INTENTIONAL RADIATOR RF TEST REPORT FOR DIGIVISION ELECTRONICS LTD MANUFACTURED BY M/s. DIGIVISION ELECTRONICS LTD., CHENNAI

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SAMEER-CENTRE FOR ELECTROMAGNETICS

November 2016

Equipment Under Test (EUT)	:	Phiro-Educational Toy	
Model Number of EUT	:	Phiro-001	SAMEER
Serial Number of EUT	:	Phiro-001	
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

INTENTIONAL RADIATOR RF TEST REPORT FOR DIGIVISION ELECTRONICS LTD MANUFACTURED BY
M/s. DIGIVISION ELECTRONICS LTD., CHENNAI

Test Request Particulars

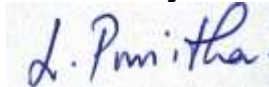|			
1.	Test Request From	:	M/s. Digivision Electronics Ltd, Chennai
2.	Equipment Under Test (EUT)	:	Phiro - Educational Toy
3.	Number of Test Sample(s)	:	One
4.	Type of Tests Requested *(Applicable Standard)*	:	RF test report based on FCC part 15C
5.	Manufacturer	:	M/s. Digivision Electronics Ltd., Chennai
6.	Model Number of EUT	:	Phiro-Pro
7.	Serial Number of EUT	:	Phiro Pro 00 0001
8.	Test plan concurred by *(Customer Representative)*	:	Mr. Harish, Technical Engineer. M/s.Digivision Electronics Ltd., Chennai
9.	EUT Arrived On	:	September 29, 2016
10.	Test duration	:	September 29- October 28, 2016
11.	Test Venue	:	SAMEER-CEM, Chennai
12.	Status of the EUT on Receipt	:	Functional

Certified that the data reported in this report are valid only for the test sample mentioned above at the time of and under the stated conditions of measurement. Particulars on Manufacturer / Supplier, given in this report, are based on the information given by the customer, along with test request and SAMEER-CEM does not assume any responsibility for the correctness of that information for the above mentioned equipment under test.

Office Seal

Tested by: *Reviewed by:*

S.Sarathkrishna)   **(L. Punitha)**
Research Scientist   Scientist - D

Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

GENERAL INFORMATION

EUT DESCRIPTION (provided by the customer)

Product Name:	Phiro
Model Name:	Phiro Pro 00 0001
Hardware Version:	V1
Software Version:	V1
Bluetooth	
Frequency Range:	2402MHz - 2480MHz
Type of Modulation:	GFSK(1 Mbps), π/4-DQPSK(2 Mbps) 8-DPSK(3 Mbps)
Channel Separation:	1MHz
Channel Number:	79
Antenna Type:	Internal
Antenna Peak Gain:	0dBi

Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

**INTENTIONAL RADIATOR TEST FOR
M/s. DIGIVISION ELECTRONICS LTD**

Sl.no	Name of the Test	Standard	Result
1.	**Peak Output Power**	FCC Part C 15.247	Within the limit
2.	**Occupied Bandwidth**	FCC Part C 15.247	Within the limit
3.	**Band Edge Measurement**	FCC Part C 15.247	Within the limit
4.	**Channel Separation**	FCC Part C 15.247	Within the limit
5.	**Minimum Hopping Channels**	FCC Part C 15.247	Within the limit
6.	**Dwell Time**	FCC Part C 15.247	Within the limit
7.	**Radiated emission**	FCC Part C 15.209	Within the limit

Equipment Under Test (EUT)	:	Phiro-Educational Toy	
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Equipment Under Test (EUT)	:	Phiro-Educational Toy	
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Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

1. PEAK OUTPUT POWER

1.1. Applicable Standard: Based on FCC Part 15C (As per ANSI C63.10 (2013))

1.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

1.3 EUT Configuration: Given in Annexure – 2

1.4 Test Procedure.

1. Set RBW = 1 MHz, VBW = 3 MHz, sweep time = auto, detector = Peak, trace= maxhold
2. Use the peak marker function to determine the maximum amplitude level.
3. Conduct test in low, mid and high frequencies.

1.5 Test Observations

Modulation	Frequency (MHz)	Peak Output power (dBm)
GFSK	2402	-9.315
GFSK	2441	-9.217
GFSK	2480	-9.422
Pi/4 DQPSK	2402	-13.69
Pi/4 DQPSK	2441	-13.42
Pi/4 DQPSK	2480	-13.06
8DPSK	2402	-13.69
8DPSK	2441	-13.09
8DPSK	2480	-10.06

1.6 Enclosed Documents

Annexure – 2: Photograph of peak output power measurement setup and measurements

Equipment Under Test (EUT)	:	Phiro-Educational Toy
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2. OCCUPIED BANDWIDTH

2.1. Applicable Standard: Based on FCC Part 15C (As per ANSI C63.10 (2013))

2.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

2.3 EUT Configuration: Given in Annexure – 3

2.4 Test Procedure.

1. Set RBW = 1 MHz, VBW = 3 MHz, sweep time = auto, detector = peak, trace= maxhold.
2. The automatic bandwidth measurement capability of a spectrum analyzer may be employed using the X dB bandwidth mode with X set to 20 dB for direct measurement.

2.5 Test Observations

Channel	20dB BW (KHz)
LOW	808KHz
MID	778.1KHz
HIGH	778.1KHz

2.6 Enclosed Documents:

Annexure – 3: Photograph of 20 dB measurement setup and measurements

Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
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Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

3. BAND EDGE MEASUREMENTS

3.1. Applicable Standard: Based on FCC Part 15C(As per ANSI C63.10 (2013))

3.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

3.3 EUT Configuration: Given in Annexure – 4

3.4 Test Procedure.

1. Set RBW = 1 MHz, VBW = 3 MHz, sweep time = auto.
2. Use the peak marker function to determine the maximum amplitude level.
3. Measure level at 100 KHz bandwidth outside the desired frequency band using delta marker function

3.5 Test Observations

Measured values at 100 KHz bandwidth outside 2402-2480 frequency bands are 20 dB below the peak amplitude of the wanted transmission.

3.6 Enclosed Documents

Annexure – 4: Photograph of measurement setup and Band edge measurements

Equipment Under Test (EUT)	:	Phiro-Educational Toy	
Model Number of EUT	:	Phiro-001	
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Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

4. CHANNEL SEPARATION

4.1. Applicable Standard: Based on FCC Part 15C (As per ANSI C63.10 (2013))

4.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

4.3 EUT Configuration: Given in Annexure – 5

4.4 Test Procedure.

1. The EUT have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = wide enough to capture the peaks of two adjacent channels Resolution Bandwidth (RBW) ≥ 1% of the span .Video (or Average) Bandwidth (VBW) ≥ RBW
3. Sweep = auto
4. Detector function = peak
5. Trace = max hold
6. Allow the trace to stabilize. Use the marker-delta function to measure the separation between the peaks of the adjacent channels.

4.5 Test Observations

Hopping Frequency separation	Limit	Center Frequency of Separation
1 MHz	>= 1MHz	2441 MHz

4.6 Enclosed Documents

Annexure – 5: Photograph of measurement setup and channel separation

Equipment Under Test (EUT)	:	Phiro-Educational Toy	
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Serial Number of EUT	:	Phiro-001	
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

5. NO. OF HOPPING FREQUENCY

5.1. Applicable Standard: Based on FCC Part 15C (As per ANSI C63.10 (2013))

5.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

5.3 EUT Configuration: Given in Annexure – 6

5.4 Test Procedure.

1. The EUT have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = the frequency band of operation,RBW ≥ 1% of the span,VBW ≥ RBW
3. Sweep = auto
4. Detector function = peak
5. Trace = max hold .Allow the trace to stabilize.
6. Measure number of hopping channels.

5.5 Test Observations

Number of hopping channels observed = 79.

5.6 Enclosed Documents

Annexure – 6: Photograph of measurement setup and measurements

Equipment Under Test (EUT)	:	Phiro-Educational Toy
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6. DWELL TIME

6.1. Applicable Standard: Based on FCC Part 15C (As per ANSI C63.10 (2013))

6.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyser	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017

6.3 EUT Configuration: Given in Annexure – 7

6.4 Test Procedure.

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = zero span, centered on a hopping channel
3. Sweep = as necessary to capture the entire dwell time per hopping channel
4. Detector function = peak, Trace = max hold.

6.5 Test Observations

Channel	Modulation	Measured value-x(ms)	Dwell Time (ms)
LOW	DH1	0.38	121.60
	DH3	1.64	262.40
	DH5	2.87	306.13
MID	DH1	0.38	121.60
	DH3	1.63	260.80
	DH5	2.87	306.13
HIGH	DH1	0.37	118.40
	DH3	1.63	260.80
	DH5	2.89	308.27

Dwell time = (1600*x*31.6)/(N*79) where N=2(DH1),N=4(DH3),N=6(DH5),
        = (1600*0.38*31.6)/(2*79) = 121.6ms

6.6 Enclosed Documents

Annexure – 7: Photograph of measurement setup and measurements

Equipment Under Test (EUT)	:	Phiro-Educational Toy
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SAMEER

7. RADIATED EMISSIONS

7.1. Applicable Standard: Based on FCC part 15.209

7.2 Test Instrumentation:

Description	Make	Model Number	Serial Number	Calibration date	Calibration due
Spectrum Analyzer	Agilent	E4407B	MY44212122	01-Aug-2016	01-Aug-2017
Double Ridged wave guide Horn antenna	R&S	HF 906	100108	02-Sep-2016	02-Sep-2018
Ultra Log Antenna	R&S	HL 562	100100	11-Mar-2015	11-Mar-2017
Active monopole Antenna	ETS-Lindgren	3301C		03-Aug-2016	03-Aug-2017
Pre-Amplifier	HP	84498	3022A03320	08-Sep-2016	08-Sep-2017

7.3 EUT Configuration: Given in Annexure – 9

7.4 Test limit frequency range and limit

Frequency Range (MHz)	Distance (m)	Limit (dBuV/m)
0.009~0.490	3	128.5~93.8
0.490~1.705	3	73.8~62.9
1.705~30.0	3	69.5
30~88	3	40
88~216	3	43.50
216~960	3	46
Above 960	3	54

7.5 Test Procedure.

The Radiated Emissions from the EUT in the frequency range of 9 KHz -26.5 GHz were picked up. The test was carried out inside the shielded semi -anechoic chamber with the EUT placed at a distance of 3 m from the receiving antenna. The EUT was rotated from 0º - 360º and the receiving antenna height varied from 1m to 2.5m to pick up the maximum emission. The measurement was done in the peak detection mode for both vertical and horizontal polarizations for frequencies above 1 GHz and with average mode for frequencies below 1GHz.

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7.6 Test Observations

8 DPSK 2402 MHz

Frequency (MHz)	Emission level (dBuV/m)*	Antenna
0.61	32.94	
9.31	32.74	
14.7	28.33	
16.2	31.98	
18.68	32.37	Active monopole Antenna
21.9	37.3	
22.72	37.74	
23.18	38.11	
23.63	35.45	

Frequency (MHz)	Polarization	Emission level (dBuV/m)*	Antenna
119.725	H	29.4	Ultra Log Antenna
64	V	24.9	

8 DPSK 2441 MHz

Frequency (MHz)	Emission level (dBuV/m)*	Antenna
0.61	35.02	
9.23	34.35	
14.4	27.64	
15.23	28.27	
16.88	28.12	Active monopole Antenna
18.53	35.42	
21.6	36.27	
22.58	39.34	
0.61	35.02	

Frequency (MHz)	Polarization	Emission level (dBuV/m)*	Antenna
64	V	25.6	
51.8	V	25.59	Ultra Log Antenna
136.7	H	27.67	
119.7	H	28.24	

Equipment Under Test (EUT)	:	Phiro-Educational Toy
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8 DPSK 2480 MHz

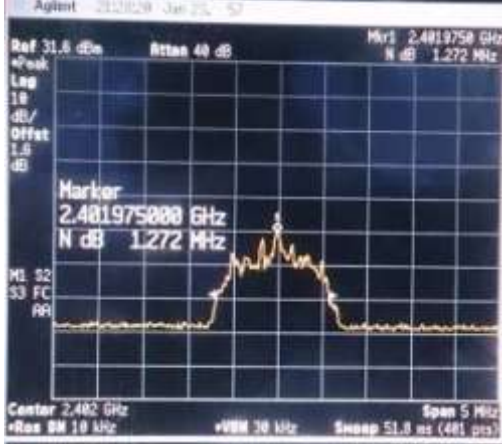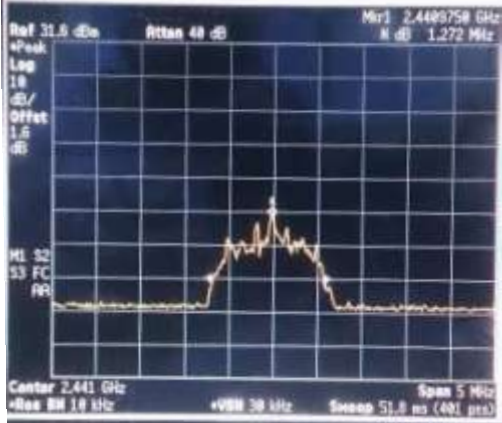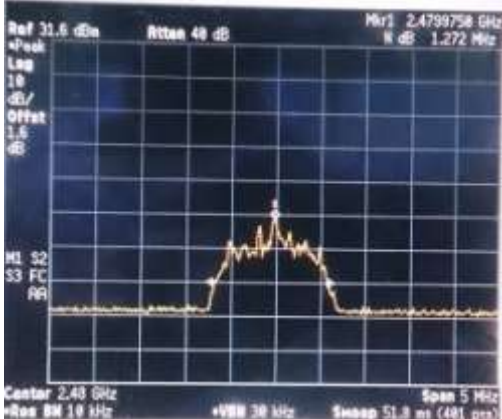| Frequency (MHz)	Emission level (dBuV/m)*	Antenna
0.61	34.1	Active monopole Antenna
9.08	31.55	
15.53	29.33	
18.08	32.26	
18.6	32.02	
21.38	35.69	
22.95	38.81	

Frequency (MHz)	Polarization	Emission level (dBuV/m)*	Antenna
63.95	**V**	25.06	Ultra Log Antenna
136.7	**H**	29.25	
124.6	**H**	29.07	
5790	**V**	50.3	Horn Antenna

Emission level = Spectrum Analyser reading +Antenna factor +Cable loss- Preamplifier gain

7.7 Enclosed Documents

Annexure – 9: Photograph of measurement setup and measurements

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Serial Number of EUT	:	Phiro-001	
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

Annexure – 1

Product details (provided by the customer)

Digivision Electronic Ltd
Plot No - 279,285&286, Estate 2nd Main Road
Burma Colony, Perungudi, Chennai – 600096

PHIRO

Product Name: Phiro Pro

Description and Application
Phiro is an affordable programmable robot for kids ages 4-18 to learn computational thinking through coding and robotics in an easy and fun way. Students can code and control Phiro in 5 ways : without a computer - using sequential keys on the robot and with Swish Cards or with a computer - using Scratch 2.0, Snap! and Pocket Code, all open source software developed by Massachusetts Institute of Technology USA, UC Berkeley USA and University of Austria respectively.

Specifications	
Feature	**Data**
Microcontroller	ATmega 2560-16AU
Operating Voltage	4.5V-5.5V
Connectivity	Wireless Bluetooth HC-05 (2.4Ghz ISM band)
Software interface	Scratch, Snap 4 Arduino & Pocket Code(Android)
Battery	Rechargeable LI-PO (3.7v, 2000mah)
Charging port type	DC jack 1.1mm
Sensors	8 IR proximity sensors
Locomotion	2 DC motors (298:1 gear ratio, 75 RPM)
PCB	FR4 grade, 4 layers
Speaker	8ohms , 1watt

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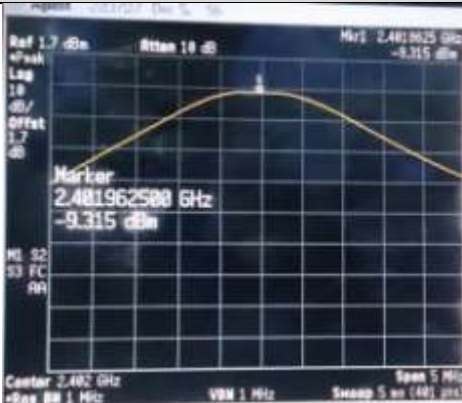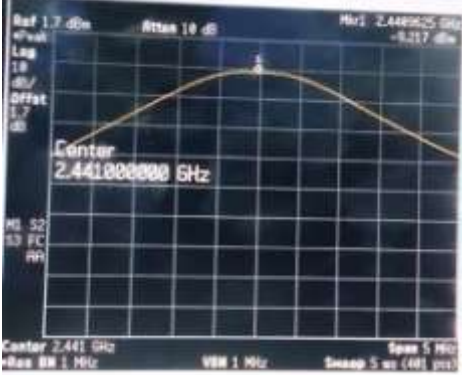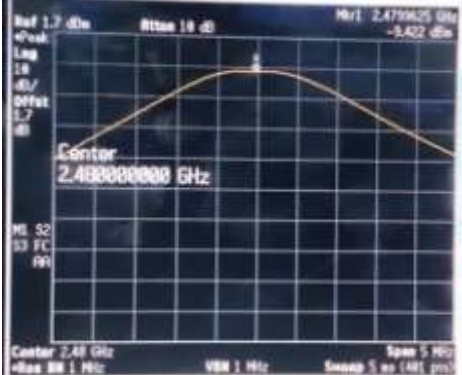
Annexure – 2

Measurement set up for peak output power
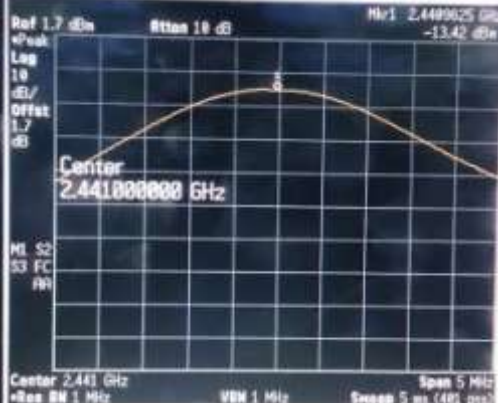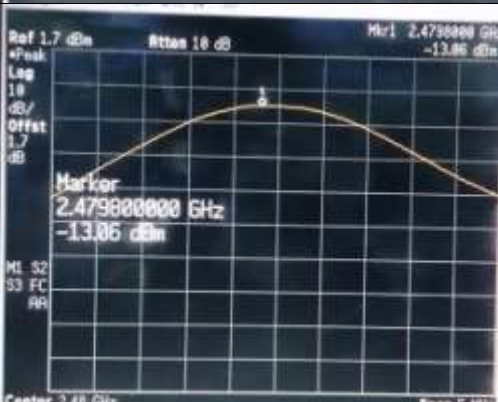
Measurement plots
GFSK:

Channel	Peak output power
LOW	
MID	
HIGH	
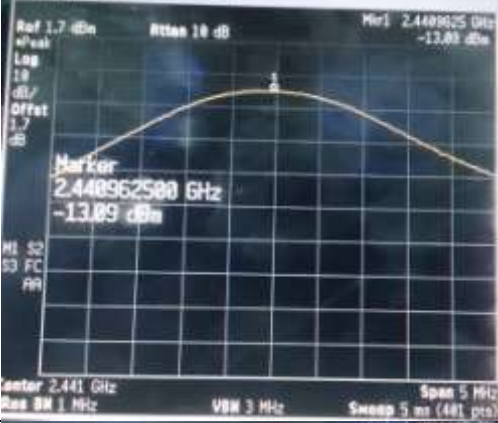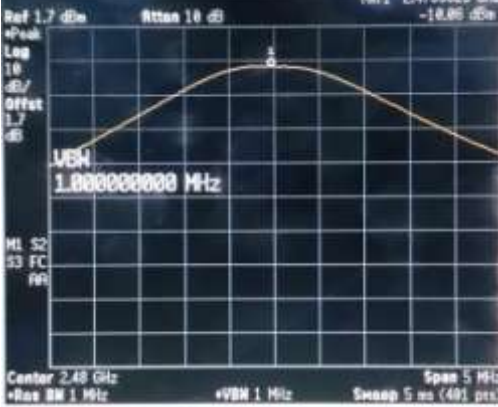
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Pi/4DPSK:

Channel	Peak output power
LOW	
MID	
HIGH	

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8DPSK

Channel	Peak output power
LOW	
MID	
HIGH	
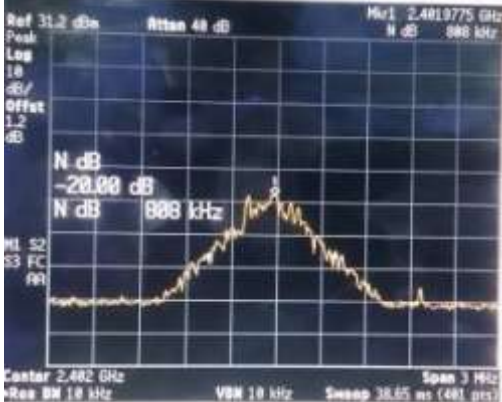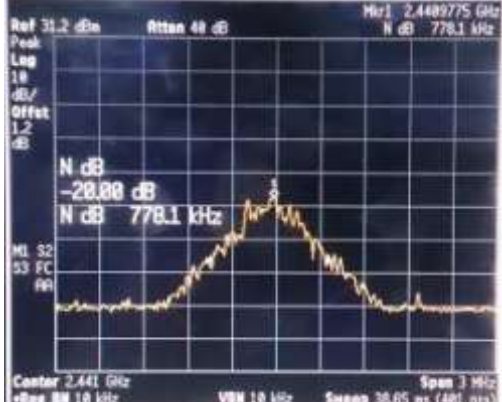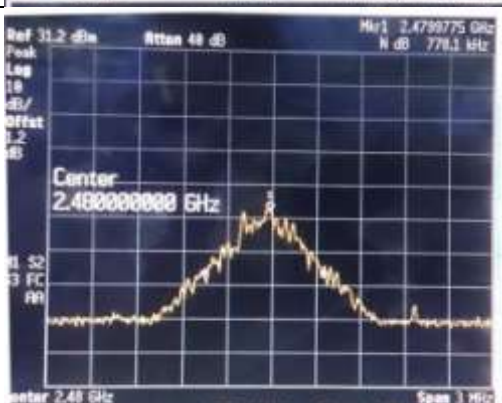
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Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

Annexure – 3

Measurement set up for occupied bandwidth

Measurement plots
GFSK

Channel	20dB BW
LOW	
MID	
HIGH	
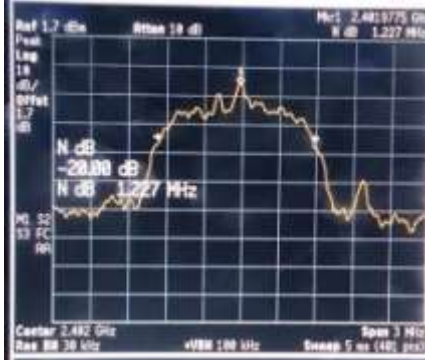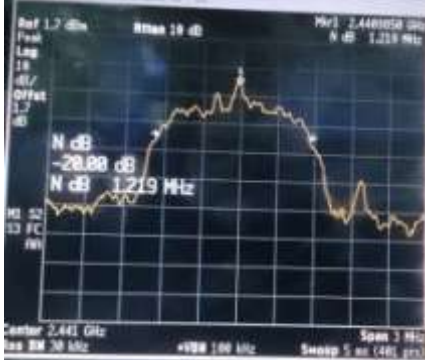
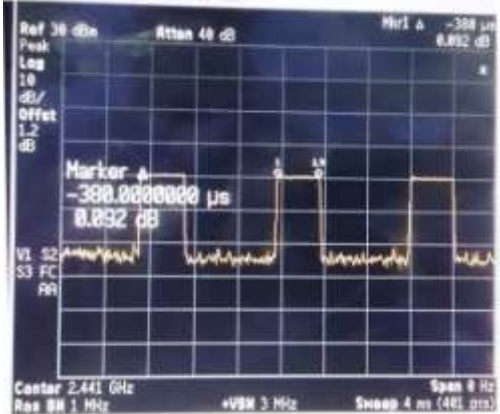| Equipment Under Test (EUT)	:	Phiro-Educational Toy
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Pi/4 DPSK

Channel	20dB BW
LOW	
MID	
HIGH	

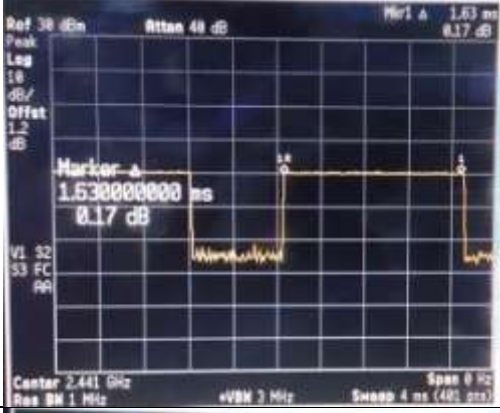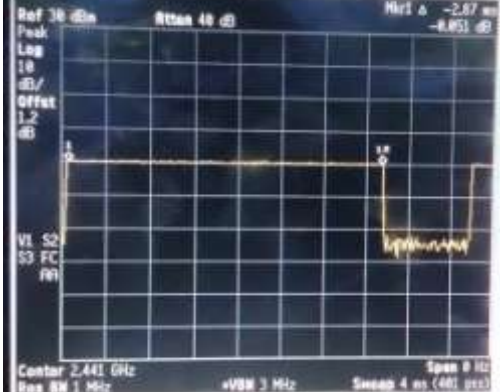| Equipment Under Test (EUT)	:	Phiro-Educational Toy
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8 DPSK

Channel	20dB BW
LOW	
MID	
HIGH	

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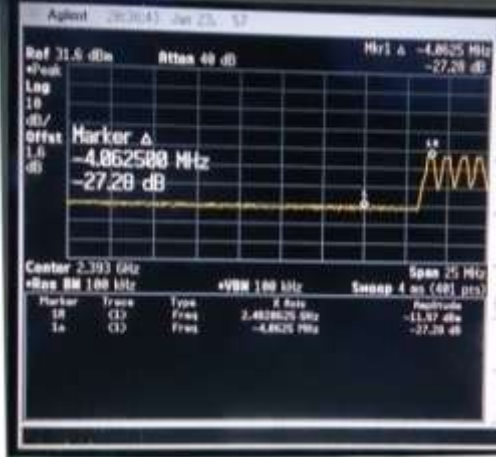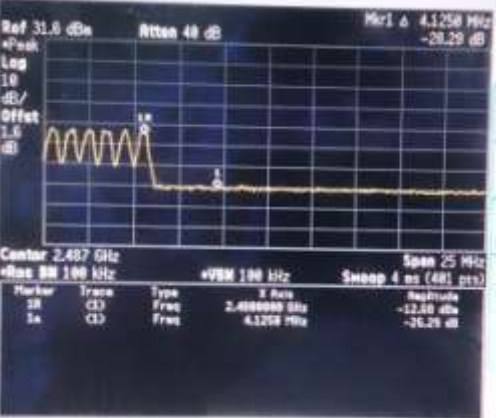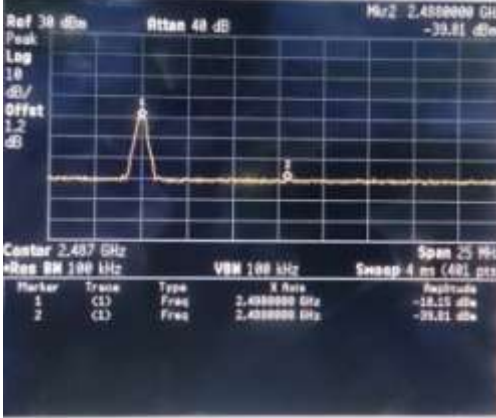
Annexure – 4

Measurement set up for Band edge measurements

Measurement plots

GFSK

Channel	With hopping	Without hopping
LOW		
HIGH		

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Pi/4DPSK

Channel	With hopping	Without hopping
LOW		
HIGH		

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Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

SAMEER

8 DPSK

Channel	With hopping	Without hopping
LOW		
HIGH		

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Model Number of EUT	:	Phiro-001	
Serial Number of EUT	:	Phiro-001	
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

Annexure – 5

Measurement set up for Channel separation

Measurement plot

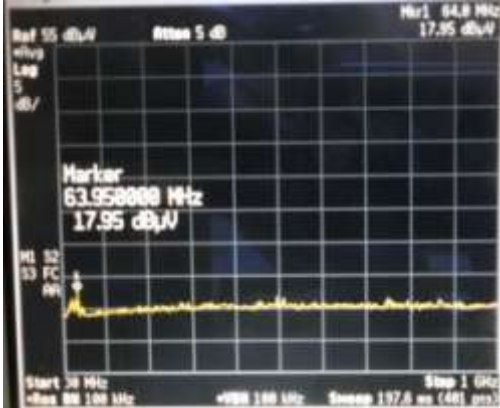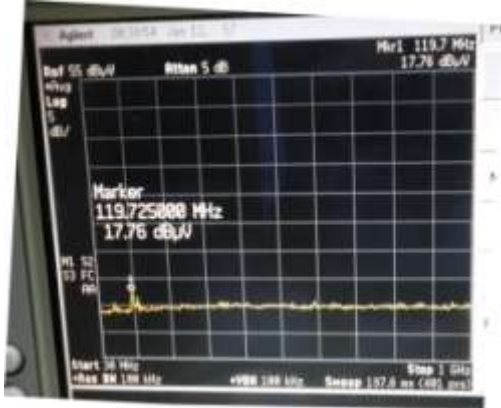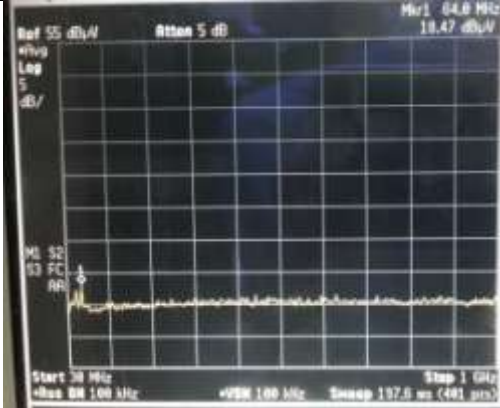| Equipment Under Test (EUT)	:	Phiro-Educational Toy	
Model Number of EUT	:	Phiro-001	
Serial Number of EUT	:	Phiro-001	
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai	

Annexure – 6

Measurement set up for No of hopping frequency

Measurement plot
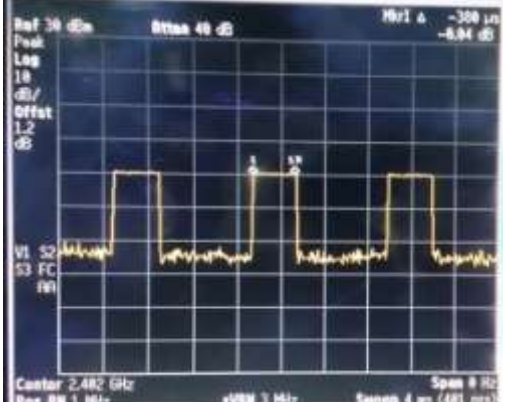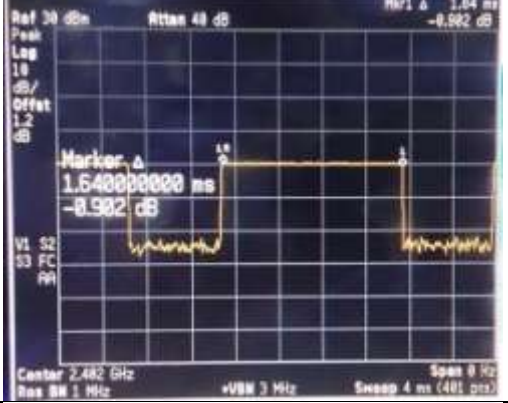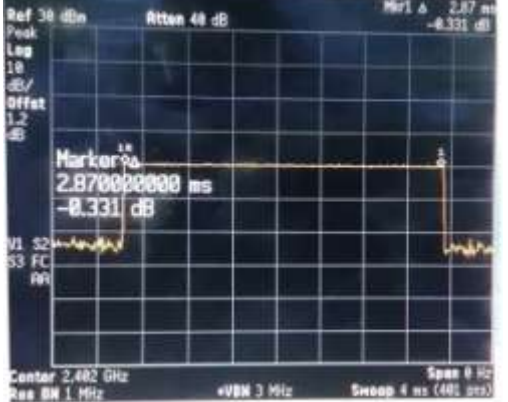
Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

Annexure – 7

Measurement set up for dwell time
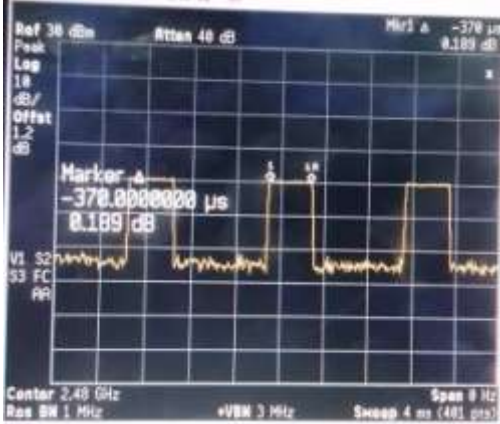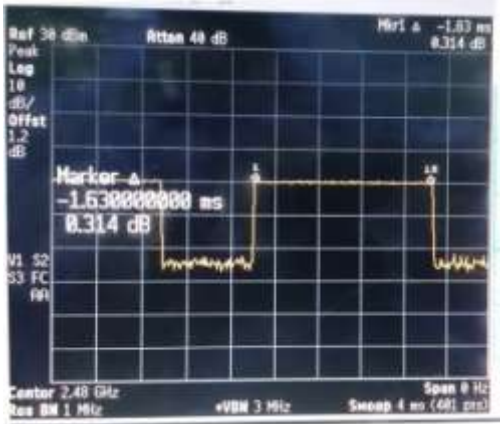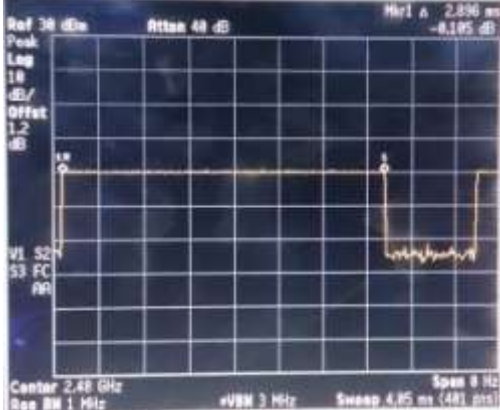
Measurement plots

Channel	Modulation	Dwell Time
LOW	DH1	
	DH3	
	DH5	

Channel	Modulation	Dwell Time
MID	DH1	
	DH3	
	DH5	

Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

Channel	Modulation	Dwell Time
HIGH	DH1	
	DH3	
	DH5	
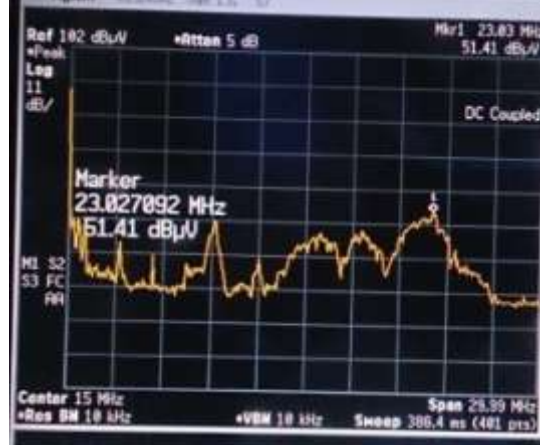
Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

Annexure – 8
Measurement set up for Radiated emmsion
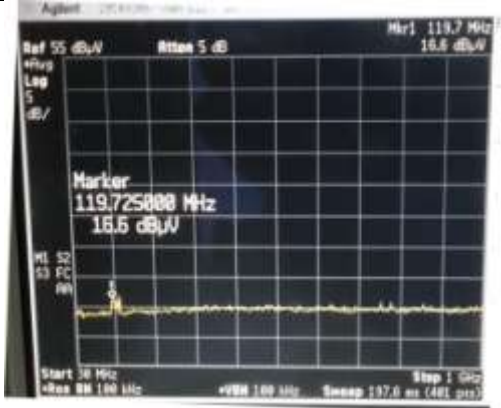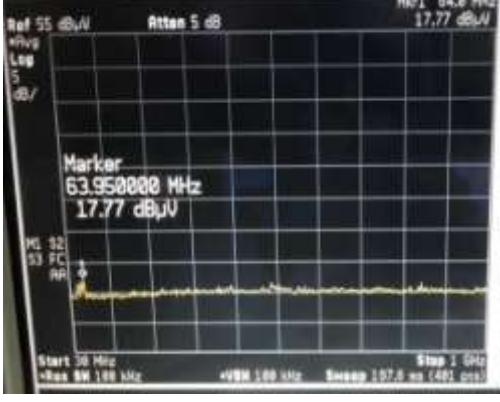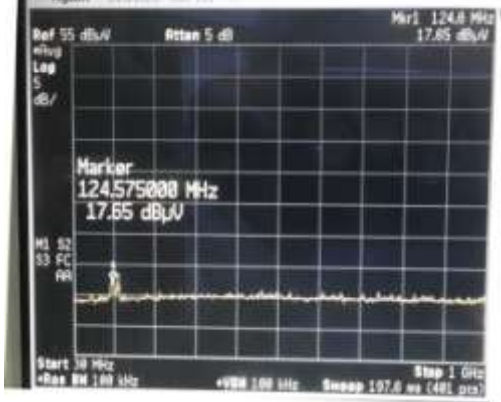
Measurement plots

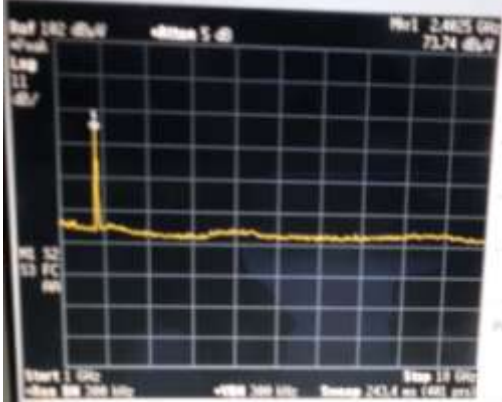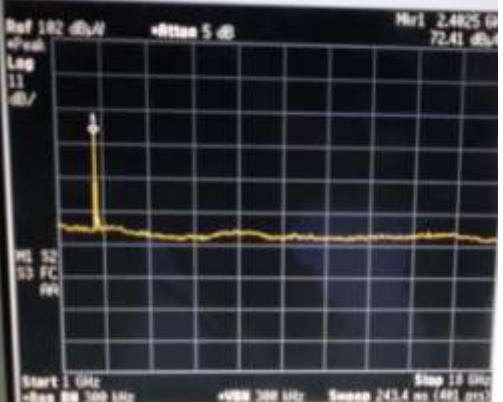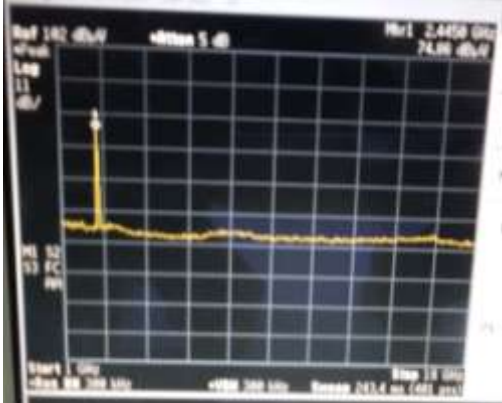**8DPSK: 9 KHz- 30 MHz**

Channel	Radiated Emissions
LOW	
MID	
HIGH	
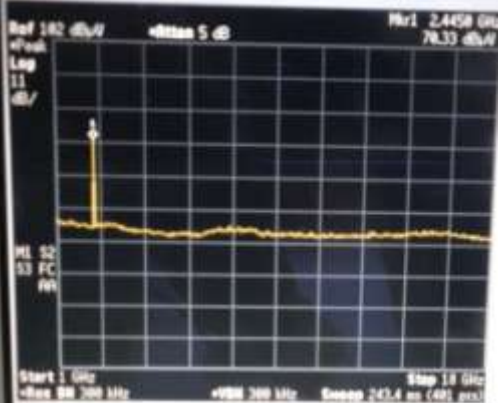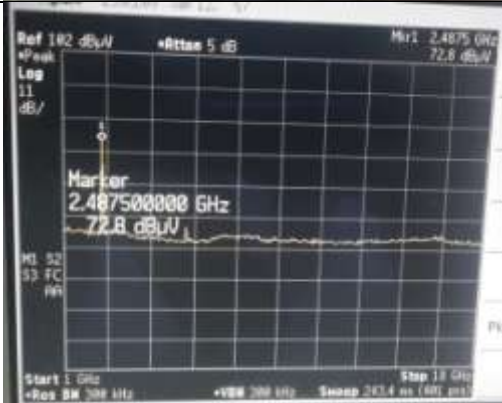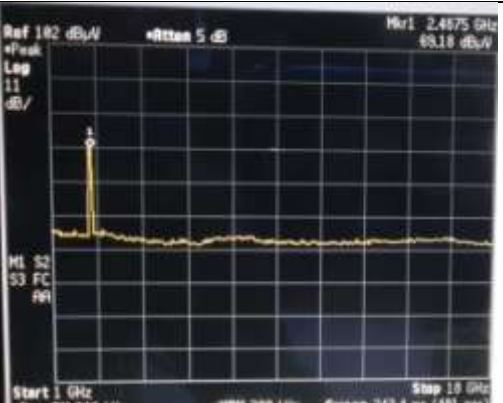
Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

8DPSK: 30 MHz – 1 GHz

Channel	Vertical	Horizontal
LOW		
MID		
HIGH		

Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai
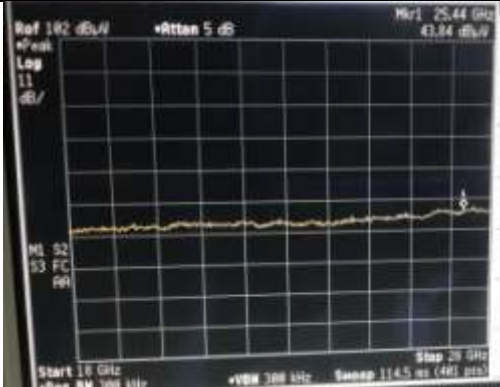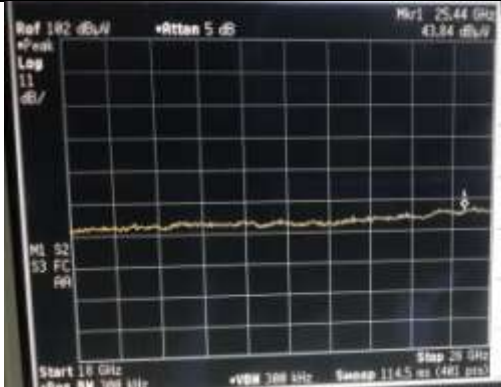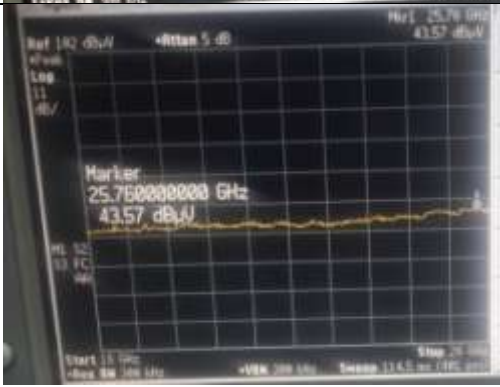
8DPSK: 1 GHz – 18 GHz

Channel	Vertical	Horizontal
LOW		
MID		
HIGH		

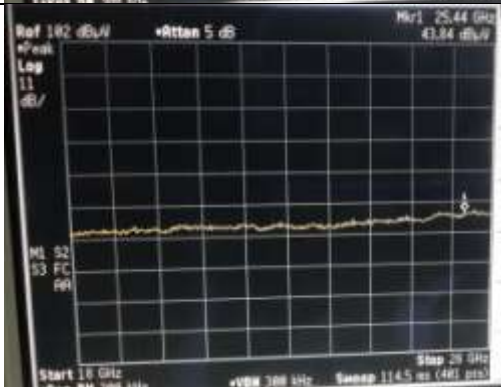| Equipment Under Test (EUT)	:	Phiro-Educational Toy
Model Number of EUT	:	Phiro-001
Serial Number of EUT	:	Phiro-001
Manufactured by	:	M/s. Digivision Electronics Ltd., Chennai

8DPSK: 18 GHz – 26 GHz

Channel	Vertical	Horizontal
LOW		
MID		
HIGH		