FCC TEST REPORT

REPORT NO.: RF930813L07
MODEL NO.: Toggle/Main Standard Range Transmitter
(Refer to page 5 for the other models.)
RECEIVED: Jul. 17, 2004
TESTED: Jul. 17 ~ Aug. 23, 2004

APPLICANT: ftech Corporation

ADDRESS: No. 16, Nan-ke 9th Rd., Science-based Industrial Park, Tainan 741, Taiwan, R.O.C.

ISSUED BY: Advance Data Technology Corporation

LAB LOCATION: No. 19, Hwa Ya 2nd rd., Kueishan, Taoyuan, Taiwan, R.O.C.

ACCREDITED
No. 2177-01

CNLA
0528
ILAC MRA

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1 CERTIFICATION

PRODUCT :	Lightning Switch
MODEL NO. :	Toggle/Main Standard Range Transmitter (Refer to page 5 for the other models.)
BRAND :	Lightning
APPLICANT :	ftech Corporation
TESTED :	Jul. 17 ~ Aug. 23, 2004
TEST ITEM :	ENGINEERING SAMPLE
STANDARD :	FCC Part 15, Subpart C (Section 15.231) ANSI C63.4-2001

The above equipment (model: TMS020 Transmitter, Main, Standard Range) has been tested by **Advance Data Technology Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

PREPARED BY : _____ , **DATE:** Aug. 27, 2004
(Suntee Liu)

TECHNICAL ACCEPTANCE : Responsible for RF _____ , **DATE:** Aug. 27, 2004
(Gary Chang)

APPROVED BY : _____ , **DATE:** Aug. 27, 2004
(Cody Chang, Deputy Manager)

2 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD PARAGRAPH	**TEST TYPE**	**RESULT**	**REMARK**
15.207	Conducted Emission Test	NA	NA
15.231 15.209	Radiated Emission Test	PASS	Minimum passing margin is –0.40 dB at 1302.00 MHz
15.231	20 dB Occupied Bandwidth Measurement	PASS	Meet the requirement of limit

2.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Radiated emissions	30MHz ~ 200MHz	3.55 dB
	200MHz ~1000MHz	3.58 dB
	1GHz ~ 18GHz	2.20 dB
	18GHz ~ 40GHz	1.88 dB

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Lightning Switch
MODEL NO.	Toggle/Main Standard Range Transmitter (Refer to Note 2 for the other models.)
POWER SUPPLY	3Vdc, 1.5mA, 50ms
MODULATION TYPE	ASK
CARRIER FREQUENCY OF EACH CHANNEL	433.92MHz
NUMBER OF CHANNEL	1
ANTENNA TYPE	Wire antenna
DATA CABLE	NA
I/O PORTS	NA
ASSOCIATED DEVICES	NA

NOTE:

1. The EUT is a transmitter. The model no.: TMS020 Transmitter, Main, Standard Range includes Tx of 433.92 MHz application used for control signal transmitting. The receiver part which model no.: Toggle Receiver has been presented in another report which report no.: D930713L03.
2. The series models below are identical to each other except for their model due to product differentiation.

Model	Difference
TTS010 Transmitter, Toggle, Standard Range	Without switch button
TMS020 Transmitter, Main, Standard Range	With switch button
TDTS50 Transmitter, Dual Toggle, Standard Range	With switch button (The hardware is the same as TMS020 Transmitter, Main, Standard Range, only the software is different)

3. The above EUT information was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 DESCRIPTION OF TEST MODES

One channel is provided to the EUT.

Channel	Frequency
1	433.92 MHz

NOTE: Since the EUT is considered a potable unit, it was pre-tested on the positioned of each 3 axis. The worst case was found when positioned on Z-plane. There for only the test data of this Z-plane was used for Radiated test.

There are 2 test modes pre-tested as below. The worst case, test mode B, is shown for a representative in the report.

Test Mode	Description
A	The EUT was upright.
B	The EUT was recumbent.

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a Lightning Switch. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.231)
ANSI C63.4:2001

All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

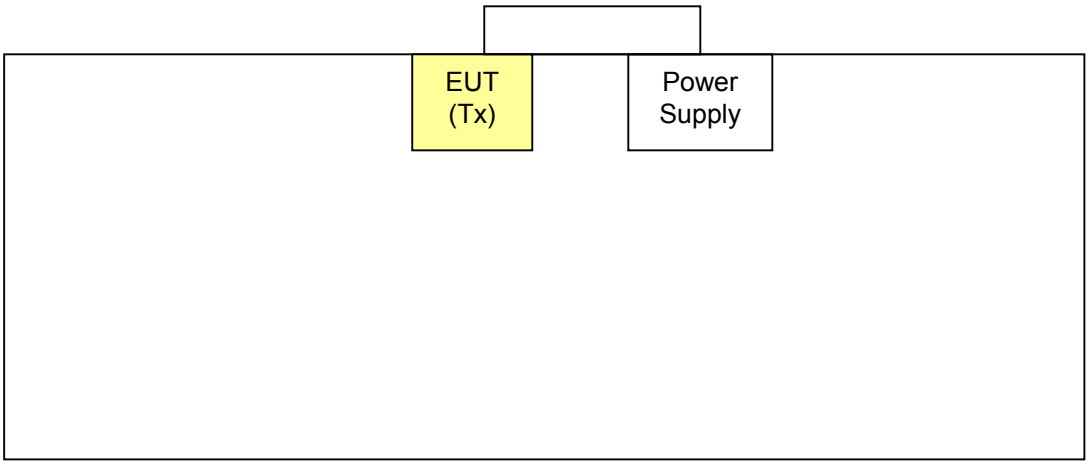
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	POWER SUPPLY	TOP WARD	6306A	713585	VERIFICATION

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

NOTE: All power cords of the above support units are non-shielded (1.8m).

3.5 CONFIGURATION OF SYSTEM UNDER TEST



4 TEST TYPES AND RESULTS

4.1 RADIATED EMISSION MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

According to 15.231 the field strength of emissions from intentional radiators operated under these frequencies bands shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	uV/meter	dBuV/meter	uV/meter	dBuV/meter
40.66 ~ 40.70	2250	67.04	225	48.04
70 ~ 130	1250	61.94	125	41.94
130 ~ 174	1250 ~ 3750	61.94 ~ 71.48	125 ~ 375	41.94 ~ 51.48
174 ~ 260	3750	71.48	75	37.50
260 ~ 470	3750 ~ 12500	71.48 ~ 81.94	375 ~ 1250	51.48 ~ 61.94
Above 470	12500	81.94	1250	61.94

NOTE:

1. 1 Where F is the frequency in MHz, the formula for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, uV/m at 3 meters = 56.81818(F)-6136.3636; for the band 260-470 MHz, uV/m at 3 meters = 41.6667(F)- 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.
2. 2 The above field strength limits are specified at a distance of 3meters. The tighter limits apply at the band edges.

Emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209 as following:

Frequencies (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/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

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.1.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED UNTIL
Test Receiver ROHDE & SCHWARZ	ESI7	100033	Jun, 08, 2005
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100040	Dec. 15, 2004
BILOG Antenna SCHWARZBECK	VULB9168	9168-153	Feb. 03, 2005
HORN Antenna SCHWARZBECK	9120D	9120D-408	Feb. 03, 2005
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA 9170243	Feb. 23, 2005
Preamplifier Agilent	8447D	2944A10633	Jan. 15, 2005
Preamplifier Agilent	8449B	3008A01964	Jan. 27, 2005
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	218183/4	Mar. 05, 2005
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	218195/4	Mar. 05, 2005
Software ADT.	ADT_Radiated_V5.14	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA
Antenna Tower Controller inn-co GmbH	CO2000	017303	NA
Turn Table ADT.	TT100.	TT93021703	NA
Turn Table Controller ADT.	SC100.	SC93021703	NA

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Chamber 2.

3. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.

4. The IC Site Registration No. is IC4924-3.

4.1.3 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 mater semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using the quasi-peak method or average method as specified and then reported in Data sheet peak mode and QP mode.

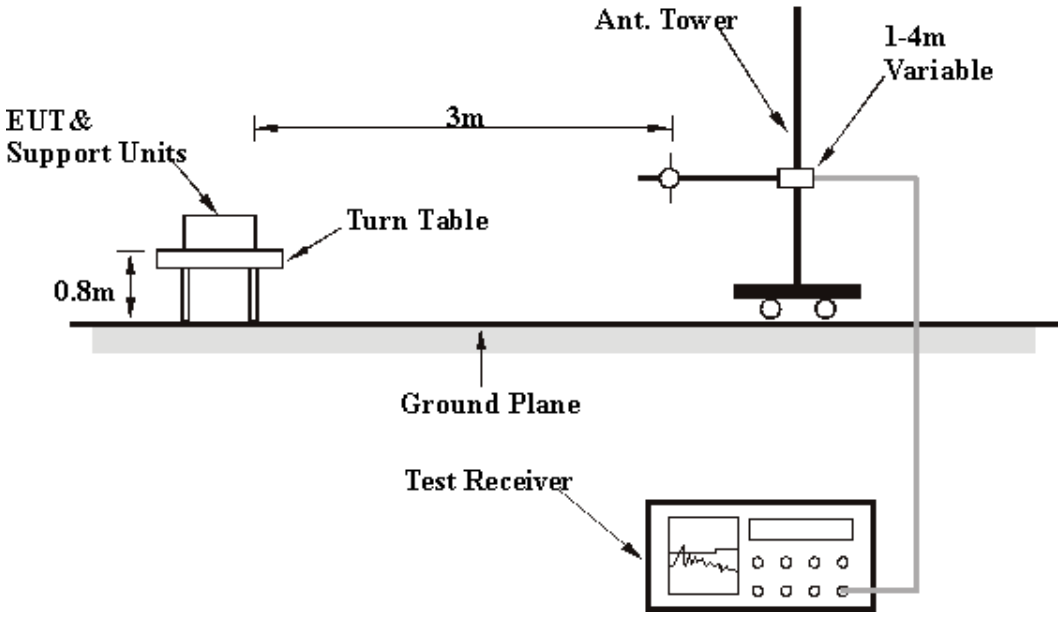
NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1GHz.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.1.6 EUT OPERATING CONDITION

Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.

4.1.7 TEST RESULTS

EUT	Lightning Switch	**MODEL**	TMS020 Transmitter, Main, Standard Range
FREQUENCY RANGE	Below 1000MHz	**DETECTOR FUNCTION**	Quasi-Peak / Peak / Average
INPUT POWER (SYSTEM)	120 Vac, 60 Hz	**ENVIRONMENTAL CONDITIONS**	24 deg. C, 64% RH, 991hPa
TESTED BY	Long Chen		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	52.71	29.67 QP	40.00	-10.33	1.58 H	249	14.67	15.00
2	117.58	31.69 QP	43.50	-11.81	1.19 H	248	19.05	12.64
3	189.00	30.98 QP	43.50	-12.52	1.45 H	228	18.68	12.30
4	*434.00	92.41 PK	100.80	-8.39	2.01 H	306	74.67	17.74
4	*434.00	74.91 AV	80.80	-5.89	2.01 H	306	57.17	17.74
5	868.00	59.58 PK	74.00	-14.42	1.58 H	201	34.97	24.61
5	868.00	42.08 AV	54.00	-11.92	1.58 H	201	17.47	24.61
6	908.00	35.91 QP	46.00	-10.09	1.00 H	119	10.58	25.33

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	53.58	29.67 QP	40.00	-10.33	1.12 V	38	14.80	14.87
2	116.00	31.28 QP	43.50	-12.22	1.15 V	218	18.77	12.51
3	241.00	32.69 QP	46.00	-13.31	1.50 V	248	19.42	13.27
4	*434.00	84.83 PK	100.80	-15.97	1.84 V	231	67.09	17.74
4	*434.00	67.33 AV	80.80	-13.47	1.84 V	231	49.59	17.74
5	868.00	51.20 PK	74.00	-22.80	1.68 V	231	26.59	24.61
5	868.00	33.70 AV	54.00	-20.30	1.68 V	231	9.09	24.61
6	904.00	32.68 QP	46.00	-13.32	1.00 V	214	7.39	25.29

NOTE: 1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB)
2. Correction Factor(dB) = Antenna Factor (dB) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. "*" = Fundamental frequency
6. The average value of fundamental frequency is: Average = Peak value + 20log(Duty cycle)
Where the duty factor is calculated from following formula:

$$20\log(\text{Duty cycle}) = 20\log\frac{20*99us + (4*35+2)*80us}{100ms} = -17.50dB$$

Please see page 16 ~ 17 for plotted duty.

EUT	Lightning Switch	**MODEL**	TMS020 Transmitter, Main, Standard Range
INPUT POWER (SYSTEM)	120 Vac, 60 Hz	**FREQUENCY RANGE**	1~5 GHz
ENVIRONMENTAL CONDITIONS	24 deg. C, 64% RH, 991 hPa	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
TESTED BY	Long Chen		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1302.00	71.10 PK	74.00	-2.9	1.07 H	197	41.99	29.11
1	**1302.00**	**53.60 AV**	**54.00**	**-0.4**	**1.07 H**	**197**	**24.49**	**29.11**
2	1736.00	57.89 PK	74.00	-16.11	1.60 H	113	29.21	28.68
2	1736.00	40.39 AV	54.00	-13.61	1.60 H	113	11.71	28.68
3	2170.00	56.05 PK	74.00	-17.95	2.35 H	204	25.38	30.67
3	2170.00	38.55 AV	54.00	-15.45	2.35 H	204	7.88	30.67
4	2604.00	60.40 PK	74.00	-13.6	1.25 H	79	27.91	32.49
4	2604.00	42.90 AV	54.00	-11.1	1.25 H	79	10.41	32.49
5	3038.00	62.79 PK	74.00	-11.21	1.00 H	217	29.32	33.47
5	3038.00	45.29 AV	54.00	-8.71	1.00 H	217	11.82	33.47
6	3472.00	58.39 PK	74.00	-15.61	1.03 H	230	24.16	34.23
6	3472.00	40.89 AV	54.00	-13.11	1.03 H	230	6.66	34.23
7	3906.00	52.70 PK	74.00	-21.3	1.05 H	223	17.60	35.10
7	3906.00	35.20 AV	54.00	-18.8	1.05 H	223	0.10	35.10
8	4330.00	56.90 PK	74.00	-17.1	1.05 H	223	20.12	36.78
8	4330.00	39.40 AV	54.00	-14.6	1.05 H	223	2.62	36.78

REMARKS:

1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The average value of fundamental frequency is: Average = Peak value + 20log(Duty cycle)
   Where the duty factor is calculated from following formula:

$$20\log(\text{Duty cycle}) = 20\log\frac{20*99us + (4*35+2)*80us}{100ms} = -17.50dB$$

Please see page 16 ~ 17 for plotted duty.

EUT	Lightning Switch	**MODEL**	TMS020 Transmitter, Main, Standard Range
INPUT POWER (SYSTEM)	120 Vac, 60 Hz	**FREQUENCY RANGE**	1~5 GHz
ENVIRONMENTAL CONDITIONS	24 deg. C, 64% RH, 991 hPa	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
TESTED BY	Long Chen		

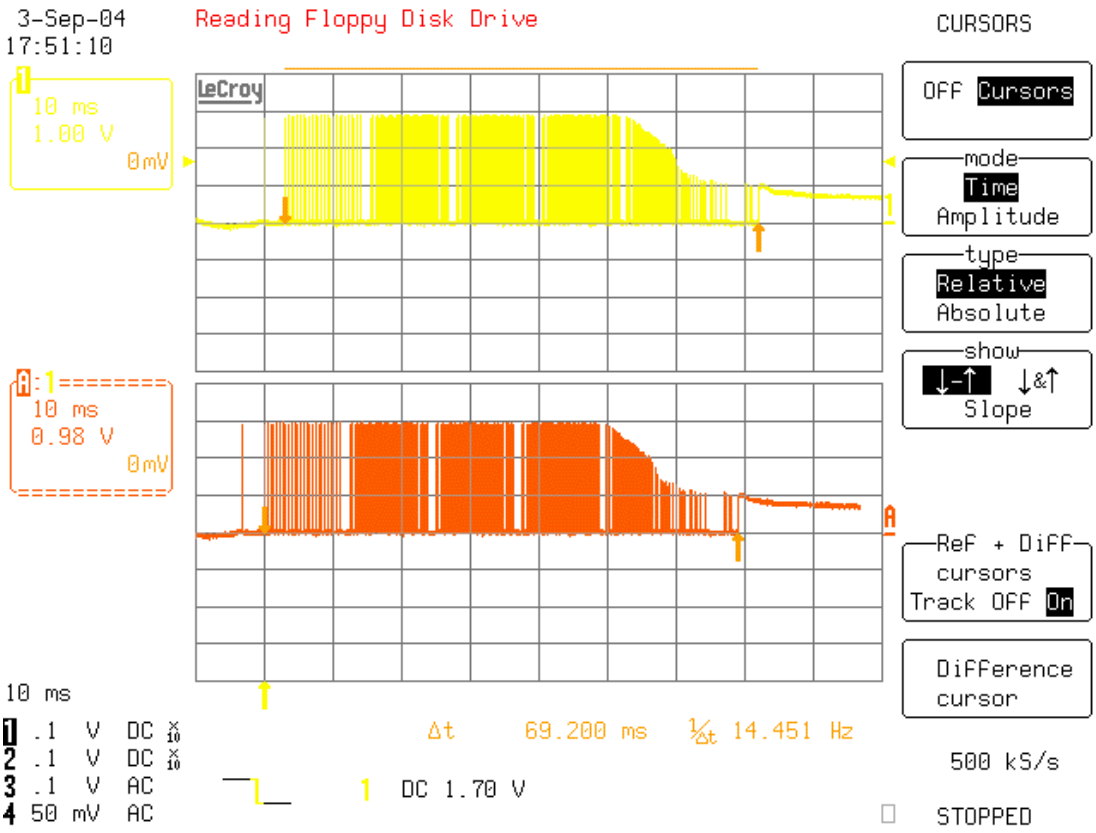
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1302.00	62.66 PK	74.00	-11.34	1.51 V	297	33.55	29.11
1	1302.00	45.16 AV	54.00	-8.84	1.51 V	297	16.05	29.11
2	1736.00	53.60 PK	74.00	-20.4	2.30 V	343	24.92	28.68
2	1736.00	36.10 AV	54.00	-17.9	2.30 V	343	7.42	28.68
3	2170.00	52.05 PK	74.00	-21.95	1.34 V	160	21.38	30.67
3	2170.00	34.55 AV	54.00	-19.45	1.34 V	160	3.88	30.67
4	2604.00	53.24 PK	74.00	-19.76	2.10 V	199	21.75	32.49
4	2604.00	35.74 AV	54.00	-18.26	2.10 V	199	3.25	32.49
5	3038.00	59.36 PK	74.00	-14.64	1.68 V	13	25.89	33.47
5	3038.00	41.86 AV	54.00	-12.14	1.68 V	13	8.39	33.47
6	3472.00	57.09 PK	74.00	-16.91	1.00 V	145	22.86	34.23
6	3472.00	39.59 AV	54.00	-14.41	1.00 V	145	5.36	34.23
7	3906.00	51.57 PK	74.00	-22.43	1.00 V	145	16.47	35.10
7	3906.00	34.07 AV	54.00	-19.93	1.00 V	145	-1.03	35.10
8	4330.00	54.46 PK	74.00	-19.54	1.62 V	158	17.68	36.78
8	4330.00	36.96 AV	54.00	-17.04	1.62 V	158	0.18	36.78

REMARKS:

1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The average value of fundamental frequency is: Average = Peak value + 20log(Duty cycle)
   Where the duty factor is calculated from following formula:

$$20\log(\text{Duty cycle}) = 20\log\frac{20*99us + (4*35+2)*80us}{100ms} = -17.50dB$$

Please see page 16 ~ 17 for plotted duty.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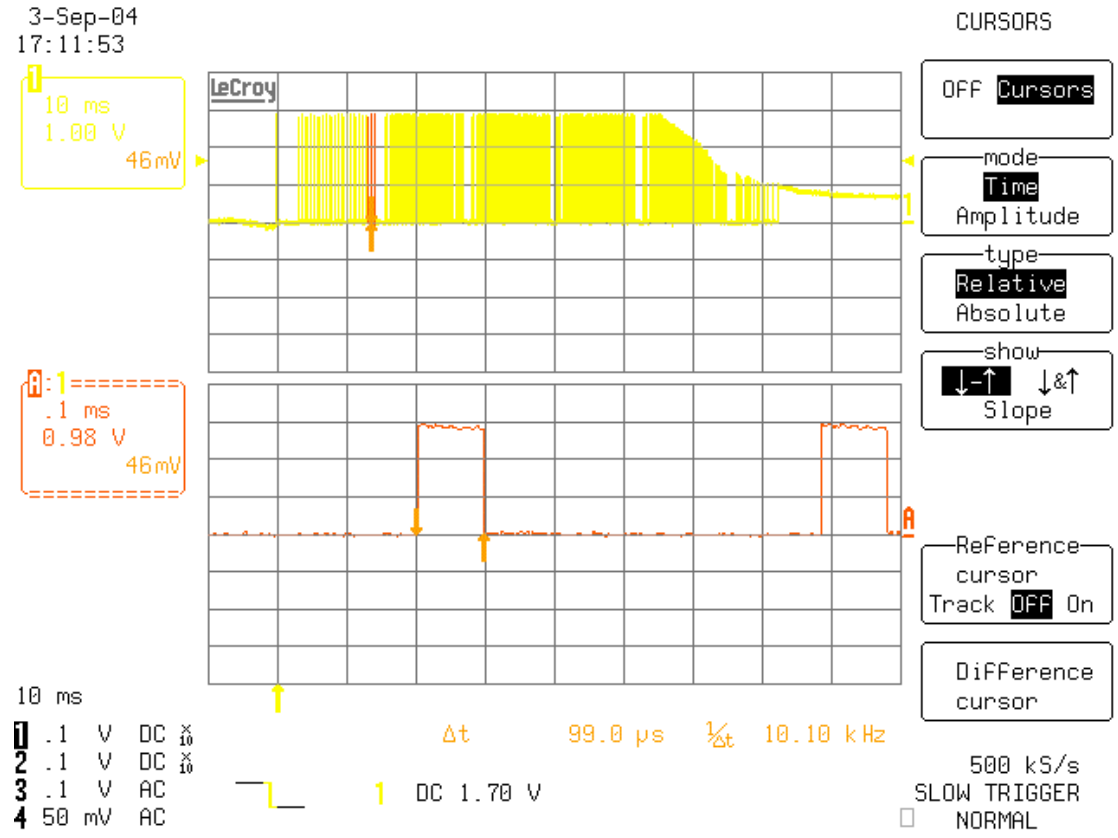
CURSORS
LeCroy
10 ms
1.00 V
0mV
A:1========
10 ms
0.98 V
0mV
==========
OFF Cursors
mode
Time
Amplitude
type
Relative
Absolute
show
↓-↑ ↓&↑
Slope
Ref + Diff
cursors
Track OFF On
Difference
cursor
10 ms
1 .1 V DC
2 .1 V DC
3 .1 V AC
4 50 mV AC
Δt 69.200 ms 1/Δt 14.451 Hz
500 kS/s
1 DC 1.70 V
STOPPED


3-Sep-04
17:11:53
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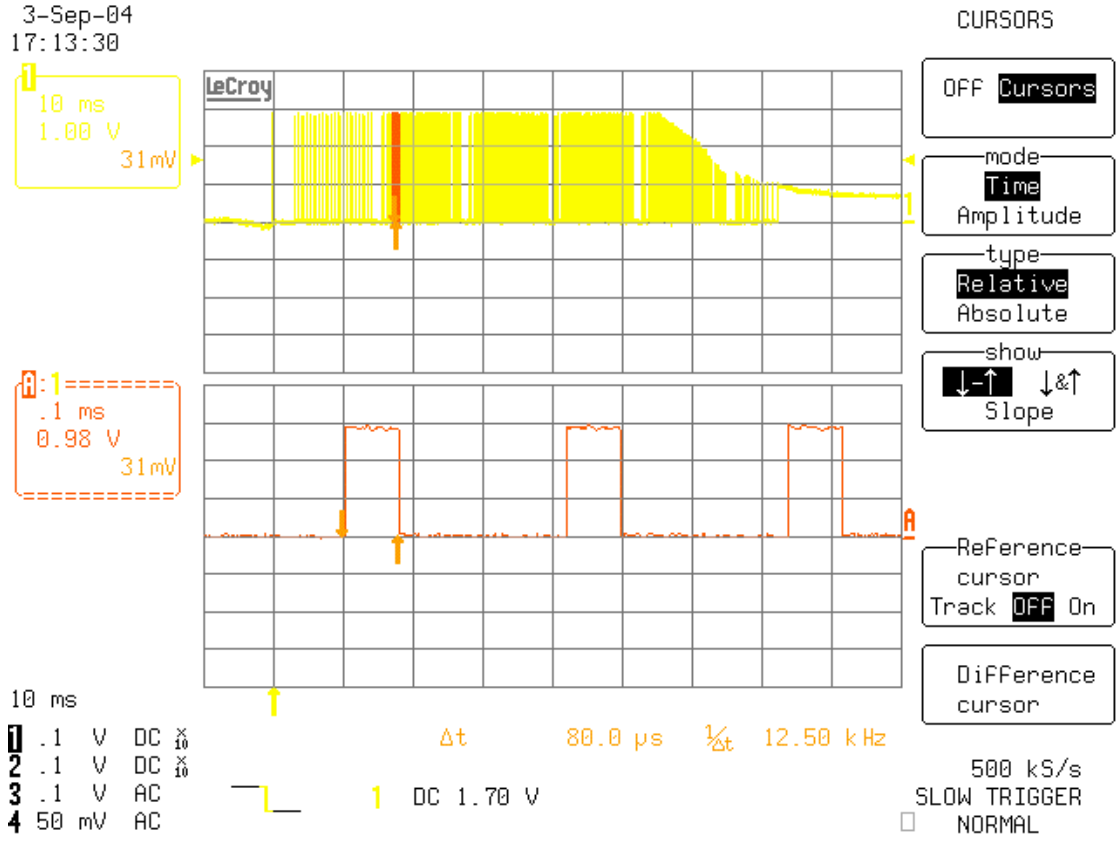
LeCroy
10 ms
1.00 V
46mV
A:1========
.1 ms
0.98 V
46mV
==========
OFF Cursors
mode
Time
Amplitude
type
Relative
Absolute
show
↓-↑ ↓&↑
Slope
Reference
cursor
Track OFF On
Difference
cursor
10 ms
1 .1 V DC
2 .1 V DC
3 .1 V AC
4 50 mV AC
Δt 99.0 µs 1/Δt 10.10 kHz
500 kS/s
SLOW TRIGGER
1 DC 1.70 V
NORMAL


3-Sep-04
17:13:30
CURSORS
10 ms
1.00 V
31mV
LeCroy
OFF Cursors
mode
Time
Amplitude
type
Relative
Absolute
show
↓-↑ ↓&↑
Slope
A:1
.1 ms
0.98 V
31mV
ReFerence
cursor
Track OFF On
DiFFerence
cursor
10 ms
1 .1 V DC
2 .1 V DC
3 .1 V AC
4 50 mV AC
Δt 80.0 µs 1/Δt 12.50 kHz
1 DC 1.70 V
500 kS/s
SLOW TRIGGER
NORMAL

4.2 OCCUPIED BANDWIDTH MEASUREMENT

4.2.1 LIMITS OF BAND EDGES MEASUREMENT

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for device operating above 70 MHz and below 900 MHz.

Fundamental Frequency (MHz)	Limit of 20 dB Bandwidth(kHz)
433.92	1084.8

4.2.2 TEST INSTRUMENT

Description & Manufacturer	Model No.	Serial No.	Calibrated Until
SPECTRUM ANALYZER	FSEK30	100049	Aug. 12, 2005

NOTE: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.2.3 TEST PROCEDURE

a. The EUT was placed on the turn table.

b. The signal was coupled to the spectrum analyzer through an antenna.

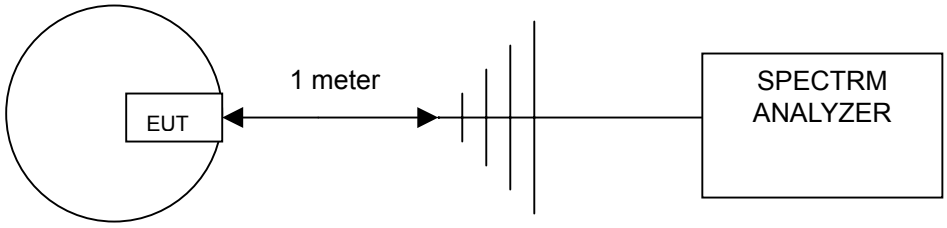
c. Set the resolution bandwidth to 10 kHz and video bandwidth to 30 kHz then select Peak function to scan the channel frequency.

d. The 20 dB bandwidth was measured and recorded.

4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

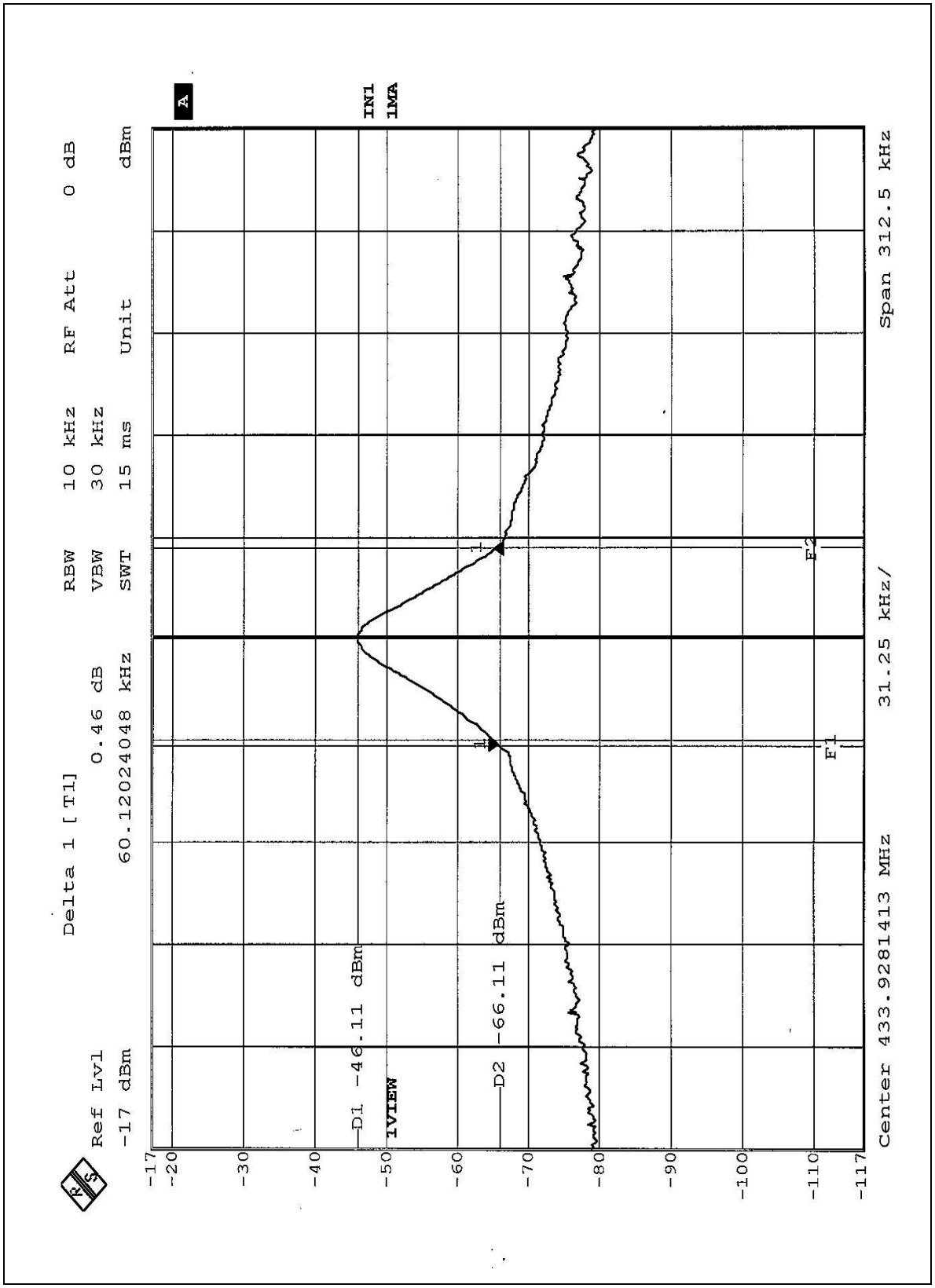
4.2.5 TEST SETUP



4.2.6 TEST RESULTS

Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	PASS/FAIL
433.92	60.12	1084.80	PASS

The plot of test result is attached as below.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Delta 1 [T1]
0.46 dB
60.12024048 kHz
RBW 10 kHz
VBW 30 kHz
SWT 15 ms
RF Att 0 dB
Unit dBm
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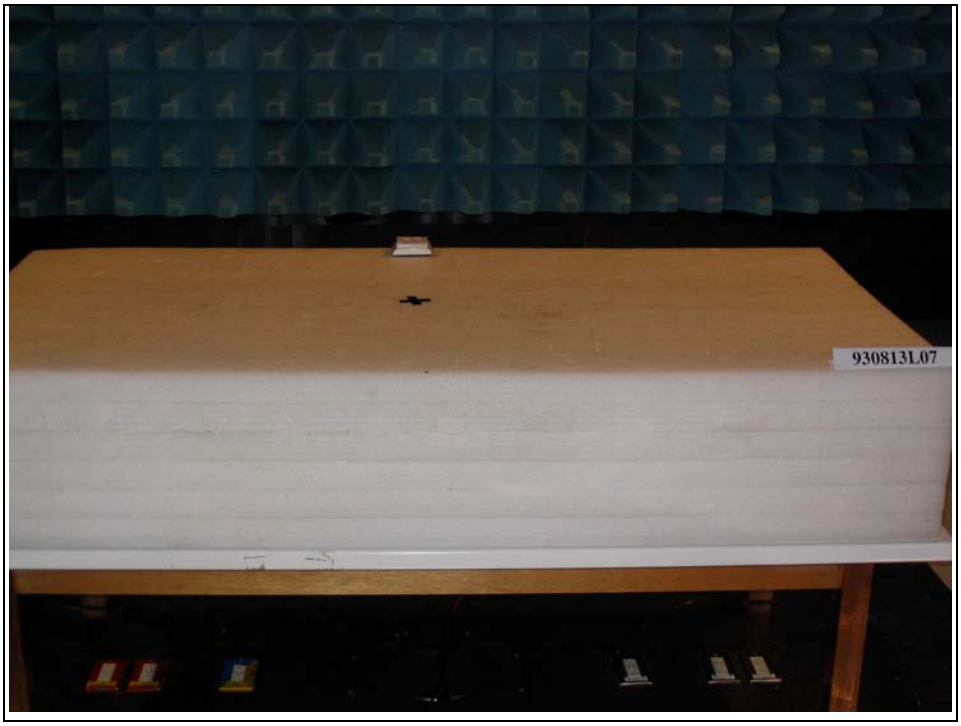
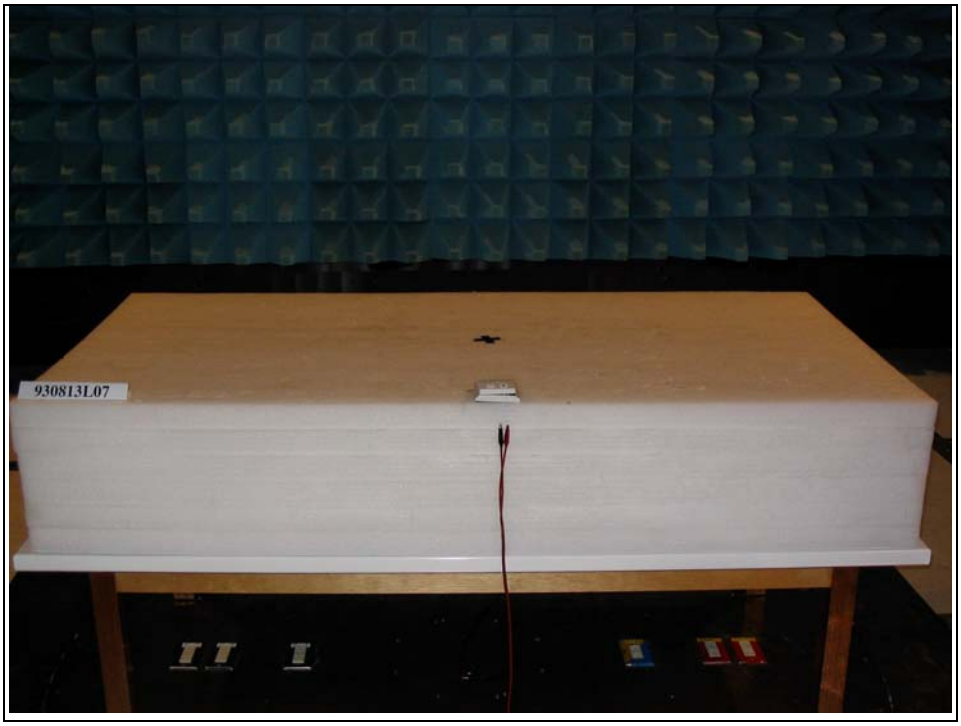
1N1
1MA
1VIEW
D1 -46.11 dBm
D2 -66.11 dBm
F1
F2
Center 433.9281413 MHz
31.25 kHz/
Span 312.5 kHz
-17
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-117

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

RADIATED EMISSION TEST





6 INFORMATION ON THE TESTING LABORATORIES

We, ADT Corp., were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025, Guide 25 or EN 45001:

USA	FCC, NVLAP, UL
Germany	TUV Rheinland
Japan	VCCI
Norway	NEMKO
Canada	INDUSTRY CANADA , CSA
R.O.C.	CNLA, BSMI, DGT
Netherlands	Telefication
Singapore	PSB , GOST-ASIA(MOU)
Russia	CERTIS(MOU)

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site: www.adt.com.tw/index.5/phtml. If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:
Tel: 886-2-26052180
Fax: 886-2-26052943

Hsin Chu EMC/RF Lab:
Tel: 886-3-5935343
Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety/Telecom Lab:
Tel: 886-3-3183232
Fax: 886-3-3185050

Linko RF Lab.
Tel: 886-3-3270910
Fax: 886-3-3270892

Email: service@mail.adt.com.tw
Web Site: www.adt.com.tw

The address and road map of all our labs can be found in our web site also.

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