ENGINEERING TEST REPORT

Wireless Remote Thermo Sensor
Model No.: CLT-OTW25

FCC ID: MBH-OTW25

Applicant:

Sanyo Canada Inc.
1-300 Applewood Crescent
Concord, Ontario
Canada, L4K 5C7

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.231
Momentarily Operated Transmitters at 433.92 MHz

UltraTech's File No.: SAN-096F15C231

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: June 24, 2004	
Report Prepared by: Dan Huynh Issued Date: June 24, 2004	Tested by: Hung Trinh, Technician Test Dates: April 5 - May 4, 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.*

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1	Test Setup Photos	Radiated Emissions Setup Photos	OK
2	External EUT Photos	External EUT Photos	OK
3	Internal EUT Photos	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 ▪ Letter from the Applicant to request for Confidentiality Filing	OK
	Attestation Statements	Modification Required for Compliance	OK
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Operational Description	Detailed Operational Description	OK
10	RF Exposure Info	N/A	N/A
11	Users Manual	Instruction Manual	OK

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 a Low Power Transmitter operating 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:	▪ Residential ▪ Commercial, light industry & heavy industry

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 – 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	2002 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3: PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	SANYO Canada Inc.
Address:	1-300 Applewood Crescent Concord, Ontario Canada L4K 5C7
Contact Person:	Akio Ichimori Phone #: 905-760-4051 Fax #: 905-760-9301 Email Address: aichimor@sci.sanyo.com

MANUFACTURER	
Name:	Integrated Display Telecommunications (Shenzhen) Co., Ltd.
Address:	Block 21, Chentian Industrial Village Xixian Town, Bao An District, Shenzhen City China
Contact Person:	S.D Park Phone #: (0755)27936930 Fax #: (0755)27936020 Email Address: sdpark.td@idthk.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	Sanyo Canada Inc.
Product Name	Wireless Remote Thermo Sensor
Model Name or Number	CLT-OTW25
Serial Number	Pre-production
Type of Equipment	Low Power Communication Device Transmitter
Input Power Supply Type	Internal Battery
Primary User Functions of EUT:	Remote thermo sensor

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile
Intended Operating Environment:	▪ Residential ▪ Commercial, light industry & heavy industry
Power Supply Requirement:	2 x 1.5V AA size batteries
RF Output Power Rating:	68.8 dBμV/m at 3 meters
Operating Frequency Range:	433.92 MHz
RF Output Impedance:	50 Ohms
Duty Cycle:	50 %
20 dB Bandwidth:	7.66 kHz
Modulation Type:	OOK
Oscillator Frequencies:	32.768 kHz
Antenna Connector Type:	Integral (the antenna component is soldered onto the radio printed circuit board and located inside the enclosure)

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Shielding (Yes/No)
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3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

None.

3.6. GENERAL TEST SETUP

Stand-alone unit

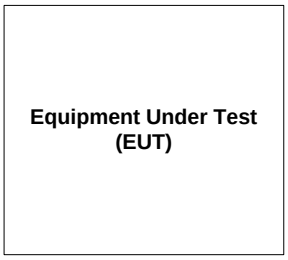


EXHIBIT 4: EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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 1.5V AA size batteries

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMTNT FOR TESTS

Operating Mode(s):	Continuous transmission with typical modulation.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	Integral

Transmitter Test Signals	
Frequency Band(s):	433.92 – 433.92 MHz
Frequency(ies) Tested:	433.92 MHz
Transmitter Wanted Output Test Signals:	
RF Power Output (measured maximum output power):	68.8 dBμV/m (at 3 metres distance)
Normal Test Modulation:	OOK
Modulating Signal Source:	Internal

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) x 16'(W) x 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 EMISSION TEST RESULTS

FCC Section (s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna Requirement	Yes
15.231(a)	Provisions of Periodic Operation	N/A
15.231(b) / (e)	Transmitter Radiated Emissions – Fundamental, Harmonic and Spurious and/or Transmission Duration	Yes
15.231(c)	20 dB Bandwidth	Yes
15.231(d)	Frequency Stability	N/A
15.107	AC Power Line Conducted Emissions	N/A, device is battery operated.
15.109	Unintentional Radiated Emissions (Digital Circuit Portions)	Yes

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

- R18 change from 180R to 330R
- Add C7 and C8 1p

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 15.231 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. ANTENNA REQUIREMENTS [§ 15.203]

6.5.1. Limits

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Notes: This requirement does not apply to carrier current devices operated under the provisions of @ 15.211, 15.213, 15.217, 17.219 or 15.221.

6.5.2. Engineering Analysis

The antenna component is soldered onto the radio printed circuit board and located inside the enclosure.

6.6. TRANSMITTER RADIATED EMISSIONS @ 3 METERS [§§ 15.231(e), 15.209 & 15.205]

6.6.1. Limits

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emission (microvolts/meter)
260 - 470	1,500 to 5,000 **	150 to 500 **
** 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, uV/m at 3 meters = 16.6667(F) - 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

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

FCC 47CFR 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 - 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 - 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 - 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 - 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 - 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 - 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 - 156.9	2200 - 2300	9000 - 9200	

FCC 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

6.6.2. Method of Measurements

Refer to Section 8.2 of this test report & ANSI C63.4

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. he maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Sections 15.35(b) and (c).

6.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Log Periodic/Bow-Tie Antenna	EMCO	3143	1029	20 - 1000 MHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

6.6.4. Test Data

6.6.4.1. Field Strength of Fundamental and Spurious Emissions Data

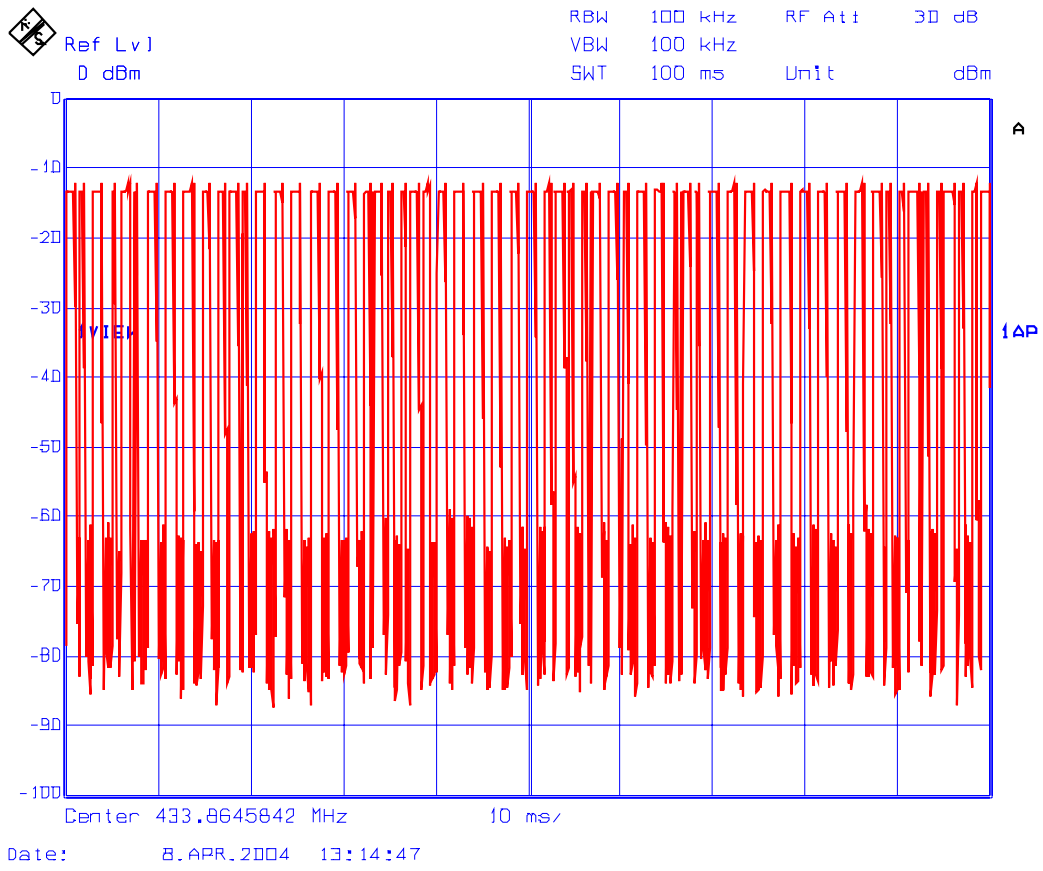
Duty Cycle Measurements: 50 % or Peak-Average Conversion factor = -6.02 dB
Please refer o the Plot 1 to 3 for detailed duty cycle measurements

The emissions were scanned from 10 MHz to 10th harmonic of the highest oscillator frequency and all emissions less 20 dB below the limits were recorded.

Note:
- For portable transmitter was placed in three different orthogonal positions for searching maximum field strength level.
- In the restricted band per §15.205: Limit per §15.209 is applied
- Outside the restricted band per §15.205: Limit per §15.231 or Limit §15.209, whichever allows higher field strength emission, is applied.

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	15.231(e) Limit @3m (dBµV/m)	15.209(a) Limit @3m (dBµV/m)	Margin (dB)	(Pass/Fail)
433.92	74.8	68.8	V	72.9	--	-4.1	Pass
433.92	73.7	67.7	H	72.9	--	-5.2	Pass
867.84	57.8	51.8	V	52.9	46.0	-1.1	Pass
867.84	57.7	51.7	H	52.9	46.0	-1.2	Pass
1301.76	56.6	50.6	V	52.9	54.0	-3.4	Pass
1301.76	55.0	49.0	H	52.9	54.0	-5.0	Pass
1735.68	55.2	49.2	V	52.9	54.0	-4.8	Pass
1735.68	47.9	41.9	H	52.9	54.0	-12.1	Pass
2169.60	52.8	46.8	V	52.9	54.0	-7.2	Pass
2169.60	49.1	43.1	H	52.9	54.0	-10.9	Pass
2603.52	48.3	42.3	V	52.9	54.0	-11.7	Pass
2603.52	49.9	43.9	H	52.9	54.0	-10.1	Pass
3037.44	50.8	44.8	V	52.9	54.0	-9.2	Pass
3037.44	53.6	47.6	H	52.9	54.0	-6.4	Pass
3471.36	47.1	41.1	V	52.9	54.0	-12.9	Pass
3471.36	49.8	43.8	H	52.9	54.0	-10.2	Pass
3905.28	50.5	44.5	V	52.9	54.0	-9.5	Pass
3905.28	48.9	42.9	H	52.9	54.0	-11.1	Pass
4339.20	48.5	42.5	V	52.9	54.0	-11.5	Pass
4339.20	47.5	41.5	H	52.9	54.0	-12.5	Pass

Plot 1:
Duty Cycle Measurements in 100 ms

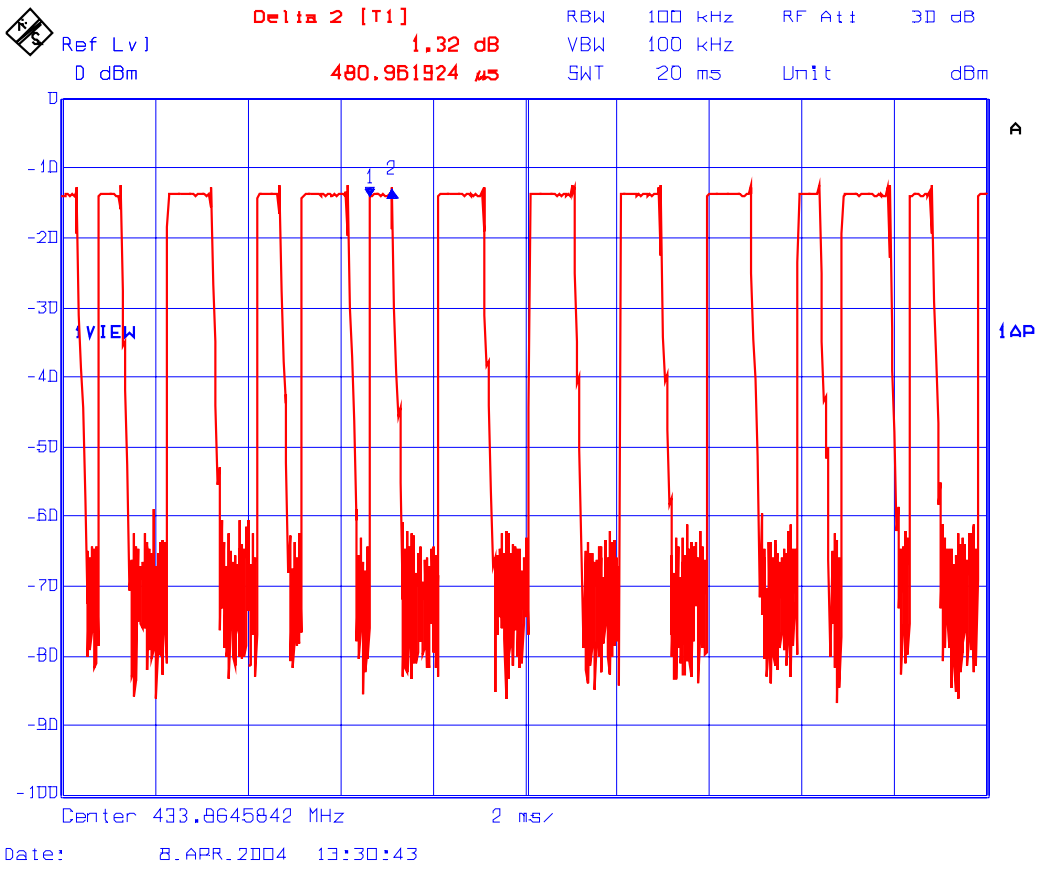


Pulse train in 100ms consists of 42 long pulses (at 961.92 μS each) and 20 short pulses (at 480.96 μS each)

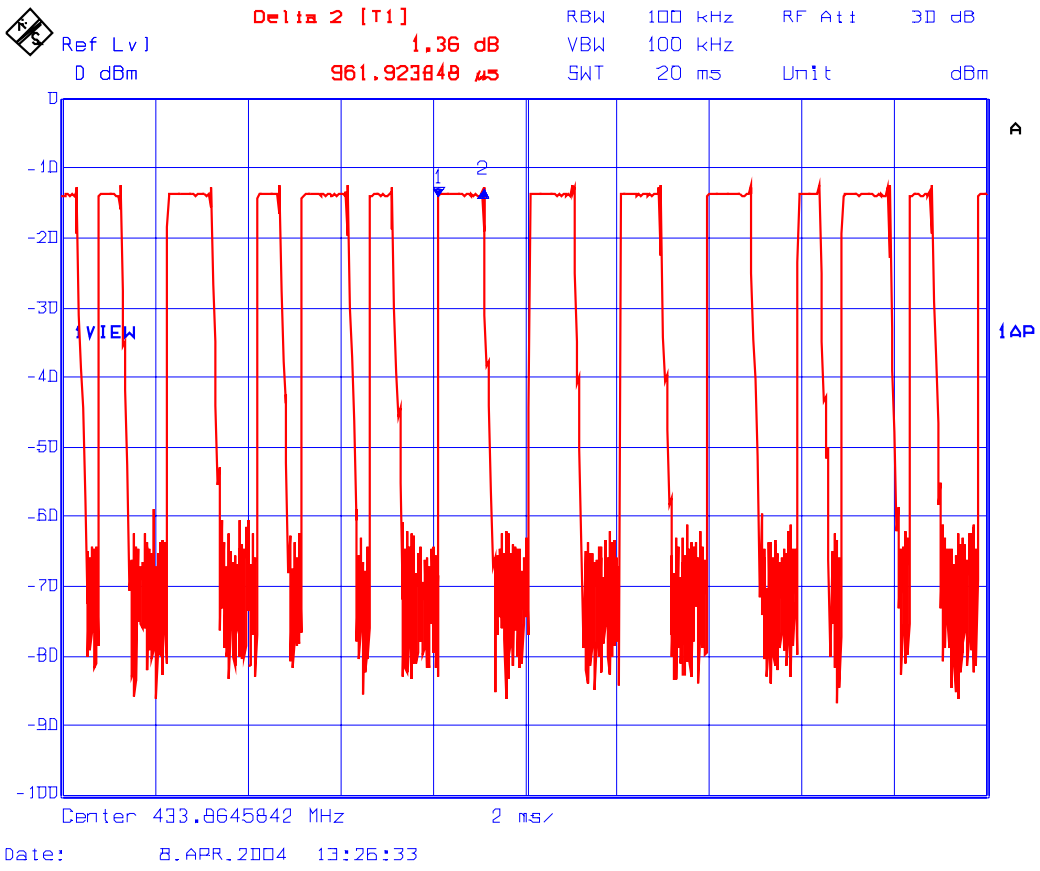
Duty Cycle = ((42 x 961.92 μS) + (20 x 480.96 μS)) / 100 = 50%

Hence, Duty Cycle Factor = 20log(0.5) = -6.02 dB

Plot 2:
Duty Cycle Measurements in 20 ms
Single short pulse = 480.96 μs



Plot 3:
Duty Cycle Measurements in 20 ms
Single long pulse = 961.92 μs

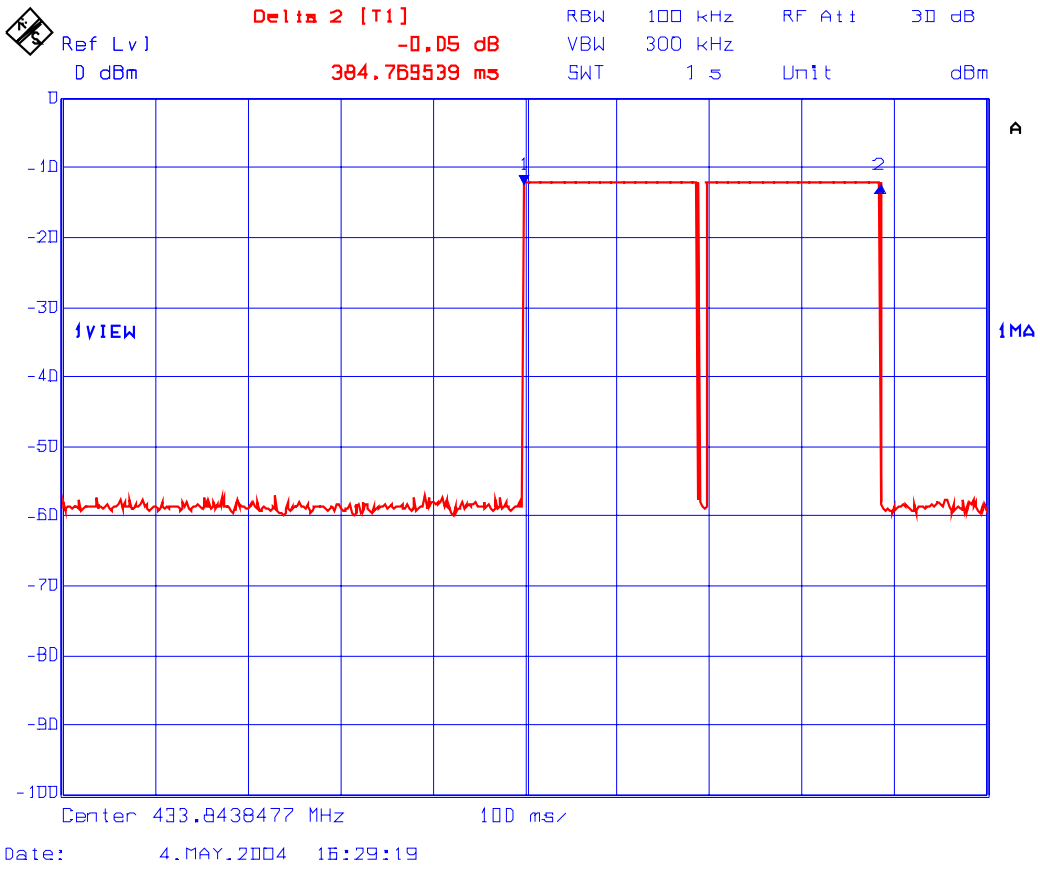


6.6.4.2. Transmission Characteristic

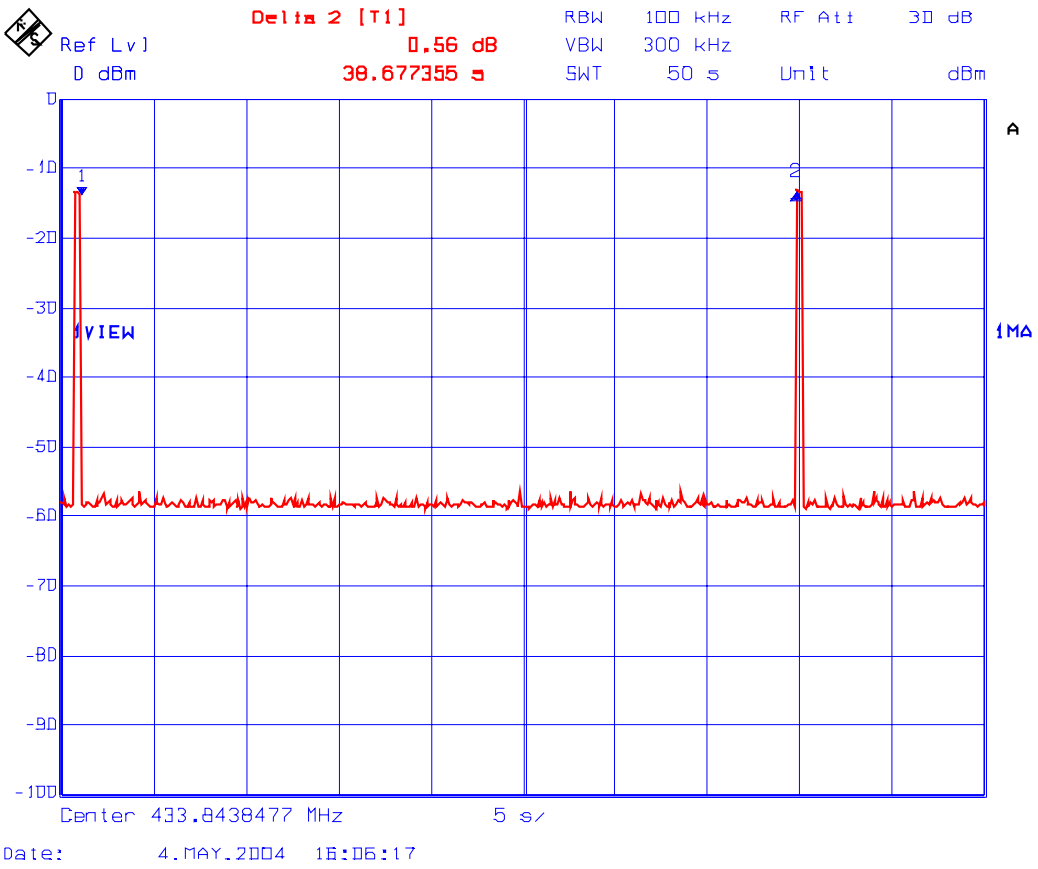
Requirement: The duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

The following plots demonstrate compliance with the above requirement: Plot 4 shows the duration of each transmission and Plot 5 is the silent period between transmissions.

Plot 4:
Transmission Characteristic
Transmission Duration



Plot 5:
Transmission Characteristic
Silent Period Between Transmissions



6.7. 20 dB BANDWIDTH [§ 15.231(c)]

6.7.1. 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.

6.7.2. Method of Measurements

Refer to Section 8.3 of this report and 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.

6.7.3. Test Arrangement

6.7.4. Test Equipment List

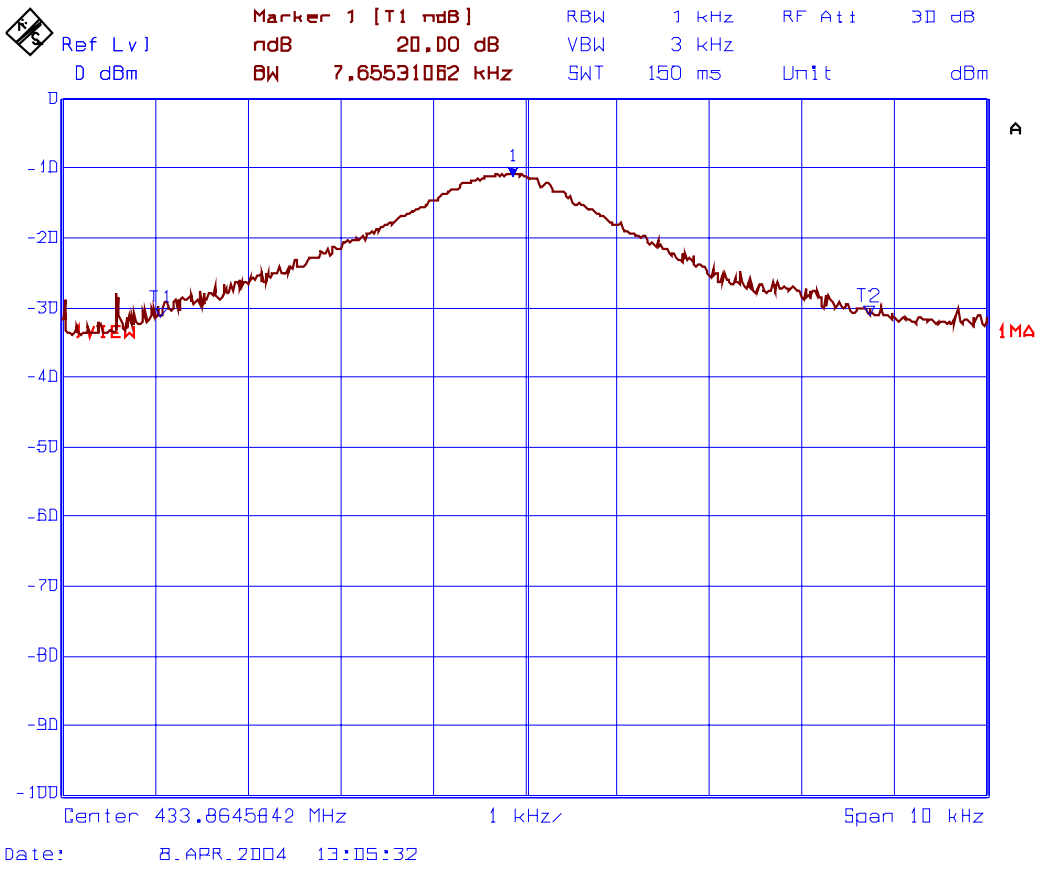
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Log Periodic Antenna	EMCO	3148	23845	200 kHz - 2 GHz

6.7.5. Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
433.92	7.66	1084.8	Pass

See Plot 6 for detailed measurement.

Plot 6:
20 dB Bandwidth



6.8. RADIATED EMISSIONS FROM CLASS B UNINTENTIONAL RADIATORS (DIGITAL DEVICES) [§ 15.109(a)]

6.8.1. Limits

The equipment shall meet the limits of the following table:

Frequency Range (MHz)	Class B Limits @ 3 m (dBμV/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	40.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
216 – 960	46.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
Above 960	54.0	Average	RBW = 1 MHz, VBW ≥ 1 Hz

6.8.2. Method of Measurements

ANSI C63.4.

The EUT shall be scanned from 30 MHz to the 5th harmonic of the highest oscillator frequency in the digital devices or 1 GHz whichever is higher.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
EMI Receiver System/ Spectrum Analyzer	Hewlett Packard	HP 8546A	3520A00248	9KHz-5.6GHz, 50 Ohms
Microwave Amplifier	Hewlett Packard	HP 83017A	311600661	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

6.8.4. Test Data

The emissions were scanned from 30 MHz to 2 GHz; all emissions were more than 20 dB below the permissible limits.

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 Directivit	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 Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	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:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ 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 shall be performed with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle.
1 to 10 MHz	2	1 near top and 1 near bottom.
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom.

- 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. SPURIOUS EMISSIONS (RADIATED)

For 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. Calibrated Advantest spectrum analyzer and pre-selector were used. The spectrum analyzer would be used as follows:

     For frequencies below 1 GHz:

     - Resolution BW: 100 kHz
     - Video BW: same or greater
     - Detector Mode: Positive Peak
     - Averaging: Off
     - Span: 100 MHz
     - Amplitude: Adjust for middle of the instrument's range
     - Sweep Time: Auto

     For frequencies above 1 GHz:
     - Resolution BW: 1 MHz
     - Video BW: same or greater
     - Detector Mode: Positive Peak
     - Averaging: Off
     - Span: 500 MHz
     - Amplitude: Adjust for middle of the instrument's range
     - Sweep Time: Auto

- 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 effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step 7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

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:

$$FS = RA + AF + CF - AG$$

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 dBμV 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 dBμV/m.
Field Level = $10^{(38/20)}$ = 79.43 μV/m.

8.3. 20 dB BANDWIDTH MEASUREMENTS

- Couple the RF output signal to the spectrum analyzer by means of direct connection or by a receiving antenna.
- The spectrum analyzer shall be se as follows:

  - Span: Minimum span to fully display the entire emission, approximately 3 x emission BW.
  - Resolution RBW: 1% to 3% of the approximate emission BW
  - Video VBW: 3 x RBW
  - EMI Detector: Peak
  - Sweep Time: Coupled or set to a slow rate
  - Trace: Max-hold

- Place the marker at both sides of the emission slope and at -20 dB down from the peak value.
- The difference of frequencies of 2 markers will be the 20 dB bandwidth
- Record and plot the test results.