EXHIBIT E: REPORT OF MEASUREMENTS [2.1033(B6)]

Test Report for FCC ID: IVS1000TKTM

FCC Part 2.1031, Part 15 Subpart C(15.231b)

Report #0801093
Issued 2/29/2008

433.92MHz POWERTOUCH 1000-TK / 1000-TM TRANSMITTER

Prepared for: TOUCHTRONICS. INC..
57315 Nagy Drive
Elkhart, IN 46517

Test Date(s): Feb 8, 2008

Data recorded by

Gordan L. Helm

Gordan L. Helm, NCE

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This report prepared by:
Gordan L. Helm, NCE
Technical Manager/Test Engineer, AHD

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Statements Concerning this Report

NVLAP Accreditation: NVLAP Lab Code 200129-0

The scope of AHD accreditation is the conducted emissions, radiated emissions test methods of:

IEC/CISPR 22: Limits and methods measurement of radio disturbance characteristics of information technology equipment.

FCC Method – 47 CFR Part 15 – Digital Devices.

AS/NZS 3548: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment.

IEC61000-4-2 and Amend.1: ElectroStatic Discharge Immunity

IEC61000-4-5: Surge Immunity

Test Data:

This test report contains data covered by the NVLAP accreditation..

Test Traceability:

The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

Limitations on results:

The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

Limitations on copying:

This report shall not be reproduced, except in full, without the written approval of AHD.

Limitations of the report:

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

Statement of Test Results Uncertainty: Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: ± 1.4 dB

Retention of Records:

1) For equipment verified to comply with FCC regulations, the manufacturer is obliged to retain this report with the product records for two years following the manufacture of the equipment that was tested.

Manufacturer/Applicant [2.1033(b1)]

The manufacturer and applicant:

TouchTronics.Inc.
57315 Nagy Drive
Elkhart, IN 46517

Measurement/Test Site Facility & Equipment

Test Site [2.948, 2.1033(b6)]

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is Michigan Hwy 152, Sister Lakes, Michigan 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC (No.90413) and Industry Canada (file:IC3161).

Measurement Equipment Used [2.947(d), 15.231(b)]

Equipment	Model	S/N	Last Cal Date	Calibration Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	21-June-07	12 months
RF Receiver Section	HP-85462A	3625A00342	21-June-07	12 months
EMCO BiconiLog Antenna	3142	1069	30-Aug-07	12 months
Double Ridged Horn	ONO91202-2	A00329	calibration by design & physical inspection.	
(3-m) LMR-400 Ultra Flex	LMR400	9812-11	09-Nov-07	6 months
(3-m) CS-3227 RG8	CS-3227	C060914	09-Nov-07	6 months

Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 20deg.C., the relative humidity 34%.

FCC required statements: [Class B Digital Device or Peripheral]

1. A statement required to be placed in the User's Manual shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2. The User's Manual shall include this or similar statement:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

Summary of Results:

1. This test series evaluated the Equipment Under Test to FCC Part 15.231b for intermittent control signal. The EUT is manually operated by momentary push button with a hold over time of less than 0.1 seconds after release as shown in the plot in the formula section.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for intermittent control signal operation in the allowed frequency bands outside of 410-470MHz band, (Part 15.231b).
3. The equipment under test was received on Jan 29, 2008 and this test series commenced on Jan 29, 2008.
4. The unit operates only at the frequency 433.92MHz.
5. The -20dBC Occupied Band width of the fundamental,with a 30 KHz RBW, measured 473 KHz. The 99% Occupied Band width of the fundamental,with a 10 KHz RBW,measured 683 KHz.
6. The field strength level of the fundamental was measured with corrected average detection (79.1dBuV)* and observed to be 1.7dB below the peak limit of 80.8dBuV/m. The EUT was positioned on the 'Flat' position and the receive antenna oriented in the horizontal polarization.
7. The evaluation of the field strength levels of the transmitter harmonics showed the emission nearest the limit occurred at 4339MHz. This signal was measured to be 2.3dB below the average limit of 54dBuV/m. The EUT was configured in the 'End' position, and the receive antenna oriented in the vertical polarization.
8. Spurious emissions, not harmonics of transmitter, were initially characterized in a shielded enclosure. There were no discernible spurious emissions from the device that could be measured off the noise floor of the measurement chamber.
9. The line conducted emission testing does not apply to this product. The device is powered from a 3 volt lithium battery.

* Please refer to FORMULAS and SAMPLE CALCULATIONS for Duty Cycle correction factor calculation

EUT DESCRIPTION

Description: Key chain transmitter
Model: PowerTouch 1000-TK / 1000-TM
Serial/ID No.: TK4, TK5, TM4, and TM5.
TK4 and TM4 are CW. TK5 and TM5 are normal for BW and spurious.
FCC ID: IVS1000TKTM
Manufacturer: TouchTronics Inc.

Details: Plastic chassis
2-layer printed circuit board
Silicone rubber keypad
13.56 MHz Oscillator
433.92 MHz Resonator circuit
operating frequency is approximately 434MHz
3-volt Lithium battery is power source

EUT Pictures

PowerTouch 1000-TK and 1000-TM Transmitter in case – Top View

PowerTouch 1000-TK and 1000-TM Transmitter PCB – Top View

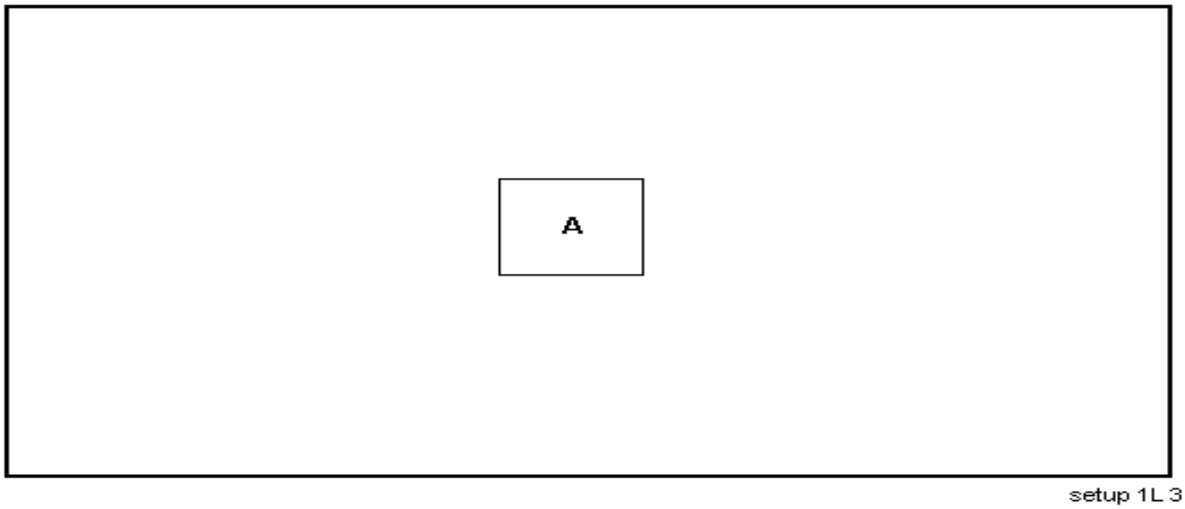
Tested Configuration /Setup:

Support Equipment & Cabling

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] control module	TouchTronics 1000-TM	preproduction	FCC ID: IVS1000TKTM

Setup Diagram

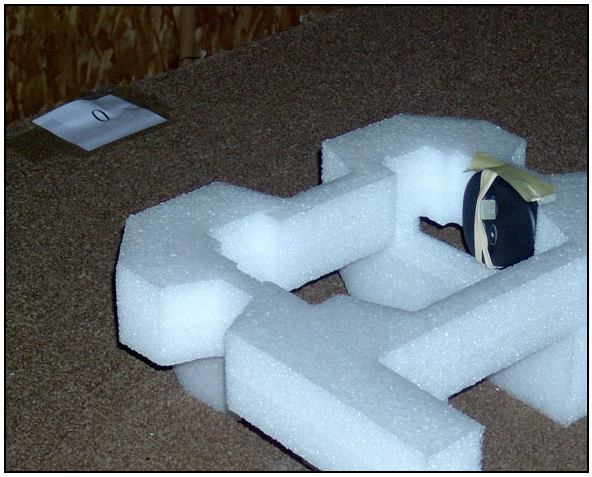
Note: Setup photographs are located in Attached Electronic File, Exhibit E.



BASIC EUT SETUP
(Legend designation is above)

Flat Position

Side Position



End Position

Standards Applied to Test:

ANSI C63.4 - 2001
CFR47 FCC Part 2;, Part 15, SubPart C, 15.249 Intentional Radiator; SubPart B, Digital Device
AHD test procedures TP0101-01, TP0102-01

Equipment Configuration

For the testing, the placement of the EUT and the support equipment was selected to --

1) be a representation of the installed configuration, and
2) comply with the minimum system configuration of ANSI C63.4.

Test Methodology:

Radiated testing, performed at a 3 meter open field test site, was completed according to the procedures in FCC 15, SubPart C with supporting instructions from ANSI C63.4

For the testing, the EUT was placed at the center of the table 80cm above the ground plane pursuant to ANSI C63.4 for stand-alone equipment. The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.

The setup pictures in this report indicate the configuration of testing for this product.

The internal lithium battery was replaced periodically throughout the testing to ensure that the greatest available battery power was available to the transmitter.

The line conducted emission testing was not performed on this product. In its final configuration the product is powered from an internal lithium battery only.

At frequencies up to 1000MHz a BiconiLog broadband antenna was used for measurements.

At frequencies above 1000MHz a double-ridge Horn broadband antenna was used for measurements.

During the transmitter evaluation the EUT was transmitting continuously.

The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.
The principle settings of the EMI Receiver for radiated testing include:

IF Bandwidth:	120KHz for frequencies less than 1GHz.
	1 MHz for frequencies greater than 1GHz.
Detector Function:	Peak Mode
	The Average levels were determined mathematically based upon the duty cycle of the pulsed modulation of the transmitted signal.

The final measurements were made with the EUT placed in one of two positions (designated as side, and end). Measurements were recorded in each of these two positions and with the measuring antenna in vertical and horizontal positions.

The unit was evaluated up to the tenth harmonic of the transmit fundamental, and up to 5000MHz for other spurious signals.

The nominal operating frequency of the transmitter is 433.92 MHz. The frequency determining element is quartz crystal Y1 which operates at 13.56 MHz. The crystal frequency is multiplied by a factor of 32 using a phase-locked loop to produce the output frequency.

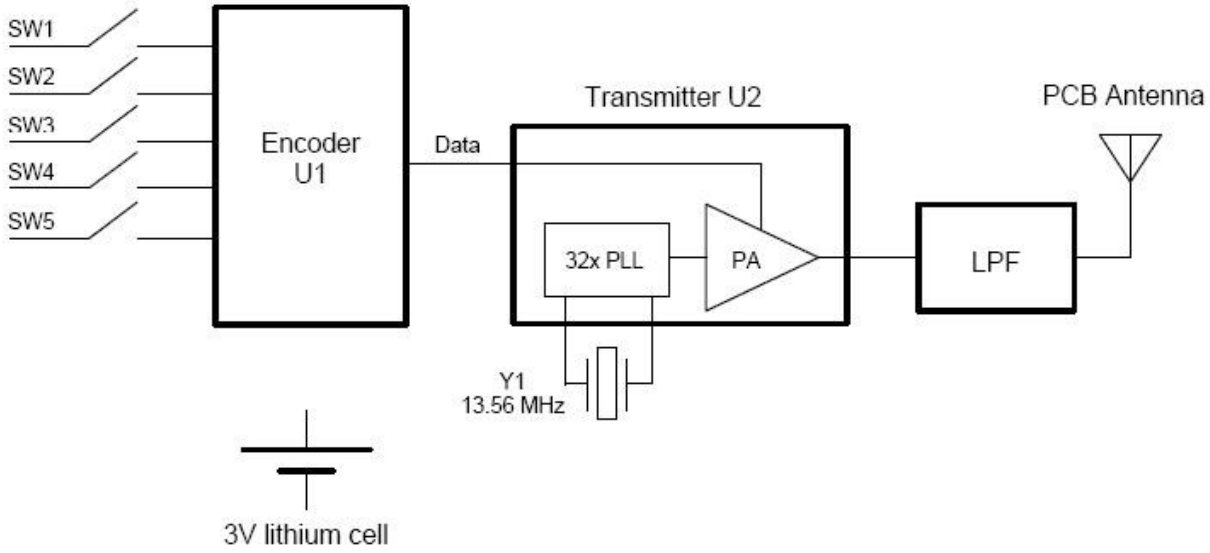
Whenever a button is pressed, encoder IC U1 produces Manchester encoded data pulses. Data packets consist of a preamble, a header, a start bit, 69 data bits, and a stop bit. The minimum time between pulse transitions is nominally 200 μs.

The transmitter section consists of IC U2. Input pulses on the DATA pin (U2-6) activate the transmitter and amplitude modulate its output using On-Off Keying (OOK). The transmitter IC powers down approximately 5 ms after the last pulse transition.

Transmitter output PAOUT (U2-4) is biased through inductor L1 and resistor R1 which are bypassed by C6. R1 limits the available drive current to the transmitter output stage, thereby providing a means to control the output power.

The RF output is lowpass filtered by a pi-filter consisting of C8, L2, and C9. The circuit board printed wire antenna is connected to the output of the pi-filter.

The transmitter is powered by one 3V lithium coin cell.



FORMULAS AND SAMPLE CALCULATIONS:

THE HP8546A EMI Receiver has stored in memory the antenna and coax correction factors used in this test. The resultant Field Strength (FS) in dBuV/m presented by the HP8546A is the summation in decibels (dB) of the Received Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF).

Formula 1: FS(dBuV/m) = RF(dBuV) + AF(dB/m) +CF(dB)
With the EUT in transmitting mode the resultant Field Strength measurement is recorded using the peak hold detector of the HP8546A.
Where it was necessary to move the EUT to 1 meter distance to take measurements a 'dB' factor which adjusts for this distance variance is used before comparing the emission level to the FCC limits. This factor is determined by the following formula.

Formula 2: The FCC field strength limit of the fundamental is [125*f(MHz)/3 – 21250/3]uV/m at a measurement distance of 3 meters. This number is equivalent to 80.82dBuV/m.
Since f = 433.92MHz, the FCC field strength limit of fundamental is:
[125*433.92/3 – 21250/3]uV/m = [18080 – 7083]uV/m = 10996.67uV/m

20*Log(10996.67uV/m)=80.82dBuV/m

Formula 3: Duty Cycle Calculations:
The data stream of the encoder IC modulates the output of the transmitter using on-off keying (OOK). The data is Manchester encoded with a nominal element (baud) time of 200 µs. A zero is transmitted as 200 µs off followed by 200 µs on. A one is transmitted as 200 µs on followed by 200 µs off.

If a one follows a zero, or a zero follows a one, the signal will stay on or off for 400 µs, respectively. Since the data is encrypted in a way that results in a pseudo-random sequence of one's and zero's, and each bit always contains equal parts of off and on time, the probability of any of the four possible event durations occurring are the same over a 100 ms window. Furthermore, there is a header of nominally 800 µs duration with no signal output used to identify the start of a new data packet. There will always be at least two of these header intervals within any 100 ms window.

The measured durations of the four possible pulse widths and the header are given below. These were measured using the zero span setting on a spectrum analyzer and bracketing the width at the -20 dB points, relative to the peak value.

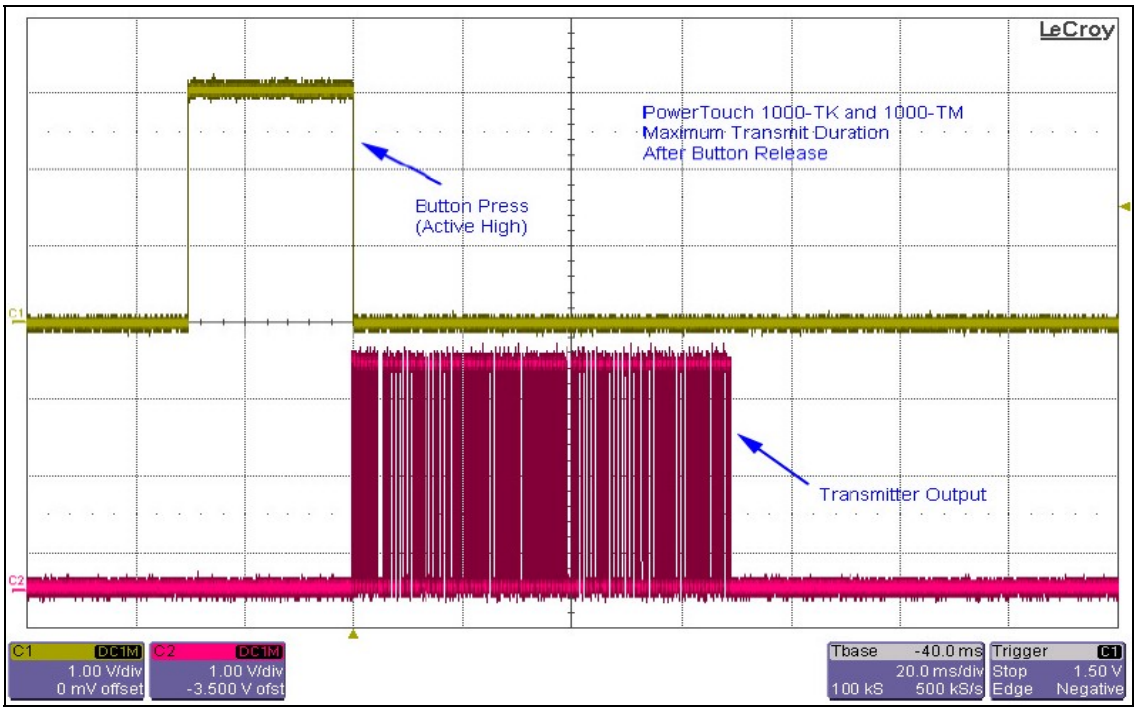
Parameter Time	**Duration (µsec)**
Short "on" pulse	303
Short "off" pulse	112
Long "on" pulse	493
Long "off" pulse	338
Header pulse (off)	720

The average duty cycle over a 100 ms window is calculated in two parts, using the fraction of time when data sent and the times when the headers are sent as weighting factors.

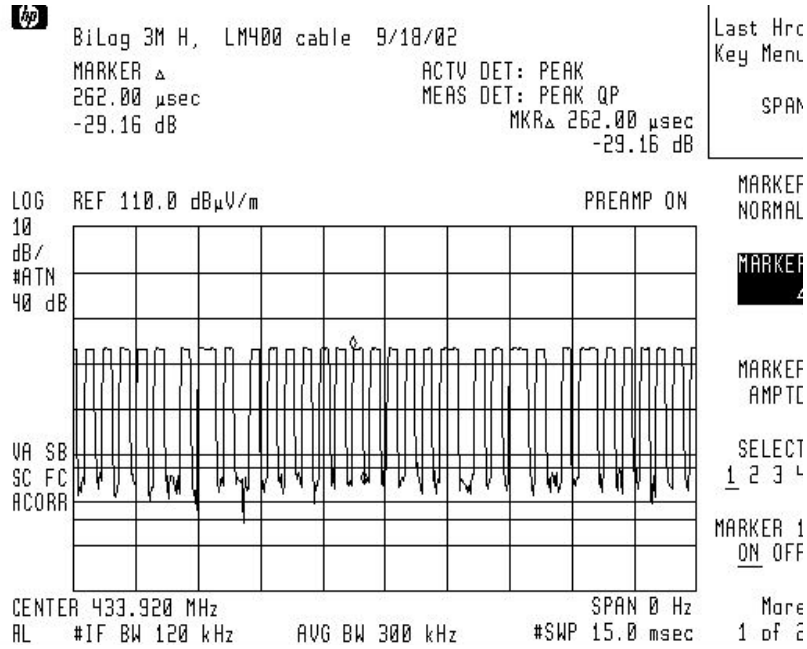
Avg duty for data = (Tshort_on + Tlong_on) /
(Tshort_on + Tshort_off + Tlong_on + Tlong_off)
= (303 + 493) / (303 + 112 + 493 + 338)
= 0.639 (or 63.9 %)

Since there will be at least two periods of no output during the header times, this applies for (2 x 0.720 ms) / 100 ms = 1.4 % of the time. The other 98.6 % of the time will contain the "average duty for data" calculated above.

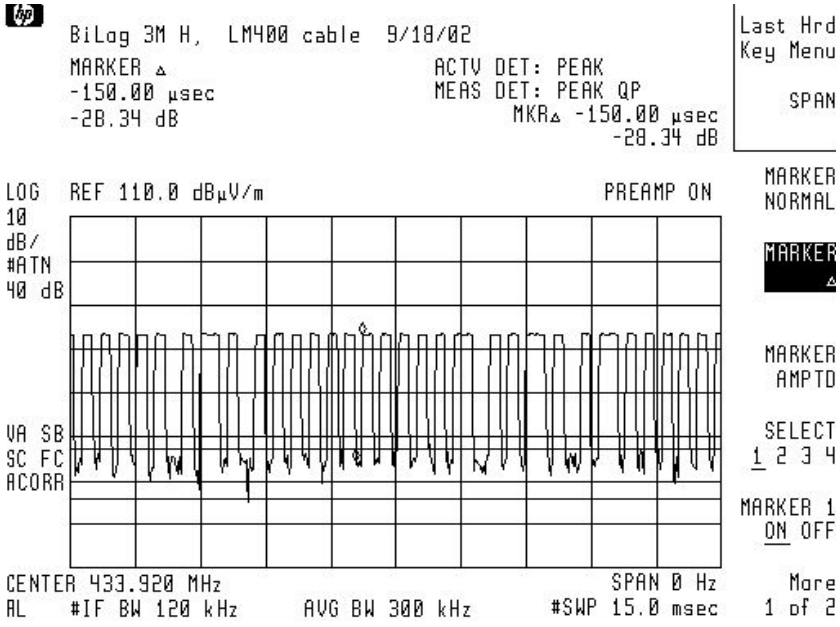
Maximum Duty cycle averaged over any 100ms interval = 98.6ms * 63.9% / 100ms
Therefore, the maximum averaged duty cycle = 63.0%



Picture showing maximum transmit duration after button release



Picture showing duration of high time



Picture showing duration of low time

Formula 4: Correction factor for Maximum averaged duty cycle

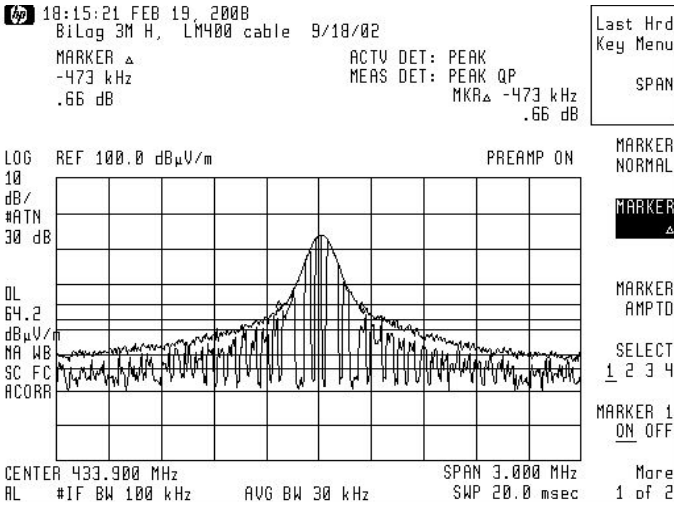
Correction factor = -20 * log(0.63) = 4.0 dB

Test Data

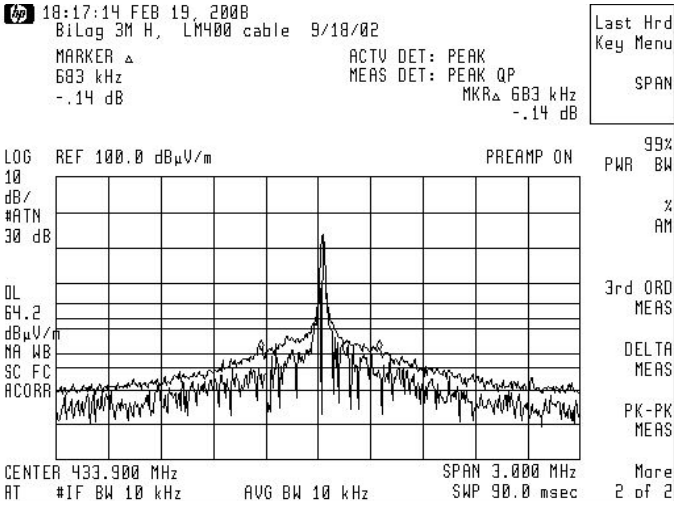
Radiated Field Strength Measurements: [15.231(b), 15.205]

Occupied Bandwidth [15.231(c)]

An RBW of 30 kHz is selected for a -20db measurement:



An RBW of 10 kHz is selected for a 99% measurement:



These charts show typical measured bandwidth signals.

Fundamental (MHz)	Measured Bandwidth (kHz)	LIMIT Fundamental * .0025 (kHz)	Standard
433.9	473	1085	FCC
433.9	683	1085	IC

Radiated Field Strength Measurements: [15.231(b), 15.205, 15.209)]

Field Strength Measurements of Fundamental & LO

MEASUREMENT PROCEDURE:
1. The EUT was setup to one of the three positions.
2. The receive antenna is positioned vertical or horizontal polarity.
3. Steps 1-2 were repeated to cover all positions.

Transmit Mode. Fundamental

Frequency	Peak Measurement	Corrected Average Measurement	Included Cable+Antenna Factors	Turntable Azimuth	Antenna Height	FCC Limit	**Margin**	EUT	Ant. Pol.
MHz	dBuV/m	dBuV/m	dB+dB/m	deg	Mtr	dBuV/m	**dB**		
433.9	83.1	83.1-4.0 = 79.1	19.38	260	1	80.8	**1.7**	Flat	H

**Duty Cycle factor is 4.0dB and is used in table above

Transmit Mode. Harmonics

Frequency	Peak Measurement	Corrected Average Measurement**	Included Cable +Antenna	Turntable Azimuth	Antenna Height	FCC Limit	**Margin from FCC Limit**	EUT position	Ant. Pol
MHz	dBuV/m	dBuV/m	dB+dB/m	deg	Mtr	dBuV/m	**dB**		
867	38.71	34.71	26.48	230	1.1	60.8	**26.09**	End	V
1301	52.51	48.51	28.22	270	1	54	**5.49**	End	V
1735	54.77	50.77	29.17	350	1	60.8	**10.03**	End	V
2169	50.24	46.24	30.45	70	1.8	60.8	**14.56**	Side	H
2603	51.61	47.61	31.54	270	1.6	60.8	**13.19**	Side	H
3037	58.22	54.22	31.85	80	1.2	60.8	**6.58**	End	V
3471	52.24	48.24	32.94	230	1.7	60.8	**12.56**	Side	H
3905	54.7	50.7	32.89	300	1.7	54	**3.3**	Side	H
4339	55.7	51.7	33.25	180	1.3	54	**2.3**	Side	V

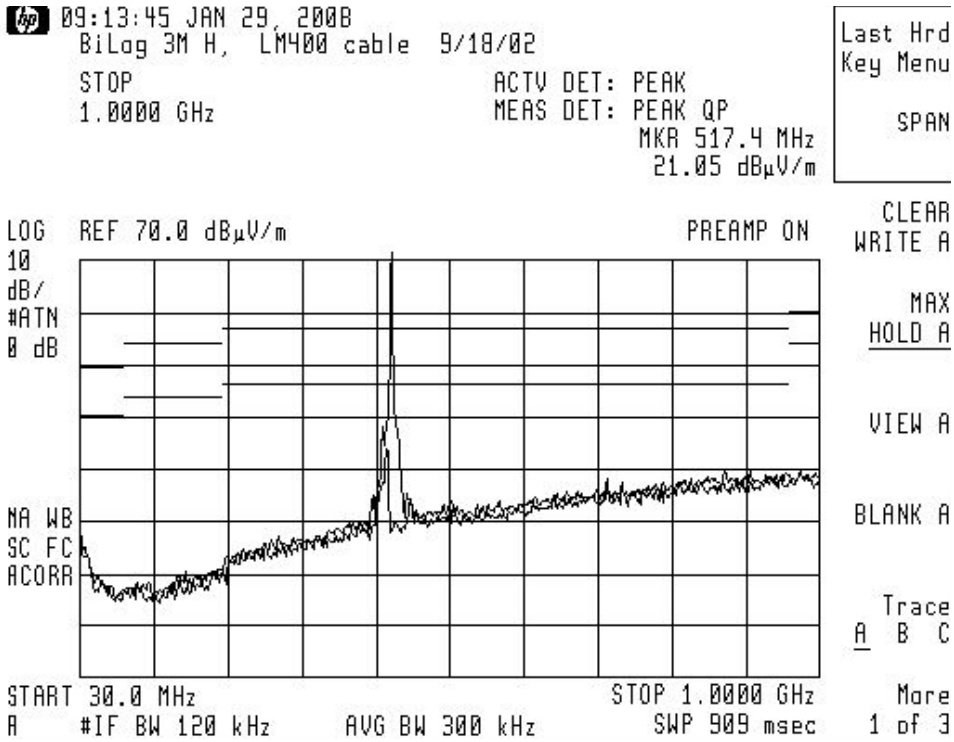
**Duty Cycle factor is 4.0dB and is used for corrected average measurement in the table.

Out of Band Emissions [15.231(b)]

The emissions outside the 410-470MHz band are to be either 20dB below the level of the fundamental or the limits of section 15.205.

A scan of the EUT was made in a shielded room to study the emission profile. These scans indicate there are no spurious emissions from the unit other than the fundamental.

Spurious Emissions: [15.205]



Graph of scan made in shielded enclosure

The scan clearly shows no spurious emissions from 30MHz – 1GHz.