one of sixteen (16) switch selectable carrier frequencies in the range of 432.4 to 438.4 MHz. The RF carrier is produced using a digital phase-locked loop (PLL) with the voltage controlled oscillator (VCO) operating at the desired RF carrier frequency. An L/C bandpass filter couples the carrier output from the VCO to the antenna and suppresses harmonics. The antenna consists of a five inch length of insulated 24 AWG wire permanently soldered onto the circuit board. It remains out of sight, within the plastic transmitter case.

The 400 KHz PLL reference frequency is derived from a 12.000 MHz voltage controlled crystal oscillator (VCXO) using a $\div 30$ frequency counter. Binary frequency shift keying (FSK) modulation is impressed on the carrier using direct FM modulation of the VCXO by the recognition code, nominally at 244 bits/sec. The code signal passes through a 1.6 KHz lowpass filter before modulating the VCXO. After multiplication in the PLL, the FM deviation produced at the transmitter output is ± 6 KHz.

A CMOS microcontroller I.C. operating from a 4.000 MHz crystal, generates the recognition code. Normally it operates in a "sleep" mode, shutting down the entire transmitter, including all oscillators, by interrupting the output of the +5 v.d.c. linear regulator. Input power is provided from the internal 9V battery. When any one of the twenty-two (22) front-panel pushbutton switches is pressed, the microcontroller "wakes up", reads the setting of the channel selection switch, and initiates transmission on the selected channel. At the end of the transmission, which lasts for approximately 200 mS, the transmitter shuts down and can only be re-activated by the next pushbutton press.



TRANSMITTER BLOCK DIAGRAM

CRITERION PRODUCT INFORMATION FORMDate: March 26, 1999

General Instrument Information:

Model/s: REMOTE RF (Transmitter)Serial Number: E002

Customer Contacts:

Compliance Eng. Stan ZubiellDesign Engineer: Stan Zubiell

Test Facility

Name: Criterion TechnologyLocation: Rollinsville, Colorado 80474**TEST DESCRIPTION:**

☐ Development	☐ Initial Design Verification
☐ Design Change	☒ Production Model

CIRCUIT BOARDOscillator Frequencies: 432.4 to 438.4 MHz frequency synthesized, 12.000 MHz crystal

Oscillator Manufacturer/s:

Clock Frequency: 4.000 MHz crystal

Other: _____

POWERPower Supply Topology: Battery, alkaline

Switching Frequency: _____

Power supply Primary Frequency and Voltage: DC 9VNumber of Input Phases: Current Draw: 40 mAManufacturer: Duracell, Union CarbideModel Number: NEDA 1604A