

Measurement Report

Class II Permissive Change

Product.....: **REMOTE CONTROL TRANSMITTER**
Manufacture.....: **FEGO PRECISION INDUSTRIAL CO., LTD.**
FCC ID.....: **M8CRL202**
Model.....: **BC4162D**
Report No......: **MLT0406P15001**
Test Date.....: **06/07/2004**

Test By

Max Light Technology Co.,Ltd.

*Room 5, 8F, No.125, Section 3 Roosevelt Road,
Taipei, Taiwan., R.O.C.*

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CERTIFICATION

We here by verify that :

The test data, data evaluation, test procedures and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2001. All test were conducted by *MLT (Max Light Technology Co.,Ltd) Room 5, 8F, No.125, Section 3 Roosevelt Road, Taipei, Taiwan, R.O.C* Also, we attest to the accuracy of each.

We further submit that the energy emitted by the sample EUT tested as described in the report is in compliance with radiated emission limit of FCC Rules Part 15 Subpart C Section 15.231.

EUT : REMOTE CONTROL TRANSMITTER

Applicant : FEGO PRECISION INDUSTRIAL CO., LTD.
NO. 947 LIN-SEN RD., WU FONG
SHIANG, TAICHUNG HSIEN,
TAIWAN

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.
NO. 947 LIN-SEN RD., WU FONG
SHIANG, TAICHUNG HSIEN,
TAIWAN

Model No : BC4162D

FCC ID : M8CRL202

Prepared by:  Country Huang approved by:  Roger Chen



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I. GENERAL

1.1 Introduction

The following measurement report is submitted on behalf of Fego Precision Industrial Co., Ltd. In support of an Intentional Periodic Radiator certification in accordance with Part 2 Subpart J and Part 15 Subpart A And C of the Commission's and Regulations.

1.2 Description of EUT

EUT : REMOTE CONTROL TRANSMITTER

Applicant : FEGO PRECISION INDUSTRIAL CO., LTD.
NO. 947 LIN-SEN RD., WU FONG
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Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.
NO. 947 LIN-SEN RD., WU FONG
SHIANG, TAICHUNG HSIEN,
TAIWAN

Model No : BC4162D

FCC ID : M8CRL202

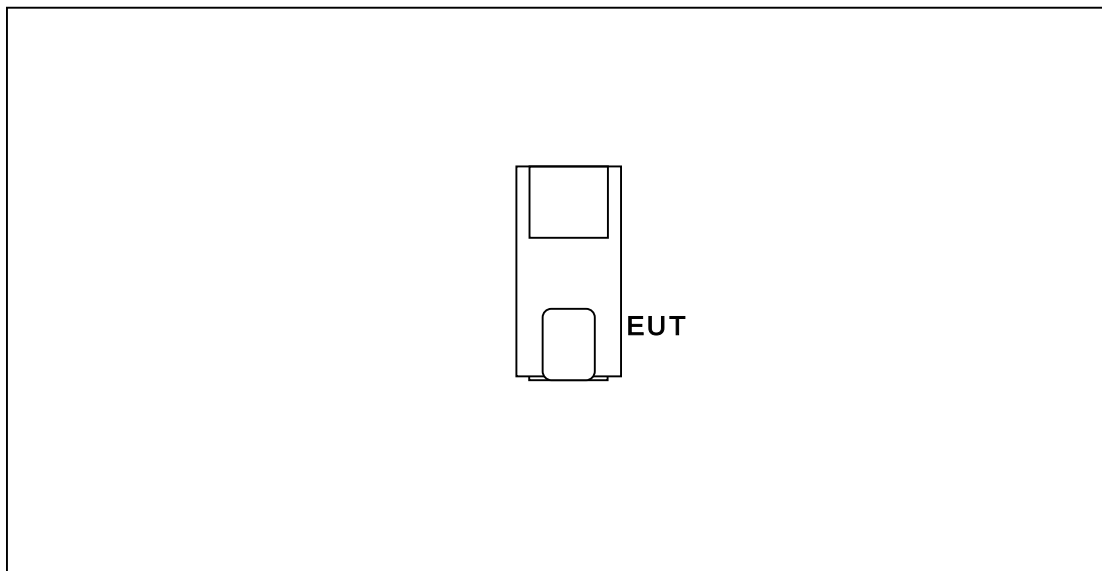
Power Type : Powered by DC 9V Battery

The EUT(BC4162D) is Remote Control of Lamp/Fan Controller. The operation frequency is 315.54Mhz. Press the button on remote transmitter, can set the can set the 0 / I / II / III / DIMMER / DELAY OFF / LIGHT (ON/OFF) button.

1.3 Description of Support Equipment

The EUT itself forms a system. No support equipment is required for its normal operation.

1.4 Configuration of System Under Test



1.5 Related Submittal / Grant)

This submittal is intended for filing a ClassII Permissive Change for the certified equipment FCC ID : M8CRL202 (Data of grant:11/04/99)



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1.6 Change Description

The differences between the BC4162D and the RL202 (FCC ID: M8CRL202) are:

- a) The layout of the PCB is different.
- b) The ANT Type change.

1.7 Test Procedure

All measurements contained in this report were performed according to the techniques described in Measurement procedure ANSI C63.4:2001 "Measurement of Intentional Radiators."

1.8 General Test Condition

The conditions under which the EUT operates were varied to determine their effect on the equipment's emission characteristics. The final configuration of the test system and the mode of operation used during these tests was chosen as that which produced the highest emission levels. However, only those conditions which the EUT was considered likely to encounter in normal use were investigated.



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II. Conducted Emissions Requirements

The EUT operates solely by the battery. According to the rule of Section 15.207(c), the EUT exempt to the power line conducted test.



III. Radiated Emissions Requirements

3.1 General Configuration:

Prior to open-field testing, the EUT was placed in a shielded enclosure and scanned at a close distance to determine its emission characteristics. The physical arrangement of the EUT was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude, directivity, and frequency. The exact system configuration which produced the highest emissions was noted so it could be reproduced later during the open-field tests. This was done to ensure that the final measurements would demonstrate the worst-case interference potential of the EUT.

3.2 General Configuration:

Final radiation measurements were made on a three-meter, open-field test site. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 30 MHz to 5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.



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A nonconductive material surrounded the EUT to supporting the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

The field strength below 1 GHz was measured by EMCO Biconilog Antenna (mode 3142) at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna (model BBHA9120D&9170) was used in frequencies 1 – 40 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20dB/decade).

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The actual field intensity is referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.



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$$(1) \text{ Amplitude (dBuV/m)} = FI(\text{dBuV}) + AF(\text{dBuV}) + CL(\text{dBuV}) - \text{Gain(dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dBuV/m)} = \text{Amplitude (dBuV)} - \text{Duty(dB)} - \text{Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(1) For fundamental frequency :

$$\text{Emission Limit(uV/m)} = [F_{\text{EUT}}(\text{MHz}) - 260(\text{MHz})] \times \frac{12500(\text{uV/m}) - 3750(\text{uV/m})}{470(\text{MHz}) - 260(\text{MHz})} + 3750(\text{uV/m})$$

F_{EUT} = EUT Operating Frequency.

(2) For spurious frequency :

Spurious emission limits = fundamental emission limit /10

3.3 Test Equipment List:

- A. HP 8591EM 9KHz-1.8GHz Spectrum Analyzer (S/N:73412A00230)
- B. HP 8447D Pre Amplifier (S/N:2944A08954)
- C. EMCO 3142 26MHz~2000MHz Biconilog Antenna (S/N:1184)
- D. R&S ESVP 20MHz~1300MHz Test Receiver (S/N:881121/01)
- E. Agilent E4407B 9KHz-26.5GHz Spectrum Analyzer (S/N:A872JS02291)
- F. HP 8449B 1GHZ~26.5GHZ PRE Amplifier (S/N:1982901A91)
- G. SCHWARZBECK BBHA 9120D 1GHz~18GHz Horn Antenna (S/N:141S3)
- H. SCHWARZBECK BBHA 9170 15GHz~40GHz Horn Antenna (S/N:192S5)

3.4 Test Configuration:



Front View of The Test Configuration



Rear View of The Test Configuration



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3.5 Measurement Data Of Radiated Emissions:

3.5.1 Open Field Radiated Emissions (Horizontal/X-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.

Model No : BC4162D

EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (HORIZONTAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	71.75	1.5	210	11.75	0	60.00	75.71	-15.71
631.09	47.27	1.5	360	11.75	0	35.52	55.71	-20.19
946.66	43.26	2	300	11.75	0	31.51	54.00	-22.49
1262.10	52.45	1	210	11.75	9.54	31.16	55.71	-24.55
1577.76	50.65	1	200	11.75	9.54	29.36	54.00	-24.64
1893.24	53.65	1	220	11.75	9.54	32.36	55.71	-23.35
2208.75	52.90	1	180	11.75	9.54	31.61	54.00	-22.39

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.

3.5.2 Open Field Radiated Emissions (Vertical/X-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following.

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.

Model No : BC4162D

EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (VERTICAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	74.89	1.5	360	11.75	0	63.14	75.71	-12.57
631.10	57.21	1	340	11.75	0	45.46	55.71	-10.25
946.65	48.98	2	270	11.75	0	37.23	54.00	-16.77
1262.10	55.87	1	180	11.75	9.54	34.58	55.71	-21.13
1577.75	53.77	1	320	11.75	9.54	32.48	54.00	-21.52
1893.20	52.55	1	190	11.75	9.54	31.26	55.71	-24.45
2208.71	53.87	1	200	11.75	9.54	32.58	54.00	-21.42

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.

3.5.3 Open Field Radiated Emissions (Horizontal/Y-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.
 Model No : BC4162D
 EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (HORIZONTAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	68.45	1.2	290	11.75	0	56.70	75.71	-19.01
631.10	42.44	2	310	11.75	0	30.69	55.71	-25.02
946.62	44.87	1.5	190	11.75	0	33.12	54.00	-20.88
1262.19	50.55	1	260	11.75	9.54	29.26	55.71	-26.45
1577.76	47.98	1	230	11.75	9.54	26.69	54.00	-27.31
1893.25	50.12	1	200	11.75	9.54	28.83	55.71	-26.88
2208.79	49.23	1	160	11.75	9.54	27.94	54.00	-26.06

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.

3.5.4 Open Field Radiated Emissions (Vertical/Y-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following.

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.

Model No : BC4162D

EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (VERTICAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	66.21	1.5	320	11.75	0	54.46	75.71	-21.25
631.12	45.76	1.6	270	11.75	0	34.01	55.71	-21.70
946.68	48.45	1	140	11.75	0	36.70	54.00	-17.30
1262.14	48.34	1	190	11.75	9.54	27.05	55.71	-28.66
1577.75	49.45	1	230	11.75	9.54	28.16	54.00	-25.84
1893.22	51.87	1	210	11.75	9.54	30.58	55.71	-25.13
2208.76	48.11	1	190	11.75	9.54	26.82	54.00	-27.18

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.



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3.5.5 Open Field Radiated Emissions (Horizontal/Z-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.
Model No : BC4162D
EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (HORIZONTAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	68.34	1.5	200	11.75	0	56.59	75.71	-19.12
631.13	48.67	1.5	350	11.75	0	36.92	55.71	-18.79
946.65	45.44	1.5	320	11.75	0	33.69	54.00	-20.31
1262.13	51.98	1	200	11.75	9.54	30.69	55.71	-25.02
1577.75	49.23	1	150	11.75	9.54	27.94	54.00	-26.06
1893.20	50.32	1	210	11.75	9.54	29.03	55.71	-26.68
2208.77	51.45	1	180	11.75	9.54	30.16	54.00	-23.84

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.

3.5.6 Open Field Radiated Emissions (Vertical/Z-axis)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation , etc. are recorded on the following.

Manufacturer : FEGO PRECISION INDUSTRIAL CO., LTD.

Model No : BC4162D

EUT : REMOTE CONTROL TRANSMITTER

Radiated Emissions (VERTICAL)								
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Dist (dB)	Actual Amp (dBuV/m)	Limit (dBuV/m)	Margin (dB)
315.54	68.71	2	220	11.75	0	56.96	75.71	-18.75
631.12	46.88	1.5	290	11.75	0	35.13	55.71	-20.58
946.68	42.22	2	320	11.75	0	30.47	54.00	-23.53
1262.18	50.78	1	190	11.75	9.54	29.49	55.71	-26.22
1577.72	51.09	1	220	11.75	9.54	29.80	54.00	-24.20
1893.24	52.67	1	210	11.75	9.54	31.38	55.71	-24.33
2208.75	50.22	1	200	11.75	9.54	28.93	54.00	-25.07

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter (30-1000MHz)

3.Height of table for EUT placed: 0.8 Meter.

4.ANT= Antenna height.

5.Duty= Duty cycle correction factor.

6.Dis= Distance extrapolation factor.

7.Amplitude= Reading Amplitude – Amplifier gain+Cable loss
+Antenna factor

(Auto calculate in spectrum analyzer)

8.Actual Amp= Amplitude – Duty – Dis.

9. EUT Orthogonal Axes : X denotes Laid on Table ; Z denotes Side Stand ; Y denotes Vertical Stand.

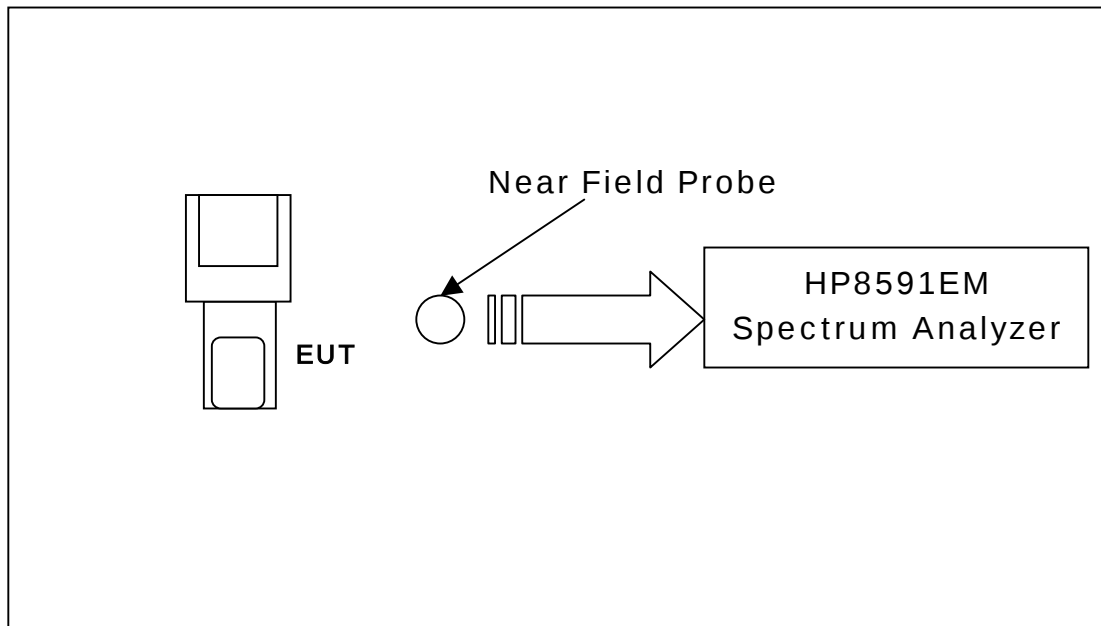
IV. Transmitter Bandwidth Measurement

4.1 Test Condition & Setup :

The transmitter bandwidth measurements were performed in a shielded enclosure. The EUT was placed on a wooded table which is 0.8 meters height and a near field probe was used at a distance about 20 cm for receiving. While testing, EUT was set to transmit continuously.

The resolution bandwidth of the spectrum analyzer was set to 10KHz. The detector function was set to peak and hold mode to clearly observe the components. The maximum permitted bandwidth at -20dB with respect to the reference level specified by the rule was 0.25 % of the center frequency of the EUT.

4.2 Test Instruments Configuration:





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4.3 Test Equipment List:

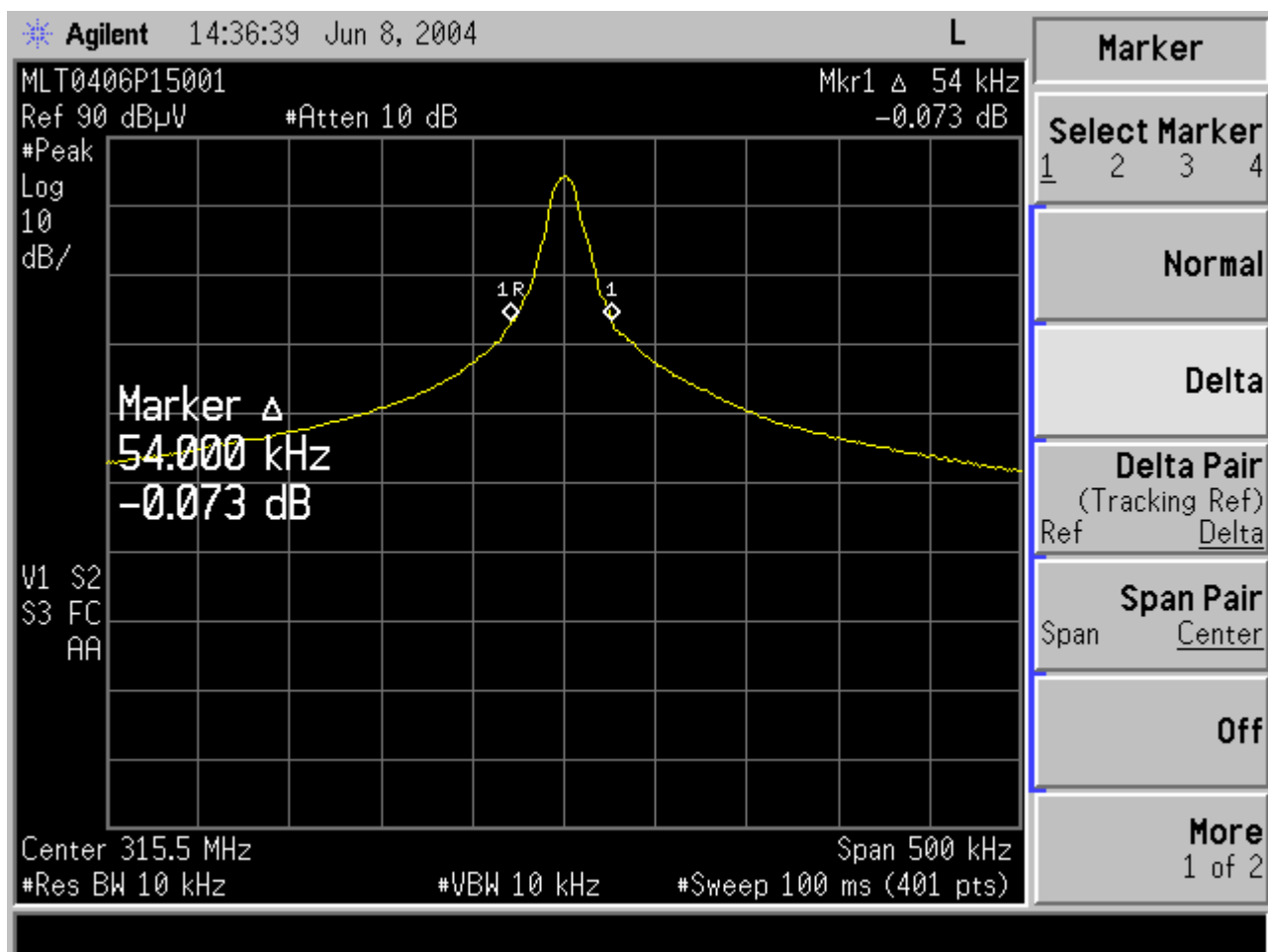
- A. Tektronix FG504 0.1H~40MHz (S/N:43AS251)
- B. EMCO Near Field Probe (S/N:7901-291)
- C. HPE4407B 9KHz~26.8GHz Spectrum Analyzer (S/N: US39240419)
- D. Shielded Room (MLT-SR1)

4.4 Test Result:

Permitted Maximum Bandwidth	788.85KHz
Bandwidth Measurement	54.00KHz

4.5 Test Graphs:

See next page.





V. Transmitter Duty Cycle Measurement

5.1 Test Condition & Setup :

The transmitter bandwidth measurements were performed in a shielded enclosure. The EUT was placed on a wooded table which is 0.8 meters height and a near field probe was used at a distance about 20 cm for receiving. While testing, EUT was set to transmit continuously. Various key configurations were also investigated to find the maximum duty cycle.

The spectrum analyzer resolution bandwidth and video bandwidth were all set to 1 MHz to encompass all Significant spectral components during the test. The analyzer was operated in linear scale and zero span mode after tuning to the transmitter carrier frequency. A digital oscilloscope was connected to the aux video output of the spectrum analyzer for measuring pulse width. The pulse width was determined by the difference between the half voltage points on a pulse.

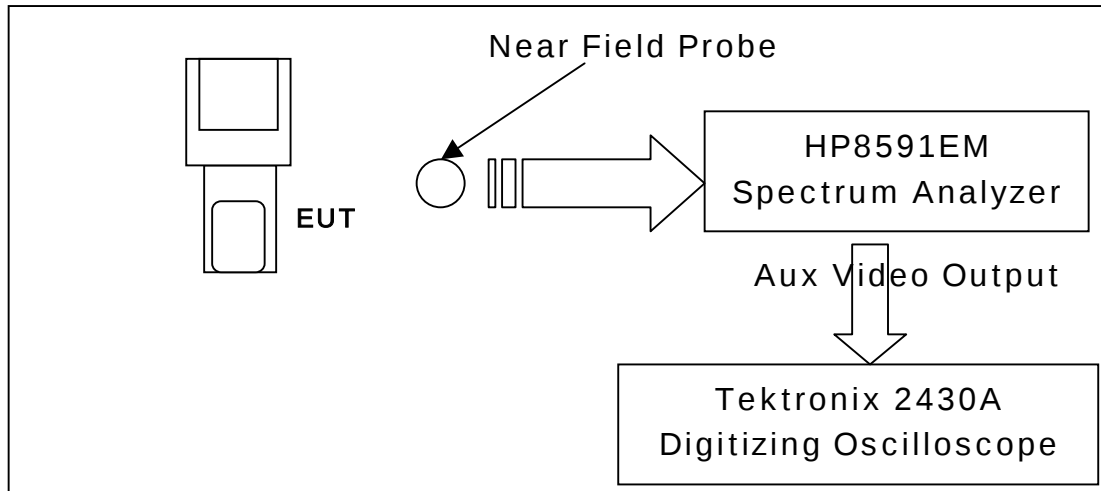
The duty cycle was determined by the following equation :

TO calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion :

$$\text{Duty Cycle(\%)} = \frac{(\text{Total On Interval in a Complete Pulse Train})}{(\text{Length of a Complete Pulse Train})} \times 100\%$$

$$\text{Duty Cycle Correction Factor (dB)} = 20 \times \text{Log}_{10} (\text{Duty Cycle(\%)})$$

5.2 Test Instruments Configuration:



5.3 Test Equipment List:

- A. Tektronix FG504 0.1H~40MHz (S/N:43AS251)
- B. EMCO Near Field Probe (S/N:7901-291)
- C. HPE4407B 9KHz~26.8GHz Spectrum Analyzer (S/N: US39240419)
- D. Tektronix 2230 Digitizing Oscilloscope (S/N:A13F148F09)
- E. Shielded Room (MLT-SR1)

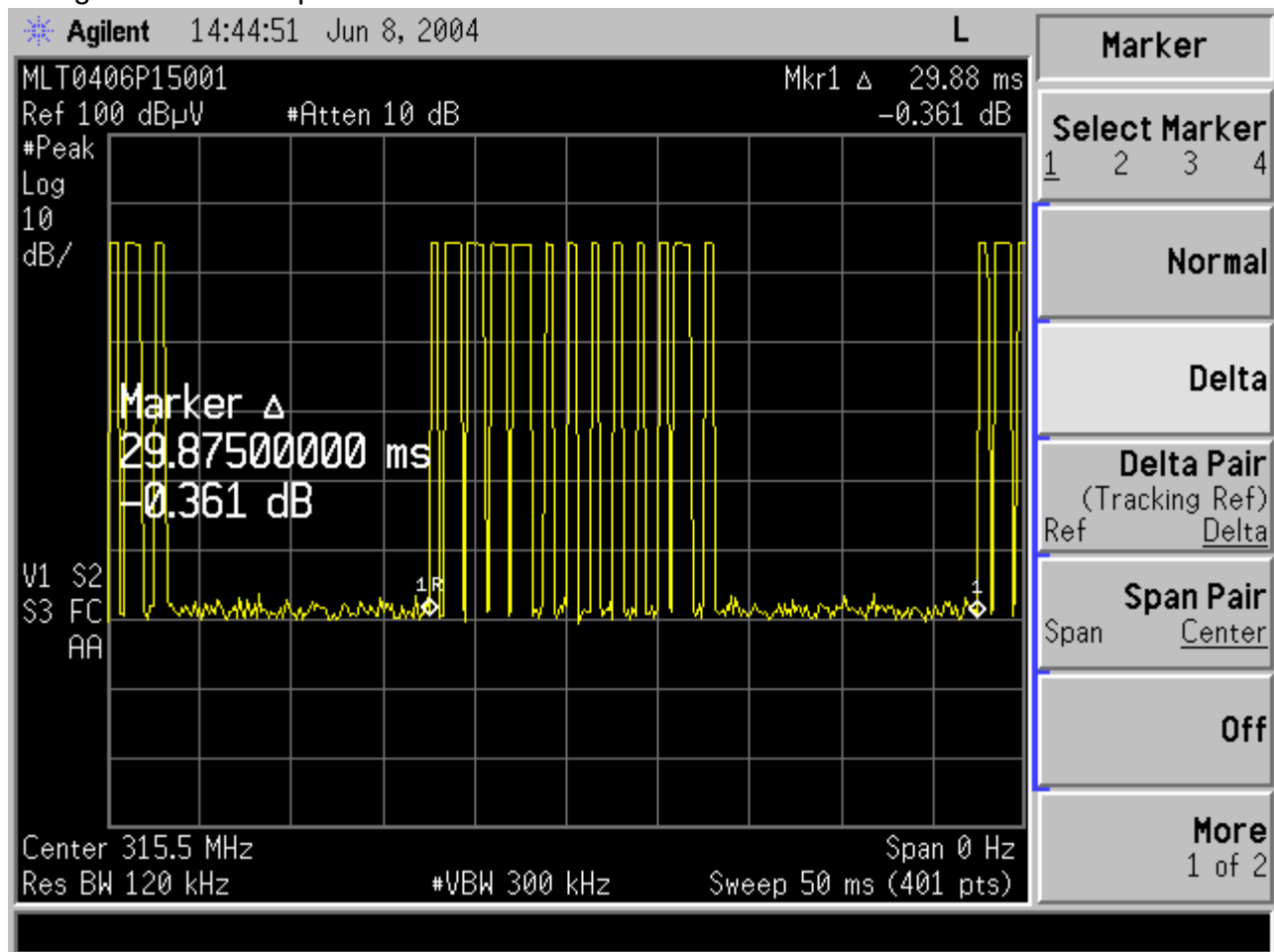
5.4 Test Result:

Pulse Train	Number of Pulse	T(ms)	Total Time (ms)
Long Pulse	5	0.825	4.125 msec
Short Pulse	8	0.45	3.6 msec

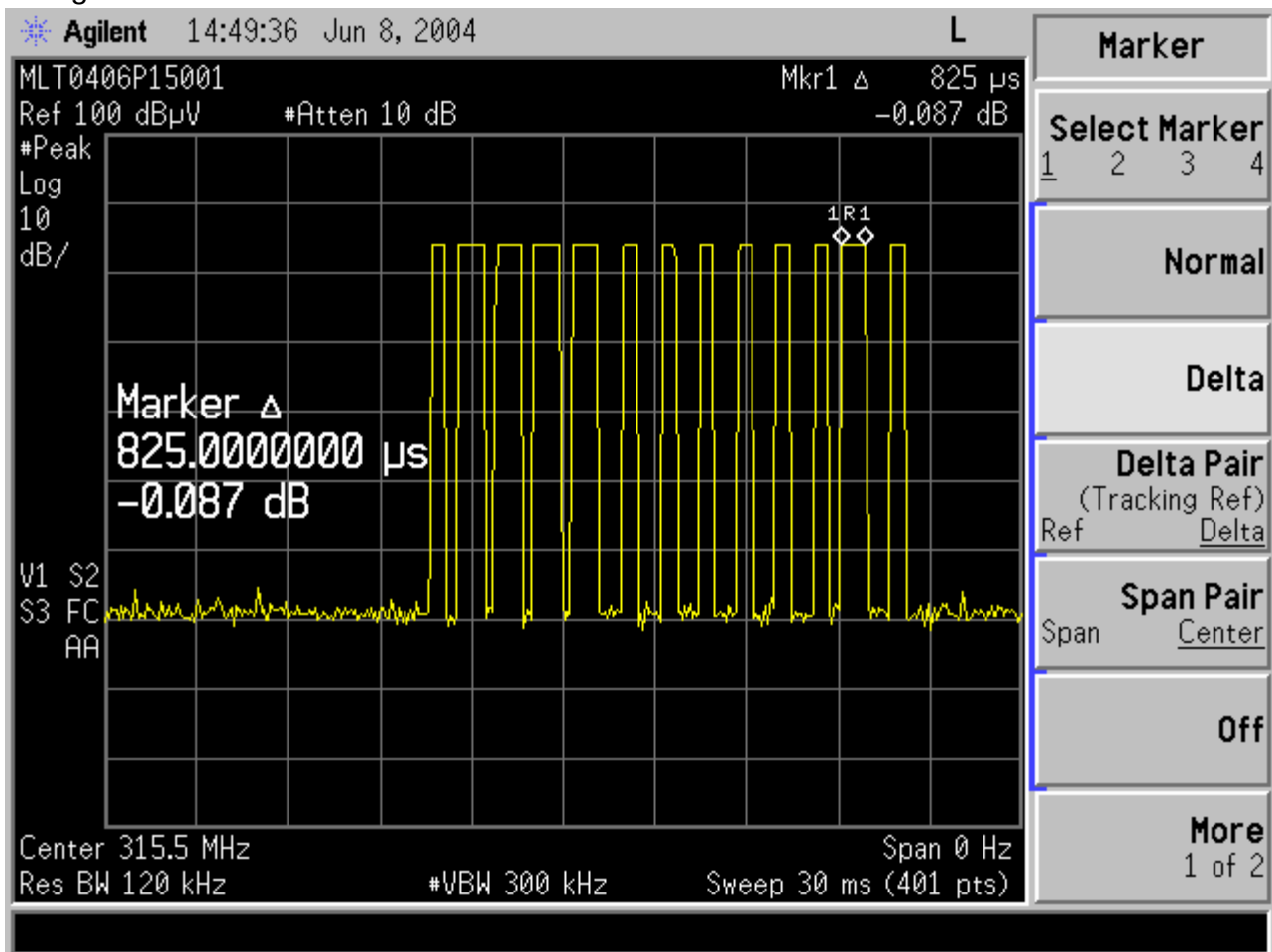
Total ON interval in a complete pulse train	7.725 msec
Length of a complete pulse train	29.88 msec
Duty Cycle (%)	25.85%
Duty Cycle Correction Factor (dB)	11.75

5.5 Test Graphs: See next page.

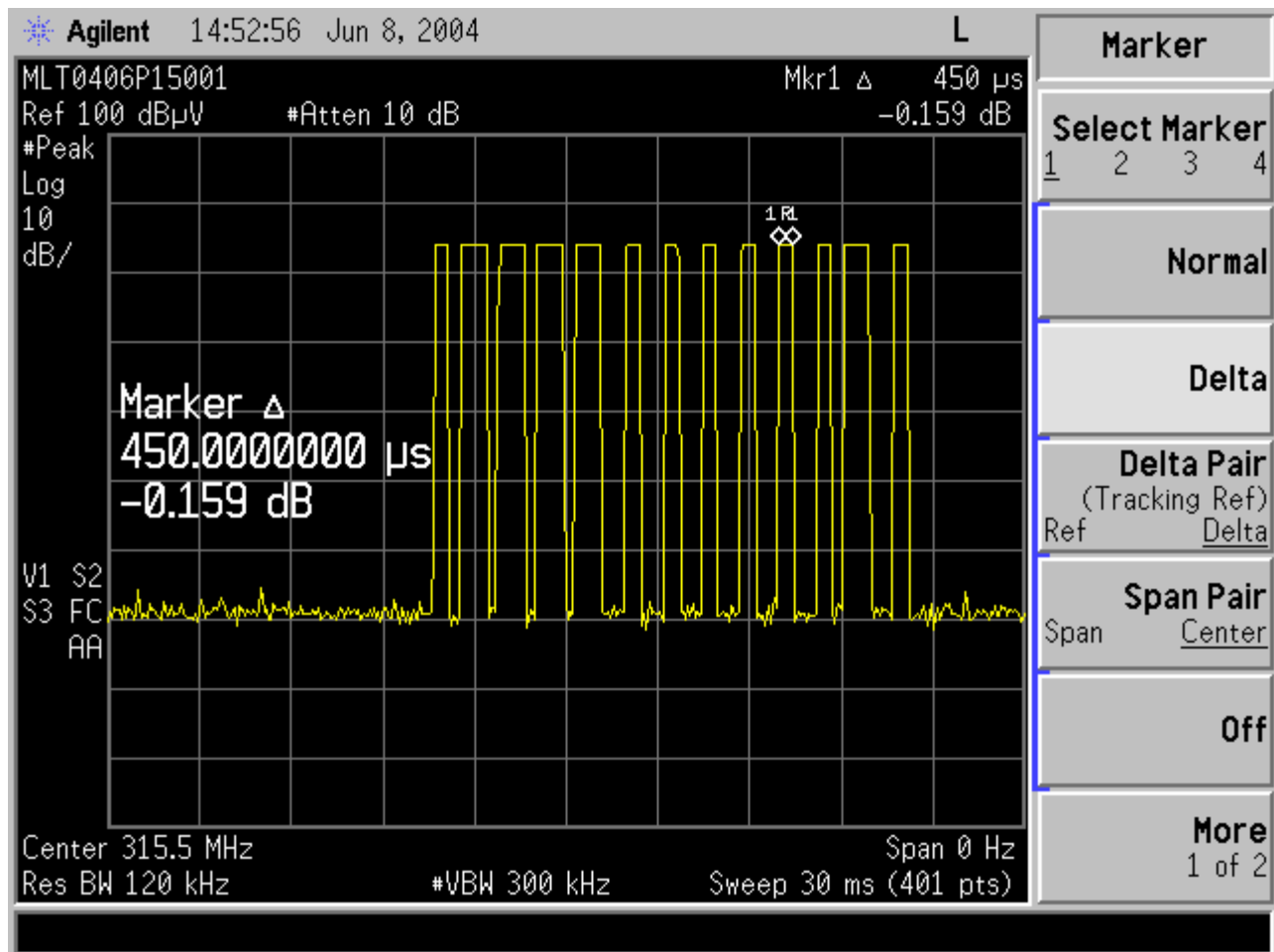
Length of A Complete Pulse Train



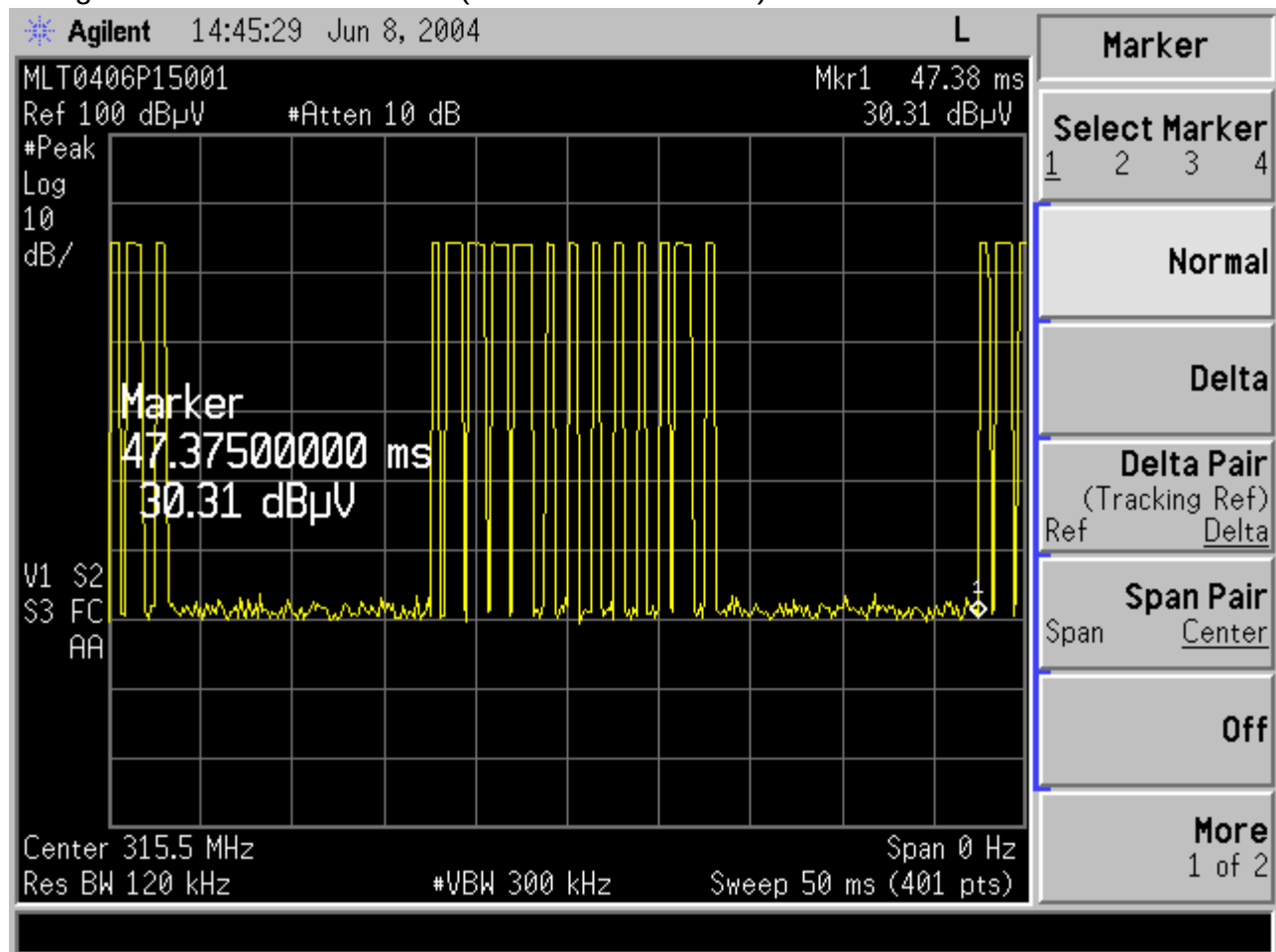
Long Pulse



Short Pulse



Long Pulse & Short Pulse (Number of Pulse)



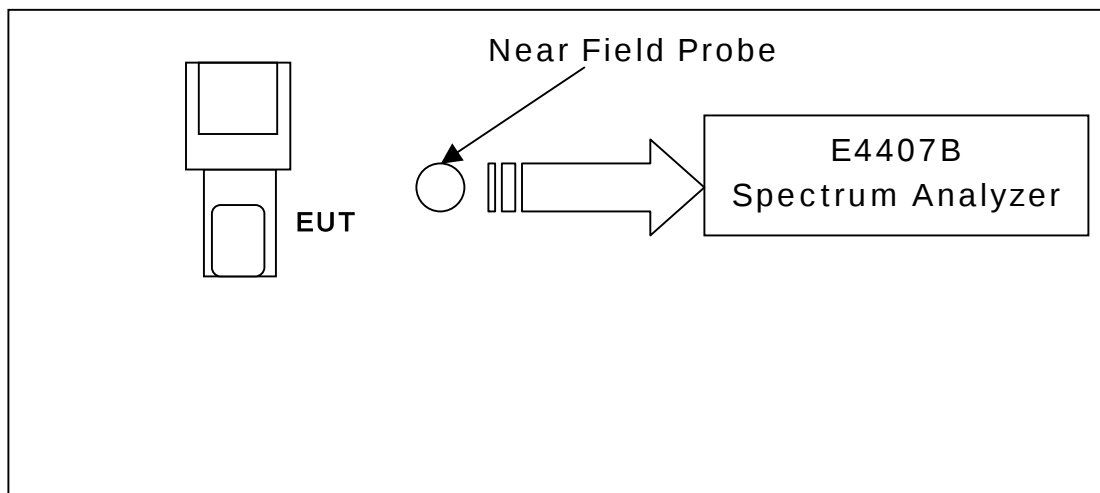
VI. Verification of De-activation after 5 seconds

6.1 Test Condition & Setup :

The transmitter bandwidth measurements were performed in a shielded enclosure. The EUT was placed on a wooded table which is 0.8 meters height and a near field probe was used at a distance about 20 cm for receiving. While testing, EUT was set to transmit continuously. Various key configurations were also investigated to find the maximum duty cycle.

The spectrum analyzer resolution bandwidth and video bandwidth were all set to 100KHZ to encompass all Significant spectral components during the test. The analyzer was operated in linear scale and zero span mode after tuning to the transmitter carrier frequency.

6.2 Test Instruments Configuration:



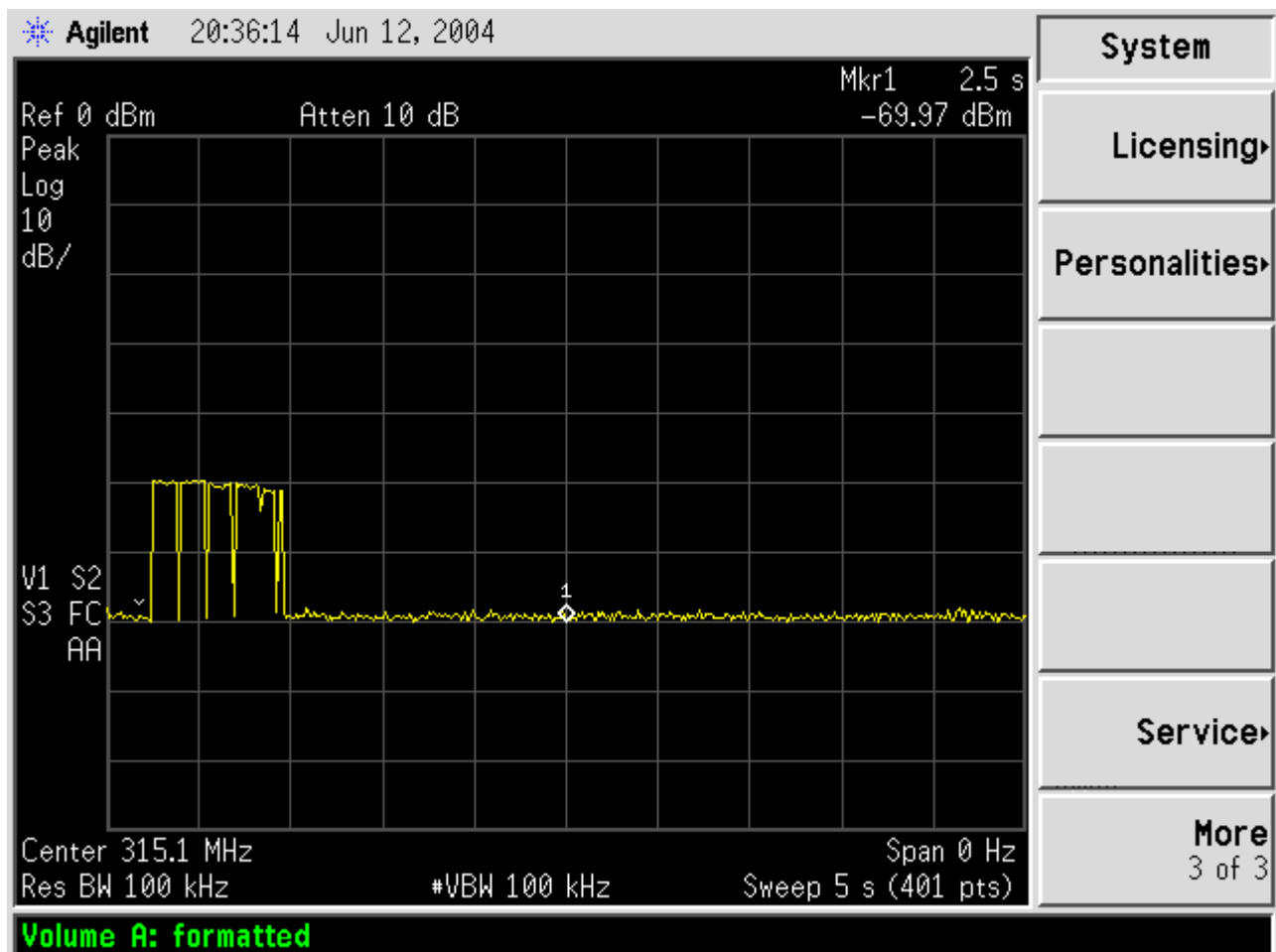
6.3 Test Equipment List:

- A. Tektronix FG504 0.1H~40MHz (S/N:43AS251)
- B. EMCO Near Field Probe (S/N:7901-291)
- C. E4407B 9KHz~26.8GHz Spectrum Analyzer (S/N: US39240419)
- E. Shielded Room (MLT-SR1)

6.4 Test Result:

Compliant Conditions (Section 15.231)	EUT Status	
Was the EUT manually operated ?	☒ Yes	☐ No
If yes, did the EUT employ a switch that would automatically deactivate the transmitter within not more than 5 seconds of being released ?	☒ Yes	☐ No
Was the EUT automatically activated ?	☐ Yes	☒ No
Was the EUT used for periodic transmissions at regular predetermined intervals ?	☐ Yes	☒ No

Note: This device stops transmitting once the activation button in depressed.



Appendix I- EUT Test SETUP

MEASUREMENT OF RADIATED EMISSION

