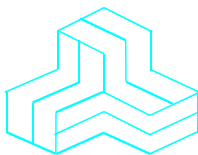


ENGINEERING TEST REPORT



Multi-button Key Tag Transmitter

Model No.: CLIK64-M2

FCC ID: LW3-CLIK64M

Applicant:

Active Control Technology Inc.

201-1300 Shawson Drive

Mississauga, Ontario

Canada, L4W 1C3

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)

Part 15, Subpart C, Section 15.231

Momentarily Operation at 433.92 MHz

UltraTech's File No.: ACCT-007F15C231

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: November 15, 2004



Report Prepared by: Anca Dobre

Tested by: Hung Trinh, RFI Technician

Issued Date: November 15, 2004

Test Dates: October 16, 2004

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
- This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4

Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



31040/SIT



C-1376



46390-2049



200093-0



SL2-IN-E-1119R



00-034



TABLE OF CONTENTS

EXHIBIT 1.	SUBMITTAL CHECK LIST	1
EXHIBIT 2.	INTRODUCTION.....	2
2.1.	SCOPE	2
2.2.	RELATED SUBMITTAL(S)/GRANT(S).....	2
2.3.	NORMATIVE REFERENCES	2
EXHIBIT 3.	PERFORMANCE ASSESSMENT	3
3.1.	CLIENT INFORMATION	3
3.2.	EQUIPMENT UNDER TEST (EUT) INFORMATION	3
3.3.	EUT'S TECHNICAL SPECIFICATIONS	4
3.4.	LIST OF EUT'S PORTS.....	4
3.5.	ANCILLARY EQUIPMENT	4
3.6.	GENERAL TEST SETUP.....	5
EXHIBIT 4.	EUT OPERATION CONDITIONS AND CONFIGURATIONS DURING TESTS.....	6
4.1.	CLIMATE TEST CONDITIONS	6
4.2.	OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS	6
EXHIBIT 5.	SUMMARY OF TEST RESULTS.....	7
5.1.	LOCATION OF TESTS.....	7
5.2.	APPLICABILITY & SUMMARY OF EMC EMISSIONS TEST RESULTS.....	7
5.3.	MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES.....	7
EXHIBIT 6.	MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS	8
6.1.	TEST PROCEDURES	8
6.2.	MEASUREMENT UNCERTAINTIES	8
6.3.	MEASUREMENT EQUIPMENT USED	8
6.4.	METHOD OF MEASUREMENTS	8
6.5.	ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER	8
6.6.	PERIODIC OPERATION PROVISIONS [§15.231(a)].....	9
6.7.	TRANSMITTER RADIATED EMISSIONS @ 3 METERS – FUNDAMENTAL & SPURIOUS EMISSIONS [§§15.231(b), 15.209 & 15.205]	10
6.8.	EMISSION BANDWIDTH [§15.231(c)].....	16
EXHIBIT 7.	MEASUREMENT UNCERTAINTY.....	18
7.1.	RADIATED EMISSION MEASUREMENT UNCERTAINTY	18
EXHIBIT 8.	MEASUREMENT METHODS.....	19
8.1.	GENERAL TEST CONDITIONS.....	19
8.2.	RADIATED EMISSIONS.....	20

EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	- Exhibit 1: Submittal check lists - Exhibit 2: Introduction - Exhibit 3: Performance Assessment - Exhibit 4: EUT Operation and Configuration during Tests - Exhibit 5: Summary of test Results - Exhibit 6: Measurement Data - Exhibit 7: Measurement Uncertainty - Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Radiated Emissions Test Setup Photos	OK
2	External Photos of EUT	External EUT Photos	OK
3	Internal Photos of EUT	Internal EUT Photos	OK
4	Cover Letters	- Letter from Ultratech for Certification Request - Letter from the Applicant to appoint Ultratech to act as an agent	OK
5	ID Label/Location Info	- ID Label - Location of ID Label	OK
6	Block Diagrams	Block Diagram	OK
7	Schematic Diagrams	Schematics	OK
8	Parts List/Tune Up Info	Parts List	OK
9	Operational Description	Functional Description	OK
10	RF Exposure Info	--	N/A
11	Users Manual	Installation Instructions	OK

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231
November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.231
Title:	Code of Federal Regulations (CFR) Title 47 Telecommunication, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Section 15.231 - Momentarily Operation at 433.92 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.
Environmental Classification:	• Commercial, industrial or business • Residential

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2003	Code of Federal Regulations, Title 47 – Telecommunication
ANSI C63.4	2003	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
CISPR 22 & EN 55022	2003 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	2003	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Active Control Technology Inc.
Address:	201-1300 Shawson Drive Mississauga, Ontario Canada, L4W 1C3
Contact Person:	Steve Barrett Phone #: (905) 670-5500/ext. 21 Fax #: (905) 670-2345 Email Address: sbarrett@activecontrol.com

MANUFACTURER	
Name:	Active Control Technology Inc.
Address:	201-1300 Shawson Drive Mississauga, Ontario Canada, L4W 1C3
Contact Person:	Steve Barrett Phone #: (905) 670-5500/ext. 21 Fax #: (905) 670-2345 Email Address: sbarrett@activecontrol.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Active Control Technology Inc.
Product Name:	Multi-button key tag transmitter
Model Name or Number:	CLIK64-M2
Serial Number:	Test Sample
Type of Equipment:	Low Power Transmitter
Power Input Source:	3 V Internal Battery
Primary User Functions of EUT:	To remotely open vehicle lift gates or overhead parking doors

3.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Portable
Intended Operating Environment:	- Commercial, industrial or business - Residential
RF Output Power Rating:	0.0 Watt
Operating Frequency Range:	433.92 MHz
Duty Cycle:	31.95 %
20 dB Bandwidth:	13.55 kHz
Modulation Type:	ASK, OOK (on OFF keying)
Oscillator Frequencies	The transmitter is a SAW-stabilized oscillator (SAW resonator 433.92 MHz)
Antenna Connector Type:	Integral antenna (part of the printed circuit board) housed inside the enclosure.
Antenna Description:	Manufacturer: Active Control Technology Type: Integral Model: Printed on PCB Frequency Range: 433.92 MHz In/Out Impedance: 50 Ohms

3.4. LIST OF EUT'S PORTS

None.

3.5. ANCILLARY EQUIPMENT

None

3.6. GENERAL TEST SETUP

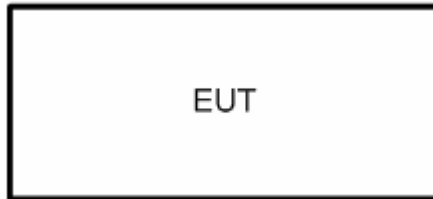


EXHIBIT 4. EUT OPERATION CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	3 V Battery

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was set to transmit continuously by means of special setting of jumpers on the printed circuit board for testing purpose only.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as an integral antenna equipment.

Transmitter Test Signal	
Frequency	433. 92 MHz

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: February 17, 2004.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSIONS TEST RESULTS

FCC Sections	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirement (The transmitter shall use a transmitting antenna that is an integral part of the device).	Yes. Integral antenna (part of the printed circuit board, housed inside the enclosure).
15.231(a)	Provisions for periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz.	Yes
15.231(b)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
15.231(c)	Bandwidth of the emission.	Yes
15.231(d)	Frequency Stability for devices operating within the frequency band 40.66 - 40.70 MHz.	N/A
15.107(a)	AC Power Line Conducted Emissions Measurements (Transmit & Receive)	N/A (Battery operated device) See Note 1

Note 1: The digital circuits portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices. The engineering test report can be provided upon request.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231
November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3, FCC 15.209 and CISPR 16-1.

6.4. METHOD OF MEASUREMENTS

The measurements were performed in accordance with Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

6.5. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to remotely open vehicle lift gates or overhead parking doors.

6.6. PERIODIC OPERATION PROVISIONS [§15.231(a)]

6.6.1. Engineering Analysis

FCC PROVISIONS	ANALYSIS ON COMPLIANCE
The intentional radiator restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted.	Door opener
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds after activation.	The manually operated transmitter is deactivated within 5 seconds if the button is pressed for a long period of time.
A transmitter activated automatically shall cease transmission within 5 seconds after activation.	No automatic activation.
Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions do not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed 2 seconds per hour.	N/A
Internal Radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	The transmitter is deactivated within 5 seconds.

6.7. TRANSMITTER RADIATED EMISSIONS @ 3 METERS – FUNDAMENTAL & SPURIOUS EMISSIONS [§§15.231(b), 15.209 & 15.205]

6.7.1. Limits

The RF radiated emissions measured at 3 Meters distance shall not exceed the field strength below:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
260 - 470	3,750 to 12,500 **	375 to 1,250 **

** linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

Field Strength of Fundamental Limit @ 433.92 MHz = $41.6667(433.92) - 7083.3333 = 10996.68 \mu\text{V/m} = 80.8 \text{ dB}\mu\text{V/m}$

Field Strength of Spurious Limit @ 433.92 MHz = $80.8 \text{ dB}\mu\text{V/m} - 20 \text{ dB} = 60.8 \text{ dB}\mu\text{V/m}$

Emissions within the restricted bands specified in §15.205(a) shall not exceed the general radiated emission limits specified in §15.209(a).

47 CFR 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

6.7.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Hewlett Packard	HP 8546A	3520A00248	9 kHz – 5.6 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

6.7.4. Test Data

Frequency (MHz)	Peak E-Field @3m (dBμV/m)	Average E-Field @3m (dBμV/m)	Antenna Plane (V/H)	§15.231(b) Limits @3m (dBμV/m)	§15.209 (a) Limits @3m (dBμV/m)	Margin (dB)
433.92	78.6	68.7	V	- 80.8	--	-12.2
433.92	79.1	69.1	H	- 80.8	--	-11.7
867.84	64.3	54.4	V	- 60.8	- 46.0	-6.4
867.84	65.0	55.1	H	- 60.8	- 46.0	-5.7
*1301.76	48.3	38.4	V	- 60.8	- 54.0	-15.6
*1301.76	48.5	38.6	H	- 60.8	- 54.0	-15.4
1735.68	53.1	43.2	V	- 60.8	- 54.0	-17.6
1735.68	56.1	46.2	H	- 60.8	- 54.0	-14.6

- The emissions were scanned from 10 MHz to 5 GHz and all emissions less than 20 dB below the limits were recorded.
- The transmitter was placed in three different orthogonal positions for searching maximum field strength level.

* Emission within restricted band.

Remarks:

- $T_{\text{xon}} = (36 \times 400.80 \mu\text{s}) + (23 \times 761.52 \mu\text{s}) = 31.95 \text{ ms}$
- Duty cycle = $T_{\text{xon}}/100 = 0.3195$
- Peak-to-Average Factor = $20 \times \log(0.3195) = -9.91 \text{ dB}$

Please refer to the following plots (Plot # 1 to 4) for detailed duty cycle measurements.

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

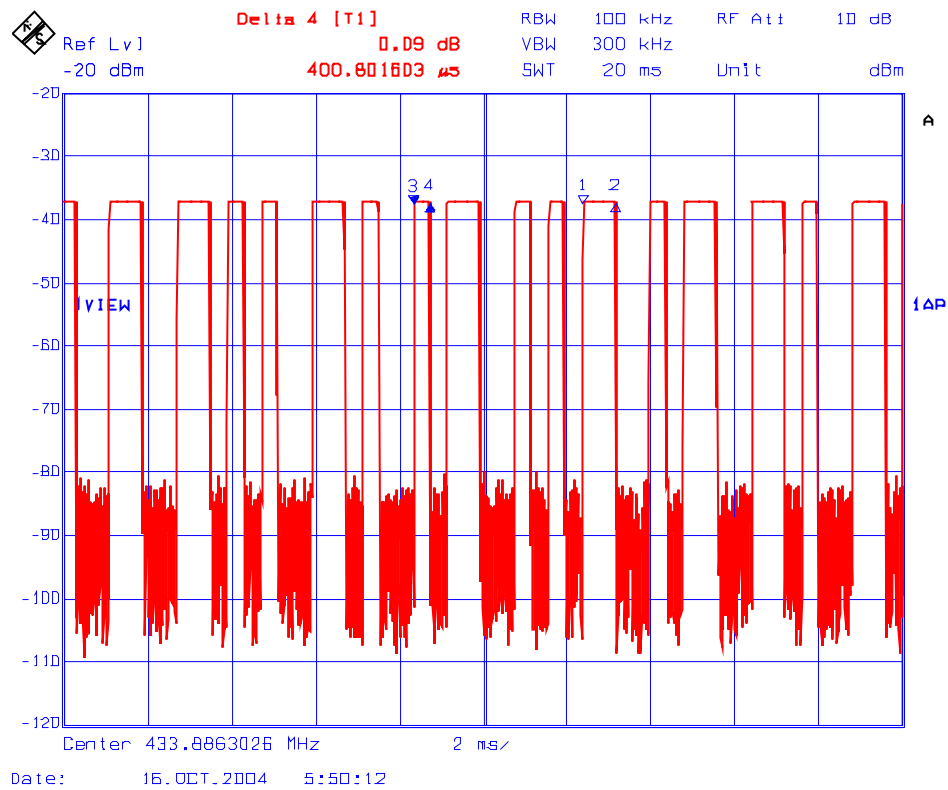
File #: ACCT-007F15C231

November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot #1:
Duty Cycle Measurement

Note: Short Time ON = 400.80 μ s
Long Time ON = 761.52 μ s



ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

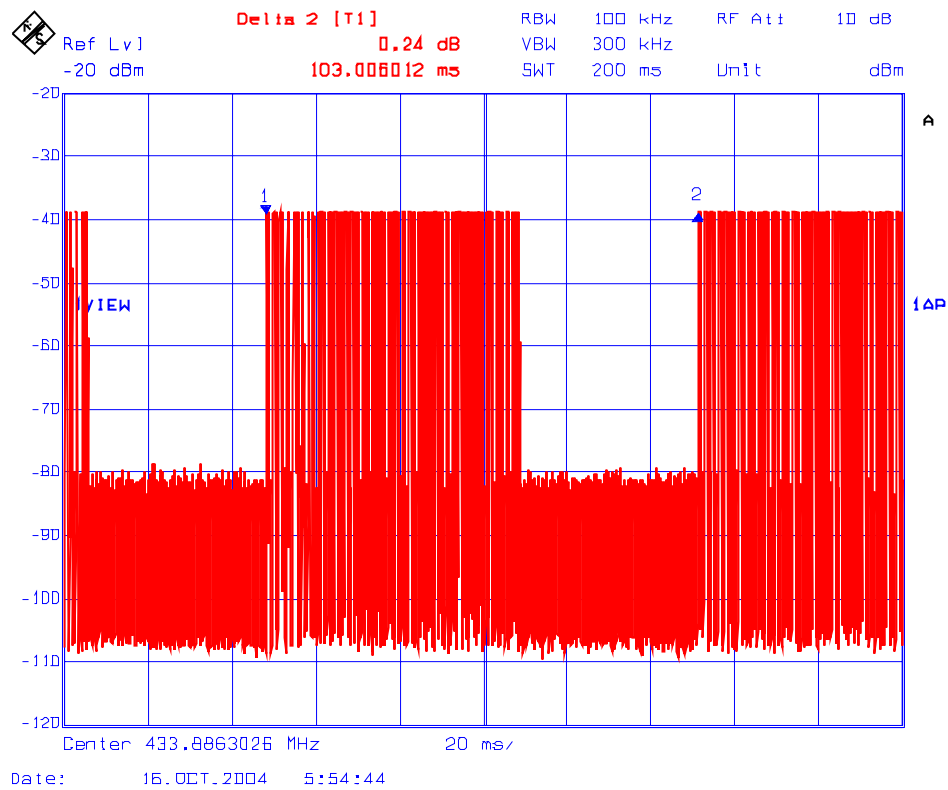
File #: ACCT-007F15C231

November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

**Plot #2:
Duty Cycle Measurement**

Note: Duty Cycle = $[(36 \times 400.80 \mu\text{s}) + (23 \times 761.52 \mu\text{s})] / 100 = 0.3195$



ULTRATECH GROUP OF LABS

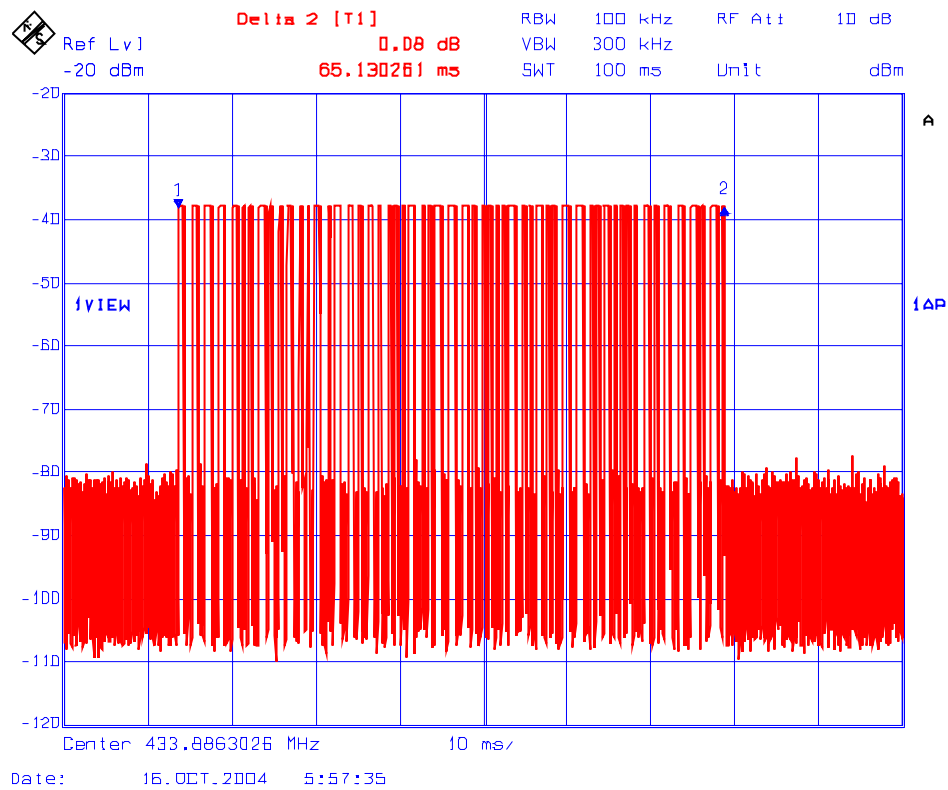
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231

November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot #3:
Duty Cycle Measurement



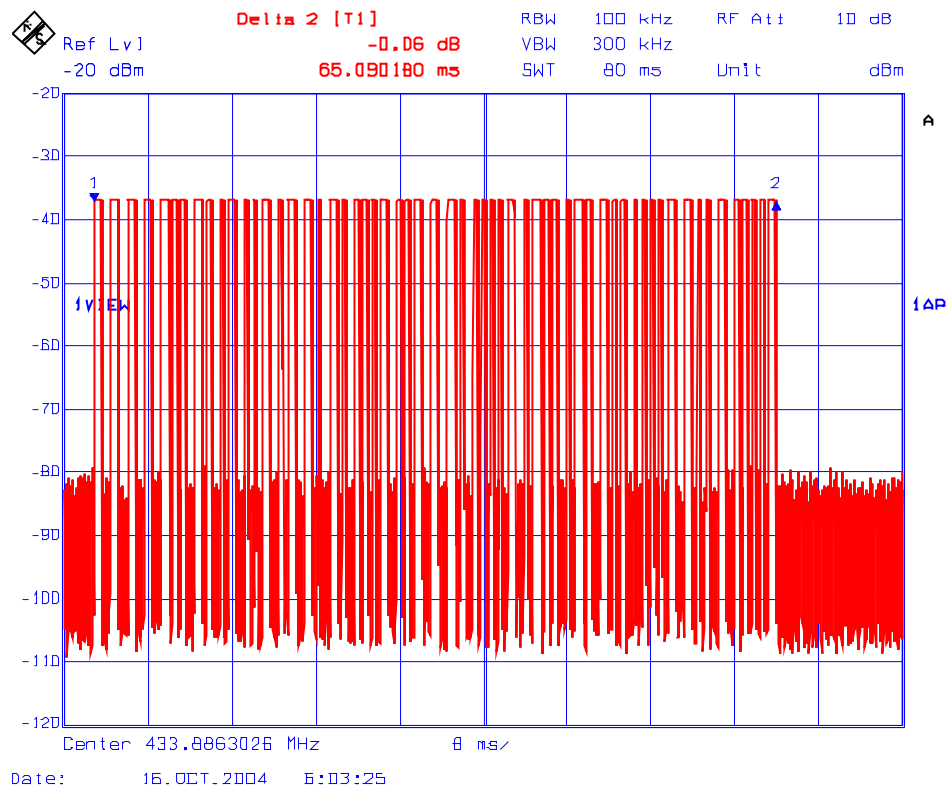
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231
November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot #4:
Duty Cycle Measurement



ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231

November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

6.8. EMISSION BANDWIDTH [§15.231(c)]

6.8.1. Limits

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

6.8.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004, §15.231(c) & ANSI C63-4.

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI C63.4.

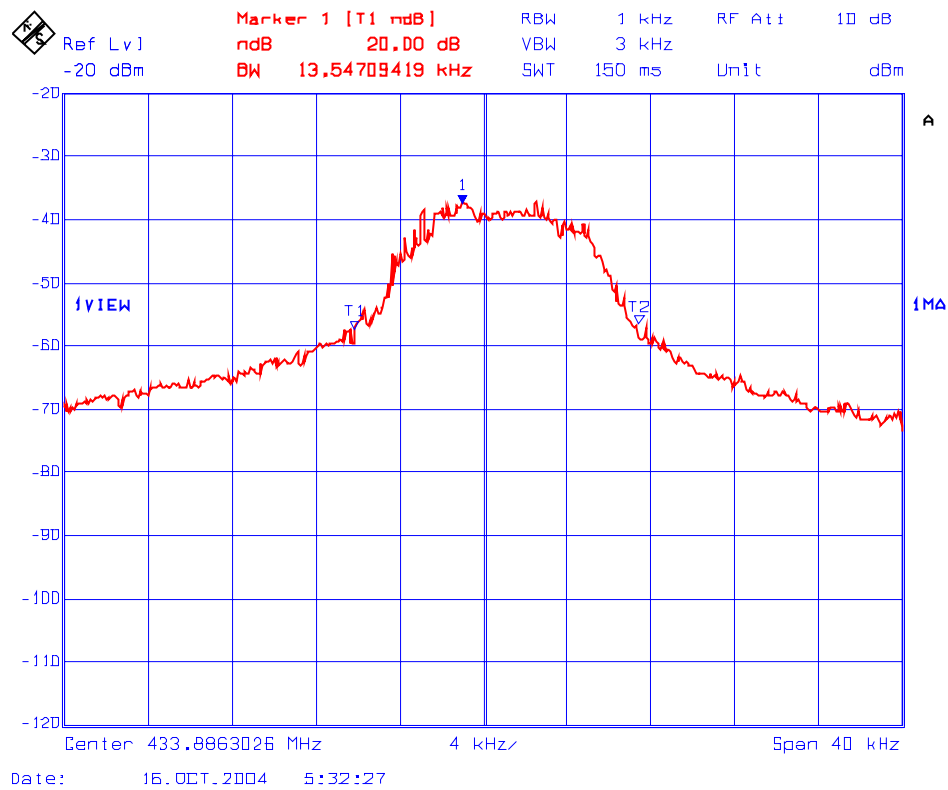
6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz

6.8.4. Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
433.92	13.55	1085	Pass

20 dB Bandwidth
Test Frequency: 433.92 MHz



ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ACCT-007F15C231
November 15, 2004

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (+ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	± 1.0	± 1.0
Cable Loss Calibration	Normal (k=2)	± 0.3	± 0.5
EMI Receiver specification	Rectangular	± 1.5	± 1.5
Antenna Directivity	Rectangular	± 0.5	± 0.5
Antenna factor variation with height	Rectangular	± 2.0	± 0.5
Antenna phase center variation	Rectangular	0.0	± 0.2
Antenna factor frequency interpolation	Rectangular	± 0.25	± 0.25
Measurement distance variation	Rectangular	± 0.6	± 0.4
Site imperfections	Rectangular	± 2.0	± 2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67(\text{Bi}) 0.3 (\text{Lp})$ Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	+1.1 -1.25	± 0.5
System repeatability	Std. Deviation	± 0.5	± 0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of $k = 2$ is used:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$

EXHIBIT 8. MEASUREMENT METHODS

8.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

8.1.1. Normal Temperature and Humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

8.1.2. Normal Power Source

8.1.2.1. Mains Voltage

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

8.1.2.2. Battery Power Source

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

8.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
 - The lowest operating frequency,
 - The middle operating frequency and
 - The highest operating frequency
- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

8.2. RADIATED EMISSIONS

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:
 1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
 2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
 3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:
 - RBW = 100 kHz for $f < 1\text{GHz}$ and $\text{RBW} = 1\text{ MHz}$ for $f \geq 1\text{ GHz}$
 - VBW = RBW
 - Sweep = auto
 - Detector function = peak
 - Trace = max hold
 - Follows the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
 - Allow the trace to stabilize.
 - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc.... is the peak field strength which comply with the limit specified in Section 15.35(b)

Calculation of Field Strength:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$\text{FS} = \text{RA} + \text{AF} + \text{CF} - \text{AG}$$

Where

FS	=	Field Strength
RA	=	Receiver/Analyzer Reading
AF	=	Antenna Factor
CF	=	Cable Attenuation Factor
AG	=	Amplifier Gain

Example: If a receiver reading of 60.0 dB μ V is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level = $60 + 7.0 + 1.0 - 30 = 38.0\text{ dB}\mu\text{V/m}$.

Field Level = $10^{(38/20)} = 79.43\text{ }\mu\text{V/m}$.

- Submit this test data
- Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100ms, then the reading obtained may be further adjusted by a "duty cycle correction factor", derived from $10\log(\text{dwell time}/100\text{mS})$ in an effort to demonstrate compliance with the 15.209.
- Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step 1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step 2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step 3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step 4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step 5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step 6: The effect of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.