



L.S. Compliance, Inc.  
W66 N220 Commerce Court  
Cedarburg, WI 53012  
Phone: 262.375.4400 Fax: 262.375.4248

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**Compliance Testing of:**

M3740 Keypad

**Prepared For:**

TG3 Electronics

**Test Report Number:**

305256 TX

**Test Date(s):**

May 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup>, 2005

***All results of this report relate only to the items that were tested. This report may not be reproduced, except in full, without written approval of L.S. Compliance, Inc.***

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## 1. L.S. Compliance in Review

### L.S. Compliance - Accreditations and Listing's

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

#### A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 1999  
with Electrical (EMC) Scope of Accreditation  
A2LA Certificate Number: **1255.01**

#### Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948  
FCC Registration Number: **90756**

Listing of 3 and 10 meter OATS based on Title 47CFR – Part 2.948  
FCC Registration Number: **90757**

#### Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1  
File Number: **IC 3088-A**

On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1  
File Number: **IC 3088**

#### U. S. Conformity Assessment Body (CAB) Validation

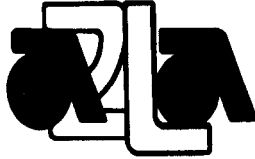
Validated by the European Commission as a **U. S. Competent Body** operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 89/336/EEC, Article 10.2.

Date of Validation: **January 16, 2001**

Validated by the European Commission as a **U.S. Notified Body** operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: **November 20, 2002**  
Notified Body Identification Number: **1243**

## 2. A2LA Certificate of Accreditation



THE AMERICAN  
ASSOCIATION  
FOR LABORATORY  
ACCREDITATION

### ACCREDITED LABORATORY

A2LA has accredited

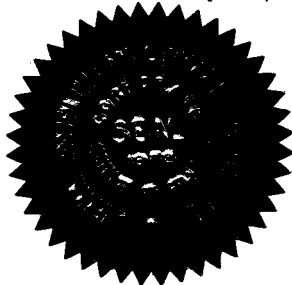
**L.S. COMPLIANCE, INC.**  
**Cedarburg, WI**


for technical competence in the field of

### Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 29<sup>th</sup> day of April 2005.



  
\_\_\_\_\_  
President  
For the Accreditation Council  
Certificate Number 1255.01  
Valid to January 31, 2007

For tests or types of tests to which this accreditation applies,  
please refer to the laboratory's Electrical Scope of Accreditation.

### 3. Validation Letter – U. S. Competent Body for EMC Directive 89/336/EEC



January 16, 2001



UNITED STATES DEPARTMENT OF COMMERCE  
National Institute of Standards and Technology  
Gaithersburg, Maryland 20899-

Mr. James J. Blaha  
L.S. Compliance Inc.  
W66 N220 Commerce Court  
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

- (✓) Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)
- ( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
- ( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
- Identification Number:
- ( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
- Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

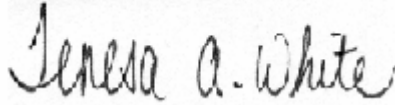
- (✓) Only the facility noted in the address block above has been approved.
- ( ) Additional EMC facilities:
- ( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at <http://ts.nist.gov/mra>. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

**NIST**

4. Signature Page

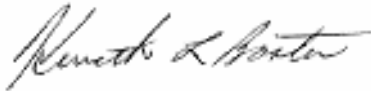


Prepared By:

June 30, 2005

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Teresa A. White, Document Coordinator      Date



Tested and  
Approved By:

June 30, 2005

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Kenneth L. Boston, EMC Lab Manager      Date  
PE # 31926 Licensed Professional Engineer  
Registered in the State of Wisconsin, United States

## 5. Product and General Information

Manufacturer:	TG3 Electronics				
Date(s) of Test:	May 18 <sup>th</sup> , 19 <sup>th</sup> and 20 <sup>th</sup> , 2005				
Test Engineer(s):		Tom Smith		Abtin Spantman	√ Ken Boston
Model #:	M3740				
Serial #:	Engineering Unit				
Test Frequency and Voltage:	3.0 VDC				
Operation Mode:	Normal				

### Environmental Conditions in the Test Lab:

Temperature:	20-25° C
Atmospheric Pressure:	86 kPa - 106 kPa
Humidity:	30-60%

## 6. Introduction

On May 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup>, 2005 a series of Radiated Emissions tests were performed on one sample of the TG3 Keypad, Model Number M3740, here forth referred to as the "Equipment Under Test" or "EUT".

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.231(b) for a periodic operation of a low power transmitter.

All Radiated Emission tests were performed to measure the emissions in the frequency bands described later in this report, and to determine whether said emissions are below the limits established by the aforementioned standards.

These tests were performed in accordance with the procedures described in the American National Standard for methods of measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4, 2003).

Also used as a reference for the EMI Receiver specification is the International Special Committee on Radio Interference – CISPR 16-1, 2003.

## **7. Product Description**

The TG3 Keypad transmitter has (generally) 6 keys that, when pressed, transmit commands a short distance inside a restaurant to a matching receiver. The transmitter and matching receiver are used to manage orders in a restaurant kitchen and the drive-thru window. They operate on 433.9 MHz, using on-off keying. The transmitter sends only one burst of code, corresponding to a menu item for each key pressed, even if the button is held down.

## **8. Test Requirements**

The EUT was tested for Conducted and Radiated Emissions, and for compliance with the limits set forth by FCC Title 47 CFR Parts 15.35, 15.205, 15.209, 15.231(a), 15.231(b) and 15.231(c) for manually operated periodic transmitters, as well as for compliance with Industry Canada RSS-210, for low power license-exempt radio-communication devices.

## **9. Summary of Test Report**

The Equipment Under Test (EUT) was found to **MEET** the requirements as described within the specifications of FCC Title 47 CFR Part 15.231 and Industry Canada RSS-210, Section 6.1 for a low power transmitter.

Some emissions are seen to be within 3dB of their respective limits. As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

The enclosed test results pertain to the sample(s) of the test item listed, and only for the tests performed on the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.



## **10. Radiated Emissions Test**

### **Test Setup**

The EUT was operated within the 3 Meter FCC listed Semi-Anechoic Chamber, located at L.S. Compliance, Inc., in Cedarburg, Wisconsin. The EUT was placed on an 80cm high, non-conductive pedestal, which was centered on a flush-mounted 2m diameter metal turntable. The EUT was configured to run in a continuous CW transmit mode during the 15.231(a) and 15.231(b) measurements. The EUT was then returned to normal operation for measurements of the data packet length and occupied bandwidth.

### **Test Procedure**

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to FCC Title 47 CFR Part 15.231(b) limits for manually operated periodic devices.

The EUT was tested from the lowest frequency generated by the transmitter (without going below 9 kHz) to the 10<sup>th</sup> harmonic of the fundamental frequency generated by the device. The appropriate limits were also observed when the fundamental or spurious signals were located within any of the restricted bands as described in FCC Part 15.205(a).

The EUT was placed on an 80cm high non-conductive pedestal, with the Antenna Mast placed 3 m from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz, and a Double Ridged Waveguide Horn Antenna was used to measure emissions above 1 GHz.

The EUT was configured to operate in a continuous transmit mode, with repeating data packets. The resultant signals from the fundamental harmonics and spurious signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the Antenna between 1 and 4 meters. The EUT was also given three different orientations to determine the maximum signal levels, using both horizontal and vertical antenna polarities.

The battery voltage was monitored to ensure proper level, and replaced as necessary during the test sequence.

### **Test Results**

No significant emissions were found, aside from the transmitter fundamental and harmonics. The unit was scanned for emissions over the range of 30 MHz to 5000 MHz to establish compliance with FCC Parts 15.231 and 15.205 while in a continuous transmit mode. At frequencies below the fundamental, no spurious signals, other than the noise floor of the system, could be found within 20 dB of the limits. A numeric list of measured emissions appears in the Data Chart(s) of this report.

## **Occupied Bandwidth**

In addition to measuring the levels of Radiated Emissions, the Occupied Bandwidth of the transmitter was measured. In accordance with FCC Part 15.231(c), the 20 dB bandwidth of the transmitted signal should be within a window of 0.25% of the center carrier frequency. The resolution bandwidth was set to the closest available filter setting on the HP 8546A EMI Receiver, then corresponded to 5% of the allowable bandwidth determined in the calculation mentioned above, without going below the resolution bandwidth of 10 kHz, as dictated in ANSI C63.4, 2003, Section 13.1.7.

The EUT was activated to transmit in a continuous mode and was placed on the aforementioned test configuration within the 3 Meter Chamber. The transmitted signal was received on a Log Periodic Antenna and provided to the HP 8546A EMI Receiver, where the fundamental frequency was displayed, and a plot of the Occupied Bandwidth was produced. The measured Occupied Bandwidth of 310 kHz is within the calculated limit of 1085 kHz. Results can be seen in the Occupied Bandwidth scans in this report.

## **Test Equipment Utilized**

A list of the test equipment used for the Radiated Emissions tests can be found in Appendix C of this report. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All antenna calibrations were performed at a N.I.S.T. traceable site, and the resultant correction factors were entered into the HP 8546A EMI Receiver software database.

The connecting cables used were also measured for loss using a calibrated Signal Generator and the HP 8546A EMI Receiver. The resulting loss factors were entered into the HP 8546A EMI Receiver database. This allowed for automatic change in the antenna correction factor. The resulting data taken from the HP 8546A EMI Receiver is an actual reading and can be entered into the database as a corrected meter reading.

When a reading is taken using the Peak Detector, a duty cycle correction factor can be applied for conversion to an average reading. This operation can be used when measuring short-duration bursts of data transmission, under FCC Part 15.231.

The resultant average reading can then be compared to the appropriate limit in order to determine compliance with the limits. The HP 8546A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

**Radiated Emissions Data Chart**  
**3 Meter Measurements of Electromagnetic Radiated Emissions**  
**Within the 3 Meter FCC Listed Semi-Anechoic Chamber**  
**Test Standard: FCC Parts 15.205, 15.209 and 15.231(b)**  
**Frequency Range Inspected: 30 MHz to 4500 MHz**

Manufacturer:	TG3 Electronics						
Date(s) of Test:	May 18 <sup>th</sup> , 19 <sup>th</sup> and 20 <sup>th</sup> , 2005						
Test Engineer:		Abtin Spantman		Tom Smith	√	Ken Boston	
Model #:	M3740						
Serial #:	Engineering Unit						
Voltage:	3.0 VDC						
Distance:	3 meters						
Configuration:	Continuous Data Modulation						
Detectors Used:		√	Peak	√	Quasi-Peak	√	Average

**Environmental Conditions in the Lab:**

Temperature: 20 – 25°C  
Atmospheric Pressure: 86 kPa – 106 kPa  
Relative Humidity: 30 – 60 %

**Test Equipment Used:**

EMI Measurement Instrument: HP8546A  
Biconical Antenna: EMCO #93110  
Log Periodic Antenna: EMCO #93146  
Horn Antenna: EMCO #3115

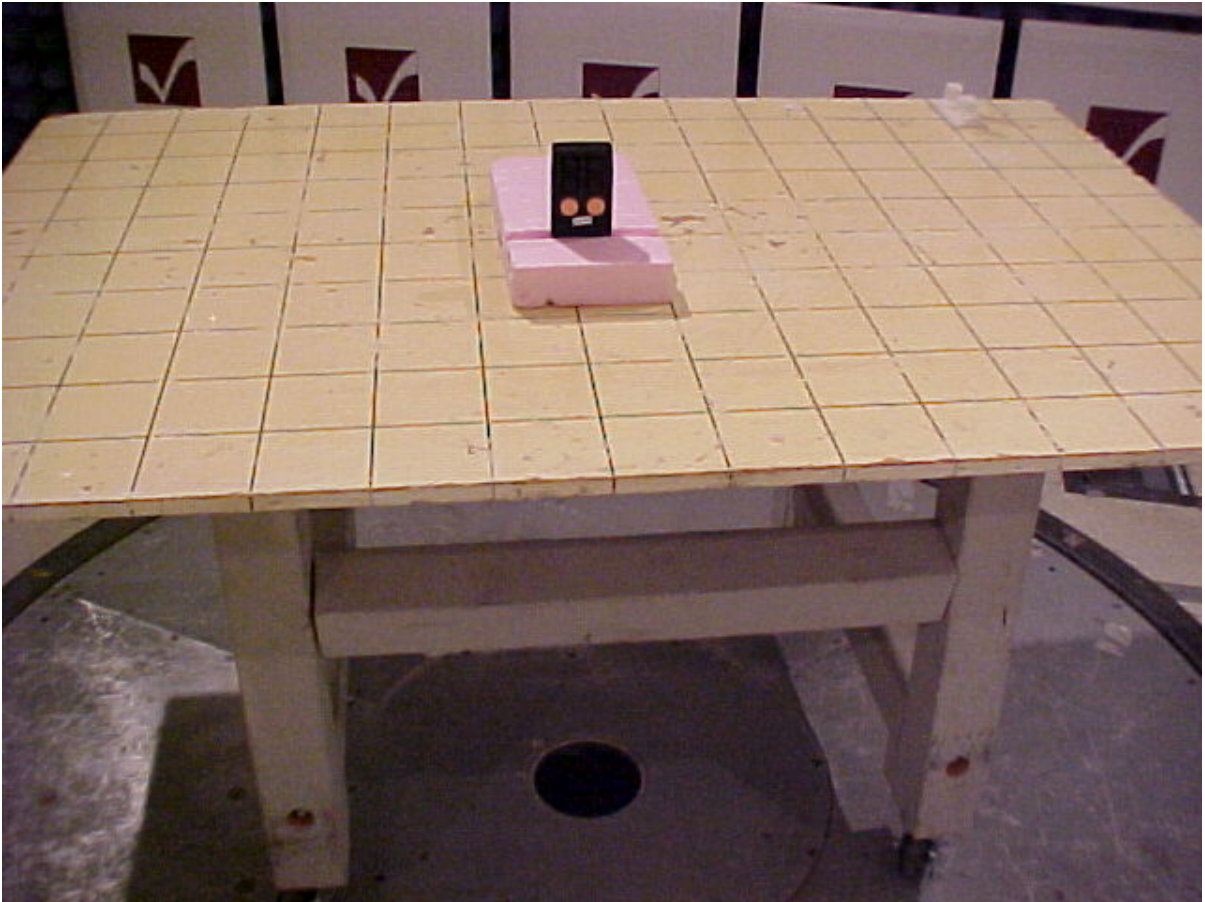
**The table depicts the level of significant radiated emissions found:**

Frequency (MHz)	Antenna Polarity	Height (m)	Azimuth (Degree)	EMI Meter Reading (dBμ V/m)	Duty Cycle Allowance (dB)	Corrected Reading (dBμV/m)	15.231(b) Limit (dBμV/m)	Margin (dB)
433.9	V	1.1	340	78.9	13.7	65.2	80.8	15.6
867.8	V	1.05	60	58.5	13.7	44.8	60.8	16.0
1301.7	V	1.2	260	51.3	13.7	37.6	54.0	16.4
1735.6	V	1.2	20	57.2	13.7	43.5	60.8	17.3
2169.5	V	1.45	40	54.5	13.7	40.8	60.8	20.0
2603.4	V	1.15	55	63.6	13.7	49.9	60.8	10.9
3037.3	V	1.0	95	56.5	13.7	42.8	60.8	18.0
3471.2	H	1.3	255	56.6	13.7	42.9	60.8	17.9
3905.1	H	1.2	295	53.9	13.7	40.2	54.0	13.8
4339.0	H	1.1	50	57.4	13.7	43.7	54.0	10.3

**Notes:** 1) When measuring frequencies below 1 GHz, the 'Peak' detector function was used with a receiver bandwidth of 120 kHz, and a video bandwidth of 300 kHz. When measuring frequencies above 1 GHz, the 'Peak' detector function was used with a receiver bandwidth of 1 MHz, and a video bandwidth of 1 MHz.

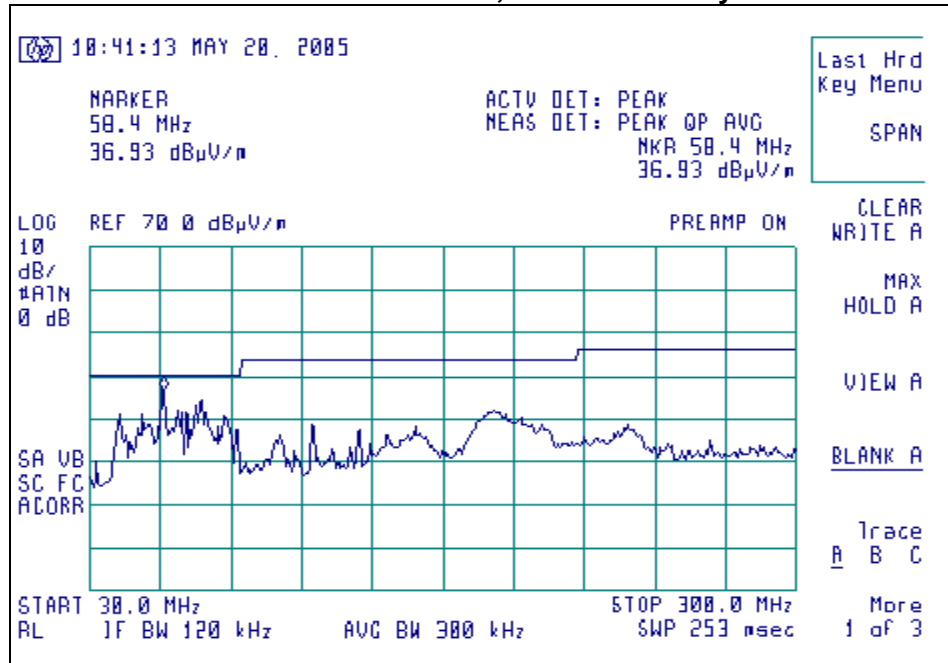
2) No other significant emissions were noted. All other emissions observed were better than 20 dB below the limit.

**Photo(s) of Radiated Emission Test Setup**

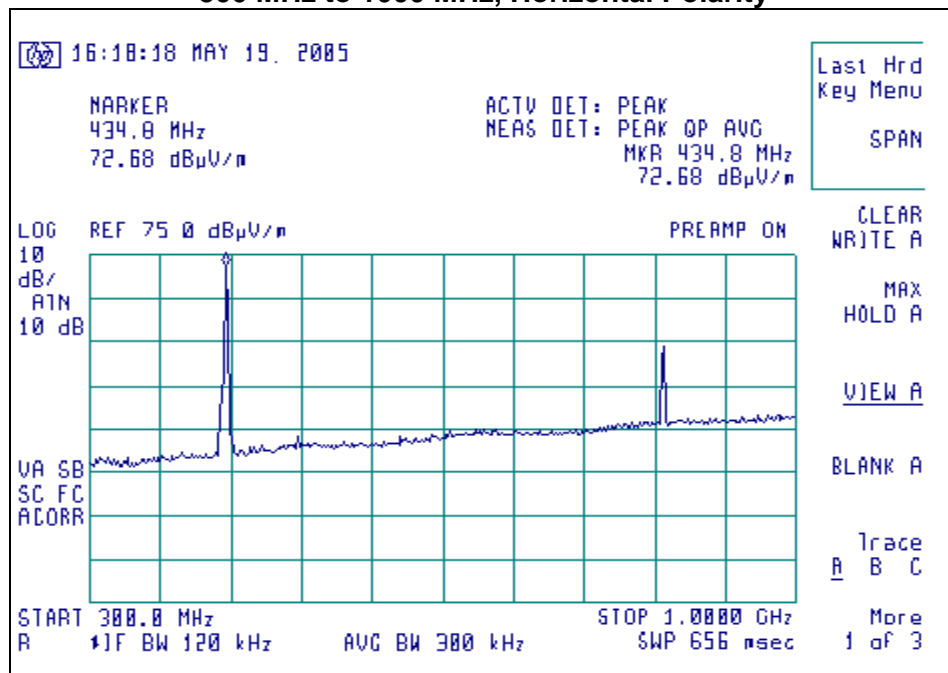


## Signature Scans of Radiated Emissions

### Signature Scan of Peak Radiated Emissions 30 MHz to 300 MHz, Vertical Polarity

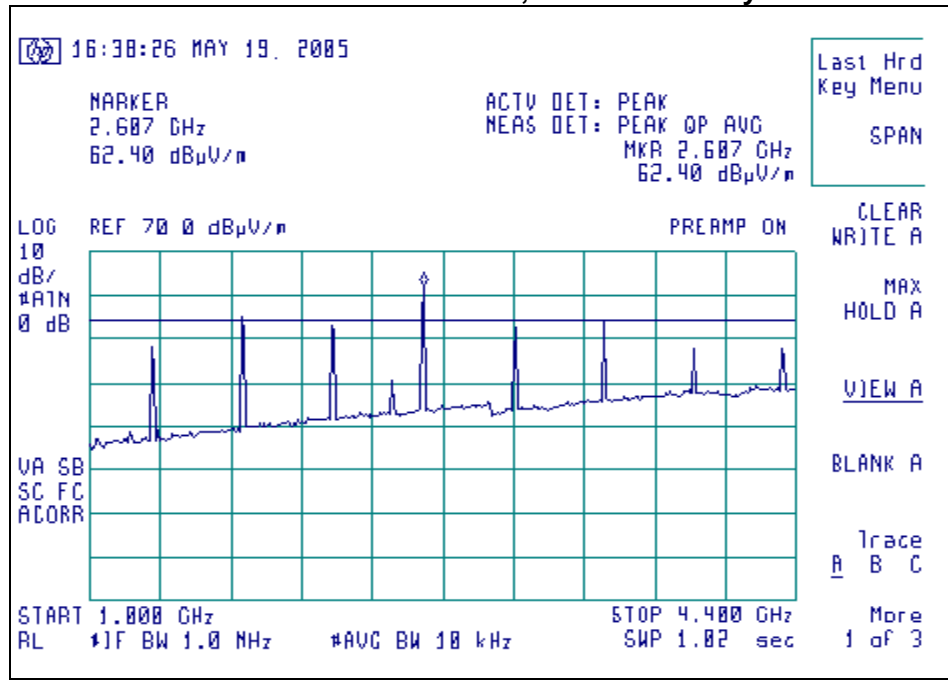


### Signature Scan of Peak Radiated Emissions 300 MHz to 1000 MHz, Horizontal Polarity

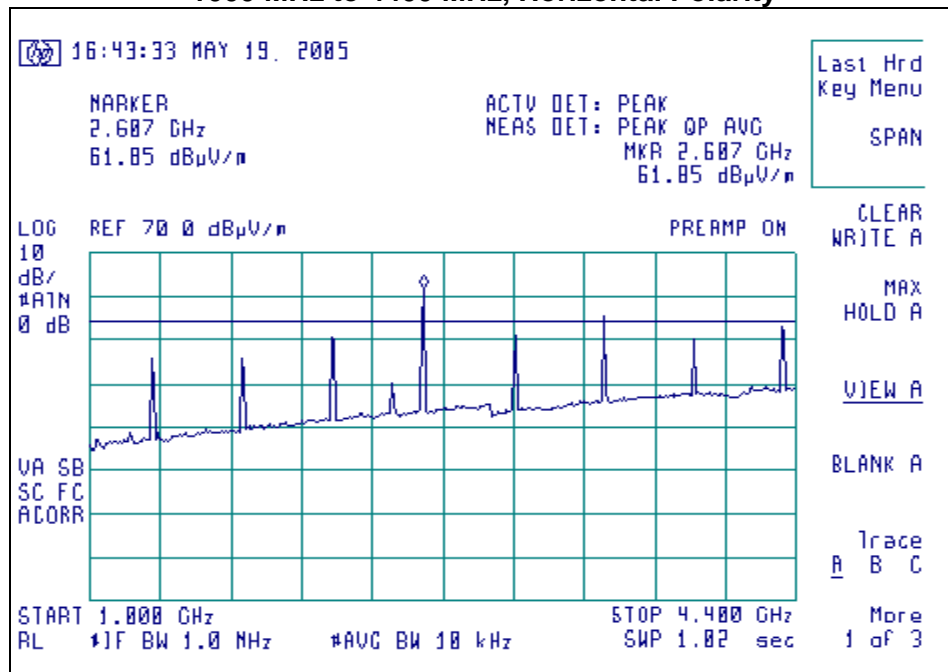


## Signature Scans of Radiated Emissions (continued)

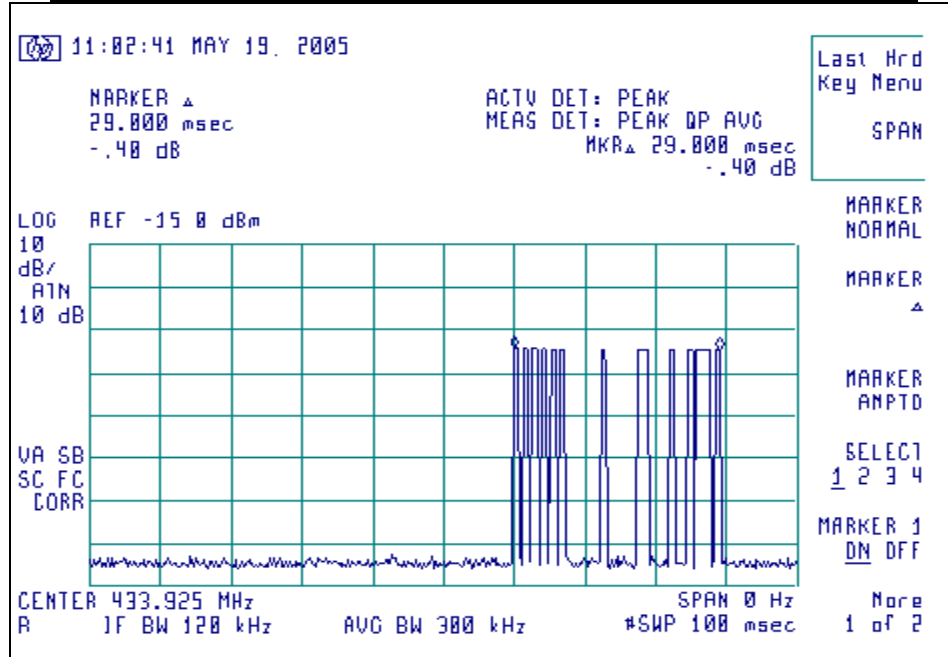
### Signature Scan of Peak Radiated Emissions 1000 MHz to 4400 MHz, Vertical Polarity



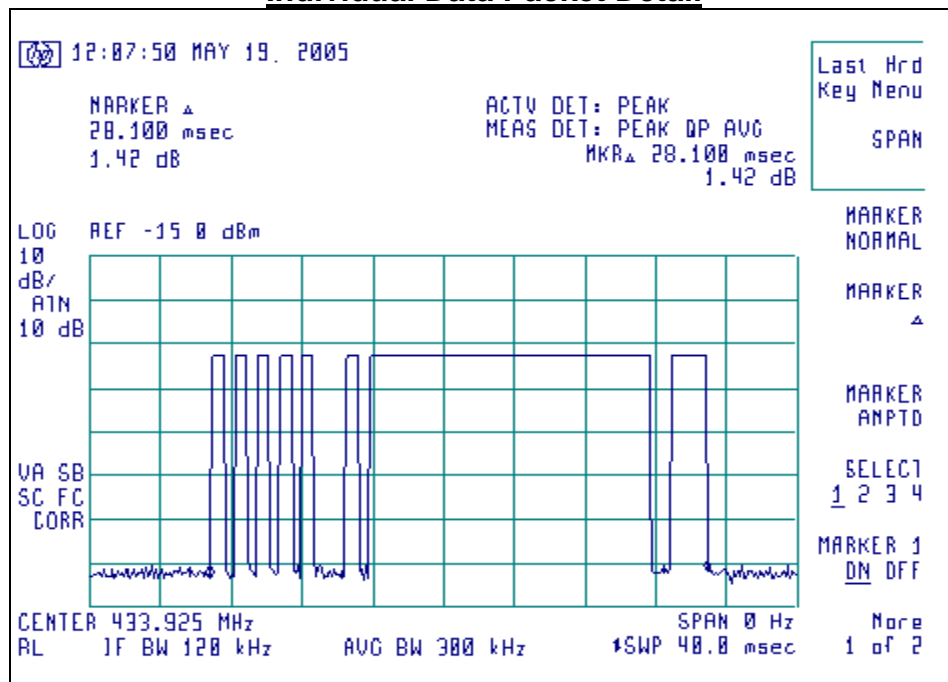
### Signature Scan of Peak Radiated Emissions 1000 MHz to 4400 MHz, Horizontal Polarity



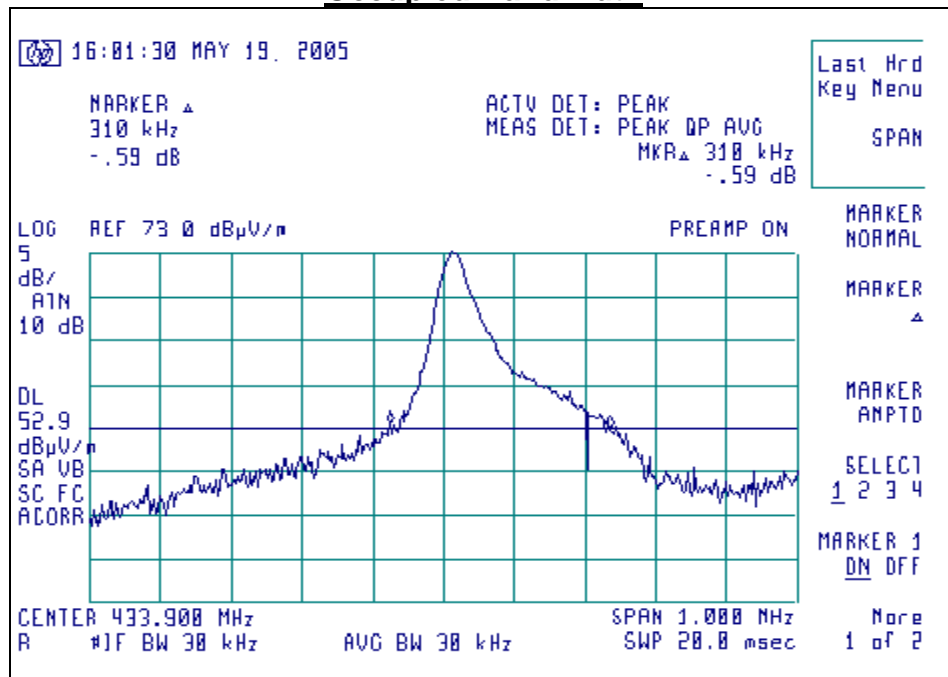
## Data Packet Detail - Radiated Emissions, 100 ms Window



## Individual Data Packet Detail



## Occupied Bandwidth





**APPENDIX A**  
**CALCULATIONS**

Manufacturer: TG3 Electronics  
Model: M3740  
Serial: Engineering Unit

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**CALCULATION OF RADIATED EMISSIONS LIMITS  
FOR FCC PARTS 15.209, and 15.231(b) (260-470 MHz)**

**FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:**

The calculation involves a linear interpolation of 3750 to 12500  $\mu\text{V/m}$  over 260-470 MHz, where field strength of the fundamental frequency ( $f_0$ ) when  $260 \leq f_0 \leq 470$  MHz, can be found by:  $3750 + 41.6667 (f_0 - 260)$ , where  $f_0$  is in MHz.

**FIELD STRENGTH OF SPURIOUS/HARMONIC FREQUENCIES:**

The spurious and harmonic emissions are subject to the limits expressed in FCC Parts 15.205 and 15.209, if within the restricted bands and dictated by the following calculation elsewhere.

The calculation involves a linear interpolation of 375 to 1250  $\mu\text{V/m}$  over 260 to 470 MHz, where field strength of the harmonic frequencies ( $2f_0, 3f_0, \dots$ ) when  $260 \leq f_0 \leq 470$  MHz, can be found by:  $375 + 4.1667(f_0 - 260)$ , where  $f_0$  is in MHz.

At fundamental frequency  $f_0 = 433.9$  MHz

Fundamental Limit:  $3750 + 41.6667 (433.9 - 260) = 10997 \mu\text{V/m @ 3m}$

Harmonic Limit:  $375 + 4.1667 (433.9 - 260) = 1099.7 \mu\text{V/m @ 3m}$

Frequency (MHz)	Fundamental Limit ( $\mu\text{V/m @ 3m}$ )	Fundamental Limit (dB $\mu\text{V/m @ 3m}$ )	Harmonic Limit ( $\mu\text{V/m @ 3m}$ )	Harmonic Limit (dB $\mu\text{V/m @ 3m}$ )
433.9	10,997	80.8	1099.7	608

## **APPENDIX B**

### **DUTY CYCLE CORRECTION**

For a graphical presentation of the data packets from the transmitter, refer to the Data Packet Detail – Radiated Emissions in this report. These images were captured on the EMC receiver while in zero span, on the transmitter fundamental frequency. The transmitter was functioning in normal operating mode, and activated by pressing one of the transmit buttons.

#### **Average (Relaxation) Factor**

Average Factor =  $20 * \log_{10}$  (Worst Case EUT On-time over 100 ms time window)

In this particular case, the transmit packet envelope can be used to calculate the relaxation factor. The transmit packet occupies 20.5 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

$$\text{Average Factor} = 20 * \log_{10} (20.5 / 100 \text{ ms}) = 13.76$$

A relaxation factor of 13.7 dB would be allowable for this product.

#### **OCCUPIED BANDWIDTH CALCULATIONS**

FCC Part 15.231(c) states that the bandwidth of a manually operated device shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz and 900 MHz.

Said bandwidth is determined at the -20 dB reference to peak carrier points.

Refer to the set of screen captures in this report, which show the actual Occupied Bandwidth of the transmitters as measured.

For this device, operating at a center frequency of 433.9 MHz, the allowed Occupied Bandwidth is calculated to be:

$$433.9 \text{ MHz} \times 0.0025 = 1.08475 \text{ MHz}$$

### **APPENDIX C - Test Equipment List**

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/15/04	9/15/05
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/16/04	9/16/05
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/16/04	9/16/05
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/07/04	12/07/05
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	12/06/04	12/06/05
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/16/04	9/16/05
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/16/04	9/16/05
N/A	LSC	Cable	0011	3 Meter ½" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

**Note 1 - Equipment calibrated within a traceable system.**

### **Uncertainty Statement**

This uncertainty represents an expanded uncertainty  
expressed at approximately the 95% confidence level, using a coverage factor of k=2.

### **Table of Expanded Uncertainty Values, (K=2) for Specified Measurements**

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V