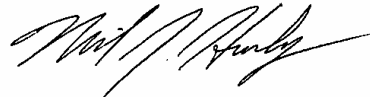




Measurement of RF Interference from a Model TCU1P03_M1202D In-Vehicle Bluetooth Module Transmitter

For : Motorola TCG
21440 W. Lake Cook Rd
Deer Park, IL 60010

P.O. No. : NP1385823
Date Received : September 9, 2004
Date Tested : September 9 and 10, 2004
Test Personnel : Mark E. Longinotti
Specification : FCC "Code of Federal Regulations" Title 47 Part 15,
Subpart C, Section 15.247 for Frequency Hopping
Spread Spectrum Intentional Radiators Operating within
the 2400-2483.5MHz band.

Test Report By : 
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ATL-0149-E

Approved By : 
Raymond J. Klouda
Registered Professional Engineer of
Illinois - 44894

TABLE OF CONTENTS

<u>PARAGRAPH NO.</u>	<u>DESCRIPTION OF CONTENTS</u>	<u>PAGE</u>
1.0	INTRODUCTION.....	3
1.1	Description of Test Item.....	3
1.2	Purpose.....	3
1.3	Deviations, Additions and Exclusions	3
1.4	Applicable Documents.....	3
1.5	Subcontractor Identification.....	3
1.6	Laboratory Conditions.....	3
2.0	TEST ITEM SETUP AND OPERATION	4
2.1	Power Input.....	4
2.2	Grounding.....	4
2.3	Peripheral Equipment.....	4
2.4	Interconnect Cables.....	4
2.5	Operational Mode.....	4
3.0	TEST EQUIPMENT.....	4
3.1	Test Equipment List.....	4
3.2	Calibration Traceability	4
4.0	REQUIREMENTS, PROCEDURES AND RESULTS.....	4
4.1	Powerline Conducted Emissions	4
4.2	Carrier Frequency Separation.....	5
4.3	Number of Hopping Frequencies	5
4.4	Time of Occupancy.....	6
4.5	20dB Bandwidth.....	6
4.6	Peak Output Power.....	7
4.7	Bandedge Compliance	7
4.8	Spurious Emissions	8
4.8.1	Antenna Conducted.....	8
4.8.2	Radiated Spurious Emissions	8
4.9	Spectral Density.....	9
5.0	CONCLUSIONS.....	10
6.0	CERTIFICATION.....	10
7.0	ENDORSEMENT DISCLAIMER.....	10
	TABLE I - EQUIPMENT LIST.....	11

Measurement of RF Interference from a Model TCU1P03_M1202D In-Vehicle Bluetooth Module Transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on an In-Vehicle Bluetooth Module, Model No.TCU1P03_M1202D, Serial No.07187699 spread spectrum transmitter, (hereinafter referred to as the test item). The test item is a frequency hopping spread spectrum transceiver used in vehicle bluetooth applications. It transmits in the 2400 to 2483.5MHz band and uses an external flat panel antenna. The test item was manufactured and submitted for testing by Motorola TCG located in Deer Park, IL.

1.2 Purpose - The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.247 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2001.

1.3 Deviations, Additions and Exclusions - There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 Applicable Documents - The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2003
- FCC Public Notice, DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", Released March 30, 2000
- ANSI C63.4-2001, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

1.5 Subcontractor Identification - This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 Laboratory Conditions - The temperature at the time of the test was 21°C and the relative humidity was 55%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is an In-Vehicle Bluetooth Module, Part No.TCU1P03_M1202D. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item obtained 5 VDC power through two leads from a BK Precision Model 1670 power supply. The power supply received 115V 60Hz power through lowpass powerline filters on the wall of the shielded enclosure. The leads from the power supply to the test item were approximately 6 inches long.

2.2 Grounding - Since only two wires were used to provide the input power, the test item was ungrounded during the tests.

2.3 Support Equipment - The following support equipment was submitted with the test item:

Item	Description
Flat Panel Antenna	S/N 07187699

2.4 Interconnect Cables - The following interconnect cables were submitted with the test item:

Item	Description
Antenna Cable	43cm long
RS232 Cable	Used for programming only - Unterminated for radiated tests and connected to computer during conducted tests

2.5 Operational Mode - The test item and all support equipment was placed on an 80cm high non-conductive stand. The test item and all support equipment were energized. The test item was set to transmit at frequencies of 2402MHz, 2441MHz and 2480MHz.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 Calibration Traceability - Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

4.1.1 Requirements – This requirement is not applicable since the test item receives 5VDC from the vehicle's power supply. There are no operational modes where the transmitter can be connected to the AC power public utilities. Therefore, the conducted emissions measurements are not required.

4.2 Carrier Frequency Separation

4.2.1 Requirements - Per section 15.247 (a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

4.2.2 Procedures - The test item was setup inside the chamber. The output of the test item was connected to the spectrum analyzer through a 30dB pad. With the hopping function enabled, the test item was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to $\geq$ to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the peaks of at least two adjacent channels.

When the trace had stabilized after multiple scans, the marker-delta function was used to determine the separation between the peaks of the adjacent channels. The analyzer's display was plotted using a 'screen dump' utility.

4.2.3 Results - Page 15 shows the carrier frequency separation. As can be seen from this plot, the separation is 991.9 kHz which is greater than the 20dB bandwidth (836.7kHz).

4.3 Number of Hopping Frequencies

4.3.1 Requirements - Per section 15.247(a)(1)(iii), for frequency hopping systems operating in the 2400-2483.5MHz band, the frequency hopping systems shall use at least 15 non-overlapping channels.

4.3.2 Procedures - The test item was setup inside the chamber. The output of the test item was connected to the spectrum analyzer through a 30dB pad. With the hopping function enabled, the test item was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to $\geq$ to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the entire frequency band of operation.

The test item's signal was allowed to stabilize after multiple scans. The number of hopping frequencies was counted. The analyzer's display was plotted using a 'screen dump' utility.

4.3.3 Results - Page 16 shows the number of hopping frequencies. As can be seen from this plot, the number of frequencies is 79 which is greater than the minimum required.

4.4 Time of Occupancy

4.4.1 Requirement - Per section 15.247(a)(1)(iii), for frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy shall not be greater than 0.4 seconds within a 0.4 second period multiplied by the number of hopping channels employed.

4.4.2 Procedures - The test item was setup inside the chamber. The output of the test item was connected to the spectrum analyzer. With the hopping function enabled, the test item was allowed to transmit

continuously.

The resolution bandwidth (RBW) was set to 1 MHz. The peak detector and 'Max-Hold' function were engaged. With the span set to 0Hz, the sweep time was adjusted to capture a single event in order to measure the dwell time per hop. Then, the sweep time was expanded to capture the average time between hops. When the trace had stabilized after multiple scans, the time between hops was measured. The analyzer's display was plotted using a 'screen dump' utility.

The dwell time in a 31.6 second period was then calculated from dwell time per hop divided by time between hops then multiplied by 31.6 seconds.

4.4.3 Results - Pages 17 and 18 show the plots for the time of occupancy (dwell time). As can be seen from the plots, the time of occupancy can be determined by a 400usec burst every 99.2msec multiplied by a 31.6 second period. This calculated value is equal to 0.1274 seconds which is less than the 0.4 seconds allowed.

4.5 20dB Bandwidth

4.5.1 Requirement - Per section 15.247(a)(1)(iii), for frequency hopping systems operating in the 2400-2483.5MHz band, the 20dB bandwidth shall be measured for determination of the carrier frequency separation limits.

4.5.2 Procedures - The test item was setup inside the chamber. The output of the test item was connected to the spectrum analyzer through a 30dB pad. With the hopping function disabled, the test item was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to $\geq$ to 1% of the 20 dB BW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

4.5.3 Results - The plots on pages 19 through 21 show that the maximum 20 dB bandwidth was 836.7kHz.

4.6 Peak Output Power

4.6.1 Requirement - Per section 15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5MHz band and employing at least 75 hopping channels. The peak output power shall not be greater than 1 watt.

Per section 15.247(4), the peak output power from an intentional radiator if the transmitting antenna(s) have a directional gain greater than 6dBi shall be reduced below by the amount in dB that the directional gain of the antenna exceeds 6dBi.

4.6.2 Procedures - The output of the test item was connected to the power meter. The

maximum meter reading was recorded. The peak power output was measured for the low, middle and high hopping frequencies.

The test item was placed on the non-conductive stand and set to transmit. A broadband measuring antenna was placed at a test distance of 3 meters from the test item. The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high hopping frequencies.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, another double ridged waveguide antenna was then set in place of test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss, as required. The peak power output was calculated for the low, middle and high hopping frequencies.

4.6.3 Results - The results are presented on pages 22 and 23. The maximum antenna conducted output power measured from the transmitter was 1.37dBm which meets the 30 dBm limit. The maximum EIRP measured from the transmitter was 3.7 dBm which meets the 36dBm defacto limit.

4.7 Bandedge Compliance

4.7.1 Requirement - Per section 15.247(c), the emissions at the band-edges must be at least 20dB below the highest level measured within the band. In addition, the radiated emissions which fall in the restricted band beginning at 2483.5 MHz, must meet the general limits of 15.209

4.7.2 Procedures - The test item was setup inside the chamber. The output of the test item was connected to the spectrum analyzer through a 30 dB pad. With the hopping function disabled, the test item was allowed to transmit continuously. The frequency hopping channel was set separately to low and high hopping channels. The resolution bandwidth (RBW) was set to 100 kHz.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility. The measurement was repeated with the frequency hopping function enabled.

For the emissions which fall in the restricted band the "marker-delta" method described in Public Notice DA 00-705 was used. Initially radiated measurements were performed at the fundamentals of the highest hopping frequencies using 1 MHz bandwidth. For the measurements the "delta" required to meet the general limit was calculated.

Next, the band-edge emissions were plotted using peak detector and 100 kHz bandwidth. The "delta" limit was applied to this plot to determine compliance at the band-edge.

The test item was placed on the non-conductive stand and set to transmit. A broadband measuring antenna was placed at a test distance of 3 meters from the test item. The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded.

4.7.3 Results - Pages 24 through 27 show the conducted band-edge compliance results. Page 28 shows the radiated band-edge compliance results using the marker-delta method. As can be seen from these plots, the emissions at the band-edge and in the restricted band are within the general limits.

4.8 Spurious Emissions

4.8.1 Antenna Conducted

4.8.1.1 Requirement – Per section 15.247(c), the spurious emissions in any 100 kHz BW outside the frequency band must be at least 20dB below the highest 100 kHz BW level measured within the band.

4.8.1.2 Procedures – The measuring equipment was connected to the test item's antenna port. The emissions in the frequency range from 30MHz to 25GHz were observed and plotted separately with the test item transmitting at 2402MHz, 2441MHz, and 2480MHz. Compliance above 25GHz is demonstrated with radiated measurements.

4.8.1.3 Results - The results of the antenna conducted emissions levels were plotted. These plots are presented on pages 29 through 37. These plots show that the spurious emissions were at least 20 dB below the level of the fundamental.

4.8.2 Radiated Spurious Emissions

4.8.2.1 Requirement – Per section 15.247(c), the radiated emissions which fall in the restricted bands must meet the general limits of 15.209.

4.8.2.2 Procedures – The radiated tests were performed in a 32ft. x 20ft. x 18ft. hybrid absorber lined semi-anechoic test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. The floor of the chamber is used as the ground plane. The chamber complies with ANSI 63.4 and CISPR 16 requirements for site attenuation.

Preliminary radiated measurements are performed to determine the frequencies where the significant emissions might be found. With the test item at one set position and the measurement antenna at a set height (i.e. without maximizing), the radiated emissions were measured using peak detection with 100 kHz BW. This data was then automatically plotted up through 18 GHz. The frequency range from 18 to 25 GHz was checked manually but not plotted.

Next, the harmonic or spurious emissions falling in the restricted bands were measured up through the 10th harmonic. For the measurements above 1GHz, the measurement bandwidth was set to 1 MHz RBW. The

analyzer was set to **linear mode** with 10 Hz VBW in order to simulate an average detector. A pre-amplifier was used to increase the receiver sensitivity.

4.8.2.3 Results - The preliminary emissions levels were plotted. These plots are presented on pages 38 through 49. These plots indicate that the radiated spurious emissions were below the general limit.

The harmonics and any other emissions that fall in the restricted frequency bands were then re-measured manually. This data is shown in the tables on pages 50 through 52. The field intensities levels for the harmonics in the restricted band were within the limit.

4.9 Spectral Density

4.9.1 Requirement - Per section 15.247(d), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.9.2 Procedures - The output of the test item was connected to the spectrum analyzer. The test item was put into inquiry mode.

The test item was placed on the non-conductive stand and set to transmit. A broadband measuring antenna was placed at a test distance of 3 meters from the test item. The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna.

The resolution bandwidth (RBW) was set to 3kHz, the sweep time was set to the span divided by 3kHz (1MHz/3kHz = 333 seconds). The peak detector and 'Max-Hold' function was engaged. The analyzer's display was plotted using a 'screen dump' utility.

4.9.3 Results - Page 53 shows the power spectral density results. As can be seen from this plot, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

5.0 CONCLUSIONS:

It was determined that the Motorola TCG In-Vehicle Bluetooth Module, Part No. TCU1P03_M1202D, Serial No. 07187699, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Bluetooth spread spectrum transmitters.

6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date. Any electrical or



mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.



TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC.								Page: 1
Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/	001	4.8-20GHZ	07/19/04	12	07/19/05
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---		N/A	
Equipment Type: AMPLIFIERS								
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	02/04/04	12	02/04/05
Equipment Type: ANTENNAS								
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	07/12/04	12	07/12/05
NWI0	RIDGED WAVE GUIDE	AEL	H1498	153	2-18GHZ	09/05/04	12	09/05/05
NWI1	RIDGED WAVE GUIDE	AEL	H1498	154	2-18GHZ	09/05/04	12	09/05/05
Equipment Type: ATTENUATORS								
T1E7	10DB, 25W ATTENUATOR	WEINSCHTEL	46-10-34	BG3489	DC-18GHZ	08/09/04	12	08/09/05
T2DH	20DB 25W ATTENUATOR	WEINSCHTEL	46-20-34	BN1039	DC-18GHZ	03/29/04	12	03/29/05
Equipment Type: METERS								
MPC1	DUAL POWER METER	HEWLETT PACKARD	EPM-442A	US37480258	0.1MHZ-50GHZ	05/19/04	12	05/19/05
MPC1	POWER SENSOR	HEWLETT PACKARD	8482A	US3318A27650	0.1-4200MHZ	02/24/04	12	02/24/05
Equipment Type: RECEIVERS								
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	02/04/04	12	02/04/05
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	02/04/04	12	02/04/05
RAF3	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	02/04/04	12	02/04/05
RBA1	EMI TEST RECEIVER	RHODE & SCHWARZ	ESIB26	100146	20HZ-26.5GHZ	03/29/04	12	03/29/05
Equipment Type: SIGNAL GENERATORS								
GBX1	SYNTHESIZED SWEEPER	HEWLETT PACKARD	83630A	3420A00857	10MHZ-26.5GHZ		NOTE 1	

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.



ELITE ELECTRONIC ENGINEERING INC.
Radiated Emissions Test Setup Anechoic Ferrite Chamber

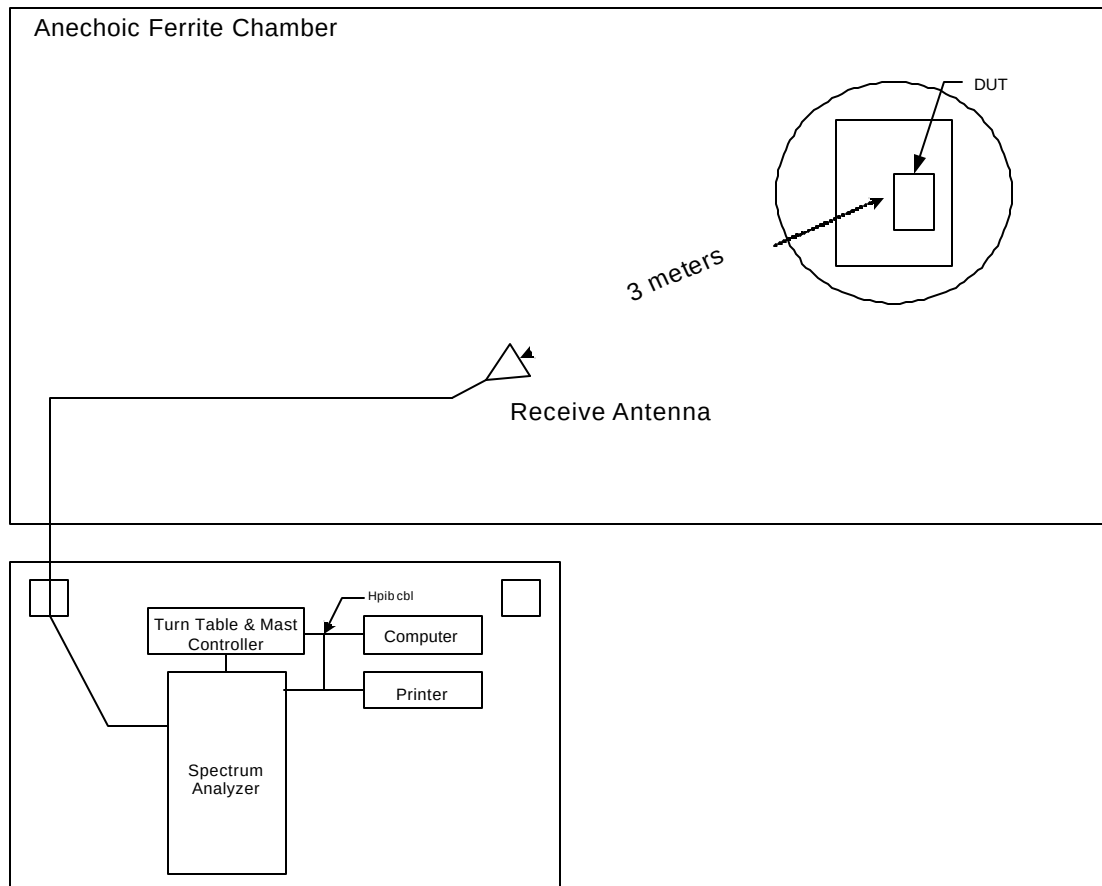


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP



Radiated Emissions 2GHz – 18GHz – Vertical Polarization



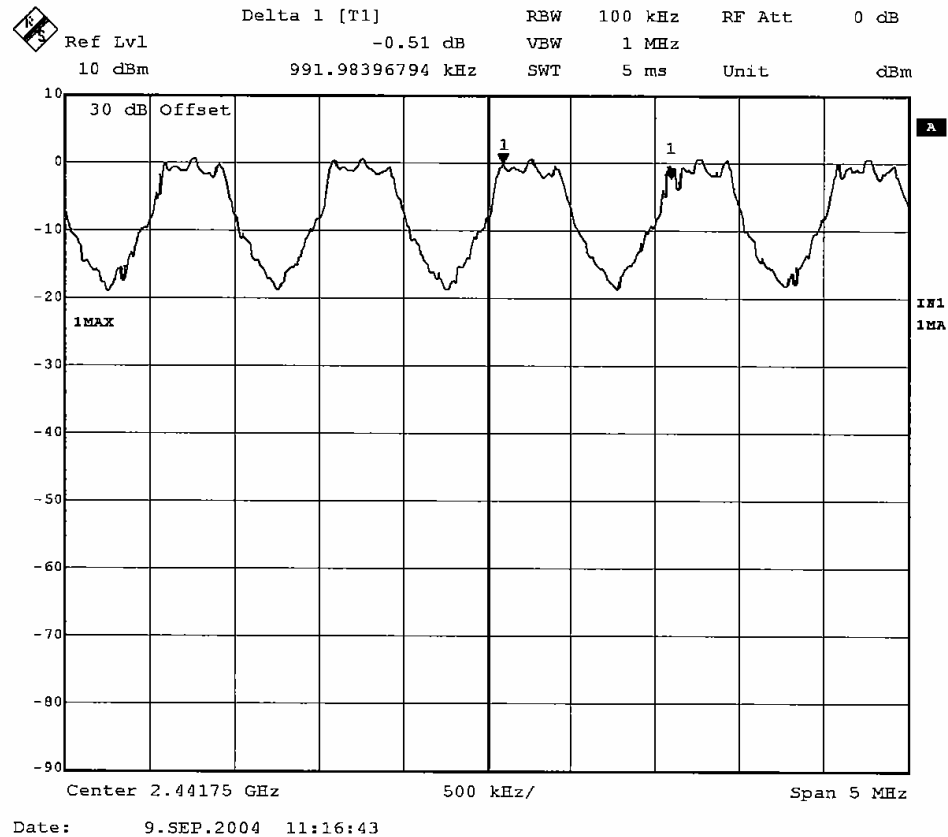
Radiated Emissions 2GHz – 18GHz – Horizontal Polarization



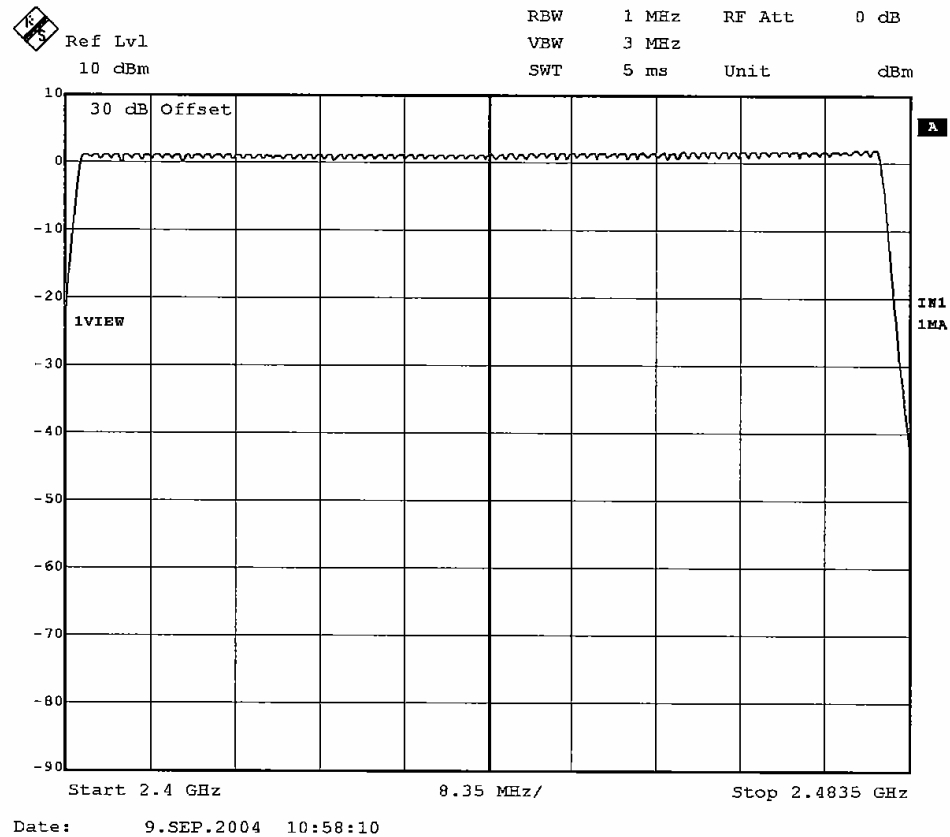
Radiated Emissions 18GHz – 25GHz – Vertical Polarization



Radiated Emissions 18GHz – 25GHz – Horizontal Polarization

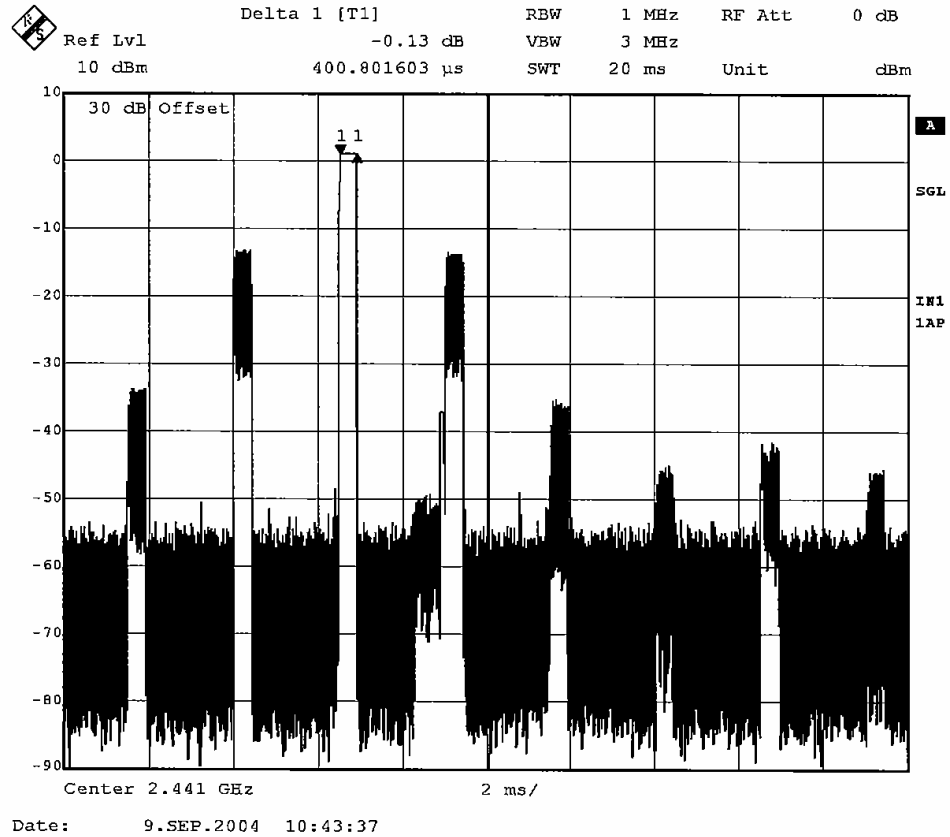


MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 CARRIER FREQUENCY SEPERATION
 MODE : FREQUENCY HOPPING ENABLED



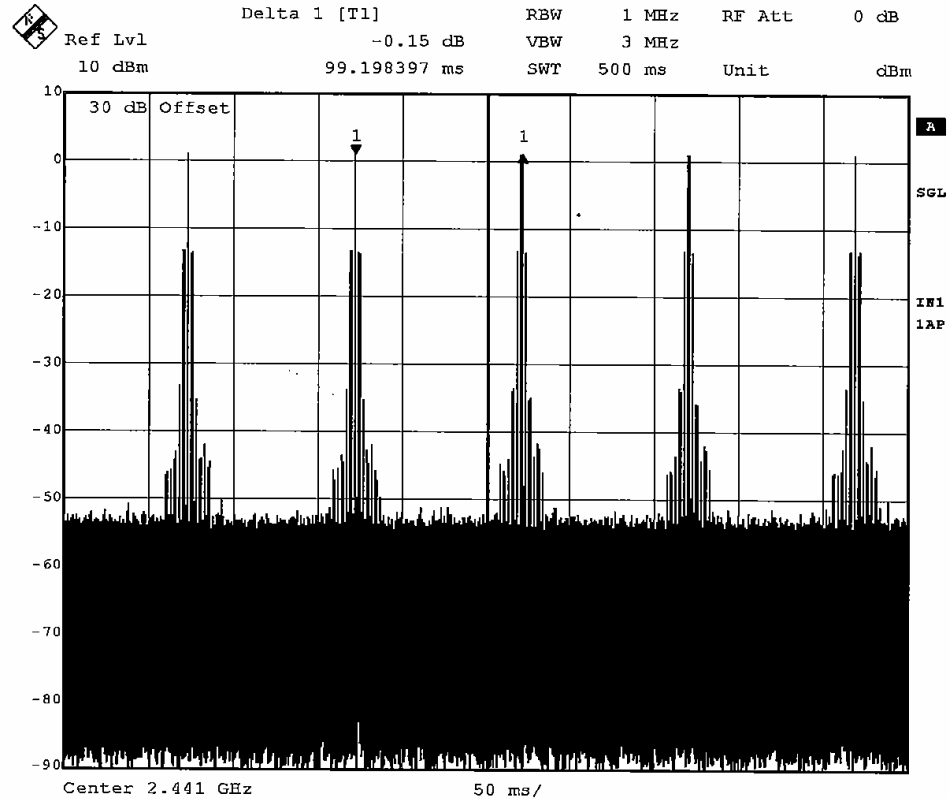
Number of Hopping Frequencies = 79

MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 NUMBER OF HOPPING FREQUENCIES
 MODE : FREQUENCY HOPPING ENABLED



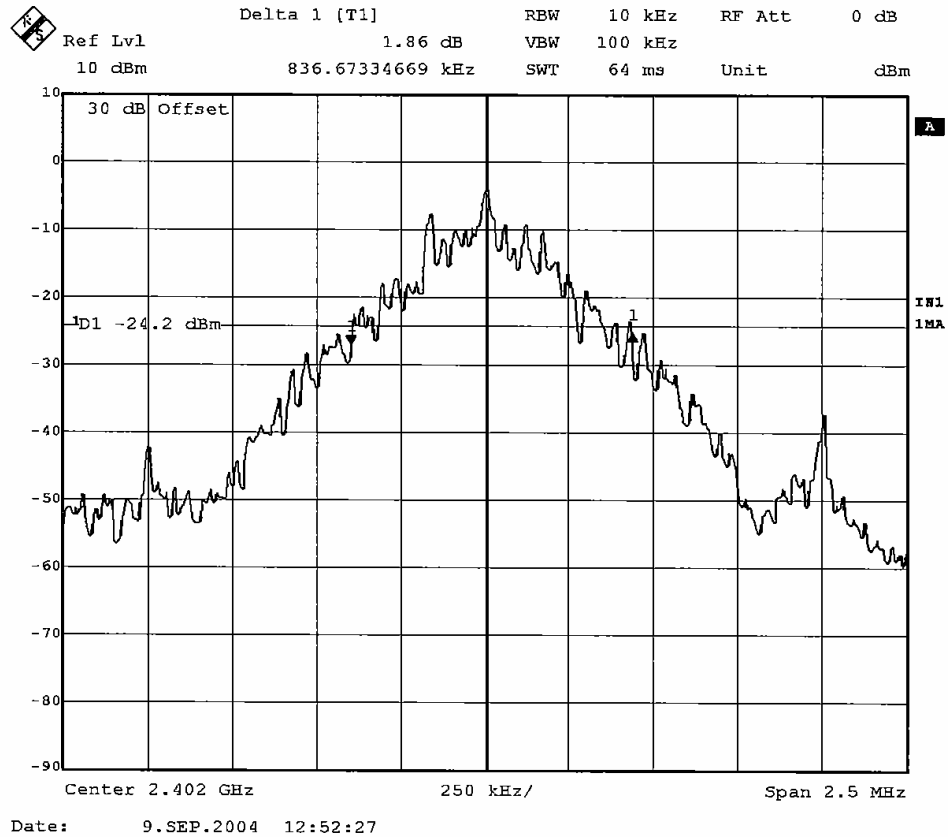
$$\text{DWELL TIME} = (400\mu\text{sec}/99.2\text{msec}) * (0.4 \text{ sec} * 79 \text{ hopping frequencies}) = 0.1274\text{sec}$$

MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 DWELL TIME
 MODE : FREQUENCY HOPPING ENABLED

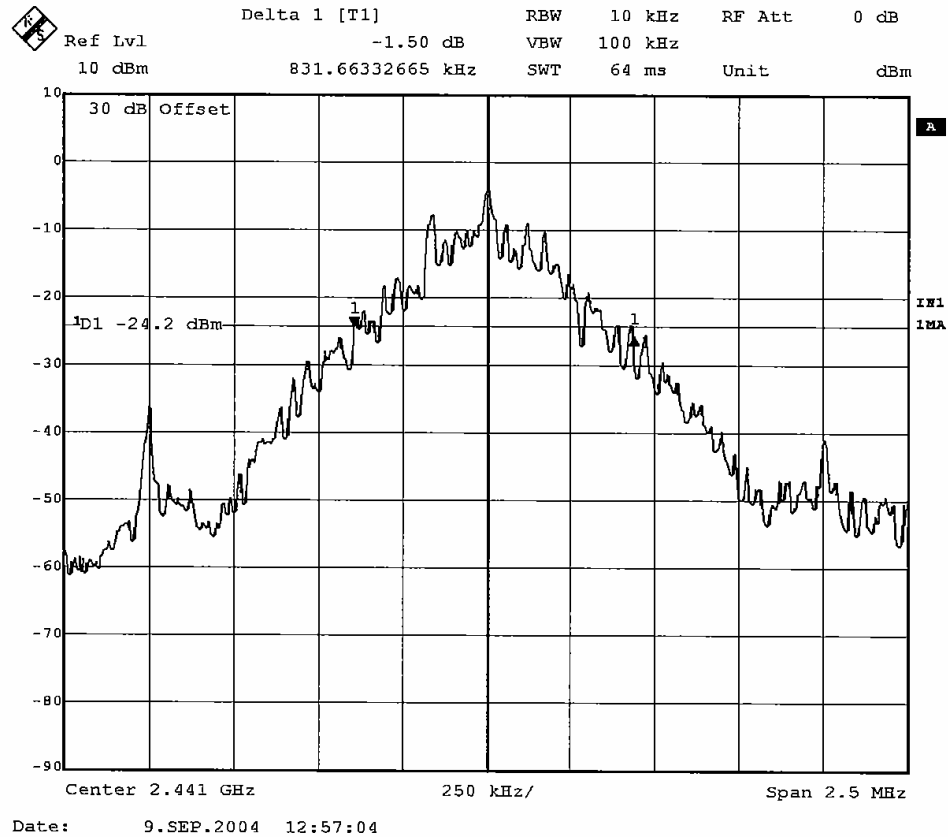


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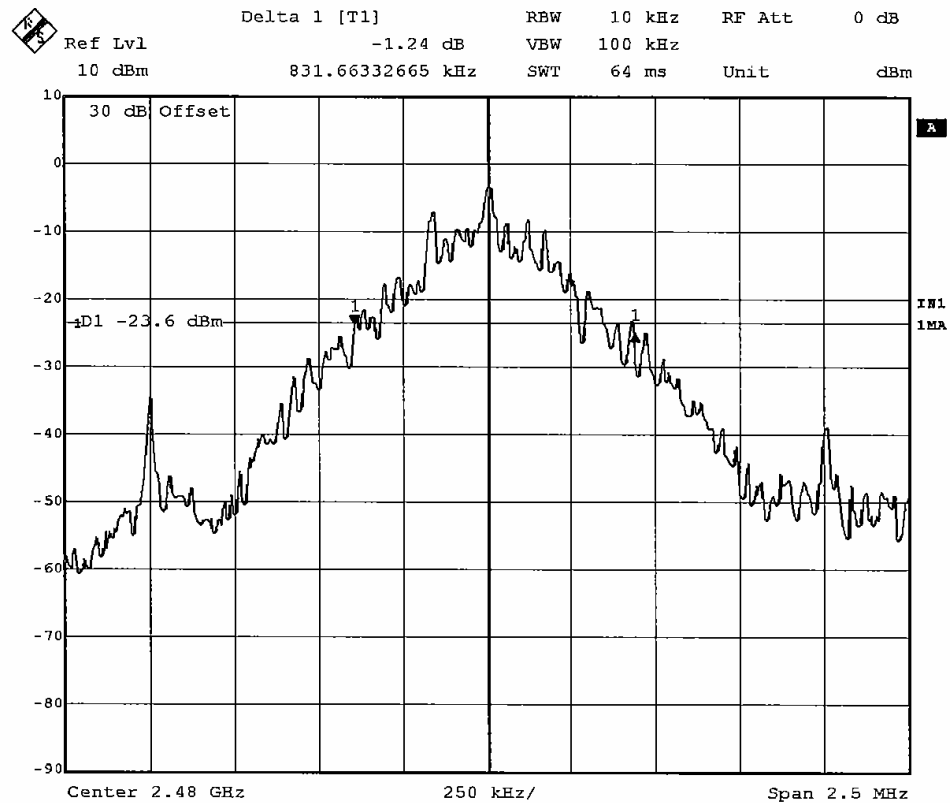
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 DWELL TIME
 MODE : FREQUENCY HOPPING ENABLED



MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 20dB BANDWIDTH
 MODE : TRANSMIT @ 2.402GHz, MAXIMUM DATA RATE



MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 20dB BANDWIDTH
 MODE : TRANSMIT @ 2.441GHz, MAXIMUM DATA RATE



Date: 9.SEP.2004 13:02:06

MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 20dB BANDWIDTH
 MODE : TRANSMIT @ 2.480GHz, MAXIMUM DATA RATE



Data Sheet

MANUFACTURER : Motorola TCG
MODEL : TCU1P03_M1202D
S/N : 07187699
SPECIFICATION : FCC Part 15, Subpart C, Section 15.247
Peak Output Power - Antenna Conducted Measurement
DATE : September 10, 2004
NOTES : CW Signal
: Power Meter Measurement

FREQ. (MHz)	PEAK POWER (dBm)
2402	0.79
2441	0.94
2480	1.37

CHECKED BY: Mark E Longinoth



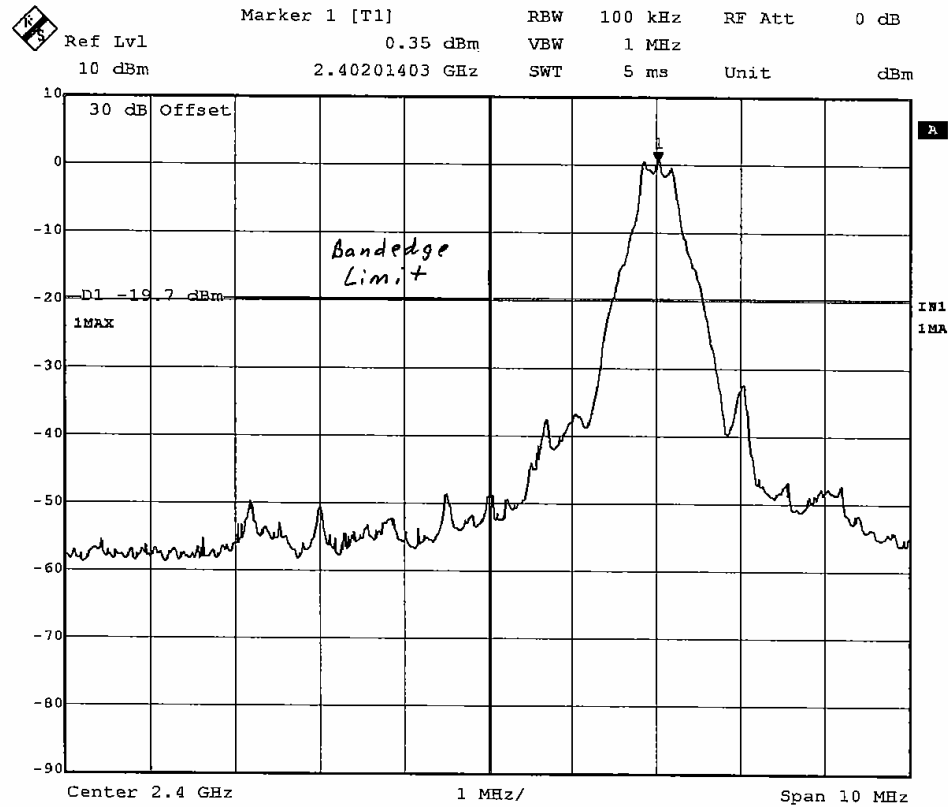
Data Sheet

MANUFACTURER : Motorola TCG
MODEL : TCU1P03_M1202D
S/N : 07187699
SPECIFICATION : FCC Part 15, Subpart C, Section 15.247
Peak Output Power - Radiated Measurement
DATE : September 10, 2004
NOTES :
: TEST DISTANCE IS 3 METERS

FREQ. (MHz)	ANT POL	SPECTRUM ANALYZER RDG(dBuV)	MATCHED SIGNAL GENERATOR RDG (dBm)	CABLE LOSS (dB)	ANTENNA GAIN (dB)	EIRP TOTAL (dBm)
2402	V	100.3	-1.00	2.8	6.8	3.0
	H	97.4	-4.30	2.8	6.8	0.3
2441	V	102.0	-0.30	2.8	6.8	3.7
	H	100.6	-1.60	2.8	6.8	2.4
2480	V	101.6	-0.40	2.8	6.9	3.7
	H	98.3	-3.40	2.8	6.9	0.7

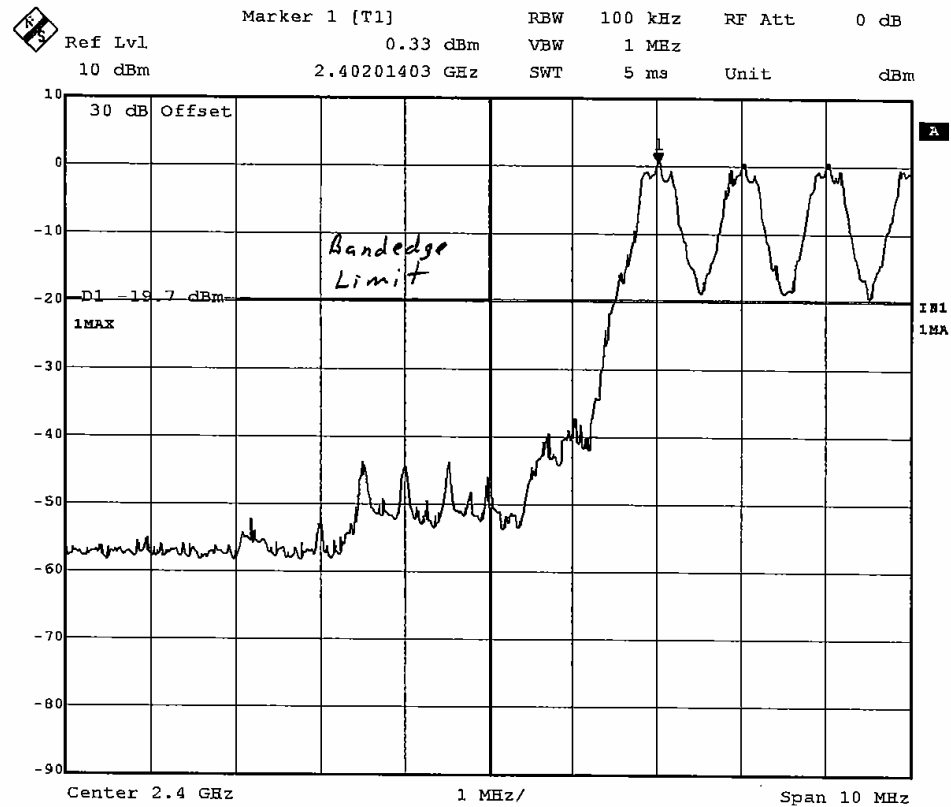
EIRP = S.G. RDG + Cable Loss - Antenna Gain

CHECKED BY: *Mark E Longino*



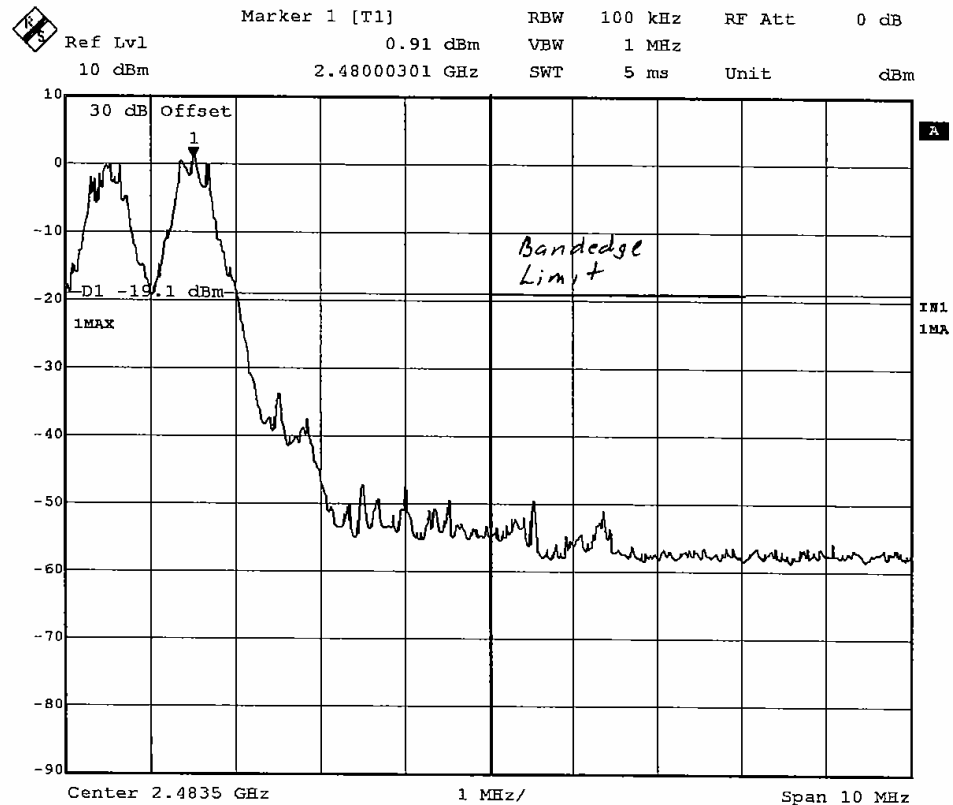
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MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 ANTENNA COND. BANDEDGE COMPLIANCE
 MODE : TRANSMIT @ 2.402GHz, MAXIMUM DATA RATE



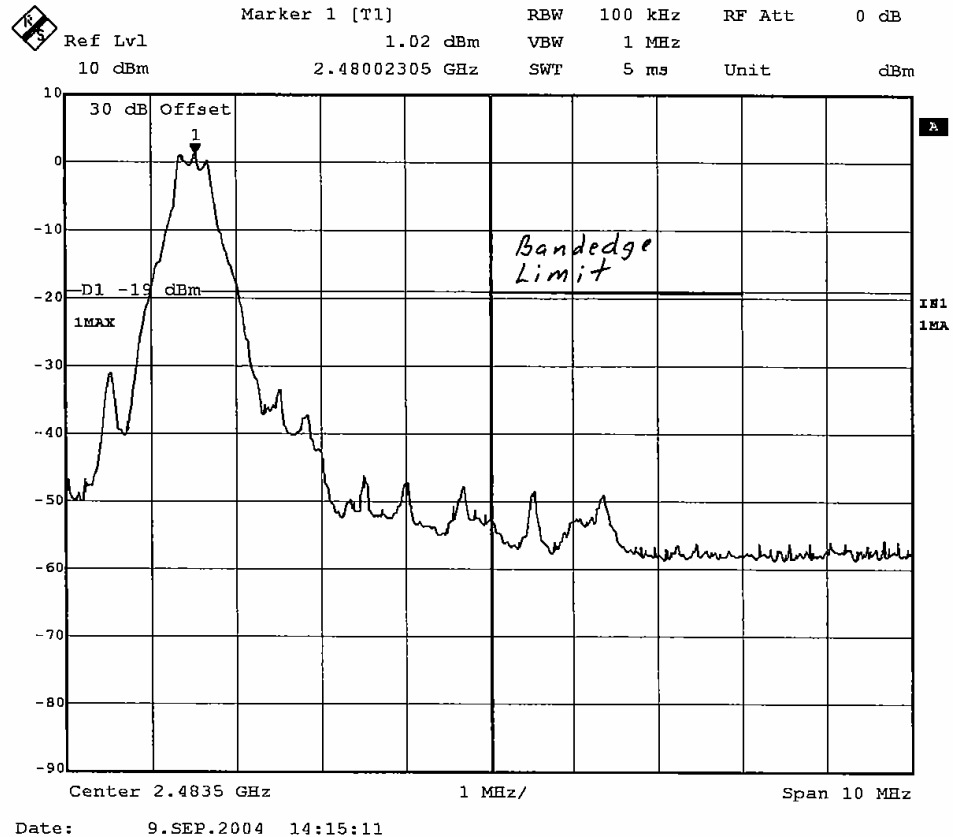
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MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 ANTENNA COND. BANDEDGE COMPLIANCE
 MODE : FREQUENCY HOPPING ENABLED



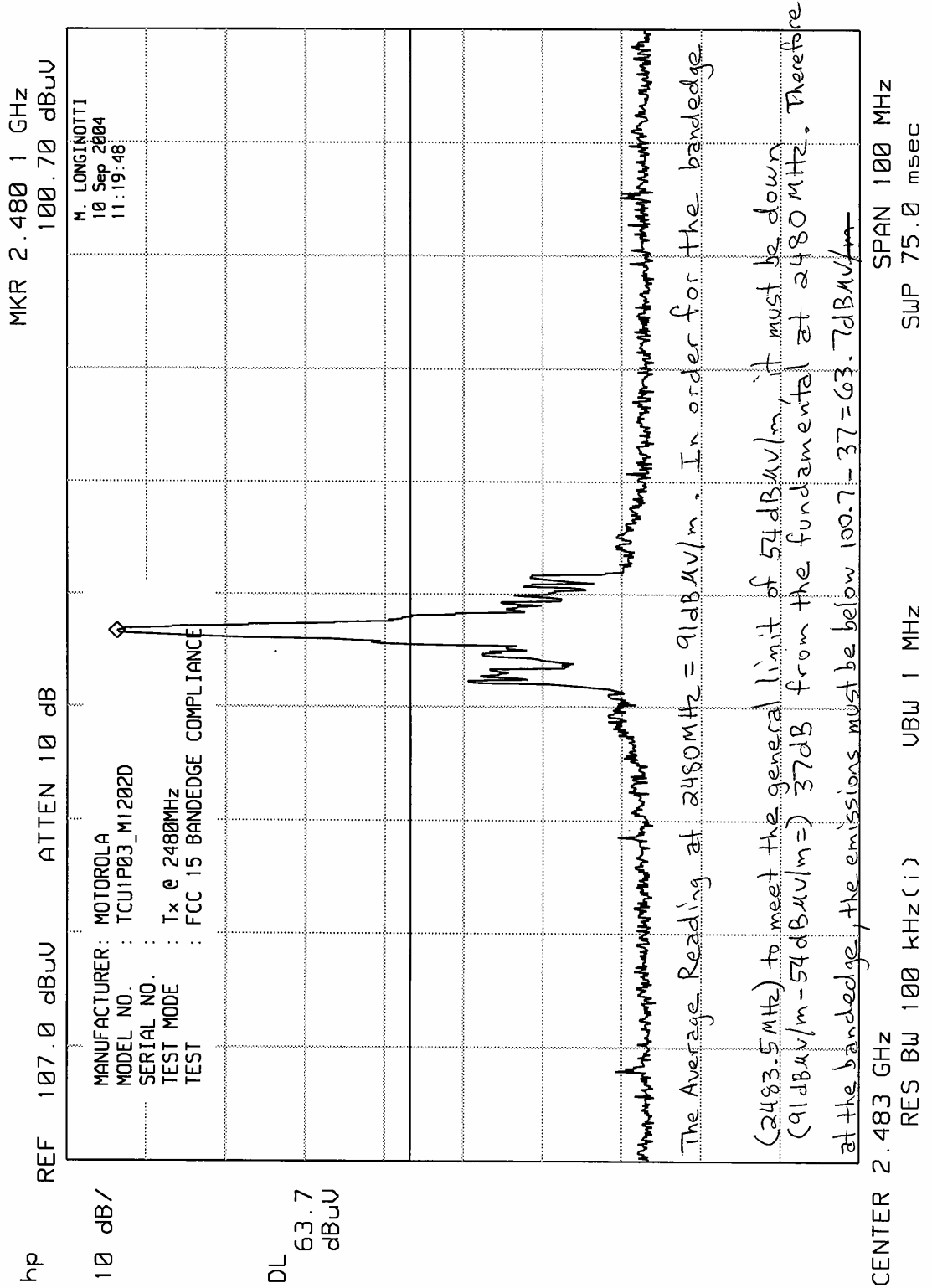
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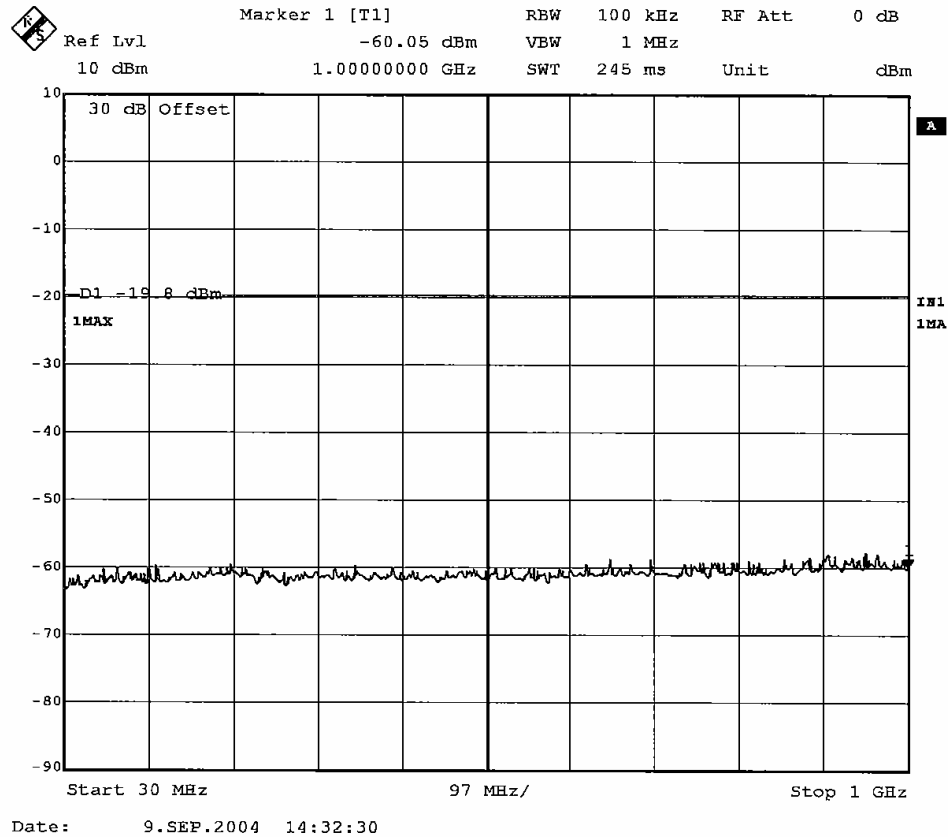
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 ANTENNA COND. BANDEDGE COMPLIANCE
 MODE : FREQUENCY HOPPING ENABLED



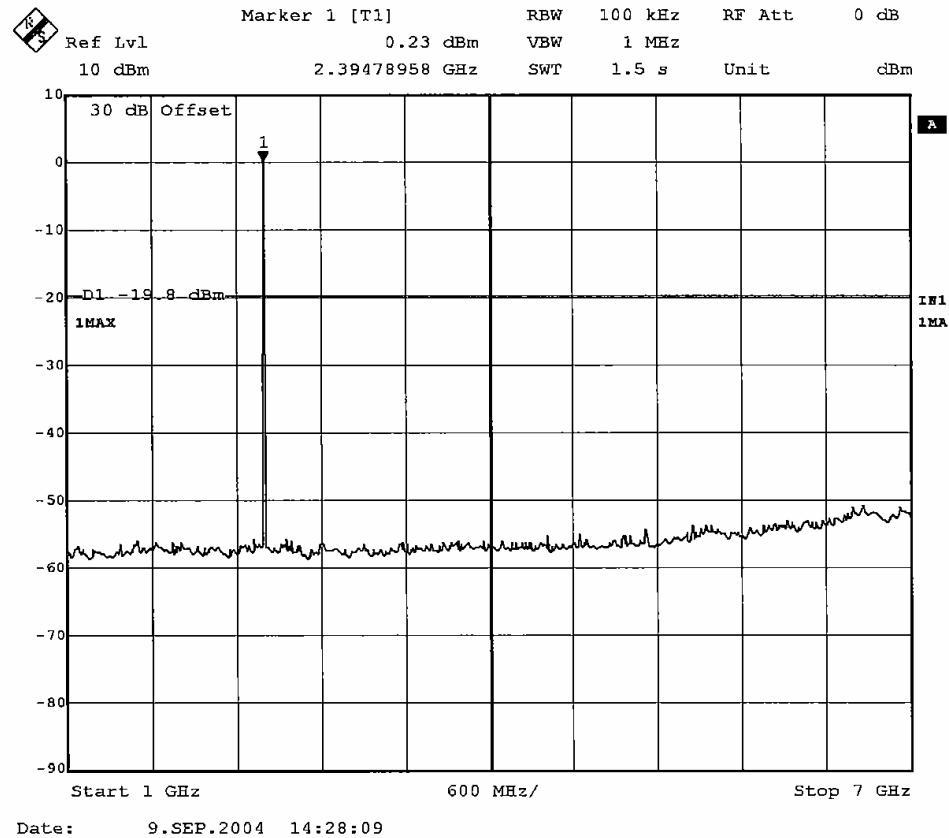
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 ANTENNA COND. BANDEDGE COMPLIANCE
 MODE : TRANSMIT @ 2.480GHz, MAXIMUM DATA RATE

ELITE ELECTRONIC ENGINEERING Inc.

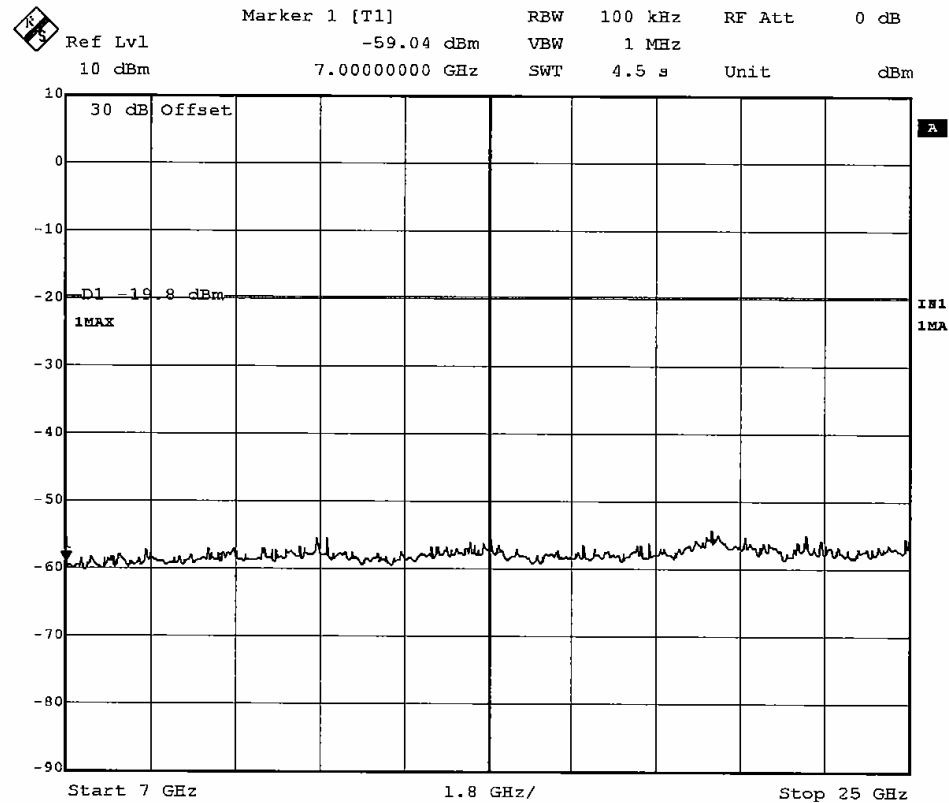




MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.402GHz, CW

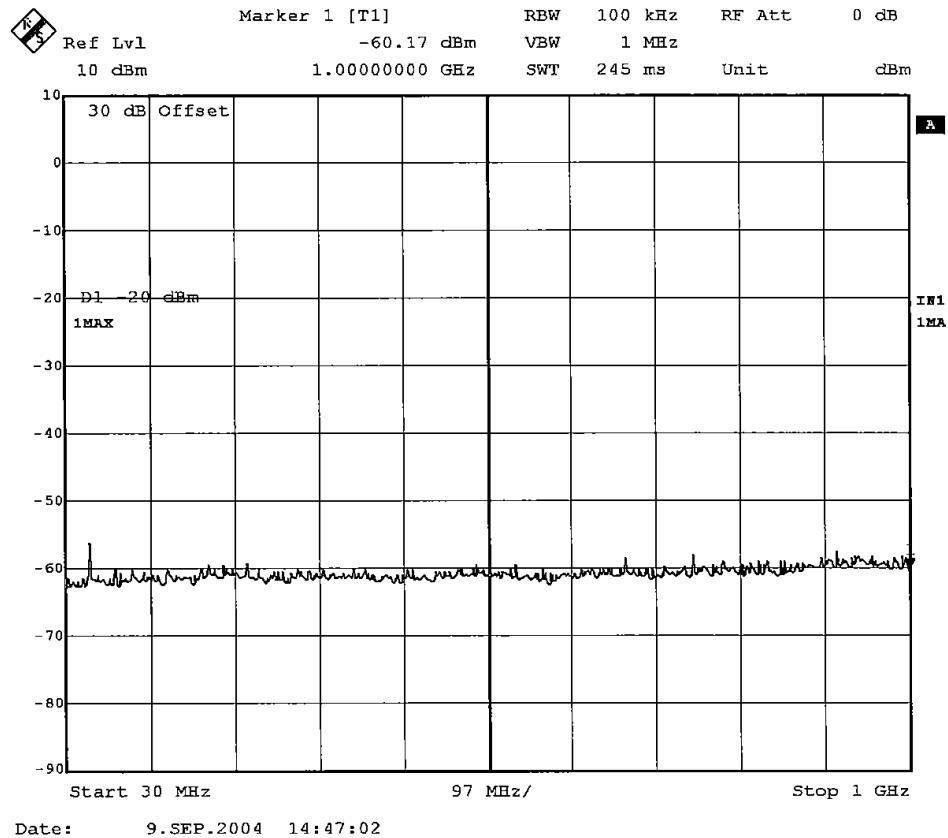


MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.402GHz, CW

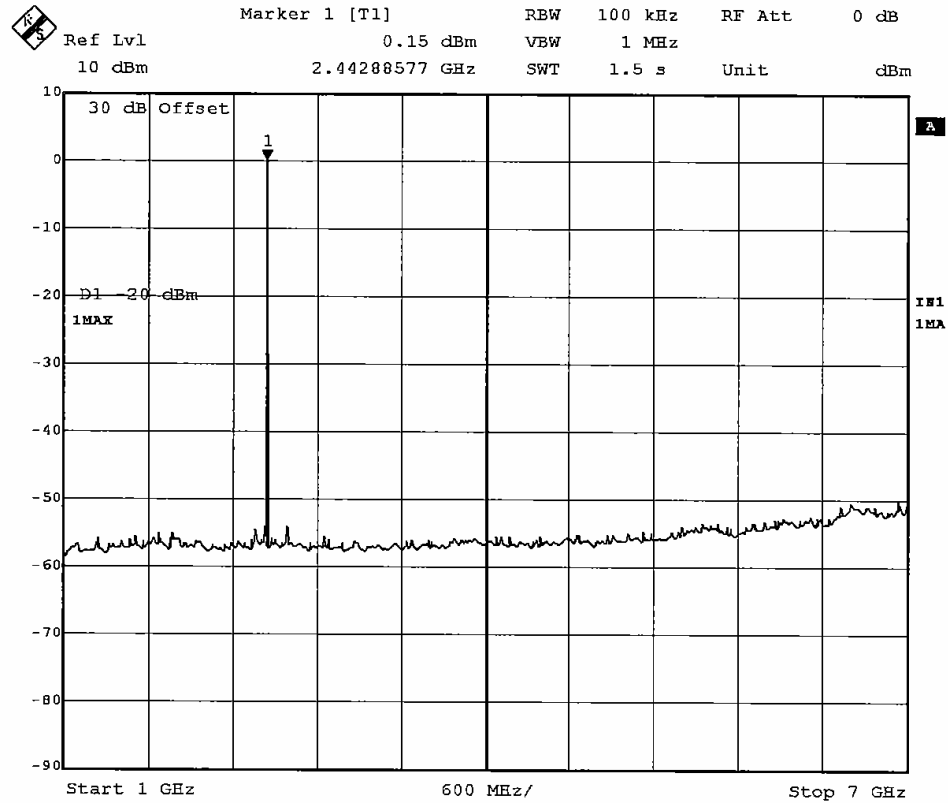


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MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.402GHz, CW

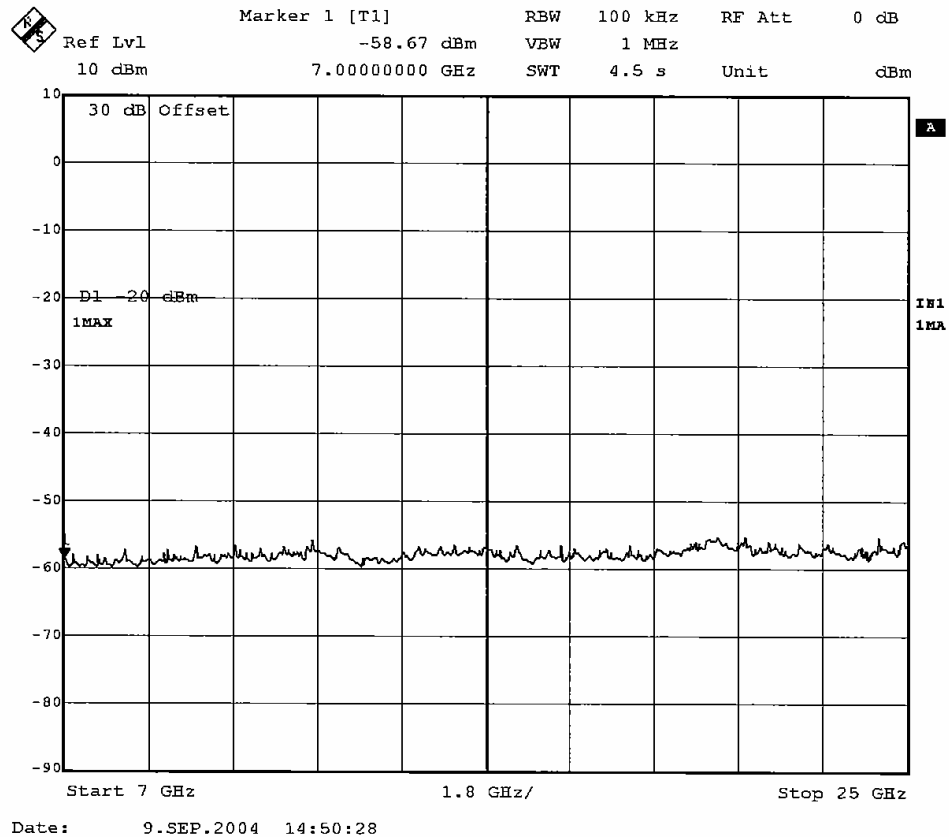


MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.441GHz, CW

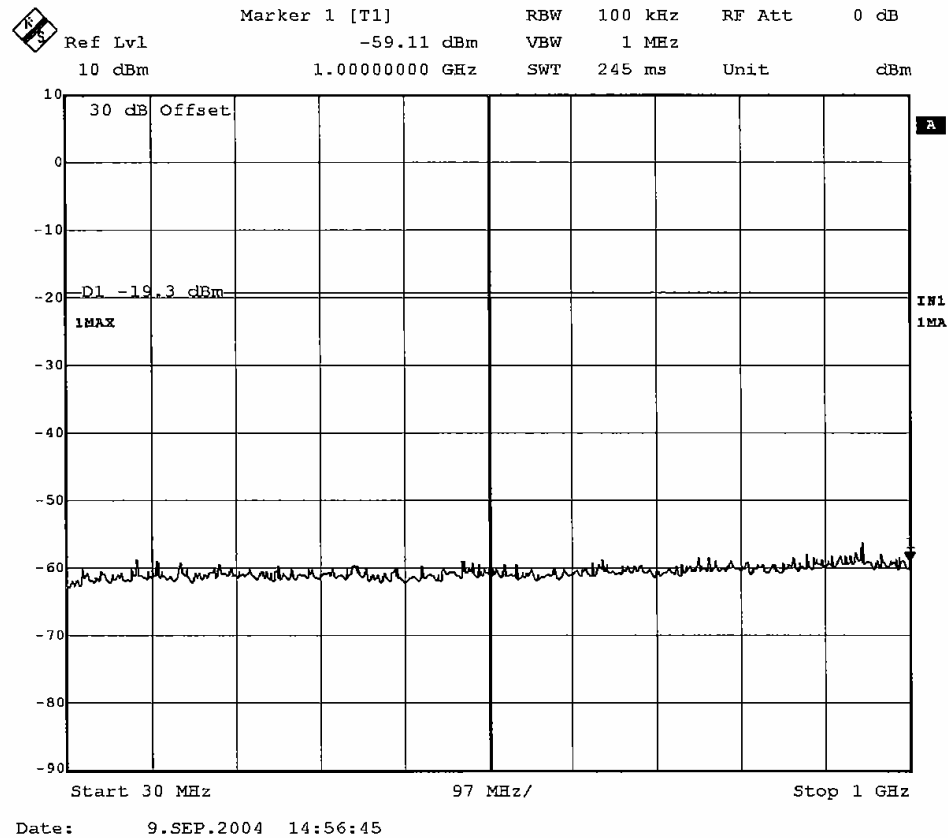


Date: 9.SEP.2004 14:44:09

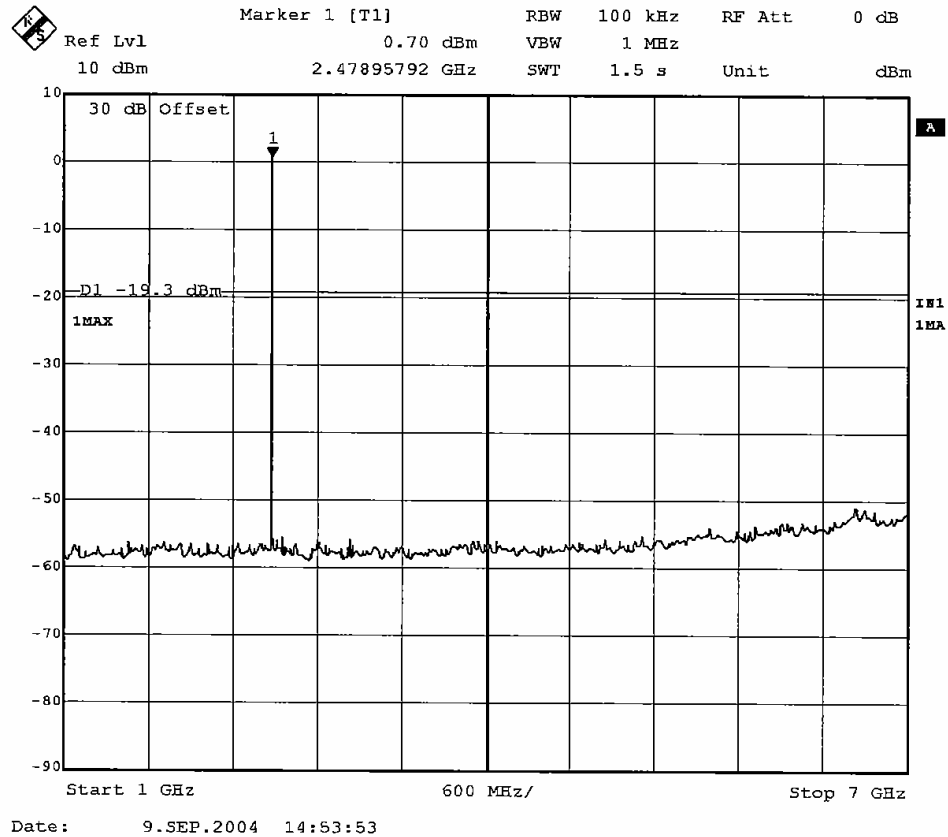
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.441GHz, CW



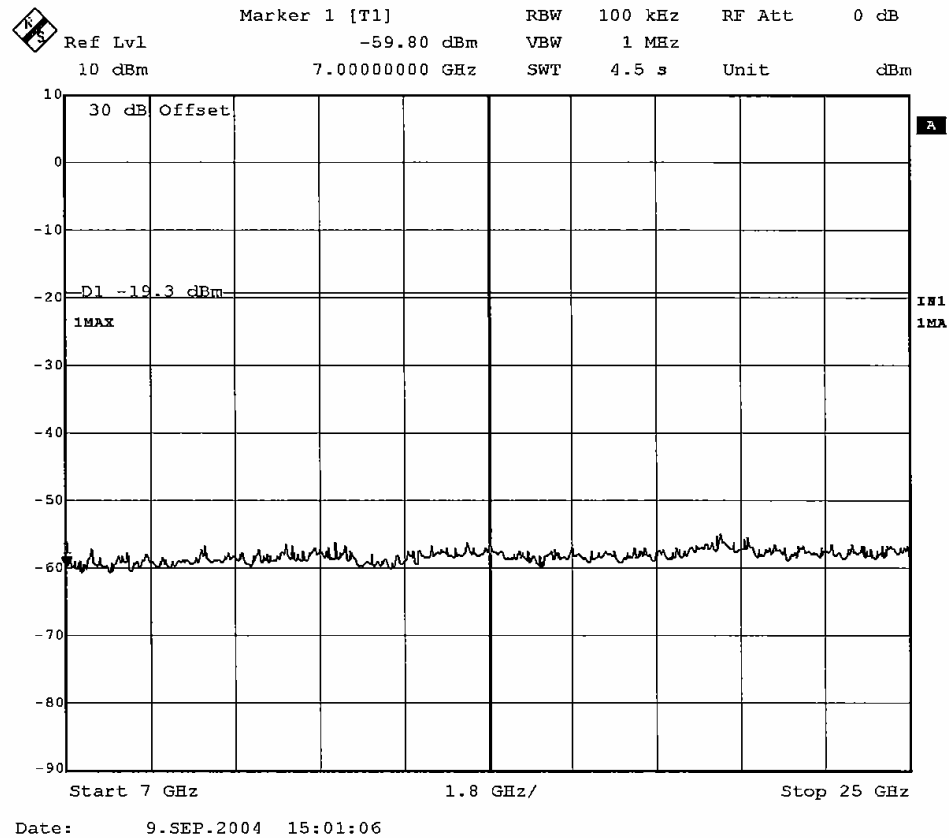
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.441GHz, CW



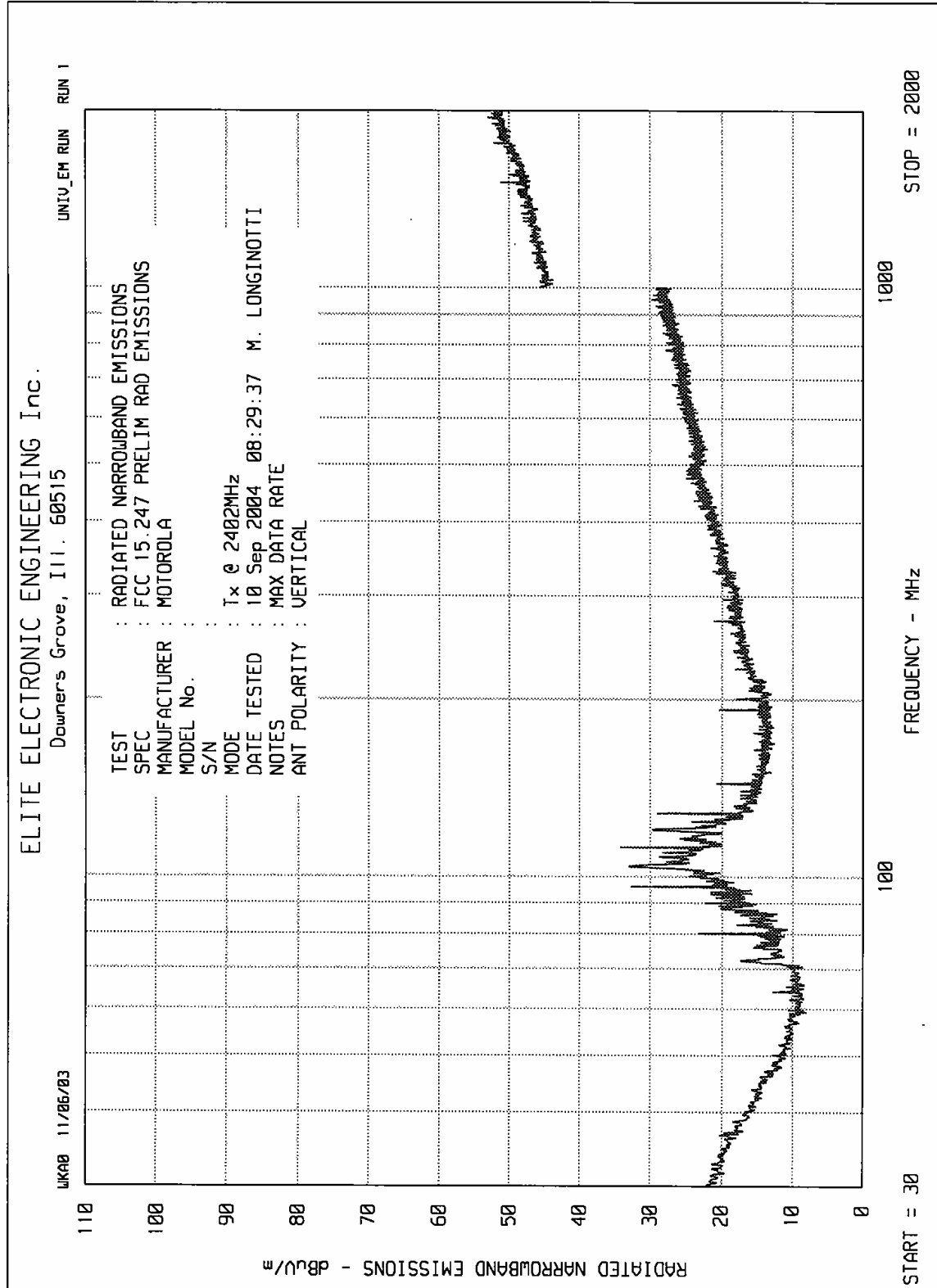
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.480GHz, CW

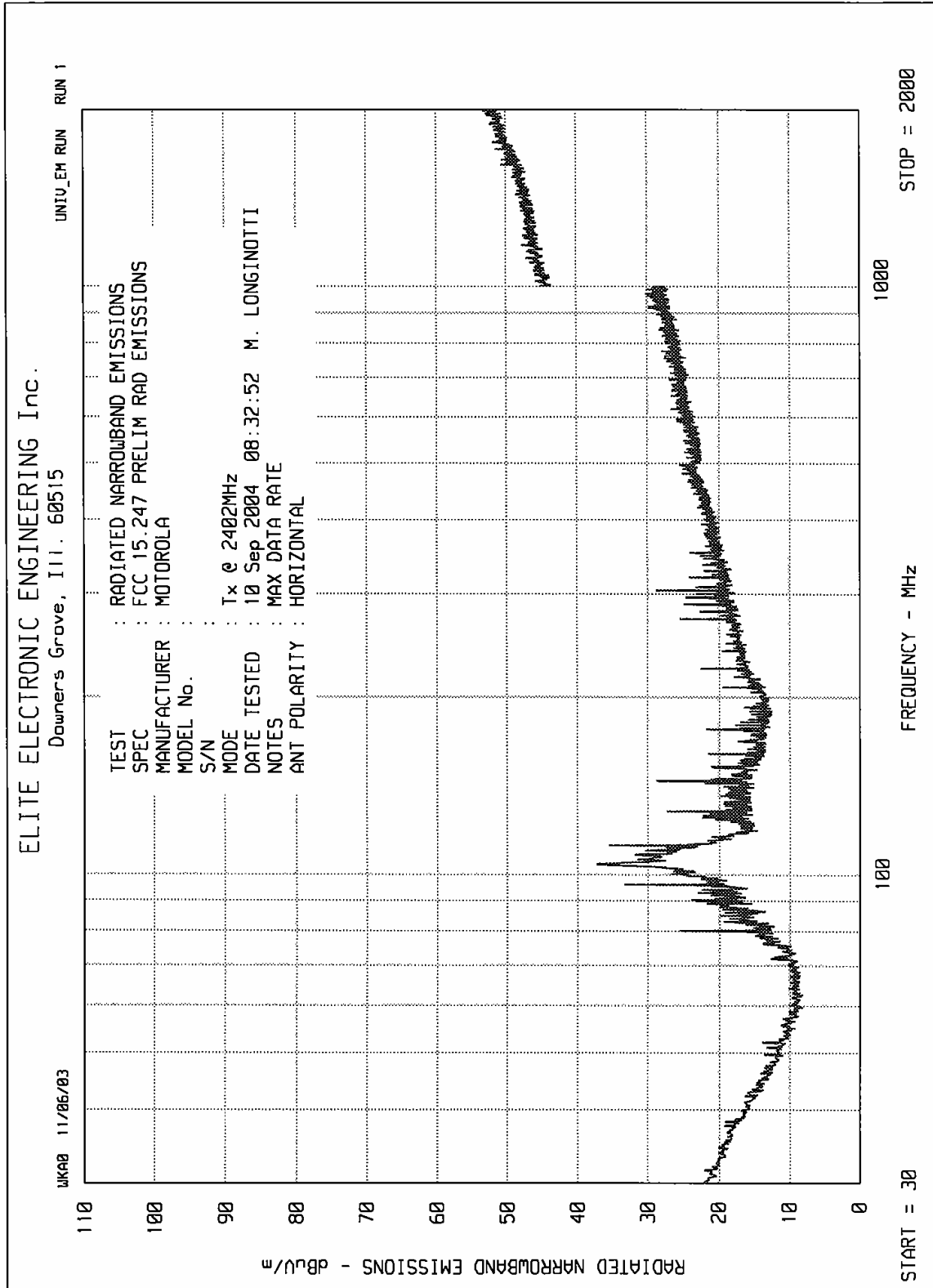


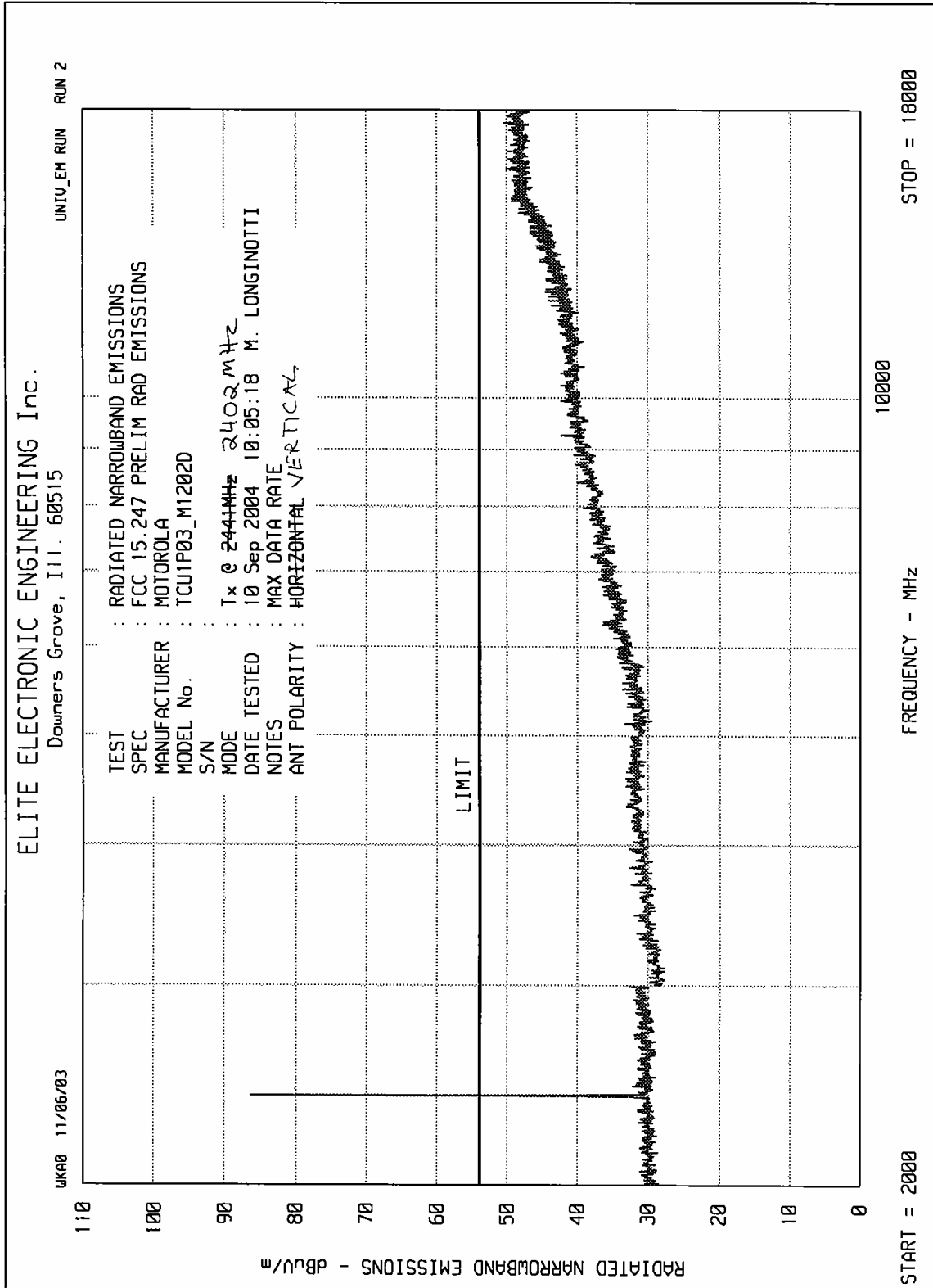
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.480GHz, CW

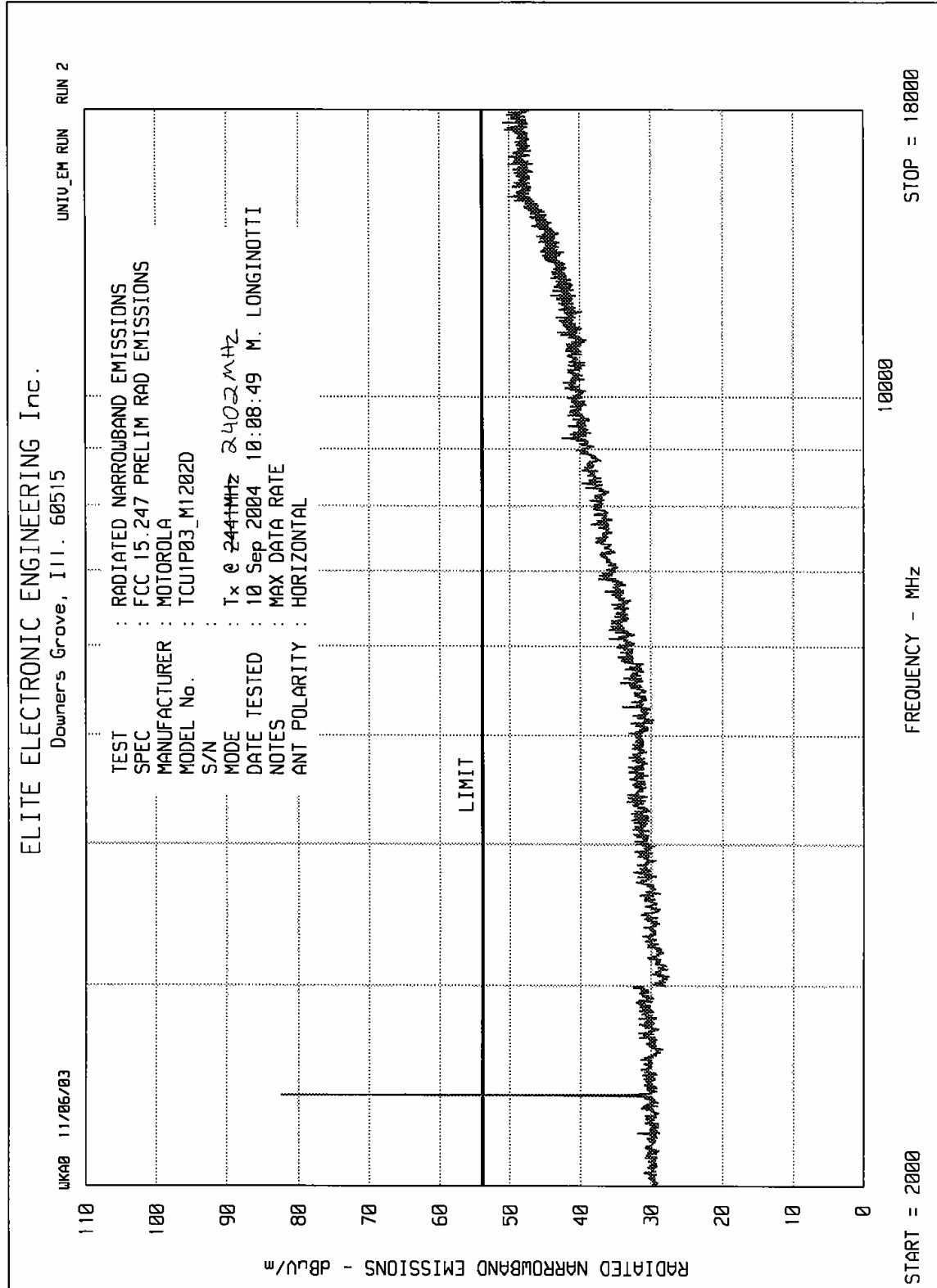


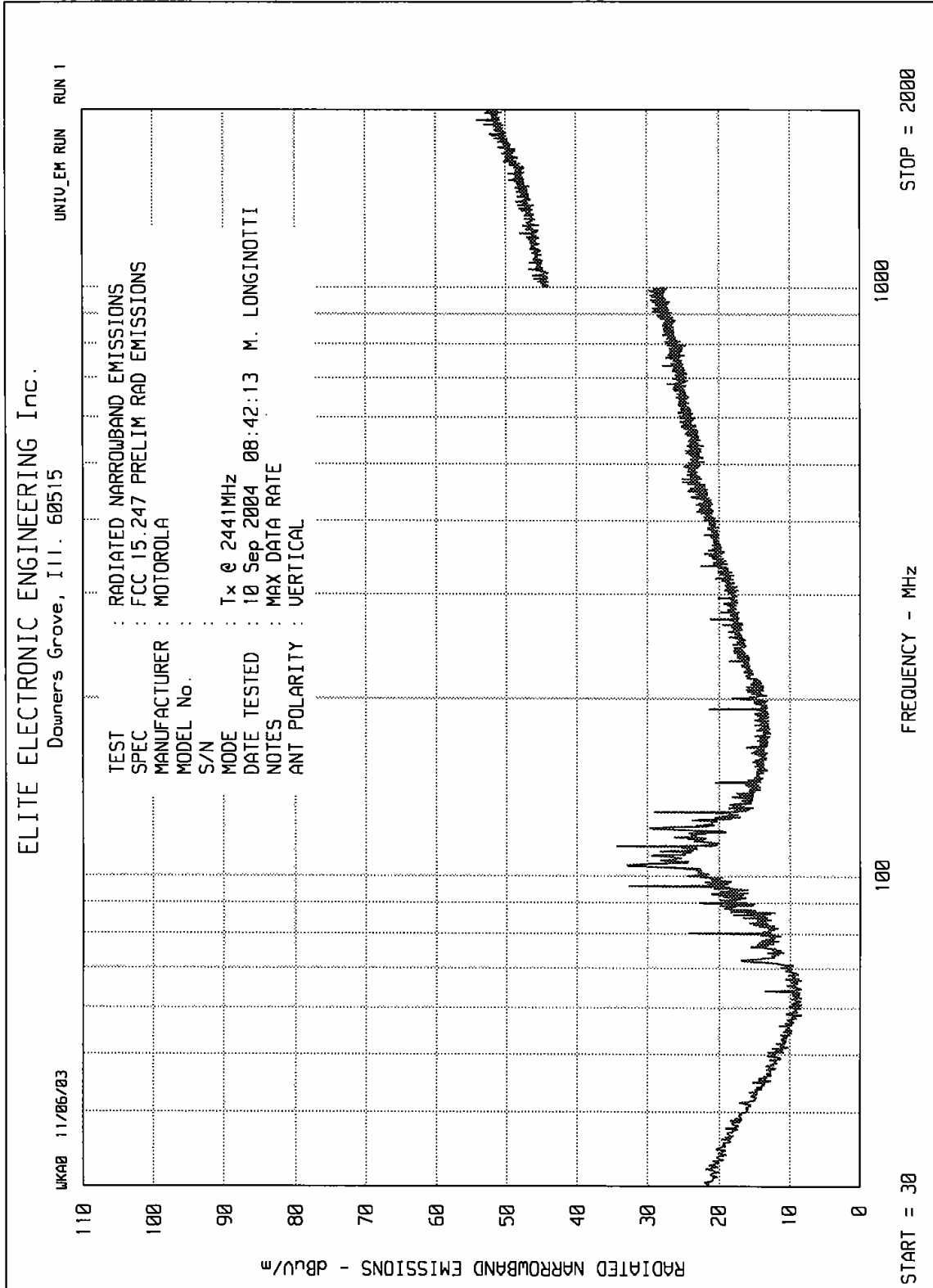
MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 SPURIOUS RF ANTENNA COND. EMISSIONS
 MODE : TRANSMIT @ 2.480GHz, CW

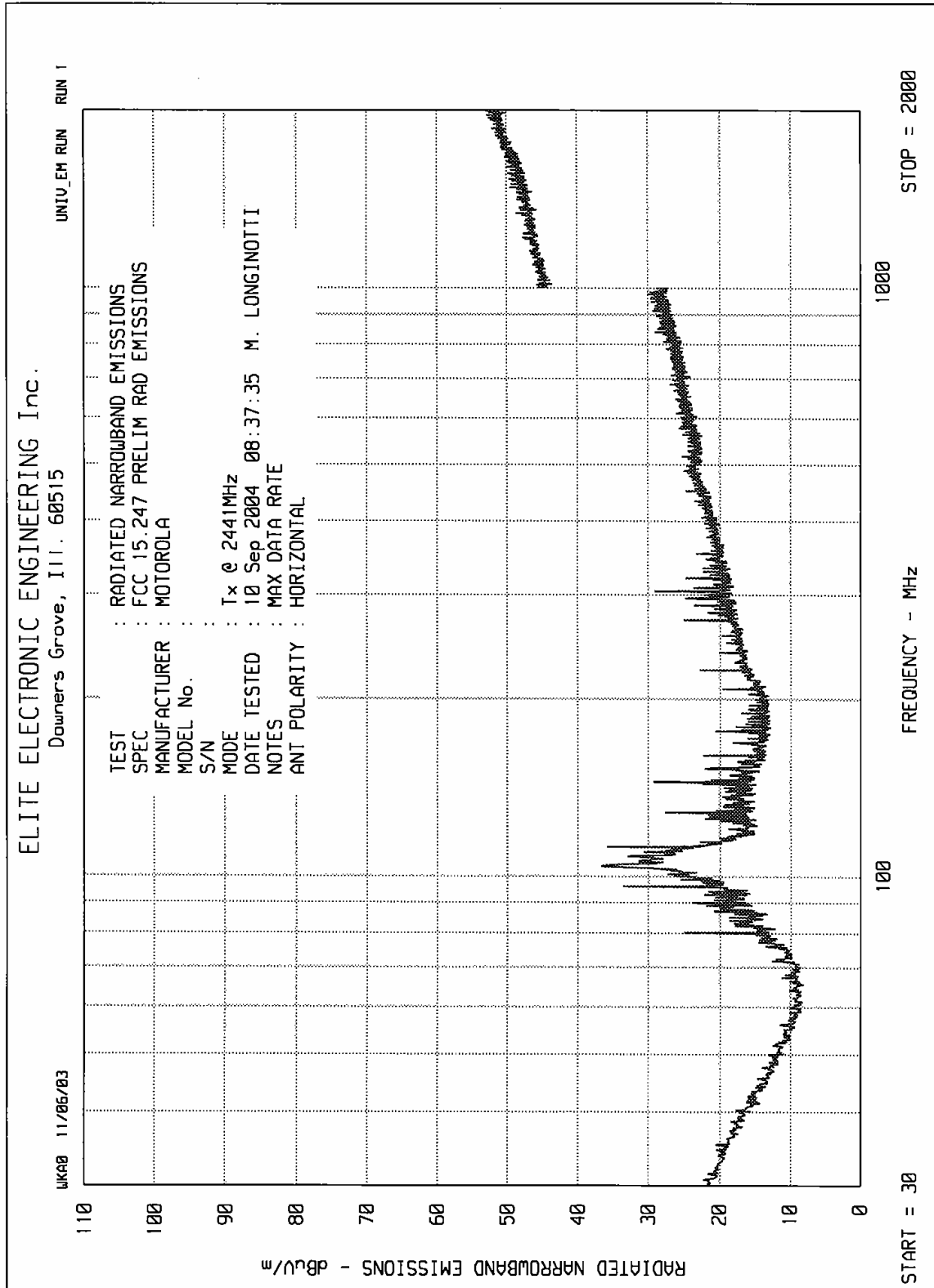


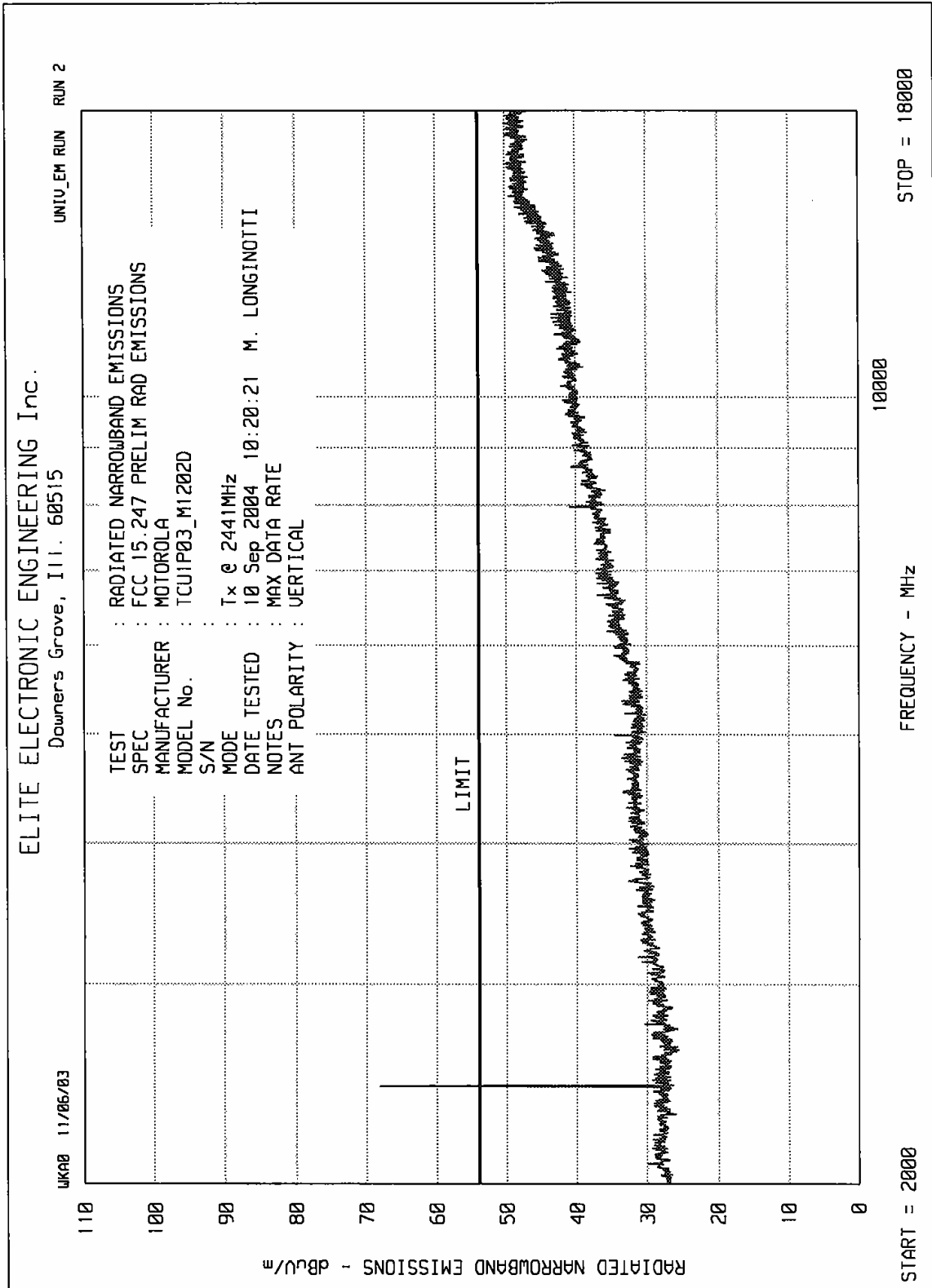


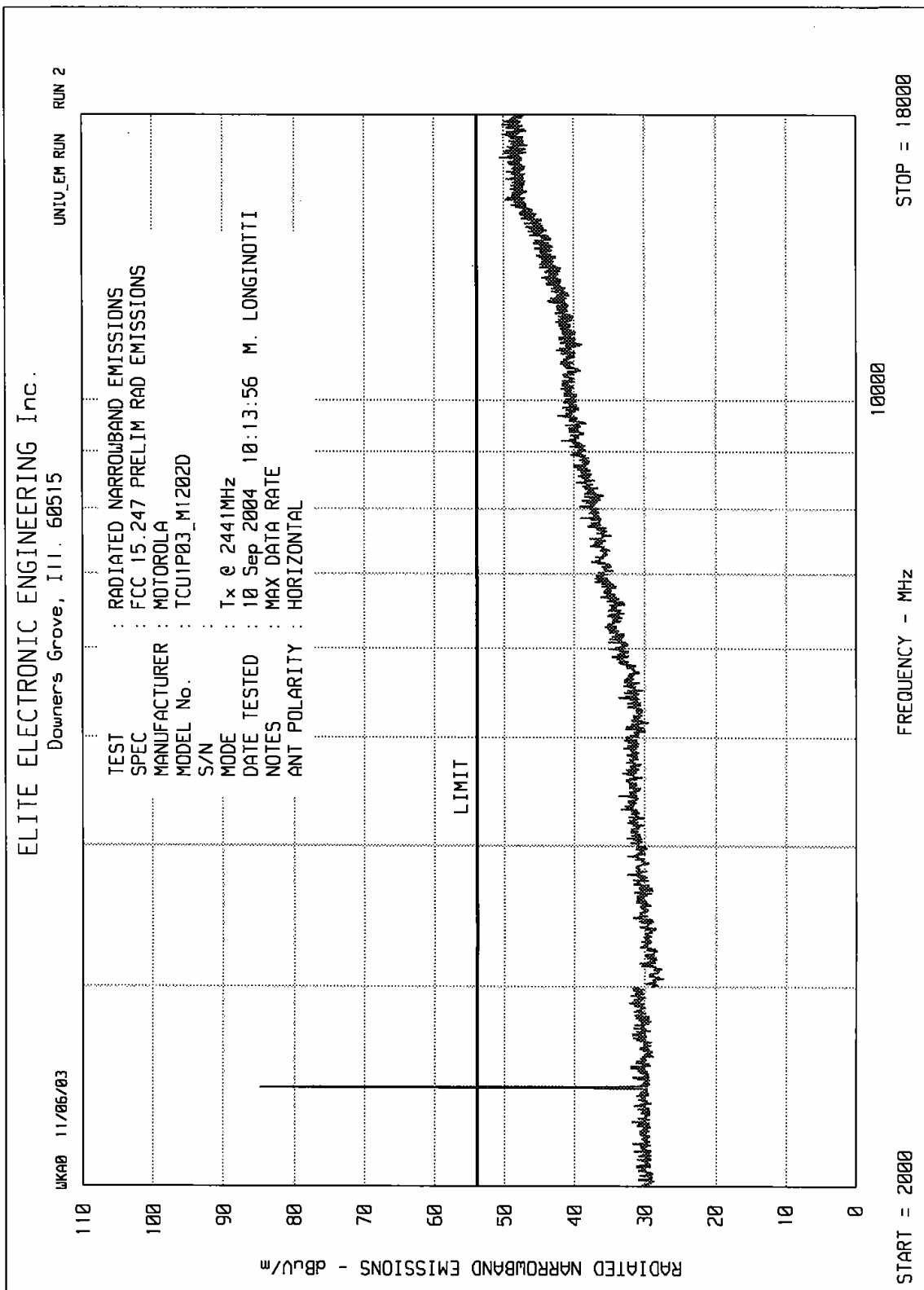


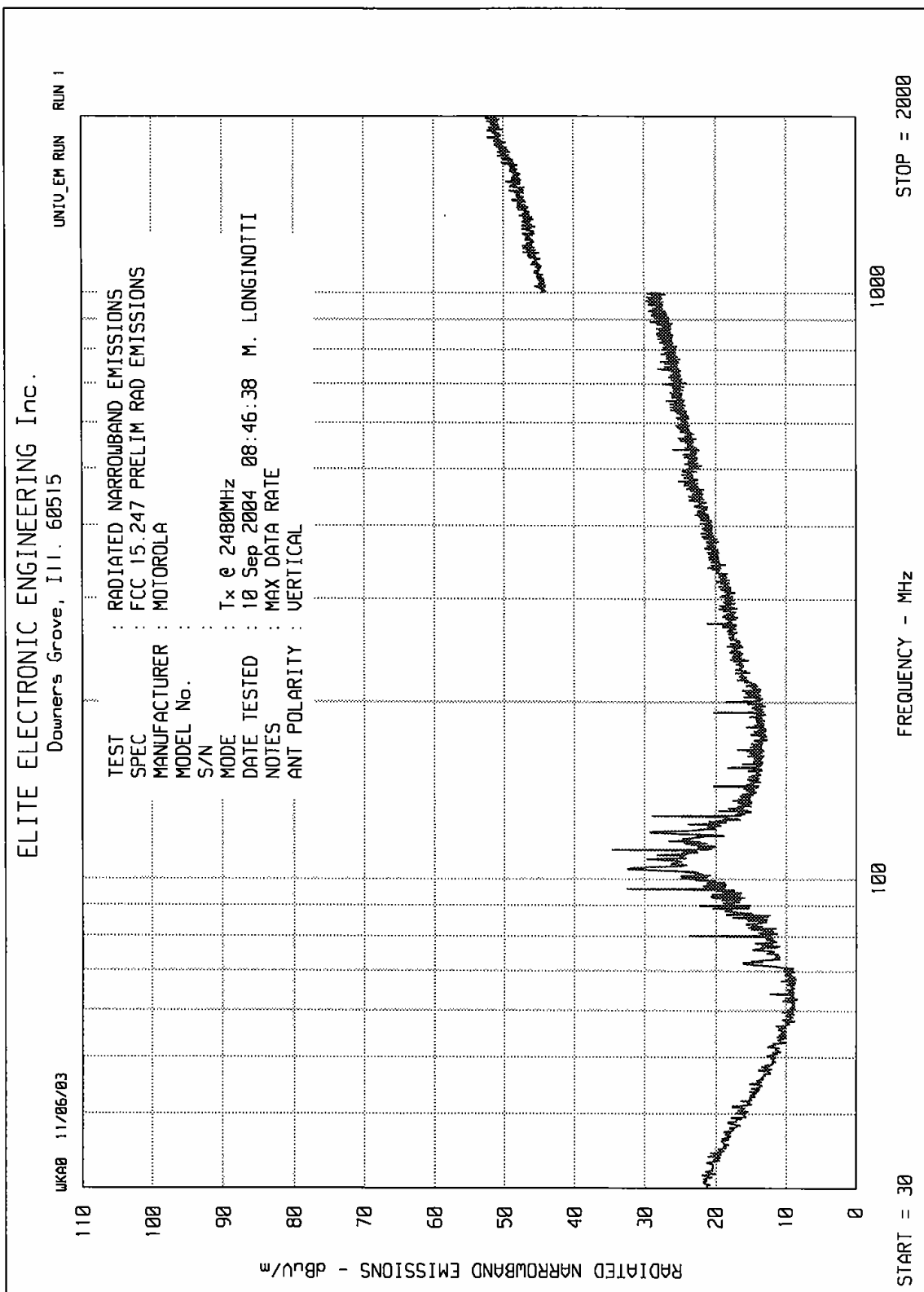


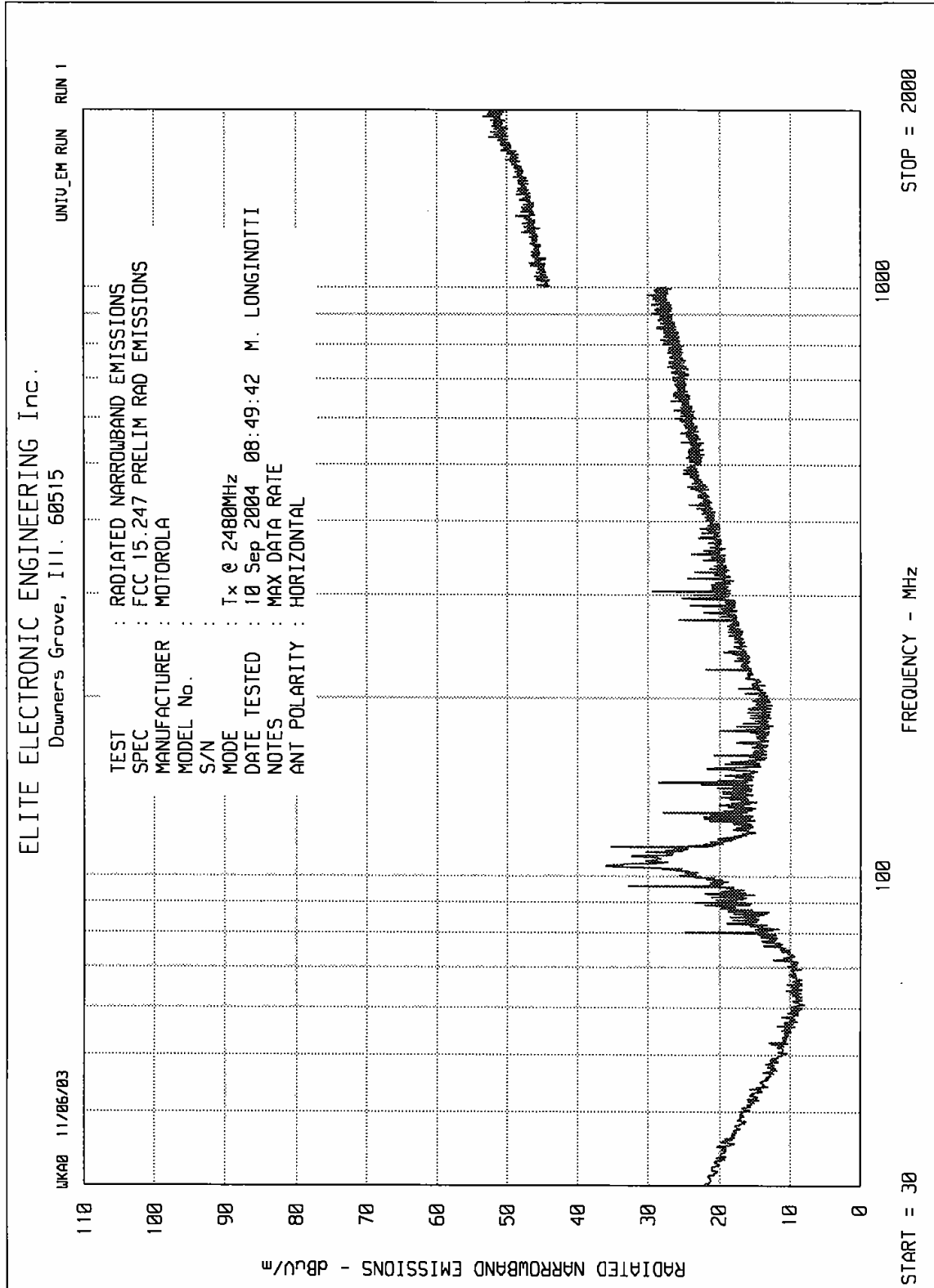


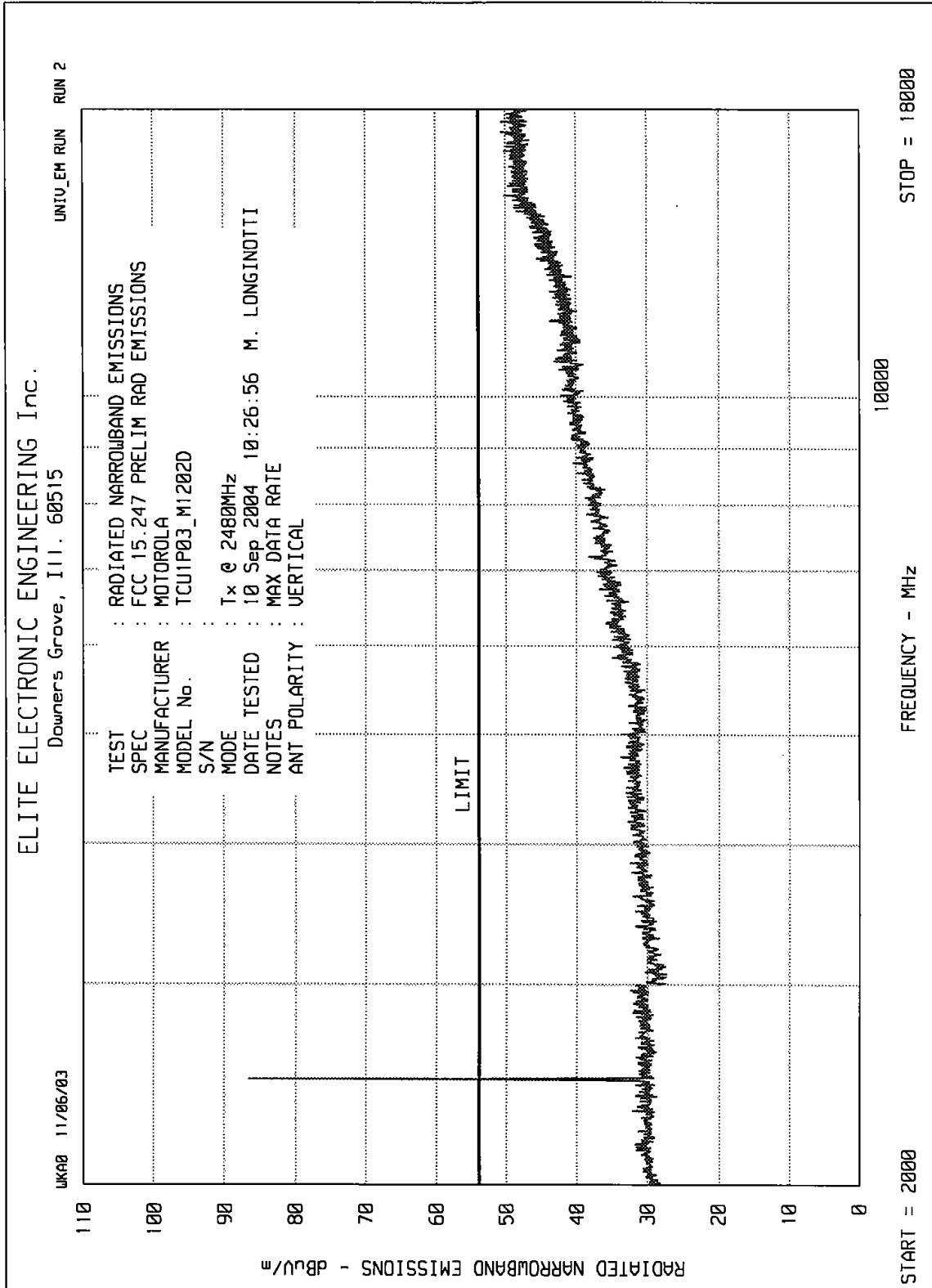


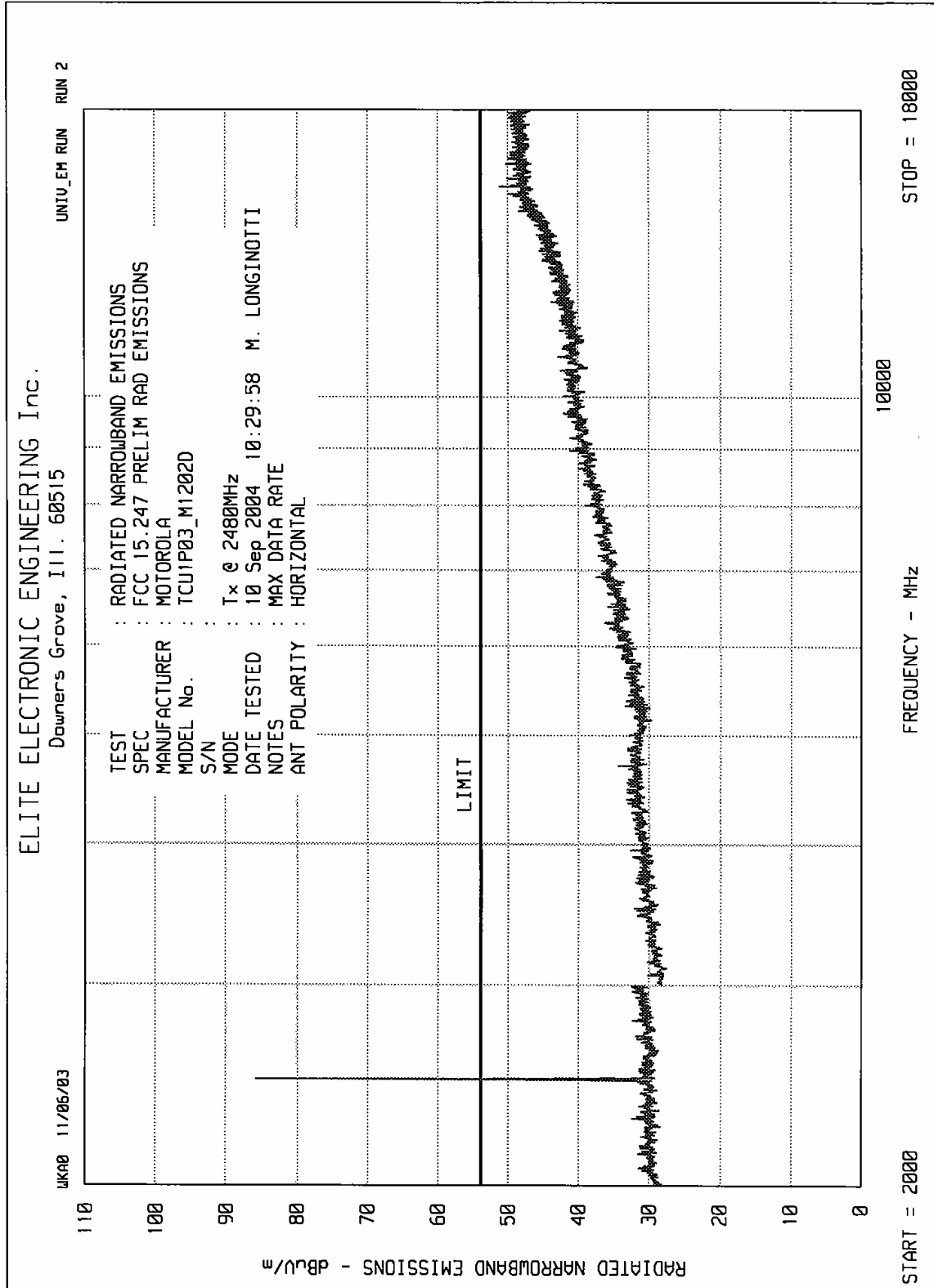














Data Sheet

MANUFACTURER : Motorola TCG
MODEL : TCU1P03_M1202D
S/N : 07187699
SPECIFICATION : FCC Part 15, Subpart C, Section 15.247
Radiated Spurious Emissions Measurement
DATE : September 10, 2004
NOTES : Transmitting at 2402MHz
: TEST DISTANCE IS 3 METERS

FREQ. MHz	ANT. POL.	MTR. RDG. dBuV	AMBIENT	B.W. RBW/VBW Hz	DIST. CORR. FACT. dB	ANT. FACT. dB	CABLE LOSS dB	PRE. AMP. dB	TOTAL dBuV/m	15.209 Limit dBuV/m
2402	V	100.3		1M/3M		31.3	3.5	-35.9	99.2	
2402	H	97.4		1M/3M		31.3	3.5	-35.9	96.3	
4804	V	28.3	AMBIENT	1M/10M		34.8	0.6	-35.2	28.5	54
4804	H	28.1	AMBIENT	1M/10M		34.8	0.6	-35.2	28.3	54
12010	V	27.3	AMBIENT	1M/10M		41.4	1	-34.8	34.9	54
12010	H	27.5	AMBIENT	1M/10M		41.4	1	-34.8	35.1	54
19216	V	32.4	AMBIENT	1M/10M		45.6	1.8	-35	44.8	54
19216	H	32.4	AMBIENT	1M/10M		45.6	1.8	-35	44.8	54

CHECKED BY: *Mark E. Longino*



Data Sheet

MANUFACTURER : Motorola TCG
MODEL : TCU1P03_M1202D
S/N : 07187699
SPECIFICATION : FCC Part 15, Subpart C, Section 15.247
Radiated Spurious Emissions Measurement
DATE : September 10, 2004
NOTES : Transmitting at 2441MHz
: TEST DISTANCE IS 3 METERS

FREQ. MHz	ANT. POL.	MTR. RDG. dBuV	AMBIENT	B.W. RBW/VBW Hz	DIST. CORR. FACT. dB	ANT. FACT. dB	CABLE LOSS dB	PRE. AMP. dB	TOTAL dBuV/m	15.209 Limit dBuV/m
2441	V	102		1M/3M		31.3	3.5	-35.9	100.9	
2441	H	100.6		1M/3M		31.3	3.5	-35.9	99.5	
4882	V	28.8	AMBIENT	1M/10M		34.9	0.6	-35.2	29.1	54
4882	H	29	AMBIENT	1M/10M		34.9	0.6	-35.2	29.3	54
7323	V	28.7	AMBIENT	1M/10M		38.2	0.8	-35.6	32.1	54
7323	H	28.7	AMBIENT	1M/10M		38.2	0.8	-35.6	32.1	54
12205	V	27.3	AMBIENT	1M/10M		41.5	1.1	-34.5	35.4	54
12205	H	27.1	AMBIENT	1M/10M		41.5	1.1	-34.5	35.2	54
19528	V	32.2	AMBIENT	1M/10M		45.8	2.2	-34.3	45.9	54
19528	H	32.1	AMBIENT	1M/10M		45.8	2.2	-34.3	45.8	54

CHECKED BY: *Mark E. Longinoth*

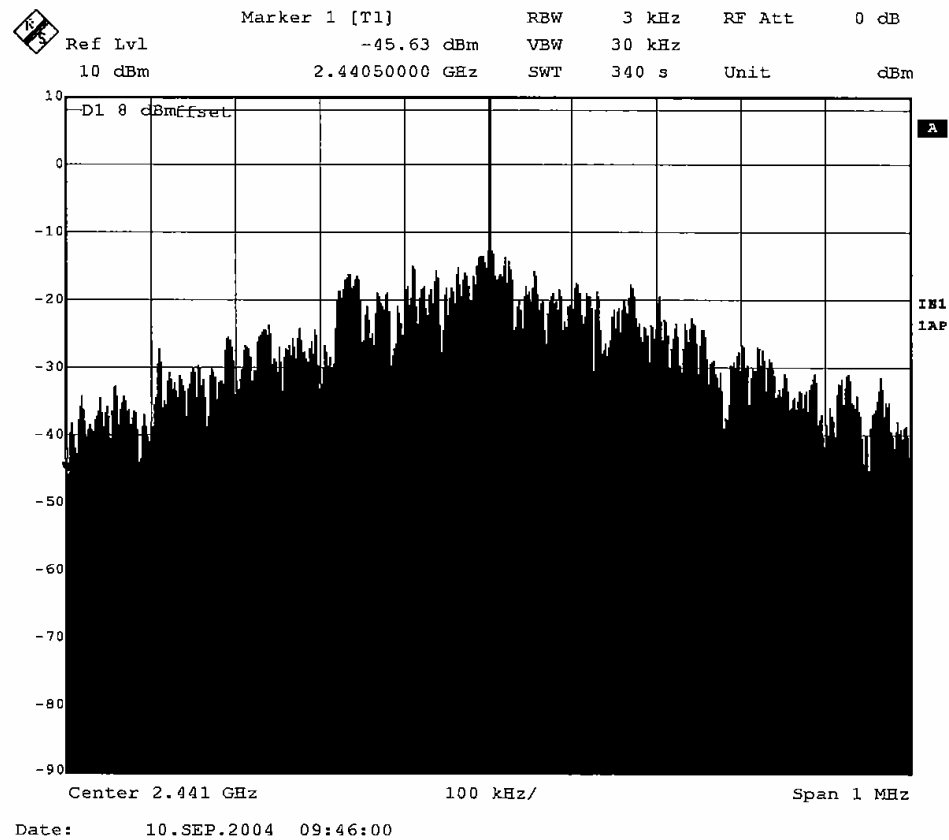


Data Sheet

MANUFACTURER : Motorola TCG
MODEL : TCU1P03_M1202D
S/N : 07187699
SPECIFICATION : FCC Part 15, Subpart C, Section 15.247
Radiated Spurious Emissions Measurement
DATE : September 10, 2004
NOTES : Transmitting at 2480MHz
: TEST DISTANCE IS 3 METERS

FREQ. MHz	ANT. POL.	MTR. RDG. dBuV	AMBIENT	B.W. RBW/VBW Hz	DIST. CORR. FACT. dB	ANT. FACT. dB	CABLE LOSS dB	PRE. AMP. dB	TOTAL dBuV/m	15.209 Limit dBuV/m
2480	V	101.6		1M/3M		31.4	3.5	-35.9	100.6	
2480	H	98.3		1M/3M		31.4	3.5	-35.9	97.3	
4960	V	25.6	AMBIENT	1M/10M		34.9	0.6	-35.2	25.9	54
4960	H	25.5	AMBIENT	1M/10M		34.9	0.6	-35.2	25.8	54
7440	V	30.1	AMBIENT	1M/10M		38.2	0.8	-35.6	33.5	54
7440	H	30.1	AMBIENT	1M/10M		38.2	0.8	-35.6	33.5	54
12400	V	27.3	AMBIENT	1M/10M		41.5	1.1	-34.2	35.7	54
12400	H	27.2	AMBIENT	1M/10M		41.5	1.1	-34.2	35.6	54
19840	V	31.9	AMBIENT	1M/10M		45.9	2.3	-33.4	46.7	54
19840	H	31.9	AMBIENT	1M/10M		45.9	2.3	-33.4	46.7	54
22320	V	31.6	AMBIENT	1M/10M		46.5	2.8	-34.8	46.1	54
22320	H	31.6	AMBIENT	1M/10M		46.5	2.8	-34.8	46.1	54

CHECKED BY: *Mark E. Longinoth*



MANUFACTURER : MOTOROLA
 MODEL NO. : TCU1P03_M1202D
 SERIAL NO. : 07187699
 TEST PERFORMED : FCC 15.247 POWER SPECTRAL DENSITY
 MODE : INQUIRY MODE
 NOTES : 20dB EXTERNAL ATTENUATION