3DH5_Ant1_2402

3DH5_Ant1_2441

3DH5_Ant1_2480


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr RCal
Freq Ref: Int (S)
#Atten: 40 dB
Preamp: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS)
Avg|Hold: 100/100
Trig: Free Run
1 Spectrum
Ref Lvl Offset 21.43 dB
Ref Level 30.00 dBm
ΔMkr3 1.272 MHz
-0.01 dB
Scale/Div 10 dB
Center 2.480000 GHz
#Res BW 30 kHz
#Video BW 100 kHz
Span 3.000 MHz
Sweep ~5.79 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 2.479 388 GHz -15.96 dBm
2 N 1 f 2.480 036 GHz 4.219 dBm
3 Δ1 1 f (Δ) 1.272 MHz (Δ) -0.01112 dB
Oct 26, 2022
3:42:27 PM
Frequency
Center Frequency
2.480000000 GHz
Span
3.00000000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
AUTO TUNE
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

Occupied Channel Bandwidth

Test Result

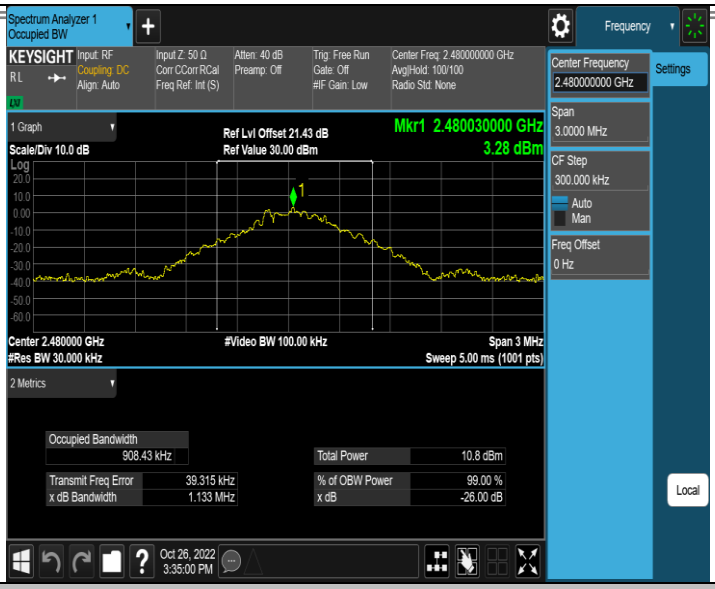
Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.89440	2401.5914	2402.4858	---	---
		2441	0.89853	2440.5879	2441.4864	---	---
		2480	0.90843	2479.5851	2480.4935	---	---
2DH5	Ant1	2402	1.2001	2401.4282	2402.6283	---	---
		2441	1.2016	2440.4264	2441.6280	---	---
		2480	1.1985	2479.4264	2480.6249	---	---
3DH5	Ant1	2402	1.2179	2401.4143	2402.6322	---	---
		2441	1.2202	2440.4146	2441.6348	---	---
		2480	1.2292	2479.4093	2480.6385	---	---

Test Graphs

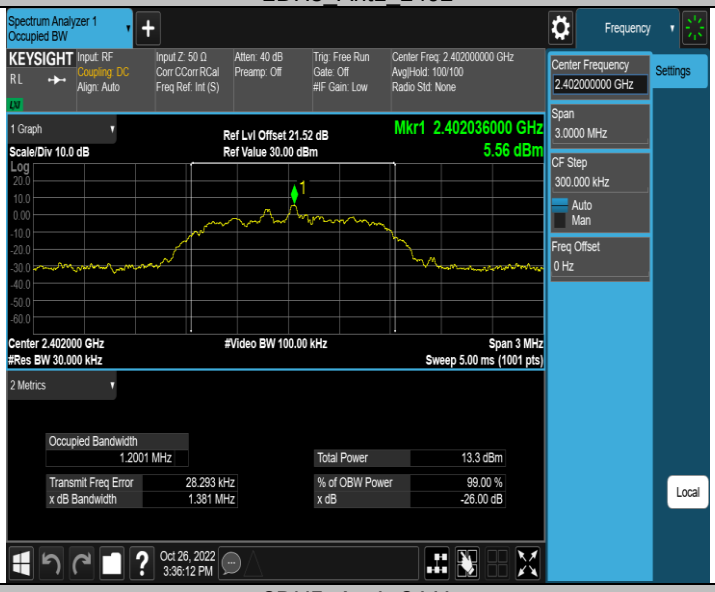
DH5_Ant1_2402

DH5_Ant1_2441

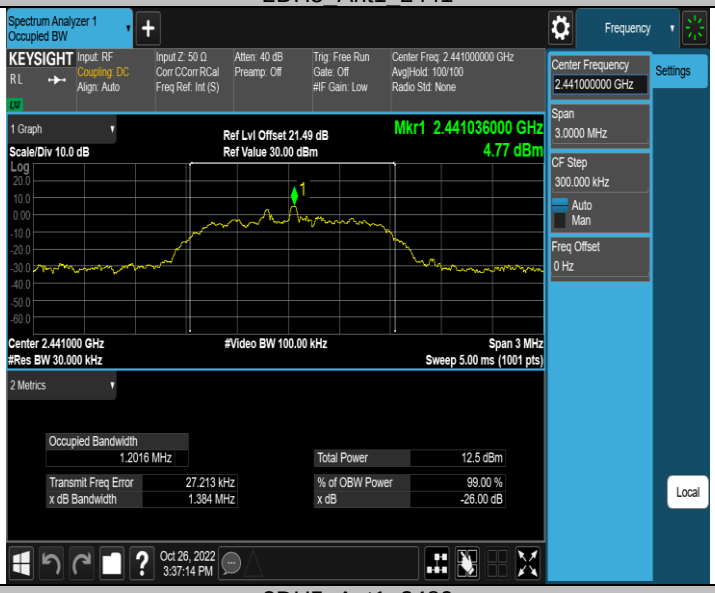
DH5_Ant1_2480



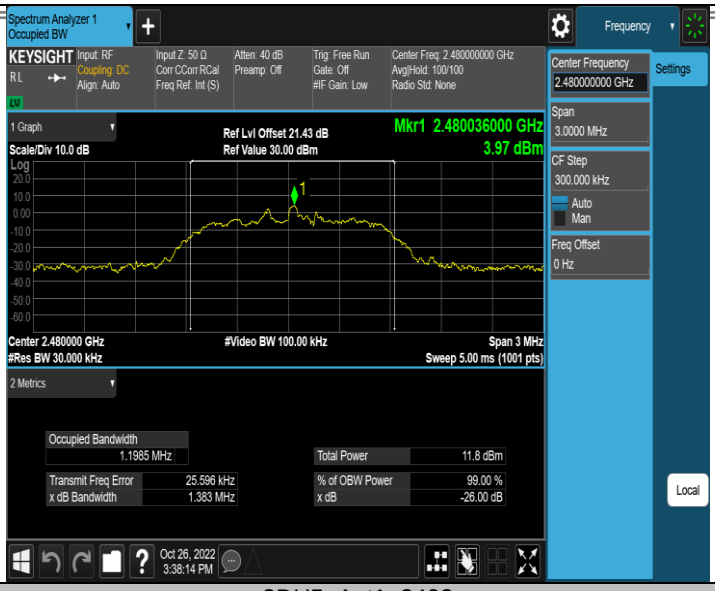
2DH5_Ant1_2402



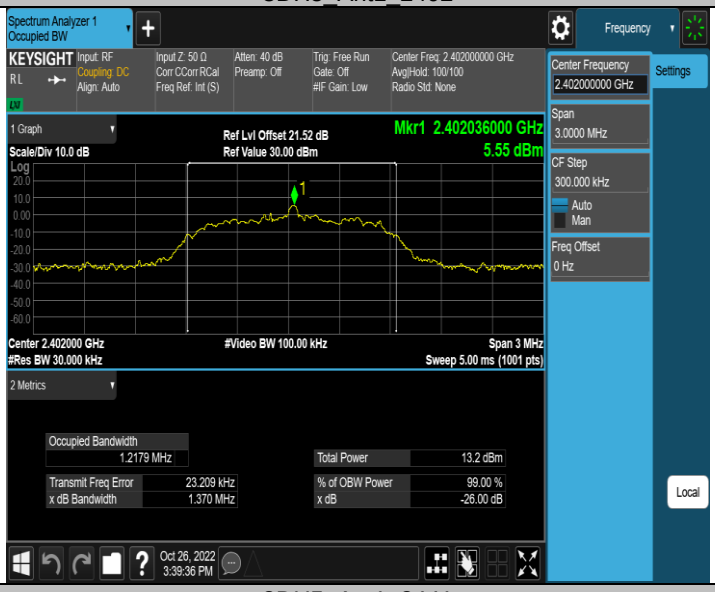
2DH5_Ant1_2441



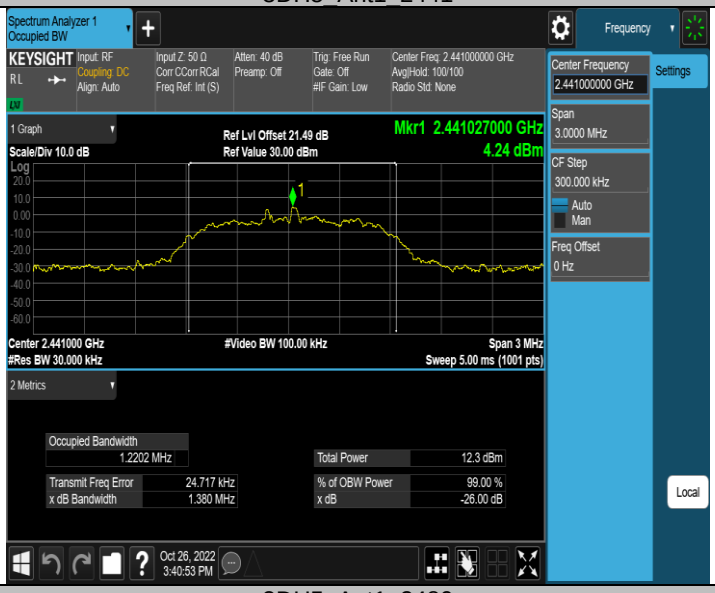
2DH5_Ant1_2480



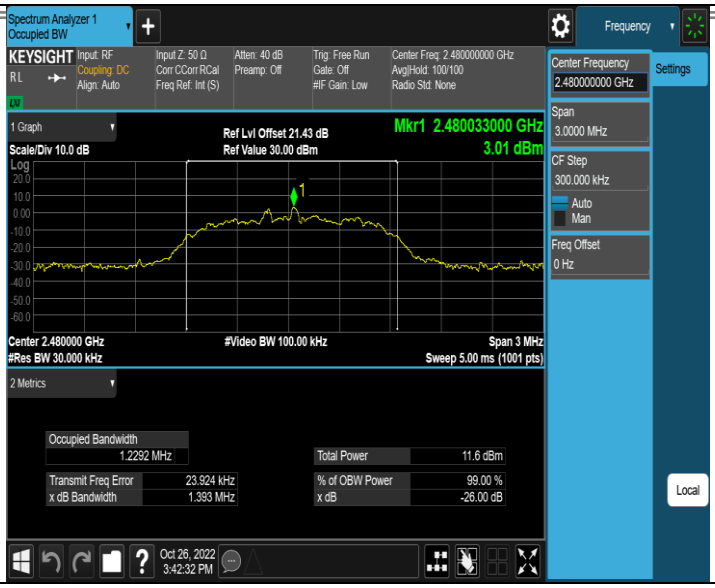
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480


Spectrum Analyzer 1
Occupied BW
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr RCal
Freq Ref: Int (S)
Atten: 40 dB
Preamp: Off
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 2.480000000 GHz
Avg|Hold: 100/100
Radio Std: None
Frequency
Center Frequency
2.480000000 GHz
Settings
Span
3.0000 MHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 21.43 dB
Ref Value 30.00 dBm
Mkr1 2.480033000 GHz
3.01 dBm
Scale/Div 10.0 dB
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 2.480000 GHz
#Res BW 30.000 kHz
#Video BW 100.00 kHz
Span 3 MHz
Sweep 5.00 ms (1001 pts)
2 Metrics
Occupied Bandwidth
1.2292 MHz
Total Power
11.6 dBm
Transmit Freq Error
23.924 kHz
% of OBW Power
99.00 %
x dB Bandwidth
1.393 MHz
x dB
-26.00 dB
Local
Oct 26, 2022
3:42:32 PM

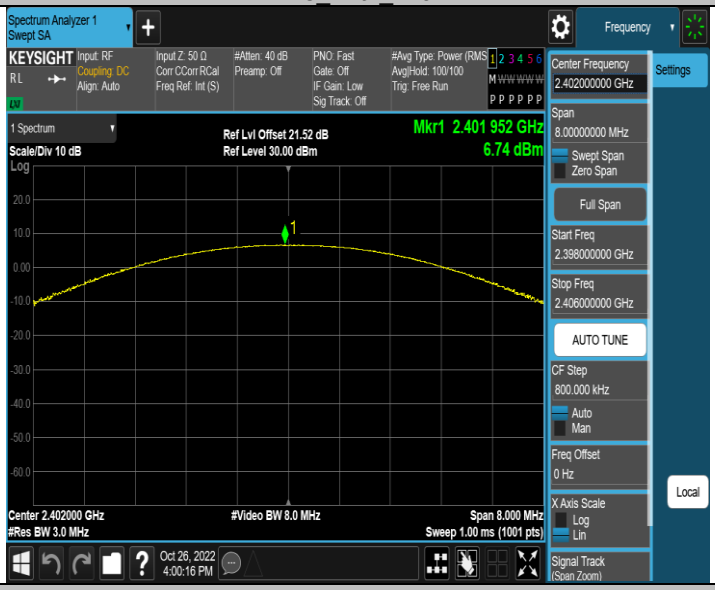
APPENDIX I - MAXIMUM OUTPUT POWER

Test Result Peak

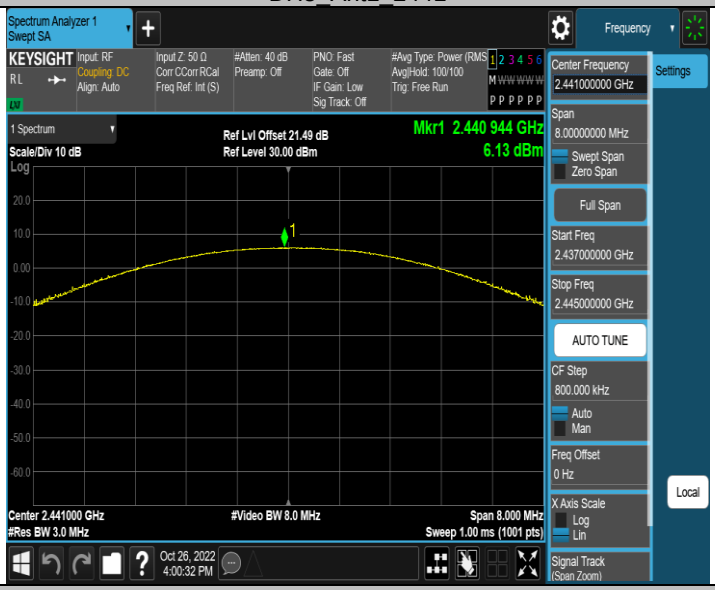
Test Mode	Antenna	Channel	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Conducted Limit[W]	Verdict
DH5	Ant1	2402	6.74	≤20.97	0.125	PASS
		2441	6.13	≤20.97	0.125	PASS
		2480	5.42	≤20.97	0.125	PASS
2DH5	Ant1	2402	8.51	≤20.97	0.125	PASS
		2441	7.85	≤20.97	0.125	PASS
		2480	6.93	≤20.97	0.125	PASS
3DH5	Ant1	2402	8.56	≤20.97	0.125	PASS
		2441	8.01	≤20.97	0.125	PASS
		2480	7.26	≤20.97	0.125	PASS

Test Graphs

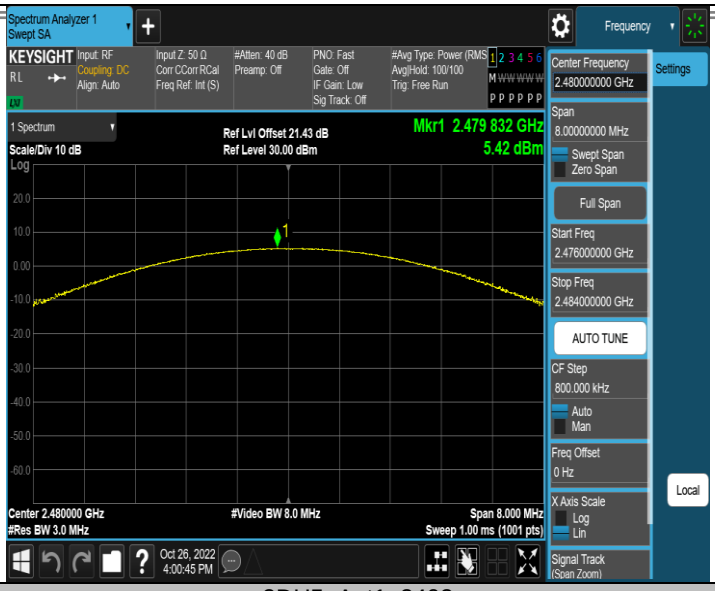
DH5_Ant1_2402



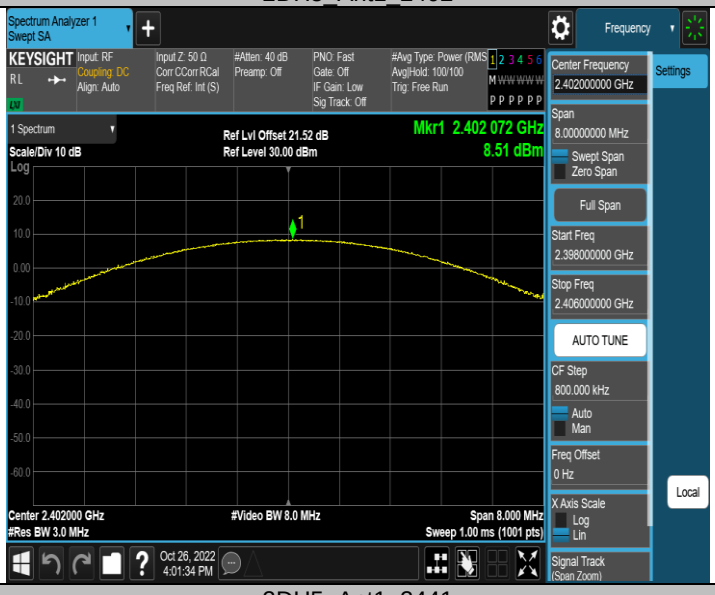
DH5_Ant1_2441



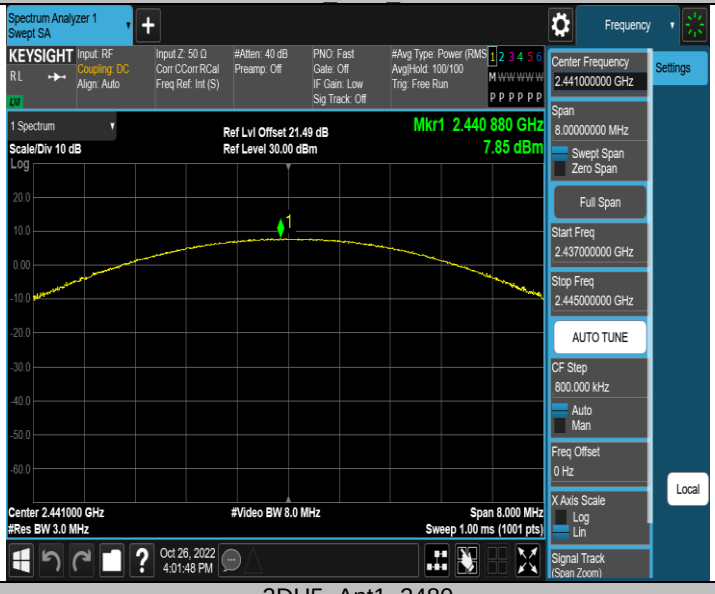
DH5_Ant1_2480



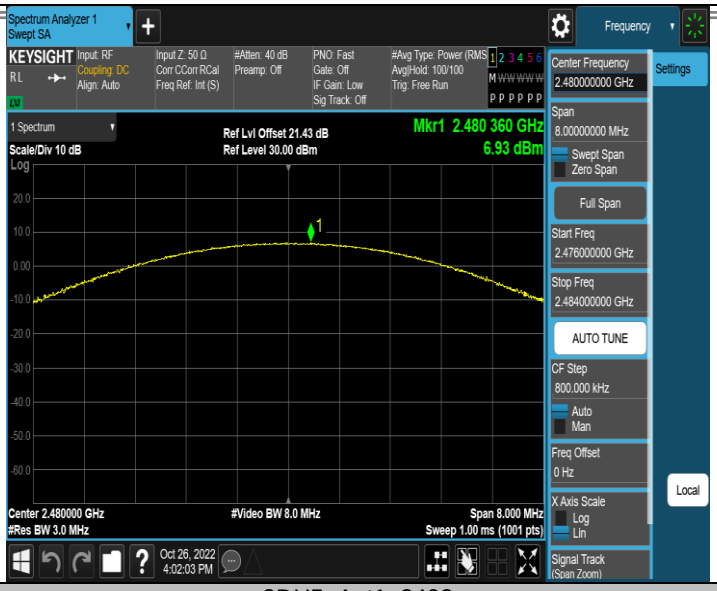
2DH5_Ant1_2402



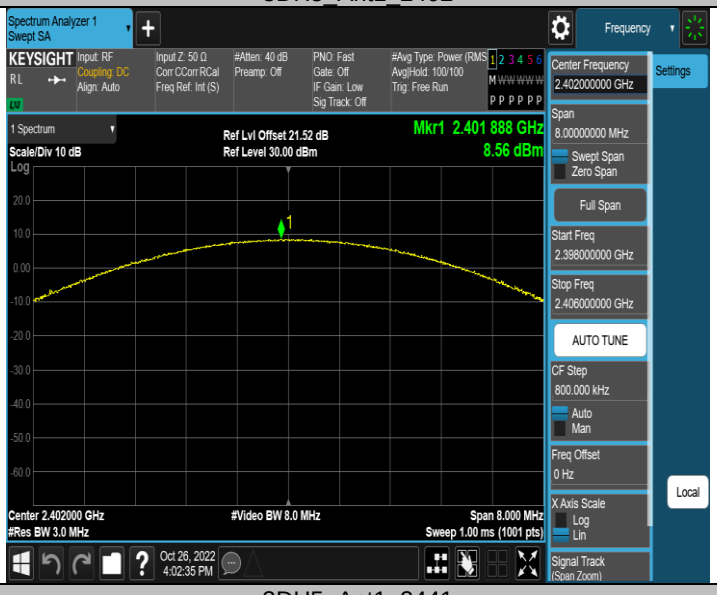
2DH5_Ant1_2441



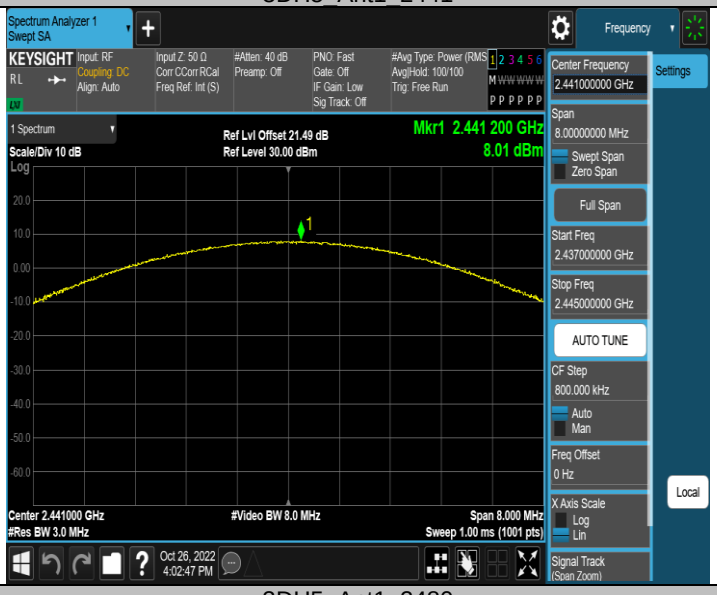
2DH5_Ant1_2480



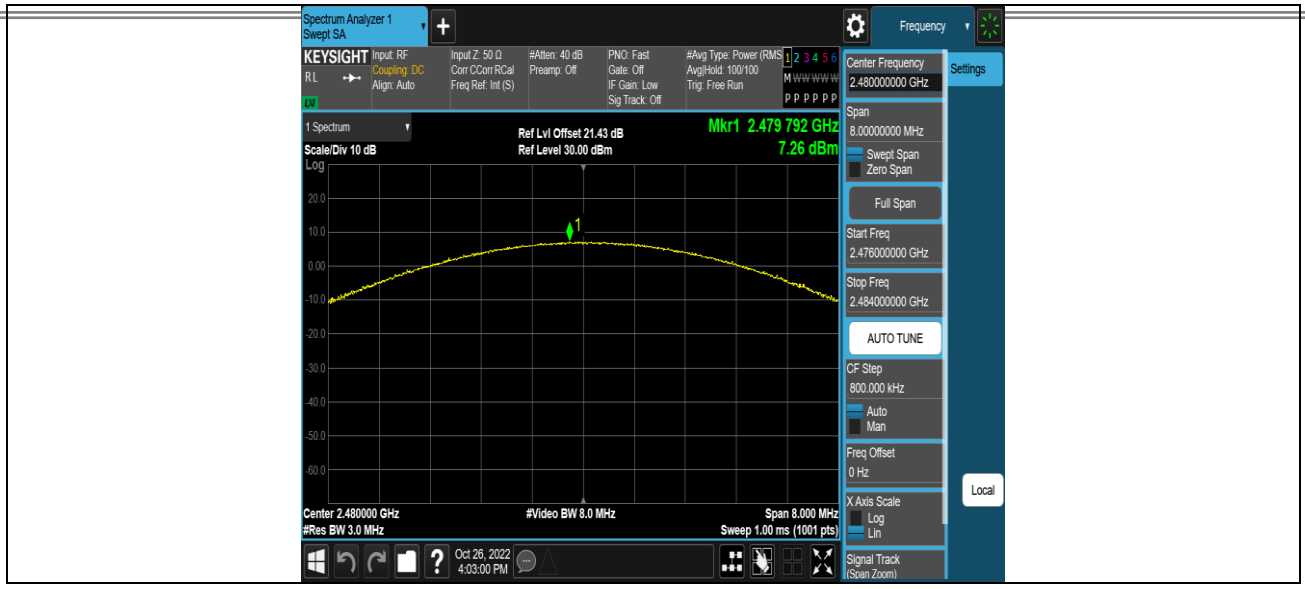
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480

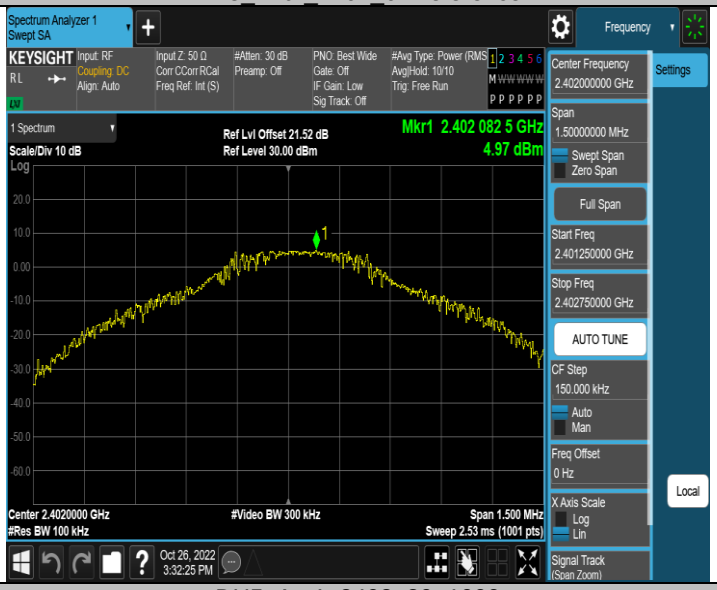

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr RCal
Freq Ref: Int (S)
#Atten: 40 dB
Preamp: Off
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS)
Avg|Hold: 100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 21.43 dB
Ref Level 30.00 dBm
Mkr1 2.479 792 GHz
7.26 dBm
Center 2.480000 GHz
#Res BW 3.0 MHz
#Video BW 8.0 MHz
Span 8.000 MHz
Sweep 1.00 ms (1001 pts)
Oct 26, 2022
4:03:00 PM
Frequency
Center Frequency
2.480000000 GHz
Span
8.00000000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.476000000 GHz
Stop Freq
2.484000000 GHz
AUTO TUNE
CF Step
800.000 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

APPENDIX J - CONDUCTED SPURIOUS EMISSION

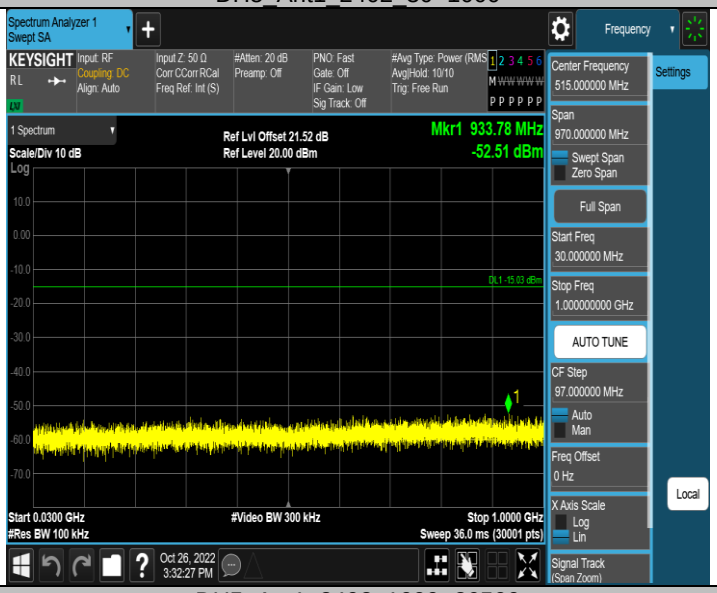
Test Result

Test Mode	Antenna	Channel	Freq Range [MHz]	Ref Level [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	4.97	4.97	---	PASS
			30~1000	4.97	-52.51	≤-15.03	PASS
			1000~26500	4.97	-39.91	≤-15.03	PASS
		2441	Reference	4.36	4.36	---	PASS
			30~1000	4.36	-51.27	≤-15.64	PASS
			1000~26500	4.36	-40.27	≤-15.64	PASS
		2480	Reference	4.07	4.07	---	PASS
			30~1000	4.07	-51.45	≤-15.93	PASS
			1000~26500	4.07	-39.16	≤-15.93	PASS
2DH5	Ant1	2402	Reference	5.08	5.08	---	PASS
			30~1000	5.08	-50.95	≤-14.92	PASS
			1000~26500	5.08	-39.42	≤-14.92	PASS
		2441	Reference	4.98	4.98	---	PASS
			30~1000	4.98	-50.65	≤-15.02	PASS
			1000~26500	4.98	-39.21	≤-15.02	PASS
		2480	Reference	3.77	3.77	---	PASS
			30~1000	3.77	-52.22	≤-16.23	PASS
			1000~26500	3.77	-39.98	≤-16.23	PASS
3DH5	Ant1	2402	Reference	3.91	3.91	---	PASS
			30~1000	3.91	-52.09	≤-16.09	PASS
			1000~26500	3.91	-39.64	≤-16.09	PASS
		2441	Reference	4.44	4.44	---	PASS
			30~1000	4.44	-51.61	≤-15.56	PASS
			1000~26500	4.44	-39.13	≤-15.56	PASS
		2480	Reference	4.14	4.14	---	PASS
			30~1000	4.14	-51.15	≤-15.86	PASS
			1000~26500	4.14	-39.71	≤-15.86	PASS

DH5_Ant1_2402_0~Reference

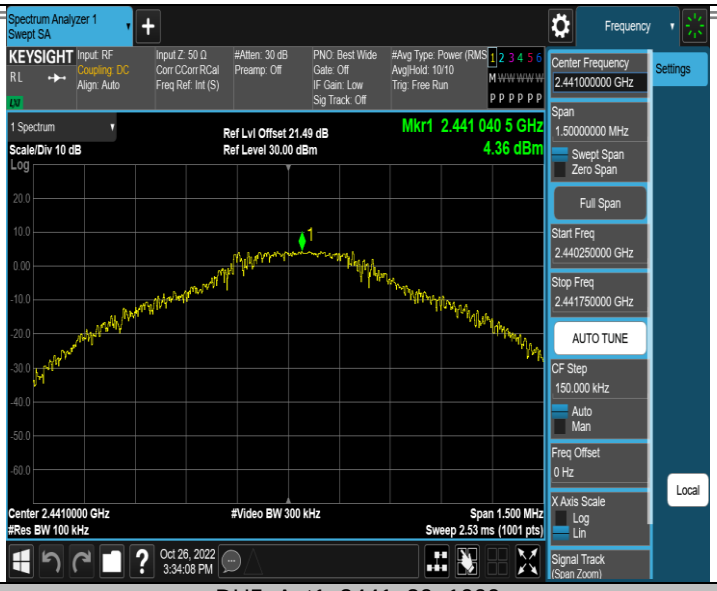


DH5_Ant1_2402_30~1000

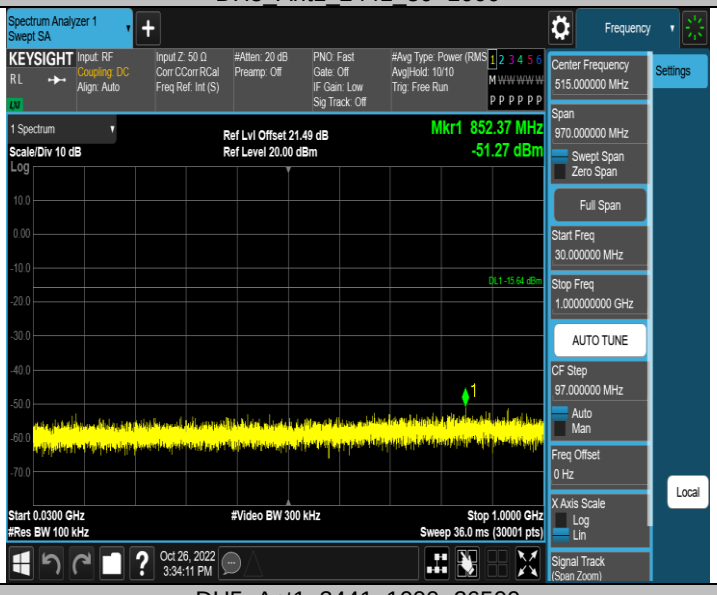


DH5_Ant1_2402_1000~26500

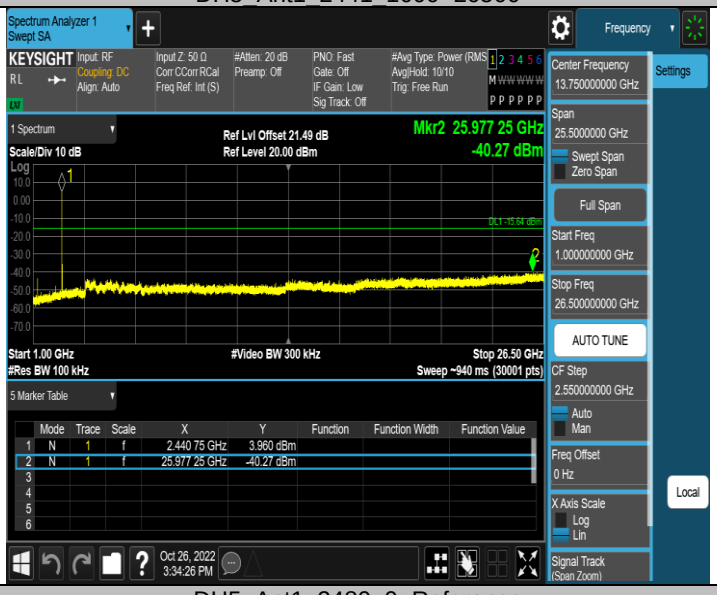
DH5_Ant1_2441_0~Reference



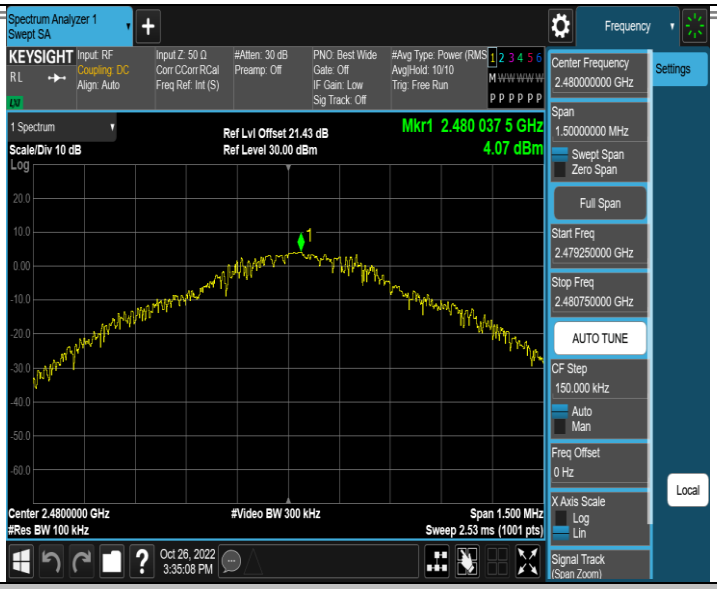
DH5_Ant1_2441_30~1000



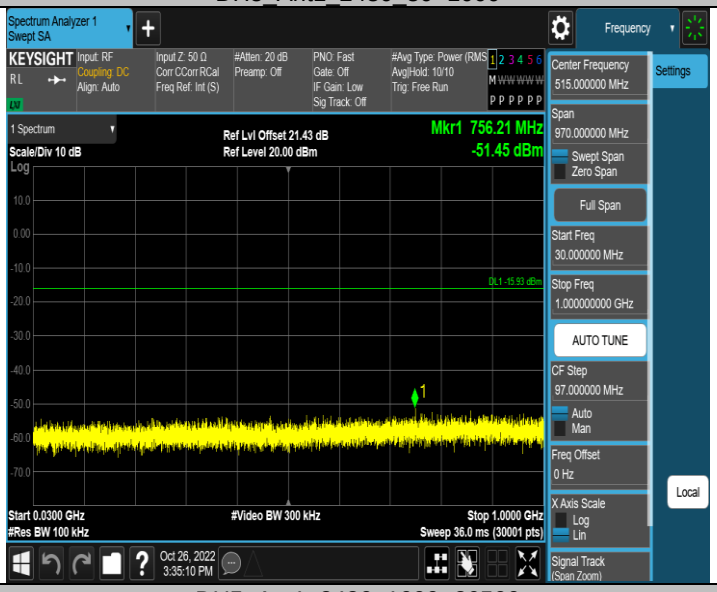
DH5_Ant1_2441_1000~26500



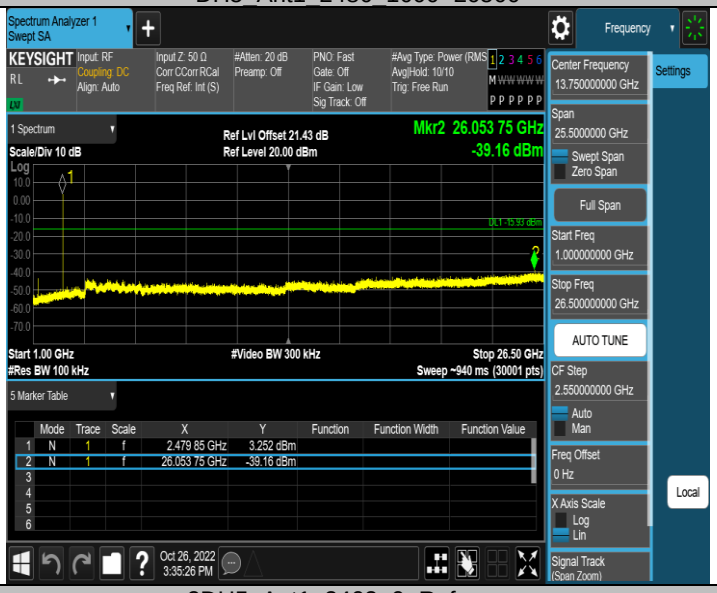
DH5_Ant1_2480_0~Reference



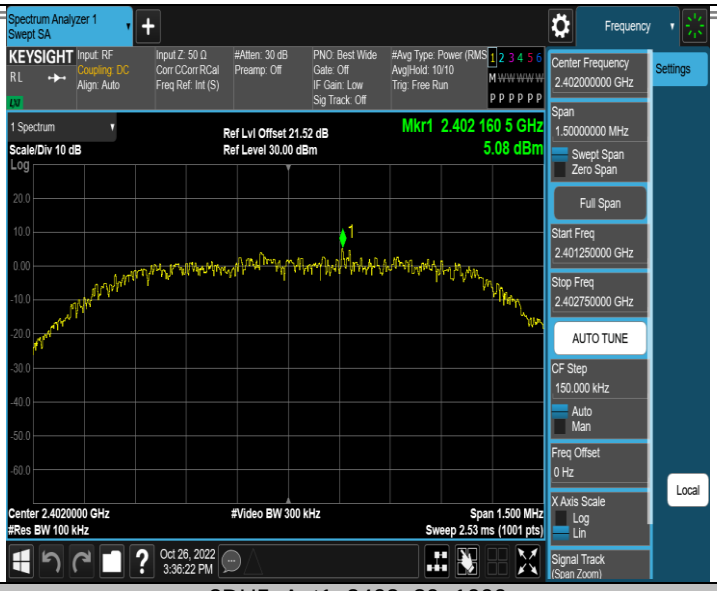
DH5_Ant1_2480_30~1000



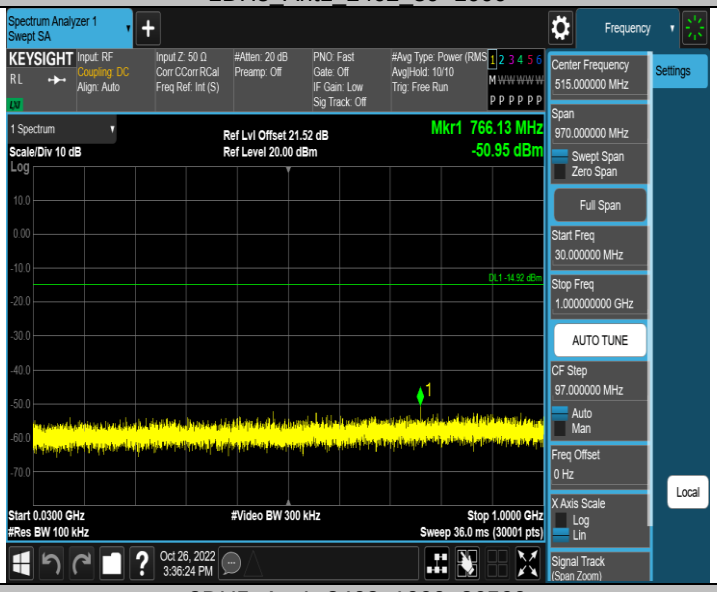
DH5_Ant1_2480_1000~26500



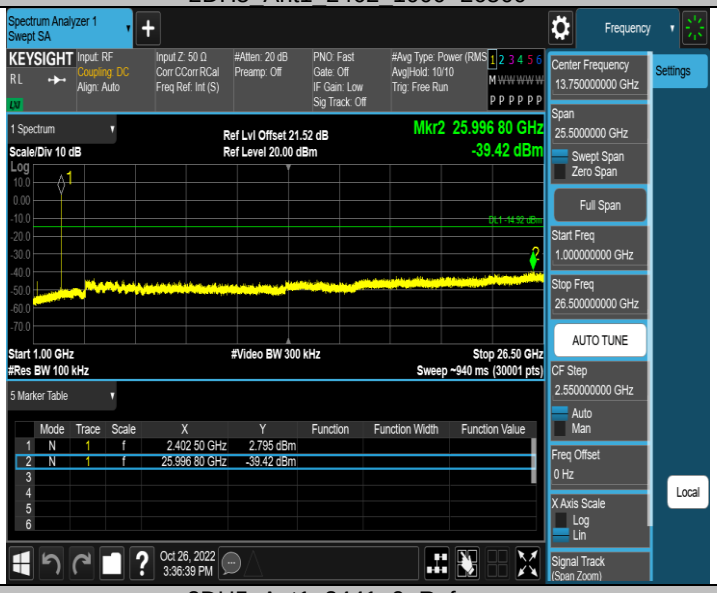
2DH5_Ant1_2402_0~Reference



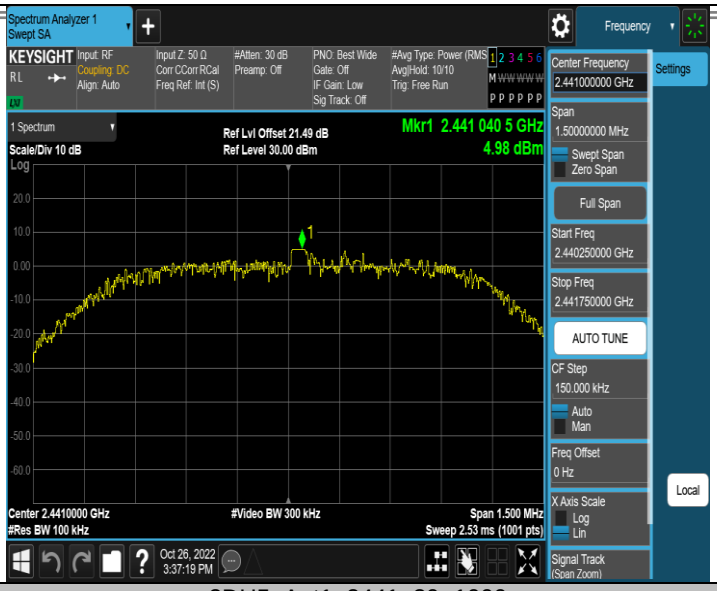
2DH5_Ant1_2402_30~1000



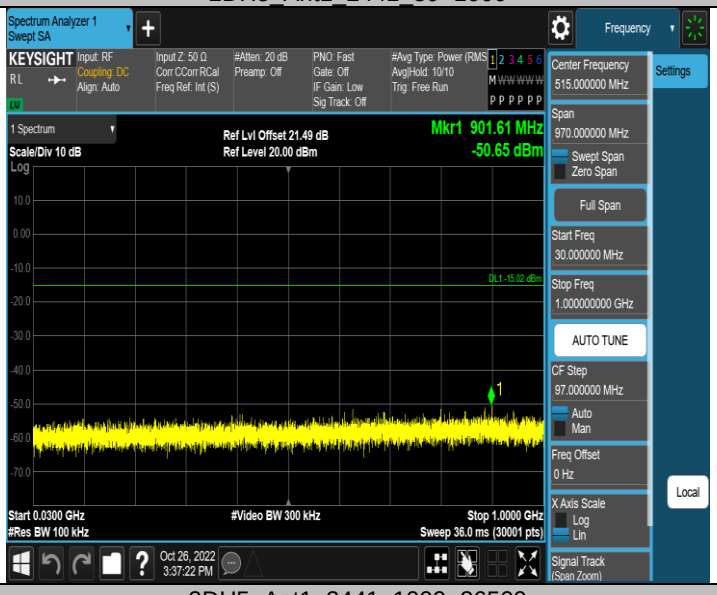
2DH5_Ant1_2402_1000~26500



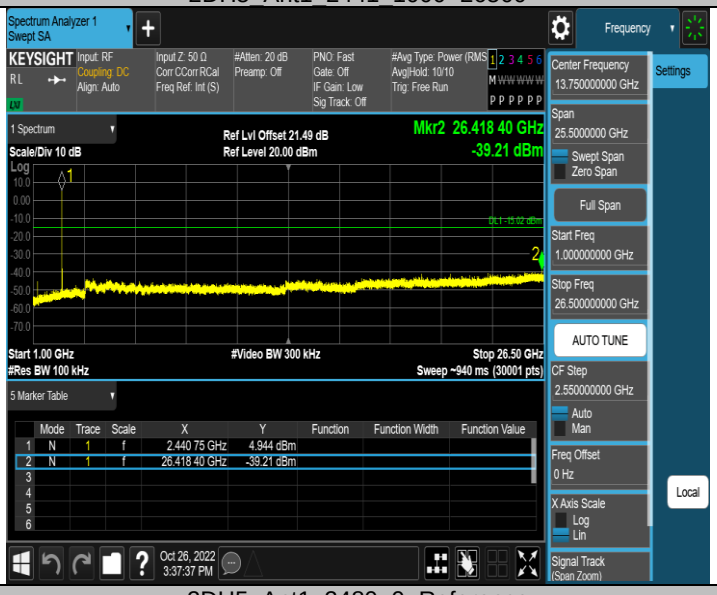
2DH5_Ant1_2441_0~Reference



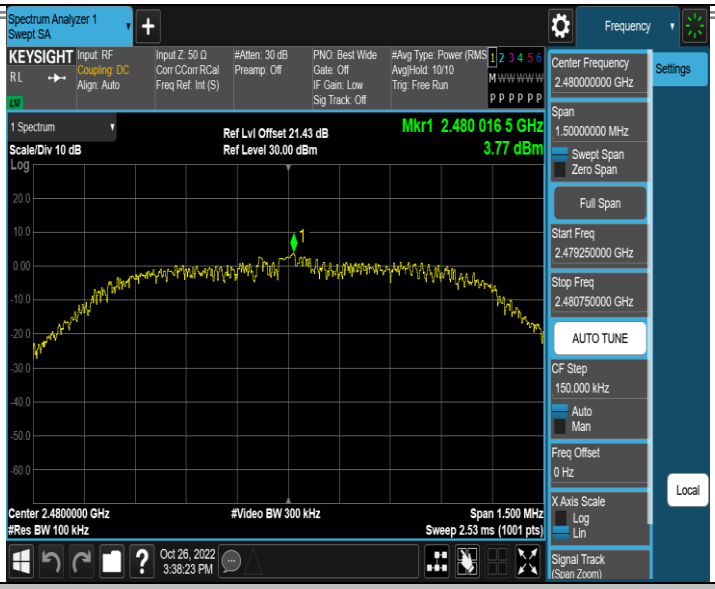
2DH5_Ant1_2441_30~1000



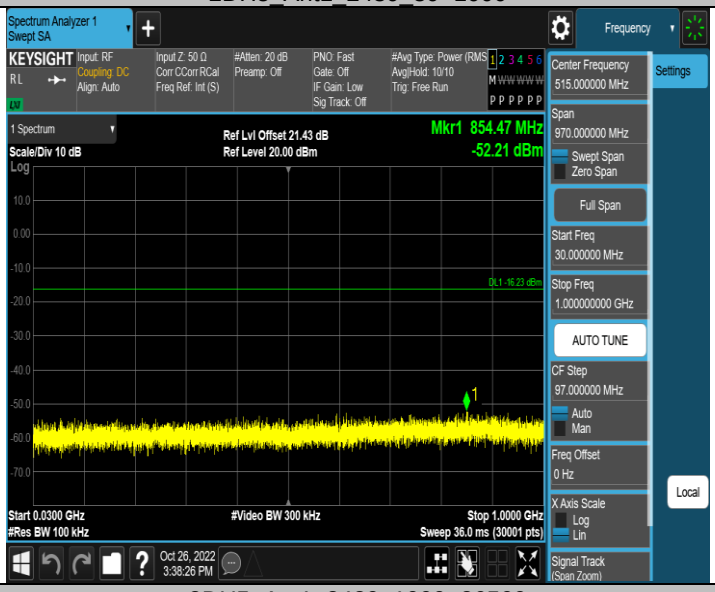
2DH5_Ant1_2441_1000~26500



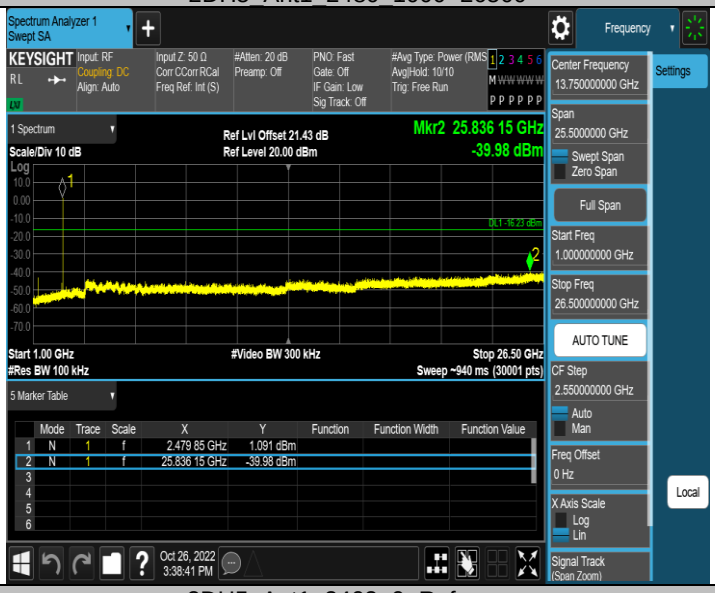
2DH5_Ant1_2480_0~Reference



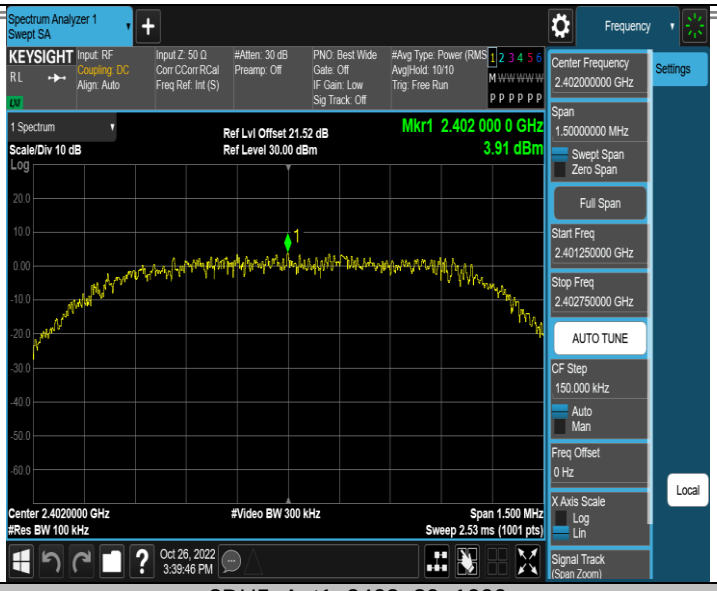
2DH5_Ant1_2480_30~1000



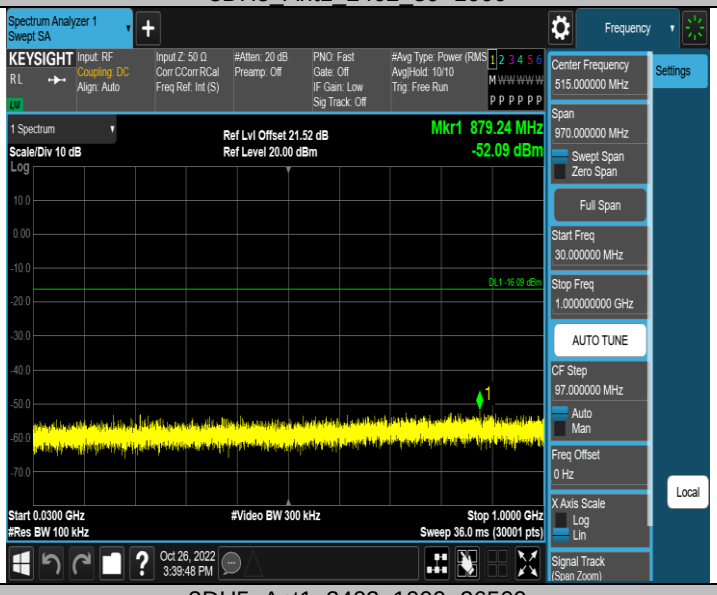
2DH5_Ant1_2480_1000~26500



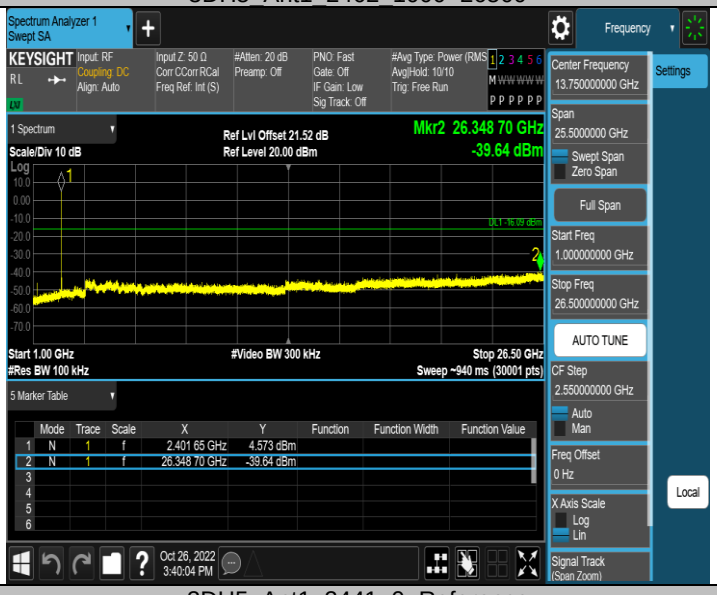
3DH5_Ant1_2402_0~Reference



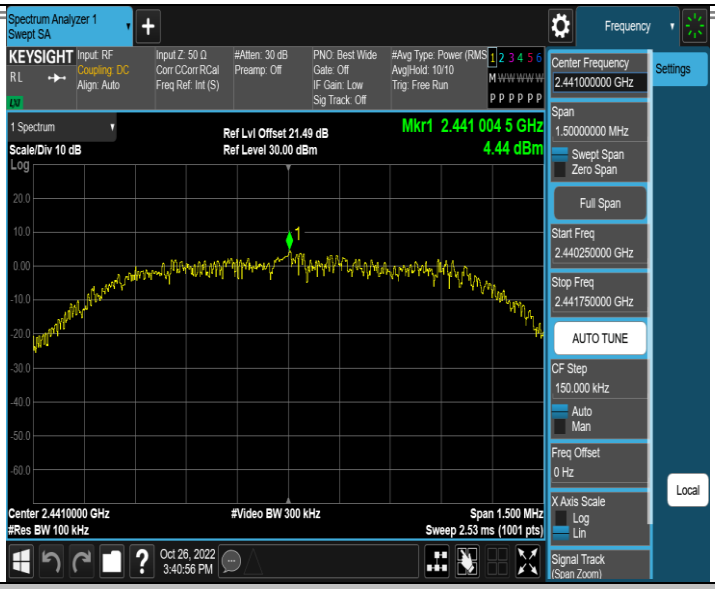
3DH5_Ant1_2402_30~1000



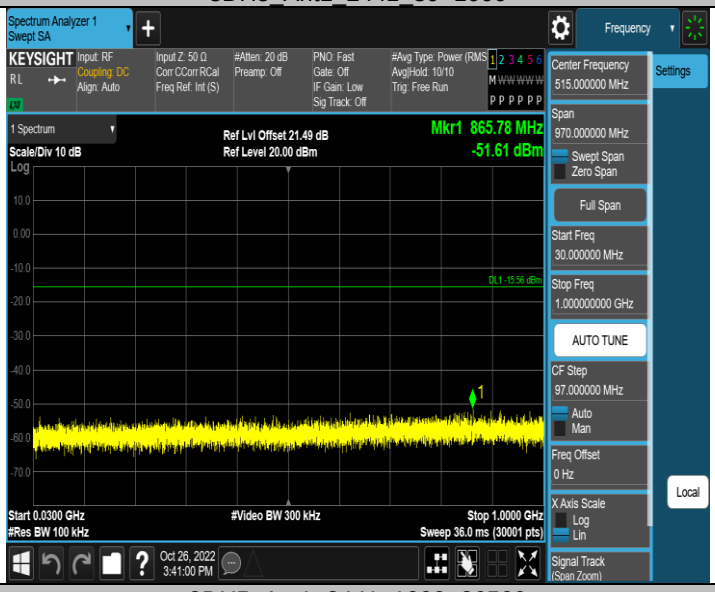
3DH5_Ant1_2402_1000~26500



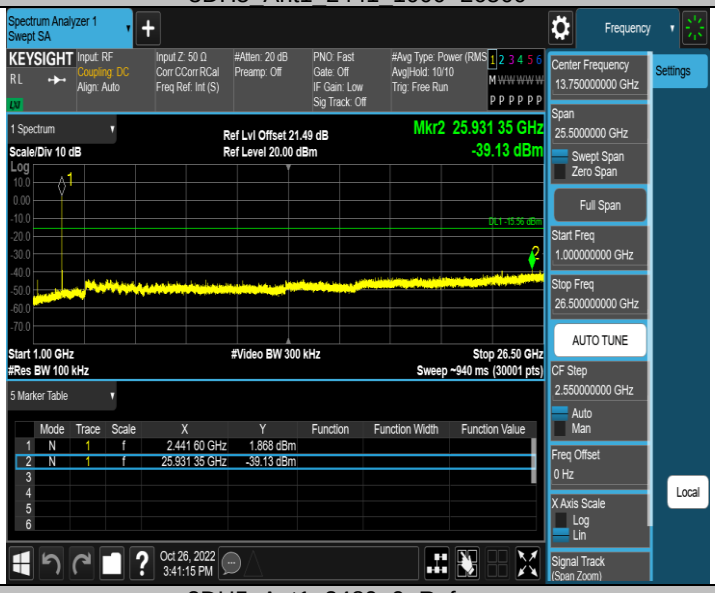
3DH5_Ant1_2441_0~Reference



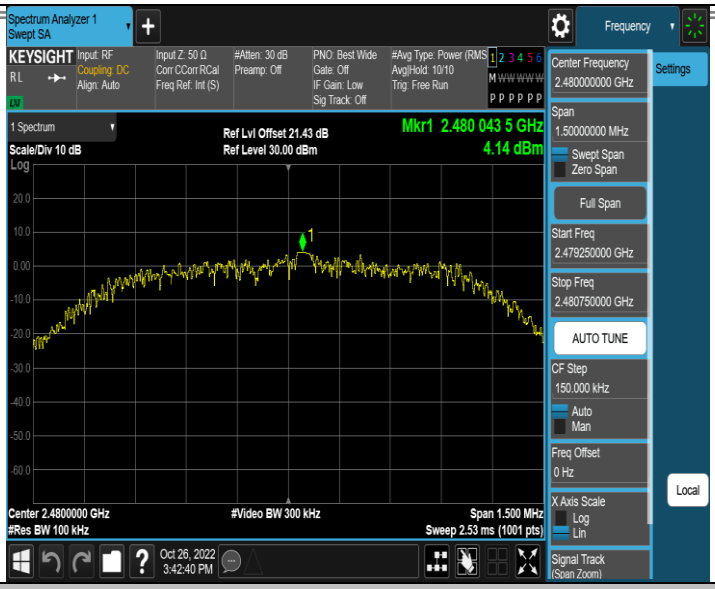
3DH5_Ant1_2441_30~1000



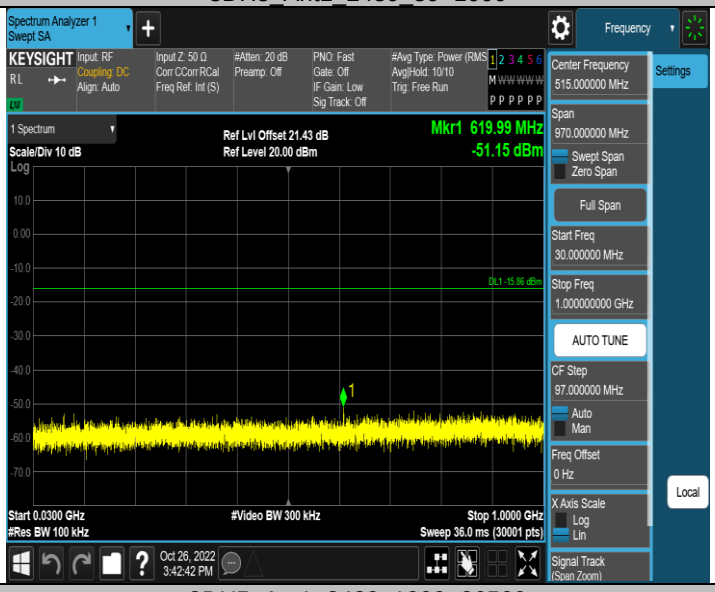
3DH5_Ant1_2441_1000~26500



3DH5_Ant1_2480_0~Reference



3DH5_Ant1_2480_30~1000



3DH5_Ant1_2480_1000~26500

APPENDIX K - DECLARATION FOR BLUETOOTH DEVICE

1. Output power and channel separation of a Bluetooth device in the different operating modes:

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.
Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

2. Frequency range of a Bluetooth device:

Hereby we declare that the maximum frequency of this device is: 2402 - 2480MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:

Bluetooth units which want to communicate with other units must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

4. Example of a hopping sequence in data mode:

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

5. Equally average use of frequencies in data mode and behaviour for short transmissions:

The generation of the hopping sequence in connection mode depends essentially on two input values:
a) LAP/UAP of the master of the connection.
b) Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire.
LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR- operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour:
The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.
The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

6. Receiver input bandwidth and behaviour for repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.
Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.
Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

End of Test Report