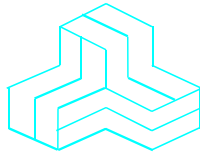


ENGINEERING TEST REPORT



Remote Control Engine Starter

Model No.: TX5BA

FCC ID: J5F-TX5BA

Applicant:

Astroflex Electronics
6146 Chemin St-Élie
St-Elie d'Orford, Québec
Canada, J0B 2S0

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
Part 15, Subpart C, Section 15.231
Momentarily Operation at 372.6 MHz

UltraTech's File No.: ATR-025F15C231

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



Date: September 25, 2006

Report Prepared by: JaeWook Choi

Tested by: Hung Trinh, RFI Technician

Issued Date: September 25, 2006

Test Dates: August 29 & September 14, 2006

- *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



0685



31040/SIT



C-1376



46390-2049



200093-0



SL2-IN-E-1119R

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)].....	14
EXHIBIT 7.	MEASUREMENT UNCERTAINTY.....	17
7.1.	RADIATED EMISSION MEASUREMENT UNCERTAINTY	17

EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	<ul style="list-style-type: none"> ▪ 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 	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	<ul style="list-style-type: none"> ▪ Letter from Ultratech for Certification Request ▪ Letter from the Applicant to appoint Ultratech to act as an agent ▪ Letter from the Applicant to request for Confidentiality Filing 	OK
5	ID Label/Location Info	<ul style="list-style-type: none"> ▪ ID Label ▪ Location of ID Label 	OK
6	Block Diagrams	Block Diagram	OK
7	Schematic Diagrams	Schematics	OK
8	Parts List/Tune Up Info	Bill of Material	OK
9	Operational Description	Operational Description	OK
10	RF Exposure Info	--	n/a
11	Users Manual	User Manual	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 #: ATR-025F15C231
 September 25, 2005

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:	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Section 15.231- Momentarily Operation at 372.6 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:	Residential

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

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-15	2005	Code of Federal Regulations – Telecommunication
ANSI C63.4	2004	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 CISPR 22 +A1 EN 55022	2003-04-10 2004-10-14 2003	Information Technology Equipment - Radio Disturbance Characteristics – Limits and Methods of Measurement
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2004	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance 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 #: ATR-025F15C231
September 25, 2006

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

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Astroflex Electronics
Address:	6146 Chemin St-Élie St-Elie d'Orford, Québec Canada, J0B 2S0
Contact Person:	Mr. Jean-François Gagné Phone #: (819) 566-0280 ext 253 Fax #: (819) 566-0298 Email Address: JFGagné@astroflex.com

MANUFACTURER	
Name:	Astroflex Electronics
Address:	6146 Chemin St-Élie St-Elie d'Orford, Québec Canada, J0B 2S0
Contact Person:	Mr. Jean-François Gagné Phone #: (819) 566-0280 ext 253 Fax #: (819) 566-0298 Email Address: JFGagné@astroflex.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:	AstroStart
Product Name:	Remote Control Engine Starter
Model Name or Number:	TX5BA
Serial Number:	Test Sample
Type of Equipment:	Low Power Transmitter
Power Input Source:	2 x 3V battery
Primary User Functions of EUT:	Remote car starter

3.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter @ 372.6 MHz	
Equipment Type:	Portable
Intended Operating Environment:	Residential
RF Output Power Rating:	76.4 dBµV/m E-field @ 3 meters
Operating Frequency Range:	372.6 MHz
Duty Cycle:	8.72 % (ASK), 18.2 % (FSK)
20 dB Bandwidth:	144.3 kHz (ASK), 140.3 kHz (FSK)
Modulation Type:	ASK, FSK
Antenna Connector Type:	Integral antenna (part of the printed circuit board) housed inside the enclosure.
Antenna Description:	Type: Integral Model: Printed on PCB Frequency Range: 372.6 MHz

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:	2 x 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	372.6 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.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site 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 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: June. 20, 2005.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSIONS TEST RESULTS

FCC Sections	Test Requirements	Compliance (Yes/No)
FCC 15.231 – MOMENTARILY TRANSMITTER @ 372.6 MHz		
15.203	Antenna requirement (The transmitter shall use a transmitting antenna that is an integral part of the device).	Yes
15.231(a)	Provisions of FCC 15.231	Yes
15.231(b)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
15.231(c)	20 dB Bandwidth	Yes
15.107(a)	AC Power Line Conducted Emissions Measurements (Transmit & Receive)	N/A (battery operated device)
Remote Control Engine Starter, Model No.: TX5BA, by AstroFlex Electronics has also been tested and found to comply with FCC Part 15, Subpart B - Radio Receivers and Class B Digital Devices . The engineering test report has been documented and kept on file and it is available upon request.		

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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 Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

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 start a car engine via RF link.

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.	Remote Control
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	Complies.
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.	N/A

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 Emission (microvolts/meter)
260 - 470	¹ 3,750 to 12,500	¹ 375 to 1,250

¹ Linear interpolation.

Field Strength of Fundamental Limit @ 372.6 MHz = 78.5 dBµV/m at 3 meters

Field Strength of Spurious Limit (outside restricted bands) = 58.5 dBµV/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.

Note: Because the EUT employs pulsed operation, the unit was modified for continuous operation and the readings were corrected by subtraction the peak-average correction factor derived from the appropriate duty cycle calculation. See §15.35 (c).

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 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

6.7.4.1. ASK Modulation

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)
372.58	97.41	76.3	V	78.5	--	-2.2
372.58	96.41	75.3	H	78.5	--	-3.2
745.16	63.63	42.5	V	58.5	46.0	-16.0
745.16	63.51	42.4	H	58.5	46.0	-16.1
*1117.74	53.04	31.9	V	58.5	54.0	-22.1
*1117.74	46.57	25.5	H	58.5	54.0	-28.5
*1490.32	48.08	27.0	V	58.5	54.0	-27.0
*1490.32	54.41	33.3	H	58.5	54.0	-20.7
1862.90	56.37	35.3	V	58.5	54.0	-23.3
1862.90	54.41	33.3	H	58.5	54.0	-25.2
*2235.48	54.74	33.6	V	58.5	54.0	-20.4
*2235.48	52.51	31.4	H	58.5	54.0	-22.6
2608.06	50.09	29.0	V	58.5	54.0	-29.5
2608.06	47.15	26.0	H	58.5	54.0	-32.5
2980.64	47.46	26.3	V	58.5	54.0	-32.2
2980.64	47.41	26.3	H	58.5	54.0	-32.2
*3353.22	48.86	27.7	V	58.5	54.0	-26.3
*3353.22	48.45	27.3	H	58.5	54.0	-26.7
*3725.80	50.95	29.8	V	58.5	54.0	-24.2
*3725.80	48.81	27.7	H	58.5	54.0	-26.3

- The emissions were scanned from 30 MHz to 4 GHz at 3 meters distance and all spurious 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.
- The peak-average correction factor was obtained from the duty cycle calculation. See the Remarks below for details.

*Emissions within restricted band.

Remarks:

- Duty cycle information has been provided by manufacturer and it is 8.72 %, Refer to the attached letter from manufacturer confirming the duty cycle provided.
- Peak-to-Average Factor = $20 \cdot \log(0.0872) = -21.19$ dB

6.7.4.2. FSK Modulation

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)
372.58	91.20	76.4	V	78.5	--	-2.1
372.58	88.53	73.7	H	78.5	--	-4.8
745.16	48.21	33.4	V	58.5	46.0	-25.1
745.16	51.29	36.5	H	58.5	46.0	-22.0
*1117.74	44.25	29.5	V	58.5	54.0	-24.5
*1117.74	45.01	30.2	H	58.5	54.0	-23.8
*1490.32	46.69	31.9	V	58.5	54.0	-22.1
*1490.32	41.78	27.0	H	58.5	54.0	-27.0
1862.90	47.83	33.0	V	58.5	54.0	-25.5
1862.90	45.04	30.2	H	58.5	54.0	-28.3
*2235.48	51.51	36.7	V	58.5	54.0	-17.3
*2235.48	48.62	33.8	H	58.5	54.0	-20.2

• The emissions were scanned from 30 MHz to 4 GHz at 3 meters distance and all spurious 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.
 • The peak-average correction factor was obtained from the duty cycle calculation. See the Remarks below for details.

*Emissions within restricted band.

Remarks:

- Duty cycle information has been provided by manufacturer and it is 18.2 %, Refer to the attached letter from manufacturer confirming the duty cycle provided.
- Peak-to-Average Factor = $20 \cdot \log(0.182) = -14.79$ dB

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.

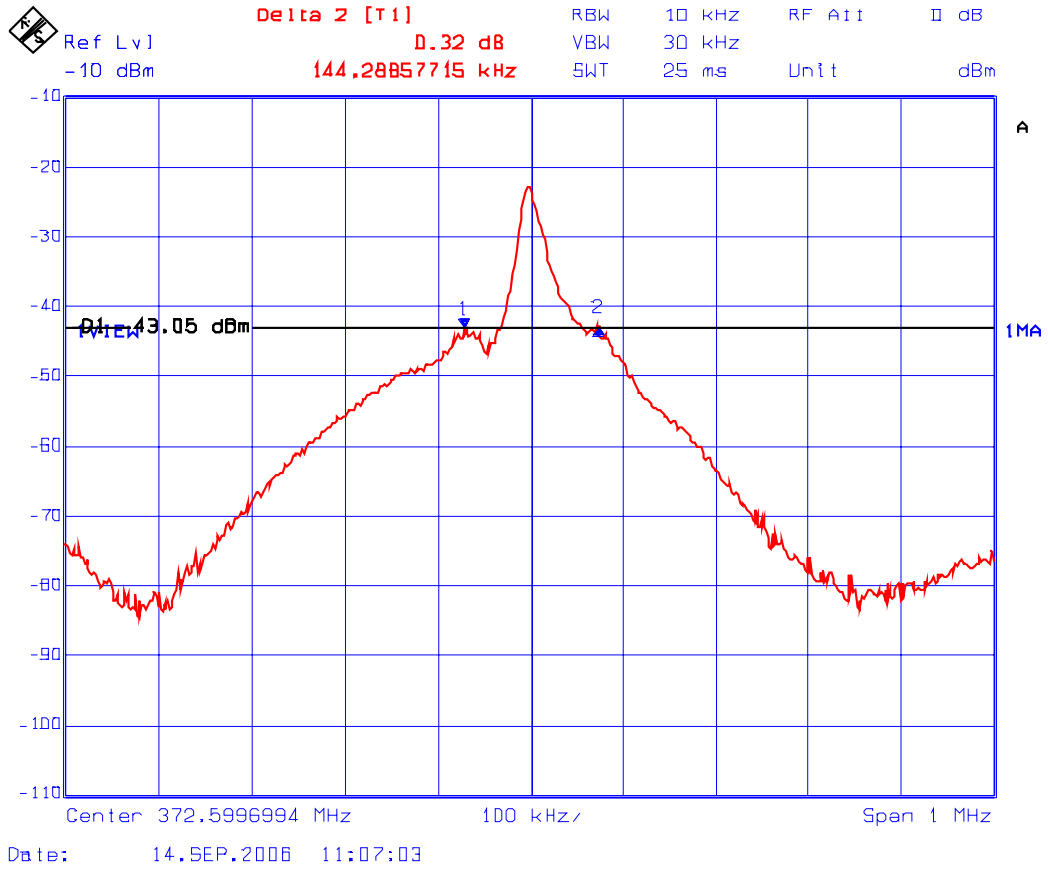
6.8.3. Test Equipment List

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)	Modulation	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
372.6	ASK	144.3	931.25	Pass
372.6	FSK	140.3	931.25	Pass

Plot #1:
20 dB Bandwidth, ASK
Test Frequency: 372.6 MHz



ULTRATECH GROUP OF LABS

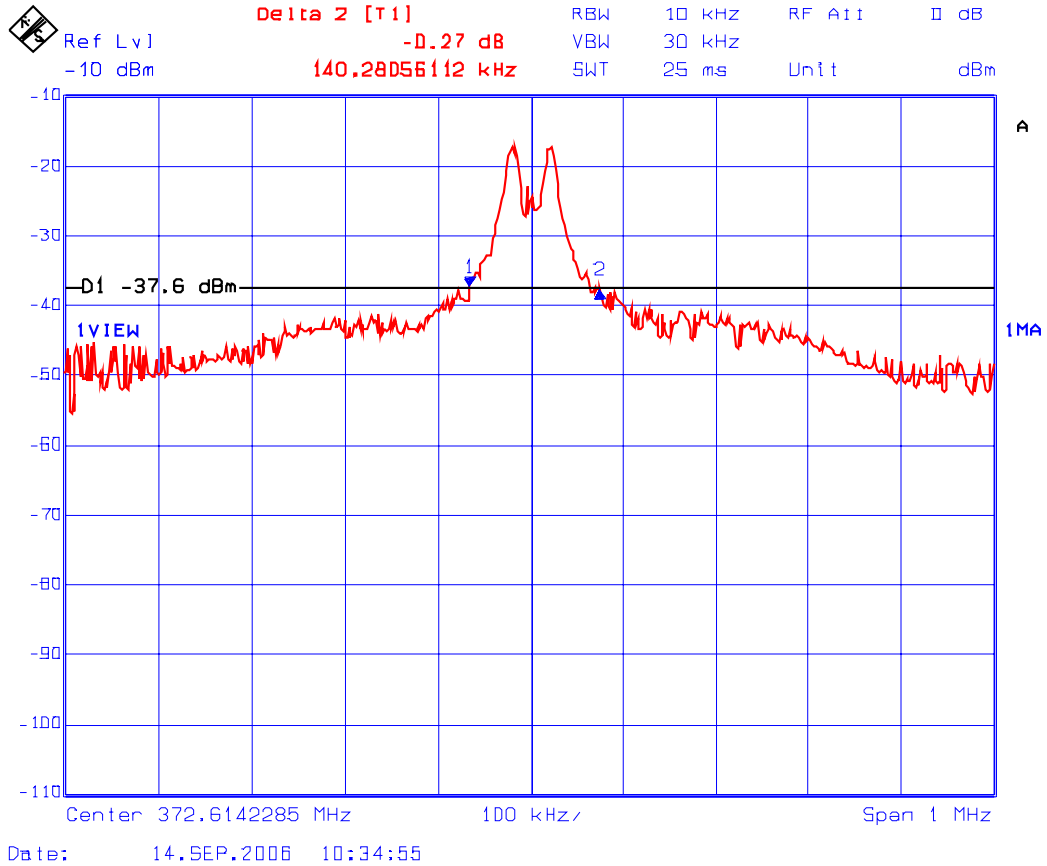
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: ATR-025F15C231

September 25, 2006

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

Plot #2:
20 dB Bandwidth, FSK
Test Frequency: 372.6 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 #: ATR-025F15C231

September 25, 2006

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 (\pm 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 $\Gamma_R = 0.67$ (Bi) 0.3 (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:

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