

12.1.3. HOPPING FREQUENCY SEPERATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 6.2.1 (b), 6.2.3.1 (a)

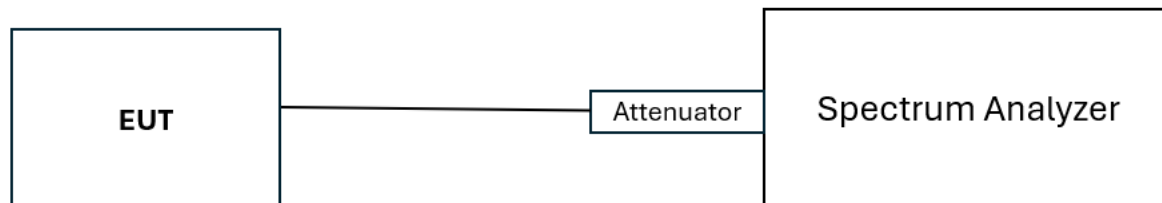
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

PROCEDURE

- The transmitter output is connected to a spectrum analyzer.
- Set resolution bandwidth (RBW) = 300kHz.
- Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$, Detector=Peak.
- Trace mode = Max Hold.
- Sweep = auto couple.

TEST SETUP

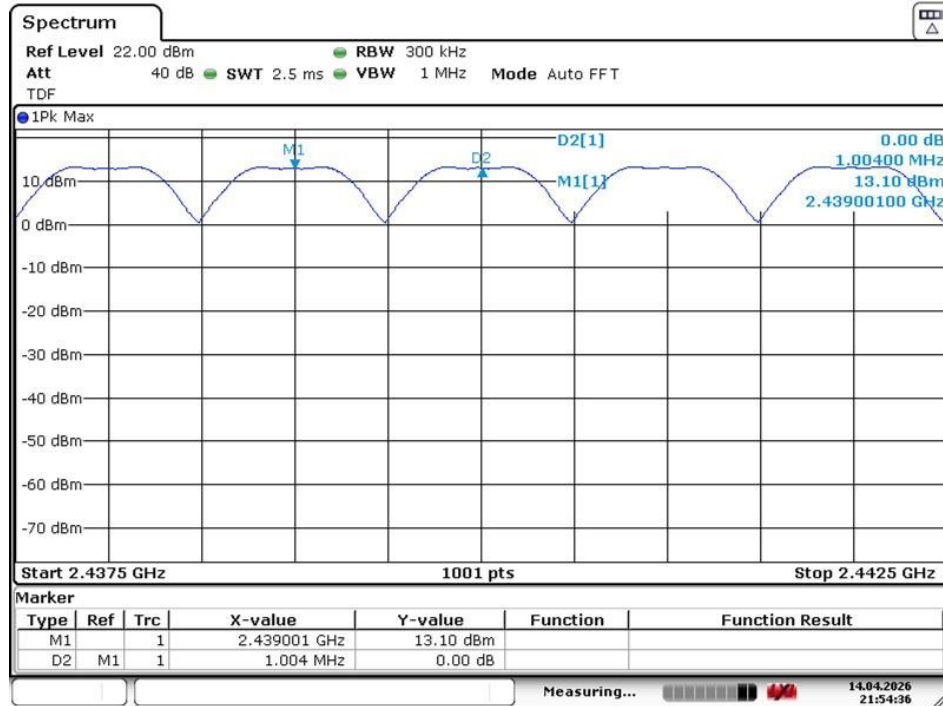


The loss between RF output port of the EUT and the input port of the spectrum analyzer has been taken into consideration.

TEST RESULTS

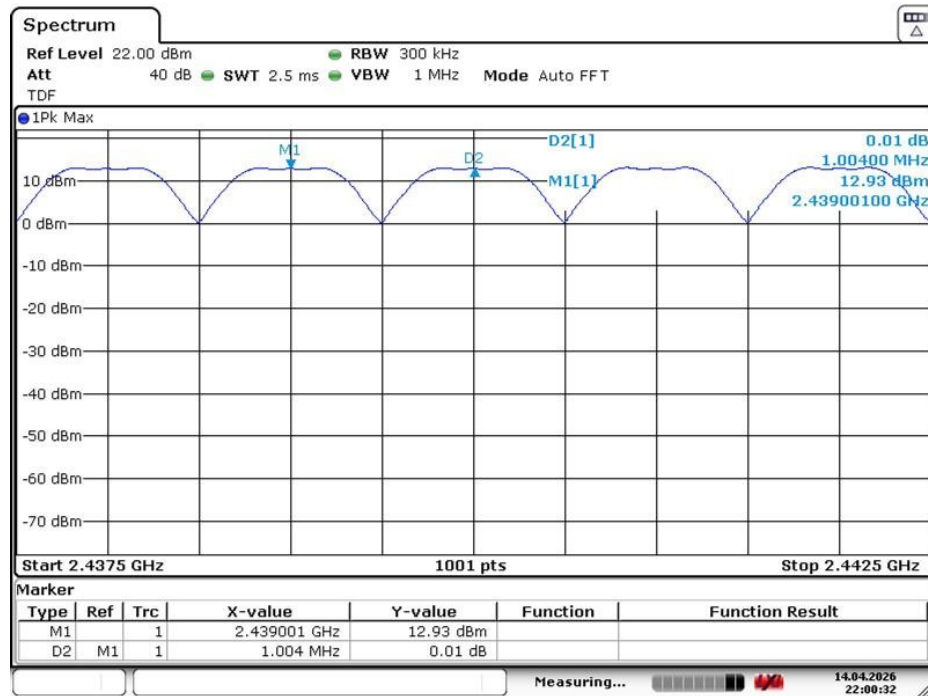
12.1.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Left Cup



Date: 14.APR.2026 21:54:36

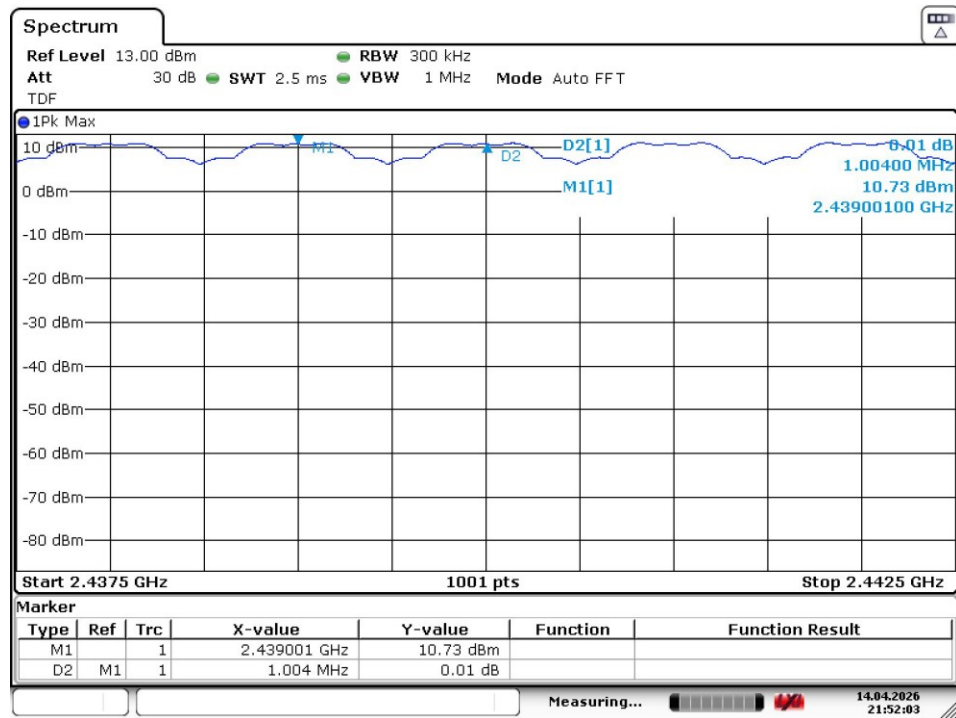
Right Cup.



Date: 14.APR.2026 22:00:32

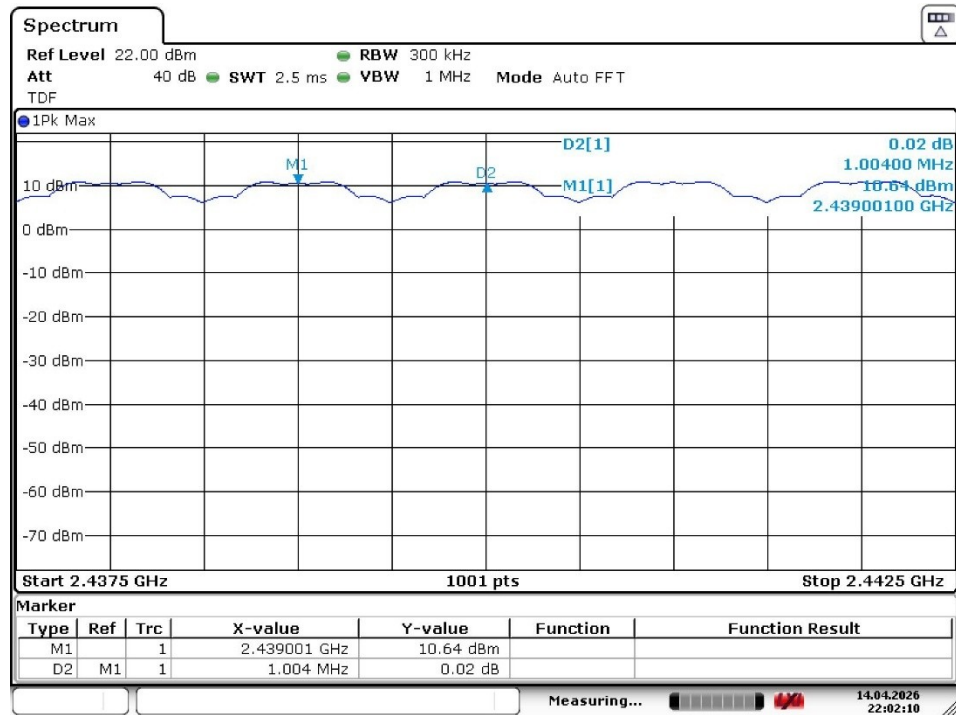
12.1.3.2. BLUETOOTH ENHAUNCED DATA RATE QPSK MODULATION

Left Cup



Date: 14.APR.2026 21:52:03

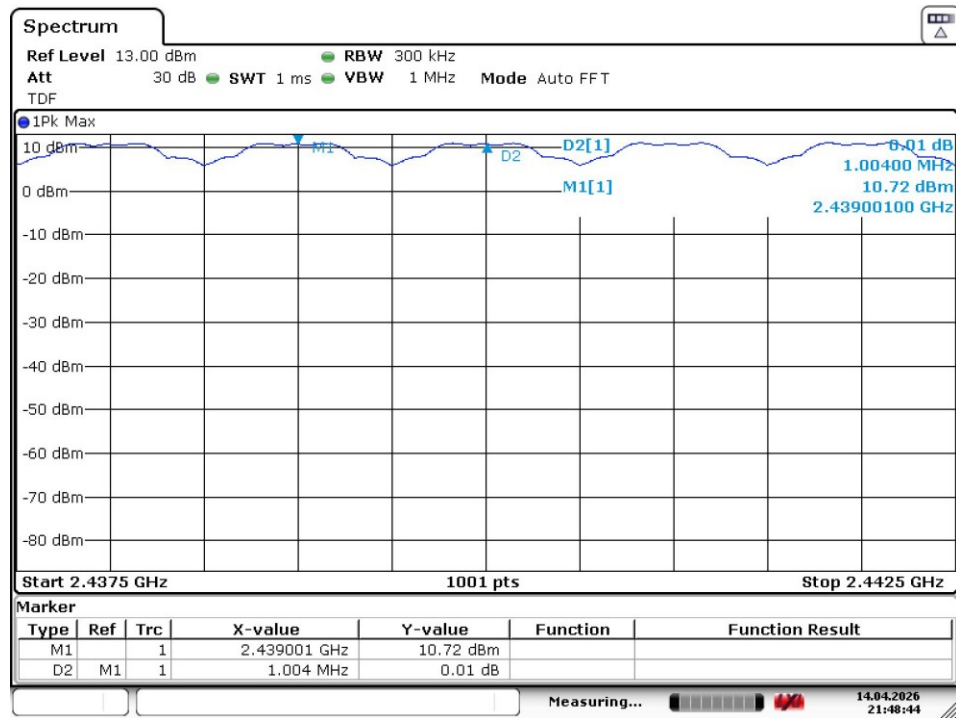
Right Cup.



Date: 14.APR.2026 22:02:10

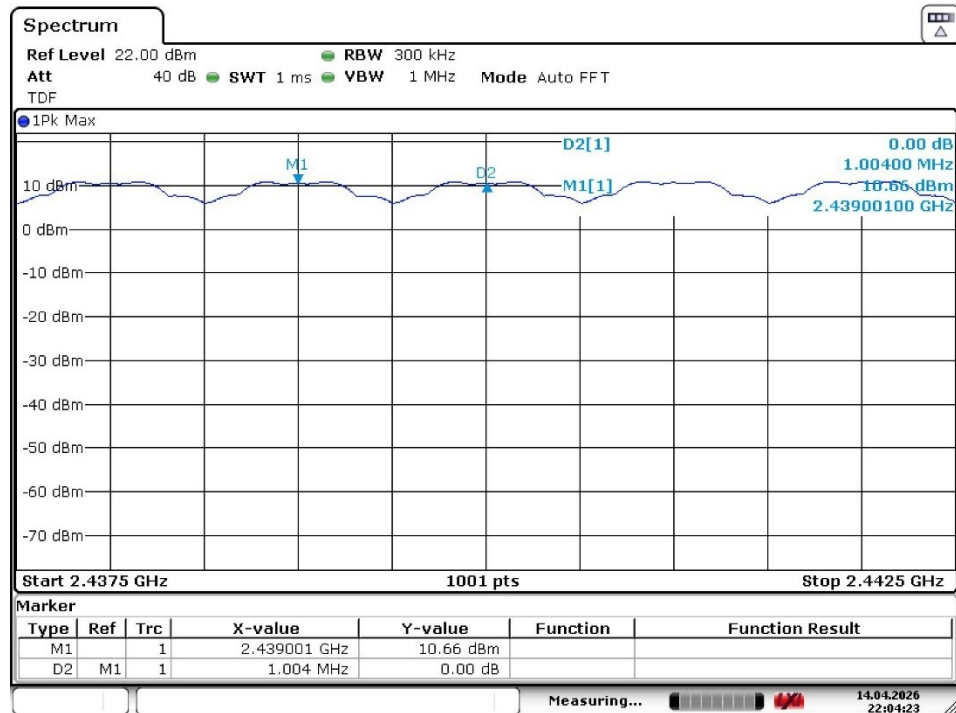
12.1.3.3. BLUETOOTH ENHAUNCED DATA RATE 8PSK MODULATION

Left Cup



Date: 14.APR.2026 21:48:44

Right Cup



Date: 14.APR.2026 22:04:23

12.1.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

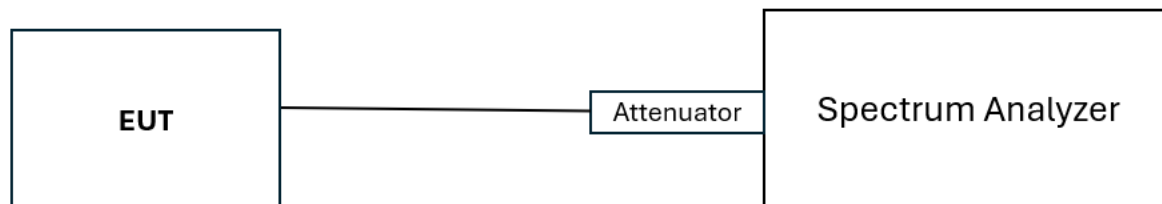
RSS-247 6.2.3.1 (b)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 nonoverlapping channels.

PROCEDURE

- The transmitter output is connected to a spectrum analyzer.
- The span is set to cover the entire authorized band. In either a single sweep or in multiple contiguous sweeps.
- The RBW is set to a maximum of 1% of the span.
- Detector=Peak.
- Trace mode = Max Hold.
- Sweep = auto couple.

TEST SETUP



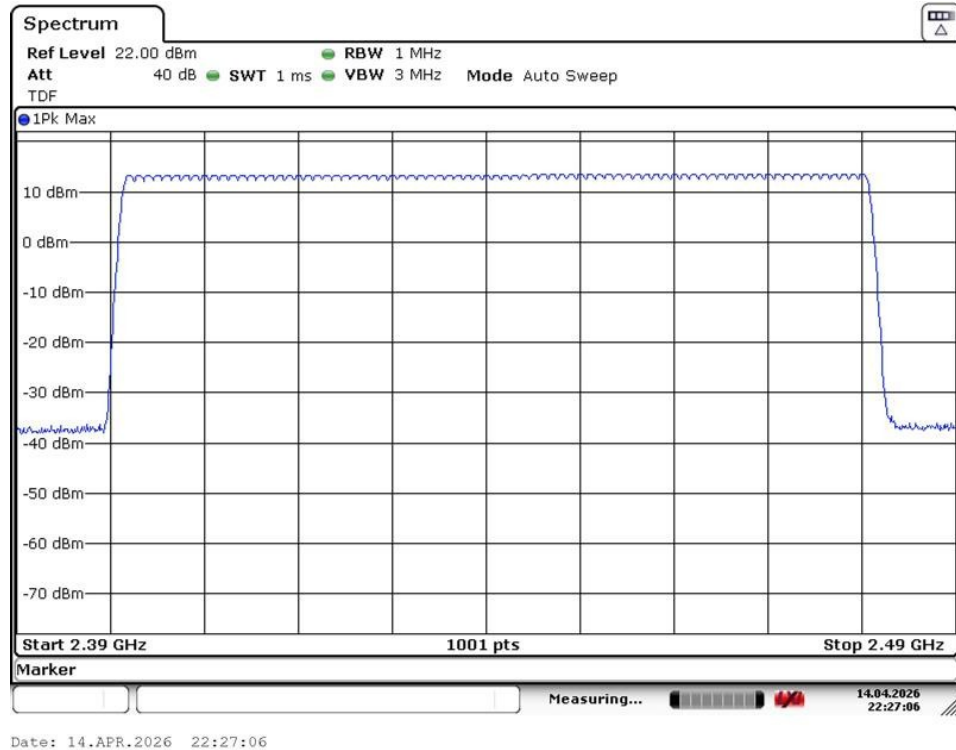
The loss between RF output port of the EUT and the input port of the spectrum analyzer has been taken into consideration.

TEST RESULTS

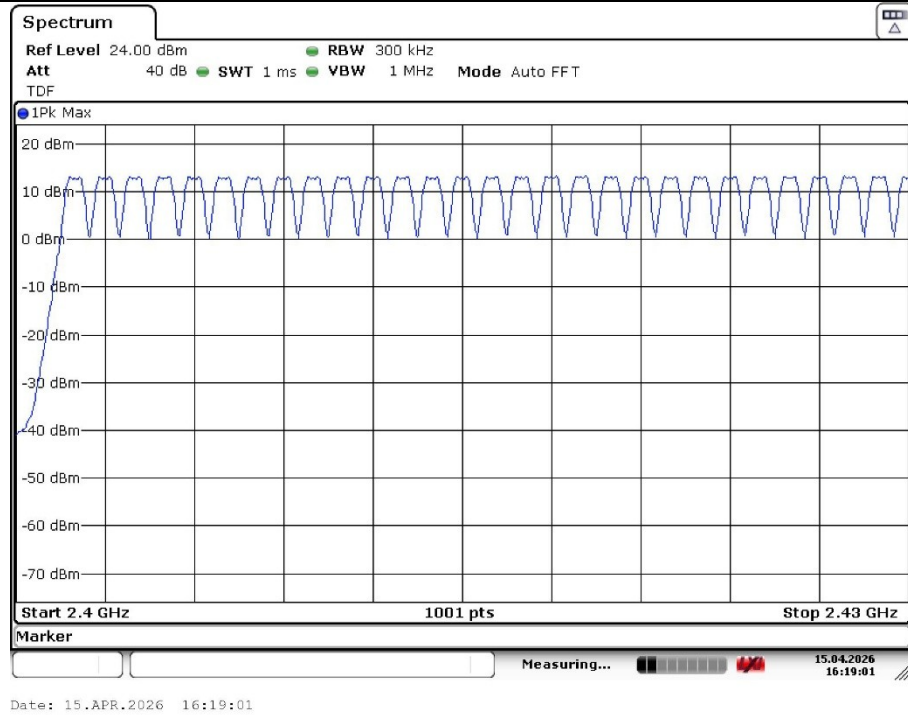
79 Channels observed.

12.1.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

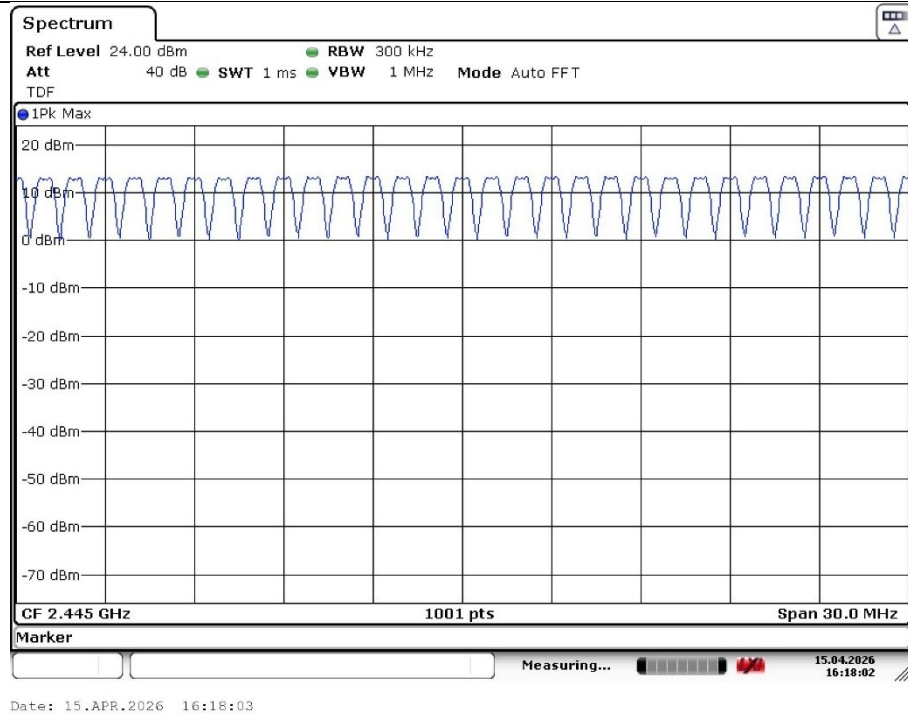
Left Cup



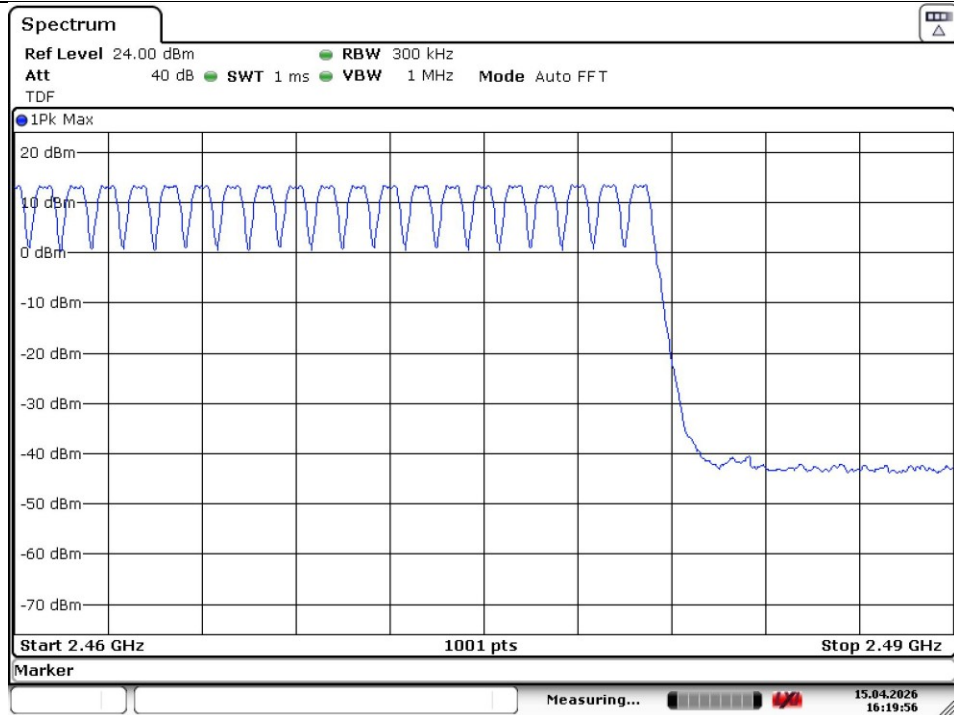
100 MHz Span.



30MHz Span Segment 1 of 3



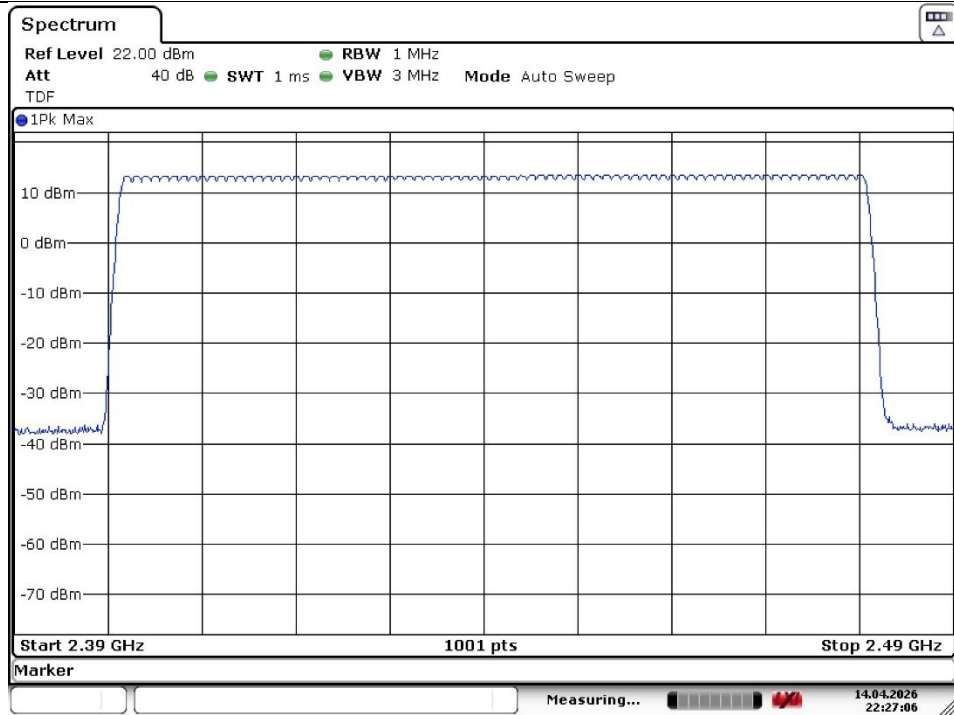
30MHz Span Segment 2 of 3



Date: 15.APR.2026 16:19:55

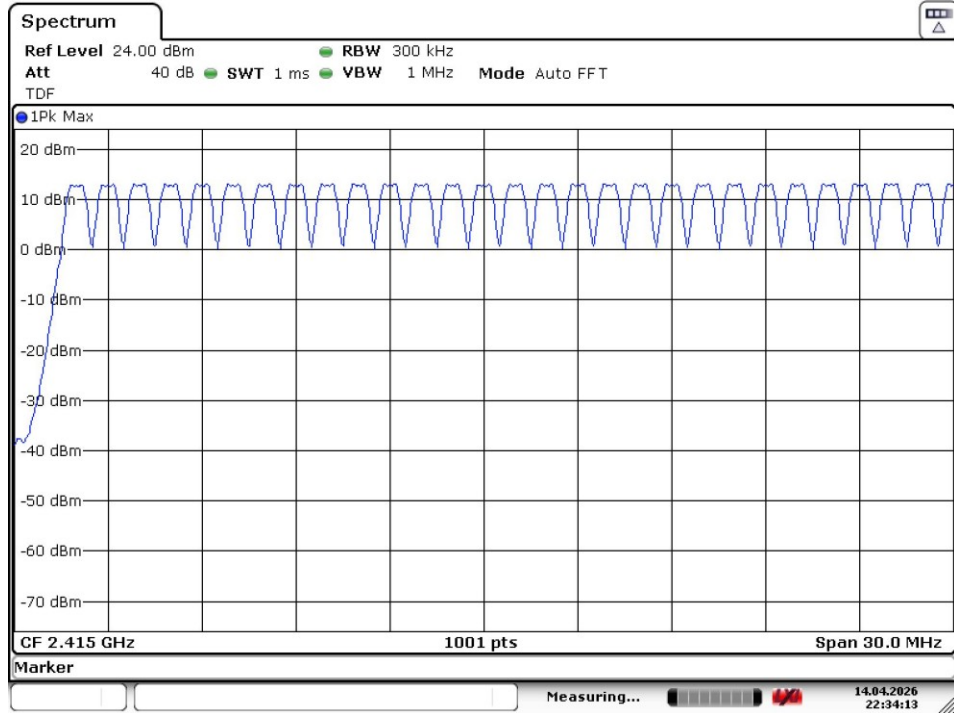
30MHz Span Segment 3 of 3

Right Cup.



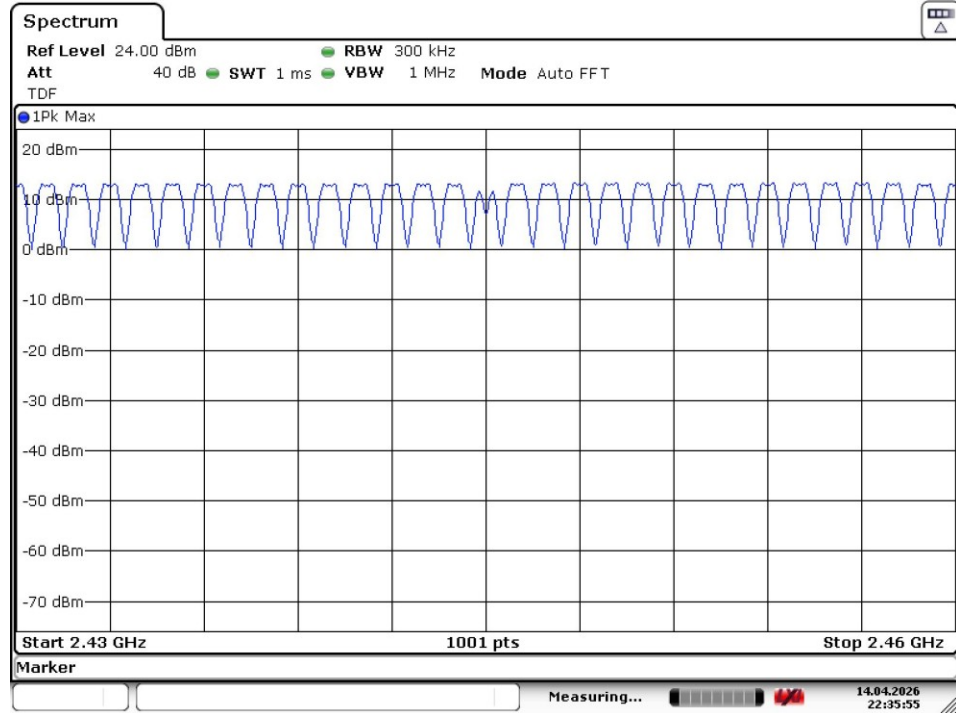
Date: 14.APR.2026 22:27:06

100 MHz Span.



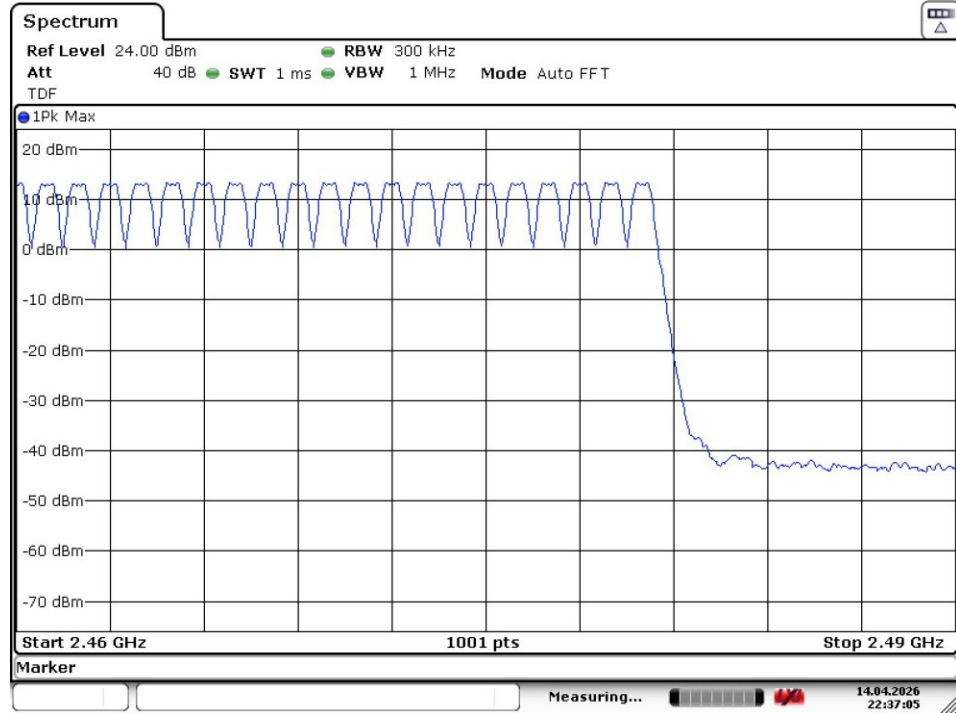
Date: 14.APR.2026 22:34:13

30MHz Span Segment 1 of 3



Date: 14.APR.2026 22:35:55

30MHz Span Segment 2 of 3

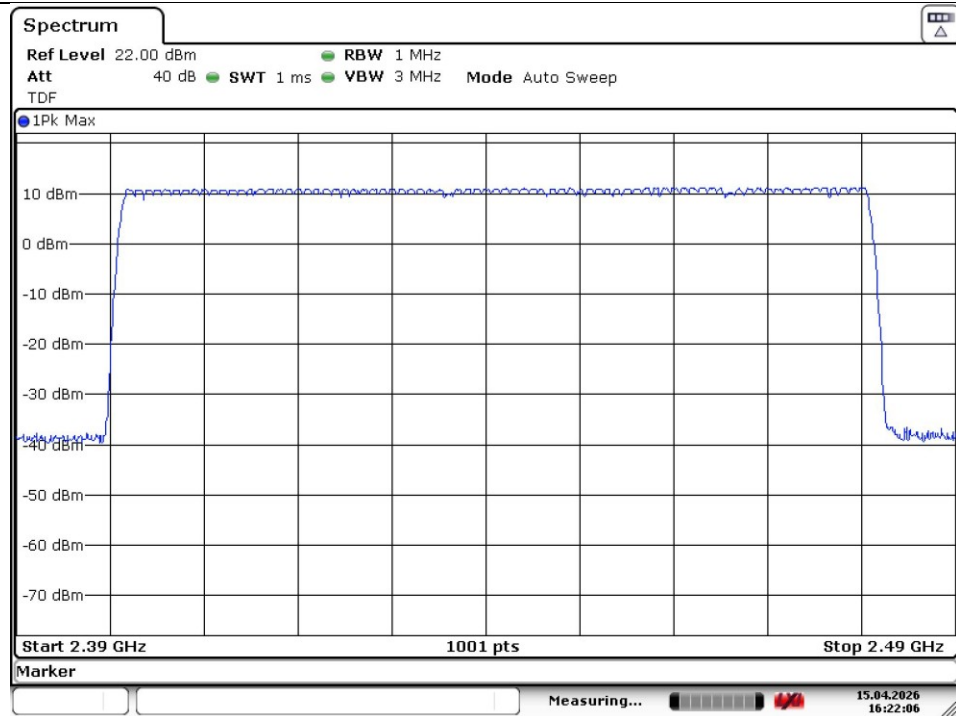


Date: 14.APR.2026 22:37:05

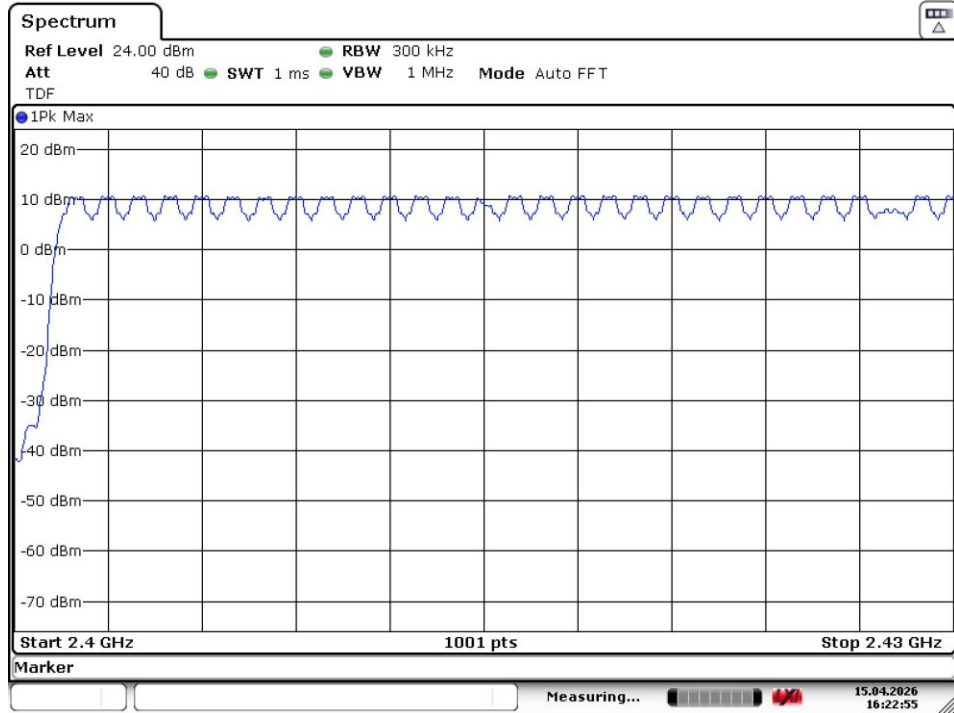
30MHz Span Segment 3 of 3

12.1.4.2. BLUETOOTH ENHANCED DATA RATE QPSK MODULATION

Left Cup

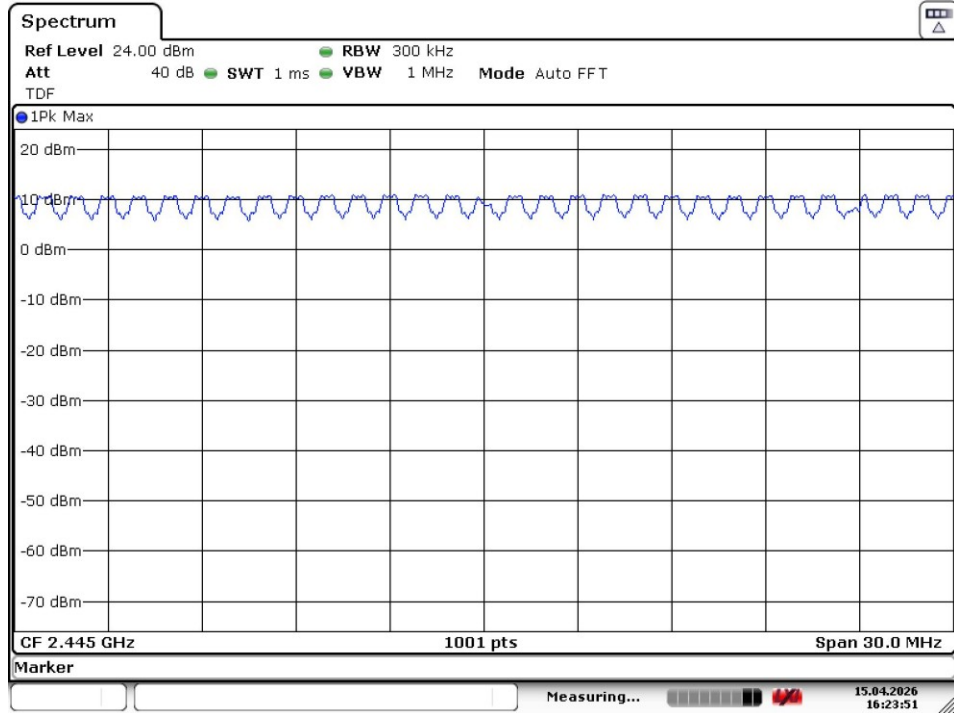


100 MHz Span.



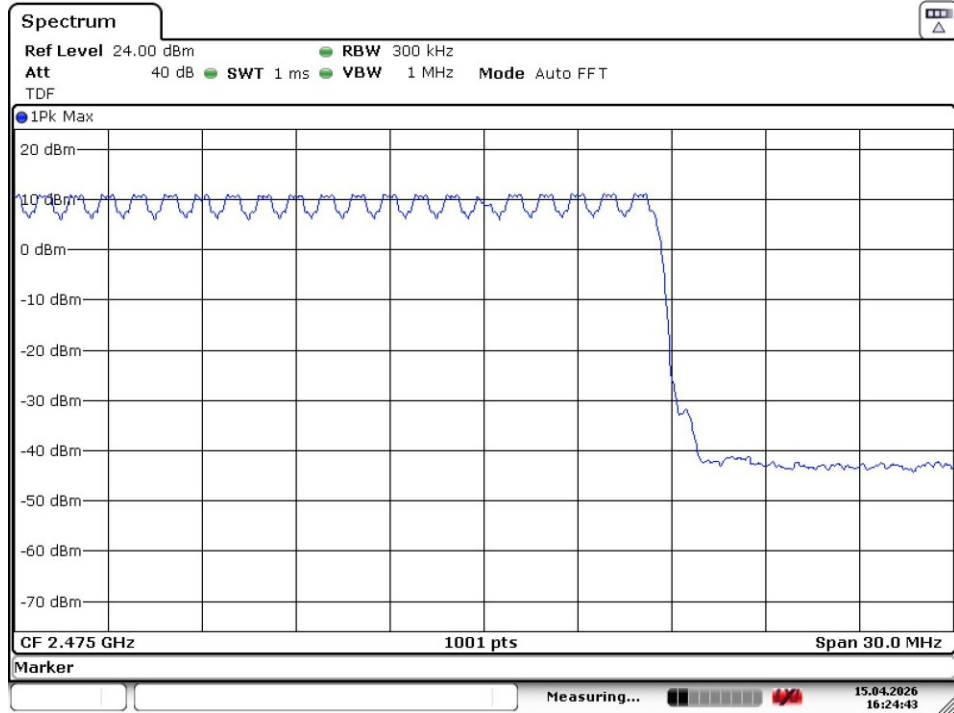
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30MHz Span Segment 1 of 3



Date: 15.APR.2026 16:23:51

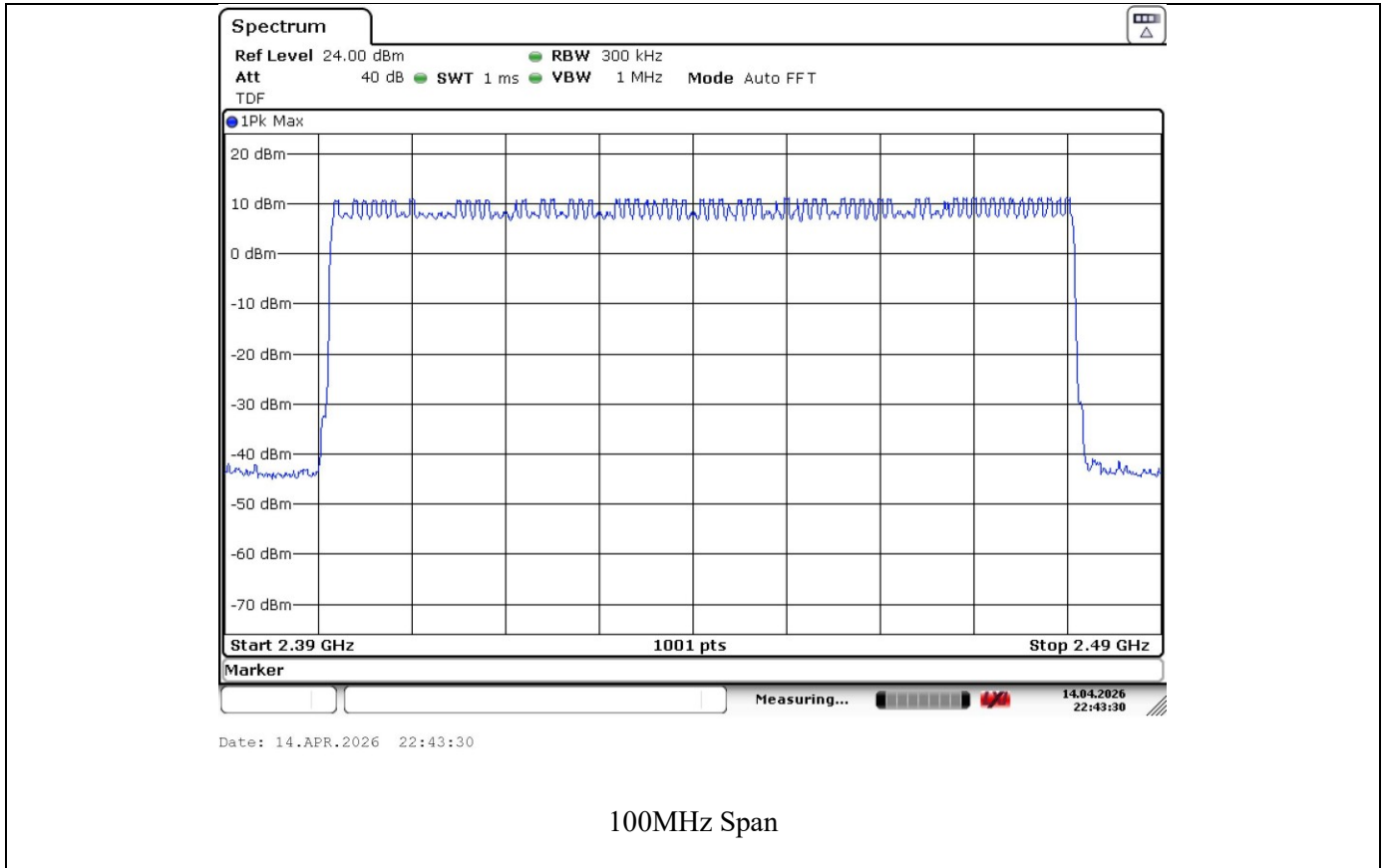
30MHz Span Segment 2 of 3

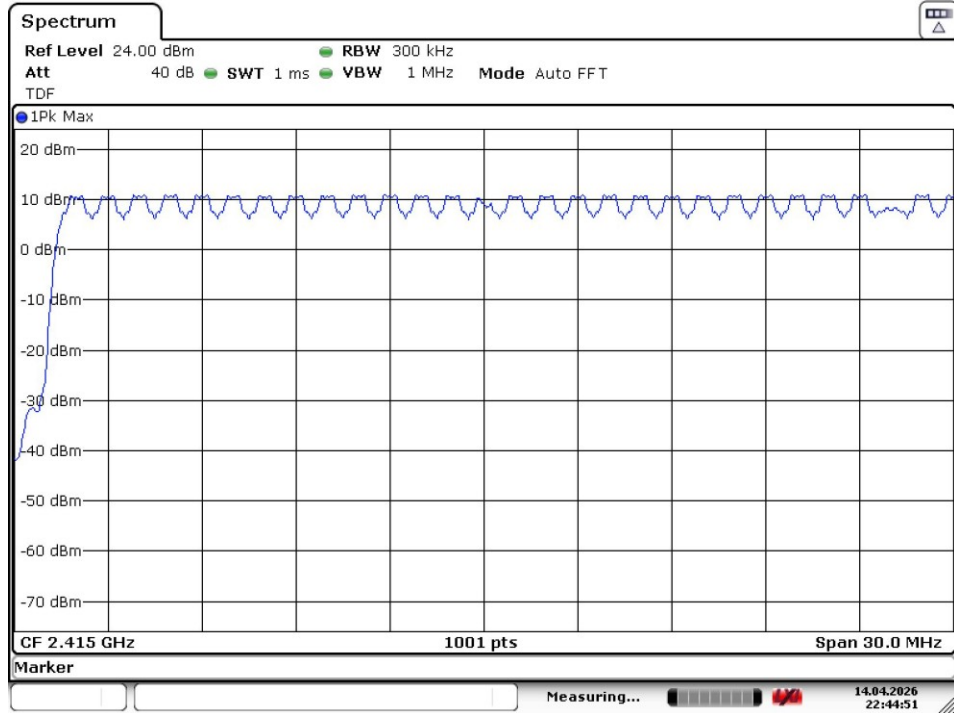


Date: 15.APR.2026 16:24:42

30MHz Span Segment 3 of 3

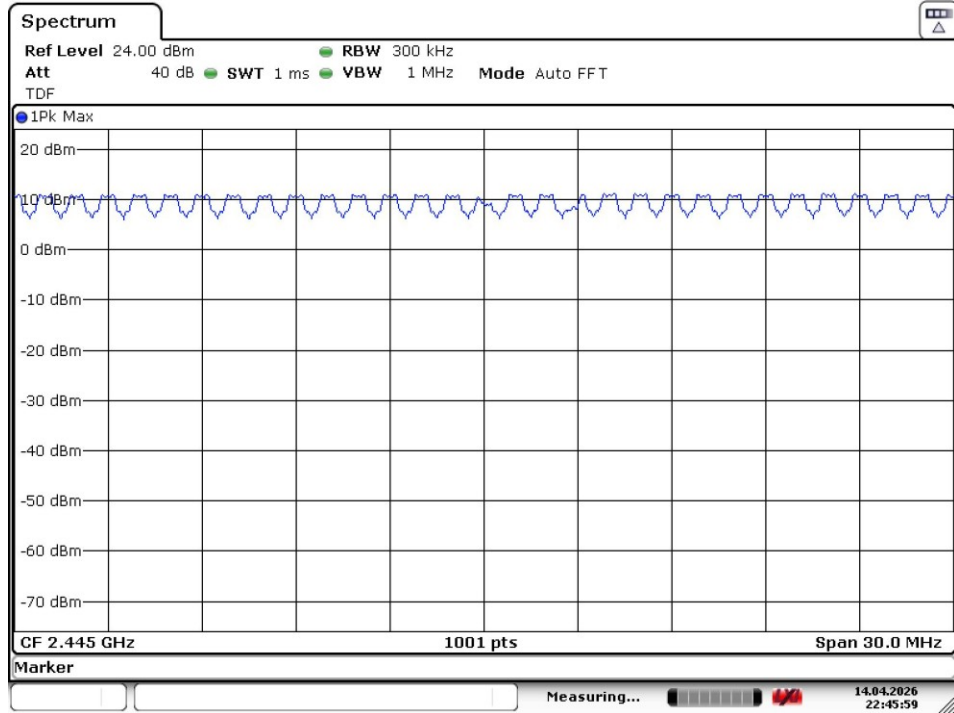
Right Cup.





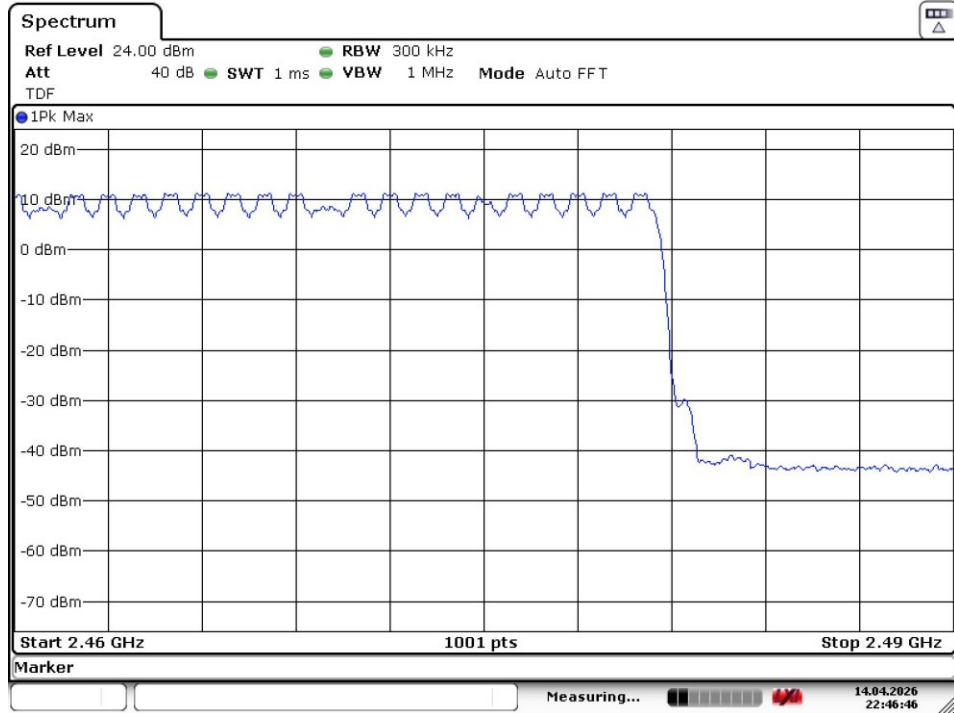
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30MHz Span Segment 1 of 3



Date: 14.APR.2026 22:45:59

30MHz Span Segment 2 of 3

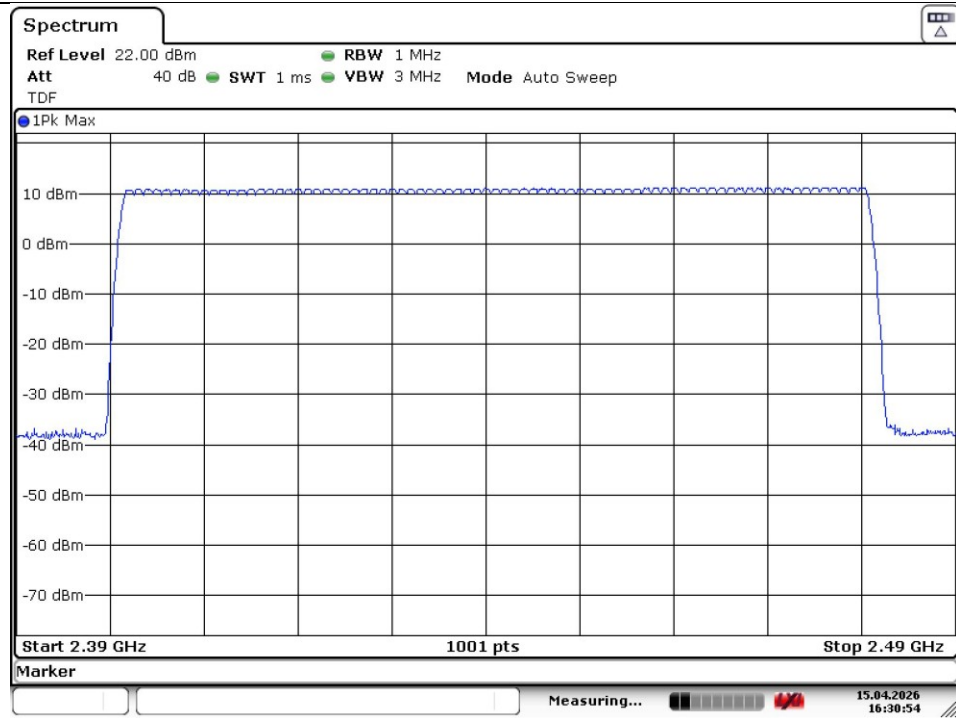


Date: 14.APR.2026 22:46:47

30MHz Span Segment 3 of 3

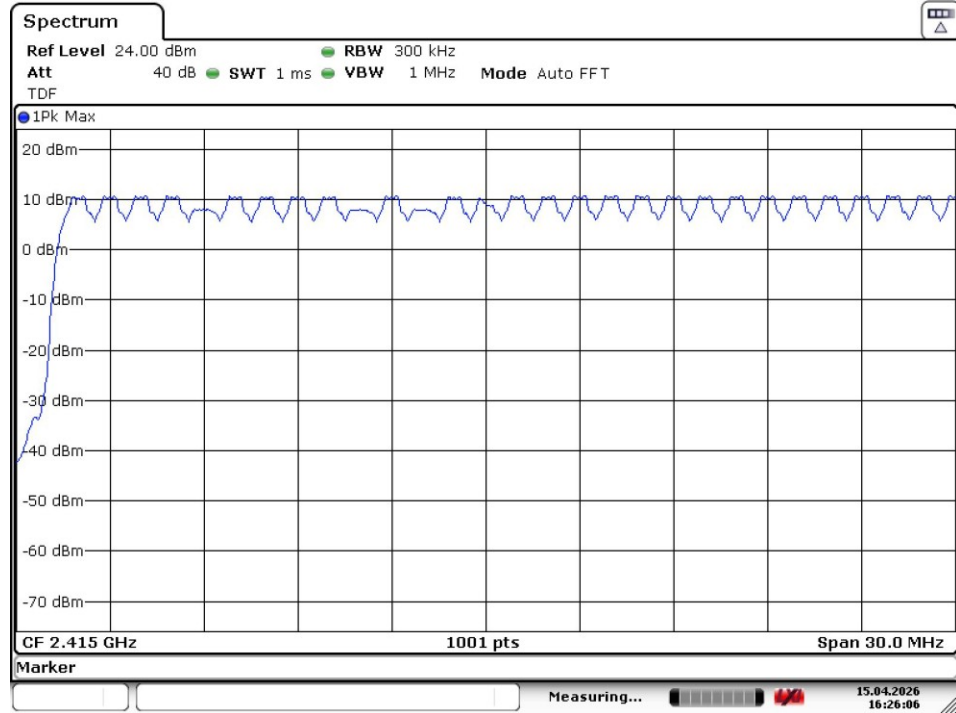
12.1.4.3. BLUETOOTH ENHAUNCED DATA RATE 8PSK MODULATION

Left Cup



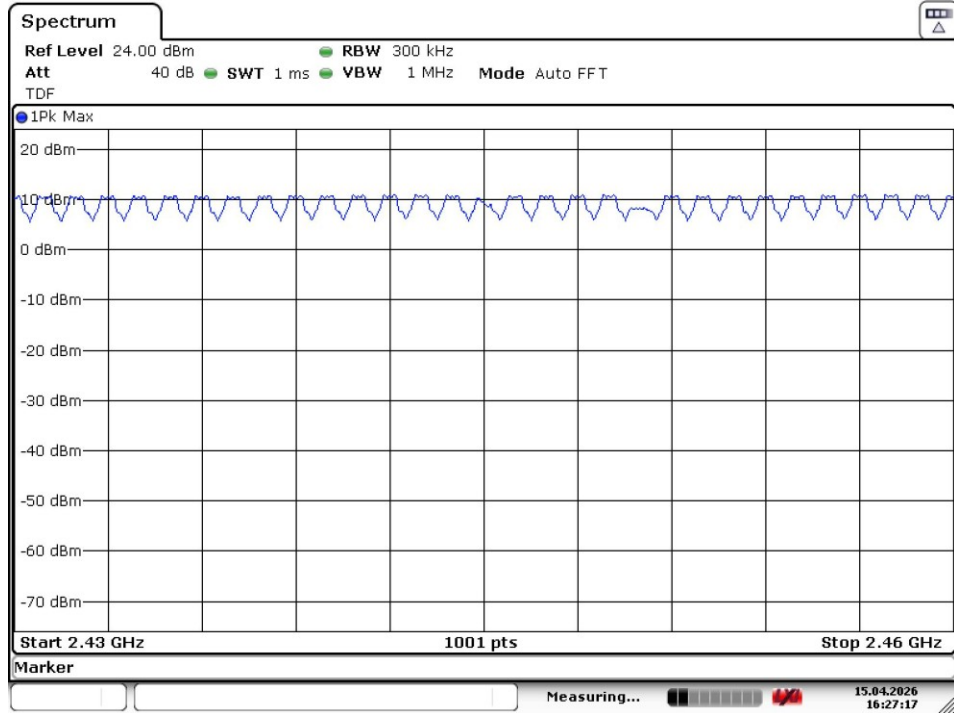
Date: 15.APR.2026 16:30:54

100MHz Span



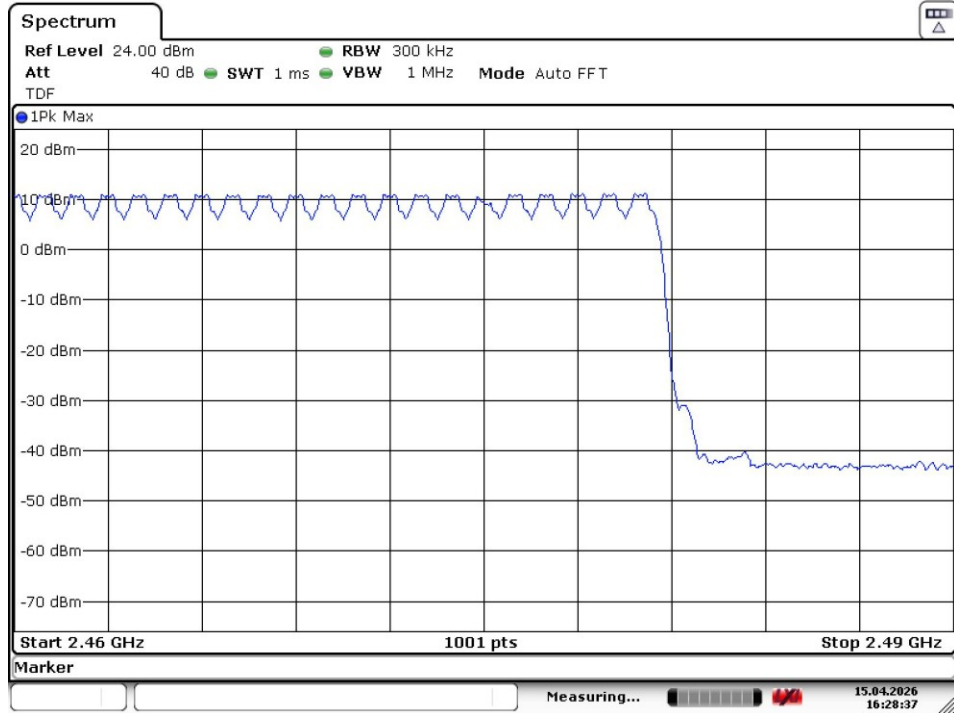
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30MHz Span Segment 1 of 3



Date: 15.APR.2026 16:27:17

30MHz Span Segment 2 of 3



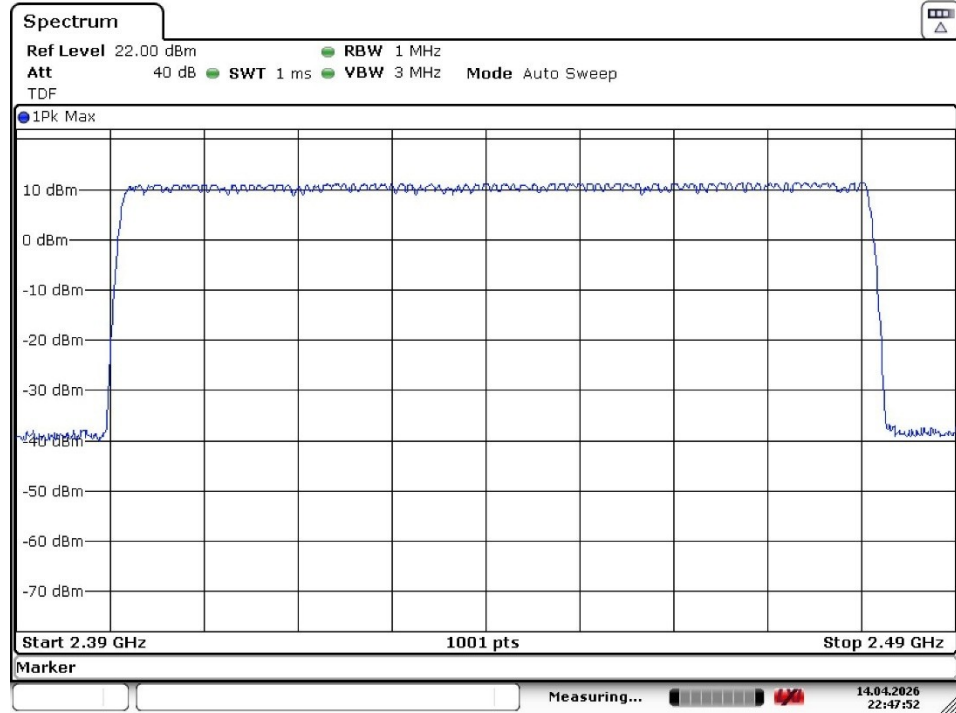
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30MHz Span Segment 3 of 3

Right cup

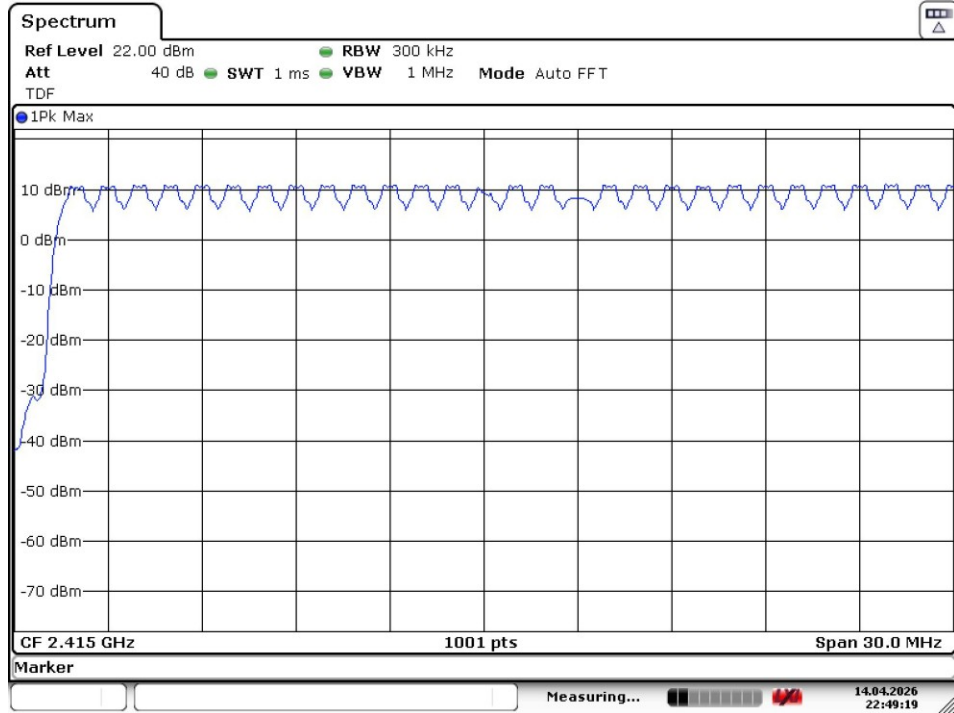
UL INDIA PRIVATE LIMITED
30/A, I Stage Vishveshwarya Industrial Estate,
Doddanekkundi Industrial Area, Bangalore – 560048
Tel: +91.080.41384400

"UL is a registered trademark under the Government of India Trademarks Act of 1999. Trademark no 1154161".



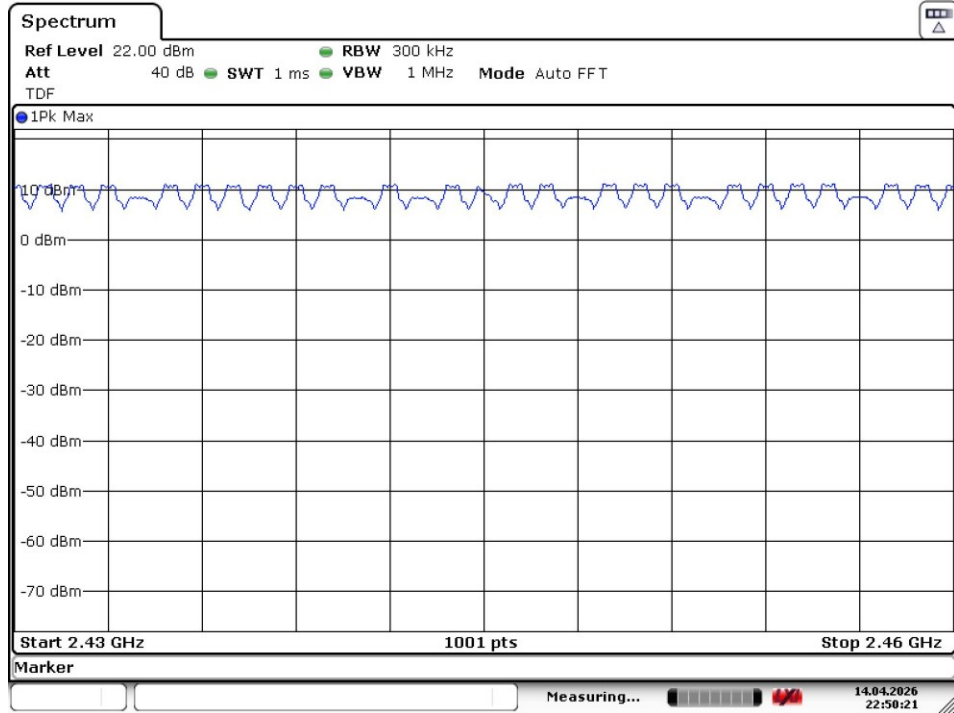
Date: 14.APR.2026 22:47:52

100MHz Span



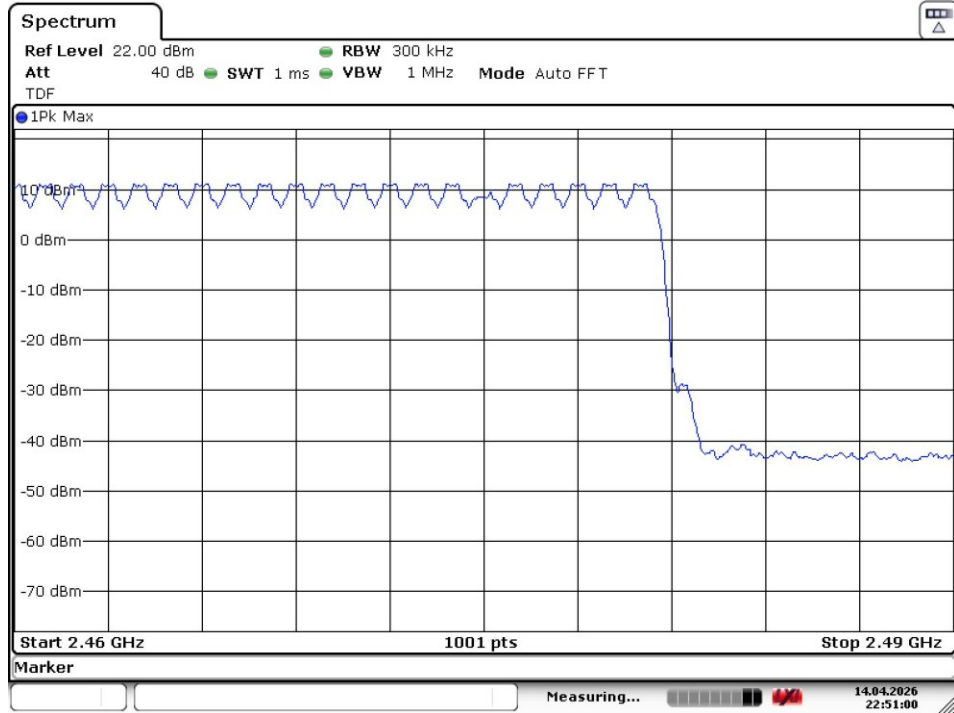
Date: 14.APR.2026 22:49:19

30MHz Span Segment 1 of 3



Date: 14.APR.2026 22:50:21

30MHz Span Segment 2 of 3



Date: 14.APR.2026 22:51:00

30MHz Span Segment 3 of 3

12.1.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 6.2.3.1 (b)

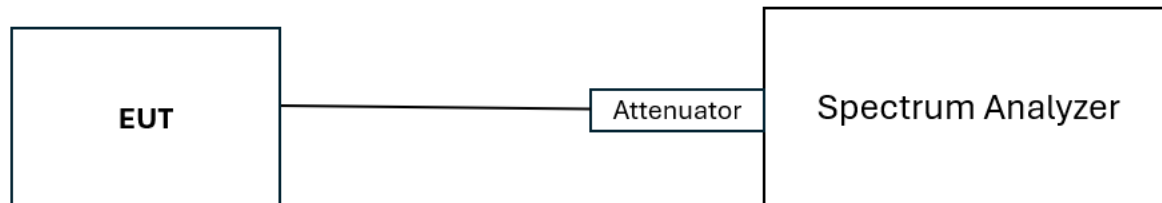
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

PROCEDURE

- a. The transmitter output is connected to a spectrum analyzer.
- b. The span is set to 0Hz, centered on a single selected hopping channel.
- c. The width of a single pulse is measured in a fast scan.
- d. RBW = 1 MHz.
- e. VBW $\geq$ RBW.
- f. Sweep = As necessary to capture the entire dwell time per hopping channel.
- g. Detector = Peak.
- h. Trace = Max Hold.

User the marker-delta function to determine the dwell time. If this value varies with different modes of operation, then repeat this test for each variation.

TEST SETUP



The loss between RF output port of the EUT and the input port of the spectrum analyzer has been taken into consideration.

TEST RESULTS**12.1.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION**

Left Cup - Packet Type – DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.867	305.8	400

Right Cup - Packet Type – DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.871	306.24	400

Calculation:

Time of occupancy on the TX channel is 31.6 sec

In case of GFSK: $2.867 * \{(1600 \div 6) / 79\} * 31.6 = 305.8 \text{ ms}$ In case of GFSK: $2.871 * \{(1600 \div 6) / 79\} * 31.6 = 306.24 \text{ ms}$

12.1.5.2. BLUETOOTH ENHANCED DATA RATE QPSK MODULATION

Left Cup - Packet Type – 2DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.879	307.0	400

Right Cup - Packet Type – 2DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.875	306.6	400

Calculation:

Time of occupancy on the TX channel is 31.6 sec

In case of GFSK: $2.879 * \{(1600 \div 6) / 79\} * 31.6 = 307.0 \text{ ms}$

In case of GFSK: $2.875 * \{(1600 \div 6) / 79\} * 31.6 = 306.6 \text{ ms}$

12.1.5.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Left Cup - Packet Type – 3DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.875	306.6	400

Right Cup - Packet Type – 3DH5

Operation mode	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2441	2.876	306.7	400

Calculation:

Time of occupancy on the TX channel is 31.6 sec

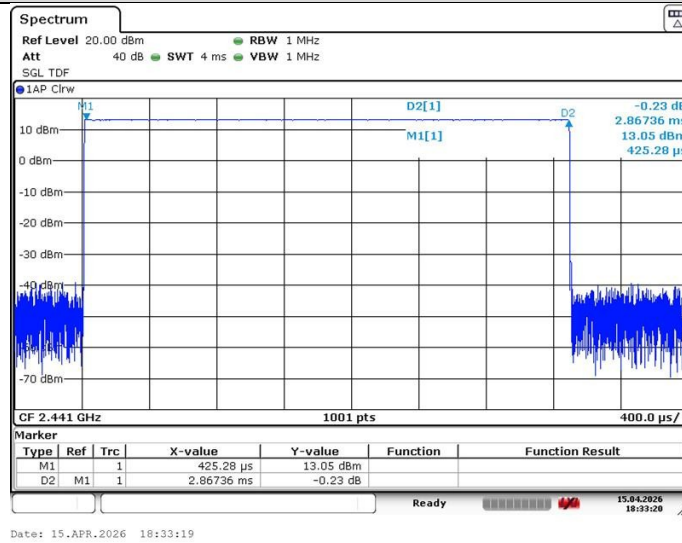
In case of GFSK: $2.875 * \{(1600 \div 6) / 79\} * 31.6 = 306.6 \text{ ms}$

In case of GFSK: $2.876 * \{(1600 \div 6) / 79\} * 31.6 = 306.77 \text{ ms}$

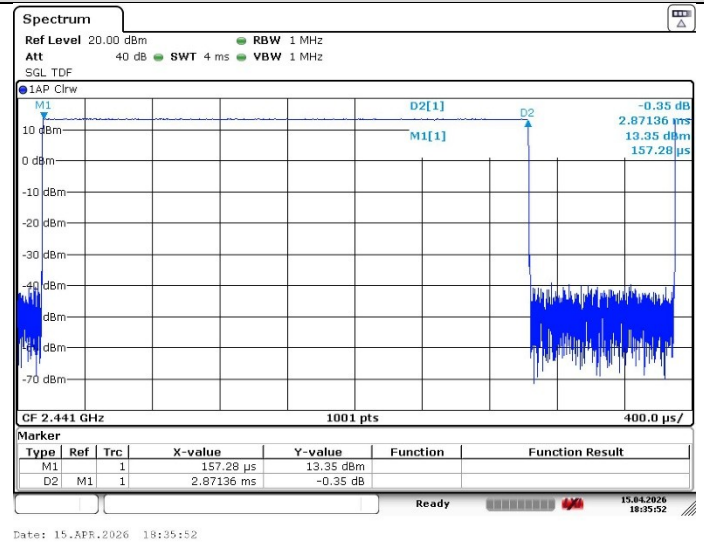


TEST PLOTS

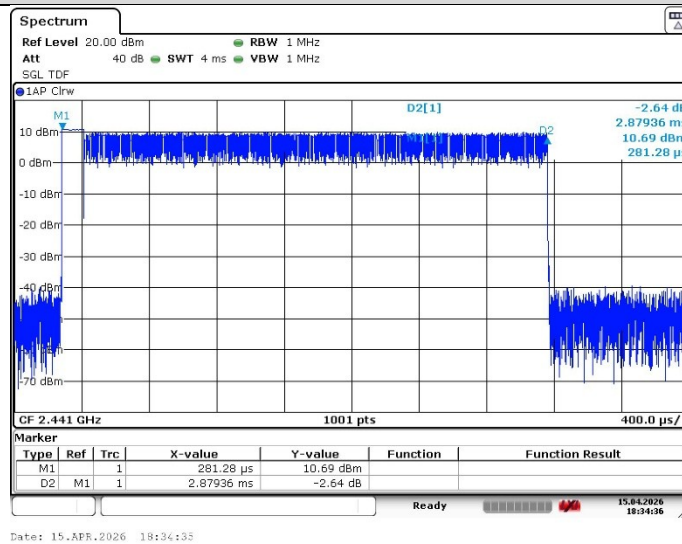
Left Cup – DH5



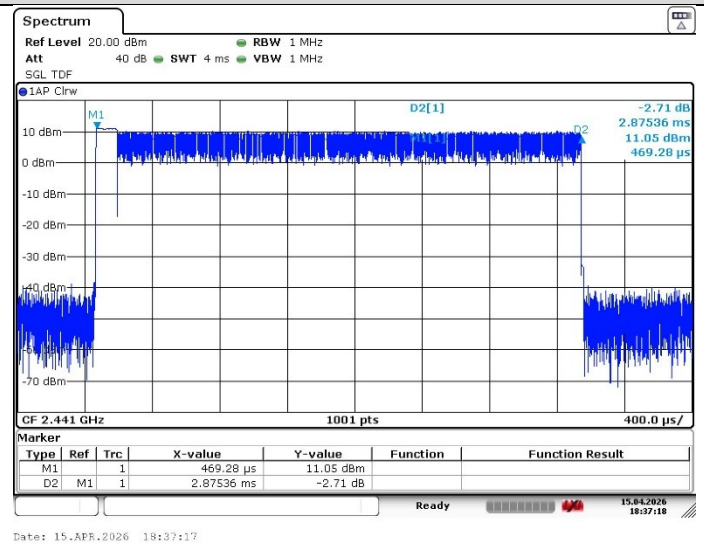
Right Cup – DH5



Left Cup – 2DH5



Right Cup – 2DH5



Left Cup – 3DH5

Right Cup – 3DH5

